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Keehi Lagoon

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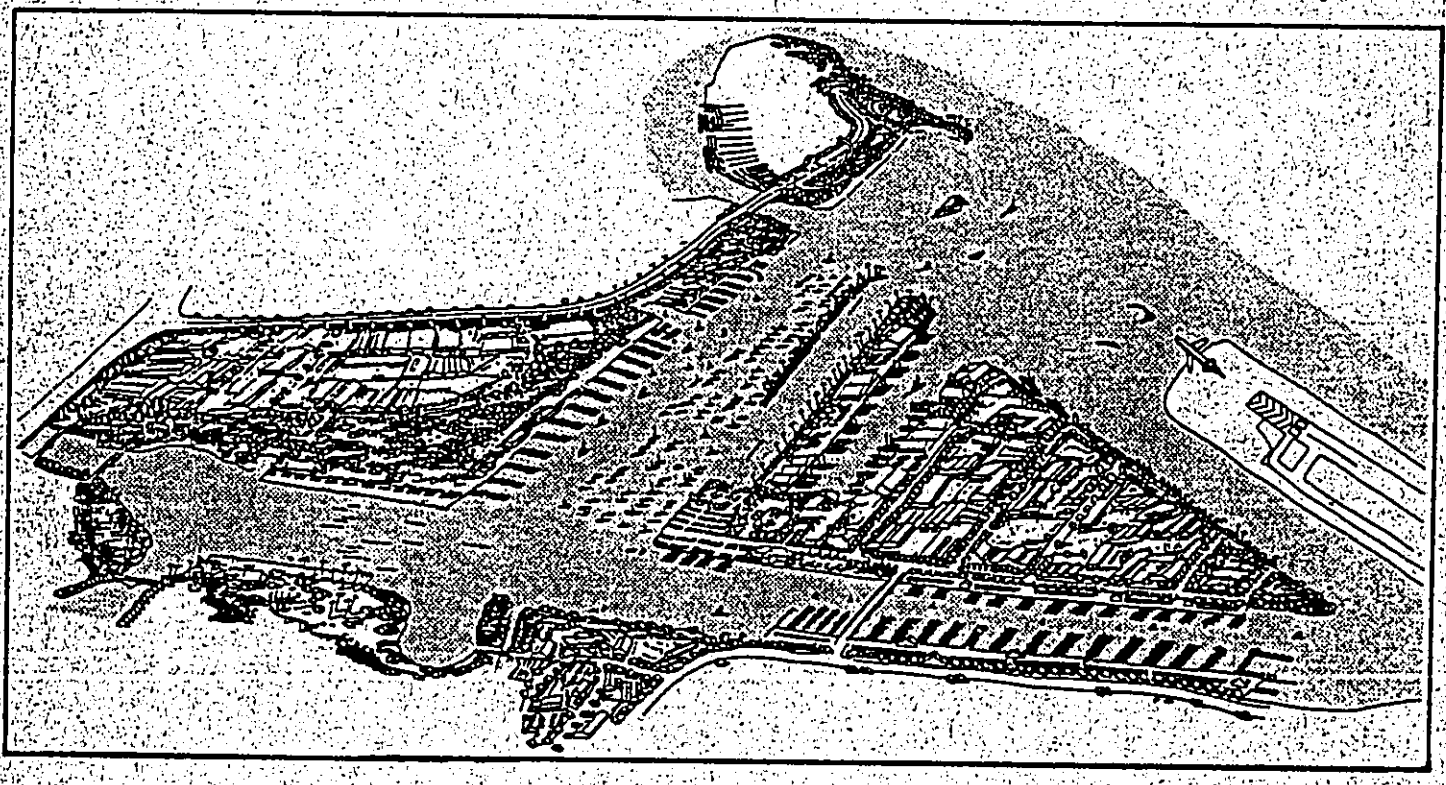
KE'EHI LAGOON RECREATION PLAN

Final
Environmental Impact Statement

Honolulu, Hawaii



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION

DECEMBER 1989

KE'EHI LAGOON RECREATION PLAN

Final
Environmental Impact Statement

Honolulu, Hawaii

This environmental document is prepared
pursuant to Chapter 343, Hawaii Revised Statutes

Proposing Agency:

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION

Accepting Authority:

GOVERNOR, STATE OF HAWAII

Responsible Official:

EDWARD Y. HIRATA
DIRECTOR OF TRANSPORTATION

1/3/90
DATE

DECEMBER 1989

Prepared by:

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Honolulu, Hawaii 96814

KE'EHI LAGOON RECREATION PLAN
FINAL EIS

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Introduction and Summary

CHAPTER I: INTRODUCTION AND SUMMARY

1.1 PROJECT SUMMARY

Proposing Agency: State of Hawaii
Department of Transportation
Harbors Division
79 South Nimitz Highway
Honolulu, Hawaii 96813

Project Location: Ke'ehi Lagoon, including Honolulu International Airport shoreline, Kalihi-Kai shoreline, Sand Island shoreline, and central lagoon areas. Oahu, Hawaii.

Proposed Action: The State of Hawaii intends to implement improvements in Ke'ehi Lagoon and vicinity as part of an overall Recreation Development Plan. The PLAN includes recreational and commercial boating improvements, canoe racing improvements, yacht racing and ocean sports facilities, competition water skiing improvements, waterfront parks, ocean education and research facilities, commercial waterfront facility, and other commercial and industrial developments to support the Honolulu International Airport and Honolulu Harbor activities.

1.2 PURPOSE AND OBJECTIVES

PURPOSE: The Department of Transportation, Harbors Division, proposes to implement a Recreation Development Plan (hereafter referred to as the PLAN) for Ke'ehi Lagoon which is intended to provide major recreational, educational/research, commercial, and industrial infrastructure and improvements to support and encourage economic growth in the State. The implementation of the PLAN requires permits and approvals from County, State and Federal government agencies. The PLAN consists of several distinct "projects" which are intended to be implemented separately, but which in total is viewed as satisfying the long-term Master PLAN objectives for the Ke'ehi Lagoon vicinity. This EIS has been prepared pursuant to Chapter 343, Hawaii Revised Statutes. The EIS is intended to support the permit applications and approvals being sought from County, State and Federal agencies, by providing disclosure of the environmental effects of the proposed PLAN, effects of the PLAN on the economic and social welfare of the community and State, effects of the economic activities arising out of the PLAN, measures proposed to minimize adverse effects, and alternatives to the PLAN and their environmental effects.

GOALS: The proposed PLAN at Keehi Lagoon has two major goals which are intended to meet public needs and aid in financing and implementation. These are:

- o Meet the public needs for ocean recreation and water and land areas for ocean-dependent and airport-related commercial uses;

- o Provide a plan which can be implemented with private sector financing and administered by government agencies using existing public resources.

These goals set the framework for establishing the PLAN objectives stated below.

PLAN OBJECTIVES: The Ke'ehi Lagoon Recreation Development Plan objectives are as follows:

(1) Support and encourage economic growth in the State;

(2) Provide infrastructure and improvements to support Honolulu International Airport functions and future expansion needs;

(3) Provide infrastructure and improvements to support Honolulu Harbor functions and future expansion needs;

(4) Provide terminal and landing facilities to support the proposed Oahu Intraisland Ferry System;

(5) Provide a permanent "world-class" facility for hosting international and regional yacht racing and boating regattas;

(6) Provide improvements to satisfy the needs for water recreation activities in metropolitan Honolulu for residents and tourists alike, including canoe racing, competition and recreational water skiing, and recreational boating;

(7) Support ocean research and education activities.

(8) Implement the improvements through private sector funding to the maximum extent practicable, i.e. provide public facilities at minimal or no cost to the government and optimize revenues to the State from private endeavors.

Keehi Lagoon is the only site in the Hawaiian Islands which can meet these PLAN objectives. There are several key reasons for this statement.

- o Water Dependent Public Ocean Uses. - There is an extensive listing of water-dependent public ocean uses partially in place, planned, and newly planned for Keehi Lagoon. These include marinas, boat repair facilities, water ferry service, ocean research facilities, ocean racing facilities, Hawaiian canoe racing facilities, water skiing facilities, and a broad mix of ocean

recreation activities which include swimming, boater training and fishing. The vast majority of the public who will ultimately use Keehi Lagoon will do so for these purposes.

- Land Uses to Support Water Dependent Activities. - In addition to water-dependent public ocean uses, much of the landfill proposed in Keehi Lagoon will directly support the water dependent activities described above by providing shoreside access, infrastructure, support facilities, passive and spectator viewing areas, etc. The remaining land area will support a mix of maritime and aviation-related uses. The actual amounts of land area cannot at this time be predicted because some choices will be left open to differing proposals to be presented by potential developers. The land use mix for the proposed major fill area is discussed in more detail in Section 2.4.4, Triangle Development.

- Land Uses to Support Honolulu International Airport. - A portion of the proposed Triangle Development would support the Honolulu International Airport which desperately needs land for expansion. HIA is the lifeblood of Honolulu's economic dependence on tourism and air travel and it must be supported for the overall benefit of the State and the public. The proposed aviation support land uses in the Triangle Development would share, with maritime-related land uses, the Commercial/Light Industrial Space of about 119 acres of the proposed Triangle Development. At present, the exact mix cannot be stated because of the as yet unsolicited developers proposals.

- Public Use. - It is important to note that all lands would be publicly available and that no part of the proposed PLAN is intended for exclusive use of private individuals. The PLAN provides for either open public use of park and recreation areas, public rental of boat berths or use of repair facilities, public leasing of commercial-industrial space when it is developed, public use of water sports facilities and retail/commercial facilities, public educational and research facilities.

- Constraints Imposed by Honolulu International Airport. - HIA imposes constraints on the use of the Keehi Lagoon area because of aircraft noise (residential uses are not permitted), building height limitations, and clear zones at the ends of runways for takeoffs and landings. The presence of HIA also has diminished use of the area by waterbirds due to noise and loss of habitat caused by previous dredge and fill projects.

1.3 ALTERNATIVES CONSIDERED AND THE LEAST ENVIRONMENTALLY DAMAGING PLAN

A variety of alternatives have been considered during the planning of this proposed project and in preparation of this EIS. These include: (1) Consideration alternative sites; (2) Disaggregation of plan components; (3) Reconfiguration of plan

components within Keehi Lagoon; (4) No action. The proposed PLAN is the least environmentally damaging of the alternatives available to meet the goals, objectives and criteria of the planning process.

Because of the numerous PLAN objectives, the planning and coordination efforts which have culminated in this proposed PLAN sought to achieve a balanced mix of uses which in totality achieved the PLAN objectives. Because of the site location and the significant opportunities and constraints, all of the stated objectives must be met if the PLAN is considered to serve in the best interest of the public.

1.4 PROPOSED ACTION

The Ke'ehi Lagoon Recreation Development PLAN consists of several major projects which are components of the overall PLAN. These projects are a Hawaiian Canoe Center in the northeast corner of the lagoon; marinas at Pier 60 and along Lagoon Drive to provide about 1,200 additional boat slips and other boating amenities; creation of a 250-acre island in the middle triangle portion of the lagoon to provide recreational, educational/research, commercial and light industrial uses; and a sheltered swimming beach at the southwest tip of Sand Island.

1.5 SUMMARY OF IMPACTS AND MITIGATIVE MEASURES

The significant impacts on Ke'ehi Lagoon and the surrounding area occur from the dredge and fill operations, the increase in human use of the area for ocean recreation and business purposes, the increase in traffic and the general change in the character of Ke'ehi Lagoon. There are no rare and endangered species which are significantly affected by the proposed PLAN.

Mitigation measures are proposed as follows.

- o Dredge and fill operations. The proposed PLAN will most affect the Ke'ehi Lagoon triangle area, a coral rubble and mud reef flat which has the capability to provide a feeding habitat for Hawaiian Stilts although none have been sighted there in surveys taken in 1987, 1988 and 1989. Mitigation is proposed in the form of acquisition and development of other site(s) on Oahu suitable as a feeding habitat and possibly even as nesting and breeding areas which would be more valuable to the preservation of this species than just feeding habitat.

- o Coral on the Triangle Reef Face. There is some coral growth at this location which is modest because of the turbid water conditions. The growth has occurred since the dredging of the Lagoon for the construction of seaplane runways. There would be a loss of part of this habitat due to the implementation of the Triangle Development Plan. Mitigation is proposed in the form

of construction of an artificial reef in Mamala Bay which would be accessible to divers and which would provide a far better location for coral growth.

- o Increased Traffic. There will be a substantial increase in traffic to the area and this would particularly affect Nimitz Highway and related intersections in the area. Mitigation is proposed to improve these intersections in a variety of ways for improved traffic flow.

- o Utilities. The major impact of the proposed PLAN will be on the existing sewer system. Other utilities can provide service without significant effects. Mitigation is proposed in the form of sewer improvements of various kinds.

1.6 SUMMARY OF UNRESOLVED ISSUES

This EIS is considered somewhat "generic" in the sense that the proposed action is the long-term implementation of a master plan for Ke'ehi Lagoon consisting of several major individual projects as well as many smaller "minor" projects within the overall context of the master plan objectives. The individual major projects have been conceptually designed and described in terms of areal extent, uses, access, magnitude of dredging and filling, and design constraints. Several major projects will be implemented by private developers under lease agreements with the State. Therefore, some issues remain unresolved at this initial phase and will be resolved during the preparation of detailed plans by respective developers and in the process of seeking regulatory approvals and permits for the individual projects. Significant unresolved issues in the context of the overall PLAN are as follows:

(1) Implementation Schedule. The precise time schedule for full implementation of the PLAN is cannot be specified at this time. It will be dependent on the success of the State in executing lease agreements with respective private developers, the financial and economic climate at the time of construction, and the demands of the marketplace with respect to planned use within the development. An implementation schedule is provided in Chapter II which shows the proposed staging of development.

(2) Supplemental EIS. If any specific development action may result in significantly greater impacts than described by this EIS, then a supplemental EIS will be prepared for the respective action.

(3) Mitigation. Details of the waterbird habitat and reef mitigation plans will be finalized in coordination with the appropriate governmental agencies within the context of the U.S. Army Corps of Engineers permit application.

(4) Land Use Regulation Authority. This issue pertains to the proposed Triangle Development which would be constructed on a landfill over a reef/mud flat which is presently part of a Conservation District under State land use law. At issue is which level of government would have land use regulatory

authority over the development -- the State of Hawaii, or the City and County of Honolulu.

1.7 NECESSARY PERMITS & APPROVALS

The following discussion generally summarizes the major permits, approvals and necessary actions which would precede construction of the proposed project. These are described approximately in the order of completion and generally apply to any of the PLAN components to be built on either submerged or fast land. They also apply (with the exception of legislative authorizations and appraisals) generally to both private or public developers. A more detailed description of the permit process and related plans by others can be found in Chapter V.

- o Legislative Authorizations. Appropriate legislation has been passed by the State Legislature in the form of several resolutions which allow lease development of the separate areas of Keehi Lagoon now under consideration.

- o Land Value Appraisal. The State Department of Transportation needs to obtain an appraisal of land value when executive orders, land transfers or land leases are involved. This step precedes the issuance of a land lease.

- o Environmental Impact Statement. The present EIS is intended to serve as a generic document for all work proposed as part of the Keehi Lagoon Master Plan, which is also an element of the Honolulu Waterfront Master Plan.

- o Water Quality Certification. Issued by the State Department of Health. Water quality certifications are required for most harbor or shoreline construction projects.

- o Conservation District Use Application (CDUA). The CDUA permit is issued by the State Department of Land and Natural Resources for use of submerged land.

- o U. S. Army Corps of Engineers Permit for Dredge, Fill and Work in Navigable Waters. It is anticipated that a single, generic permit for work in Keehi Lagoon under the Keehi Lagoon Master Plan Update would be sought from the Corps.

- o U. S. Coast Guard Bridge Permit. Construction of the bridge proposed to link Lagoon Drive with the triangle fill areas would require a permit from the USCG because navigable waterways are involved.

- o Coastal Zone Management Act Consistency Determination. Issued by the Office of State Planning's Coastal Zone Management Program Office. It is

anticipated that a single determination would be issued for the entire Keehi Lagoon Master Plan Update.

- Land Use District Boundary Change. Boundary changes are made by the State Land Use Commission. At present, Keehi Lagoon and the triangle fill area are designated as conservation districts. In order to use the fill area of the triangle portion for industrial or commercial activities the designation as a conservation district should be changed to an urban district. Those areas which would be intended for open space or recreational uses could retain the conservation district designation because those uses are permitted use in conservation districts. A boundary change is not required if the land remains in conservation district under State Authority.

- Special Management Area (SMA) Use Permit. Issued by the Department of Land Utilization, City and County of Honolulu. Required of construction or developments within the shoreline to some distance inland (at least 100 yards). Not required for in-water activities seaward of the certified shoreline or if the land remains in conservation district under State authority.

- General Plan Amendments. Prepared under the authority of the Department of General Planning, City and County of Honolulu. If the triangle area is filled and portions designated as a State Urban land use district, then a general plan amendment would be required to place the area under and in conformance with the County general plan. Not required for in-water activities seaward of the certified shoreline or if the land remains in conservation district under State authority.

- Issuance of Land Leases. The leases, for example to private developers or marina operators, for the use of either submerged or fast lands, may be executed by the State Department of Transportation, provided that the proper executive order transferring the land from the official State landowner (in cases where DOT is not the landowner) to the DOT has been obtained and approved by the legislature. Leases also need Land Board approval, irrespective of the State agency authorized to execute the lease.

- Development Plan Approvals and Public Facility Map Amendments. Established by the City Council pursuant to the review of City and County departments and the Planning Commission. These could be obtained either by State DOT or by a private developer where State lands are concerned. Because these approvals may have a time limit on them, they can wait until a developer has been chosen to proceed with the specific project. As long as the general plan amendment is in place, and the DP approval request is within a reasonable timeframe, county approval should be fairly certain. Not required for in-water activities seaward of the certified shoreline, or if the land remains in conservation district under State authority.

- Appropriate Zoning. Established by the City Council pursuant to the review of City and County departments and the Planning Commission. Zoning should reflect the appropriate land use designation, general plan, development plan and anticipated land use. At this time, specific zoning needs have not been identified for the triangle fill area, but a mixture of commercial and industrial uses, educational, recreation and park, waterfront and marina activities are anticipated. Not required for in-water activities seaward of the certified shoreline or if the land remains in conservation district under State authority. Furthermore such actions would wait until a developer is selected and has prepared a detailed and proposed plan of development.

Chapter II

Project Description

CHAPTER II: PROJECT DESCRIPTION

2.1 LOCATION

Ke'ehi Lagoon is situated on the south shore of Oahu between Honolulu International Airport and Honolulu Harbor (Figure II-1). Mauka of a line drawn between the Reef Runway and Sand Island shorelines, the water area within Ke'ehi Lagoon encompasses about 2.12 square miles (1,360 acres). The lagoon is a sheltered triangle-shaped body of water bordered by shallow fringing reef flat to the south, Honolulu International Airport to the west, and the Kalihi Kai and Sand Island industrial areas to the east (Figure II-2). The lagoon and all of the perimeter shoreline areas are under the jurisdiction of the State of Hawaii.

2.2 PROJECT CHARACTERISTICS

The overall PLAN for development of Ke'ehi Lagoon has been formulated through an on-going process of planning and public coordination over the past decade. In 1977, the State of Hawaii Department of Transportation published a report: Ke'ehi Lagoon Recreation Plan[1] which was the initial step towards establishing the future planning objectives for uses and activities within the lagoon. Implementation of the 1977 Recreation Plan has been slow. Because of changing needs and desires, and sparked by Hawaii's bid to host the 1991 America's Cup race, the master plan for Ke'ehi Lagoon was re-evaluated and the recommendations presented in a 1987 report to the State Legislature: Ke'ehi Lagoon Recreation Plan Update[2].

Based on legislative response to the 1987 update report and in conjunction with planning considerations as part of the Honolulu Waterfront Master Plan[3] study effort, the overall PLAN for Ke'ehi Lagoon was finalized as described herein. The major improvements planned for the lagoon and which are included in this EIS are:

- **Hawaiian Canoe Center** recreational and commercial improvements in the northeast corner of Ke'ehi Lagoon.

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[1]State of Hawaii, Department of Transportation, Air Transportation Facilities Division, Ke'ehi Lagoon Recreation Plan, by Aotani and Associates, Inc., Honolulu, Hawaii, October 1977.

[2]State of Hawaii, Department of Transportation, Harbors Division, Ke'ehi Lagoon Recreation Plan Update, Final Draft to Fourteenth State Legislature, by Edward K. Noda & Associates and Eugene P. Dashiell, December 1987.

- o **Pier 60 Marina** located off Sand Island Access Road adjacent to La Mariana Sailing Club.

- o **Lagoon Drive Marina** located along Lagoon Drive adjacent to the Honolulu International Airport South Ramp area. This development includes a ferry transit terminal that will be part of the intra-island ferry system.

- o **Triangle Development** located in the central triangle portion of the lagoon bordered by the former Seaplane runways. The mixed use development will consist of a marina, parks, Yacht Race/Ocean Sports complex, maritime commercial facilities, industrial/commercial space, and the proposed relocation of the U.H. Marine Expeditionary Center (Snug Harbor).

- o **Sheltered Swimming Beach** adjacent to Sand Island State Park at the southwest tip of Sand Island.

Figure II-3 shows the locations of proposed major improvements within the lagoon. Chapter 2.4 describes the development concepts in more detail, including the technical characteristics.

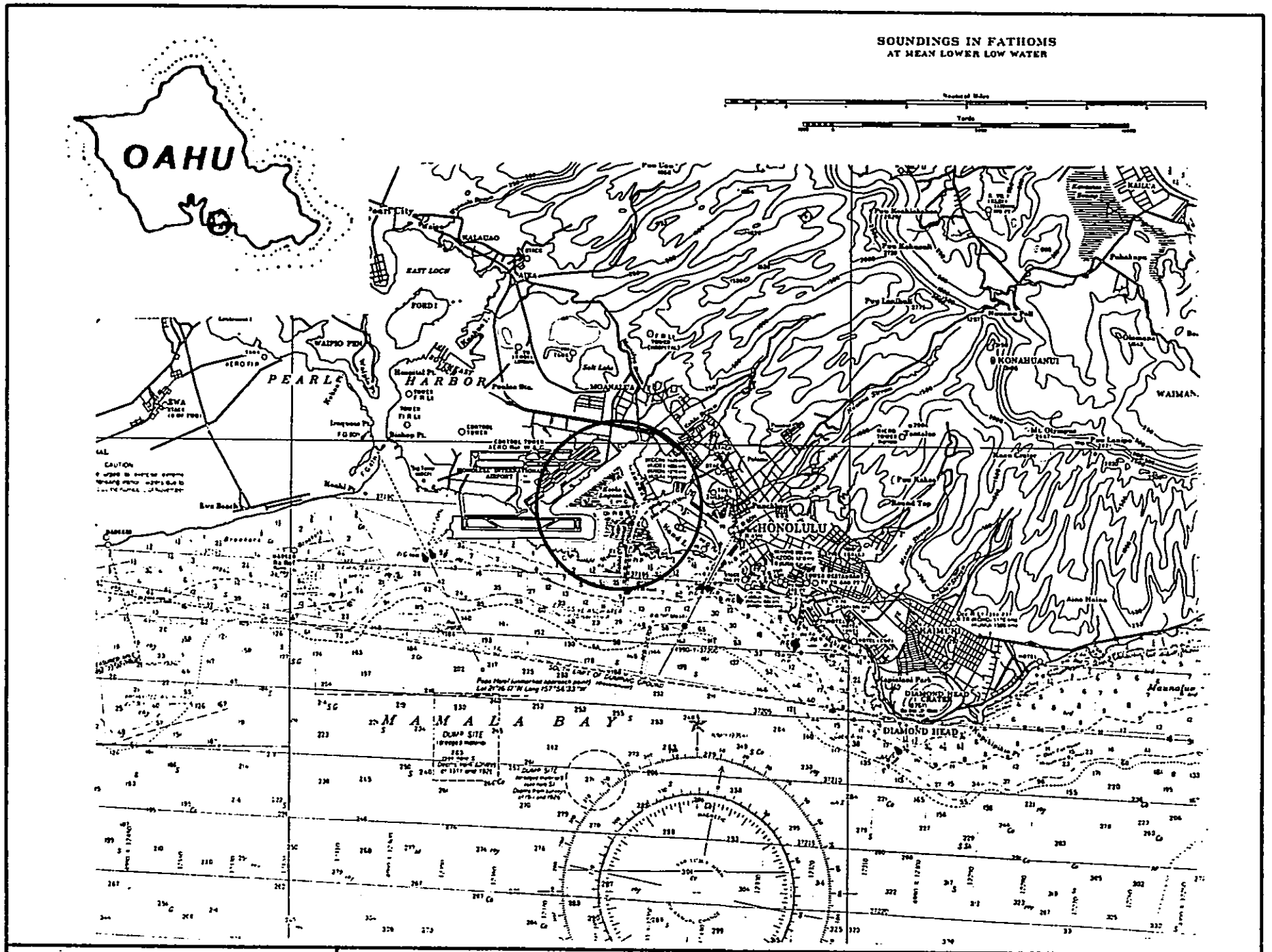
2.3 USE OF PUBLIC FUNDS OR LANDS

All lands (fast, tidal and submerged) required for this project are owned by the State of Hawaii. Figure II-4 shows the Governor Executive Orders (G.E.O.) and State-owned parcels within Ke'ehi Lagoon and vicinity.

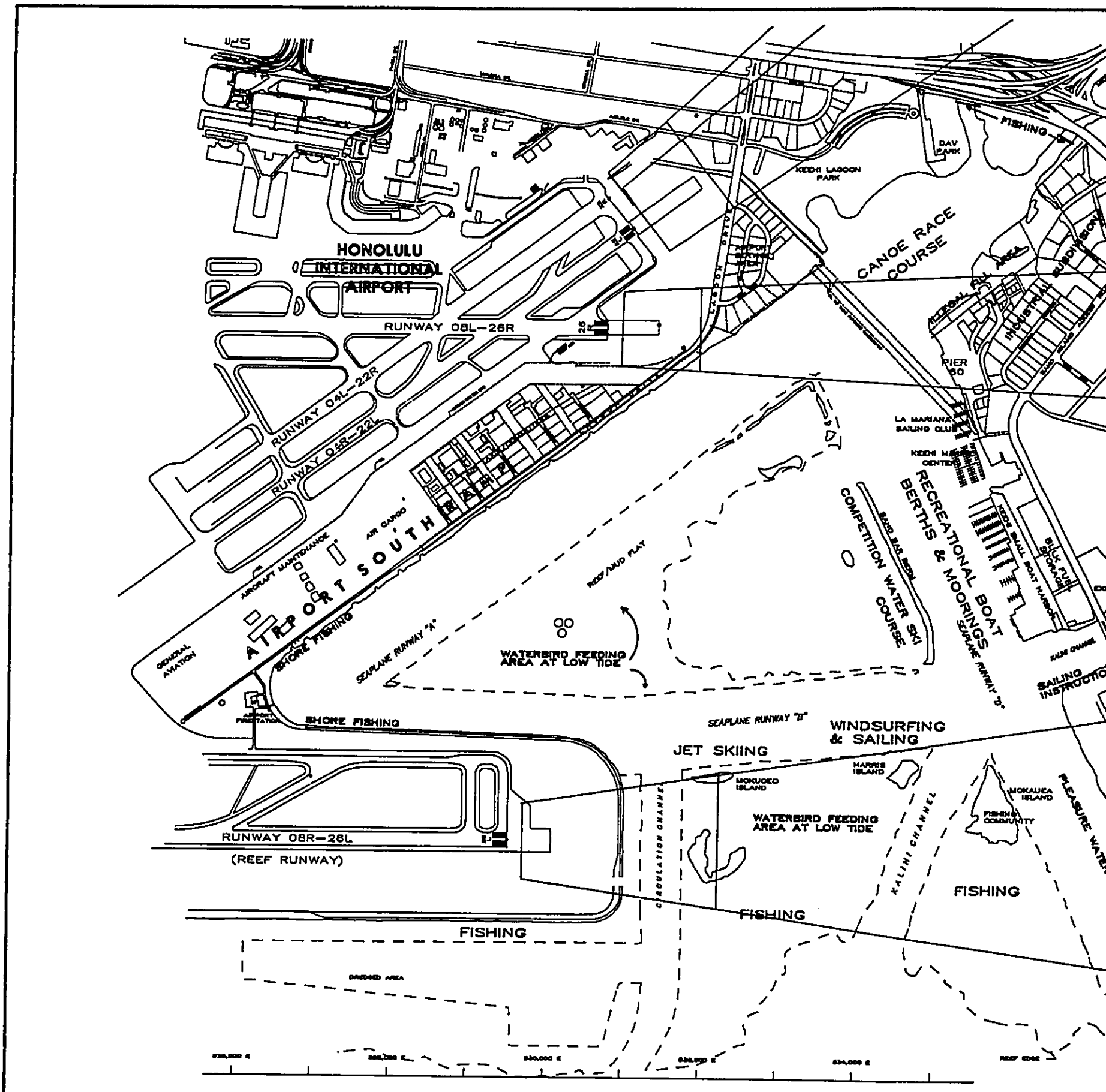
It is the State of Hawaii's intent to implement the development projects through funding derived from the private sector to the maximum extent practicable. With the exception of a portion of the Hawaiian Canoe Center and the sheltered swimming beach at Sand Island, all proposed improvements will be constructed with private developer funds under lease agreements with the State of Hawaii. Legislative authorization for the reclamation and lease of fast, tidal and submerged lands has been obtained for the proposed developments in accordance with sections 171-53, 171-59 and 171-60, Hawaii Revised Statutes.

Hawaiian Canoe Center includes:

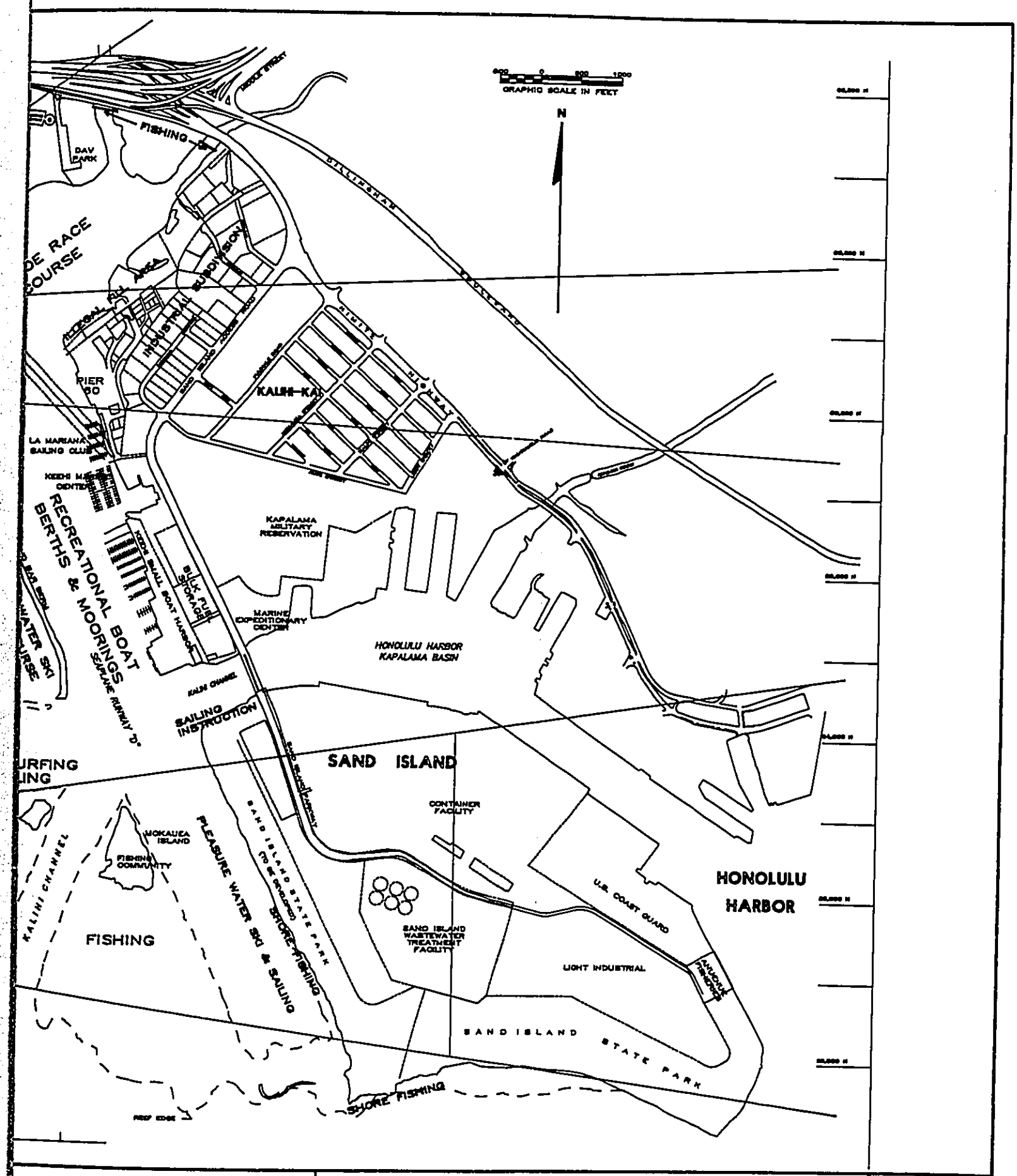
- o Approximately 13 acres of fast, tidal and submerged lands adjacent to Nimitz Highway between Moanalua and Kalihi Streams (TMK:1-1-03:3) to be developed with private funds;



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Ke'ehi Lagoon Location Map**	FIGURE II-1



EDWARD K. NODA & ASSOCIATES, INC.	HARBORS DIVISION	DEPARTMENT OF TRANSPORTATION	STATE OF HAWAII



ATION STATE OF HAWAII	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Ke'ehi Lagoon Vicinity Map and Existing Conditions**	FIGURE **II-2**

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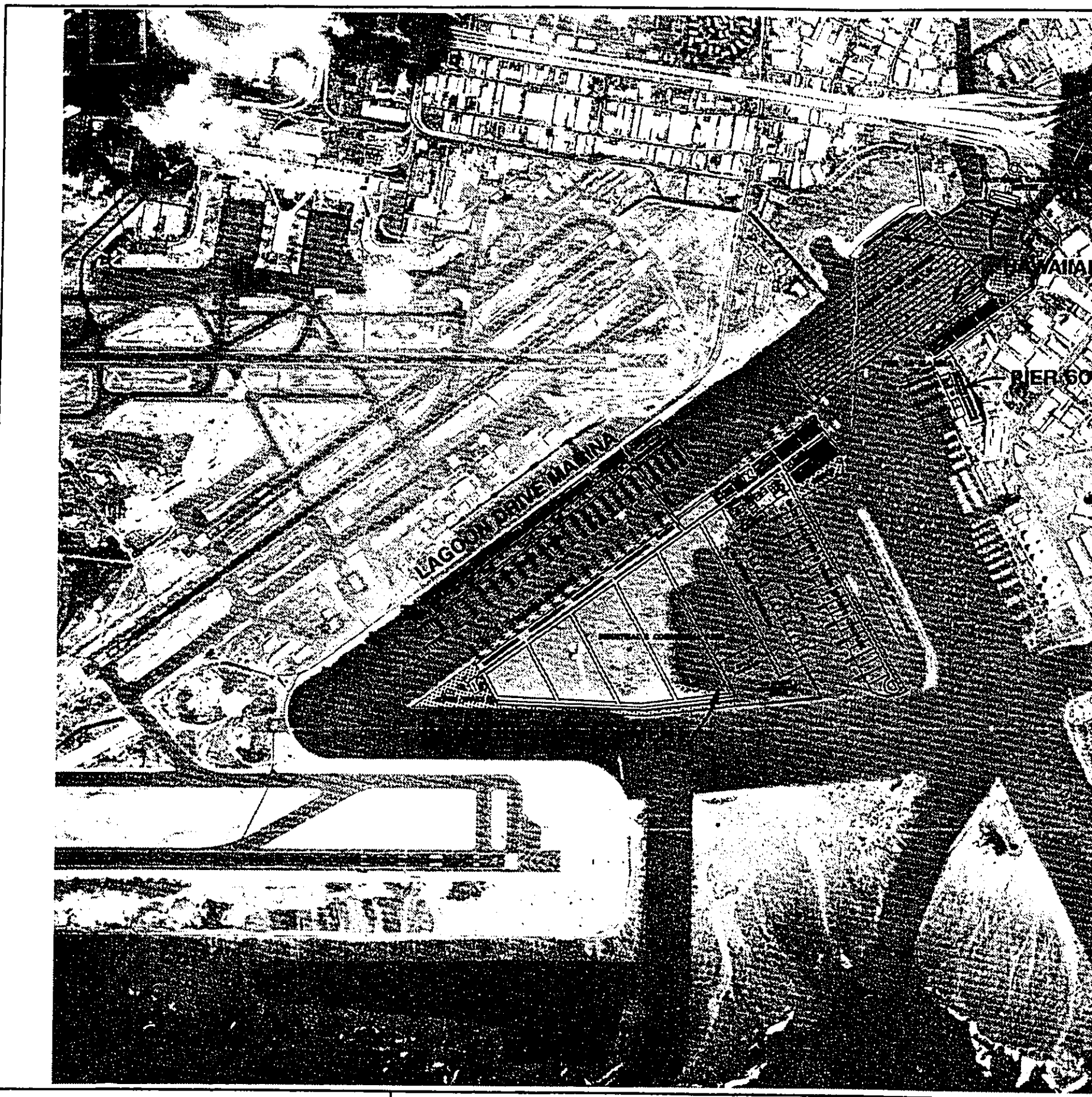

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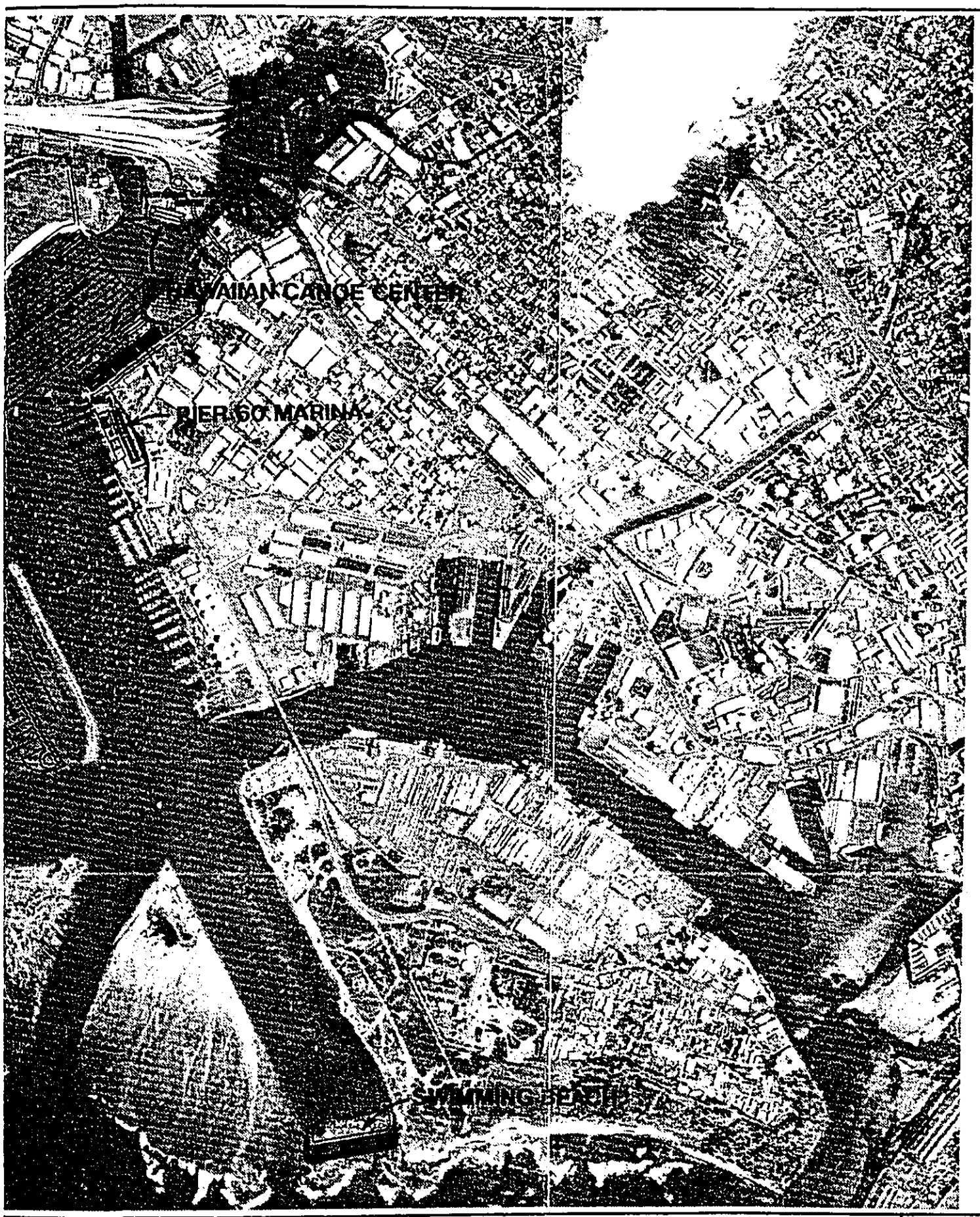
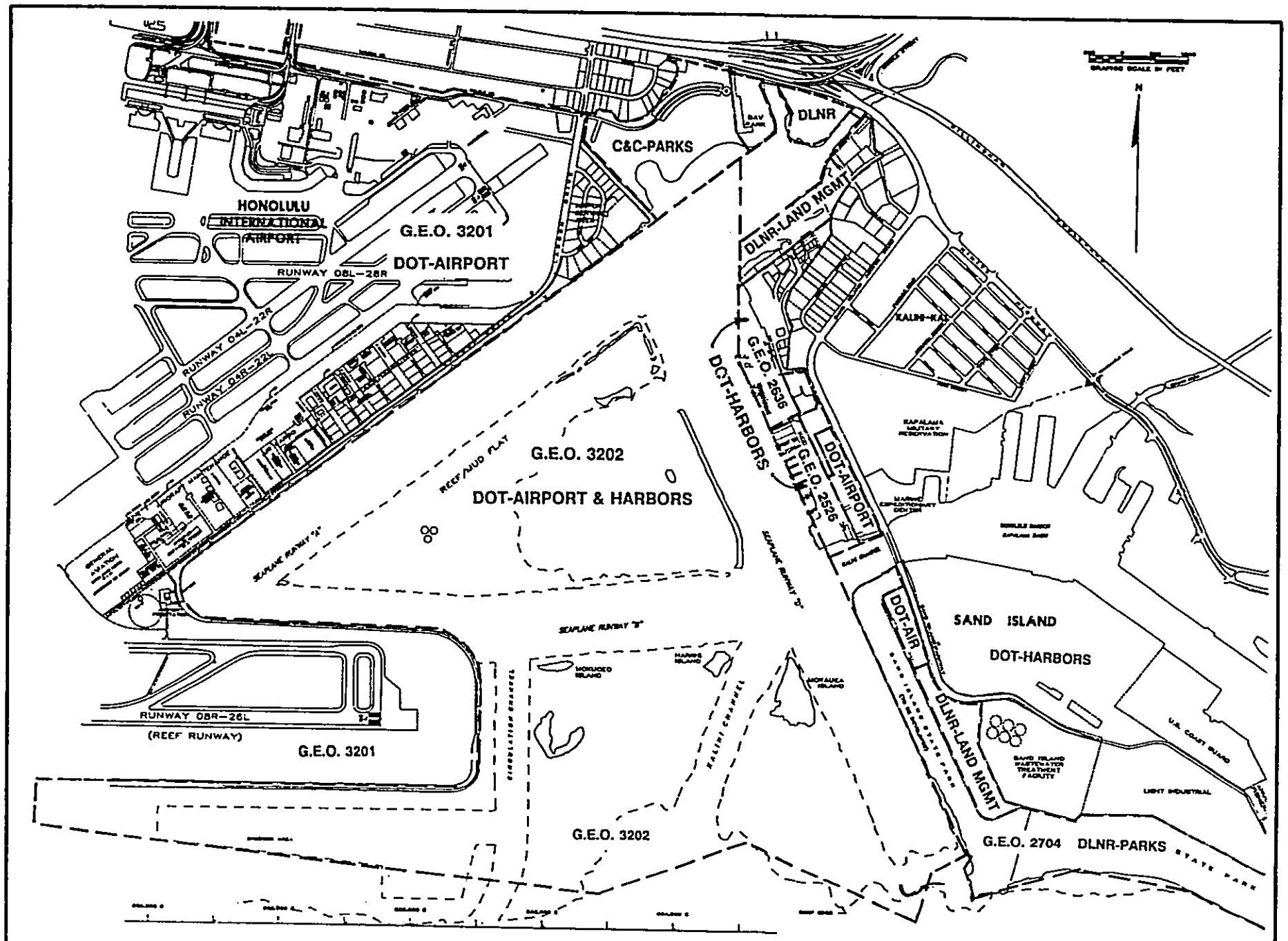


'ATION STATE OF HAWAII	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Ke'ehi Lagoon Recreation Plan Proposed Major Improvement Sites**	FIGURE II-3



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **State-Owned Lands in Ke'ehi Lagoon and Vicinity**	FIGURE II-4

- o Fast, tidal and submerged lands fronting the existing Ke'ehi Lagoon Beach Park (portions of TMK:1-1-03:6 of G.E.O. 1838 and 1-1-03:5 of G.E.O. 3202) to be developed with public funds;

- o Fast, tidal and submerged lands adjacent the Sand Island Access Road Industrial Subdivision (portions of TMK:1-2-23:39 & 44 of G.E.O. 2636, 1-1-03:5 of G.E.O. 3202, and 1-2-21:45 of G.E.O. 1016) to be developed with public funds.

Pier 60 Marina includes:

- o Fast, tidal and submerged lands adjacent La Mariana Sailing Club (portions of TMK:1-2-23:33 of G.E.O. 2636 and 1-1-03:5 of G.E.O. 3202) to be developed with private funds.

Lagoon Drive Marina includes:

- o Fast, tidal and submerged lands adjacent Lagoon Drive (portions of TMK:1-1-03:1 of G.E.O. 3201 and 1-1-03:5 of G.E.O. 3202) to be developed with private funds.

Triangle Development includes:

- o Fast, tidal and submerged lands in the central triangle portion of the lagoon bordered by the former Seaplane runways (portion of TMK:1-1-03:5 of G.E.O. 3202) to be developed with private funds.

Sheltered swimming beach includes:

- o Fast, tidal and submerged lands at the southwest tip of Sand Island (portions of TMK:1-5-41:3 of G.E.O. 2704 and 1-1-03:5 of G.E.O. 3202) to be developed with public funds.

Approximately $3 million has been appropriated by the 15th State Legislature for the initial phase of construction of the public portions of the Hawaiian Canoe Center development. With the execution of the lease for the privately-developed portion of the Canoe Complex, operation and maintenance of the publicly-developed part of the project will be made the responsibility of the private developer.

The estimated cost for construction of the sheltered swimming beach is $1.8 million. This development is considered part of the Sand Island State Park under the jurisdiction of the State of Hawaii Department of Land and Natural Resources (DLNR).

A more detailed breakdown of the preliminary cost estimates for the construction of the major improvements proposed for Ke'ehi Lagoon is contained in Appendix A of this EIS.

2.4 SUMMARY OF TECHNICAL INFORMATION

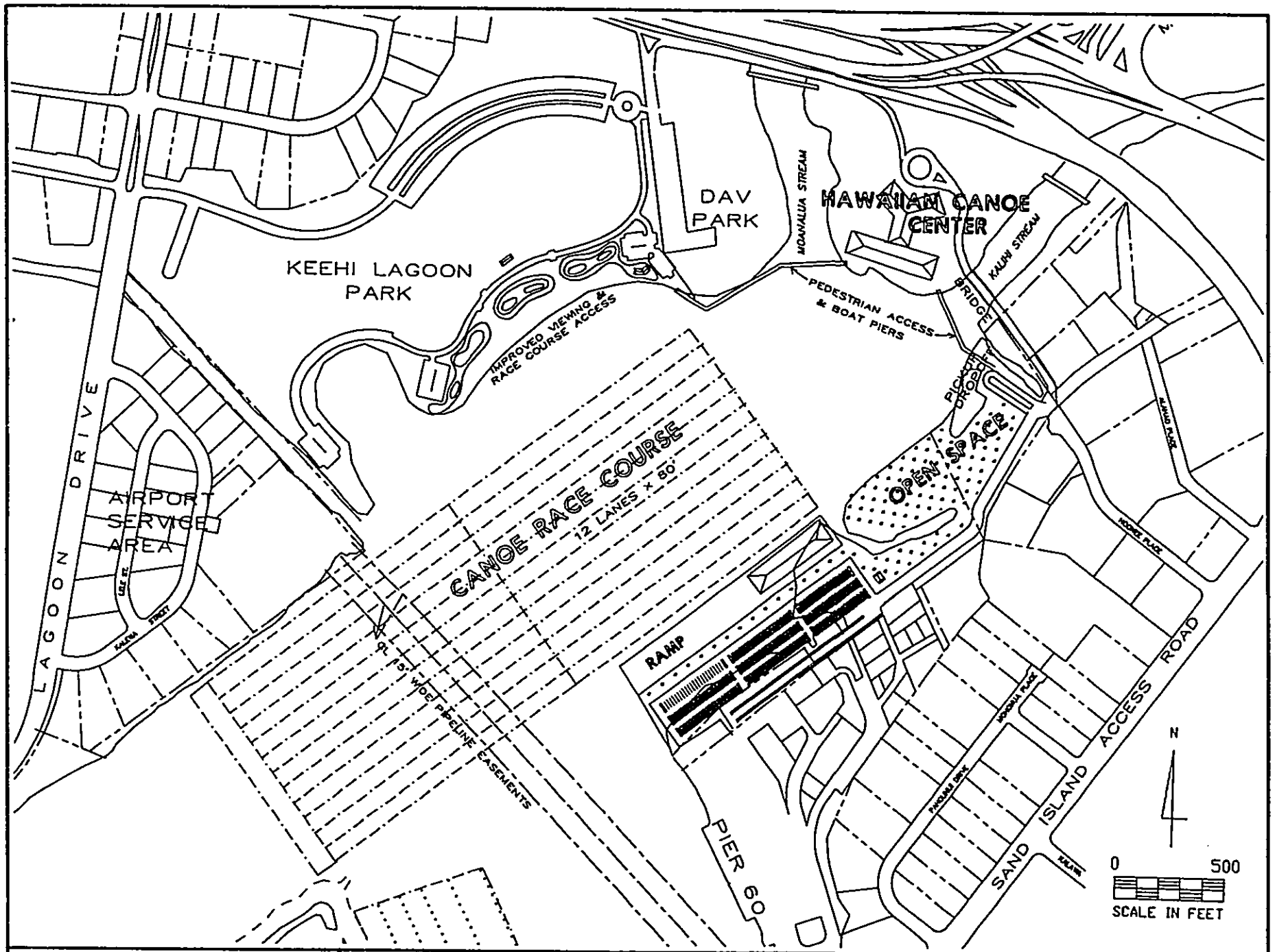
This section describes the specific development concepts and technical characteristics for each of the proposed projects as determined by conceptual level planning and engineering studies accomplished to date. Detailed engineering studies and design for the proposed developments have not yet been completed. Thus, any major changes to these plans which may have significant environmental impacts not described by this EIS, or any new information that is obtained during the course of detailed engineering and design which indicates new or greater impacts not described herein, may require the preparation of a Supplemental EIS.

2.4.1 Hawaiian Canoe Center:

The Hawaiian Canoe Center development is intended to provide improvements for the canoe racing community with the capability to efficiently accommodate international canoe regattas. Canoe races are presently held in the waters offshore Ke'ehi Lagoon Park. However, the limited parking spaces available within the existing park and the lack of infrastructure to stage these large events create a less than ideal chaotic situation for the thousands of spectators and participants.

The Hawaiian Canoe Center development consists of improvements on the peninsula adjacent to Nimitz Highway between Moanalua and Kalihi Streams, on the shoreline fronting Ke'ehi Lagoon Park, and on the opposite shoreline fronting the Kalihi-Kai industrial subdivision. Figure II-5 depicts a conceptual plan for the proposed Hawaiian Canoe Center improvements. Site plans are preliminary in nature pending detailed engineering and design studies. Detailed planning for the Canoe Center is presently ongoing and, as presently conceived, will be implemented in several phases. The initial phase includes improvements to the existing Ke'ehi Lagoon Park, the second phase will include improvements to the opposite Kalihi-Kai shore as well as in-water work related to the race course, and the third phase will include improvements on the peninsula adjacent to Nimitz Highway.

The basic recreation portion of this project consists of phases 1 and 2 (to be constructed with public funds). Phase 1 improvements to the existing park include a raised judges stand, elevated landscaped mounds for spectator viewing, paved access roads and increased parking for about 150 cars and 40 trailers, designated areas for overflow parking, outdoor showers, a public comfort station, a bicycle trail, and designated canoe landing and crew staging area. Detailed plans for these improvements are presently being coordinated with the City and County Department of Parks and Recreation to insure that the improvements are consistent



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Hawaiian Canoe Center Conceptual Plan**	FIGURE **II-5**

with the existing park uses and with the operation and maintenance responsibilities of the county. Phase 2 improvements to the opposite Kalihi-Kai shore will provide a parallel staging area to the course and the necessary marine "stadium" facilities required for training and international caliber regattas offering media coverage. Included in the phase 2 improvements are pedestrian inter-connections linking the entire Canoe Center development area, passive shoreline park space, comfort station, paved access roads and increased parking. Also included in phase 2 are the in-water work related to deepening of the canoe race course and placement of beach sand on the Ke'ehi Lagoon Park shoreline.

Phase 3 improvements will include other amenities which would provide a cultural, educational, and economic base for the Hawaiian Canoe Center located on the peninsula adjacent to Nimitz Highway. While the scope of this development is yet to be defined, facilities will likely include exhibition areas, meeting rooms, club house amenities, canoe storage area, administration offices, restaurant, and other appropriate commercial activities. Phase 3 improvements could also include debris catchment systems for Kalihi and Moanalua Streams. One option for implementation of the phase 3 improvements is to lease the area to a private developer, who will construct the on-site improvements and who may ultimately have the operational and maintenance responsibilities for the entire canoe complex. Revenues derived from the commercial activities would be used to support the public recreation portion of the complex. Other options are presently being evaluated, which may include a mix of public and private uses on the peninsula.

The conceptual plan for providing a parallel staging area to the course on the Kalihi-Kai shore would require approximately 80,000 cubic yards of fill material. A total of approximately 2,000 linear feet of shoreline stabilization structures would be required for the perimeter shorelines. Approximately 5,000 cubic yards of beach sand fill would be placed on the existing Ke'ehi Lagoon Park shoreline to improve access into the water. The present shoreline consists of coral rubble fill material which is unpleasant to walk on because of the large angular coral pieces.

Sedimentation from Kalihi and Moanalua Streams have resulted in diminished depths at the northeast end of Seaplane Runway "A" within the canoe race course limits. The present layout of the 1/2-mile race course provides sufficient space for 12 racing lanes, each 80 feet wide. Dredging within the upper reaches of the water course will be necessary to provide consistent water depths (approximately 10 feet) throughout the entire race course, and to provide navigable access to the peninsula. Periodic maintenance dredging may be required, the frequency of which will be dependent on the rate of siltation due to the stream discharges.

Access to the canoe course on the Ewa side will be through Ke'ehi Lagoon Park, which is presently used as the only access to the water for canoe racing events. Access to the canoe course on the Diamond Head side will be primarily via Hoonee Place from Sand Island Access Road. A new access road will be provided from Hoonee Place to the ramp area along the makai side of the industrial subdivision. Open space landscaped areas will be provided along this shore

fronting the new access road. This additional access to the canoe course from the Kalihi-Kai side will alleviate congestion in Ke'ehi Lagoon Park.

Primary access to the peninsula will be via a new vehicular bridge across Kalihi Stream from Hoonee Place connecting to Sand Island Access Road. Direct access to this site from Nimitz Highway will be restricted to ingress of service vehicles due to the Ke'ehi Interchange traffic patterns and potential for added congestion. Public parking will primarily be accommodated along the Kalihi-Kai side across Kalihi Stream. Pedestrian bridges across Kalihi and Moanalua Streams will allow public access to this area.

2.4.2 Pier 60 Marina:

Pier 60 is an existing barge dock used by Ameron to offload sand and gravel for their concrete batch plant located nearby in the Sand Island Access Road industrial subdivision. Three separate marinas are presently situated along this shoreline: La Mariana Sailing Club, Keehi Marine Center, and the State's Keehi Small Boat Harbor. Both La Mariana and Keehi Marine Center are privately constructed and operated facilities under lease agreements with the DOT Harbors Division. The development of a small marina at Pier 60 would fully implement the Ke'ehi Lagoon Recreation Plan recommendations for marina and boating facilities along this entire shoreline reach.

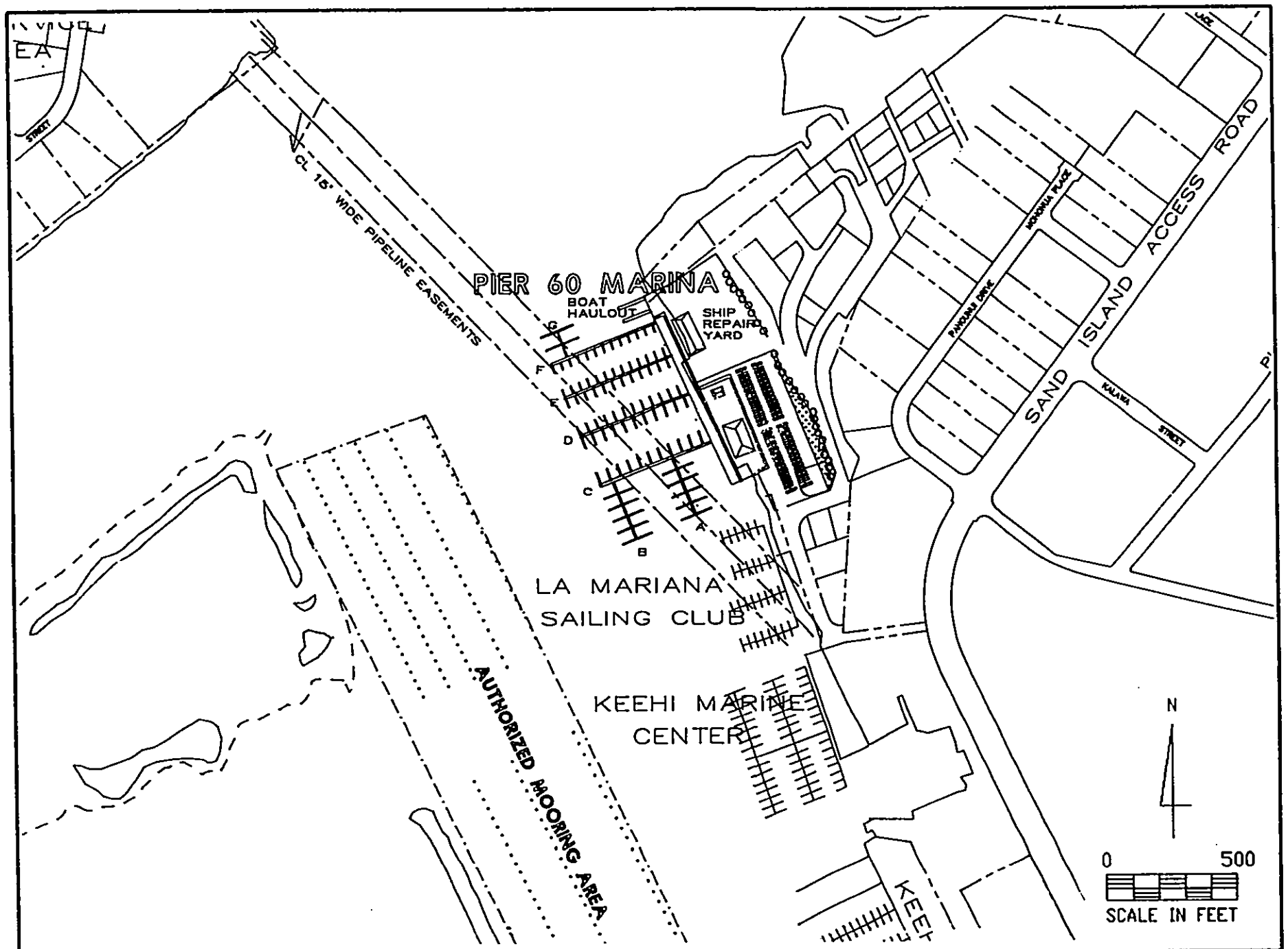
Pier 60 consists of an approximate 450 feet long lowlying bulkhead earthfill dock. Water depths average about 20-30 feet in the barge basin. Depending on the condition of the existing bulkheads, new shore stabilization may be required, as well as improved stabilization for an additional 300 feet of shore frontage.

Figure II-6 depicts a conceptual plan for the marina and boat repair yard. This layout plan accommodates about 185 boats with an average slip size of 42 feet. The actual wet storage boat capacity can vary depending on the distribution of slip sizes and other activities within the marina facility. Other possible activities may include boat building, marine supply store, snack bar/restaurant, boat dry storage racks, and other appurtenant facilities.

Three existing fuel oil pipeline easements cross the water side portion of the area. For this reason, floating piers and slips will be the required type of construction for the boat berths that are situated over the pipeline easements. Fixed piers can be used in areas that are outside the easements.

2.4.3 Lagoon Drive Marina:

As part of the on-going development of the Honolulu International Airport South Ramp area, the Lagoon Drive shoreline bordering Ke'ehi Lagoon was filled and straightened and Lagoon Drive realigned and widened to four lanes along most



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Pier 60 Marina Conceptual Plan**	FIGURE **II-6**

of its entire length. To meet the present demand for boat slips, a major marina facility is proposed along this shoreline. There are an estimated 300 or more boats anchored throughout Ke'ehi Lagoon, and about 2,300 recreational vessels currently on the State Department of Transportation waiting list as of June 1989 (1,458 of which are on the waiting list for Ala Wai Marina). The Lagoon Drive site is a suitable location for a major marina development capable of berthing about 800 boats, depending on the distribution of slip sizes and other activities within the marina.

Figure II-7 depicts a conceptual plan for a marina which accommodates about 680 boats with an average slip size of 42 feet. A narrow (50-foot wide or less) strip of shoreline exists between Lagoon Drive and the water. Major filling within the Seaplane runway will be necessary to provide the landside space for the marina. About 300 feet of shoreline fill extension would provide sufficient back-up space for parking, harbor support facilities and ancillary facilities. Based on the conceptual plan, approximately 760,000 cubic yards of fill material will be required. This conceptual plan shows the possible types and layout of facilities including marina administration office, comfort stations, restaurant/snack bar, marine supply store, yacht club, fishing charter kiosks and miscellaneous concessionaires, launch ramp facility, dinghy pier, and fuel dock/sewage pumpout facility.

The plan also includes a ferry transit landing and terminal that will be part of the water transit system for Oahu. This ferry landing will be the terminal servicing the Airport area for workers commuting to the Airport and vicinity. (Refer to Section 3.3.9 for more information on this water transit system.) It is also envisioned that passengers deplaning at the Airport could be bused to the Lagoon Drive terminal and ferried directly to Waikiki and other resort destinations at Ewa and Barbers Point. This would be a fitting introduction to Hawaii for tourists as they view Honolulu's waterfront from an ocean side perspective.

This proposed development along Lagoon Drive encompasses about 4,000 linear feet of shoreline. The Runway 26R clear zone and approach zone limits the development at the northeast end, and deep 45-50 foot water depths at the southwest end makes construction impractical beyond the present limit of the proposed development. Water depth in the Seaplane runway within the limits of proposed development averages about 12 feet, which is sufficient for the recreational small craft. Thus, no dredging will be required for this marina development.

2.4.4 Triangle Development:

After the triumphant return of the America's Cup to the United States by Dennis Conner and his crew of the yacht Stars and Stripes, the search was started to select the host site for the next America's Cup Race. Many within the yacht-racing community agreed that Hawaii would be an excellent location for the race, and Governor Waihee took on the challenge to bring the America's Cup Race to

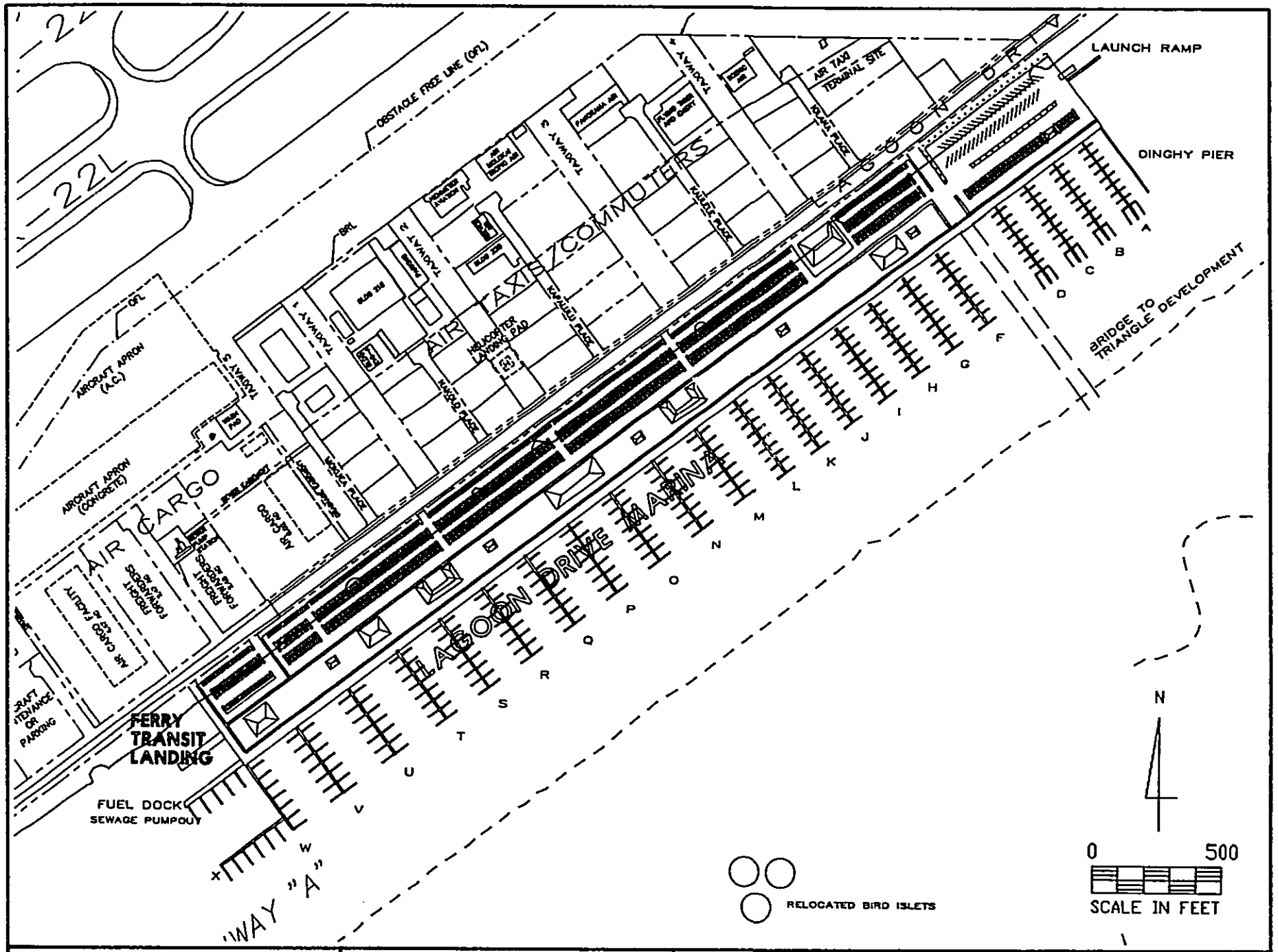
Hawaii. The development of a proposed plan for suitable facilities to host the event required immediate conceptual design work, and Ke'ehi Lagoon was quickly identified as the most suitable site for the racing yacht headquarters facility. In September of 1987, Hawaii learned that it was not selected to host the 1991 America's Cup races. Never-the-less, the planning for major yachting and marine recreation facilities was carried forward for Ke'ehi Lagoon, leading to the update of the 1977 recreation master plan and this proposed PLAN for the lagoon.

The technical considerations pertinent to the design of facilities for the America's Cup event led to the identification of two possible sites in Ke'ehi Lagoon for the construction of these facilities: Sand Island and the central triangle portion of the lagoon. A total land area of about 50 acres was required, having about 3,000 linear feet of water frontage facing to leeward of the prevailing winds. Because the west shore of Sand Island is part of the Sand Island State Recreational Area, the America's Cup facilities, if constructed on this site, would be converted to park use after the race. In view of the desire to construct permanent facilities to host major yacht racing events, the triangle site was selected for the location of a Yacht Race/Ocean Sports Complex that is a major component of the present Ke'ehi Lagoon Recreation Plan.

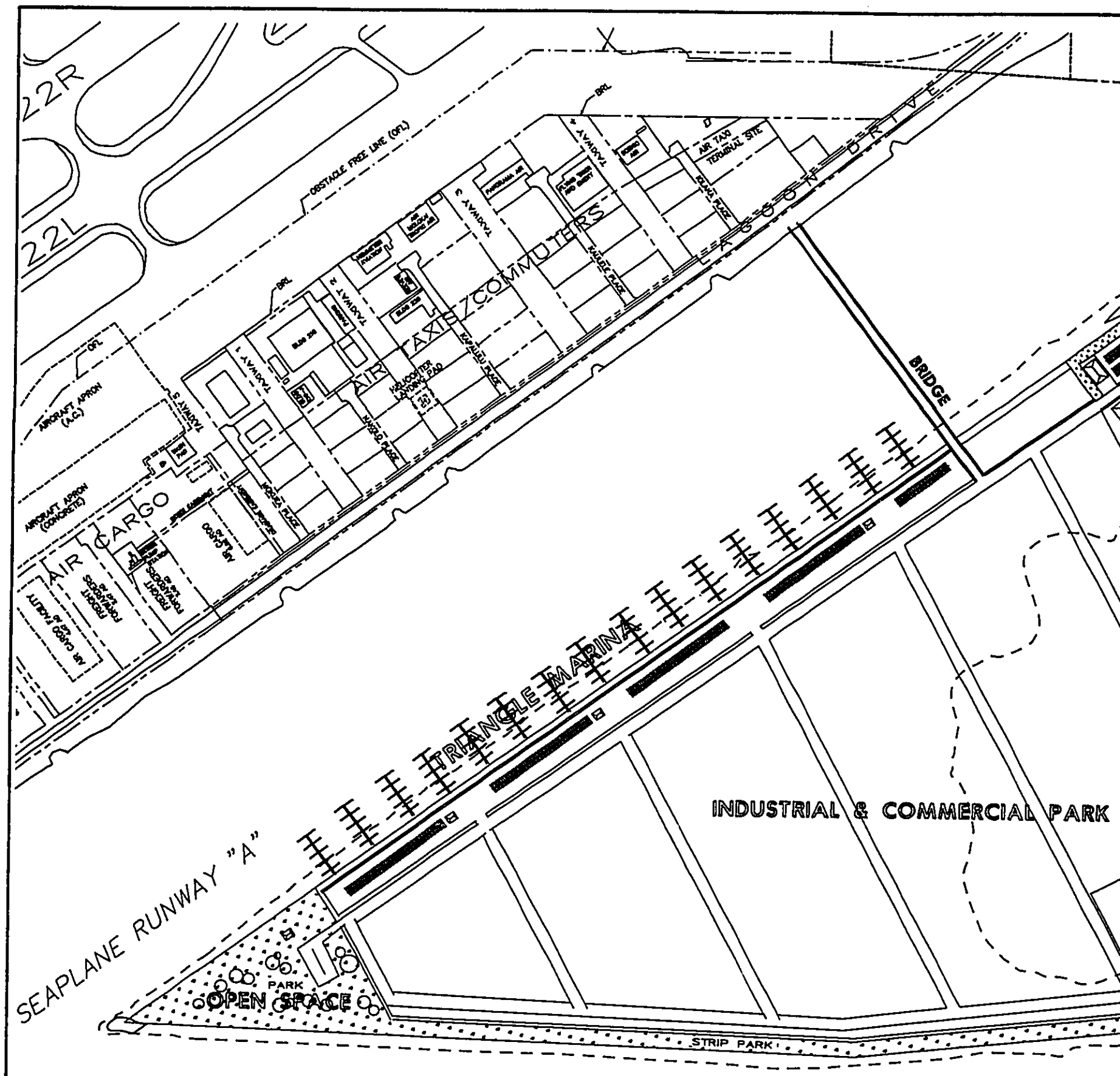
The triangular shaped area in central Ke'ehi Lagoon is bordered on all sides by the former Seaplane Runways. About one half of the approximate 300 acre triangle area has previously been dredged to about 10 feet depth or less, while the remaining area is shallow reef and mud flat at about MLLW elevation. In conjunction with the construction of the Yacht Race/Ocean Sports Complex, this shallow triangle area provides an opportunity to develop major recreational, commercial, and industrial infrastructure to support five economic growth areas in the State:

- Honolulu International Airport and aeronautical activities;
- Honolulu Harbor and commercial maritime activities;
- International and regional yacht racing and recreational boating activities;
- Other ocean recreation activities for residents and tourists;
- Ocean research and education activities.

Figure II-8 depicts a conceptual plan for the mixed-use development of the triangle area. This proposed development goes beyond the previous planning concepts for Ke'ehi Lagoon, and is in fact a new vision for a major aeronautical and maritime oriented development to serve the economic growth needs for Honolulu and the State. The synergistic relationship of the proposed facilities within the triangle development makes it attractive for private developer financing. The commercial



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Lagoon Drive Marina Conceptual Plan**	FIGURE II-7



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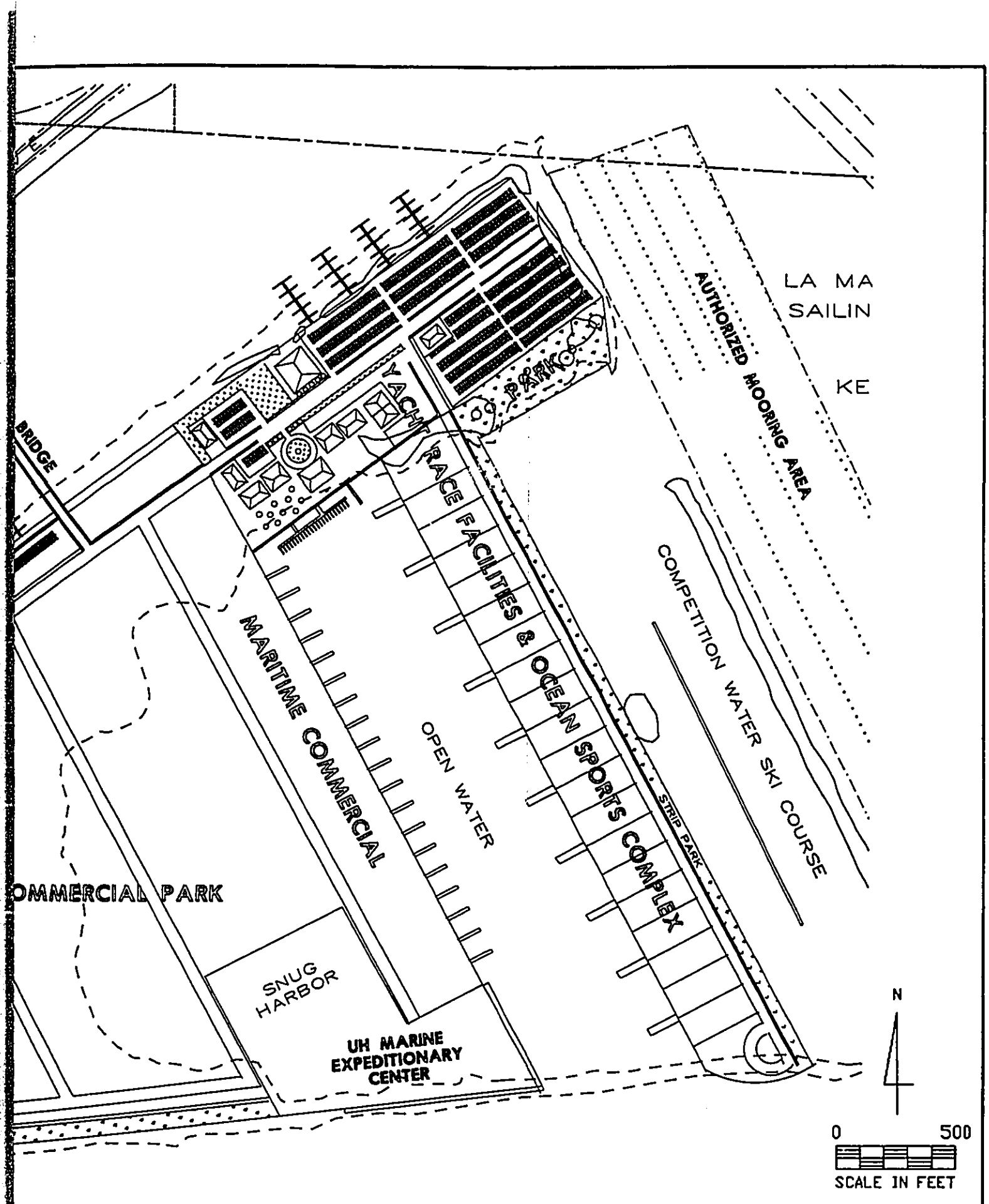

ATION STATE OF HAWAII	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Triangle Mixed-Use Development Conceptual Plan**	FIGURE **II-8**

and industrial uses provide the major revenue base for implementing the public recreation components of the overall improvements. Together with the other proposed recreational improvements within the lagoon, this would serve to identify Ke'ehi Lagoon as the premier ocean recreation center in the State.

H.C.R. (House Concurrent Resolution) No. 386 (H.D.1, S.D.1, C.D.1) authorized the Board of Land and Natural Resources and the Department of Transportation to lease and to provide for the reclamation and development by a private developer of approximately 300 plus acres in the central triangular section of Ke'ehi Lagoon bordered by and including the former Seaplane Runways. The resolution specified that lease of the parcels within the 300 plus acres shall be for the following purposes:

(1) *Not less than fifty percent is to be used for recreation, ocean-related recreation, parks, open space, ocean research and related activities, and educational activities including training for marine-related employment opportunities; provided that of the fifty percent of submerged and tidal lands previously described, at least five percent shall be used for parks and open space;*

(2) *The remaining acreage is to be used for commercial and light industrial enterprises and activities.*

The conceptual plan in Figure II-8 satisfies the legislative intent with respect to uses and space allocation. Table II-1 provides a breakdown of the acreage allocated to specific uses based on the Figure II-8 conceptual plan. Land area for major roads and utility rights-of-ways is approximately 20 acres. Depending on the detailed development plan to be prepared by the master developer of this site, reclamation of a maximum of 250 acres of fast lands may be allowed, provided that the space allocation of uses is consistent with the legislative directives.

A bridge, similar to the new Sand Island bridge, will be required to provide access to the Triangle. The preferred location for the bridge is off Lagoon Drive, through the Lagoon Drive Marina complex. The bridge would span about 900 feet of open water. An alternate bridge route to Sand Island Access Road in the vicinity of Pier 60 would require a 1,600 foot long bridge that would be directly under the approach zone for Runway 26R. Thus, in view of safety and cost considerations, the bridge will be located generally as shown in the Figure II-8 conceptual plan. The bridge would only be high enough to allow passage of small boats. The larger vessels and sailboats within the new marinas in Seaplane Runway "A" will have to travel counter-clockwise around the Triangle to exit the lagoon. This is safer for navigation since it separates the vessel traffic of the new marinas in Seaplane Runway "A" from the vessel traffic in Seaplane Runway "D".

TABLE II-1

Space Allocation for Intended Uses
in the Triangle Development (Figure 8)

Use	Acres	% of Total
Public Parks	19	6.3
Marina (fast lands)	4	4.7
Marina Berths (350+ slips)*	14	4.7
Yacht Race/Ocean Sports Complex (includes public parking 1000+ and Pacific Maritime Academy)	48	16.0
Berthing for Sports Complex*	13	4.3
U.H. Marine Expeditionary Center	15	5.0
Open Water Areas* (includes water ski area and access channel into berthing basin)	35+	11.7
	—	—
Subtotal Fast Lands	96	32.0
Subtotal Submerged Lands*	62+	20.7
Subtotal Fast and Submerged Lands	158+	52.7
Maritime Commercial	16	5.3
Berthing for Maritime*	7	2.3
Light Industrial/Commercial	119	39.7
Subtotal Fast Lands	135	45.0
Subtotal Submerged Lands*	7	2.3
Subtotal Fast and Submerged Lands	142	47.3
Grand Total Fast Lands	231	77.0
Grand Total Submerged Lands*	69+	23.0
Grand Total Fast and Submerged Lands	300+	100.0

(* Indicates submerged lands for in-water use.)

Public parks will provide views and access to the water around most of the perimeter shoreline. These parks include the "triangle park" at the west tip of the development, an "ocean strip park" along the southern shore, and the "Ocean Sports Complex park" bordering the water ski course. The Yacht Race/Ocean Sports Complex will facilitate public access to the water ski course and will enhance public viewing of the competition water ski events. Promenades/bicycle paths will be provided throughout these areas. The design criteria requirements for the entire development will stress the use of tropical landscape to ensure an attractive "park-like" setting for all areas of the project.

The conceptual layout for the Yacht Race/Ocean Sports Complex was originally developed based on needs and considerations for the America's Cup race facilities, however, it is intended as a multi-purpose water sports complex. The space allocation and general layout considerations are described in detail in the

Ke'ehi Lagoon Recreation Plan Update report[4]. In general, the present conceptual plan includes the following facilities:

- o Administration building with meeting hall, offices, conference room, restrooms;
- o Classroom building for the Pacific Maritime Academy and/or other instructional activities;
- o Restaurant and snack bar;
- o Shop and maintenance building;
- o Equipment storage building;
- o Men's and women's showers and lockers;
- o Public information center and souvenir merchandise sales;
- o Broadcast studio facility;
- o Media center;
- o Large open grassed area for drying sails;
- o Public parking (1,000± spaces);
- o Commercial space for concessionaires;
- o Twenty syndicate compounds, each with 135 feet of water frontage and 300 feet of back-up space;
- o Ten fixed piers about 130 feet in length, each shared between two syndicate compounds;
- o Slips and docks for the Yacht Race/Ocean Sports Complex support boats, instructional craft, and other support vessels expected during race events.

This facility will serve as permanent headquarters for year-round yacht racing regattas such as the Kenwood Cup Hawaii International Ocean Racing Series, Transpac Races, and regional yacht races that are presently held in Hawaii, as

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[4]Appendix D of the Ke'ehi Lagoon Recreation Plan Update report: Conceptual Planning and Design for Boating Facilities in the Airport, Ke'ehi Lagoon and Sand Island Areas Related to Development of Marinas and America's Cup Race Facilities.

well as other events which may be drawn to Hawaii such as the World 12-Meter Championships, a Pacific Basin Championship Series, and possibly even the America's Cup in the future. The sports complex will also provide "olympic caliber" training facilities for sailing and other ocean sports. Between yacht racing events, the large berths and syndicate compounds could be used to accommodate transient vessels, for staging other ocean sports events, or for short-term charter or water sports concessions.

The Maritime Commercial waterfront facilities are located across the basin from the syndicate compounds. This waterfront space can be used to satisfy the overflow needs for light draft commercial vessels which cannot be accommodated in Kewalo Basin and Honolulu Harbor. Typical tenants would include dinner cruise and tour boats, commercial fishing vessels, submarine tour operators, and other maritime businesses which need pier space for light-draft vessel operations. In addition to permanent berth space for these commercial vessels, dock space could be used as temporary berthing for transient vessels and commercial fishermen who wish to unload their catch to fish transhipping businesses.

The University of Hawaii Marine Expeditionary Center (Snug Harbor) is proposed to be relocated to the Triangle in the future. The Honolulu Waterfront Master Plan proposes redevelopment of Kapalama Military Reservation and adjacent lands as a full-scale modern containerized cargo terminal, which would require the relocation of the U.H. Snug Harbor facility. The planned location for Snug Harbor is at the southern corner of the Maritime Commercial waterfront area. Approximately 15 acres of land and 1,000 linear feet of pier frontage is required. The present conceptual plan provides about 1,300 linear feet of pier frontage (800 feet along the southern shore and 500 feet adjacent the Maritime Commercial frontage) to provide for future berthing needs of the U.H. fleet of vessels as well as visiting research vessels. It is intended that the private developer will accomplish the basic infrastructure improvements (dredging, filling, utilities to the property line) and will release the site to the State. Public funding will be required to construct the specific site improvements such as piers and buildings for the relocation of Snug Harbor to this site.

The shoreline along the former Seaplane Runway "A" facing the Lagoon Drive shoreline is planned for marina development. The Figure II-8 conceptual plan accommodates about 350 boats (including the slips in the Yacht Race/Ocean Sports Complex) with an average slip size of 45 feet. Because the cost for filling the shallow reef area within the Triangle is much less than the cost for filling in the deeper Seaplane runway, the construction cost for the Triangle marina would be less than the cost for developing the Lagoon Drive marina. It is the intent to find one master developer for both the Triangle development and the Lagoon Drive Marina development. This would provide greater flexibility in the design and construction of the integrated marina facilities. For example, the number of slips along Lagoon Drive could be reduced, with an associated reduction in the requirement for filling within the Seaplane runway, and the majority of the slips could be provided along the Triangle shoreline. A minimum access channel width

of 250 feet will be maintained within the Seaplane runway. Over 1,000 slips could be provided between the existing Lagoon Drive shoreline and the new Triangle shoreline within this integrated marina. The actual wet storage boat capacity will depend on the distribution of slip sizes and other activities within the marina complex.

The interior of the Triangle will be used for light industrial and commercial purposes. Development standards will be part of the lease document to assure that appropriate building heights, density, setbacks, landscaping, architectural treatment, etc., create an aesthetically pleasing and integrated look for the entire development. Potential developers have expressed interest in providing a wide range of possible uses within the Triangle. Potential development concepts for the interior commercial/industrial space include:

- o Commercial/Light Industrial Park. Redevelopment of the Honolulu Waterfront as envisioned by the Honolulu Waterfront Master Plan will result in displacement and/or relocation of some current activities and facilities. Plans for acquiring additional lands by the Department of Transportation, Airports Division, for expansion of airport facilities will also result in displacement of current industrial/commercial activities near the airport. The Triangle is a possible relocation site for industrial and commercial tenants. However, potential tenants should be made aware that the intended type of commercial and light industrial use within the Triangle is both maritime and aviation related, including businesses who are dependent on the maritime or aviation sectors of the economy and who would benefit greatly by the proximity to Honolulu International Airport and Honolulu Harbor. There is a shortage of vacant industrial/commercial space in metropolitan Honolulu to satisfy the current demand, especially adjacent to the airport and waterfront. The activities should also be in keeping with the beauty of the site.

- o Water Theme Park. People-oriented activities that are compatible with the surrounding ocean recreation activities could include waterfront tourist shopping complex, waterfront restaurant complex, entertainment water theme complex, aquarium complex, ocean exhibition center, etc.

In addition to the uses and activities described above for the Triangle development, other recreational and commercial uses have been suggested such as a championship golf course, tennis facilities, Olympic sized pool facilities, theatrical stages, and limited use housing. These types of activities which are not water-dependent and which do not contribute to the synergistic relationship of the maritime, aviation, and ocean recreation activities within Ke'ehi Lagoon and vicinity, will not be considered for inclusion in the Triangle development.

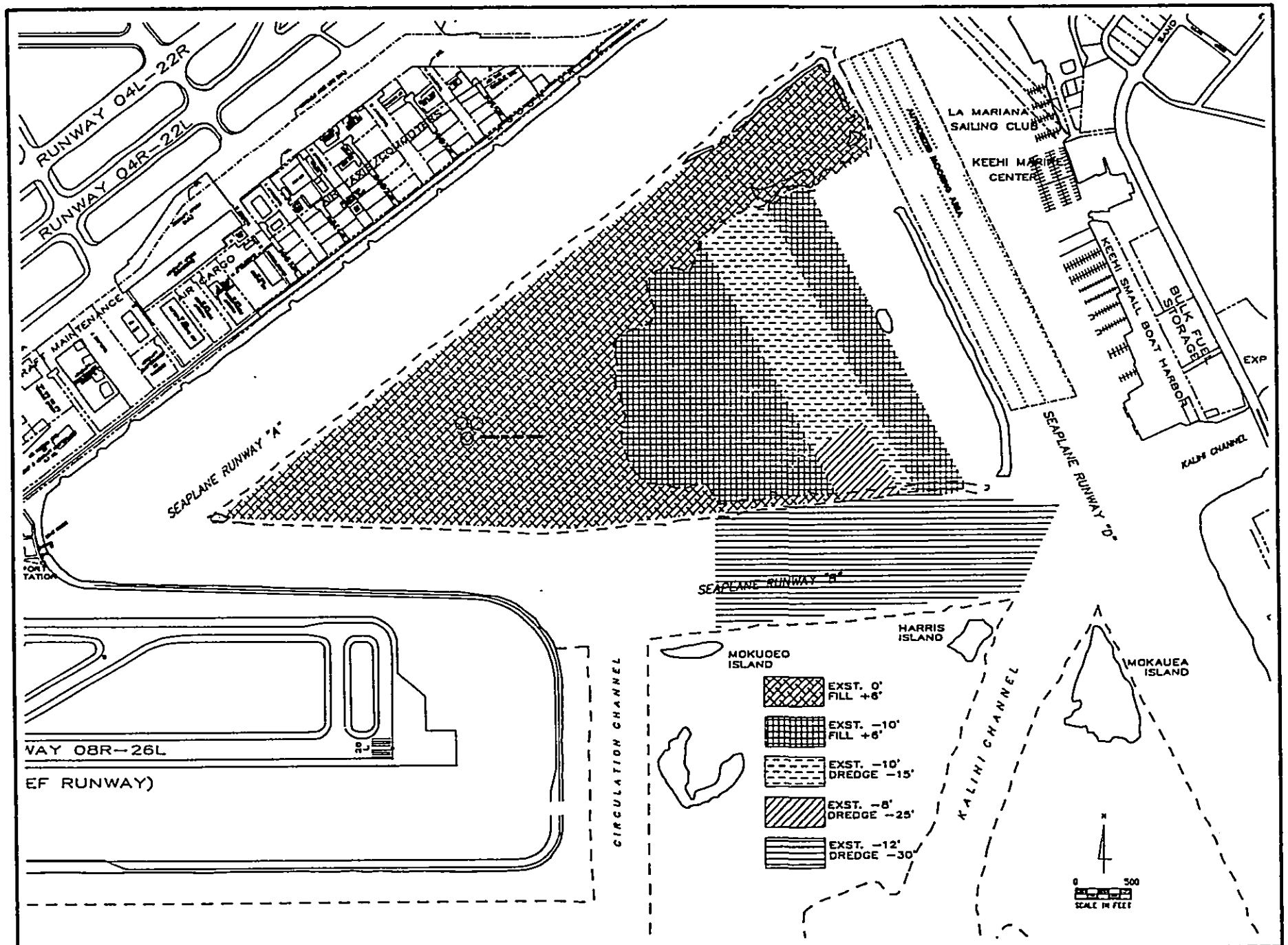
Land reclamation for the Triangle development will require major filling on the shallow reef and mud flats in the center of the lagoon to create up to 250 acres of fast lands. Dredging will be required to provide sufficient water depths within

the berthing basin as well as within the Seaplane Runway "B" to accommodate the U.H. oceanographic research vessels. The existing -35 feet MLLW depth and 400 foot width of the Kalihi Entrance Channel is sufficient to accommodate the vessels expected within Ke'ehi Lagoon. Figure II-9 shows the proposed limits of dredge and fill based on the Figure II-8 conceptual plan, and Table II-2 summarizes the dredge and fill quantities. Approximately 3.7 million cubic yards of fill material will be required, and approximately 2.2 million cubic yards of dredging will be required. The dredged spoils can be used to supplement the fill material requirements for land reclamation of the Triangle. However, there would still be a need to import about 1.6 million cubic yards of fill material from off-site. A present source of fill material of sufficient quantity to satisfy the additional fill needs for the Triangle development is the stockpile at Barbers Point Harbor. This material is coral limestone from the dredging of the deep draft harbor.

TABLE II-2

Dredge and Fill Quantities for the Triangle Development
(Based on the Figure 9 Limits of Dredge and Fill)

Dredge and Fill Areas	Elevation (MLLW) Exist	Elevation (MLLW) Finish	Acres	Cubic Yards
DREDGE:				
Berthing Basin	-10	-15	33	265,000
Snug Harbor	-8	-25	7	188,000
Seaplane Runway "B"	-12	-30	61	1,773,000
Total Dredge			101	2,226,000
FILL:				
Reef/Mud Flat	0	+6	165	1,597,000
Existing Dredged Area	-10	+6	85	2,194,000
Total Fill			250	3,791,000



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Proposed Limits of Dredge and Fill for the Triangle Development**	FIGURE **II-9**

2.4.5 Sheltered Swimming Beach:

The west shore of Sand Island facing Ke'ehi Lagoon is the presently undeveloped portion of Sand Island State Park. Plans for expansion of park improvements along this shore have been long-standing. During the public involvement process leading to the update of the Ke'ehi Lagoon Recreation Plan, the Kalihi-Palama community voiced desires for a safe swimming beach as part of the Sand Island Park development. The shallow reef flat at the southern end of the Seaplane Runway "D" provides a suitable location for the construction of a sheltered swimming beach.

Figure II-10 shows a conceptual plan for a 1,000 foot long, 150 foot wide beach protected by a shore-connected breakwater. The breakwater would be constructed at the reef edge, with beach sand fill placed on the lagoon side of the breakwater. Because of the shallow water depths on the reef flat, minor dredging of the reef flat in front of the beach would provide a slightly deeper swimming area. A narrow undredged strip of reef flat will be left intact to separate the swimming area from the deep Seaplane Channel with large boulders placed on the reef to visually mark the boundary.

An advantage of this swimming beach development is that the breakwater would provide wave protection to the Sand Island park shoreline along the southern reach facing the Seaplane Runway, which is presently suffering erosion damage. The breakwater-protected swimming beach would ensure calm waters within the Seaplane Runway for boating and other water recreation activities and would enhance the shore-fishing opportunities along the southern shore of Sand Island. The City and County of Honolulu will construct park improvements along the west shore of Sand Island in exchange for State lands on the mauka side of the park for the relocation of the City and County's Baseyards from Kakaako. The sheltered swimming beach is not part of the improvements to be constructed by the City and County. State funds of approximately $1.8 million will be necessary to implement this development project.

2.5 WATER DEPENDENCY AND SELF-FINANCING

Table II-3 compares the characteristics of the PLAN with regard to its water-dependency, its airport-dependency, its need for landfill, and its basis of financing. The table illustrates the key feature of the PLAN in that Commercial/Light Industrial development for maritime and aviation uses generate financing for ocean recreational public uses.

2.6 HISTORIC PERSPECTIVE

The physical transformation of Ke'ehi Lagoon is intimately tied to the development of Honolulu Harbor and Honolulu International Airport, the two primary centers of transportation and commerce in the State. Prior to the early 1800's when Honolulu

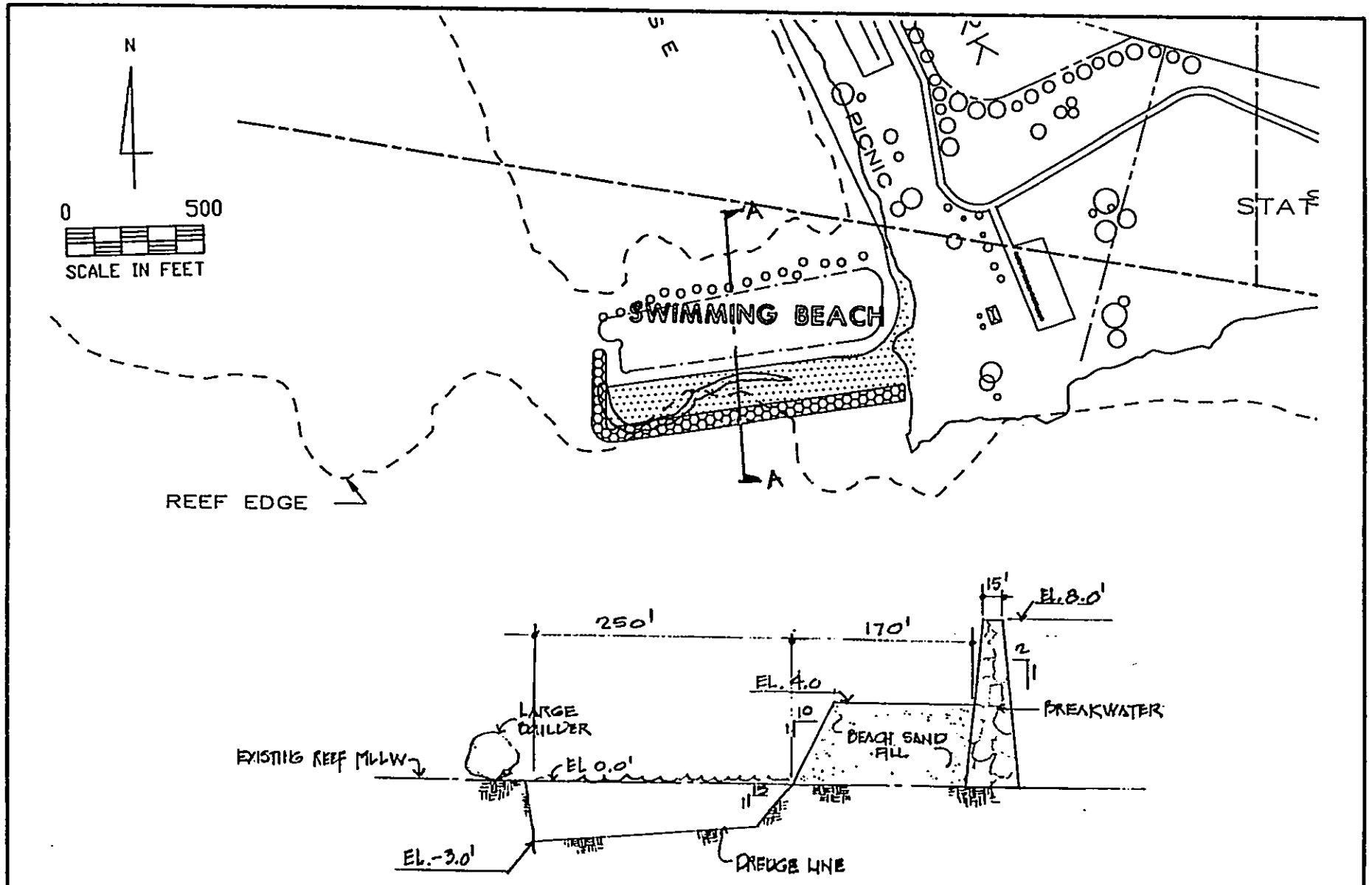
TABLE II-3
Water Dependency and Financing

Plan Component	Water Dependent	Airport Dependent	Requires Landfill	Self Financing	Finances Other Uses
Hawaiian Canoe Center	X		Minor	Part	
Pier 60 Marina	X			X	
Lagoon Drive Marina	X		X	Part	
Swimming Beach	X		X		
Triangle Development					
Marina	X		X		
Public Parks	X		X		
Yacht Racing /Ocean Sports	X		X		
Maritime Commercial	X		X	X	
UH Marine Expeditionary Center	X		X		
Commercial Light/Ind. (Maritime)	X		X	X	X
Commercial Light/Ind. (Aviation)		X	X	X	X

Harbor's physical development began, the area was a shallow embayment with numerous fishponds from Nuuanu Stream to the Ke'ehi Lagoon area. Natural channels through the reef existed at the major stream mouths, where the flow of fresh water inhibited the growth of coral.

The Honolulu Waterfront Master Plan Pre-Final Report chronicles the development of Honolulu Harbor from the time of first Western use recorded in 1794 to the present. Figure II-11 from this report shows the evolution of the Honolulu shoreline in response to the growth needs of Honolulu Harbor.

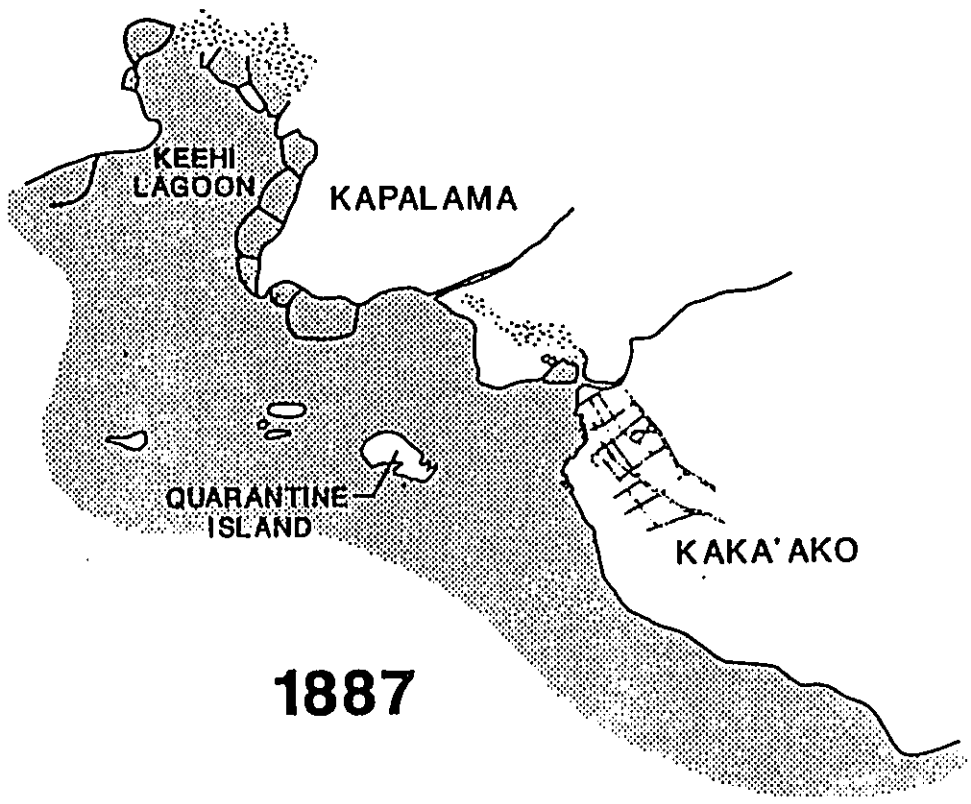
In 1925, the Territory of Hawaii acquired Ke'ehi Lagoon and adjacent land for construction of John Rodgers Airport (now Honolulu International Airport). In 1940, trans-Pacific air service had grown and the U.S. Congress authorized dredging of Ke'ehi Lagoon to construct seaplane runways. In 1941, at the beginning of World War II, the U.S. Armed Forces were responsible for the airport and Honolulu Harbor. By 1944, the U.S. Navy had completed construction of



SECTION A-A

SAND ISLAND SWIMMING BEACH

EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Sheltered Swimming Beach Conceptual Plan**	FIGURE II-10



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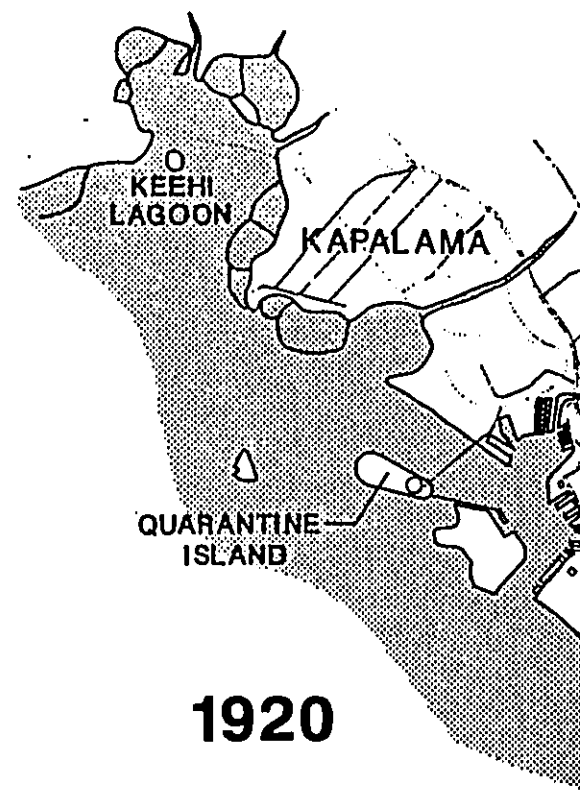

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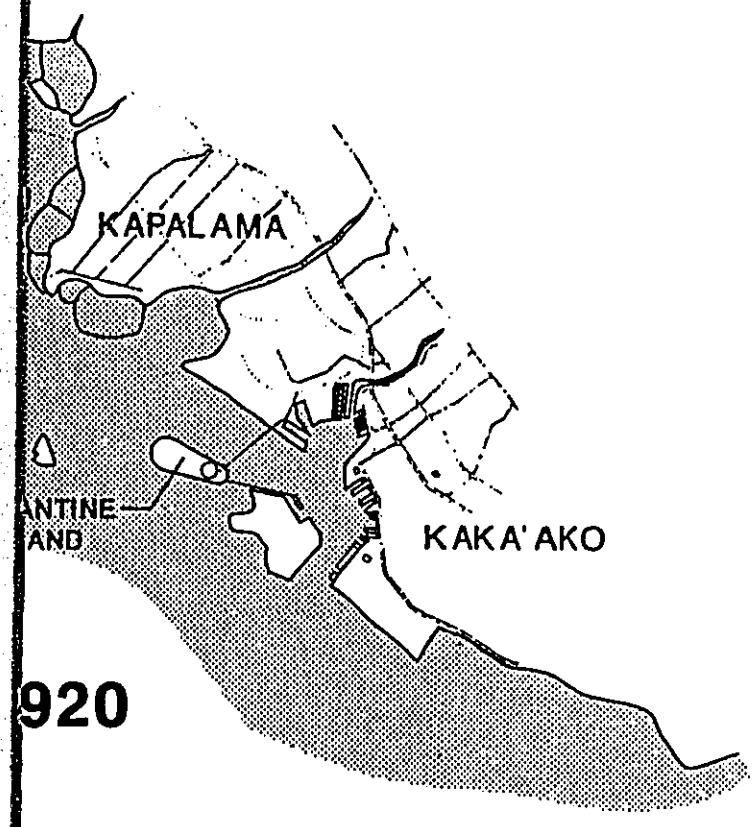

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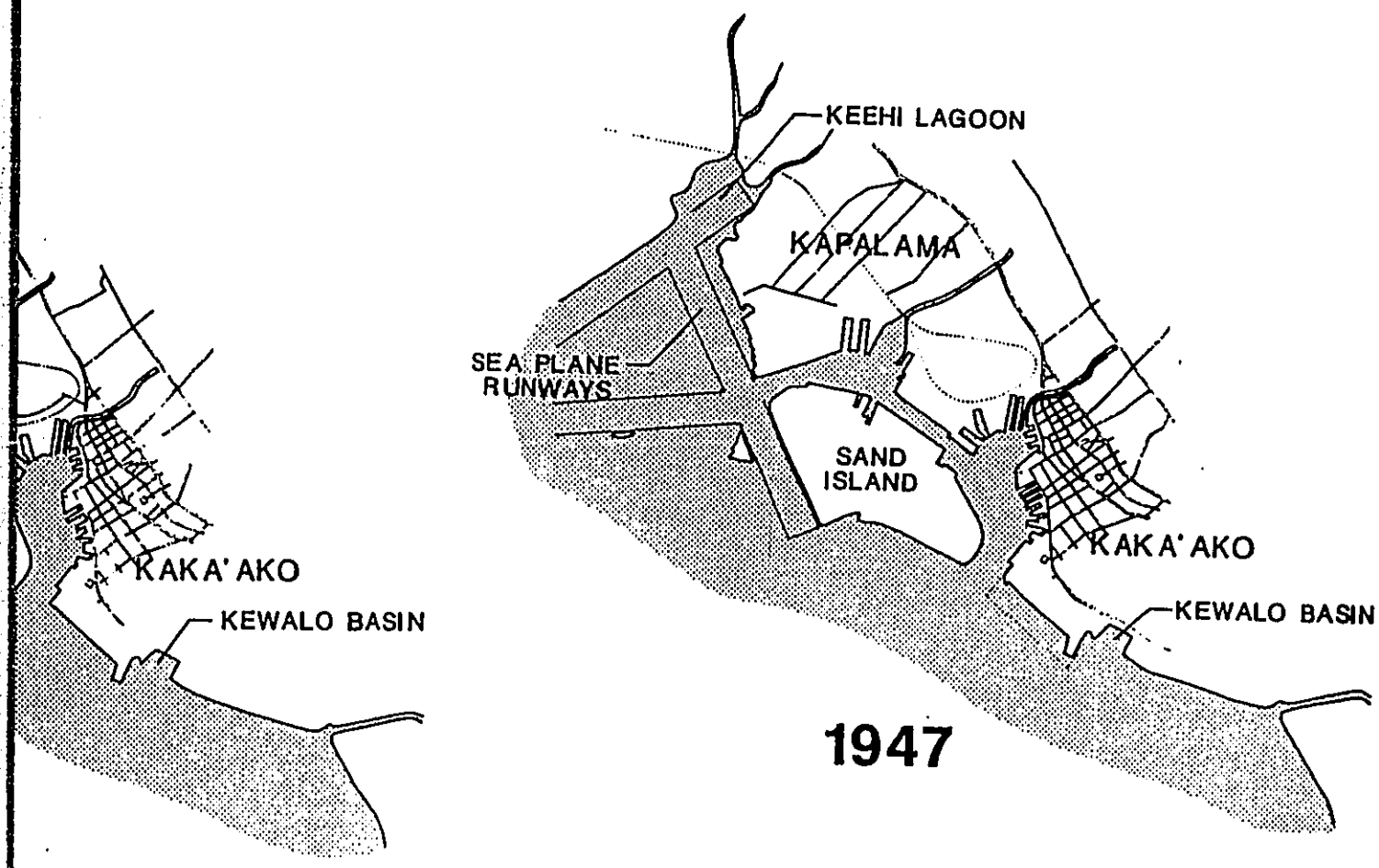


1947

ATION	STATE OF HAWAII	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Historic Evolution of the Honolulu Shoreline**	FIGURE II-11

major airport terminals and seaplane facilities. The Reserve Channel (Kalihi-Kai Channel) and Kapalama Basin areas were widened, dredged and lengthened, and new piers constructed in Honolulu Harbor.

The airport construction work during World War II required filling of much reef flat which became the site of the old "John Rodgers Terminal". Perhaps one third of Ke'ehi Lagoon prior to 1940 became filled land. The source of the fill came from the massive dredging performed to create the seaplane runways. Thus, Ke'ehi Lagoon was significantly altered from a very shallow bay with fishponds along shore, to an embayment with deep channels (where the seaplane runways were constructed) and a very shallow reef flat which roughly forms a triangle in the center of the remaining lagoon. After World War II, Ke'ehi Lagoon was used for a short period for commercial seaplane landings, but by 1950 the seaplane runways were no longer used. The lagoon remained much the same until the construction of the Reef Runway.

The Reef Runway was constructed in 1977 to alleviate aircraft noise and safety concerns over metropolitan Honolulu, provide more flexibility for aircraft takeoff and landings, and increase airfield capacity. The project encompassed dredged fill on 1,240 acres of offshore coral reef. Portions of the existing seaplane runways and offshore coral reef areas were dredged to provide the fill material. The Reef Runway significantly altered the Ke'ehi Lagoon environment. However, some of the impacts have proven beneficial such as improved flushing characteristics within the lagoon.

As urbanization and growth pressures for continued development of Honolulu International Airport and Honolulu Harbor continue, the face of the Honolulu shoreline including Ke'ehi Lagoon will continue to change. The Ke'ehi Lagoon Recreation Plan and the overall Honolulu Waterfront Master Plan address these issues of growth and development in harmony with the recreational and cultural needs of the public.

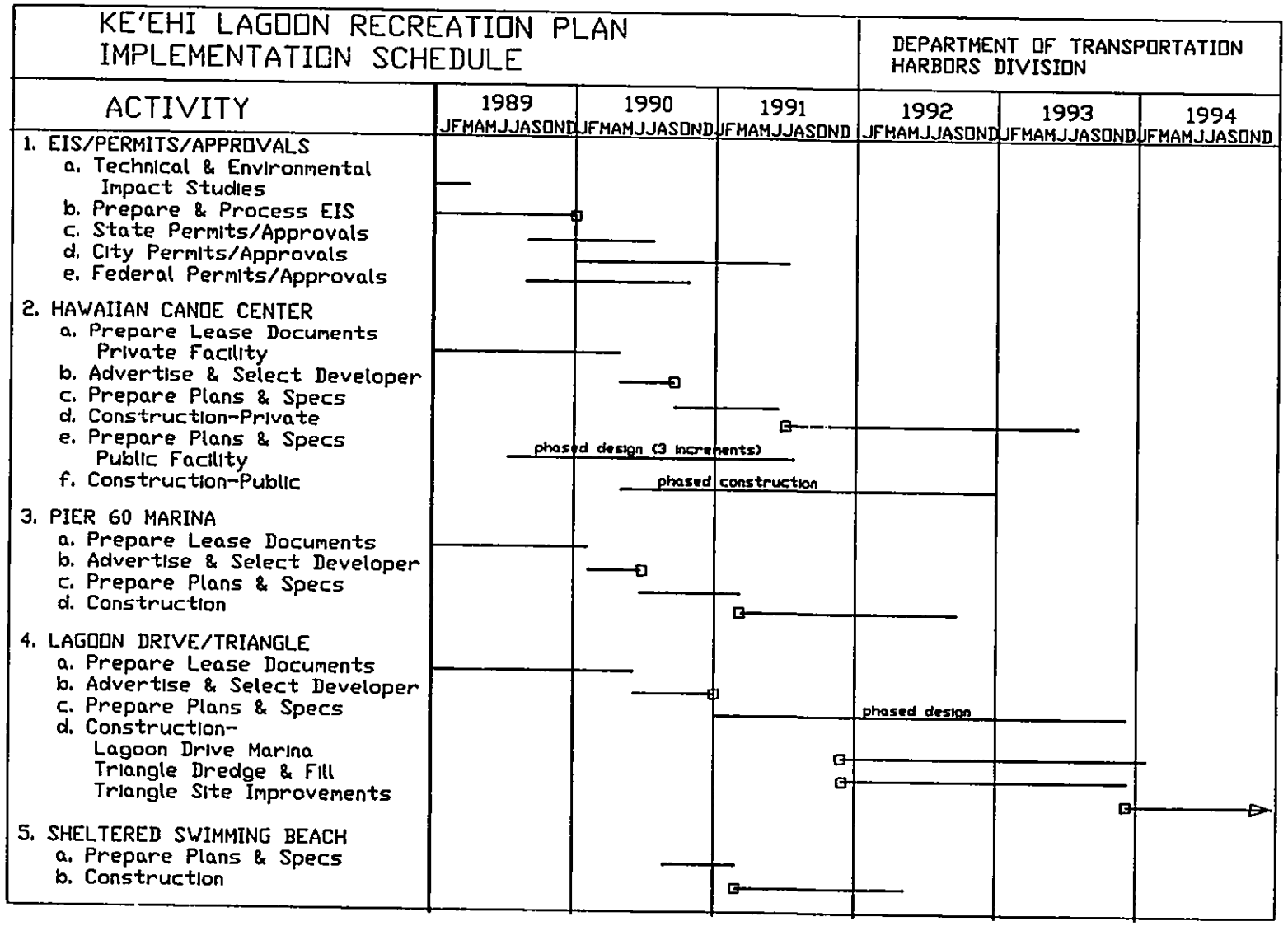
2.7 PHASING AND TIMING OF ACTION

The estimated timetable for implementation of the major development projects in Ke'ehi Lagoon is presented in Figure II-12. Major milestones such as execution of lease agreements and initiation of construction are indicated with a box. The smaller development projects are expected to be initiated and completed sooner than the Triangle Development. Full development of the industrial/commercial space on the Triangle, while expected over a 10-year time frame, would be dependent on the demands of the marketplace.

This schedule reflects a "fast track" timetable assuming no major problems arise which may delay the acquisition of permits and approvals. The potential requirement for preparation of any Supplemental EIS would necessarily delay the start of construction for the respective development project.

KE'EHI LAGOON RECREATION PLAN IMPLEMENTATION SCHEDULE

DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Project Implementation Schedule**	FIGURE II-12

Chapter III

Description of Environmental Setting

CHAPTER III:
DESCRIPTION OF ENVIRONMENTAL SETTING

3.1 PHYSICAL ENVIRONMENT

3.1.1 Physiography:

The shoreline elevations bordering Ke'ehi Lagoon are typically quite low, reflecting the generally well-protected inner lagoon environment. Shoreline elevations along the site of the proposed Lagoon Drive Marina range from 5 to 6 feet above mean sea level (MSL). The shoreline elevation of the vacant Hawaiian Canoe Center site ranges from a low of less than 1 foot above MSL near the shore to approximately 7 feet above MSL near the adjacent Nimitz Highway. At the proposed Pier 60 Marina site, shoreside elevations are on average 1 to 3 feet above MSL. On the southwestern shore of Sand Island near the proposed sheltered swimming beach and park expansion, elevations vary from approximately 0 to 4 feet above MSL.

Ke'ehi Lagoon and its shoreline have been dramatically altered over the past century. Virtually all of the land surrounding the lagoon is fill from the various dredging operations which have been undertaken in and around this coastal area. Prior to its extensive physical alteration, the lagoon was an open embayment that encompassed Honolulu Harbor. Most of the embayment was shallow reef and mud flat, with deep areas being confined to stream outlets through the reef. Salt marsh and fishponds lined the embayment's shore and extended inland around the lower reaches of the four major streams which flowed into this area (i.e., Moanalua, Kalihi, Kapalama and Nuuanu Streams). McAllister (1933) recorded and described the Ke'ehi Lagoon area prior to the filling of the lagoon's shoreline. Six fishponds, totaling 885 acres, along the shore of the Kalihi Basin were identified.

During the period between the turn of the century and the late 1950s, marsh land, salt marsh, fishponds, and shallow mud flats around the perimeter of Ke'ehi Lagoon were filled by the Corps of Engineers and a number of other public agencies to create fast land, substantially reducing the size of the embayment. Major catalysts for this change were the expansion of Honolulu Harbor around the mouth of Nuuanu Stream and the development of Honolulu's airport facility just ewa of the harbor. Over the period from 1905 to 1935 shallow portions of the Harbor were dredged, in conjunction with expanding shipping operations, with the spoils being used to fill portions of Sand Island and the Kapalama area. In 1940, the federal government authorized construction of a major land and sea based aircraft facility in and adjacent to Ke'ehi Lagoon. Mooring basins and three seaplane runways, each 1000 feet wide, were dredged to a depth of 10 feet. In connection with this, areas along Sand Island, Kapalama and Lagoon Drive were filled and straightened. In 1943, Kalihi Channel was dredged to a depth of 35 feet as part of a military project to connect Kapalama Basin in Honolulu Harbor with the open ocean.

The most recent dredging and filling project to change Ke'ehi Lagoon's physiography was the development of the Reef Runway. Over the period from 1973 to 1977, approximately 19 million cubic yards of dredged coral material was used to fill in the outer reef on the western end of Ke'ehi Lagoon as part of a project to alleviate aircraft capacity problems at the Honolulu International Airport and to reduce noise impact over metropolitan Honolulu.

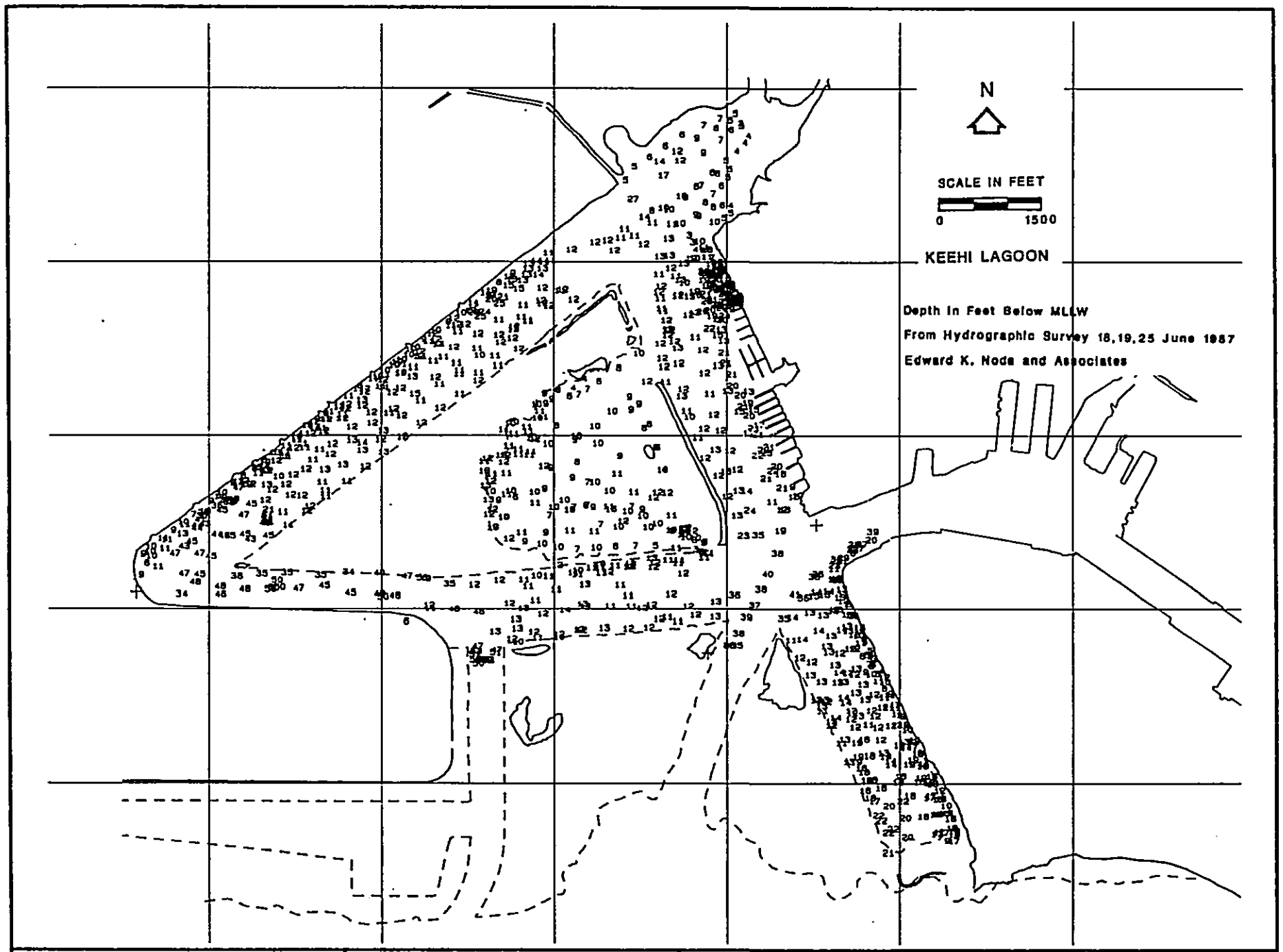
Today, Ke'ehi Lagoon's physiography reflects the alterations from the numerous dredging and filling projects. Most of the shoreline areas of the triangle-shaped lagoon have been straightened and filled to an elevation ranging from between 3 to 7 feet above MSL. Located in the inner portion of the lagoon is an approximate 300 acre triangle reef remnant which is bordered by the channels dredged for the three seaplane runways. About half of this feature is a borrow area dredged to between 9 to 11 feet below the mean lower low water (MLLW) for fill material. The remaining 160 acres of this remnant is a vast expanse of reef covered with a thin layer of silty sand at about the MLLW elevation. On the ewa corner of this triangle remnant are three small bird islets which were constructed in conjunction with mitigation efforts for the Reef Runway project. These islets constructed of sand and coral fill material range from approximately 2 to 3 feet above MSL.

On the outer portion of the lagoon, directly between the Reef Runway and Sand Island, is a reef mud flat area and three small islands. The largest of these islands, Mokauea Island, is located on a small outer reef remnant bordered by the Kalihi Channel and Seaplane Runway "D". Harris Island and Mokuoeo Island and the small sand/mud flat area are situated on the outer reef remnant divided from the inner lagoon area by Seaplane Runway "B," and bordered by the circulation channel and the Kalihi Channel.

3.1.2 Marine Environment:

Bathymetry. The dredged seaplane runways which border the triangle reef remnant, in the center of Ke'ehi Lagoon, provide excellent boating access to all three of the proposed marina facilities (Edward K. Noda & Assoc., 1987). Typical depths of the Seaplane Runways average between 12- to 13 feet below MLLW (Figure III-1).

In the southwestern end of Seaplane Runway "A", near the Reef Runway, depths along a 2,000 foot reach of shoreline increase to an average of 45 feet below MLLW. This area, as well as the portion of Seaplane Runway "B" adjacent to the Reef Runway and the circulation channel at the end of the reef runway, were dredged to provide fill material during the construction of the Reef Runway. Deeper water depths are also found in the waters off of the site of the proposed Pier 60 Marina, where depths of 20 to 30 feet below MLLW were dredged for commercial barge activities.



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Hydrographic Survey of Ke'ehi Lagoon**	FIGURE III-1

In the center of Ke'ehi Lagoon, approximately 50 percent of the triangle reef remnant has previously been dredged to depths ranging between 9 to 11 feet below MLLW. The undredged portions of the reef remnant are typically exposed at MLLW. Along the eastern side of the triangle reef remnant, in Seaplane Runway "D", depths increase to approximately 13 to 18 feet below MLLW.

Ocean access for vessels in Ke'ehi Lagoon is provided by way of Kalihi Channel. Kalihi channel was dredged to a level of approximately 35 to 40 feet below MLLW and was at one time used as a secondary entrance channel to Honolulu Harbor. However, the Sand Island Bascule Bridge, which was raised to permit access to this channel by large ships, is now permanently fixed in a down position limiting use of this channel. A second fixed bridge, adjacent to the Bascule Bridge, is currently under construction and is expected to be completed by late 1989.

Water Quality. The waters of Ke'ehi Lagoon are designated Class A waters by the State Department of Health[5]. The Class A designation is intended to protect its waters for recreational use and aesthetic enjoyment. According to the standards for this class, discharges are not permitted in Ke'ehi Lagoon's waters unless they have received the best degree or control compatible with the criteria established for this class. New sewage and industrial discharges are not permitted, except for acceptable non-contact thermal and floating drydock or marine railway discharges from the Ke'ehi Lagoon Marina. An additional Water Quality Standards designation applies to the triangle mudflat reef remnant. This area is designated a class II marine bottom ecosystem according to the Department of Health. This designation is intended to protect the use of the area for propagation of fish, shellfish, and wildlife, and for recreation. Proposed improvements for the Triangle Development would require a rules change to redesignate the area.

A survey of water quality in Ke'ehi Lagoon was conducted by OI Consultants, Inc., during March 1988 (*refer* to Appendix B for further information). Water quality samples were taken at various depths from eight sample stations distributed throughout the lagoon. Biological and chemical analyses were conducted for temperature, salinity, pH, turbidity, suspended solids, dissolved nitrate-nitrite, ammonium, orthophosphate, total nitrogen, and total phosphorus persulfate digestion.

Survey findings revealed that water quality conditions in the study area were not, with a few exceptions, different from the conditions described in the 1977-1978 post-construction water quality survey for the Reef Runway (AECOS, 1979c). Observed levels for the various parameters analyzed in this study and those determined in previous water quality studies were not significantly different and were not indicative of any pattern of degradation in overall water quality. No parameters were found to exceed the 10 percent water quality criteria standard as established in the current State Water Quality Standards. Nitrate, total nitrogen

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[5]Chapter 37-A, Water Quality Standards; Public Health Regulations, 1979.

and total phosphorus levels were lower than the "Mean" criterion level, while turbidity and ammonium levels were between the "Mean" and the 10 percent criterion levels.

Within Ke'ehi Lagoon little difference in temperature or salinity was observed between the survey stations. No evidence of extensive freshwater influence was recorded, except near the mouth of Kalihi and Moanalua Streams in the northeast corner of the lagoon. Levels of suspended solids were generally similar throughout the lagoon, although lower levels were observed near the southwestern tip of Sand Island, and higher levels were observed at the mouth of Kalihi and Moanalua Streams. Variations in pH samples were considered too small to be biologically significant.

Levels of dissolved nitrate-nitrite were low, occasionally non-detectable, at survey stations throughout the lagoon. Orthophosphate levels were non-detectable in Ke'ehi Lagoon. Dissolved ammonium levels were lowest at stations nearest the ocean. Levels of total (dissolved + particulate, organic + inorganic) nitrogen and phosphorus were generally similar throughout Ke'ehi Lagoon.

The water quality survey data address only those parameters included in the water quality standard regulations; BOD and fecal coliforms are not included therein. The Department of Health (DOH) does not consider bacterial concentrations in the lagoon to be a threat to public health. The DOH does not measure BOD in marine waters, presumably since the levels are so low as to be unimportant. The DOH measures fecal coliforms in Ke'ehi Lagoon only in response to sewage spills. The only recent data available are from a single spill event in Moanalua Stream in late 1987. High coliforms (maximum of 300/100 ml) were found at the mouth of Moanalua Stream and nearby Ke'ehi Lagoon Park sometime after the actual spill, but concentrations returned to baseline levels within one day. Low levels ($\leq$23/100 ml) were consistently observed at a station along Lagoon Drive downstream of the Moanalua Stream mouth and Ke'ehi Park stations, reflecting the rapid die-off of coliforms in salt water.

Benthic Communities. (See Appendix B for further information.) A survey of Ke'ehi Lagoon's benthic communities was conducted by OI Consultants, Inc., during March 1988. Survey results reveal that the benthic environment of the inner portion of Ke'ehi Lagoon resembles those of reef flats in the more protected parts of Pearl Harbor and Kaneohe Bay, and is generally poorly populated by micro-algae, invertebrates and demersal fishes. However, the benthic environment of the outer lagoon exhibits greater abundance and diversity.

The marine ecosystem of the triangle reef remnant located in the center of the lagoon was found to lack diversity largely because of the thin layer of silt which covered much of the hard substrata on the undredged portion of the reef. This lack of exposed hard substrata on the reef flat was identified as an important factor limiting both the development of resident fauna and the reef's value as a nursery

area for juveniles of species populating more seaward portions of the reef or open flat areas.

The southern portion of the triangle reef (mauka of Seaplane Runway "B") was identified as having the greatest abundance and widest diversity of reef fauna in the inner lagoon area. Benthic fauna which were present on the reef included, sponges, tunicates (Ascidia sp.), a large colonial bryozoan, oysters (Ostrea sandwicensis), fan-worms (Sabellastrate sanctijosephi), hydrozoans (Halocordyle disticha), anemones (Aiptasia pulchella), vermetid mollusks (Vermetus alii), and a few heads of coral. Fishes identified in this area included schools of juvenile Dascyllus albisella, eleotrid (Asterropteryx semipunctatus), weke (Mulloidichthys flavolineatus), aholehole (Kuhlia sandvicensisa), porcupine fish (Diodon hystrix), acanthurid (Acanthurus leucopareius) and wrass (Thalassoma duperrey). Also considered significant in this area were the limestone outcrops along the upper edge of the channel margin which provide substratum for attached invertebrates as well as cover for fishes and cryptic invertebrates. However, when compared to similar shallow marine areas in other areas on Oahu (e.g., Hanauma Bay, San Souci/Queens Surf Reef) the level of marine life is not considered as rich.

On the southeastern side of Ke'ehi Lagoon just off of Sand Island Point a few scattered heads of coral (Pocillopora meandrina) occur behind a series of large concrete bunkers which extend out from the point toward the Reef Runway. Marine life on the mauka side of these bunkers (site of the proposed swimming beach) is dominated by a number of macroalgae species. Hoyt (1976) utilized this area for studies on algae of the genus, Gracilaria which includes the popular edible limu known as ogo. Fish, however, are not common in this area because of the lack of protective cover and vertical relief.

Immediately to the west of this area, near Mokauea Island, the character of the marine life changes. Coral growth is conspicuous and although cover is not high many of the coral heads are large. The fish fauna in this area is notably diverse and many of the species occur in large schools of adults. Twenty- nine (29) separate varieties of fish were observed in this area during the course of the survey.

3.1.3 Terrestrial Environment:

Flora. (Refer to Appendix B for further information.) Ke'ehi Lagoon's original shoreline flora has been greatly disturbed for more than a century and has largely been replaced by exotic species. A survey of Ke'ehi Lagoon's flora was conducted by OI Consultants, Inc., in March 1988. The flora identified living on Ke'ehi Lagoon's triangle reef islets and surrounding shoreline was limited in its diversity. The majority of the identified species are exotic. Only three (3) indigenous species were recorded and no endemic species were noted. None of these species were considered to be threatened or endangered.

One of the most established plants in Ke'ehi Lagoon is the American mangrove (Rhizophora mangle). This exotic plant lines the shoreline at the mouth of Kalihi and Moanalua Streams and is present on many of the lagoon's small islets including the bird islets located on the ewa corner of the triangle reef remnant. Over ten other exotic varieties of plants were identified including akulikuli-kai (Batis maritima), Pluchea indica, Pluchea odorata, small kiawe (Prosopis pallida), small ironwood (Casuarina equisetifolia), kolu (Acacia farnesiana), sea mulberry (Conocarpus erecta), saltmarsh sand spurry (Spergularia marina) and weedy species of grasses and euphorbs. The milo (Thespesia populnea), akulikuli (Sesuvium portulacastrum) and the seaside heliotrope (Heliotropium curassavicum) were the only plant species found to be indigenous to Hawaii.

Avifauna. (Refer to Appendices B, C & D for further information.) Like many coastal areas in Hawaii, Ke'ehi Lagoon serves as a resting and feeding site for a variety of bird life. A number of lowland birds and waterbirds have been recorded during past surveys of the Ke'ehi Lagoon area, including the endangered Hawaiian stilt. Recent surveys of the Ke'ehi Lagoon area's avifaunal population were conducted by OI Consultants, Inc., during September 1987, March 1988, April 1988, March 1989, April 1989, and May 1989. Observations were made both from boats and on foot with particular attention being paid to potential habitation areas near the Reef Runway, Moko'eo Island, Harris Island, and Mokauea Island.

Three groups of birds have been recorded in the Ke'ehi Lagoon area: introduced, indigenous and endemic.

Introduced Birds. The largest group of birds identified in the Ke'ehi Lagoon area are those which have been introduced to Hawaii. Seventeen (17) species of introduced birds have been recorded in the Ke'ehi Lagoon area. None of these species are endangered and a number have proven to be serious pests in Hawaii.

Indigenous Birds. These are species that are native to Hawaii, but also are present in other parts of the world. Included among these indigenous Hawaiian birds are twenty-two species of seabirds, the black-crowned night heron, and a number of migratory species that spend their winter or nonbreeding season in the islands (Berger, p. 25, 1972).

No indigenous seabirds have been identified nesting near the Ke'ehi Lagoon area. Several species have, however, been recorded flying over the area including brown booby (Sula leucogaster), common noddy (Anous stolidus), great frigatebird (Fregata minor palmerstoni), and the white tern (Gygis alba).

The black-crowned night heron (Nycticorax n. hoactli) has been noted in the Ke'ehi Lagoon area. However, this species is not classified as being threatened or endangered. In fact, in 1985, a 120-day permit to destroy these birds was issued by the State Land Board in an attempt to reduce the number of these birds feeding on prawns cultivated by Oahu's prawn farms.

A number of migratory species have also been recorded in the Ke'ehi Lagoon area during the winter months. The most conspicuous of these is the Pacific golden plover (Pluvialis dominica fulva). A common winter resident on all main Hawaiian Islands, these birds are seen frequenting a variety of open space areas throughout Oahu, including residential lawns and golf courses. During avifaunal surveys of Ke'ehi Lagoon, twelve (12) plovers were sited on the mud flats of Kahaka'aulana Island. Surveys of the area have also recorded a number of additional migratory shorebirds including sanderlings (Crocethia alba), black-bellied plover (Squatarola squatarola), ruddy turnstone (Arernaria interpres), and wandering tattler (Heteroscelus incanum). All of these species are common winter residents on all of the main Hawaiian Islands (Berger, p. 242, 1972).

Endemic Birds. These are species that are unique to the Hawaiian Islands and do not live naturally anywhere else in the world. On Oahu four species of endangered endemic Hawaiian waterbirds are presently known to exist. These species consist of the koloa or Hawaiian duck (Anas wyvilliana), 'alae 'ula or Hawaiian gallinule (Gallinula chloropus sandvicensis), 'alae ke'oke'o or Hawaiian coot (Fulica americana alai) and the 'ae'o or Hawaiian stilt (Himantopus mexicanus knudseni). Of these four waterbird species, only the Hawaiian stilt has been identified as historically utilizing portions of Ke'ehi Lagoon and its shoreline for habitation. This habitation has, however, been limited to "feeding and resting," no known instances of the Hawaiian stilt nesting in the Ke'ehi Lagoon area have been recorded.

In the Hawaiian Waterbirds Recovery Plan published by the U.S. Fish and Wildlife Service in 1985, Ke'ehi Lagoon was classified, along with 25 other sites on Oahu, as a "primary" or "essential habitat" for the Hawaiian stilt and the other three endangered waterbirds (USFWS, p. 96, 1985). Primary habitats are defined as those habitats which are "necessary to complete distribution and acreage of suitable habitat needed to satisfy the prime objective"(USFWS, p. 32, 1985). The "prime objective" identified in the Recovery Plan is to: "provide and maintain minimum populations of at least 2,000 Hawaiian stilts, 2,000 Hawaiian coots, 2,000 Hawaiian gallinules and 2,000 Hawaiian koloa for three consecutive years in, at a minimum, the habitats and island distribution as of 1976" (USFWS, p. 31, 1985). The Recovery Plan goes on to state that "in the event that any of the identified essential habitat sites cannot be maintained, despite all efforts to preserve their value to waterbirds, it is possible that suitable substitutes could be used." This potential for substitution would exist provided "the 'in-kind' substitution would be made so that distribution and abundance patterns of waterbirds would not be significantly altered" (USFWS, p. 95, 1985). Although studies have shown that Hawaiian stilts fly from one island to another, the largest stilt populations are located on the islands of Maui and Oahu (Berger, p. 25, 1972). Annual censuses of the stilt taken by personnel of the State Division of Forestry and Wildlife reveal that from 1980 to 1986 the stilt population in the state increased by approximately 47 percent from 1,012 to 1,492 (USFWS, p. 29, 1985 & Walker, 1986). However, the stilt population in Ke'ehi Lagoon has not been paralleling the state's growth. During a series of surveys monitoring the impact of the Reef Runway construction

on Ke'ehi Lagoon's avifaunal population, the number of stilt recorded decreased from 114 in 1971 to 33 in 1978 (Walker, p. 9, 1978). It was noted that although only an estimated 20 percent of the feeding habitat was eliminated, the number of stilt using the area had decreased by over 70 percent (Walker, p. 9, 1978). More recent surveys of Ke'ehi Lagoon support this trend. A survey in July 1985 by the State Division of Forestry and Wildlife recorded 11 stilts. During the surveys conducted in September 1987, March 1988, April 1988, March 1989, April 1989 and May 1989, no stilts were recorded (Appendix B & C).

One of the most commonly cited reasons behind the decline of the stilt in the past has been the destruction of its nesting areas by encroaching development and feral animals. While sightings of the stilt have been made on the islets in Ke'ehi Lagoon, there are no known records of the stilt using these islets for nesting. The unwillingness of the stilt to use these islets for nesting may be due to the lack of a "protected environment" which is characteristic of other habitation areas such as the Pearl Harbor National Wildlife Refuge. While waterbirds are not seriously affected by noise or people when they are feeding or resting, nesting birds are greatly disturbed by the presence of people. During one visual observation of the islets on the mudflat from Lagoon Drive, fisherman were noted using these islets as bases to cast their lines into the channel. The general decline of stilts using the mudflats for feeding may possibly be attributed to a decline in food source and increases in human activity throughout the lagoon.

3.1.4 Air Quality:

The air quality in the Ke'ehi Lagoon area, as with most areas on the island of Oahu, is generally considered good due to the presence of the northeast tradewinds which blow emissions from inland areas out to sea. However, because the lagoon is situated between the Honolulu International Airport (HIA) and the light industrial area in Kalihi Kai it is susceptible to periods of lower air quality when tradewinds give way to southerly winds (Kona winds). Localized problems of poor air quality generally occur along heavily traveled traffic corridors (e.g. Sand Island Access Road) and near concentrations of industrial activity.

Air quality standards (AQS) applicable to the Ke'ehi Lagoon area are set by the State Department of Health (DOH) and the U.S. Environmental Protection Agency (EPA). DOH standards are generally set at a more stringent level than national standards. Stations established to monitor compliance with the AQS standards are located in a number of areas across Oahu. The long-term sampling station closest to Ke'ehi Lagoon is located approximately one mile away at the Kalihi-Kai Fire Station.

According to a study conducted for the development of HIA's South Ramp[6], air quality samples indicate that there have been few compliance problems with both DOH and EPA air quality standards in the Ke'ehi Lagoon area. On average, the particulate matter concentration at the Kalihi-Kai sampling station is well below the State AQS. In 1982, the average particulate matter concentration was approximately 47 ug/m^3 (microgram per cubic meter) significantly below the State AQS for particulate matter of 100 ug/m^3. Only once during the period from 1975 to 1984 was the State AQS for particulate matter exceeded in a 24-hour period. Sulfur dioxide concentrations (SO_2) also average well below the State AQS of 80 ug/m^3.

Long-term sampling data for carbon monoxide (CO) is available only from the survey station located at the State Department of Health Building in downtown Honolulu. In 1985, the average CO level at this survey station was 1.5 mg/m^3 (milligram per cubic meter) based on a maximum average in any one hour period. In comparison the State AQS for CO is 10 mg/m^3, based on a maximum average in any one hour period.

Surveys of CO emissions near the Honolulu International Airport, located on the western shore of Ke'ehi Lagoon, revealed that at certain times CO levels exceed State AQS along some heavily traveled roadways near the airport. However, CO levels at monitoring stations located on the airport grounds did not exceed State AQS.

3.1.5 Noise:

Aircraft Noise. Ambient noise levels, generated by aircraft and airport operations, in the project site and its environs have been subject to study as part of the U.S. Federal Aviation Administration's (FAA) FAR Part 150 Noise Control and Compatibility Planning Program. A noise exposure analysis for the Honolulu International Airport which encompassed the Ke'ehi Lagoon area[7] indicates that noise levels in the Ke'ehi Lagoon area in 1985 range between 70 and 75 L_{dn}. L_{dn} or day-night sound level represents the equivalent A- weighted sound level, in decibels, during a 24 hour day with a 10 dBA human reaction correction factor added to each equivalent sound level to reflect the greater impact of noise during nighttime periods [that is, 10 PM to 7 AM (HUD, 1979)]. A comparison between 1992 L_{dn} noise contours (Figure III-2) and those projected for 2007 reveals an expected noise reduction of approximately 5 L_{dn} over a significant portion of the Ke'ehi

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[6]Wilson Okamoto & Associates, South Ramp Development Plan Honolulu International Airport, for Department of Transportation, Airports Division, Oct. 1988.

[7]KFC Airports, Inc., Honolulu International Airport Master Plan and Noise Compatibility Program, Working Paper No. 5, Draft Report, for Department of Transportation, Airports Division, December 1988.

Lagoon area (Figure III-3). This projected reduction can be attributed to quieter aircraft and more efficient operating and management procedures.

Table III-1
Land Use Compatibility Matrix For Average Exterior Noise Levels
Upper L_{dn} Limits For Each Category*

LAND USE CATEGORY	Clearly Acceptable	Normally Acceptable	Normally Unacceptable
Residential - Single Family, Duplex, etc.	60	65	75
School Classrooms, Libraries Churches	60	65	75
Hospitals	60	65	75
Auditoriums, Concert Halls, Music Shells	50	60	70
Sports Arenas, Outdoor Spectator Sports	60	65	75
Playgrounds, Neighborhood Parks	55	65	75
Water Recreation, Golf Courses, Riding Stables	60	70	80
Office Buildings	65	75	80
Commercial - Retail, Restaurants, Movie Theaters	65	75	80
Commercial - Wholesale, Ind., Some Retail, Mfg., Util.	70	80	85
Manufacturing, Communication (Noise Sensitive)	55	70	80
Agriculture, Mining, Fishing	75	95	N/A
Public Right-of-Way	75	85	95
Extensive Natural Recreation Areas	60	75	85

*A fourth category "Clearly Unacceptable" exists for all L_{dn} exceeding the values of the upper limit in the "Normally Unacceptable" category.

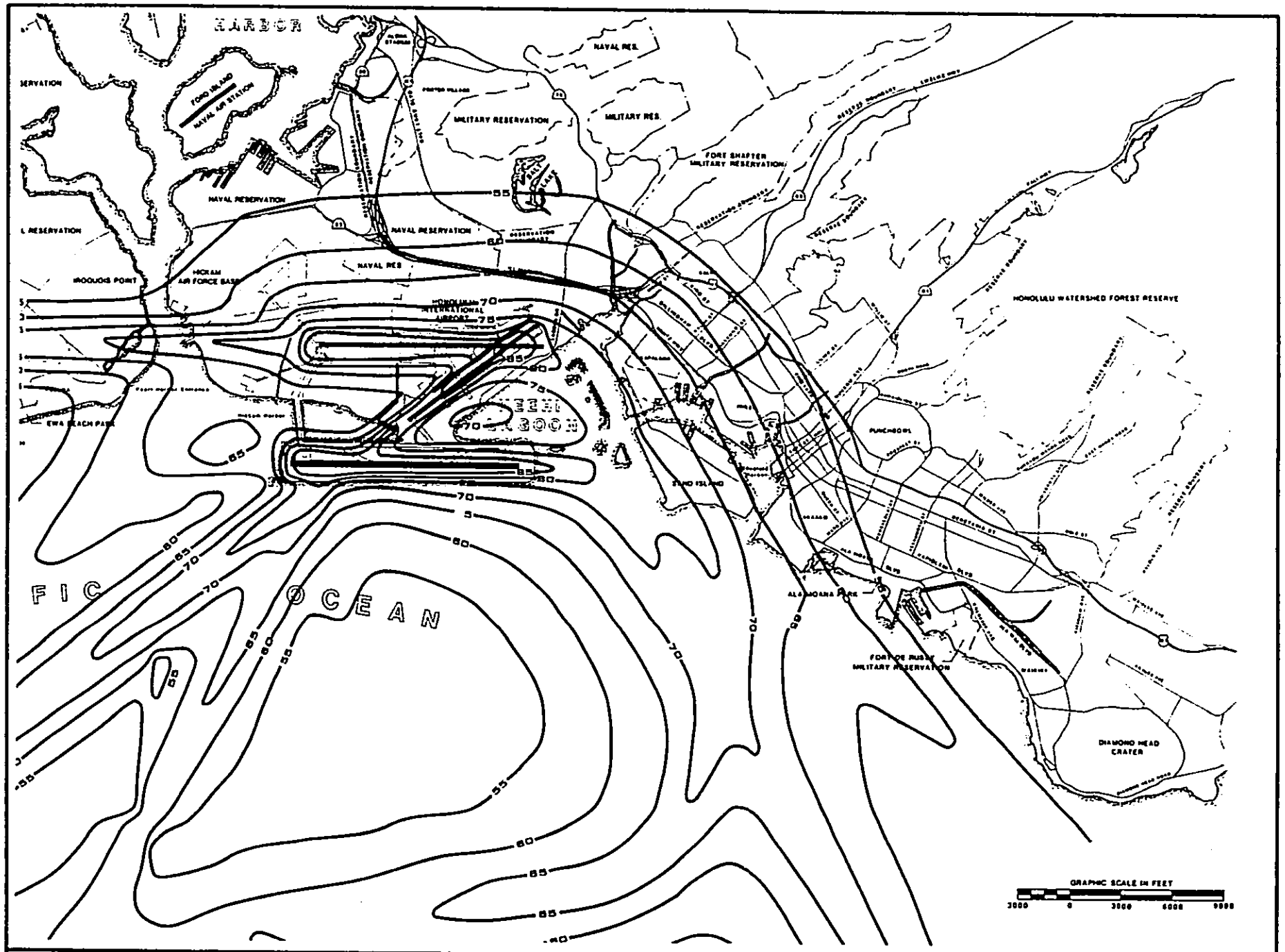
N/A = Not Applicable

Source: U.S. Department of Housing and Urban Development, The Noise Guidebook. 85-21135, pg 2, 1985.

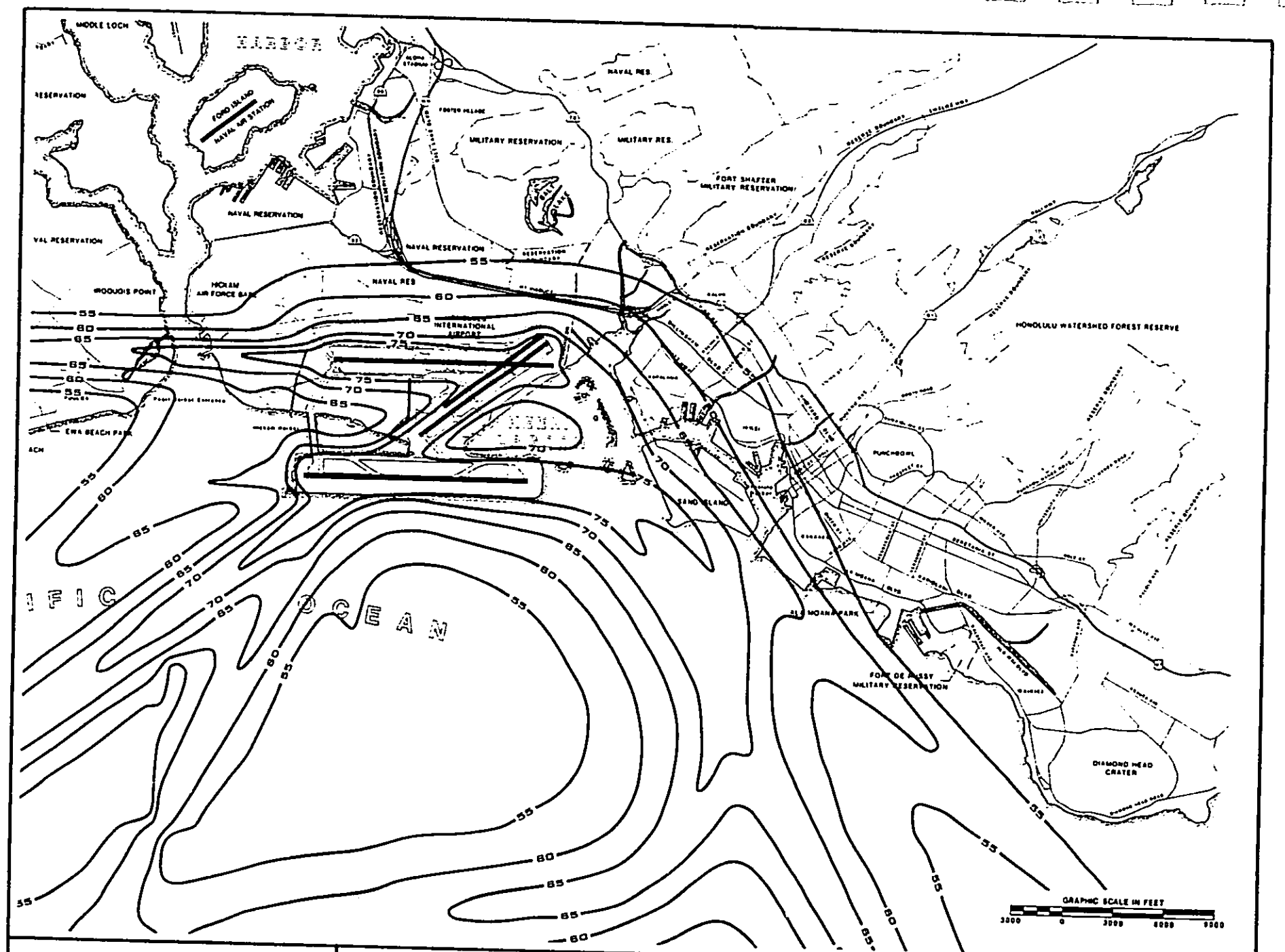
The U.S. Department of Housing and Urban Development (HUD) has established a land use compatibility matrix which sets an exterior average annual noise level of 80 L_{dn} as the noise level which should not be exceeded in commercial/light industrial areas in order to protect public health and welfare. For water recreational areas a level of 70 L_{dn} is considered as the "normally acceptable" noise limit (Table III-1). HUD's regulations do not contain standards for interior noise levels. Rather a goal of 45 decibels is set forth and attenuation requirements (e.g., acoustical sound proofing) are then geared toward achieving that goal.

Traffic Noise. Ke'ehi Lagoon is located within close proximity to a number of major transportation routes, making portions of the lagoon area susceptible to noise from vehicular traffic. According to a study[8] conducted for the Office of State Planning noise from Nimitz Highway, the principal traffic corridor feeding through

[8]Helber, Hastert & Kimura Planners, et. al., Honolulu Waterfront Master Plan, Jan. 1989.



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **1992 LDN Noise Contours**	FIGURE III-2



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **2007 LDN Noise Contours**	FIGURE III-3

the Ke'ehi Lagoon area, is shown to cause maximum hourly noise levels of 65 dBA at distance of 250 to 350 feet from the roadway. During evening periods, when traffic volumes decrease by about one-third, average hourly noise levels decrease to approximately 60 dBA.

3.1.6 Access and Traffic:

Access and traffic, both existing conditions and impacts, are the subject of a report[9] (Appendix E) prepared for this investigation. Nimitz Highway provides the main access to the Keehi Lagoon area. It is heavily traveled and experiences congested traffic conditions during weekday peak commute periods. There are congestion problems at the key intersections of Nimitz Highway with Waiakamilo Road, Kalihi Street, and Sand Island Access Road. During the morning peak commute hours, there may be congestion at the Nimitz Highway Lagoon Drive intersection, however, these tend to be caused by constraints at the intersection of Waiakamilo Road and Nimitz Highway. Weekend peak traffic volumes are 60 to 70 percent of weekday peaks, and traffic is smooth flowing during weekends.

3.1.7 Natural Hazards:

In coastal areas such as Ke'ehi Lagoon the major natural hazards to development are caused by tsunami and flooding resulting from severe rainstorms, and hurricane wave-induced coastal inundation.

Tsunami are sea waves of seismic origin caused principally by earthquakes, coastal and submarine landslides, and volcanic eruptions. According to the Federal Emergency Management Agency (FEMA), tsunami typically have wave heights of one foot or less and have durations of several minutes to several hours (FEMA, p. 15, 1987). Speeds of propagation for tsunami may reach over 500 mph, resulting in severe destruction to coastal areas. Most of the destructive tsunami affecting Oahu have been generated along the coast of South America, the Aleutian Islands, the Kamchatka Peninsula, and Japan. Since 1945, five tsunami have struck the island of Oahu [1946, 1952, 1957, 1960, 1964 (FEMA, p. 15, 1987)]. The coastal areas in Ke'ehi Lagoon are subject to tsunami inundation. However, because the area is well protected by the broad coastal reef extending seaward from the outer lagoon area, such flooding is considered to be minor in comparison to that which could occur from storm runoff (FEMA, p. 20, 1987). Potential tsunami inundation areas for the Ke'ehi Lagoon have been delineated by the Tsunami Research Program of the Hawaii Institute of Geophysics. For the Ke'ehi Lagoon vicinity the inundation area is determined to be a line inland from the shore at a

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[9]Ke'ehi Lagoon Recreation Plan Traffic Impact Study, Wilbur Smith Associates, Honolulu, March 3, 1989.

height four feet above MSL or 400 feet inland where shoreline elevations are less than 4 feet above MSL.

Flood problems are generally confined to low lying areas, and older areas which were developed prior to the adoption of existing storm drainage standards. Flood Insurance Rate Maps (FIRM)[10] show the 100-year regulatory flood zones established by the Federal Emergency Management Agency (FEMA). There are no shoreline areas within Keehi Lagoon that are in Zone V (high velocity tsunami wave flood zones). Flood zones within Keehi Lagoon that are designated Zone AE (base flood elevations determined) are elevation +5 feet MSL or less. Hatched areas in Zone AE are floodways. Zone A areas have undetermined base flood elevations, and are susceptible to hurricane-induced coastal inundation. Zone AO areas have flood depths of one to three feet (usually areas of sheet flow on sloping terrain), with the average depth of flooding as indicated on the map. Zone X shaded areas are areas of the 500-year flood and areas of 100 year flood with average depths of less than one foot or with drainage areas less than one square mile. Zone X unshaded areas are determined to be outside the 500-year flood plain. Zone D area areas in which flood hazards are undetermined.

A large portion (approximately 75 percent) of the site for the proposed Hawaiian Canoe Center and its associated facilities are located in Zone AE with base flood elevations between three to five feet above MSL. On the eastern side of Kalihi Stream a small portion of the Canoe Center site , which is planned as open space, is located in Zone AO with flood depth of one foot. The remaining portion of the Canoe Center's project area is either located in Zone X with flood depth less than one foot or is outside of the 500-year flood plain. A portion of the Pier 60 Marina site is located in Zone AE, with base flood elevation determined to be five feet above MSL. The site of the proposed sheltered swimming beach at Sand Island Point, falls within the area designated Zone A. The Lagoon Drive marina site is located in Zone D. Mokauea, Harris, and Mokuoea Islands are located in Zone X outside the 500-year flood plain.

Another potential future hazard to coastal development is the speculation on rising sea level. Several studies have suggested that the rate of eustatic[11] sea level rise may accelerate due to future warming of the atmosphere associated with the "greenhouse effect", melting of glaciers, and expansion of near-surface ocean water due to global ocean warming. The Marine Board of the National Research Council convened a committee on "Engineering Implication of Changes in Relative Mean Sea Level" to examine the knowledge concerning mean sea level changes,

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[10]Flood limits for the Keehi Lagoon vicinity are shown on FIRM Panel No. 15001 0115B, dated September 4, 1987, published by FEMA.

[11]Eustatic means a global change of oceanic water level. The difference between the eustatic change and any local change in land elevation results in the relative mean sea level change at a particular location.

establish the rate of relative sea level change based on past data, develop projections of future sea level rise, examine the responses of sandy shorelines and wetlands to sea level rise, examine the consequences on engineering works and built facilities, and to develop recommendations.[12] Their findings indicate that relative mean sea level, on statistical average, is rising at a majority of tide gauge stations situated on continental coasts around the world, although it is generally falling near geological plate boundaries and in formerly glaciated areas such as Alaska, Canada, Scandinavia, and Scotland, and it is not rising in limited areas of the continental U.S. including portions of the Pacific coast. The differences are due to differing rates of vertical motion of land surfaces due to subsidence or uplift. However, they concluded that the risk of accelerated mean sea level rise is sufficiently established to warrant consideration in the planning and design of coastal facilities. Based on their recommendations, the range of possible future sea level rise for Honolulu is relatively small over the next 50 years or so, with estimates between 0.71 to 1.75 feet by the year 2050.[13] Thus, the relative rise in sea level above present levels can be considered in the planning and design for Ke'ehi Lagoon improvements, since most of the development will be accommodated on filled lands.

3.1.8 Public/Quasi-Public Facilities, Services and Utilities:

Emergency Medical Services and Facilities. Ke'ehi Lagoon's central location permits direct access to a variety of Oahu's medical service facilities. The closest acute care facilities are Kuakini Medical Center, Tripler Army Medical Center, and the Kaiser-Permanente Moanalua Medical Center. All are located within an approximate 4 mile radius of the Ke'ehi Lagoon area. Less than 10 miles away from the lagoon are a number of additional acute care facilities including the Queens Medical Center and Straub Hospital. Emergency ambulance service for the Ke'ehi Lagoon area is provided by either the Charley One Unit or the Aiea Unit depending on availability. The Charley One Unit is dispatched out of Saint Francis Hospital and the Aiea Unit is dispatched out of Aiea Fire Station. Response time for these units varies with their location at the time of the call but generally averages between 7 to 8 minutes.

Fire and Police Protection. A number of fire stations are located within a one to three mile radius of the Ke'ehi Lagoon area. Those stations with the closest

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[12]The results of the 2-year study effort are summarized in the publication Responding to Changes in Sea Level, Engineering Implications, Marine Board, Commission on Engineering and Technical Systems, National Research Council, published by the National Academy Press, Wash. D.C., 1987.

[13]Estimates for the relative sea level rise for Honolulu are described in the report, "Honolulu Waterfront Master Plan, Ocean Engineering Considerations", prepared by Edward K. Noda and Assoc., Inc., February 1989.

response time include: Kalihi Station, Kalihi-Kai Station, Moanalua Station and Iwilei Station. In addition, a fire department helicopter unit is located on the ewa side of the lagoon at the Honolulu International Airport. At the end of Lagoon Drive near the southwest corner of the lagoon is one of the airport's airfield rescue and fire fighting stations. This airport station is for aircraft and airport fires only, and has direct access to Ke'ehi Lagoon via an exclusive airport boat ramp. Police service for the Ke'ehi Lagoon area is provided from the Kalihi Station located less than three miles away. Enforcement over water areas within the lagoon is the responsibility of the State Harbors Division Marine Patrol.

Solid Waste Disposal. Currently, solid wastes from non-residential uses and multi-family residential uses near Ke'ehi Lagoon are serviced by private refuse collection companies. Residential areas are serviced by the City and County of Honolulu, Department of Public Works, Refuse Collection and Disposal Division. Solid wastes are currently disposed of at the Kapaa or Kalaheo Landfills.

Public Transportation. Honolulu's public transportation system TheBus is operated by the City and County of Honolulu, Department of Transportation Services (DTS). TheBus system is composed of 30 base routes covering the island of Oahu. Currently two routes serve areas within the immediate vicinity of Ke'ehi Lagoon. Route 19 travels from Waikiki through the Downtown area past Ke'ehi Lagoon to the Honolulu International Airport. Route 10 links the Kalihi Kai area with Upper Kalihi and Liliha.

The City and County of Honolulu is currently in the process of preparing preliminary engineering studies and an environmental impact statement for a 15-mile rapid transit system from Moiliili to Waiawa. Preliminary proposals identify a location on Kalihi Street, approximately 1-mile from Ke'ehi Lagoon, as a future site for a rapid transit station.

The State Department of Transportation is in the process of implementing a water transit system for Oahu's south shore. Ferry vessels will operate between seven ferry terminals situated from Barbers Point to Hawaii Kai. One of the terminals will be located in Ke'ehi Lagoon. (Refer to Section 3.3.9 for more detailed discussion on this proposed system.)

Wastewater Disposal. Most of the Ke'ehi Lagoon area is serviced by the City and County of Honolulu's Sand Island Wastewater Treatment Plant (WWTP) which lies near the southern point of Sand Island adjacent to the Sand Island State Recreational Area. A portion of the Ke'ehi Lagoon area from Pier 60 to the Ke'ehi Small Boat Harbor presently is outside the service area of the city's system and must rely on self contained facilities which are periodically emptied by pump trucks. Sewer connection to the existing City sewage collection system is presently unavailable for all sites in the PLAN. The sites lie within the service of an aging sewer interceptor along Nimitz Highway which has reached capacity. Relief line construction will not be possible with City funding for several years. Potential developers of any of the sites may consider privately funding the needed relief line

in exchange for future compensation. (See Appendix F for a detailed discussion of this matter.).

Water Supply Systems. The Ke'ehi Lagoon area obtains its water service from the Board of Water Supply (BWS) Honolulu Water District Low Service System. Major water sources for this system include the Punanani Wells, Kalauao Wells, Kaamilo Wells and Halawa Shaft located in the Pearl Harbor District and the Moanalua Wells, Kalihi Shaft, Kalihi Station, Beretania Station, Wilder Wells and Kaimuki Station which are located in the Honolulu District (OSP, p. 2-33, 1989). According a report[14] prepared for the Office of State Planning (OSP), water sources that serve the area are at capacity. At present the entire Low Service System has an average daily water demand of approximately 57.5 million gallons per day (mgd). Of this amount approximately 11.5 mgd are used by the neighborhood areas surrounding the Ke'ehi Lagoon area.

To increase water capacity in the Central Honolulu area, the BWS, in conjunction with the Department of Land and Natural Resources is involved with work on the development of new groundwater sources. In addition, alternative means of potable water development such as wastewater reclamation and desalinization are also being examined.

The primary water transmission line serving the Ke'ehi Lagoon area is a 42-inch transmission line that runs from Kalihi Street along Dillingham Boulevard, Kamehameha Highway and Kilihau Street to the intersection of Kilihau Street and Puuloa Road. On the airport side of Ke'ehi Lagoon water service is provided via a 16-inch transmission line that extends along the entire length of Lagoon Drive. Service on the eastern side of the lagoon is provided by a 12-inch transmission line which extends along Sand Island Access Road from Nimitz Highway to Pahounui Drive. At the intersection of Pahounui Drive and Sand Island Access Road, the water transmission line upgrades to a larger 16-inch transmission which extends from the intersection along Sand Island Access Road to the Sand Island State Recreational Area.

Electrical Power and Communications. Electrical power and telephone needs in the Ke'ehi Lagoon area are presently supported via existing overhead pole lines and underground duct systems. Facilities for these utility lines are along road rights-of-way or in easements granted to utility companies. Presently Hawaiian Electric Company's (HECO) generation capacity is approximately 1,300 MW, with a peak hour demand of approximately 1,000 MW. In the Ke'ehi Lagoon area electrical power needs are supported by 12 KV distribution lines from HECO's Ke'ehi, Kapalama and Sand Island Substations. Existing telephone service in the Ke'ehi Lagoon area is provided by Hawaiian Telephone Company Kalihi's office.

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[14]Helber, Hastert & Kimura Planners, et. al. Honolulu Waterfront Master Plan, Jan. 1989.

Petroleum Facilities. On the eastern side of Ke'ehi Lagoon just behind the Ke'ehi Small Boat Harbor are the jet fuel storage facilities for the Honolulu International Airport (HIA). Fuel from these storage facilities is transported to the HIA for aircraft refueling in a series of pipelines which travel underground through Ke'ehi Lagoon to the airport terminals. In addition to the jet fuel pipelines a number of other pipelines from petroleum-oils-lubricant (POL) facilities along the Honolulu waterfront travel through Ke'ehi Lagoon. These pipelines include:

- Three 4-inch jet fuel pipelines, operated by Chevron USA, which run underground along Nimitz Highway, through the Kapalama area and under Ke'ehi Lagoon to the HIA terminal;

- A single 10-inch pipeline, operated by HFFC, which runs along Sand Island Access Road, under Ke'ehi Lagoon and to the HIA terminal; and

- Two 6-inch pipelines, operated by HIRI and HFFC which run along Sand Island Access Road, under Ke'ehi Lagoon and to the HIA terminal.

3.1.9 Aesthetics:

Ke'ehi Lagoon and Sand Island comprise the central portion of the "South Shore Viewshed". According to the Coastal View Study[15] the views of this area are dominated by the built environment and are in a constant state of modification. Significant roadway views which were identified include intermittent views of Ke'ehi Lagoon from Kamehameha Highway and continuous views of Ke'ehi Lagoon from Lagoon Drive. Significant pedestrian views identified included views from Ke'ehi Lagoon Park and Sand Island State Recreational Area.

The variety of urban and maritime views seen from vantage points around Ke'ehi Lagoon are one of the area's most significant resources from an aesthetic perspective. Along the southwestern side of Sand Island an uninterrupted view of airplanes on the reef runway and boating activities in the lagoon presently exists. The offshore islands of Mokauea and Harris are also clearly visible. Ke'ehi Lagoon Park on the northwestern side of the lagoon provides a vantage point for viewing a variety of marine recreational activities including boating and canoeing. On the western side of Ke'ehi Lagoon a number of vantage points provide a panoramic view of Ke'ehi Lagoon, Sand Island and the downtown skyline contrast against the Koolau Mountain Range.

With the exception of Ke'ehi Lagoon Park, however, many of the vantage points around Ke'ehi Lagoon do not presently provide a high quality environment for enjoying the area's visual resources. The shoreline areas of the Pier 60 site and southwestern side of Sand Island are littered with twisted reinforcement bar,

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[15]City and County of Honolulu, Department of Land Utilization, 1987.

sunken concrete blocks, abandoned automobiles, rusted automobile parts, tires and a variety of floating debris. Within the lagoon a number of derelict vessels, some of considerable size, obstruct views of the lagoon and are hazards to navigation.

While these conditions make the area aesthetically unattractive for the casual observer they also have contributed to reducing the perception of the area as a safe and suitable recreation area. In a recent newspaper article which voiced concerns about Ke'ehi Lagoon being used as a site for the World Sprint and Marathon Canoe Championships, Ke'ehi Lagoon was described as "Oahu's cesspool". The article went on to quote one paddler as saying "I can't believe that a world paddling championship will take place in that dirty water among those ugly boats from a beach loaded with rocks and rubble. It's hardly what visitors think of paradise"[16].

3.1.10 Historic and Archaeological Resources:

No historic structures or surface archaeological resources have been identified within the Ke'ehi Lagoon project area. Although there is a long history of habitation of the Ke'ehi Lagoon area[17], the extensive dredging and filling of the lagoon's shoreline since 1938 suggests that no undisturbed subsurface archaeological remains exist in the areas proposed for development. The entire shoreline of the lagoon from the Reef Runway around to Sand Island Point is composed of primarily crushed coral fill material.

3.1.11 Cultural Resources:

Located on Mokauea Island in the southeastern corner of Ke'ehi Lagoon, outside of the proposed project area, is a small fishing community. As one of only two remaining fishing communities in Hawaii (the other being Milolii on the island of Hawaii) this community historically consisted of Hawaiians undertaking traditional fishing practices (Napoka, p. 1, 1976). In the early 1970s, a long term lease for Mokauea Island was granted by the State Department of Land and Natural Resources with an agreement that those occupying the island would provide a facility to educate individuals about traditional fishing practices of the Hawaiians. Today, this fishing community lifestyle is perpetuated by a number of multi-ethnic families living on the island.

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[16]Wyatt, F-1, 1988.

[17]Permanent habitation of the Keehi Lagoon area has been documented since 1853 (Napoka, p. 7, 1976).

3.2 SOCIOECONOMIC FACTORS

This section presents a detailed discussion of the existing socioeconomic environment of Ke'ehi Lagoon and its surrounding environs. Ke'ehi Lagoon is bordered by four major communities. Located on its western side are the Airport, Salt Lake-Aliamanu and Moanalua communities. On its eastern side is the Kalihi-Palama community. Physical boundaries which generally establish the outward boundaries of these communities include Nuuanu Stream, School Street, Fort Shafter Military Reservation, Moanalua Road and Pearl Harbor.

3.2.1 Community Characteristics:

Kalihi-Palama Community. On the eastern side of Ke'ehi Lagoon is the Kalihi-Palama community. The Kalihi-Palama community is one of the oldest and most densely populated areas on Oahu. Existing patterns of activity in this area are characterized by a diverse range of residential, commercial and light industrial uses. Most of Oahu's commercial harbor related activities (e.g., ship repair, container shipping, etc.) are located in the lower portion of Kalihi-Palama along the industrial area fronting Honolulu Harbor. Although designated for an industrial/commercial emphasis, residential uses are also present in the area. Most notable among these areas is the Kalihi Kai area located just mauka of the Kapalama Military Reservation. This area contains a number of moderate density residential uses (two- and three-story walk- up apartments) interspersed between light industrial uses.

Historically, Kalihi-Palama has served as an entry community for low income immigrants to Honolulu. Census figures for 1980 reveal that over 76 percent of the area's residents are considered to be in the low to moderate income bracket. The residential areas of Kalihi-Palama are composed of a mixture of single-family homes and low-rise walk-up apartments, along with over one-third of Oahu's public housing. The age of the housing stock in this area is quite old with many structures dating around the early 1940s. As is characteristic with a number of Oahu's residential areas, many of the residentially zoned lots in Kalihi-Palama contain two or more dwelling units.

Airport, Salt Lake-Allamanu and Moanalua Communities. The communities surrounding the western side of Ke'ehi Lagoon are composed primarily of a mix of residential, commercial and light industrial developments. Stretching from Moanalua to the Airport, these communities are defined by the Koolau mountains on one side and the Honolulu International Airport on the other. The residential portion of this area is a cluster of established communities which began emerging in the 1950s. The communities of Moanalua and Aliamanu are characterized by a number of dense single-family residential development.

Over 300 vessels (e.g., boats, and floating structures) are currently anchored throughout Keehi Lagoon. Many of these vessels are not seaworthy and cannot

propel themselves under their own power. A number of submerged and partially submerged vessels are also present, posing a hazard to navigation in this area. Currently no organized anchoring scheme exists for this area. Vessels select a location to "drop anchor" based on loosely defined boundaries, existing available space and the operator's discretion. While these vessels are supposed to be on some form of dedicated anchorage (i.e., can pull up anchor and relocate at any time) many are moored (i.e., permanent) using concrete blocks, large ships anchors or multiple anchors. The State Harbors Division is presently undertaking a cleanup of the lagoon and will establish permanent moorings in the designated mooring area adjacent to the east side of the sand bar berm.

Resident access between these vessels and the shore is provided by personal dinghies. Presently, Ke'ehi Lagoon has two dinghy docks for the area's users. One dock is state owned (DOT Harbors) and the other is private (Ke'ehi Island Marine Center). These dinghy docks are heavily used and it is not uncommon to see twenty or more dinghies tied to these docks.

3.2.2 Population:

The population of the island of Oahu has been steadily increasing. From 1970 to 1985 the island's resident population increased by over 28 percent from 631,600 to 811,100. Current population forecasts for Oahu project that the island's resident population will increase to 1 million by the year 2010. Over this same fifteen year period Oahu's average daily visitor population has also increased, roughly tripling from 26,669 to 80,600.

The Kalihi-Palama, Moanalua, Aliamanu-Salt Lake and Airport neighborhoods are the major residential areas surrounding Ke'ehi Lagoon. In 1985, these four neighborhood's combined population of 116,344 accounted for over 14 percent of Oahu's total population (Table III-2). Although these neighborhoods are some of the most densely populated residential areas on Oahu, their rate of growth has been leveling off in comparison to other areas on the island. Over the five year period from 1980 to 1985, the rate of growth for these neighborhoods was approximately 3.2 percent, well below the island-wide growth rate of 6.4 percent.

While the neighborhoods surrounding Ke'ehi Lagoon have continued to grow, the resident population in the area within the immediate vicinity of the proposed project (i.e., census tract 59 and portions of tracts 57 & 72) has been declining. In 1980, the resident population in the area bounded by Honolulu International Airport, Paiea Street, Nimitz Highway, Kapalama Stream, and Honolulu Channel was 1,991 a decrease of approximately 28 percent over the 1970 resident population of 2,768. This decline can be largely attributed to the area's gradual transition from residential to commercial and light industrial use. In 1980, the majority of the area's remaining resident population (90 percent) was concentrated in the light industrial transition area of Kalihi Kai.

Table III-2
Resident Population of Neighborhoods
Surrounding Ke'ehi Lagoon (1985)

Neighborhoods	Resident Population	Percent of Oahu's Resident Population
Kalihi-Palama	39,859	4.9%
Moanalua	12,951	1.6%
Salt Lake-Aliamanu	35,272	4.3%
Airport	28,262	3.5%
Total	116,344	14.3%

Source: DBED, The State of Hawaii Data Book, Table 11, 1987.

According to the 1980 U.S. Census, the ship-based resident population in private vessels moored off shore in the Diamond Head seaplane runway (Runway "D") and in the Ke'ehi Lagoon marina facilities was 21 in 1980. This figure appears, however, to under-represent the lagoon's present population. Based on a recent survey of the area, the lagoon's present resident population is closer to 450. Approximately, 280 of these residents are located in vessels moored off shore and the remaining 170 residents are located in vessels tied up to slips in the marina facilities. This discrepancy may be attributed in part to a lack of representation in the 1980 Census because of the transient nature of the live-aboard vessel population. In addition, Oahu's dwindling available housing supply and rising housing costs might have contributed to making this type of living more appealing economically.

3.2.3 Economy and Employment:

The economic activity of the neighborhoods surrounding Ke'ehi Lagoon is closely linked to Oahu's air transportation and maritime industries as well as the military. On the ewa side of Ke'ehi Lagoon, economic activity is centered around the Honolulu International Airport. HIA is a joint use airport with civil air carrier, general aviation and military flights, from Hickam Air Force Base, being supported. Since the early 1980s, passenger traffic at the HIA has been steadily expanding. Over the period from 1982 to 1987 the total number of overseas and interisland passengers utilizing the airport increased by over 40 percent from approximately 14 to 20 million passengers annually.

Economic activity on the diamond head side of Ke'ehi Lagoon is centered around Honolulu Harbor. As the state's largest commercial port, Honolulu Harbor is the focal point for the state-wide ocean transportation system and a major center of commerce and maritime activity for Oahu. All general cargo, including mainland

and foreign containers destined for Hawaii, is handled through Honolulu Harbor. During the fiscal year 1986-87 a total of approximately 7.25 million short tons of cargo were shipped through the Harbor.

The Kapalama-Iwilei area, which fronts Honolulu Harbor, serves as one of the major staging areas for the harbor's activities. Existing activities in this area range from maritime activities such as bulk cargo handling, general cargo shipping, fishing support services, and ship repair to non-maritime related activities such as petroleum storage, grain milling, light manufacturing and auto repair.

Although contiguous with Honolulu Harbor, Ke'ehi Lagoon's economic role presently is not as integral as the waterfront areas within Honolulu Harbor. Existing maritime related industrial and commercial activities are limited. The site of the proposed Pier 60 marina presently serves as a berthing area for barges bringing sand and concrete aggregate material to be processed in a concrete batch plant. Operations in the Ke'ehi Marine Center located makai of Pier 60 include drydock facilities, boat building, sail repair and other maritime support functions. The lagoon also supports a few commercial water recreation operations that specialize in thrillcraft and diving activities.

The Airport and Kalihi-Palama neighborhoods function as two of Oahu's major employment centers and account for the bulk of the employment in areas surrounding Ke'ehi Lagoon. Together with the Moanalua and Salt Lake-Aliamanu neighborhoods, the combined employment for the communities surrounding Ke'ehi Lagoon represented just under 22 percent of the island's total employment in 1980 (Table III-3). Major employment locations in these area include the

Table III-3
Employment in Neighborhoods
Surrounding Ke'ehi Lagoon (1980)

Neighborhoods	Total Employment	Percent of Oahu's Total Employment
Kalihi-Palama	25,184	7.1%
Moanalua	7,271	2.0%
Salt Lake- Aliamanu	484	0.1%
Airport	44,989	12.6%
Total	77,928	21.8%

Source: DBED. The State of Hawaii Data Book, Table 380, 1987.

Kapalama-Iwilei industrial area, Honolulu International Airport, Hickam Air Force Base, Pearl Harbor Naval Shipyard, Tripler Army Medical Center, Fort Shafter, and the Mapunapuna light industrial area.

A comparison of the labor force characteristics of the City and County of Honolulu and the neighborhoods surrounding Ke'ehi Lagoon reveals a number of trends (Table III-4). The concentration of military installations in the neighborhoods surrounding Ke'ehi Lagoon is reflected in the proportion of the labor force employed in the armed forces. In 1980, over 26 percent of the area's work force was employed in the armed forces, compared with 10 percent of the island-wide work force.

Table III-4

Labor Force Characteristics of the City and County of Honolulu and the Neighborhoods Surrounding Ke'ehi Lagoon (1980)

	The City and County of Honolulu	Ke'ehi Lagoon Neighborhoods
Labor Force		
Potential workers age 16 and over	574,882	81,205
Not in labor force	30.8%	28.9%
Armed forces	10.1%	26.1%
Civilian labor force	59.1%	45.0%
Civilian Labor Force	339,863	36,554
Unemployed	4.6%	5.3%
Total Employed Civilian Labor Force	324,113	34,628
Occupation		
Technical, sales & administration	33.8%	32.6%
Managerial	24.7%	15.5%
Service	17.6%	23.8%
Production, craft & repair	11.3%	10.8%
Operators, fabricators, laborers	10.9%	15.8%
Farming, fishing, forestry	1.8%	1.6%
Industry		
Wholesale & retail trade	24.6%	28.3%
Professional service	18.5%	14.7%
Public administration	10.9%	9.4%
Finance, insurance & real estate	8.1%	6.7%
Personal entertainment & recreation	8.1%	10.7%
Manufacturing	7.7%	10.1%
Construction	6.6%	6.3%
Transportation	6.5%	6.3%
Business & repair services	4.5%	4.7%
Communications	2.7%	1.8%
Agriculture, forest, fishing	1.7%	1.0%

Note: Percentages rounded to the nearest 0.1 of a percent.

Source: U.S. Bureau of the Census. (1980) Census of Population and Housing - Neighborhood Statistics Program.

Occupational and industry profiles of the civilian work force in the Ke'ehi Lagoon area resemble the area's light industrial/commercial emphasis. A large share of the area's work force is employed in blue collar occupations (e.g., service, operators, fabricators, laborers). In contrast, white collar managerial occupations are underrepresented when compared with the island-wide work force. Industry profiles reveal that the workers in the neighborhoods surrounding Ke'ehi Lagoon have a comparatively higher level of employment in the trade, manufacturing and personal recreation sectors and lower levels of employment in the professional service and the public administration sectors.

3.2.4 Land for Water Dependent and Airport Related Activities:

In central Honolulu the current demand for industrial land with access to the waterfront far exceeds the present supply of available land (HH&K, 1989). Based on land use classifications used for real property assessment, 10,365 acres of industrial land currently exist on Oahu (DBED, p. 182, 1988). Of this total only 404 acres are located in the Honolulu waterfront area stretching from Magic Island/Ala Moana Park to Ke'ehi Lagoon. In 1988, vacancy rates for the island's industrial space were the lowest in the nation averaging less then two percent (Grubb & Ellis, p. 11, 1989). In the central Honolulu area, where the largest amount of industrial space is located, only 303,000 square feet of industrial space was available from a total supply of over 23 million square feet (Table III-5).

Table III-5

Industrial Space In Central Honolulu, 1988 (Sq. Ft. in Thousands)

Area	Existing	Percent of Island Total	Vacant	Percent Vacant
Kaka'ako-Sand Island	14,116	47.5%	125	0.9%
Airport-Moanalua	9,671	32.5%	178	1.8%
Total	23,787	80.0%	303	1.3%

Source: Grubb & Ellis, Hawaii Real Estate 1989 , p. 13.

A more recent assessment of the demand for industrial space (Building Industry, October 1989) indicates that even with the number of new projects planned or underway, which will bring another million square feet of industrial space on the market next year, Hawaii's industrial vacancy factor will again be the lowest in the nation. In addition to the great need for industrial space in Honolulu, there is a similar demand for commercial space. "The combination of rising construction costs, a critical shortage of developable land and continued expansion of

businesses in Hawaii will make 1989 yet another year in which the landlord will rule (Villani, Hawaii Investor, April 1989)." "Despite the prevalence of smaller new properties and other limited retail space in larger, mixed-use commercial projects, commercial brokers say major developments the size of the Aloha Motors site or acreage along the Honolulu Harbor waterfront are desperately needed to satisfy the ravenous appetite for Oahu retail space going into the 1990s (Yoneyama, Hawaii Business, December 1989)."

The competition for commercial/industrial space near Honolulu Harbor and Honolulu International Airport is even more critical when considering that these two facilities serve as the economic lifelines for the State. Space limitations within these two facilities are forcing the State Department of Transportation to acquire adjacent lands for expansion of these facilities to meet future needs. The future acquisition of federal lands within the Kapalama Military Reservation will help to meet the needs for additional shoreside space for Honolulu Harbor. For Honolulu International Airport, however, lands makai of the freeway suitable for airport expansion are largely privately held. The Airports Division is presently in the process of acquiring lands adjacent to the airport bounded by Ualena and Aolele Streets, as well as additional lands at Hickam Air Force Base. The total area is approximately 50 acres. If the purchase price cannot be successfully negotiated for the Ualena/Aolele parcel, these lands will be acquired through eminent domain (condemnation). These actions, which will either remove developable lands from the market or force displacement of existing uses, will add to the growing unsatisfied demand for commercial/industrial space in the vicinity.

3.2.5 Recreation:

Existing Activities and Conditions. Ke'ehi Lagoon and its adjacent shoreline presently supports one of greatest varieties of ocean recreation activities of any single location in the state. Existing recreational uses include canoe racing, fishing, crabbing, swimming, diving, competition and pleasure water skiing, thrill craft operation, and both sail and power boat activities. Facilities in the lagoon also provide a number of recreational support functions. Approximately 582 berthings for pleasure boats are provided at the lagoon's three marina facilities, Ke'ehi Boat Harbor, Ke'ehi Marine Center and La Mariana Sailing Club. A drydock facility for repair and maintenance exists at Ke'ehi Marine Center. In addition, a large off-shore federally designated anchorage area currently exists along Seaplane Runway "D" adjacent to the sand bar berm.

Although Ke'ehi Lagoon exists presently as a viable recreation environment there are a number of conflicting ocean activities and conditions which presently threaten the public's health, safety and welfare, and are preventing Ke'ehi Lagoon from achieving its most productive economic role (Aotani & Assoc., p. 1.1, 1988). These conflicts were identified in the Statewide Ocean Recreation Management Plan (January 1988) and include:

- Conflicts among users, such as canoers, water-skiers, boaters, jet-skiers and shoreline fishermen;
- Boat squatters and derelict boats;
- Missing channel markers;
- Lack of signs showing designated use areas;
- Commercial activities in recreational areas;
- Lack of restrooms/showers and public facilities;
- Lack of recreational boat facilities and moorings;
- Inadequate enforcement of rules and regulations;
- Inadequate boat launching facilities;
- Interference with competition water ski events by boaters entering the course and fishermen laying nets in the course;
- Lack of full-scale sailing instruction and competition facility;
- Commercial operations conducting business in the middle of the lagoon.

Additional existing problematic conditions which have also been identified include:

- Lack of proper public disposal facilities for sewage from vessels moored off-shore in Ke'ehi Lagoon;
- Lack of proper public disposal facilities for hazardous marina wastes (e.g., fuel, oil, cleaning chemicals)
- Lack of access to the Ke'ehi Lagoon side of Sand Island;
- Dangerous debris located along the shoreline of the lagoon (e.g., twisted reinforcement bar, automobile parts, etc.); and
- Lack of pedestrian access between different activity areas along the shore of the lagoon.

Canoe Facilities. Outrigger paddling is Hawaii's official team sport and has historically been one of the state's most popular recreational activities both from a participator's and spectator's standpoint. Participation in canoe paddling and related activities is growing. Over 1,000 paddlers are involved in the interscholastic

Na Opio paddling clubs and thousands more are participating in the various island associations. In 1987, it was estimated that, on Oahu alone, close to 3,000 paddlers participated in clubs governed by the island's two canoe associations, Oahu Hawaiian Canoe Racing Association and Na Ohana O Na Hui Wa'a (Hogan, C-6, 1987).

The growing interest in canoe paddling in Hawaii has been paralleled by increasing interest from cities on the Mainland and other countries. This has transformed canoe paddling from a local to an international sport and has led to efforts on the part of representatives from various sports associations to make canoe paddling an official Olympic sport. Local events such as the annual Molokai to Oahu canoe race now draw participants from canoe clubs in California and from areas as far away as Tahiti and Australia.

Presently, no permanent public canoe racing facility exists in the State of Hawaii. Race courses (i.e., buoys, lane marker flags, etc.) are set up prior to a scheduled event and then dismantled after the competition. Because of this, paddlers must train in one location and then attempt to compete on an unfamiliar race course with little or no knowledge of the course's characteristics.

On Oahu, there are approximately 10 sites that are well suited for staging large canoe racing events (i.e., 12 to 14 canoes racing at one time). These consist of Waikiki Beach, Ke'ehi Lagoon, Nanakuli Beach, Ma'ili Point, Makaha Beach, Haleiwa, Kahana Bay, Kane'ohe Bay, Kailua Bay and Waimanalo Bay. An eleventh site, Moanalua Bay, has been used for canoe races held during the Special Olympics. Although each racing location has special characteristics, Ke'ehi Lagoon has emerged as one of the most favorite because it is centrally located and the course can be oriented parallel to the prevailing wind direction. Because of this, popular events such as the Oahu Hawaiian Canoe Racing Association's championship regatta and the state championships have continued to be staged in Ke'ehi Lagoon despite the area's inadequate facilities and potential marine hazards.

Marina Facilities. In 1988, there were 9,624 "undocumented state-registered vessels" on Oahu.[18] The majority of these vessels (7,509) were housed in on-land facilities. Only twenty-two percent (2,115) of the vessels were moored on the water (DOT Harbors, 1988).

At present the option for a boat owner on Oahu to moor their vessel in an on-water marina facility is limited. Approximately 2,100 public and private marina slips currently exist on Oahu and over 1,700 applicants are on the waiting list (DBED, Table 234, 1988 & DOT Harbors). Wait times for marina slips currently average from 3 to 6 years depending on the size of the boat, the type of mooring and the

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[18]Based on records of the State Division of Harbors.

desired mooring location. Ke'ehi Lagoon's marina facilities account for approximately 28 percent of Oahu's existing marina space (Table III-6).

Table III-6
Berths In Ke'ehi Lagoon, 1989

Facility	Operator	Existing Number of Berths	Percent of Oahu's Total Berths (2,115)
Ke'ehi Small Boat Harbor	State	302	14.28%
Ke'ehi Marine Center	Private	126	5.96%
La Mariana Sailing Club	Private	65	3.07%
Total		493	20.27%

Sources: Compiled from State of Hawaii Department of Transportation, Harbors Division, Statewide Planning for Marina Facilities, DOT, Harbors Division, January, 1989 and U.S. Army Corps of Engineers, State of Hawaii Small Craft Navigation Facilities, Honolulu, September, 1985.

The largest facility in the lagoon, Ke'ehi Small Boat Harbor, contains 302 berths and is state owned and operated. Two private marina facilities in the lagoon, Ke'ehi Marine Center (126 berths) and La Mariana Sailing Club (65 berths), together provide an additional 191 berths[19].

The monthly cost of a marina slip in Ke'ehi Lagoon varies with the facility operator, the type of mooring and the length of the vessel. On average for a 30-foot vessel, a marina slip in Ke'ehi Lagoon ranges from a low of $75 per month at the State's Ke'ehi Small Boat Harbor to a high of $170 per month at the two private marinas. The cost for a live-aboard slip is approximately double the respective monthly slip fee for both the state and private marinas.

Existing marina support facilities (i.e., comfort stations, boat launch facilities, fueling and dinghy docks) are also used by approximately 300 additional vessels which are moored off-shore in Ke'ehi Lagoon. As a consequence many of these facilities are overutilized and cannot be expected to adequately accommodate transient vessels and additional future demand. Presently no public disposal facilities are provided for toxic marina wastes (i.e., fuel, oil, cleaning chemicals). In addition, no

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[19]Source: Harbors Division records and U. S. Army Corps of Engineers, State of Hawaii Small Craft Navigation Facilities, Honolulu, September, 1985.

sewage pump-out facilities currently exist in Ke'ehi Lagoon. Within Ke'ehi Lagoon, boat users presently must dispose of sewage by collecting it in a holding tank and then "hand carrying" the tank to be emptied at the public comfort station.

Offshore Mooring. A federally-designated anchorage area is situated within Ke'ehi Lagoon adjacent to the sand bar berm within Seaplane Runway "D", across from the existing marinas and Ke'ehi Small Boat Harbor. This is the only authorized offshore mooring area within the lagoon, although congestion within this area has led to vessels anchoring throughout the lagoon. The Department of Transportation Harbors Division has obtained legislative funding to install permanent mooring buoys within this authorized area. The moorings will be designed to efficiently accommodate many more vessels within the mooring area than are presently randomly anchored on single point moorings. Harbors Division is also in the process of implementing rules and regulations for moorings. Within Ke'ehi Lagoon, vessels will be permitted to moor only within the authorized area, and will be required to comply with the mooring rules and regulations. This will open all other waterways for active water sports activities which have, in recent times, been "squeezed out" because of the unregulated growing numbers of vessels which have simply dropped anchor; for example, within Seaplane Runway "D" adjacent to Sand Island.

It is the intent to be able to accommodate within the authorized mooring area, all existing registered vessels that are presently anchored offshore in the lagoon. It is estimated that approximately 300 vessels are presently anchored throughout the lagoon. Vessels moored now include the following approximate numbers: 18 commercial craft, 140 live-aboards, 104 non-live-aboards, and 27 vessels not classified as boats.[20] This program is part of an ongoing effort by the Harbors Division to manage recreation uses within the lagoon and is in keeping with the PLAN.

Ocean Related Recreation. In a recent survey of Oahu residents which had them rate the importance of various recreational facilities, beach parks were identified as being the most important (DLNR, 1985). Because of the "built up" nature of the waterfront areas comprising the western portion of the Primary Urban Center (Kalihi to Pearl City), the availability of shore-oriented recreational areas is limited. Presently, Sand Island State Recreation Area and Ke'ehi Lagoon Park are the only two waterfront recreational areas providing beach access in the western portion of the Primary Urban Center. Although suitable for a number of water-related

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[20]Numbers are previous estimates compiled from sources including Harbors Division and Ke'ehi Lagoon boaters. Harbors Division is presently in the process of updating their inventory of vessels anchored offshore in the lagoon as part of the effort to design the mooring buoys and layout of moorings within the authorized area, and in anticipation of implementing the rules and regulations for moorings.

recreational activities these areas do not presently provide a protected swimming area similar to Ala Moana Beach Park.

Ke'ehi Lagoon Park is situated in the northeastern corner of Ke'ehi Lagoon at the base of the Kalihi and Moanalua Streams. Directly across from the park is the Kalihi Kai light industrial area. Designed for multipurpose use, the 56-acre park provides facilities for both active and passive recreation including tennis courts, playing fields, horseshoe pits, and picnic areas. The beach portion of this park is composed primarily of crushed coral fill material. Although this park is considered ideal for water-related activities such as canoeing, stream discharge from the adjacent streams raises the turbidity of the water in this corner of the lagoon, making recreational swimming less inviting.

The Sand Island Recreation Area encompasses 140-acres of land. At present 83 acres along the southern portion of the island have been developed. The remaining acreage yet to be developed is located along the western side of the island facing Ke'ehi Lagoon. In its development plan, the park is envisioned as a regional facility that provides both passive and active recreational opportunities with a primary orientation toward ocean, shore oriented and culturally enriching activities (Aotani & Oka, p. 4, 1973). Current usage of the park suggests these goals are beginning to be realized. In 1987, there were 832,000 annual, or approximately 2,300 daily, recreation visits recorded at the park (DBED, Table 238, 1988).

Although development of the park is not complete, its existing facilities support a broad range of activities including picnicking, camping, fishing, reef exploration, limu picking, surfing and swimming. Swimming activities are, however, hampered by the presence of coral heads and metal debris scattered along the park's waterfront. Currents generated by the wash of the waves on the southern shore also tend to restrict swimming activities. On the northern tip of Sand Island adjacent to Kalihi Channel, the University of Hawaii currently runs its Outdoor Recreational classes under a permit from DLNR. Their classes include sailing instruction, boating safety, motor boat handling classes, windsurfing classes, and kayaking classes.

3.2.6 Surrounding Land Uses and Ownership:

The Ke'ehi Lagoon area encompasses six miles of shoreline surrounding the lagoon. Existing land uses are predominantly limited to commercial, light industrial, maritime and public facility activities.

A number of commercial uses are located in areas along Lagoon Drive. These uses include auto sales, offices, small restaurants, hotel accommodations, tour bus facilities and the island's primary visitor car rental facilities. Light industrial land uses such as tool manufacturing, laundry plants, airport support services and distribution warehouses are also located in the area off of Lagoon Drive. Along

Sand Island Access Road, industrial activities include light manufacturing, scrap metal processing and an 8-acre jet fuel storage site.

Maritime activities encompass both industrial and recreational uses. The largest maritime industrial activities in the Ke'ehi Lagoon area are the operations at Ke'ehi Marine Center which include drydock facilities, sail repair, boat building and engine repair. Pier 60, the site of the proposed Pier 60 Marina, currently functions as a storage and off-loading area for the batch concrete plant located nearby. Maritime recreational uses include the berthing of boats at the three marina facilities located on Sand Island access road.

Major public facilities in the Ke'ehi Lagoon area include Honolulu International Airport, the Sand Island Waste Water Treatment Plant, Ke'ehi Lagoon Park, the Sand Island State Recreation Area, and the adjacent Honolulu Harbor.

The State of Hawaii owns all land within the Ke'ehi Lagoon project area. A number of state-owned parcels are, however, encumbered by long term leases. Ke'ehi Marine Center and the La Mariana Sailing Club have leases which run to the years 2016 and 2014 respectively. Land used for the jet fuel storage tanks directly behind Ke'ehi Small Boat Harbor is leased until 2023. All other state-owned properties in the area are encumbered on month-to-month revocable permits.

3.2.7 Airport Operational & Safety Considerations:

The Honolulu International Airport (HIA) borders the entire western half of Ke'ehi Lagoon, and most of the lagoon is within the airport operational boundary. The Federal Aviation Administration (FAA) imposes height restrictions on land uses surrounding the airport for safety of aircraft operations. The airspace above Ke'ehi Lagoon lies below HIA's horizontal control surface, which is located at an altitude of 163 feet above mean sea level. Any development in Ke'ehi Lagoon cannot intrude above this horizontal surface elevation. Other restricted airspaces over Ke'ehi Lagoon include the approach surfaces and clear zones for Runways 8R-26L (Reef Runway) and 8L-26R. The approach surfaces have vertical slope criteria while the clear zone criteria applies to the entire vertical airspace within the clear zone. Any intrusion into these airspaces is considered to be an obstruction and must be approved, for safety, by the FAA. Of the major improvements proposed by the PLAN, only the Pier 60 Marina and a portion of the Canoe Center improvements on the Kalihi-Kai shore lie under any runway approach surfaces. However, due to the distance away from the end of Runway 26R, the 163-foot elevation of the horizontal surface controls.

Other specific airspace restrictions are related to navigational aids and other airport operations. For example, the northern end of the Lagoon Drive Marina and Triangle Development lies within a localizer obstruction free zone for Runway 26R. The geometry for the localizer restricted airspace has a conical-shaped vertical slope criteria originating from the navigational aid. In addition, a helicopter pad is

part of the proposed HIA South Ramp Development Plan. The helipad is situated on the south end of Taxiway 2. The proposed height limits include a transitional surface with a slope of 2:1 and an approach surface with a slope of 8:1.

In addition, the FAA Part 77 regulations state that any construction or alteration within 20,000 feet of the nearest runway requires notification of the FAA if the construction or alteration intrudes into an imaginary surface which has a 100 to 1 slope from the nearest point of the nearest runway. Construction within the Lagoon Drive Marina and Triangle Development will likely intrude into this imaginary surface. It shall be the responsibility of the developer to fully conform with the requirements of the FAA.

3.3 RELATED PROJECTS OR PLANS

3.3.1 Honolulu Waterfront Master Plan:

The Ke'ehi Lagoon PLAN is a component of the Honolulu Waterfront Master Plan. Encompassing approximately 1,680 acres of land, the Honolulu Waterfront Master Plan (HWMP) identifies both short (5 to 10 year) and long range (20 to 40 year) development plans for the waterfront area from Magic Island/Ala Moana Park to Ke'ehi Lagoon. As an ongoing planning process currently under the direction of the Office of State Planning (OSP), the Final Master Plan for the waterfront is scheduled to be released in October of 1989.

In the Honolulu Waterfront Master Plan Pre-Final Report, Ke'ehi Lagoon is identified as one of nine individual subareas within the Honolulu waterfront (the other eight subareas include Ala Moana, Kewalo, Kaka'ako, Downtown, Iwilei/Kapalama, Kalihi Kai, Sand Island and Barbers Point). In the HWMP the development of Ke'ehi Lagoon as a major marine recreation and light industrial area was identified as a significant step toward addressing the continuing needs for these facilities in central Honolulu now and in the future. The area's development was also identified as being important for providing needed space to permit the consolidation and relocation of existing activities in the other eight subareas.

In addition to the Ke'ehi Lagoon PLAN, the HWMP for this subarea also recommends that additional park improvements be made along the Kalihi Kai shoreline adjacent to the Canoe Center. This area, which at present is leased to light industrial tenants by the Department of Land and Natural Resources, was identified as "forming an important linkage between the other proposed facilities at Ke'ehi"[21].

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[21]HH&K, HWMP, p. 3-67, 1989.

3.3.2 Honolulu International Airport Master Plan Update and Noise Compatibility Program:

The Honolulu International Airport (HIA) Master Plan Update and Noise Compatibility Program[22] accomplishes two things. It provides a physical development plan for HIA to 2005 and it implements recent federal regulations pertaining to airport noise and the surrounding environment. The plan will guide the expansion of HIA to accommodate projected increases in passengers, cargo and aircraft. Some of the key features of the plan include the provision of more airfield capacity, the expansion of the overseas terminal, the provision of new interisland facilities, the provision of additional parking, and the acquisition of additional land for airport use. There is an interrelationship between the development plan and the noise compatibility program in that the expansion of HIA is planned in conformance with the noise standards appropriate to the areas surrounding the airport.

Because of recent plans for a new International Terminal Building, the HIA Master Plan Update Study will be further updated to include the HIA development plans to the year 2010. This 2010 study is presently anticipated to be completed in early 1990.

The existing uses and the planned expansion of HIA vitally affect Keehi Lagoon with respect to aircraft overflights with attendant impacts of noise and visual intrusions into the environment. Because of these impacts, Keehi Lagoon is suitable for outdoor recreation, commercial and industrial uses, but is unsuitable as a residential area.

3.3.3 Honolulu International Airport South Ramp Development Plan:

The HIA South Ramp Development Plan[23] provides for the development of South Ramp, an area of about 194 acres situated between Keehi Lagoon and HIA's runways. In the 1980's many improvements to this area have been completed. These include sewers, water supply and drainage; development of air cargo facilities; and realignment of Lagoon Drive. The current plan update has the following key components: Helicopter pad; air taxi and commuter terminal, Federal Aviation Administration service station, general aviation facilities such as tiedowns and hangers, aircraft rescue and firefighting facilities, Civil Air Patrol facilities, University of Hawaii facilities and an aircraft museum. The improvements to Lagoon Drive in particular have directly enhanced the suitability of Keehi Lagoon itself for increased public access and vehicular traffic.

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[22]By KFC Airports, Inc. for the Department of Transportation, Airports Division, October 1988.

[23]Prepared by Wilson Okamoto and Associates, for the Department of Transportation, Airports Division, October 1988.

3.3.4 Removal of Derelict and Abandoned Vessels in Ke'ehi Lagoon:

This program by the State of Hawaii Harbors Division involves the removal of derelict and abandoned vessels from the waters of Keehi Lagoon. The program was initiated in 1987 and is continuing. Some of the vessels are actually sunken and require raising prior to disposal. The vessels are being removed and sold at auction or scrapped. There are approximately 40 abandoned or derelict vessels targeted for removal at present.

The purpose of the program is to make Keehi Lagoon more attractive to all users, and to provide space for additional moorings, berths, recreational activities and overall improvements. The program is part of an ongoing effort by the Harbors Division to provide constant maintenance of the area and is in keeping with the Keehi Lagoon Master Plan Update.

3.3.5 City and County of Honolulu Corporation Yard:

The City and County of Honolulu is proposing to relocate its fleet maintenance and trade shops, presently located on 12 separate sites in central Honolulu, to a centralized 26-acre facility on Sand Island. The site which is adjacent to the Sand Island Wastewater Treatment Plant is located on state-owned land which has been land banked and is presently undeveloped (Figure III-4). According to the Proposed Honolulu Corporation Yard and Sand Island Park Extension Draft Environmental Impact Statement[24] (DEIS) the project will involve the development of automotive maintenance shops, trade shops and materials storage facilities, vehicle and equipment parking sheds, fueling facilities, open storage areas for material and spoils, and internal circulation roads.

3.3.6 Sand Island State Park Development:

In return for the state-owned land to develop its Corporation Yard, the City and County of Honolulu is also proposing to develop the remaining portion of the undeveloped land along the western shore of Sand Island for park use in accordance with the 1973 Sand Island State Park Plan. The proposed park development (Figure III-4) encompasses approximately 53 acres fronting Ke'ehi Lagoon from Sand Island Point to the Sand Island Bascule Bridge.

According to the proposed Honolulu Corporation Yard and Sand Island Park Extension DEIS, the park area will be designed utilizing topographic features and landscaping so that the buildings and structures of the Corporation Yard will not

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[24]By Wilson Okamoto and Associates, 1989.

be prominently visible to park users. The proposed park will include trees and landscaping to provide large open areas for picnicking and informal sports activities. In addition, four comfort stations will be developed and a looped jogging trail parallel to Ke'ehi Lagoon's shoreline will be connected to paths in the existing Sand Island State Park.

Adjacent to the north end of the City's Sand Island Park Extension, an area has been set aside for the future development of an ocean awareness center. The center is being proposed by the University of Hawaii and would teach aquatic skills such as sailing. The area would also include approximately four acres needed for a new boat launching ramp and trailer parking. The launching facility would be built and operated by the Department of Transportation.

3.3.7 Statewide Ocean Recreation Management Plan:

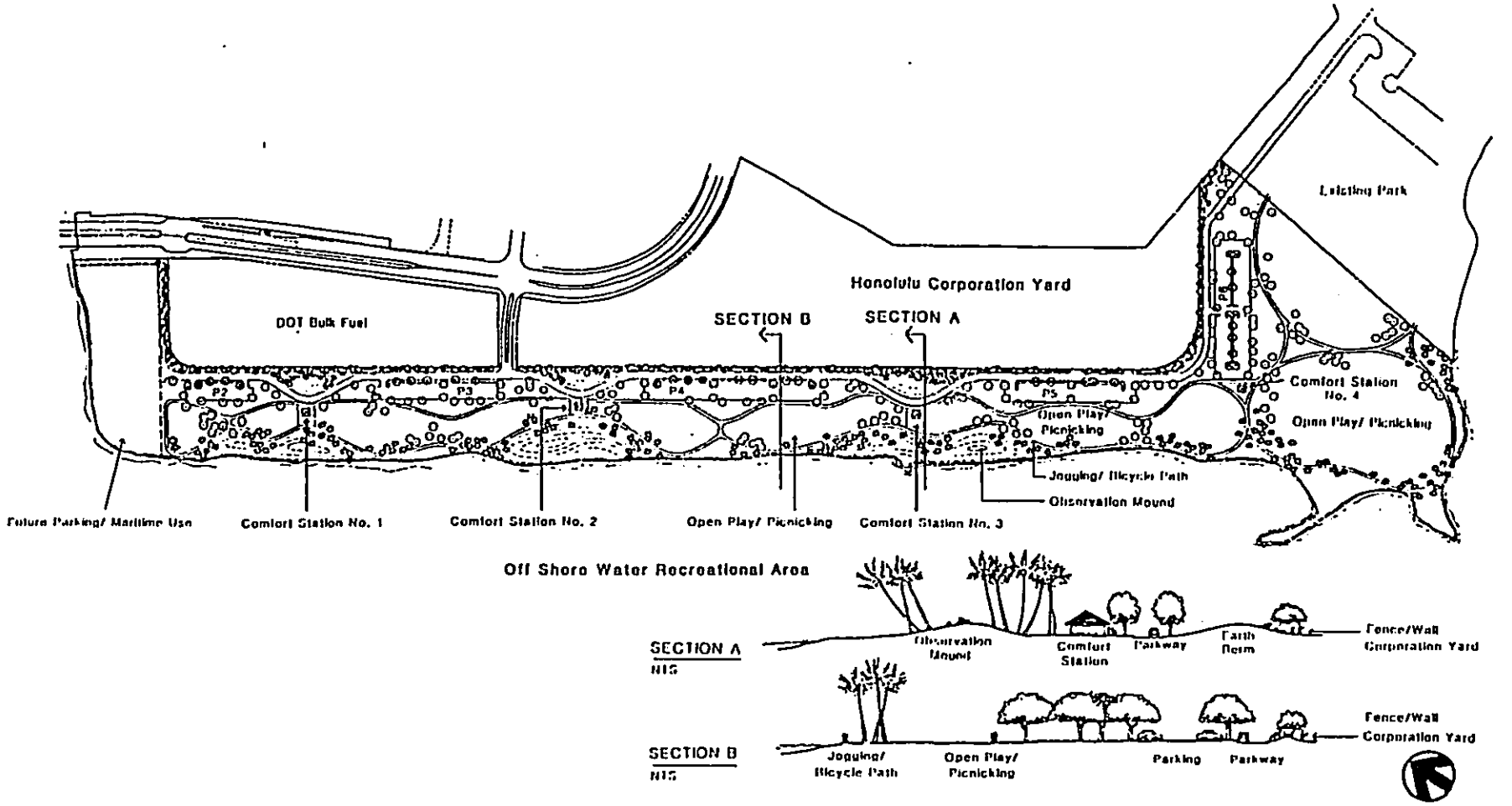
The Statewide Ocean Recreation Management Plan was prepared in response to House Resolution 170, H.D. 1, which required the State Department of Transportation (DOT) to prepare a plan aimed at primarily reducing conflicts among motorized watercraft and other ocean recreation users. The resolution also requested that all ocean recreation activities which were within the jurisdiction of the DOT also be considered. The project scope encompassed eight ocean recreation areas on four islands, from the high water mark to 1000 feet offshore. Ke'ehi Lagoon was included in the South Shore Recreation Area. Based on an interactive planning process in which government representatives and individuals from each of the activities identified in a particular recreation area participated, sub-areas of greatest concern were identified. On the South Shore of Oahu, Maunalua Bay, Waikiki and Ke'ehi Lagoon were identified as areas of greatest concern.

The top ranking management concerns identified by the plan include:

- o Lack of enforcement of rules and regulations;
- o Lack of comprehensive ocean recreation management plan;
- o Inadequate protection of aquatic life;
- o Lack of environmental concerns and shoreline protection;
- o Water safety.

Additional recommendations which were identified include:

- o Establishment of a day-use mooring system;



CORPORATION YARD AND SAND ISLAND PARK

Environmental Impact Statement

EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Proposed City and County Corporation Yard and Sand Island Park Extention**	FIGURE III-4

- o Better management of aquatic resources; and
- o Establish a permitting process for all commercial ocean recreation activities.

As a result of this study, the Department of Transportation, Harbors Division, implemented new rules and regulations aimed at reducing conflicts among ocean recreation users, especially in areas of high activity. HAR Title 19, Subtitle 3, Part 5, Chapter 86, "Ocean Recreation Management Rules and Areas", designates 10 management areas on Kauai, Oahu, Maui, and Hawaii. Subchapter 6, "South Oahu Ocean Recreation Management Area", designates restricted areas in and near Ke'ehi Lagoon. Within Seaplane Runway "B", a commercial windsurfing, sailing and diving zone is designated along the seaward edge of the channel near Harris Island. Also within Seaplane Runway "B", a commercial thrill craft (jet ski) zone is designated near Mokuoeo Island. Seaward of the Reef Runway fronting Ke'ehi Lagoon, a recreational thrill craft zone is designated in which no commercial thrill craft operations are permitted. In the vicinity of Ke'ehi Lagoon, parasailing is restricted to areas seaward of channel buoys from the Kalihi Channel Buoy R-2 to Honolulu Harbor Channel Buoy G-1. The designation of these zones for commercial ocean recreation activities and jet skiing is compatible with the PLAN.

3.3.8 State Comprehensive Outdoor Recreation Plan (SCORP):

The Federal Land and Water Conservation Fund Act (L&WCF Act) of 1965 was established by the Federal government to assist states in the acquisition and/or the development of outdoor recreation resources. The L&WCF Act authorizes the Secretary of the Interior to provide financial assistance on a matching basis to a maximum of fifty (50) percent for the following type of projects:

- o Acquisition of land and water or partial rights to them;
- o Development of certain outdoor recreation activity and support facilities needed by the public for recreational use of an area; and
- o Combined acquisition and development.

As part of the requirement to participate in the L&WCF, states are required to prepare State Comprehensive Outdoor Recreation Plans (SCORP). SCORPs present a broad view of a state's outdoor recreational opportunities, problems and issues, and propose coordinated actions toward improving the quality of these recreational activities.

Under the Hawaii State Planning Act (Act 236) the Department of Land and Natural Resources (DLNR) is delegated the responsibility to prepare and implement the State of Hawaii's SCORP program. As part of the SCORP program, needs

identified for each county and planning area are prioritized in terms of high, medium and low need for action. Based on these priority needs implementation measures are then recommended.

Statewide, the SCORP identified a high need, both over the short and long run, for improved sandy beaches, beach camping sites, moorages and boating facilities (DLNR, p. 42, 1985). In the West Primary Urban Center planning area, which encompasses Ke'ehi Lagoon, a high need was identified for a regional recreation facility that would support swimming; sunbathing, beach picnicking, fishing and boating activities (DLNR, p. 90, 1985).

3.3.9 Oahu Water Transit System:

The State Department of Transportation is in the process of implementing a marine mass transit system - a Water Transit System for Oahu - to serve the commuting public during the weekday morning (6 am to 9 am) and afternoon (3 pm to 6 pm) peak traffic periods. This ferry service supplements the Department's Transportation Management Program and offers commuters an alternative means of transportation to and from the workplace.

Seven ferry terminals will make up the system (Figure III-5). They will be located at Barbers Point in the Barbers Point Harbor, Ewa in the proposed Ewa Marina Development, Waipahu at the head of Middle Loch in Pearl Harbor, Airport in Ke'ehi Lagoon, Downtown in Honolulu Harbor at Pier 8, Waikiki in the Ala Wai Boat Harbor, and Hawaii Kai in Maunalua Bay[25]. The one-way fare will be $2.50 for holders of valid Hawaii State driver's license.

The ferry vessel will be a Surface Effect Ship having the following features: (1) 118 feet long, (2) 50 mph speed, (3) 350-passenger capacity, (4) air conditioned, (5) work tables, (6) computerized ride control system for passenger comfort, (7) snack bar, (8) airline-type seating, (9) cellular telephones, (10) wide screen television, (11) newspapers, etc. The State has awarded a contract to San Diego Shipbuilding and Repair, Inc., who will provide the required number of ferries and operate and maintain the service.

The Ke'ehi Lagoon ferry terminal is presently planned to be included in the Lagoon Drive Marina development. The ferry could service the airport and vicinity by offering an alternative means of transportation for workers commuting to the airport and vicinity.

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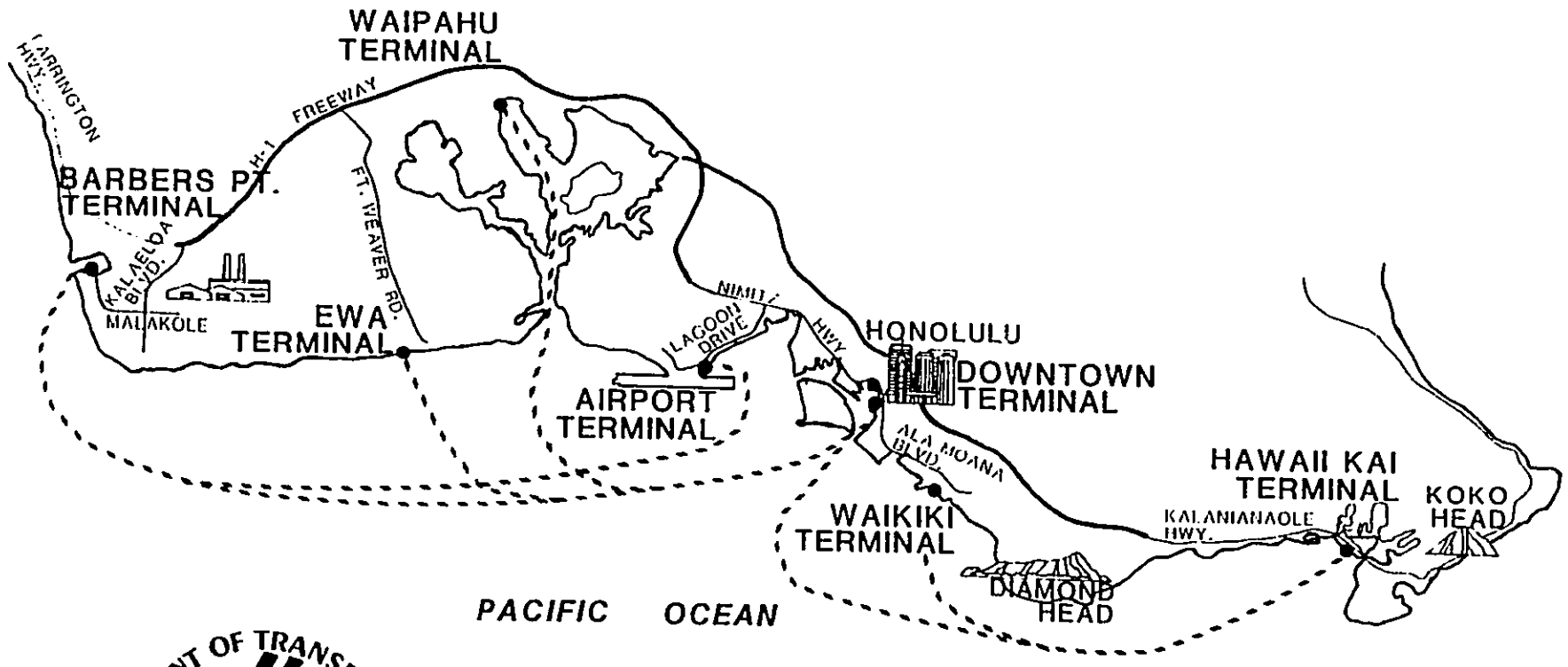
[25]A Development Plan amendment for the Hawaii Kai terminal in Maunalua Bay has not been approved by the City Council. However, it is the State's intent to resubmit for County approvals, revised plans for a terminal in Maunalua Bay.

WATER TRANSIT SYSTEM FOR OAHU



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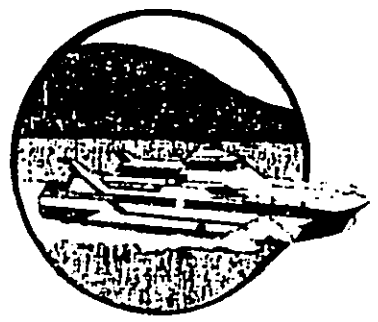

EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Proposed Oahu Intraisland Ferry System**	FIGURE **III-5**

Chapter IV

Probable Impacts and Mitigation Measures

CHAPTER IV: PROBABLE IMPACTS AND MITIGATION MEASURES OF SELECTED PLAN

4.1 LAGOON WATER QUALITY AND CIRCULATION

In order to discuss the impacts on water quality in Keehi Lagoon of the proposed PLAN, a computer model study of water circulation in the lagoon was accomplished (see Appendix G for the complete report). The model was verified and calibrated with actual measurements of current velocities and flow directions which were collected in relationship to winds, waves and tides. The model also accounts for inflows to the lagoon from Maunaloa and Kalihi Streams.

The circulation model shows that filling the shallow reef flat within the central triangle area would have little or no effect on water circulation in the lagoon because the circulation takes place predominantly in the deep Seaplane Runway channels which would not be significantly affected by the fill. Construction of a marina along Lagoon Drive would somewhat decrease the total volume of flow through Seaplane Runway "A", although mid-channel velocities would be increased. Construction of the breakwater and swimming beach at the southwest tip of Sand Island would decrease circulation flows through Seaplane Runway "D". Deepening of an existing depression through the reef at the west end to the breakwater is proposed as part of the project.

The circulation model shows that the flushing efficiency of the lagoon would be relatively unchanged after all components of the Plan were constructed. There would be a small net decrease of inflow and outflow during a tidal cycle but this is comparable to the small decrease in water volume of the lagoon so there are no significant net changes.

The circulation model shows that the proposed project would not adversely affect Keehi Lagoon's existing water quality and would provide some positive impacts as follows.

- Higher flow velocities in Seaplane Runway "A" during strong tradewind conditions would result in better flushing of the silty sediments discharged from Kalihi and Moanalua Streams. This would be especially beneficial to the increased number of paddlers who will use the canoe facilities and to water skiers.

- The potential water quality impacts from Honolulu Harbor flows into Keehi Lagoon would be reduced due to more direct discharge of the Harbor's waters through the Kalihi channel during ebb tide flows as well as during strong tradewinds.

The effects of the proposed construction on Ke'ehi Lagoon's water quality and circulation are also the subject of a report prepared for this EIS (Appendix F). There will be some temporary decrease in water clarity due to dredging and filling,

but water quality within the Lagoon is not projected to be permanently degraded. Generally, the changes in circulation in the Lagoon which will occur as a result of construction will result in a more direct discharge of water to the open ocean. There will be some decrease in flow in the vicinity of the channel in front of Sand Island due to the construction of the swimming beach breakwater, but residence times are projected to remain short and no water quality problems are predicted.

Higher bacteriological levels have been measured offshore Ke'ehi Lagoon Park due to a sewage spill in Moanalua Stream in 1987. However, fecal coliform concentrations returned to baseline levels within a day. Low levels were consistently measured at a station along Lagoon Drive, downstream of the park, reflecting the rapid die-off of coliforms in salt water. Detailed investigations to be undertaken during the planning and design for the Hawaiian Canoe Center will include sampling and analysis of bacteria levels. If it is revealed that this a potential problem, then a Supplemental EIS will be issued for the project. The construction of the proposed marinas in the Lagoon would not add to background levels because there will be restrictions on live-aboard boats and the plans include sewage pump-out stations. Because of these measures, there should be no increased bacteriological levels. Sewer improvements related to the PLAN may improve the existing water quality by providing opportunity for existing facilities to connect to the sewerage system. All facilities bordering the east side of the lagoon from Pier 60 to the Sand Island bridge are presently served by cesspools which occasionally overflow. Upgrading of the sewerage system will allow service to facilities which cannot presently be served by the municipal system.

4.2 MARINE LIFE

Impacts on the marine environment are the subject of a report[26] (Appendix F) prepared for this investigation and summarized as follows. There are two general types of impacts which may affect the marine environment: (1) Direct impacts of dredging, filling and construction; and (2) indirect impacts caused by alterations in water circulation and residence times, and changes in land use patterns.

The direct impacts of the proposed PLAN on the benthic and fish communities of Ke'ehi Lagoon would be minimal. This is because most of the Lagoon has been previously dredged, either for the seaplane runways during the 1930's or for the reef runway of the Honolulu International Airport in the mid 1980's. Areas to be dredged are largely those dredged in the past. They host organisms which are common throughout the soft bottom areas of the lagoon and which can rapidly

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[26] Assessment of Impacts on the Water Quality, Benthic Communities and Avifaunal Populations of Ke'ehi Lagoon, Honolulu, Hawaii, OI Consultants, Waimanalo, Hawaii, 1989.

repopulate new substrate, or are motile[27] and can move to avoid construction disturbance. Areas to be filled are those dredged in the past, or on the shallow mud flat which contains only scattered macroalgal growths and common burrowing crustaceans. There, fish are scarce and the habitat is typified by a muddy bottom with scattered coral rubble. None of the areas to be dredged or filled comprise unique habitat or contain rare, threatened or endangered marine species.

The indirect impacts are projected to be minimal and possibly even to result in improved water quality in some parts of the Lagoon because of slightly lessened residence times.

A survey of sea turtle populations in the area was made for this EIS (Appendix H). No turtles were observed within the dredged portions of Ke'ehi Lagoon. This is probably the normal situation because of the silty-mud type of bottom of the Lagoon and the turbid water column. There appears to be a small population of turtles which reside on the reef area fronting the Reef Runway facing the Pacific Ocean. It appears that the animals do not frequent the dredged areas during the day. It appears unlikely that the proposed Plan will alter the turtle behavior or occurrence.

4.3 REEF, MUD FLAT, AND ISLANDS

Generally, the reef surface, mud flat, and emergent islands in Keehi Lagoon are used by humans in five typical instances: (1) Picnicking/camping on the "islands"; (2) Support for waterski clubs for viewing and clubhouses on the sand bar, and water skiing on the west side of the berm; (3) Squatting and dumping of junk boats, barges, and other trash; (4) Hawaiian fishing community on Mokauea Island; (5) Reef fishing, snorkeling, and diving on the outer reef margins. On the interior reef face, which has been created by dredging of the seaplane runways, there is some coral growth on the seaward side of the triangle area.

The PLAN will not affect the islands on the outer reef margin, including Mokuoeo, Harris and Mokauea Islands. The PLAN will also not adversely affect the sand bar berm and existing water skiing area adjacent to the berm. The Triangle Development will enhance spectator viewing and access for the waterski course. The PLAN will not affect the outer reef areas seaward of Seaplane Runway B.

The reef surface and mud flat in the triangle area is relatively depauperate being extremely shallow and disturbed by previous dredging of the seaplane runways and the reef runway. As such, although it may provide some organisms suitable for food for Hawaiian Stilts or migratory waterbirds, it is presently little used by Hawaiians Stilts. Just why is not clear, perhaps because of the noise of the airport

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[27]These include small fish such as Nehu used as a bait fish by tuna fishermen.

or the extensive human recreational activity in Keehi Lagoon, or the general decline in food source on the mudflats.

Mitigation is proposed for two items. The first, loss of potential waterbird feeding areas, would be mitigated through purchase and development of suitable habitat in other locations (see 4.4 WATERBIRDS, for additional information). The second, potential damage to corals along the seaward side of the reef face of the triangle area, would be mitigated through construction of an artificial reef, offshore, in protected ocean waters in Mamala Bay at a location to be selected.

Detailed mitigation for any loss of viable coral reef fringe areas on the southern edge of the triangle flats would be designed when more detailed plans for the development are prepared which will indicate the exact losses due to the proposed development. Based on the present concept plan, construction of the fill area can be accomplished such that minimal impact to the seaward face of the triangle occurs. Mitigation for any coral reef loss would involve construction of an artificial reef in Mamala Bay. The nearshore areas fronting Sand Island and Kaka'ako are possible locations for artificial reef enhancement. As proposed in the Kaka'ako Makai Area Plan Draft Supplemental EIS, an "artificial reef sanctuary and research area" offshore Kaka'ako would complement and enhance the proposed Kaka'ako Park and offshore improvements recommended by the Honolulu Waterfront Pre-Final Master Plan, and would also be consistent with the legislative resolution (H.R. No. 266, H.D.1) which mandated the Department of Land and Natural Resources to designate a site as an Artificial Reef Zone and Marine Life Conservation District. Any proposed artificial reef mitigation for the Ke'ehi Lagoon PLAN would certainly be complementary within such a designated site. Such a reef would provide a much better opportunity than in Ke'ehi Lagoon for coral growth and creation of a coral habitat for reef animals, plants, and fish. The nearshore ocean environment in Mamala Bay (seaward of Ke'ehi Lagoon) is in the protected leeward waters of Oahu and is near the popular diving areas which are accessible from boat launch facilities and marinas in Ke'ehi, Ala Wai, and Pearl Harbor.

4.4 WATERBIRDS

Implementation of the Triangle Development Plan will cause the loss of some feeding and resting habitat for the endangered Hawaiian stilt and for several species of migratory water shorebirds. In recent years there has been a decline in sightings of Hawaiian Stilts at Keehi. In 1971, 114 were observed; in 1978 (after construction of the reef runway) 33 were observed; in 1985, 11 were observed. In 1987, 1988 and 1989 no stilts were observed (Appendices B, C, and D). The lack of sightings implies that the existing habitat is presently not attractive to stilts and the decline from 1971 to the present offers little hope for improvement without human intervention.

As noted by Dr. Andrew Berger, who has witnessed the decline in waterbird populations in Ke'ehi Lagoon over the past decade:

"The significant point about the "mitigation" islets and the mudflats of Keehi Lagoon is that although a greatly reduced number of stilts now use these areas for feeding and resting, they do not nest there. And, significantly, the critical factor for all the endangered Hawaiian waterbirds is the presence of safe nesting sites. ...Hence, because of the absence of safe and appropriate nesting sites in Keehi Lagoon, the Waiawa NWR (National Wildlife Refuge) in Middle Loch and the Honouliuli NWR in West Loch of Pearl Harbor assume a major habitat for providing safe nesting habitat for the endangered Hawaiian waterbirds. ...The mudflat Triangle between Seaplane Runways A & B is now of no importance for the endangered Hawaiian stilt. The mudflats at low tide now are used extensively by migrant shorebirds, but when these species return to Hawaii in August and September, they go to areas that are suitable for feeding and resting. If the mudflat triangle is not there when they return, they will find other areas." (Excerpted from Appendix C)

In spite of the apparent poor quality of the existing habitat in Ke'ehi Lagoon and the lack of sitings in recent years, mitigation is proposed for the loss of waterbird habitat that consists of three small man-made islets created as part of the mitigation for the Reef Runway construction, and the mudflats of the triangle area. The proposed mitigation, as part of the present PLAN, should prove to be more valuable towards maintaining and enhancing species production than existing conditions in Ke'ehi Lagoon.

The proposed mitigation consists of either purchasing or regulating waterbird habitat in other location(s) on Oahu for support of stilt populations and to provide substitute feeding and resting habitat for migratory shorebirds. Suitable habitat tends to be comprised of swampy or marshy areas which are protected from humans and animals such as mongooses, rats, cats and dogs. A suitable habitat area will be developed to provide improved habitat for breeding, as well as feeding and resting. Critical to the survival of the species is suitable habitat, not present in Keehi Lagoon now, for breeding. The planning and implementation for these programs will be carried out by the State of Hawaii, Department of Land and Natural Resources (DLNR) and the Department of Transportation. Details of the mitigation plan will be developed during coordination efforts with the applicable federal agencies within the context of the Corps of Engineers permit action.

Several areas have been identified as potential mitigation sites by the Division of Forestry and Wildlife, Department of Land and Natural Resources. These sites include Ukoa Marsh (on the north shore near Waialua), Pouhala Wetland (on the leeward shore in the Pearl Harbor area), and Heeia Wetlands (on the windward shore near Heeia State Park). Of these areas, Pouhala Wetland is the preferred site for development of improved habitat for mitigation. This site is in close proximity to the existing Waiawa and Honouliuli National Wildlife Refuges, and would serve the same populations of waterbirds that range in the vicinity of Ke'ehi Lagoon and the leeward shore of Oahu. Development of this habitat could include

clearing/vegetation control, grading and water impoundments with water level control structures, fencing to reduce predation, and access for maintenance. Of the 57-acre wetland area, 18 acres are owned by the City and County of Honolulu and 39 acres are owned by the State. About 30 acres of mangrove mudflats adjacent to the wetland area are owned by the U.S. Navy. Acquisition of this entire site would require successful negotiations with the City and County and the Navy.

The National Wildlife Refuges established in Pearl Harbor as mitigation for the Reef Runway construction have successfully provided safe nesting habitat for the endangered Hawaiian waterbirds. According to the Refuge Manager (personal communication, September 14, 1987), all four of the endangered Hawaiian waterbirds have nested there. There is no record of stilts nesting in Ke'ehi Lagoon, and the other Hawaiian waterbirds do not use Ke'ehi Lagoon and its islets and mud flats, as they require a different type of habitat (Appendix C). The Pearl Harbor Refuges also provide foraging habitat for migratory shorebirds: "Dotting the flats are plovers, tattlers, sanderlings, and other seasonal refugees from the arctic north (Wagner, p.G-1, December 10, 1989)." The Pearl Harbor National Wildlife Refuge serves as an excellent example of not only successful mitigation/compensation but also habitat enhancement for the waterbirds and shorebirds. It is the State's intent to provide similar substitute habitat for the loss of mudflats in Ke'ehi Lagoon due to the PLAN, to benefit both the Hawaiian stilt and the migrant shorebirds. The experience and example set by the Reef Runway mitigation would assure the success of the proposed mitigation for the PLAN.

Several abandoned salt evaporation ponds are located on the Kalihi-Kai shore southeast from the mouth of Kalihi Stream. According to the U.S. Fish and Wildlife Service, two Hawaiian stilts were observed at this area during a November 1989 site visit. Wandering tattlers and a single black-crowned night heron were also seen. The Canoe Center improvements will not affect this habitat area. The salt ponds will be preserved, and possibly even enhanced as mitigation for loss of other potential "wetland" areas along the Kalihi-Kai shore. Improvements to this salt pond habitat could include clearing of vegetation and fencing to prevent direct human disturbances. Activities related to traffic and people in the vicinity should not significantly affect feeding or resting activities of these migratory shorebirds and the Hawaiian stilt. Detailed delineating of any possible "wetland" areas along the Kalihi-Kai shore and development of possible mitigation plans will be accomplished within the context of the Department of the Army permit action.

4.5 TERRESTRIAL PLANTS AND ANIMALS

There is little terrestrial flora and fauna in this area. The shorelines and backshores of the entire Lagoon are highly disturbed by landfills and commercial/industrial development. There is terrestrial habitat in the form of islets in the Triangle Area. Impacts on these areas are discussed above (4.3 REEF, MUDFLAT, AND ISLANDS, and 4.4 WATERBIRDS).

4.6 AIR QUALITY AND NOISE

A report[28] (Appendix I) was specially prepared for this investigation which describes the air quality impacts of the proposed PLAN based on a computer model using the parameters related to meteorology, traffic flows, and climate.

According to the Environmental Assessment for the HIA Master Plan Update and Noise Compatibility Program, air quality in the vicinity of HIA and Keehi Lagoon is generally good and meets federal and state standards except for a few hot spots at intersections where carbon monoxide standards are exceeded. Emissions from vehicular traffic associated with the PLAN after it is fully developed could result in long-term, indirect impacts on the local air quality. Air quality model projections predict that, based on the vehicular volumes and patterns described by the traffic impact study, the State air quality standards for carbon monoxide would continue to be exceeded in hot spot areas near roadway intersections. The national standards, on the other hand, would be met. Despite the continued exceedance of the State AAQS, worst-case carbon monoxide concentrations with the PLAN would improve compared to present concentrations at the locations where the highest values are predicted to occur for the existing case. With or without development of the PLAN, carbon monoxide concentrations in the area will likely improve during the next several years due to the overall reduction in emissions from the vehicle fleet as older model vehicles with less effective emission control devices drop out of service.

It should be noted that the projected number of vehicles does not consider any of the proposed measures under the Honolulu Waterfront Plan which suggested that rapid transit and high occupancy vehicle systems would be required in Honolulu, especially the waterfront and metropolitan areas because of the general growth in the number of vehicles which is projected without the project. Because much of the traffic predicted to and from the Keehi Lagoon area during weekdays would be work commuters, the situation lends itself to alternative access methods if the need for reduction in vehicle source emissions becomes significant.

Keehi Lagoon is presently a high noise environment due to existing aircraft operations. It is unsuited for residences, but acceptable for outdoor recreation, commercial and industrial uses. The proposed project would not add significantly to this noise environment. For persons who would work or recreate in this area, however, there may be special concerns. Adequate noise reduction measures would be included in building design specifications to ensure a safe and healthful working environment indoors. Outdoor workers may need to use sound attenuator devices depending upon their exact location in the Keehi Lagoon area or the type of work they do. There should be no significant or adverse impacts on outdoor

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[28] Air Quality Study for the Proposed Ke'ehi Lagoon Recreation Plan, Barry D. Root & Barry D. Neal, September 1989.

recreators who spend short periods of time (for example, a few hours a day, a few days a week) in the area.

4.7 ACCESS AND TRAFFIC

There would be significant impacts caused by the increased vehicular traffic to the project area as described by the Traffic Impact Study report[29] (Appendix E). At the stage of ultimate development on a typical work week day 17,900 vehicles would enter or exit the project. Similarly on a Saturday during a Canoe Race Regatta there could be 21,000 vehicles. The estimated weekday peak hour traffic volumes would exceed the capacity of the Lagoon Drive intersections with Nimitz Highway and Aolele Street and would exceed the capacity of Aolele Street between Lagoon Drive and the H-1 Freeway ramps. The project traffic would slightly worsen conditions at the Nimitz Highway intersections in the Kalihi Kai area and at the Sand Island Access Road intersections with Auiki Street, all of which are expected to have peak hour volumes near or in excess of the intersection capacities by 1998.

Therefore, the proposed project includes mitigation measures for improved traffic flow at key locations such as Lagoon Drive - Nimitz Highway Intersection, Ohohia Street, Lagoon Drive Intersections with Koapaka and Ualena Streets and Wai Wai Loop, Lagoon Drive Intersection with Aolele Street, Aolele Street, Triangle Bridge, and Hoonee Place. Additionally, the proposed ferry commuter service will help to reduce traffic in the vicinity.

Because of uncertainties regarding future projects planned within the general vicinity that may create additional traffic impacts, some of the specific mitigation measures described in the Appendix E report may not be applicable at the time the projects are ready for implementation. For example, planning efforts are currently underway to expand the airport terminal facilities to include a new International Terminal building. This could result in major changes to the traffic volumes and circulation patterns affecting Lagoon Drive and the Ke'ehi Lagoon vicinity. A traffic study presently underway for the HIA Master Plan development to the year 2010 will consider the anticipated traffic due to the PLAN. Additionally, it may be optimistic to assume that the proposed Makai Boulevard viaduct above Nimitz Highway would be completed and available for use within the timeframe for full development of the PLAN. Planning assumptions will be reevaluated and traffic mitigation measures revised, as necessary, at the time of PLAN implementation. Construction work within the State highway right-of-way will require approval from the State Highways Division. At the time that major components of the PLAN are designed, any proposed traffic mitigation measure will be evaluated in the context

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[29]Keehi Lagoon Recreation Plan Traffic Impact Study, Wilbur Smith Associates, May 1989.

of traffic volumes and patterns at the time including other definitive major planned developments in the area.

All parking needs for the specific proposed developments will be accommodated on site, including increased parking needs for park users.

4.8 UTILITIES

A report (Appendix F) which was prepared to support this investigation[30], identified the impacts of the proposed PLAN on existing utilities in the area. The impacts on utilities can be summarized as follows.

- Electrical and telephone - These services can be made available by the respective providers as required.

- Potable Water - Potable water can be provided to the Lagoon Drive Marina from the Department of Transportation, Airports Division system in the South Ramp area. The Hawaiian Canoe Center, and the Pier 60 Marina sites may be serviced from existing local water mains. The Triangle Development site can be served from the Honolulu Board of Water Supply (BWS) system, but because of the volume required, the site developer would be required to financially share in expansion of BWS storage facilities.

- Sanitary Sewers - Because the sewer interceptor along Nimitz Highway has reached capacity, developers of all sites in the proposed PLAN would be required to financially share in the needed upgrades to the municipal system. Alternatively, a new submarine force main could be considered to be routed from the Triangle Development across Ke'ehi Lagoon to connect directly to the Sand Island Sewage Treatment Plant. Developers of other sites could then connect to this new force main. Construction of a submarine force main would be more costly than improving the Nimitz Highway interceptor assuming that the City was funding the interceptor improvement.

In sum, there are no unusual problems related to utilities given the large scope of the proposed PLAN. Major impacts will not occur on existing utility systems, rather, developers (private or government) would be required to provide financial assistance for upgrading existing utilities, or providing new utilities, prior to initiation of service.

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[30]Utility Master Plan for Ke'ehi Lagoon Recreation Development Plan, Wilson Okamoto and Associates, Inc., Honolulu, May 1989.

4.9 AESTHETICS

An important factor in evaluating the aesthetic impact of the PLAN is the vantage point from which the proposed developments will occur. Two types of vantage points exist: 1) those vantage points which are located within the project area and 2) those vantage points which are located outside of the project area. Although aesthetic quality is subjective in nature, in general, implementation of the PLAN will serve to improve the overall aesthetic quality of Ke'ehi Lagoon (described in Section 3.1.9) from both of these vantage points.

From vantage points within the project area such as Ke'ehi Lagoon Park, the western side of Sand Island and the proposed park facilities on the triangle island development, construction of the Pier 60 Marina, Hawaiian Canoe Center and Lagoon Drive Marina will serve to enhance the visual quality of the area. Park users will be provided with a variety of maritime views ranging from canoe paddling to major yachting activities. The removal of derelict vessels surrounding the triangle area, which will occur in conjunction with implementation of the PLAN, will also enhance the views of maritime activities from vantage points throughout the lagoon.

Improved views of the lagoon resulting from removal of the derelict vessels and construction of the shoreline facilities will be obstructed to some degree by the construction of the proposed triangle development. In order to minimize this impact, the heights of the proposed facilities will be restricted and extensive landscaping will be utilized to act as a visual screen.

The aesthetic quality of the Keehi Lagoon area will also be improved from vantage points outside of the lagoon. Two of the most prominent of these "outside vantage points" are from high-rise office buildings in the downtown area and from the many flights which travel through the Honolulu International Airport. Views from these vantage points will reflect an active, well landscaped and maintained marine recreational area and will provide a positive impression of Oahu to airplane passengers who view the lagoon arriving and departing from the Honolulu International Airport.

4.10 RECREATION

Implementation of the PLAN will serve as a major step towards addressing many of the water recreational issues for Oahu and the central Honolulu area which were identified in the State Comprehensive Outdoor Recreational Plan and the State Ocean Recreation Management Plan. The proposed PLAN will significantly improve the availability of the following recreational facilities.

- Active Ocean Recreation Areas - The Hawaiian Canoe Center will provide permanent facilities for canoe practice and racing permitting Hawaiian Canoe clubs to actively encourage the staging of international canoe regattas on

Oahu. Public parks which are part of the PLAN will provide views and access to water around most of the Keehi Lagoon shoreline and will support recreational activities such as water skiing, sailing, fishing and swimming. The addition of these waterfront parks, which include the "triangle park" at the western tip of the triangle development, an "ocean strip park" along the southern shore of the lagoon, and an "Ocean Sports Complex park" bordering the water ski course, will greatly expand the number of water recreational areas currently available in central Honolulu and will reduce use pressures on those facilities on Oahu which currently exist.

- Berthing Areas and Support Facilities for Small and Mid-Sized Vessels - The proposed marina facilities will almost double the number of existing marina berths on South Oahu depending on the distribution of berth sizes. Over 1,000 berths will be added to South Oahu's existing inventory of marina berths through construction of the Pier 60 Marina, Lagoon Drive Marina and the Triangle Development. This will serve as a significant step in meeting existing and future demand for marina facilities on the island of Oahu.

- Yacht Racing Facilities - The Ocean Sports Complex, which includes 20 syndicate compounds for berthing 12-m yachts, will provide a permanent facility for year-round yacht racing regattas such as the Kenwood Cup and the Transpac Races. Construction of a facility of this size will serve as an initial step in the State's effort to promote the expansion of international yacht racing events in Hawaii. Between yacht racing events these facilities will serve as areas to support large transient vessels which currently cannot be accommodated in other marinas on Oahu, or to support other water recreation sports events such as major water skiing competitions.

4.11 SOCIOECONOMIC FACTORS

Keehi Lagoon's development as a major marine recreational area is an integral component of the Office of State Planning's Honolulu waterfront development effort. In addition to addressing marine recreation needs, discussed above, the proposed project will provide area for the relocation of the University of Hawaii Marine Expeditionary Center from its Kapalama facility (Snug Harbor). Approximately 119 acres of industrial and commercial land will also be developed for airport and water related activities. The relocation of the Expeditionary Center and development of the industrial and commercial land area will contribute to reducing the critical shortage of available waterfront industrial and commercial land in the central Honolulu area. This will permit planned redevelopment efforts for other "subareas" of the Honolulu waterfront (e.g. Ala Moana, Kewalo, Kaka'ako, Downtown, Iwilei/Kapalama, Kalihi Kai and Sand Island), which require suitable waterfront industrial and commercial relocation areas for existing activities, to proceed in accordance with the Honolulu Waterfront Master Plan.

Besides providing additional waterfront recreational area and contributing to reducing the critical shortage of airport and waterfront commercial and industrial land, implementation of the PLAN will have a number of other positive socioeconomic impacts. The PLAN will not require a substantial commitment of public revenues (e.g. tax dollars). Although a major portion of the PLAN encompasses the construction of public or quasi-public facilities, the synergistic relationship of these facilities with other components of the project makes it attractive for private developer financing. Development of the commercial and industrial uses will provide the major revenue base for implementing the public components of the PLAN.

The development of Keehi Lagoon as a major ocean recreational area will also be a significant step toward encouraging the development of a marine recreational industry in Hawaii. Yacht racing events such as the America's Cup have evolved into huge international events which generate strong interest in the sport, travel, and related technology. The benefits of hosting events of this caliber include:

- Substantial income to the state from excise and hotel room taxes and user fees;
- The incremental benefit to the entire community from the re- circulation of monies spent by the yacht racing syndicates, supporters and spectators;
- The "goodwill" benefits resulting from exposure of Hawaii to various media coverage; and
- The opportunity to attract suppliers of various types of boating research and technology to locate facilities in Hawaii once it becomes evident that Hawaii has facilities which can support major events.

Implementation of the PLAN will also increase public use and access to Ke'ehi lagoon and its shoreline. The Lagoon Drive shoreline, Pier 60 area, and western shore of Sand Island presently provide only limited public access points. Access to each of these areas will be substantially improved by providing public walkways and amenities.

Although the PLAN will have a number of positive socioeconomic impacts, some unfavorable socioeconomic impacts also exist. The barging and stockpiling of sand and gravel at Pier 60 for the concrete batch processing plant and a number of other industrial warehouse facilities on the shore of Ke'ehi Lagoon, adjacent to the Pier 60 area, will be displaced. All of these land uses and facilities are on month-to-month revocable permits and the tenants are aware of the impending redevelopment of the area.

Vessels anchored in areas outside of the designated mooring area will be required to move into the authorized mooring area or to berths elsewhere prior to PLAN construction. (Refer to Section 3.2.5 for a discussion of the ongoing actions

related to the authorized mooring area.) Those vessels which are derelict or are not seaworthy will be removed from the lagoon. As presently planned, no live-aboards will be permitted in any of the new marina facilities because of the aircraft high noise environment. As a result, those vessels which do not comply with the mooring rules and regulations for the anchorage area or are live-aboard will be required to find alternative locations.

Structures which have been illegally erected along the strip of land which divides the water-ski area and Seaplane Runway "D" will be removed. This will result in the displacement of the squatters who currently inhabit this area. Permitted structures erected by the waterski clubs will not be affected.

Near the proposed Hawaiian Canoe Center some aku (tuna) fisherman presently catch baitfish (nehu, a small anchovy-like fish). The proposed development is not expected to significantly affect this fishing area. However, the turbidity of Ke'ehi Lagoon's waters will increase while dredging and filling activities are underway. This could result in the short-term reduction in the number of nehu caught. However, in the long-term it is expected that these sites would be restored through a natural flushing and resettling process. Upon completion of the project, canoe race lanes will not be permanently buoyed off, thereby allowing fishermen continued access to the nehu.

A portion of the reef area near the site of the proposed sheltered swimming beach on the southern tip of Sand Island has been known to be used for limu (seaweed) collection. Hoyle (1976) identified this area as containing algae of the genus, Gracilaria which contains the popular edible limu know as ogo. To minimize the impact on this area construction of the sheltered beach area will be limited to the northern side of the existing concrete surge breakers as much as practicable.

Implementation of the PLAN will result in a substantial increase in boat traffic within Ke'ehi Lagoon. However, the existing Seaplane Runways have been determined to provide ample width for access to the marina facilities and the existing 400-foot wide Kalihi Entrance Channel is considered adequate for entry-exit to Ke'ehi Lagoon. Improved channel markers will aid navigability and improve public safety.

4.12 HISTORIC AND ARCHAEOLOGICAL RESOURCES

Implementation of the PLAN is not expected to have any impact on historic or archaeological resources in the Ke'ehi Lagoon area. The area which will be affected by the PLAN has been heavily disturbed by urban development and extensive dredging and filling. No surface historic or archaeological resources have been identified within the project area. Although habitation of the Ke'ehi Lagoon area has been documented since the mid-1850s, the extensive dredging and filling of the shoreline area, described in Section 3.1.1, suggests that no intact subsurface archaeological remains exist.

Despite the substantial alteration of Keehi Lagoon's shoreline, the possibility does exist that archaeological remains which have been transported with the fill material may be uncovered during construction. As a precautionary measure construction crews and supervisors will be alerted to the possibility of archaeological remains. If remains are discovered, the Historic Sites Office of the State Department of Land and Natural Resources will be consulted immediately to determine appropriate mitigation measures.

Chapter V

Relationship to Land Use Plans, Policies and Controls for the Affected Area

CHAPTER V: RELATIONSHIP OF THE PLAN TO FEDERAL, STATE, AND COUNTY LAND USE PLANS, POLICIES, AND CONTROLS

This Chapter analyzes the relationship of the PLAN to existing public plans, policies and controls administered by the Federal Government, the State of Hawaii and the City and County of Honolulu. The intent of the applicable plans, policies and controls is examined along with an analysis of their relationship to permit requirements necessary to implement the PLAN.

5.1 FEDERAL

A variety of federal legislative acts and programs pertain to the implementation of the PLAN. These include:

5.1.1 U.S. Army Corps of Engineers:

The U.S. Army Corps of Engineers (Corps) regulates activities within the waters of the United States through the administration of the Department of the Army Permit Program. Statutory authorities for this program, that pertain to the project proposed for Ke'ehi Lagoon, are based on the following laws:

- **Section 10 of the Rivers and Harbors Act of 1899** (33 U.S.C. 403), which prohibits the construction of any structure in or over any navigable water of the United States, the excavating from or depositing of material in such waters, or any other action which affects the course, location, condition, or capacity of such waters without a permit from the Corps;

- **Section 11 of the Rivers and Harbors Act of 1899** (33 U.S.C. 404), which prohibits the construction of any structure "channelward" of established harbor lines without a permit from the Corps; and

- **Section 404 of the Clean Water Act** (33 U.S.C. 1344), which prohibits the discharge of any dredge or fill material into the waters of the United States without a permit from the Corps.

Issuance of a Department of the Army (DA) Permit for the PLAN will be based on a "public interest review" which will evaluate the probable impacts of the PLAN, including its cumulative impacts, and its intended use. This decision process will require a balancing of the reasonable benefits which can be expected to accrue from an activity against its reasonable foreseeable detriments. All factors which may be relevant to a proposed activity are required to be considered including, but not limited to, conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, property ownership and in general the needs and welfare of the people (51 FR 41223). The decision whether

to authorize the project, and if so the conditions under which it will be permitted to occur, will then be determined by the outcome of this "general balancing process" (51 FR 41223).

The review process for the Ke'ehi Lagoon DA permit will trigger a number of applicable Federal laws and general policy requirements which are described below:

- **Section 401 of the Clean Water Act (33 U.S.C. 1341),** is directed at maintaining the chemical, physical and biological integrity of the Nation's water resources. It requires an applicant proposing any activity that may result in the discharge of a pollutant into the waters of the State of Hawaii to obtain a State Water Quality Certification from the State Department of Health. Prior to receipt of this certification the Corps will not issue a DA Permit.

- **The Coastal Zone Management Act of 1972,** is intended to assist the states in order to preserve, protect, develop and where possible restore or enhance resources in the coastal zone through the development and implementation of management programs (i.e. Coastal Zone Management Programs). Applicable requirements of this act state that at minimum

  > *these management programs should provide for:*
  >
  > *the protection of natural resources including wetlands, flood plains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitats in the coastal zone;*
  >
  > *the management of coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion- prone areas;*
  >
  > *priority consideration being given to coastal-dependent uses and orderly processes for siting major facilities related to national defense, energy, fisheries development, recreation, ports and transportation, and the location, to the maximum extent practicable, of new commercial and industrial development in or adjacent to areas where such development already exists; and public access for recreation purposes* (16 U.S.C. 1451).

Section 307 (c) of this act, as amended (16 U.S.C. 1456(c)), requires non-federal applicants for a federal license or permit to conduct any activity affecting land or water uses in the State of Hawaii's coastal zone to furnish a certification that the proposed activity will comply with the state's federally

approved Coastal Zone Management Program (CZM). As with the Clean Water Act above, the Corps will not issue a DA Permit until the Office of State Planning, which administers Hawaii's CZM Program, conducts this consistency review and concurs with the applicants certification.

- **The National Environmental Policy Act of 1969,** declares the national policy to encourage the a productive and enjoyable harmony between man and his environment. Section 102 of this act specifies that "to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with technical and economic considerations" (42 U.S.C. 4321). In accordance with this Act, the Corps will be required to determine whether or not an Environmental Impact Statement is required for a project under NEPA prior to issuing a DA Permit.

- **The National Historic Preservation Act of 1966,** declares a national policy to preserve for public use historic sites, buildings and objects of national significance. The Act created the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. In carrying out its duties the Council is authorized to review and comment upon activities licensed by the Federal Government which may have an effect on properties listed on the National Register of Historic Places, or those eligible for such listing (16 U.S.C. 461). Under this Act the Corps is required to determine whether consultation with the Advisory Council on Historic Preservation is required based on the projects potential for affecting any significant historic or archaeological resources.

- **The Endangered Species Act of 1973,** was enacted in an effort to conserve threatened and endangered species and the ecosystems on which these species depend. The Act requires that federal agencies (e.g. the Corps), in consultation with the U.S Fish and Wildlife Service and the National Marine Fisheries Service, use their authorities in furtherance of its purpose by carrying out programs for the conservation of endangered or threatened species and, by taking action necessary to insure that any action authorized, funded, or carried out by the agency is not likely to "jeopardize the continued existence" of an endangered or threatened species or result in the destruction or adverse modification of the habitat of a species which is determined by the Secretary of the Interior or Commerce to be "critical habitat" as defined in 50 CFR Part 17 and Part 402 (51 FR 41223).

- **The Fish and Wildlife Act of 1956, the Migratory Marine Game-Fish Act and the Fish and Wildlife Coordination Act,** are intended to protect the quality of the Nation's aquatic environment as it affects the conservation, improvement and enjoyment of fish and wildlife resources. Under these

Acts, any federal agency that proposes to control or modify any body of water must consult with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service, as appropriate, and with the head of the state office exercising administration over wildlife resources (i.e. the State Department of Land and Natural Resources).

Fills for Non-water Dependent Activities

Fills for non-water dependent activities are generally discouraged by the Corps. Much of the area on the Triangle Development designated for light industrial and commercial use to support Honolulu International Airport would be considered non-water dependent. Non-water dependent discharges are those discharges that do not require access, proximity to or siting within a special aquatic site to fulfill their basic project purpose. For example, the basic project purpose of airport-related activities is to support airport functions and does not require access, proximity to or siting within an aquatic site to fulfill its basic project purpose.

When a proposed project is determined to be non-water dependent, the guidelines under the Clean Water Act presume that a less damaging, practicable alternative or a less vulnerable, practicable fill site is available. This presumption forces study of the feasibility of using less environmentally damaging or vulnerable fill sites. A practicable alternative is an alternative that is available and capable of being done after taking into account cost, existing technology and logistic factors in light of the overall project purpose. The practicable alternatives analysis is based on overall project purpose, not a basic project purpose. (Basic project purpose is used for the determination of water dependency and not for the evaluation of practicable alternatives.) The analysis of alternatives is based upon reasonableness in terms of overall scope and cost of the practicable alternative. The overall project purpose for the PLAN is described in Chapter I of this EIS and consists of two major goals and eight plan objectives. The discussion of alternatives in Chapter VI of this EIS indicates that the PLAN is the only alternative that meets the stated project purpose. This discussion of alternatives may not completely satisfy the federal requirements of the Corps' "practicable alternatives analysis", however, it is the State Department of Transportation's intent to address this requirement within the context of the Corps permit action.

Where non-water dependent fills cannot be avoided, mitigation and/or compensation plans for the loss of aquatic resources must be developed. Mitigation is intended to accomplish one or more of the following: it reduces any impacts of the practicable alternative by limiting the degree or magnitude of the action; it imposes preservation and maintenance operations; where justified, it imposes measures to avoid loss to environmental resources; and in some cases, it imposes compensation, to include off-site compensation. Because the State Department of Transportation believes that fills for non-water dependent activities are necessary and that the PLAN is the only reasonable alternative for satisfying the overall project purpose, mitigation and/or compensation plans will be

developed for the loss of aquatic resources. Details of the mitigation plan(s) will be developed during coordination efforts with the applicable federal agencies within the context of the Corps permit action.

5.1.2 U.S. Coast Guard

Section 7 of the Rivers and Harbors Act of 1915: This statute authorizes the establishment of anchorage grounds for vessels in navigable waters of the United States whenever it is apparent that these are required by the maritime or commercial interests for safe navigation. The statute also authorizes the adoption of suitable rules and regulations regarding the establishment of anchorage grounds, which are enforced by the U.S. Coast Guard (USCG) (33 U.S.C. 471). In accordance with this act the USCG designates Special Anchorage Areas wherein vessels not more than sixty-five feet in length, when at anchor, will not be required to carry or exhibit anchorage lights. The areas designated as Special Anchorage Areas are required to be well removed from fairways and located where general navigation will not endanger or be endangered by unlighted vessels.

In accordance with this statute the USCG has established a Special Anchorage Area in Ke'ehi Lagoon along the northern portion of Seaplane Runway "D". *Specific bearings for this anchorage area are as follows: the waters of Ke'ehi* Lagoon enclosed by a line beginning at 21°19'04"N. latitude, 157°53'50"W. longitude; thence 21°19'06"N. latitude, 157°53'44"W. longitude ; thence 21°19'37"-N. latitude, 157°54'00"W. longitude; thence 21°19'35"N. latitude, 157°54'06"W. longitude; thence to the beginning point (33 CFR 110.128d).

Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946: This statute regulates the construction of bridges and causeways across navigable waterways. It requires anyone desiring to construct a new bridge or causeway to obtain a Bridge and Causeway Permit from the U.S. Coast Guard. Issuance of the permit is based on the structures impact on navigation, public comment and consultation other federal agencies. A Bridge and Causeway Permit will not be issued prior to a CZM consistency review and receipt of a State Water Quality Certificate from the DOH.

5.1.3 Federal Aviation Administration

Federal Aviation Act of 1958: The intent of this act is to regulate air commerce in such a manner as to best promote its development and safety. It requires the Department of Transportation (DOT) to control the use of the navigable airspace of the United States and regulate both civil and military operations in such airspace. As part of the Act, the DOT requires the submittal of a Notice of Proposed Construction or Alteration to the Air Traffic Division Chief of the Federal

Aviation Administration's Western-Pacific Regional Office, prior to undertaking any of the following activities:

1) Any construction or alteration of more than 200 feet in height above the ground level at its site;

2) Any construction or alteration of greater height than an imaginary surface extending outward and upward at a slope of 100 to 1 for a horizontal distance of 20,000 feet (3.78 miles) from the nearest point of the nearest runway of an airport with a runway more than 3,200 feet in length.

This act also provides for DOT to assist airport operators, in conjunction with other local, State, and Federal authorities, in the preparation and execution of appropriate noise compatibility planning and implementation programs. The programs are directed at providing noise mitigation and abatement alternatives to reduce incompatible land use found within the vicinity airport's environs.

5.1.4 National Flood Insurance Program:

This program enacted pursuant to the National Flood Insurance act of 1968, as amended, and the Flood Disaster Protection Act of 1973, is intended to avoid the long and short term adverse impacts associated with the occupancy and modification of floodplain development wherever there is a practicable alternative. The program, which on Oahu is administered by the City and County of Honolulu, Department of Land Utilization, requires its Director to evaluate and determine whether a proposed project is located in a floodway or flood fringe area and review related flood information for the area such as velocities and historical records. If it is determined that the proposed project is within a flood hazard area, the project will be required to comply with the siting and design standards outlined in the City and County of Honolulu's Land Use Ordinance (LUO), Section 7.10.

5.1.5 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service has particular interest in Ke'ehi Lagoon through the Hawaiian Waterbird Recovery Plan (1985) which describes protective measures for the Hawaiian Stilt. The Fish and Wildlife Service also has responsibility under the Fish and Wildlife Coordination and Endangered Species Acts (see Section 5.1.1, above) for the protection of endangered species and related habitats. They are particularly concerned with mitigation measures which are proposed for Ke'ehi Lagoon for Hawaiian Stilts and for coral reefs.

5.1.6 National Marine Fisheries Service

The National Marine Fisheries Service has responsibilities under the Endangered Species Act and the Marine Mammal Protection Act to safeguard threatened marine life. With regard to Ke'ehi Lagoon, they are particularly concerned with the protection of sea turtles. They are also responsible for commercial fisheries and the industry's well-being. They have an interest in assuring that the Nehu baitfishery (which supports commercial tuna fishing) at Ke'ehi is not damaged and they generally are interested in the development of facilities which support commercial fishing boats and the fishing industry.

5.2 STATE

State plans, policies and controls which are relevant to the PLAN include the following.

5.2.1 Hawaii State Plan:

The Hawaii State Plan (Chapter 226 of the Hawaii Revised Statutes, as amended) serves as a guide for the future long-range development of the State. The plan identifies goals, objectives, policies, and priorities and provides a basis for allocating limited resources such as public funds, services, human resources, land, and energy. Sections of the Hawaii State Plan that are relevant to the PLAN are discussed below.

State Goals. A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.
A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of people.

Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

Objective and Policies for Population

Objective

- Guide population growth to be consistent with the achievement of the physical, economic, a social objectives of the State Plan.

Policies

- o Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.

- o Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.

Objectives and Policies for the Economy - General

Objectives

- o Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

- o A steadily growing and diversified economic base that is not overly dependent on a few industries.

Policies

- o Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people.

- o Expand existing markets and penetrate new markets for Hawaii's products and services.

- o Foster greater cooperation and coordination between the government and private sectors in developing Hawaii's employment and economic growth opportunities.

- o Encourage businesses that have favorable financial multiplier effects within Hawaii's economy.

Objective and Policy for the Economy - Visitor Industry

Objective

- o Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth.

Policy

- o Improve the quality of existing visitor destination areas.

Objectives and Policies for the Physical Environment Land-Based, Shoreline, and Marine Resources

Objective

- o Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed toward the prudent use of Hawaii's land- based, shoreline, and marine resources and the effective protection of Hawaii's unique and fragile environmental resources.

Policies

- o Exercise an overall conservation ethic in the use of Hawaii's natural resources.
- o Ensure compatibility between land-based and water-based activities and natural resources, and ecological systems.
- o Take into account the physical attributes of areas when planning and designing activities and facilities.
- o Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.
- o Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.
- o Pursue compatible relationships among activities, facilities, and natural resources.
- o Promote increased accessibility and prudent use of inland and shoreline area for public recreational, educational and scientific purposes.

Objective and Policies for the Physical Environment -Scenic, Natural Beauty, and Historic Resources

Objective

- o Planning for the State's physical environment shall be directed toward the achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multicultural/ historic resources.

Policies

- Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

- Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes and other natural features.

- Encourage the design of developments and activities that complement the natural beauty of the islands.

Objectives and Policies for the Physical Environment - Land, Air and Water Quality

Objectives

- Planning for the State's physical environment with regard to land, air and water quality shall be directed toward the maintenance and pursuit of improved quality in Hawaii's land, air, and water resources and greater public awareness and appreciation of Hawaii's environmental resources.

Policies

- Promote proper management of Hawaii's land and water resources.

- Promote effective measures to achieve desired quality in Hawaii's surface, ground and coastal waters.

- Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

- Encourage urban developments in close proximity to existing services and facilities.

Objectives and Policies for Facility Systems - General Objectives

Objective

- Planning for the State's facility systems in general shall be directed toward achievement of the objective of water transportation, waste disposal, and energy and telecommunications systems that support statewide social, economic, and physical objectives.

Policies

- o Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.

- o Ensure that required facility systems can be supported within resource capacities and at a reasonable cost to the user.

Objective and Policy for Facility Systems - Solid and Liquid Wastes

Objective

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

Policy

- o Encourage the adequate development of sewerage facilities that complement planned growth

Objective and Policy for Facility Systems - Water

Objective

- o Planning for the State's facility systems with regard to water shall be directed toward achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.

Policy

- o Coordinate development of land use activities with existing and potential water supply.

Objectives and Policies for Facility Systems - Transportation

Objectives

- o An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.

- o A statewide transportation system consistent with planned growth objectives throughout the State.

Policies

- o Design, program, and develop a multi-modal system in conformance with desired growth and physical development.
- o Encourage transportation systems that accommodate the present and future development needs of communities.
- o Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs.

Objective and Policies for Socio-Cultural Advancement - Education

Objective

- o Planning for the State's socio-cultural advancement with regard to education shall be directed toward the achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their, needs, responsibilities, and aspirations.

Policies

- o Support educational programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuit of all groups.
- o Support research programs and activities that enhance the education programs of the State.

Objective and Policies for Socio-Cultural Advancement - Leisure

Objective

- o Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

Policies

- o Foster and preserve Hawaii's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities.

- o Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.

- o Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved design and maintenance.

- o Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring their inherent values are preserved.

- o Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.

- o Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.

Objective and Policies for Socio-Cultural Advancement - Culture

Objective

- o Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.

Policy

- o Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawaii's people and which are sensitive and responsive to family and community needs.

5.2.2 State Functional Plans:

The Hawaii State Plan directs the appropriate State agencies to prepare functional plans for the program areas of agriculture, transportation, conservation lands, housing, tourism, water resources development, historic preservation, energy, recreation, education, higher education and health. These twelve plans serve as the fundamental implementing vehicle for the goals, objectives and policies of the Hawaii State Plan. The following functional plans are relevant to the proposed PLAN:

State Conservation Lands Functional Plan. The State Conservation Lands Functional Plan is prepared and implemented by the State Department of Land

and Natural Resources. The purpose of the plan is to "establish a rational basis for managing the Conservation lands and resources in Hawaii." The plan defines and addresses the areas of statewide concern including watersheds, terrestrial habitat, ocean habitat, areas with endangered species, natural streams, shoreline areas, open space, natural areas, air and water quality sensitive areas, and historic and cultural sites.

State Water Resources Functional Plan. The State Water Resources Functional Plan is prepared and implemented by the State Department of Land and Natural Resources. The purpose of this plan is to present guidelines for the: (1) regulation of the development and use of water to assure adequate supplies for the future; (2) development of water resources to meet municipal, agricultural and industrial requirements, and the reduction of flood damage; and (3) preservation of water-related ecological, recreational, and aesthetic values and quality of water resources.

State Historic Preservation Functional Plan. The State Historic Preservation Functional Plan is prepared and implemented by the State Department of Land and Natural Resources. The plan identifies the major priorities for the collection and conservation of oral histories, historic records and artifacts, the perpetuation of traditional arts and skills, the preservation of historic properties, and the education of the public with regards to Hawaii's past.

State Recreation Functional Plan. As with the three previous functional plans the State Recreation Functional Plan is also prepared and implemented by the State Department of Land and Natural Resources. The purpose of the plan is to "assess present and potential demand and supply of outdoor recreation resources and to guide State and County agencies in acquiring or preserving lands of recreation value, providing adequate recreation facilities and programs, and ensuring public access to recreation areas."

State Transportation Functional Plan. The State Transportation Functional Plan is prepared and implemented by the State Department of Transportation. The objectives of the plan are: (1) development of a balanced, multi-modal statewide transportation system that serves clearly identified social, economic and environmental objectives; (2) develop and update airport master plans which serve statewide needs relating to the efficient, safe, and convenient movement of people and goods in support of planned growth objectives; (3) develop and update highway master plans which service statewide needs relating to the efficient, safe, and convenient movement of people and goods within Hawaii; (4) develop and update harbor master plans which service statewide needs relating to the efficient, safe, and convenient movement of people and goods to accommodate planned growth objectives; and (5) encourage energy conservation in transportation.

State Health Functional Plan. The State Health Functional Plan is prepared and implemented by the State Department of Health. The plan's objectives policies and implementing actions are intended to: (1) prevent disease and promote

healthful lifestyles and environmental conditions; (2) provide direct health services to persons for whom needed services would, otherwise, be unavailable due to economic, geographic or language barriers; (3) protect society from potential dangers (e.g., hazardous environmental conditions); and (4) prevent environmental degradation and enhance the quality of the air, land and water.

5.2.3 **Hawaii Coastal Zone Management Program** (Chapter 205A, H.R.S):

In accordance with the National Coastal Zone Management Act of 1972, Hawaii's Coastal Zone Management Program (HCZM) outlines objectives, policies, laws, standards and procedures to guide and regulate the use of the State's coastal resources. Administered by the Office of State Planning (OSP), the HCZM encompass broad concerns regarding coastal recreational resources; ecosystems; historic and archaeological resources; scenic and open space resources; economic uses; coastal hazards; and managing development. As part of the CZM Program, OSP is required to review federal programs, permits, licenses and development proposals, and state programs within the coastal zone management area from the shoreline to the seaward limit of the State's jurisdiction, for their *consistency with the Program's goals and objectives.*

5.2.4 **Environmental Impact Statements** (Chapter 343, H.R.S.):

Chapter 343 establishes a system of environmental review for actions which propose: (1) the use of State or County lands or funds; (2) any use within land classified as conservation by the State Land Use Commission; (3) any use within the shoreline as defined in section 205-31, H.R.S.; (4) any use within any historic site designated on the State or National Register; (5) any use within the Waikiki-Diamond Head area of Oahu; and (6) amendments to existing county general plans where such amendments would result in designations other than agriculture, conservation or preservation. For these actions Chapter 343 requires the preparation of an environmental assessment (EA) to determine whether the preparation of and environmental impact statement (EIS) will be required. Preparation of an EIS will be required if the agency receiving the request for approval determines the proposed action may have a significant environmental impact.

5.2.5 **State Land Use Law** (Chapters 183 and 205, H.R.S.):

Pursuant to Chapters 183 and 205, H.R.S. all lands in the State have been classified into one of four land use districts, urban, rural, agriculture and conservation, by the State Land Use Commission. Jurisdiction over the use of land in these districts is divided among State and County governments. Control of Land classified agriculture and rural is divided among the State Land Use Commission and the counties. Land use in the Conservation district is controlled by the Board

of the State Department of Land and Natural Resources (DLNR). Land classified urban is controlled directly by the counties.

Existing State Land Use Classifications

With the exception of a small strip of illegally filled land along the northern side of the proposed Pier 60 Marina site, which is classified as Conservation, all of the shoreside lands (i.e. those lands above the maximum inland line of the zone of wave action) surrounding Ke'ehi Lagoon are classified Urban (Figure V-1) and are regulated in their use by the City and County of Honolulu. Fast, tidal and submerged lands offshore in Ke'ehi Lagoon are classified Conservation and are regulated in their use by the DLNR.

Subzones for Lands Classified Conservation

The Administrative Rules of the Department of Land and Natural Resources, Chapter 2 of Title 13, establishes subzones for lands classified conservation (see Figure V-2). The three offshore islands in Ke'ehi Lagoon (Mokauea, Kahaka'aula-na (Harris) and Mokuoeo Islands), which are not directly affected by the PLAN, are situated in the Protective subzone. All of the remaining conservation lands (fast, tidal and submerged) in Ke'ehi Lagoon are located in the Resource subzone. Permitted land uses in the Resource subzone include:

1) Research, recreational, and educational uses which require no physical facilities;

2) Establishment and operation of marine, plant, and wildlife, sanctuaries and refuges; wilderness and scenic areas, including habitat improvements;

3) Restoration or operation of significant historic and archaeological sites listed on the National or State Register;

4) Maintenance and protection of desired vegetation, including the removal of dead, deteriorated and noxious plants;

5) Programs for the control of animal, plant, and marine populations, including fishing and hunting;

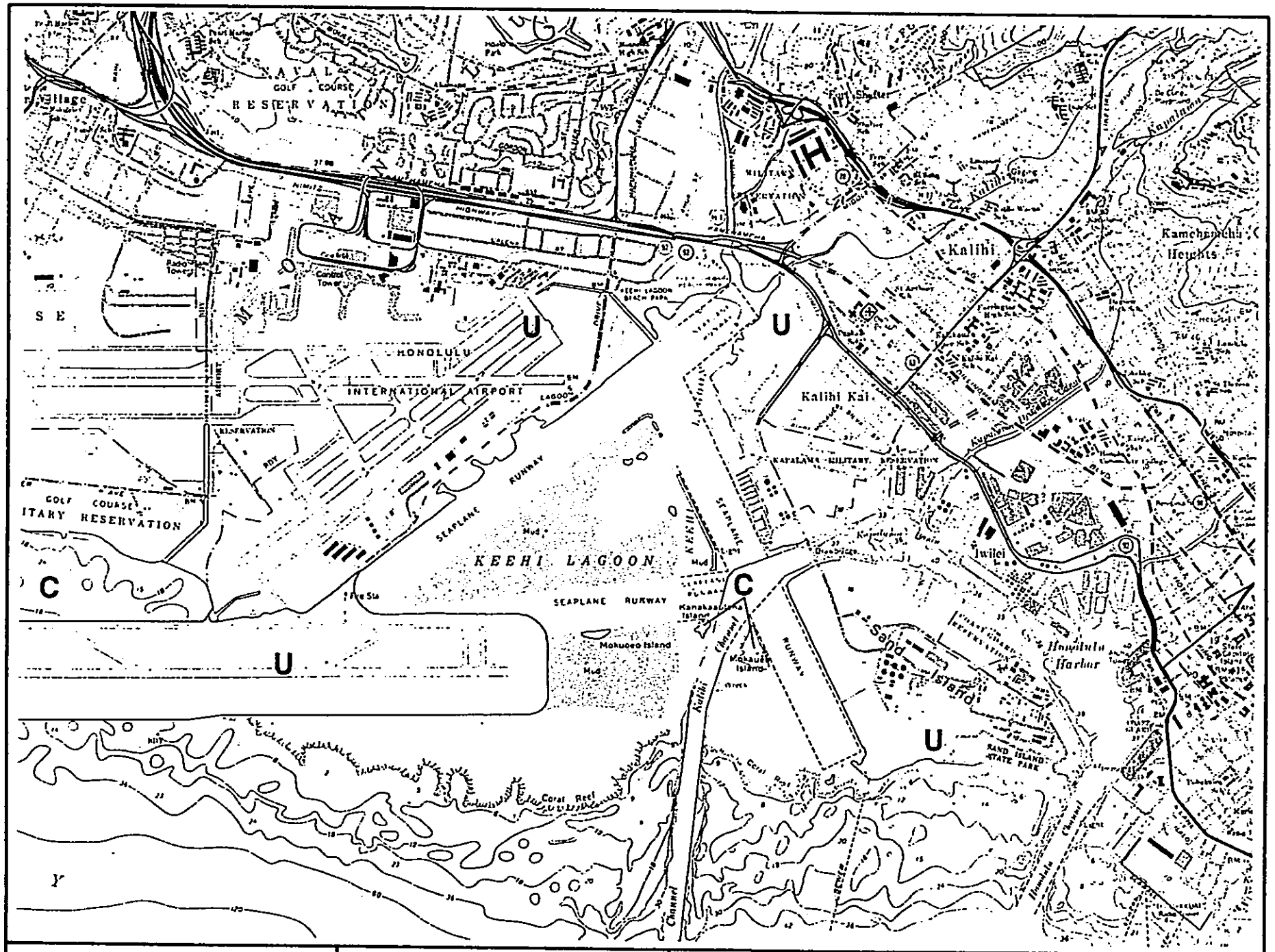
6) Monitoring, observing, and measuring natural resources;

7) Government use where public benefit outweighs any impact on the conservation district;

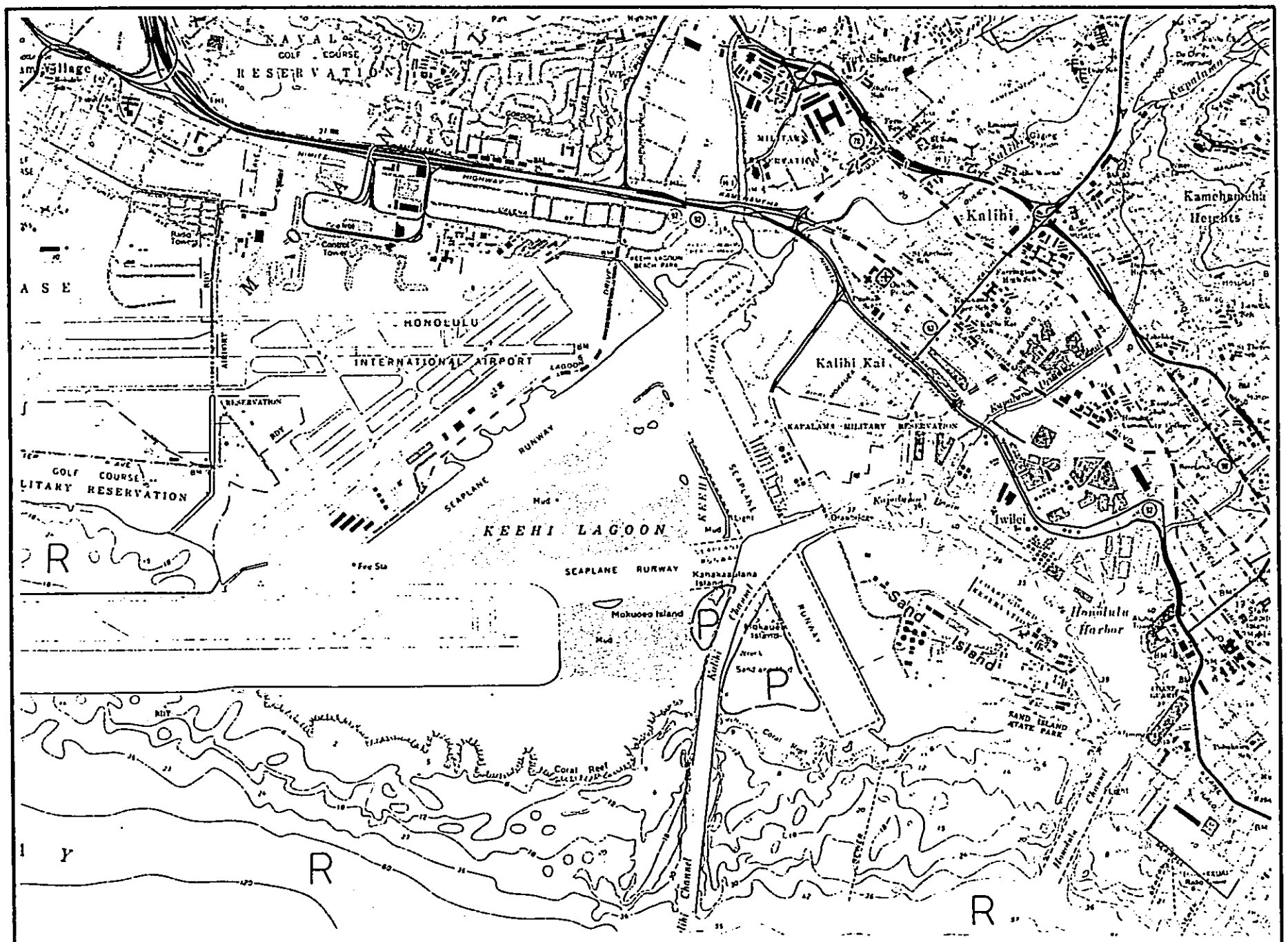
8) Emergency warning systems or emergency telephone systems;

9) Flood, erosion, or siltation control projects;

10) Growing or harvesting of forest products;



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **State Land Use District Classification for Ke'ehi Lagoon**	FIGURE V-1



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **State Land Use District Subzones Classification for Ke'ehi Lagoon**	FIGURE V-2

11) Aquaculture;

12) Artificial reefs; and

13) Commercial fishing operations.

Possible Amendments to State Land Use Classifications

Regarding the proposed improvements for the filled triangle area, if a decision is made to seek redistricting of this area, the action would require submittal of a petition to the State Land Use Commission to reclassify the parcel from Conservation to Urban after the required dredging and filling of the triangle area is completed.

Conservation District Use Application

A Conservation District Use Application (CDUA) is required for any use of lands located within the Conservation District. The Board of Land and Natural Resources is the responsible agency for reviewing and granting a CDUA according to guidelines specified in Chapter 2 of Title 13, Administrative Rules for Conservation Districts.

Because the PLAN represents a number of distinct "projects" which are intended to be implemented separately individual CDUAs may be required for each project affecting land designated Conservation. The improvements listed below will require a CDUA prior to any construction being undertaken.

o	Hawaiian Canoe Center:	Required for minor filling and construction of ramps on tidal, submerged and illegally filled land.
o	Pier 60 Marina:	Required for construction of a bulkhead and piers.
o	Lagoon Drive Marina:	Required for major filling and construction of piers.
o	Triangle Area:	Required for major dredging, filling and construction of a bridge and piers.
o	Sheltered Beach:	Required for dredging, beachfill and construction of rock breakwater.

5.3 CITY AND COUNTY OF HONOLULU

City and County plans, policies and controls which may be relevant to implementing the PLAN, if a decision is made to seek redistricting as discussed above in 5.2.5, include the following.

5.3.1 General Plan:

The General Plan for the City and County of Honolulu is a policy document that contains a "comprehensive statement of objectives and policies setting forth the long-range aspirations of Oahu's citizens and providing a broad plan of action to achieve them." Areas which are covered in the plan include, population, economic activity, housing, transportation and utilities, energy, physical development and urban design, public safety, health and education, culture and recreation, the natural environment, and government operations. The General Plan was first adopted in 1977 and has since been revised on five separate occasions, with the most recent revisions to the General Plan being adopted by resolution in January of 1989. Relevant objectives and policies of the General Plan are discussed below.

Economic Activity

Objective

- To promote employment opportunities that will enable all the people of Oahu to attain a decent standard of living.

Policies

- Encourage the growth and diversification of Oahu's economic base.
- Encourage the development of small businesses and larger industries which will contribute to the economic an social well-being of Oahu's residents.

Objective

- To make full use of the economic resources of the sea.

Policy

- Encourage the development of aquaculture, ocean research, and other ocean related industries.

Natural Environment

Objective

- To protect and preserve the natural environment.

Policies

- o Protect Oahu's natural environment, especially the shoreline, valleys, and ridges from incompatible development.
- o Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water recharge areas, distinctive land forms, and existing vegetation.
- o Require sufficient setbacks of improvements in unstable shoreline areas to avoid the need for future protective structures.
- o Protect the natural environment form damaging levels of air, water, and noise pollution.
- o Protect plants, birds, and other animals that are unique to the State of Hawaii and the Island of Oahu.

Objective

To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

Policies

- o Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, an bays; reefs and offshore islands.
- o Provide opportunities for recreational and educational use and physical contact with Oahu's natural environment.

Physical Development and Urban Design

Objective

- o To coordinate changes in the physical environment of Oahu to ensure that all new developments are timely, well-designed, and appropriate for the areas in which they will be located.

Policy

- o Locate new industries and new commercial areas so that they will be well related to their markets and suppliers, and to residential areas and transportation facilities.

Objective

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

Policy

- Foster the development of Honolulu's waterfront as the State's major port and maritime center, as a people- oriented mixed-use area, and as a major recreation area.

Objective

- To create and maintain attractive, meaningful, and stimulating environments throughout Oahu.

Policy

- Design public structures to meet high aesthetic and functional standards and to complement the physical character of the communities they serve.

Objective

- To promote and enhance the social and physical character of Oahu's older towns and neighborhoods.

Policy

- Seek the satisfactory relocation of residents before permitting their displacement by new development, redevelopment, or neighborhood rehabilitation.

Culture and Recreation

Objective

- Provide a wide range of recreational facilities and services that are readily available to all residents of Oahu.

Policies

- Develop and maintain a system of regional parks and specialized recreation facilities.

- Encourage the State to develop and maintain a system of natural resource-based parks, such as beach, shoreline, and mountain parks.

- o Encourage ocean and water-oriented activities that do not adversely impact the natural environment.

- o Encourage the private provision of recreation and leisure- time facilities and services.

- o Encourage the safe use of Oahu's ocean environments.

5.3.2 Primary Urban Center Development Plan:

The Development Plans (DP)s for the City and County of Honolulu, provide a relatively detailed framework for implementing the objectives and policies of the General Plan. They set forth desired sequence, patterns and characteristics of future development. A total of eight Development Plan regions have been established for Oahu. The area affected by the PLAN falls under the jurisdiction of the Primary Urban Center (PUC) Development Plan. Established as an ordinance the Development Plans consist of three elements: Common Provisions which outline requirements common to each of the eight regions; special provisions which detail requirements specific to a region; and the Development Plan Maps (Land Use and Public Facilities) which graphically depict the intended pattern and sequencing of development.

Special Provisions

Principles of the Special Provisions for PUC Development Plan which are relevant to the PLAN are as follows:

- o Major industrial centers and complexes shall be located near major transportation facilities such as Honolulu Harbor, the Airport, and H-1 Freeway. Areas designated industrial shall be isolated or buffered from other uses to avoid the negative impact of industrial uses.

- o Adequate amounts of recreational facilities and public parks shall be provided for active and passive recreation, particularly in areas where redevelopment or other activities create opportunities for new urban spaces.

The Special Provisions also detail urban design principles and controls for "special areas." Principles and controls which pertain to the PLAN include:

- o The height limit in the Airport area makai of Nimitz Highway and adjacent to Honolulu International Airport, bounded by Rodgers Boulevard on the west and Ke'ehi Beach Park on the east shall be the lesser of: 1) 160 feet; or 2) the height limitation as may be imposed by the Federal Aviation Administration.

- In addition to allowed uses for industrial land set forth in the Development Plan, air transportation and related uses including but not limited to offices, motels and hotels, food preparation, warehousing and storage, and commercial uses shall be permitted in the airport area.

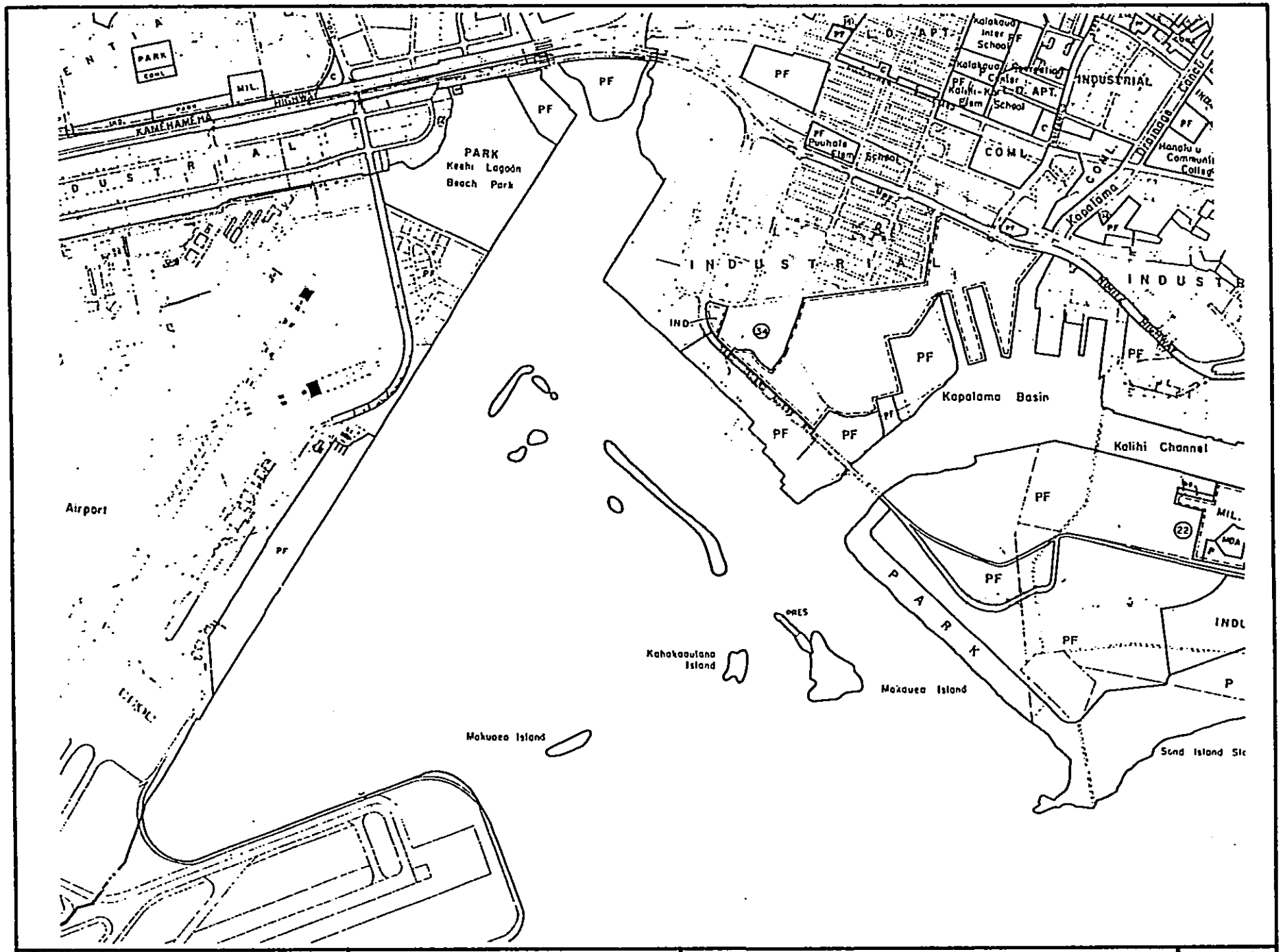
Existing DP Land Use Map

The current DP Land Use Map for the PUC designates all of the area along the western shore of Ke'ehi Lagoon from the proposed Hawaiian Canoe Center site to the Reef Runway for either Public Facility (PF) or Park use (see Figure V-3). On the eastern side of Ke'ehi Lagoon, Pier 60 and the Kalihi Kai area are designated for Industrial use. The remaining parcels along the eastern shore from the La Mariana Sailing Club to the southern tip of Sand Island are designated for Public Facility or Park use.

Possible DP Land Use Map Amendments

Because the PLAN represents a number of distinct "projects" which are intended to be implemented separately, the exact timing of these changes is unclear at this stage. If a decision is made to redistrict present Conservation Land Use Districts to Urban Designation, then DP amendments would probably be required to implement each "project" depending on whether it is developed as a public or private facility. Under the present proposal only a portion of the Hawaiian Canoe Center and the sheltered swimming beach at Sand Island will be constructed with public funds. The remaining improvement will be constructed with private developer funds under lease agreements with the State of Hawaii. Based on this proposal possible DP amendments are described below.

Hawaiian Canoe Center:	The private portion of this development located on the central land area adjacent to Nimitz Highway between Moanalua and Kalihi Streams could require a DP amendment from Public Facility to Commercial use.
Triangle Area:	Subsequent to the redistricting of the filled triangle area from Conservation to Urban, the Development Plan designation for this area would automatically become Preservation. In order to construct the proposed facilities, a DP amendment from Preservation to Public Facility, Park, Commercial and Industrial could be required. In order to permit flexibility in siting the commercial and light industrial activities proposed for the triangle area, a DP amendment to the Special Provisions for the PUC could be required to permit Industrial-Commercial Mixed Use, or Waterfront-Industrial Use development to occur in the area designated for commercial and light industrial.



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Development Plan Land Use Map,** **City and County of Honolulu**	FIGURE **V-3**

DP Public Facility Map

Figure V-4 presents the existing DP Public Facility Map for the area encompassed by the PLAN. Near the southwestern corner of the lagoon an airport transportation dock (T) (exact site undetermined) has been designated for commencement of land acquisition and/or construction within a six year period, beginning February 10, 1989. Along the northwestern end of Ke'ehi Lagoon, Ke'ehi Lagoon Park has been designated for park modification. Along the western side of Sand Island a corporation yard and a linear park have been designated for construction (refer to Section 3.3). Directly behind these planned improvements is an area designated for container facility improvements (CH/M) and sewage treatment plant modifications (EG/STP/M). A parts warehouse for the sewage treatment plant (GB) is also designated for this area.

Possible DP Public Facility Map Amendments

Based on the present proposal and if redistricting is sought, possible DP amendments are described below.

Canoe Race Course:	The proposed recreational improvements for the canoe race course in the northeast corner of Ke'ehi Lagoon could require a DP Public Facilities Map amendment to add a park/recreation expansion and modification symbol.
Pier 60 Marina:	The proposed marina improvements could require a DP Public Facilities Map amendment to add a recreation marina/commercial harbor symbol.
Lagoon Drive Marina:	The proposed marina improvements could require a DP Public Facilities Map amendment to add a recreation marina/commercial harbor symbol.
Triangle Area:	The proposed improvements could require a DP Public Facilities Map amendment to add symbols for a park and a recreation marina/commercial harbor.
Sheltered Beach:	The proposed sheltered swimming beach at the southwest tip of Sand Island could require a DP Public Facilities Map amendment to add a park/recreation symbol.

5.3.3 Zoning:

Zoning implements the purpose of the General Plan and the Development Plans and is required by statute to be in conformance with Development Plan designations. On Oahu, zoning is administered through two elements: the Land Use

Ordinance (LUO), a written text, which is intended to provide reasonable design and development standards for the use of land on Oahu; and twenty-four Zoning Maps which provide specific zoning designations for all land on Oahu under the jurisdiction of the City and County of Honolulu.

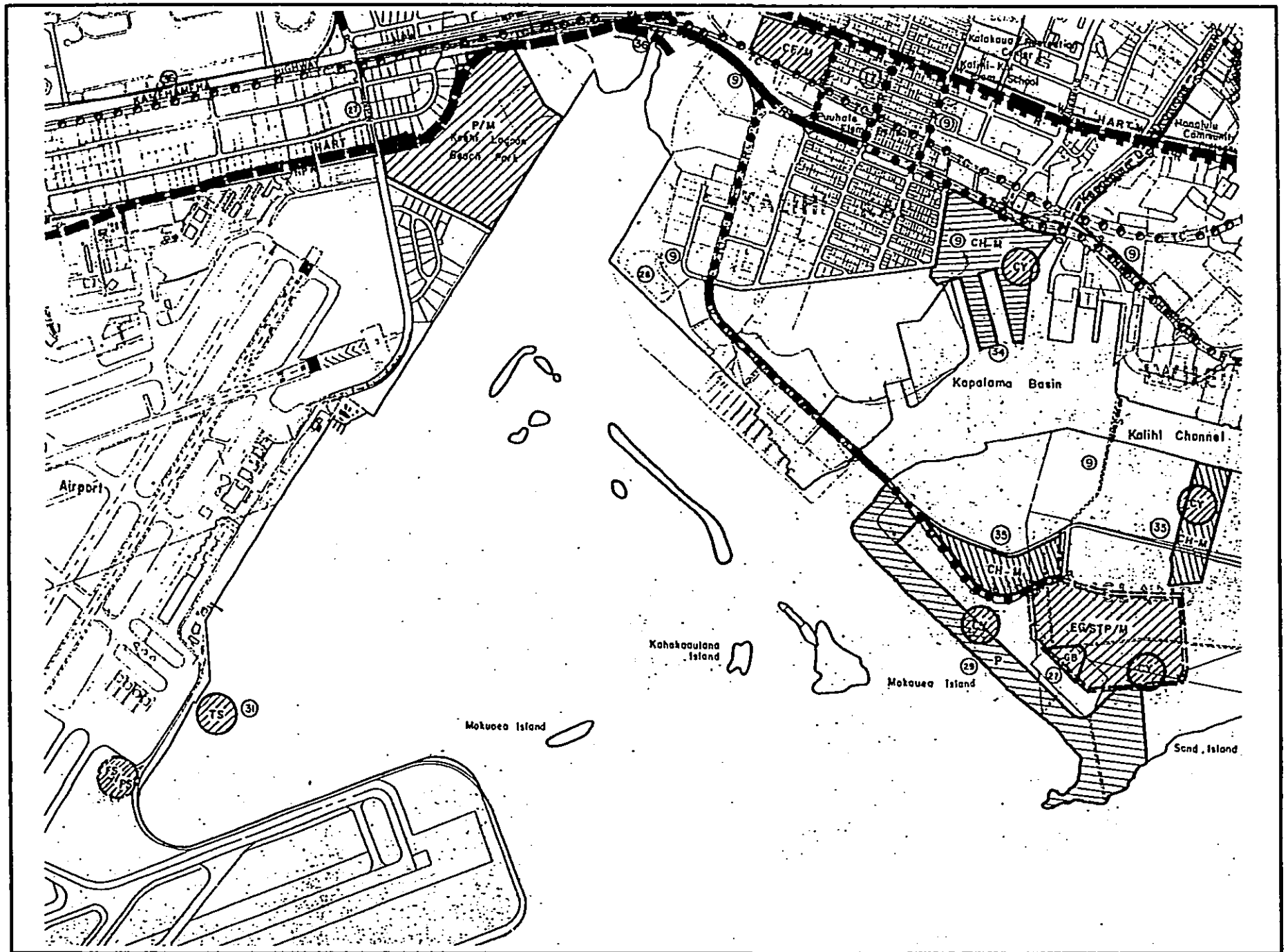
Existing Zoning

According to Zoning Maps 4 (Nuuanu-McCully) and 5 (Kalihi- Nuuanu), the majority of the area surrounding the Honolulu International Airport on the western side of Ke'ehi Lagoon is zoned for Intensive Industrial purposes (I-2) (see Figure V-5). The land area from Ke'ehi Lagoon Park to the site of the proposed Hawaiian Canoe Center is zoned for General Preservation (P-2). Land located on the Kalihi Kai side of Ke'ehi Lagoon from Nimitz Highway to Kalihi Channel is designated for a variety of industrial uses including, Intensive Industrial (I-2), Industrial Mixed Use (IMX-1) and Waterfront Industrial (I-3). The area along the Ke'ehi Lagoon side of Sand Island is designated for General Preservation (P-2).

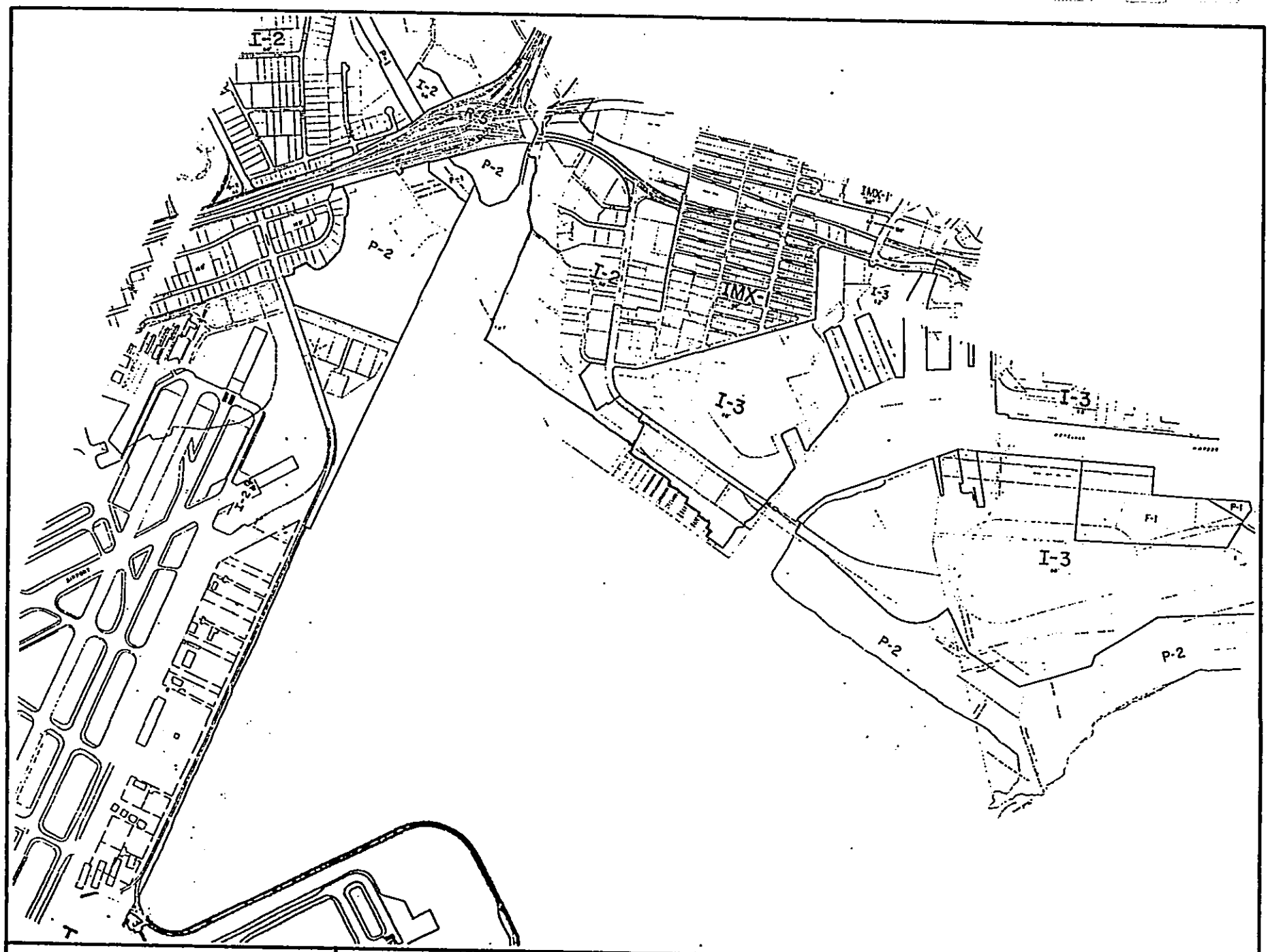
Possible Zoning Amendments

As with the possible Development Plan amendments discussed above, the exact timing of or necessity for these changes is unclear at this stage. Zoning amendments required to implement each "project" would depend on whether it is developed as a public or private facility. Based on the present proposals, possible zoning amendments are described below.

Hawaiian Canoe Center:	The private portion of this development located on the central land area adjacent to Nimitz Highway between Moanalua and Kalihi Streams could require a zoning amendment from General Preservation (P-2) to a Community Business District (B-2).
Pier 60 Marina:	Marina improvements at Pier 60 could require a zoning amendment from Intensive Industrial (I-2) to Waterfront Industrial (I-3).
Lagoon Drive Marina:	Marina improvements at the proposed Lagoon Drive Marina site could require a zoning amendment from Intensive Industrial (I-2) to Industrial Mixed Use (IMX-1).
Triangle Area:	The proposed improvements for the triangle area could require a zoning amendment from General Preservation (P-2) to Industrial-Commercial Mixed Use (IMX- 1).



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Development Plan Public Facility Map, City and County of Honolulu**	FIGURE **V-4**



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Zoning Map, City and County of Honolulu**	FIGURE V-5

5.3.4 Special Management Area (SMA)

In accordance with the State Coastal Zone Management Program (Chapter 205A-21, H.R.S.), the City and County of Honolulu is charged with designating and administering Special Management Areas (SMA)s for the island of Oahu. Figure V-6 shows the SMA boundary for the area which will be affected by the PLAN. Under Chapter 205A-21, any "development", as defined by law, determined to be within the SMA boundary requires a Special Management Area Use Permit (SMP) from the City and County of Honolulu Department of Land Utilization (DLU) prior to commencing with the project. An SMP will be required for development of the: Lagoon Drive Marina, Hawaiian Canoe Center improvements, Pier 60 Marina and the sheltered swimming beach. An SMP will not be required to fill the triangle area. However, once filling is completed, the new land area would be located within the SMA and may require issuance of an SMP prior to any further development being undertaken if the land is redistricted from conservation to urban. In reviewing the development proposed by the PLAN, DLU would be guided by:

- The project's impact on access to publicly owned or used beaches, recreation areas and natural reserves;
- Whether adequate and properly located public recreation areas and wildlife preserves are reserved;
- Whether provisions are made for solid and liquid waste management;
- The extent to which alterations to existing land forms and vegetation will adversely affect water resources, scenic and recreational amenities and the potential for floods, landslides, erosion, siltation, or failure in the event of an earthquake;
- Cumulative impact of individual developments; and
- Whether it is consistent with the General Plan and zoning.

Issuance of an SMP is required, by statute, to precede any other permit approval.

5.3.5 Shoreline Setback:

Chapter 205A, H.R.S. establishes a shoreline setback area of 40 feet inland from the upper reaches of the wash of the waves. All construction proposed within this setback area would require issuance of a Shoreline Setback Variance (SSV) from the City and County of Honolulu Department of Land Utilization. An SSV could be required for development of the Lagoon Drive Marina, Hawaiian Canoe Center improvements, Pier 60 Marina and sheltered swimming beach. An SSV could also be required for development of the triangle fill area subsequent to redistricting. Processing of an SSV is concurrent with an SMP.

5.4 PREVIOUS FEDERAL/STATE AGREEMENTS REGARDING KE'EHI LAGOON

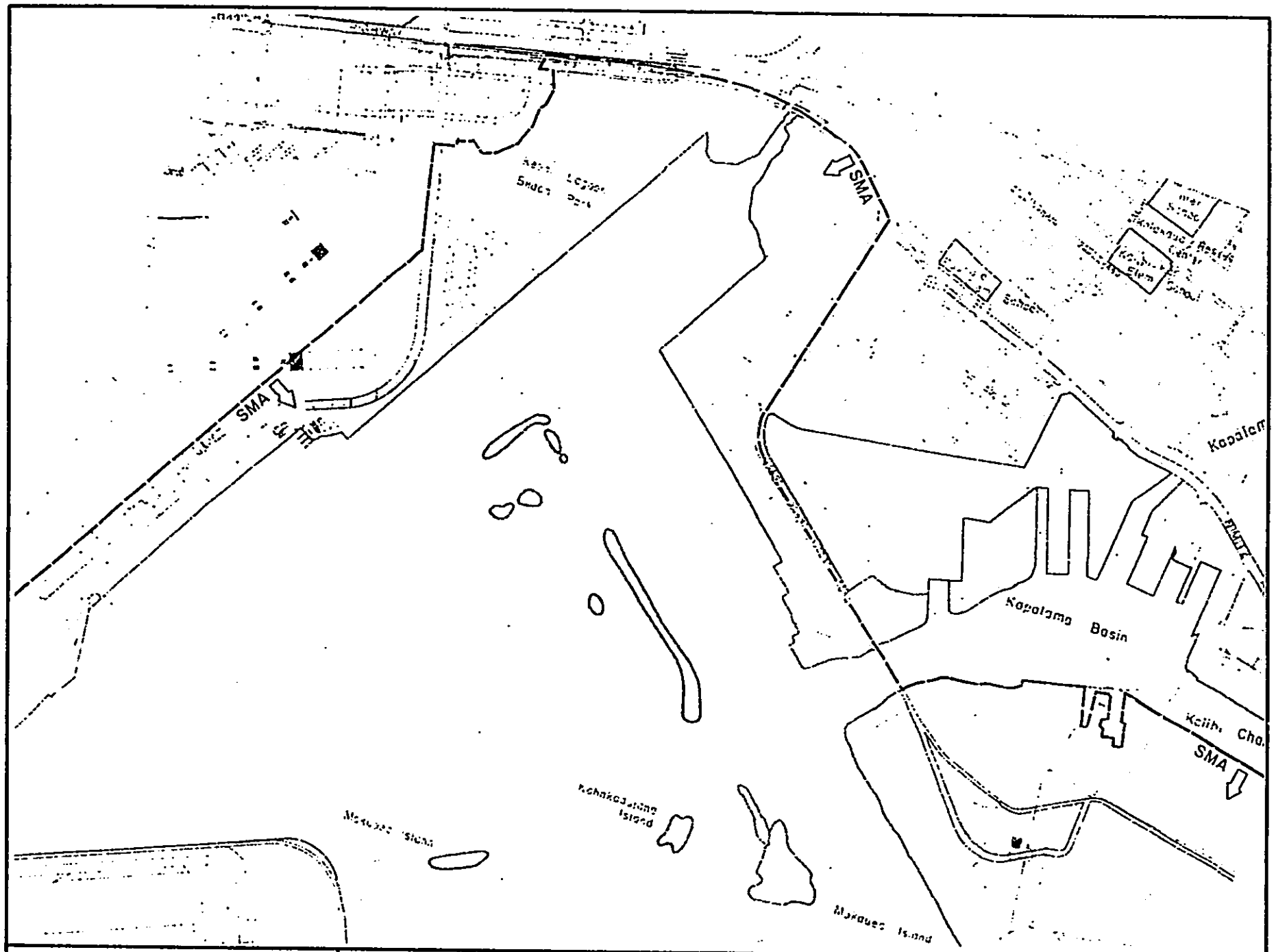
Two letters of understanding regarding Ke'ehi Lagoon were promulgated by actions proposed by the State in the past 20 years. The first was promulgated by the proposed Reef Runway construction, and the second by the granting of a long-term land lease of Mokauea Island to the residents of the island.

Reef Runway

In a letter dated April 13, 1972 from the U.S. Department of the Interior (DOI) to the Federal Aviation Administration (FAA) and the State Department of Transportation (DOT), three items were clarified following joint meetings held to resolve DOI concerns arising from the proposed Reef Runway project. The first item was whether the lagoon, if it were to remain within the periphery boundaries of HIA and thus within the jurisdiction and control of the FAA, could continue to be utilized and developed for recreational purposes. DOI's impression was that the FAA considered recreational use of the lagoon as incompatible with airport uses. The letter clarifies the intent and policy of the FAA to not only permit recreational use of the lagoon, but to actively encourage such use, acknowledging the limitation that any recreational use must not physically interfere with airport facilities. Further clarification from the FAA was also noted that even though the lagoon is physically within the airport boundaries, the lagoon is actually managed and controlled by the DOT. Based on the DOT's statement that it had primary responsibility and authority to develop bay facilities for recreational purposes and it was their intent to do so in Ke'ehi Lagoon, the DOI agreed to withdraw their suggestion that the lagoon be deleted from the airport boundaries.

The second item concerned the substitute stilt habitat areas set aside in Pearl Harbor for mitigation of the Reef Runway project. The letter clarifies the intent of the Navy to relinquish the substitute areas so that they would be available at or about the time destruction of the primary areas occur in Ke'ehi Lagoon. The letter also clarifies the agreement by the DOI Bureau of Sport Fisheries and Wildlife to accept the responsibility to manage these areas as satellite refuges within the National Wildlife Refuge System.

The third item concerned the request of the FAA and DOT that the Corps of Engineers issue one permit which would cover the entire project, rather than two permits covering the project in two increments. The letter clarifies the agreement that the Corps would issue one permit covering the complete project with the proviso that the permit contain not only a clause requiring specific compliance with current environmental considerations, but also provide for additional review at any future time prior to completion of the project if substantial changes in circumstances so warrant.



EDWARD K. NODA & ASSOC., INC.	HARBORS DIVISION DEPARTMENT OF TRANSPORTATION State of Hawaii	KE'EHI LAGOON RECREATION DEVELOPMENT PLAN **Special Management Area Boundary, City and County of Honolulu**	FIGURE **V-6**

Mokauea Island

In a memorandum dated March 22, 1978 from State Senator Jean King to the U.S. Fish and Wildlife Service (USFWS), the Mokauea Fishermen's Association, the State Wildlife Branch, and the Governor's Office, several items were confirmed following a meeting held to resolve concerns arising from the granting of a lease of Mokauea Island to the Mokauea Fishermen's Association. The USFWS had expressed concerns regarding potential resources losses due to this action. The memorandum confirms the understandings reached:

"1. U.S. Fish & Wildlife will write a letter within a day or so to the Federal Aviation Administration stating they have no objection to the leases being granted to the current residents of Mokauea Island.

2. The State Wildlife Branch will include in their proposal to the Board of Land and Natural Resources the following provisos:

   a. The entire area of Keehi Lagoon will be for recreation and wildlife.[31]

   b. There will be no structures on any of the islands other than Mokauea.

   c. There will be a Manana Island type of kapu prohibition for the mudflats facing Mokauea Village.

3. Further, the State Division of Wildlife will continue to work toward establishment of seabird wildlife sanctuaries on the Leeward side of Oahu.

4. The Mokauea Village residents pledge their support at the hearing before the Board of Land and Natural Resources on the proposal presented by the State Wildlife Branch."

Both letters described above clarified certain understandings reached with respect to proposed actions, based on the circumstances prevailing at that time and the mitigation for the proposed actions. Similarly, based on the present findings, it is the Department of Transportation's intent to pursue new agreements and understandings regarding mitigation for the proposed PLAN. Changed conditions, circumstances, and needs since the dates of the correspondance have justified the recent re-evaluation and update to the Ke'ehi Lagoon Recreation Plan. Federal concerns regarding resource loss and other regulatory issues will be resolved within the context of the Corps of Engineers permit action.

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[31]Note that only the three offshore islands in Ke'ehi Lagoon (Mokauea, Harris, and Mokuoeo Islands) are presently classified in the Protective subzone in Conservation District. These islands are not directly affected by the PLAN. All other conservation lands in Ke'ehi Lagoon are located in the Resource subzone.

Chapter VI

Alternatives to the Proposed Action

CHAPTER VI:
ALTERNATIVES TO THE PROPOSED ACTION

6.1 PLANNING GOALS AND OBJECTIVES

In order for an alternative to the proposed PLAN to be considered it should meet the major goals and detailed PLAN objectives stated in Chapter I. These goals and objectives also form the basis for the general site selection criteria stated below.

6.2 SITE SELECTION CRITERIA

In order to meet the two major goals and the detailed PLAN objectives, a variety of alternative sites were considered. This process consisted of testing each site against a set of evaluation criteria which were established for the purpose of comparing each site against the others. The criteria are discussed below.

- Proximity to protected ocean waters. In order for most harbors in the Hawaiian Islands to be available for use during a majority of days in the year, their entrance channels and near-shore ocean waters should be in the lee of the island to provide some protection (from the normal tradewind waves and storm winds and waves which tend to approach from a north or northeast direction). This siting criterion permits smaller craft to enter or exit a harbor with a modicum of safety and frequency which is especially critical if the benefits of construction are to outweigh the costs of a new harbor. Haleiwa Harbor on the north shore of Oahu is an example of a northerly exposed harbor which does not meet the above criterion. Hilo Harbor, on Hawaii, although exposed to the north represents an unusual geophysical setting where a wind shadow condition exists nearshore even though there is fairly direct exposure to north Pacific storm waves. The wide and deep harbor entrance also provides a calmer entrance and exit condition. Ala Wai Harbor, on Oahu, provides access to calmer nearshore conditions in the lee of the island.

- A protected body of water such as a lagoon, estuary or embayment. This criterion fills two needs. The first is for safe and easy water use and access in which people may practice or enjoy calm water boating or recreation. The second is to provide extensive areas for wet storage of larger boats (over, say, 28 feet in length), for docking of larger vessels, for mooring and for cargo handling at piers. Because of Hawaii's geology, there are few areas along the coastline which are naturally, or which may be artificially, protected from deep ocean waves and storms. Furthermore, the steep dropoffs from shore and the lack of a continental shelf generally prohibits the construction of large offshore breakwaters. This is the reason for construction of inland harbors such as at Barbers Point on Oahu which was formed by excavation from the land.

- Proximity to population centers and boaters. This criterion meets the existing needs of the vast number of ocean recreators and boaters because of the large numbers of residents and visitors. Also, population centers already have developed infrastructure which can more easily accommodate access to transportation facilities and utilities for lower development costs per user. There has been an increasing and unfilled demand for ocean recreation and ocean commercial land and water areas due to the growth of Hawaii's population and of tourism, the major industry of the State. The largest demand is on the Island of Oahu, where about 80 per cent (about 900,000 persons) of the State's population lives and where about 90 percent of the State,s 6,000,000 visitors annually visit. This criterion required that a site on the Island of Oahu, and in and within a reasonable travel distance from the Honolulu Metropolitan area be sought.

- Area of adequate size. For a site to be considered it must have adequate size in order to accommodate the proposed uses. It is not feasible to disaggregate the proposed uses into significantly smaller units and then allocate them to sites which could only accept small-scale activities. Disaggregation causes loss of critical mass and economy of scale (see discission in 6.4) so that the goal of obtaining private financing and development cannot be met.

- Water quality standards of Class A. This standard permits recreational uses, which would not be permitted in Class B waters. The Class A standard implies waters of high quality which are safe for swimming, but not so high that the site selection process would threaten estuarine areas or embayments which have extensive natural values and which are designated as Class AA. Class AA waters are considered pristine and are not well suited for development because of this designation. This criterion eliminated from consideration sites such as Kaneohe Bay which has suitable protection by a natural fringing reef, but the Class AA rating of its waters precludes the development of extensive marinas or the construction of landfills or shoreline alterations.

- Consistency with federal, state and county plans. The activities and uses proposed should be generally consistent with federal, state and county plans for a site. This implies that the proposed PLAN would generally be harmonious with the existing or planned land or water uses.

- Acceptable to land owners and land users. The proposed PLAN must be acceptable to land owners and land users at the site. For example, areas within Pearl Harbor might be technically suitable as protected bodies of water. However, the land owner and land user there is predominantly the U.S. Navy who will not allow ocean recreation or commercial uses to commingle with military use of the navigation channels, water areas and surrounding land areas (the Navy is the dominant land owner).

o Contribute to environmental values. The proposed PLAN must not damage environmental values which may exist at a selected site and if damage may occur, there must be reasonable mitigation measures included in the PLAN. The PLAN should contribute to improving the environmental quality of the site as well as benefiting the human environment.

6.3 ALTERNATIVE SITE EVALUATION

Table VI-1, Alternative Site Evaluation, which lists the alternative sites and the site evaluation criteria, shows which of the alternative sites met or did not meet the selection criteria. These sites were chosen for evaluation for a number of reasons. First, a large number of sites on Oahu were identified for consideration. This is because Oahu is the center of population within the State with the vast majority of residents, boaters and visitors. No site on Oahu with any physical possibility of selection was omitted from the process.

TABLE VI-1

Alternative Site Evaluation

Site Selection Criteria	Ala Wai Harbor	Haleiwa Bay	Kaneohe Bay	Keehi Lagoon	Maunalua Bay	Neighbor Island	Pearl Harbor	Waimanalo Bay
Proximity to Protected Ocean Waters	X		X	X	X	X	X	X
Protected Body of Water	X	X	X	X	X	X	X	
Proximity to Population Centers	X		X	X	X		X	X
Area of Adequate Size		X	X	X	X		X	X
Class A Water Quality Standards	X	X		X	X	X	X	X
Consistency with Existing Plans				X				
Acceptable to Land Owners and Users				X				
Contribute to Environmental Values				X				

Notes: 1) X means the site meets the criterion.

Second, an unspecified neighbor island site was also evaluated, even though any were far from the major population centers. This was done because if a suitable site on a neighbor island had emerged, it might have been possible to consider it for some type of development to partially meet the two main goals or the detailed PLAN objectives. However, it should be noted at this time that no site on the neighbor islands was identified as having any likelihood of being developed in a significant fashion. This is partly because of the physical lack of suitable sites for harbors of any magnitude, and also because of environmental concerns affecting both construction in Class AA waters which have significant coral resources and because of concerns focused on whale conservation which particularly affects sites on West Hawaii, Maui, Kauai and Molokai. The evaluation process is described below.

- Ala Wai Harbor. The site was evaluated because it is an existing harbor which physically could be expanded and it is near the major population center of Honolulu. It is currently the harbor which serves as a base of operations for ocean yacht races. It failed to meet 5 of the 8 criteria. The site is surrounded by existing parks and hotels. There is no possibility of shoreside development to support the required infrastructure. Landfills offshore have been proposed in the past, but due to conflicts with popular surfing sites, have been always rejected by the community. Construction at this site would require extensive dredging of popularly used reef and surf zones where the water quality is Class AA. Existing plans would not permit the commercial/industrial areas intended in the overall project which are requisite to its financial support. The proposed PLAN would not be acceptable to hotel owners who believe that the present plan for resort-hotel use has a much higher economic return. The proposed PLAN would not contribute to environmental values except in-so-far as additional recreational boating opportunities would be provided.

- Haleiwa Bay. This site was evaluated because there is an existing small craft harbor, there is surrounding land of relatively lower cost than the Ala Wai area, and it would be technically feasible to expand the protected harbor boundaries seaward, although at a fairly high cost because of the northern exposure of the site and the deeper waters seaward. The site did not meet 5 of the 8 criteria. First, Haleiwa Bay has a northern exposure and the nearshore waters are rough and unpredictable. The conditions there would yield a very few number of hospitable operational days for small craft. Haleiwa is also a long (about one hour) and inconvenient drive for the majority of residents and visitors on Oahu. Development of the proposed PLAN would be inconsistent with existing planning which calls for the area to remain largely residential. As such, the proposed PLAN would not be acceptable to the numerous residential landowners in the area. The proposal would not contribute to the environmental values of the area which has a relatively undisturbed and natural coastline hosting a variety of coastal

recreational activities including surfing, swimming, beach-going, and sightseeing.

- o Kaneohe Bay. This site was considered because it is close to Honolulu and is well protected. It met 4 of the 8 criteria. The bay is designated as Class AA water quality standards, because it is one of the most significant areas in Hawaii with its numerous patch reefs and extensive coral growth. Implementation of the proposed PLAN to dredge, fill or promote major ocean-related development at this site, which is also primarily a residential area, would be inconsistent with existing plans. The proposed PLAN would not be acceptable to either major, or individual small parcel, landowners. This includes a large parcel of land, on Mokapu Peninsula, Kaneohe Marine Corps Air Station, which is owned by the federal government. Any major construction in Kaneohe Bay would not contribute to environmental values.

- o Keehi Lagoon. Keehi Lagoon, the selected site, was evaluated because it is a large area near metropolitan Honolulu and has long been the site of ocean recreation and water dependent commerce and industry including recreational and commercial berthing facilities, boat repair yards, marine stores, and marine cargo piers. The site is close to protected leeward ocean waters and it is a large protected body of water with Class A standards. There have long been plans to upgrade existing and develop new facilities, both for ocean recreation as well as for commercial maritime facilities. The proposed PLAN would be acceptable to land owners, and to most users. On an overall basis, the proposed PLAN appears to contribute to the environmental values of the area by meeting the need for new and improved ocean recreation and marine economic opportunities. No significant adverse environmental impacts are likely and mitigation measures are feasible in areas where there could be disagreement (for example, the loss of reef/mud flat).

- o Maunalua Bay. This Hawaii Kai site was evaluated because a new, fairly large, marina and passenger ferry landing have been proposed in addition to the popular boat launching ramp. The site is near metropolitan Honolulu and is relatively protected by a fringing reef which opens out into Maunalua Bay, in protected Class A leeward waters. The site met 5 of the 8 criteria. It was not selected because the proposed PLAN would be inconsistent with existing plans which call for largely residential development in the area. There is no provision in these plans for development of commercial and industrial areas of the size required to assist in payback of the financial needs of the overall proposal. Furthermore, the proposed PLAN was unlikely to meet with the approval of the numerous residential lot owners or with the large estate which is the dominant land owner.

- o Neighbor Island. Although the neighbor islands were considered in the early part of the investigations, no site was found to meet a significant number of the criteria. The remoteness from the area of need, the major

population center of Honolulu, caused rejection of any potential neighbor island site.

- Pearl Harbor. Pearl Harbor met 5 of the 8 criteria and is an attractive site from a physical standpoint. The dominant land owner and user, the U.S. Department of Defense, would not accept the proposed PLAN. The PLAN is not consistent with existing Pearl Harbor development plans of either the federal or local government. The site also hosts the major breeding, nesting and feeding habitats for waterbirds on the west of Oahu and for this reason alone it is unlikely that the proposed PLAN would contribute to environmental values.

- Waimanalo Bay. This site met 4 of the 8 criteria. It is not an especially well protected body of water and major dredging, filling and breakwater construction would be required. Such work would be inconsistent with existing plans which designate the area as a natural recreation area which has great beauty and is predominantly residential or open space in use. There are numerous land owners of small residential parcels. Both they and the large landowners (U.S. Air Force and the Hawaiian Homes Commission) and would not accept the proposed commercial and industrial uses.

On the above basis, Keehi Lagoon was selected as the site which met the most number of site selection criteria and which would fulfill the overall goals and the detailed PLAN objectives as previously described.

6.4 THE ALTERNATIVE OF DISAGGREGATION OF PLAN COMPONENTS

Disaggregation of project components to several sites was evaluated as a means of reducing the scope, size and site requirements of the proposed PLAN. Disaggregation would have placed one or several of the main project components at different sites. (Disaggregation does not imply partial implementation or phased implementation of components of the PLAN.) Disaggregation of capital improvements has long been a mainstay of State of Hawaii infrastructure planning with the goal of providing a base for economic development. In the case of the proposed PLAN, however, the goals are not economic development, but rather to meet increasing needs for ocean recreation and ocean commercial/industrial facilities near the major population centers and to finance this with private capital. The significant difference here is that the present project is intended to be self-financing and, although there will be economic benefits (in the form of employment and gross excise taxes) from these planning goals, the concept differs from the past in which the State has always provided infrastructure development through capital improvements programs subsidized by taxes rather than private capital.

For example, disaggregation of capital improvements has been especially important in building-up areas of the State which had no infrastructure so that

economic development could occur. In these cases, the State funded, through tax revenues, the construction of capital improvement infrastructure such as roads, airports, ports, water and sewer systems. This technique of using CIP infrastructure was especially important in the development of the neighbor islands where State planning goals have long been to encourage economic growth. Today, in 1989, economic growth is generally considered to be presently ongoing throughout the State, largely through private capital, and without the requirement of government stimulus. However, coupled with that economic growth, particularly on Oahu, is an increasing need for ocean recreation facilities and ocean commercial/industrial areas.

There are two features of the proposed PLAN which work against disaggregation. The first is critical mass. If a sufficient number of ocean-related activities and uses can be clustered in a single location, users (or customers) will be attracted in sufficient numbers to provide reasonable payback of private investment costs. The second feature is economy of scale. The costs of infrastructure and universal services to the ocean-related uses will be less on a unit cost basis than if the various uses were disaggregated to disparate sites. Economy of scale coupled with critical mass serves to make the developments proposed at Keehi economically feasible so that private investment sources can act as the principal developers, under the guidance of the State Department of Transportation. These concepts are crucial to meeting the two basic goals of the PLAN under consideration in this EIS.

The alternative of locating non-water dependent activities (i.e. related to airport needs) on existing land areas outside of Ke'ehi Lagoon is not a viable alternative for two reasons. The first is proximity to the airport. Businesses and activities which directly support the airport need to be situated adjacent to the airport from a functional and operational standpoint. While uses which are not aviation related can be sited in vacant industrial/commercial areas distant from Ke'ehi Lagoon with possibly only minor economic consequences, uses which directly support the airport must be able to respond to the airport operations in a timely and efficient manner. The second reason is lack of vacant space adjacent to the airport for expansion. As discussed in Section 3.2.4, airport expansion needs have led to the State's initiating action to acquire private lands adjacent to the airport, which would displace many existing businesses. Because of the lack of vacant commercial/industrial space in metropolitan Honolulu to satisfy demand, there will be significant social and economic impacts to the community as well as to the businesses to be dislocated. It is apparent that additional acreage will be needed in the future to support the airport. Ke'ehi Lagoon is under Governor's Executive Order (G.E.O.) 3202 to the Department of Transportation, Airport and Harbors. Development of the lagoon for airport and maritime uses is therefore consistent with the G.E.O. and would result in least social and economic impacts to the community.

6.5 THE ALTERNATIVE OF RECONFIGURATION WITHIN KEEHI LAGOON

The alternative of reconfiguring the PLAN components within Keehi Lagoon was evaluated with respect to the planning constraints, goals and the detailed PLAN objectives. The factors constraining planning at Keehi Lagoon include: (1) the high noise environment, (2) the building height limitations and (3) the airport clear zones. Any alternatives proposed must be practicable within the confines of these existing constraints.

Reconfiguration would involve relocation of various PLAN components to alternate sites in Keehi Lagoon. The following discussion evaluates key siting factors for each of the PLAN components and examines the feasibility of relocation.

- Hawaiian Canoe Center - The Hawaiian Canoe Center has two principal components: The race course improvements and the ancillary support facilities. The canoe racing lanes are located in Seaplane Runway A, adjacent to the existing Keehi Lagoon State Park. The racing lanes are sited here because of the favorable wind direction. This has become a popular canoe racing area and Canoe Clubs presently use the park for staging and storage of canoes. When events are held, the park hosts visitors for shoreside viewing, a key feature of canoe racing. Shoreside improvements on both sides of the race course will provide for visitor parking, canoe trailer parking, launch areas, a grandstand and comfort stations. The second component of the Center is a complex of structures to be constructed on a peninsula of land located at the confluence of Kalihi and Moanalua Streams, at the north end of Seaplane runway A. The structures will include a visitor complex which is intended to generate revenues to support the costs of developing and operating the Center.

  The racing course and the ancillary support facilities are an integral package of facilities which are advantageously located at the proposed sites because of (1) the existing availability of Keehi Lagoon Park and the opposite shore for both parking and viewing, (2) the lower aircraft noise climate at this site than for others (this is beneficial to the visitor center which is necessary to partially finance the entire Canoe Center), (3) the close physical relationship of the canoe racing lanes and the support area located on the peninsula, (4) the location of the racing lanes away from power boat channel traffic, and (5) the proximity of the proposed visitor center to the main Airport - Waikiki route which is advantageous to tapping the visitor market. The proposed PLAN implements the long accepted Keehi Lagoon Recreation Plan of 1977, a plan which canoe clubs and the State have semi-formally implemented from that time to the present. An alternative site is the Seaplane Runway "D" and adjacent Sand Island shoreline that is planned for future park improvements as part of the Sand Island State Park. However, this alternative site is not acceptable because (1) the wind direction is not favorable for the orientation of the canoe racing lanes, (2) the shoreside support facilities would interfere with passive park use, and (3) the Kalihi-

Palama community prefers passive park activities for this Sand Island Park extension. For the above reasons, there is no acceptable alternate site in Keehi Lagoon for the Hawaiian Canoe Center.

- Pier 60 Marina - Like the Hawaiian Canoe Center, the Pier 60 Marina has long been part of the 1977 Keehi Lagoon Recreation Plan. One reason the Pier 60 Marina has been sited there is because of the compatibility with existing marinas along this shore and adjacent land uses which are predominantly commercial and light industrial. Another reason is that the boat routes through Keehi Lagoon to the ocean are well established in Seaplane Runway D. The only other site in Keehi Lagoon which would be suitable for a new Marina development would be the area along Lagoon Drive where the Lagoon Drive Marina is proposed. The Pier 60 Marina can be developed in a relatively shorter time frame than the Lagoon Drive Marina and will alleviate some of the present demand for boat slips in the short-term. Development of a marina at Pier 60 is consistent with the recreational boating activities in the adjacent waterways and would remove the present hazardous mix of commercial barge traffic with recreational small craft traffic and anchorages. For these reasons, there is no suitable alternate site in Keehi Lagoon for the Pier 60 Marina.

- Lagoon Drive Marina - In the original Keehi Lagoon Recreation Plan (1977), the narrow strip of land between Lagoon Drive and Keehi Lagoon's Seaplane Runway A was designated as a shoreline strip park. The park was never developed. The area is now ill-suited to a strip park because of the limited land between the shoreline and Lagoon Drive where there is no vacant space for parking and the public access would therefore be extremely limited. For this reason, in order to meet the demand for recreational small craft berths, a marina is proposed at this location. As mitigation for the loss of a much needed shoreline park, a new park site at the west apex, and along the south and east sides, of the Triangle Development area are proposed as part of the present PLAN. The Lagoon Drive site is ideal for a marina because the activities proposed there are more compatible with traffic along Lagoon Drive and the commercial and light industrial nature of the airport subdivision directly across Lagoon Drive. There is no alternate site in Ke'ehi Lagoon that can provide the same capacity of boat slips as the Lagoon Drive Marina. A ferry terminal is also compatible with the marina development at this site.

- Sheltered Swimming Beach -- This Beach rectifies an omission in the 1977 Recreation Plan which did not take into account the need to provide a proper ocean swimming area for families with children. The proposed Beach is sited adjacent to Sand Island State Park . It is nicely sited close to the fresh ocean waters which will provide good flushing and a very clean place to swim. There is no alternative location in Keehi Lagoon which can provide the safety and ocean cleanliness required for children to swim than this site.

- Triangle Development -- The Triangle Development area as presently configured takes advantage of the existing bottom depths there by siting boat basins in the previously dredged areas and filling over the shallow rubble reef/mud flats. This proposal minimizes costs and environmental impacts of dredging and filling. Reconfiguration of water or land based PLAN components within the Triangle is not financially or environmentally feasible. Relocation of the activities proposed for the Triangle Development is not possible for the following reasons. (1) There is no available space remaining in Keehi Lagoon for the water dependent components of the proposed PLAN. (2) The only non-water dependent component is the proposed Commercial/Light Industrial Space intended for aviation use in support of the Honolulu International Airport. Because of the present expansion of HIA, there is no land available for relocation of this component. (3) The landfill component of Commercial/Light Industrial Space which will support both maritime and aviation uses is financially irreplaceable because revenues from it are intended to finance the non-revenue producing public components of the PLAN. There are no alternate sites for the Triangle Development.

6.6 THE ALTERNATIVE OF NO ACTION

This alternative was not selected because it did not fulfill the planning goals. Furthermore, the analysis of significant impacts in Chapter IV shows that there are no significant adverse impacts which cannot be successfully mitigated.

Chapter VII

Relationship Between Local Short-term Uses of the Environment and Maintenance and Enhancement of Long-term Productivity

CHAPTER VII: RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of the PLAN will result in a long-term environmental and economic gain for the community and the State of Hawaii. The project involves the construction of major recreational, educational/research, commercial, and industrial infrastructure improvements on fast, tidal and submerged lands to support and encourage economic growth. Once developed, Ke'ehi Lagoon will serve as a major marine recreation and education area for the island of Oahu, and will be the center of the State's effort to host international and regional yacht racing regattas. A portion of the reclaimed land area in the center of the lagoon will also provide infrastructure and improvements to supplement the critical shortage of waterfront and airport industrial and commercial land.

7.1 SHORT TERM LOSSES

A number of short-term losses will occur during the project construction phase. Any vessels anchored or moored in the areas proposed for development will be required to move to alternative locations during construction. It is anticipated that the installation of mooring buoys within the authorized mooring area and implementation of the mooring rules and regulations will be completed prior to construction of the PLAN. If this action is not completed prior to plan construction, then temporary relocation of vessels to other areas of the lagoon during construction will be coordinated by Harbors Division.

In some areas, access to portions of the lagoon and its shoreline will be temporarily limited during construction. This includes access to the canoe race course during construction of certain phases of the Canoe Complex. Alternative canoe racing sites may have to be used. Navigation access between the Kalihi Channel and existing boating facilities within the lagoon will not be obstructed during construction of any components of the PLAN. However, boating access to all areas within the limits of construction will be precluded during construction activities. Phasing of construction of the individual projects under the PLAN will mitigate impacts to existing uses.

The turbidity of Keehi Lagoon's waters will increase while dredging and filling activities are underway. This could result in the short- term disturbance of the nehu sites (e.g. bait fish). However, in the long-term it is expected that these sites would be restored through a natural flushing and resettling process.

Additional short-term impacts include the increased generation of noise, fugitive dust and disruption of traffic. Air quality within close proximity to the construction activity will also be reduced.

7.2 LONG-TERM LOSSES

Some long-term losses related to the PLAN's implementation also exist. Unauthorized residents living on the land area adjoining the triangle and water-ski course and on derelict vessels in the lagoon will be displaced.

The sand and gravel operations at Pier 60 that supports the nearby concrete batch processing plant will be displaced. A number of other industrial warehouse facilities on the shore of Ke'ehi Lagoon, adjacent to the Pier 60 area, will also be displaced.

Development of the triangular reef flat area will result in the loss of feeding and resting habitat for the endangered Hawaiian Stilt and several species of migratory water shorebirds. Filling of the triangle reef flat, Lagoon Drive marina and sheltered swimming beach at the southern tip of Sand Island will result in the loss of existing benthic organisms. Filling for the sheltered swimming beach will also result in the elimination of this area as a limu collection site.

The presence of additional maritime, commercial and industrial users in the area may result in additional point-source and non-point source pollution of the lagoon's waters.

7.3 LONG-TERM PRODUCTIVITY

The long-term productivity of the PLAN will offset these adverse environmental consequences. The long-term productivity of the PLAN includes:

1) Increase in the number of available waterfront recreational areas in metropolitan Honolulu for residents and visitors;

2) Encouraging the development of a maritime recreation industry in Hawaii by the provision of a "world-class" facility for hosting international and regional boat racing regattas and other ocean sports events;

3) Providing infrastructure and improvements to support Honolulu Harbor functions and expansion needs;

4) Providing infrastructure and improvements to support Honolulu International Airport functions and expansion needs;

5) Providing improved facilities for accommodating existing water sports activities in the lagoon; and

6) Supporting ocean research and education activities.

Chapter VIII

Irreversible and Irretrievable Commitments of Resources

CHAPTER VIII: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementation of the PLAN will result in an irreversible commitment of investment capital, labor, and construction materials. Once completed, the facilities will remain there for the life of the project. The proposed dredging and filling operations will also result in an irreversible commitment of the existing submerged reef area for use as developable land. In the future the project could be demolished and the land area utilized for another purpose. However, it is unlikely the reef area could be restored to present conditions.

The unavoidable adverse impacts of the PLAN must be weighed against the significant long term benefits of the project for the community and the State of Hawaii. The unavoidable adverse impacts must also be evaluated against the numerous State and County plans and policies which the PLAN is intended to implement.

Chapter IX

Probable Adverse Environmental Effects Which Cannot Be Avoided

CHAPTER IX: PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

There will be no long-term adverse environmental effects which cannot be mitigated.

Chapter X

Summary of Unresolved Issues

CHAPTER X: SUMMARY OF UNRESOLVED ISSUES

This EIS is considered somewhat "generic" in the sense that the proposed action is the long-term implementation of a master plan for Ke'ehi Lagoon consisting of several major individual projects as well as many smaller "minor" projects within the overall context of the master plan objectives. The individual major projects have been conceptually designed and described in terms of areal extent, uses, access, magnitude of dredging and filling, and design constraints. Several major projects will be implemented by private developers under lease agreements with the State. Therefore, some issues remain unresolved at this initial phase and will be resolved during the preparation of detailed plans by respective developers and in the process of seeking regulatory approvals and permits for the individual projects. Significant unresolved issues in the context of the overall PLAN are as follows:

(1) Implementation Schedule. Although a proposed and approximate implementation schedule has been presented in Chapter II, the precise time schedule for full implementation of the PLAN cannot be fully predicted at present. It will be dependent on the success of the State in executing lease agreements with respective private developers, the financial and economic climate at the time of construction, and the demands of the marketplace with respect to planned use within the development. For example, boat slips in the marinas may be developed for occupancy in phases, depending on the market demand. Therefore, the impacts associated with the PLAN may be felt gradually over an extended time frame which is difficult to predict at this time.

(2) Supplemental EIS. If any specific development action may result in significantly greater impacts than described by this EIS, then a supplemental EIS will be prepared for the respective action.

(3) Mitigation. Details of the waterbird habitat and reef mitigation plans will be finalized in coordination with the appropriate governmental agencies within the context of the U.S. Army Corps of Engineers permit application.

(4) Land Use Regulation Authority. This issue pertains to the proposed Triangle Development which is presently in Conservation District under State land use law. At issue is which level of government would have land use regulatory authority over the development. The options at present include: 1) Request designation as a Special Subzone in Conservation District which would retain administration by the State; 2) place the Triangle Development under the Hawaii Community Development Authority (HCDA) or similar special purpose agency which would retain State administration of the project; 3) request Urban District classification from the State Land Board and let the project come under the jurisdiction of the City and County of Honolulu.

Chapter XI

Consulted Parties and Participants in the DEIS Preparation

CHAPTER XI: CONSULTED PARTIES AND PARTICIPANTS IN THE DEIS PREPARATION

11.1 CONSULTED PARTIES

Many agencies and organizations and the general public have been contacted and consulted during the process of planning and preparation of this EIS. In 1987, on November 10, a public meeting was held to discuss alternative plans and their environmental effects for Ke'ehi Lagoon. This meeting was the culmination of several months of planning and meetings with a broad range of public agencies and private groups. An early assessment of impacts and a full account of the early phase of coordination has been published as Appendix B of the Ke'ehi Lagoon Recreation Plan Update, Final Draft to Fourteenth State Legislature (December 1987)[32].

A second phase of public coordination and involvement occurred during preparation of the recently completed Honolulu Waterfront Master Plan (1989) in which the updated Ke'ehi Lagoon Master Plan was incorporated in its entirety. The Waterfront Master Plan includes an assessment of impacts and the planning process involved many public agencies, organizations and the public.

The third phase of consultation involved discussions which specifically occurred and are related to the preparation of the DEIS. An Environmental Impact Statement Preparation Notice (EISPN) was published in the OEQC Bulletin on February 8, 1989. The thirty-day response period, announced in the OEQC Bulletin, ended on March 10, 1989. There were two requests for consultation resulting from this. These were from (1) The Conservation Council for Hawaii (February 15, 1989) and the Sierra Club Legal Defense Fund, Inc. (March 2, 1989). A third letter came from the Environmental Center of the University of Hawaii (March 8, 1989). It listed areas of environmental concern which should be addressed in the EIS. These three letters of response to the EISPN are reproduced herein, and the organizations were included in the list of recipients of the DEIS. Following is a list of public agencies who have also participated in discussions related to the DEIS.

Federal

U.S. Coast Guard
U.S. Environmental Protection Agency
Federal Aviation Administration
National Marine Fisheries Service
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service

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[32]Prepared by Edward K. Noda and Associates and Eugene P. Dashiell, AICP for the Department of Transportation, State of Hawaii.

State of Hawaii

Department of Business and Economic Development
Department of Health
Department of Land and Natural Resources
Department of Transportation
Hawaii Community Development Authority
Office of State Planning
Office of Environmental Quality Control

City and County of Honolulu

Department of Buildings
Department of General Planning
Department of Land Utilization
Department of Parks and Recreation
Department of Public Works
Department of Transportation
Office of the Mayor

Others

Boater's Groups
Canoe Clubs
Water Ski Clubs
Kalihi-Palama Community Council
Kalihi-Palama Neighborhood Board

11.2 LIST OF PREPARERS

The following persons are the authors of this document. Much of their writing, however, is directly based on the special reports on key environmental topics which are included in this document as appendices and which were prepared by technical specialists in their respective fields.

1. Elaine Tamaye, Project Manager and Chief Engineer,
   Vice President, Edward K. Noda and Associates, Inc.

   Role: Principal author and project manager, responsible for coastal and other engineering matters, cost estimating, preparation of alternatives, discussion of impacts, and overall direction of the document.

2. Eric Parker, Environmental Planner, DHM Planners, Inc.

Role: Environmental planner, responsible for social, environmental and land use planning.

3. Eugene P. Dashiell, AICP, Principal Planner
Planning Services

Role: Preparation of alternatives, discussion of impacts and mitigation measures, general assistance to EKNA in writing and preparing the EIS.

Technical Subconsultants

FPS Engineering Associates: construction cost estimating
OI Consultants, Inc.: water quality and marine biota
Andrew Berger: avifauna
Wilbur Smith Associates: traffic
Wilson Okamoto and Associates, Inc.: utilities
Marine Research Consultants: sea turtle survey
Barry D. Root & Barry D. Neal: air quality

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HARBORS DIVISION

CONSERVATION COUNCIL for HAWAII

A CITIZENS' ORGANIZATION PROMOTING ENVIRONMENTAL HEALTH AND EDUCATION, CONSERVATION AND MANAGEMENT OF HAWAII'S NATURAL RESOURCES

RS 2735

February 15, 1989

Mr. David K. Higa, Chief
Department of Transportation
Harbors Division
79 So. Nimitz Highway
Honolulu, HI 96813

Dear Mr. Higa:

Re. Development of Boating Facilities in the Airport Keehi Lagoon, Oahu

The Conservation Council for Hawai'i, O'ahu Chapter wishes to be a consulted party on the proposed Development of Boating Facilities in the Airport Keehi Lagoon, Oahu.

Please provide us with a copy of the environmental assessment and notice of determination so that CCH-O'ahu can review it and submit comments.

Thank you for your attention on this.

Yours truly,

Rick Scudder

Rick Scudder

XI-4

State Board/O'ahu Chapter
P.O. Box 2923
Honolulu, Hawaii 96802
(808) 531-[illegible] ✓

Big Island Chapter
P.O. Box 1222
Hilo, HI 96721

Kaua'i Chapter
P.O. Box 752
Kilauea, HI 96754

Maui Chapter
Rt. 1, Box 224
Haiku, HI 96708

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HARBORS DIVISION

RS 2808

Sunrise, Mt. McKinley — Ansel Adams

SIERRA CLUB LEGAL DEFENSE FUND, INC.

212 Merchant Street, Suite 202 Honolulu, Hawaii 96813 (808) 599-2436
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HAWAII OFFICE
Arnold L. Lum
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Marjorie F. Y. Ziegler
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Other Officers

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2044 Fillmore Street
San Francisco, CA 94115
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ROCKY MOUNTAIN OFFICE
1600 Broadway St.
Suite 1600
Denver, CO 80202
(303) 861-6698

WASHINGTON, DC OFFICE
1516 P Street, N.W.
Suite 200
Washington, DC 20005
(202) 667-4500

ALASKA OFFICE
323 Fourth Street
Juneau, AK 99801
(907) 586-2751

NORTHWEST OFFICE
216 First Avenue, South
Suite 330
Seattle, WA 98104
(206) 343-7340

March 2, 1989

David K. Higa
Harbors Division
Department of Transportation
79 S. Nimitz Highway
Honolulu, HI 96813

Re: EIS Preparation Notice for Development of Boating Facilities in the Airport, Keehi Lagoon, Oahu

Dear Mr. Higa:

The Sierra Club Legal Defense Fund would like to request a copy of the environmental assessment for the above-referenced project, and in addition would like to be a consulted party.

Very truly yours,

Arnold L. Lum

ALL:sw/harblet

cc: Steve Holmes
Fred Madlener
Ed Stevens

RS3083

University of Hawaii at Manoa

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

March 8, 1989
PN:0070

Mr. Edward Y. Hirata, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Environmental Impact Statement Preparation Notice
Keehi Lagoon
(Development of Boating Facilities)
Honolulu, Oahu

Plans for recreational development of Keehi Lagoon have been debated since the early 1970's. This development could have significant impacts with regard to:

1) endangered water bird habitats;
2) the third largest bait fish (nehu) spawning grounds on Oahu;
3) feeding and resting areas for migratory water fowl;
4) traffic congestion to adjacent areas and access routes;
5) noise and safety considerations with siting between airport runways; and
6) existing federal/state agreements (April 13, 1972) regarding maintenance of the area as a State Wildlife Area.

The Environmental Center strongly recommends that all of these issues be addressed in your preparation of the Draft Environmental Impact Statement.

Thank you for the opportunity to comment on the Keehi Lagoon development. We hope that our suggestions will be helpful.

Yours truly,

John Harrison
Environmental Coordinator

cc: OEQC
L. Stephen Lau
Carolyn Cook

AN EQUAL OPPORTUNITY EMPLOYER

XI-5

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
79 S. NIMITZ HIGHWAY
HONOLULU, HAWAII 96813

April 4, 1989 HAR-ED 3809

Dr. John Harrison
Environmental Coordinator
University of Hawaii at Manoa
Environmental Center
Crawford 317, 2550 Campus Road
Honolulu, Hawaii 96822

Dear Dr. Harrison:

Development of Boating Facilities
in the Airport, Keehi Lagoon and
Sand Island Areas, Oahu
Job H. C. 2241

Thank you for your letter of March 8, 1989 giving your environmental comments on this project. Your list of impacts will be addressed in our Draft Environmental Impact Statement.

Very truly yours,

Edward Y. Hirata
Director of Transportation

PSN:bk

cc: Office of Environmental
Quality Control

bcc: Elaine Tamaye, (Edward K. Noda & Associates)
HAR-B

RECEIVED
APR 12 1989
EDWARD K. NODA & ASSOCIATES

Chapter XII

Comments Received and Responses During Preparation of the FEIS

CHAPTER XII: COMMENTS RECEIVED AND RESPONSES DURING PREPARATION OF THE FEIS

The DEIS was published in the OEQC Bulletin on October 8, 1989. The forty five-day review period, announced in the OEQC Bulletin, ended on November 21, 1989. The agencies, organizations, and individuals listed below were sent copies of the DEIS with a request for their comments on the project. These consulted parties included those who requested consulted party status, those who requested a copy of the DEIS, and those who expressed interest in the project or were believed to have an interest in the project. Written comments from these parties and responses to these comments are reproduced herein.

* Indicated parties who sent a written response indicating no comments to the DEIS.

** Indicated parties who sent substantive written comments requiring written response.

Federal Agencies

U.S. Environmental Protection Agency, Region IX
U.S. Army-DAFE (Facilities Eng.-USASCH)
* U.S. Department of the Navy
** U.S. Department of Agriculture, Soil Conservation Service
** U.S. Army Corps of Engineers (USCOE)
** USCOE Operations Branch
U.S. Coast Guard
** U.S. Fish and Wildlife Service
U.S. Department of Transportation
U.S. Department of the Air Force
** Federal Aviation Administration
National Parks Service
National Marine Fisheries Service
* Honorable Daniel K. Inouye
Honorable Spark M. Matsunaga
Honorable Daniel K. Akaka
Honorable Patricia Saiki

State Agencies

Office of Environmental Quality Control
* Department of Agriculture
Department of Accounting and General Services
* Department of Defense
** Department of Health
** Department of Land and Natural Resources (DLNR)
DLNR State Historic Preservation Officer

** Department of Business and Economic Development (DBED)
* DBED Energy Division
Housing Finance & Development Corporation
Department of Transportation
State Archives
Office of State Planning
* Hawaii Community Development Authority
Department of Budget & Finance
* Hawaii Air National Guard
** State Land Use Commission
** Department of Human Services, Hawaii Housing Authority
* State Public Works
Honorable Paul Oshiro-House Committee Chrm. Transportation
Honorable Robert Bunda-House Committee Chrm. Ocean and Marine Resources
Honorable David Hagino-House Committee Chrm. Water and Land Use
Honorable David Ige-House Committee Chrm. Economic Development and Hawaiian Affairs
Honorable Lehua Fernandes Salling-Senate Committee Chrm. Transportation
Honorable Mike Crozier-Senate Committee Chrm. Housing, Hawaiian Programs and Natural Resources
Honorable Milton Holt-Senate Committee Chrm. Tourism and Recreation

University of Hawaii

** Environmental Center
Water Resources Research Center
Athletic Department
Seagrant Extension Service

City and County of Honolulu

** Board of Water Supply
* Building Department
** Department of General Planning
** Department of Land Utilization
Department of Parks and Recreation
** Department of Public Works
Department of Transportation Services
* Honolulu Fire Department
Municipal Reference and Records Center
** Honolulu Police Department
* Department of Housing and Community Development
** Kalihi-Palama Neighborhood Board No. 15
Honorable Frank F. Fasi
Honolulu City Council

Non-Governmental Agencies and Organizations

American Lung Association
* Hawaiian Electric Company
Office of Hawaiian Affairs
Hawaiian Telephone Company
Hawaii Audubon Society
** Sierra Club Legal Defense Fund, Inc.
Conservation Council for Hawaii
** Life of the Land
** Sand Island Business Association
** Hawaii's Thousand Friends
Chamber of Commerce of Hawaii
Hawaii Water Sports Council
Kalihi-Palama Community Council
** Water Skiers for a New Keehi Lagoon
Disabled American Veterans Dept. HI
Mokauea Fishermen Association
Oahu Water Ski Club
Na Alii Water Ski Club
Hawaii Water Ski Club
Hawaiian Canoe Racing Association
Tuna Boatowners Co-Op Inc.
The Ocean Recreation Council for Hawaii (TORCH)

Tenants & Lessees in Ke'ehi Lagoon

La Mariana Sailing Club
Ameron, HC&D
Keehi Marine Inc.
K.T. Mataele Contractors
C.W. Welding Company
MB Maritime, Inc.
Richard Masuda Masonry
Kumu Corporation
LeCorp Construction, Ltd.
Haitsuka Brothers, Ltd.
Hawaiian Aqua Products
Hawaii Stevedores, Inc.
Mr. Alex Jakubenko
Hawaiian Bitumuls and Paving Co., Ltd.
Imperial Trucking, Inc.
Island Recycling Inc.
Hawaiian Catamaran Multihull Design
Container Storage of Hawaii, Inc.
Erik Builders, Inc.

K & R Plumbing
A & D Painting & Sandblasting, Inc.
Aloha Tool & Rental, Inc.
Aloha Agricultural Consultants, Inc.
BFI of Hawaii, Inc.
Transcend, Inc.
J's Machinery Service
Tokunaga Masonry, Inc.
Steinke Bros. Inc.
Sonnie Gay, Ltd.
Advance Roofing Co.
Stanaire Sheetmetal & A/C Co., Inc.
Rons Construction Corp.
Plas-Tech, Ltd.
George Poysky
Kalei Crane Service
Aquelino Pagala
Nortex Corp.
Total Mechanical & Welding, Inc.
Maglinti Builders, Inc.

Other Interested Individuals and Companies

** Mr. Joseph Dougherty
Asian American Associates
Hadley-Pruyn Inc.
Kahawainui Developers
Parry Corporation Ltd.
Beauchamp Enterprises
Mr. Masuji Kurashige
McConnell Dowell Corporation, Ltd.
Mr. Tom Ritchie
** Royal Hawaii International Sports, Inc.
Mr. Fred Smales
Mr. Ron Rose
Aliomanu Development
Mr. Robert Schlesinger
Pacific Resources, Inc.
Servco Pacific Inc.
Hi-Tech Transportation
Waiala Investment Corp.
Parsons Hawaii
Hawaiian Trust Company, Ltd.
Mr. Mike Baker
R.M. Towill Corp.
Helber, Hastert & Kimura

Newspapers

Honolulu Star Bulletin
Honolulu Advertiser
Sun Press

Libraries

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

IN REPLY REFER TO

11010
Ser 03(2022A)/2992
22 NOV 1989

Mr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 S. King Street, #104
Honolulu, HI 96813

Dear Mr. Miura:

KE'EHI LAGOON RECREATION PLAN AND DRAFT EIS

Thank you for your letter which requested the Navy to review and comment on the subject plan and draft environmental impact statement.

The Navy has no comments to offer at this time.

Sincerely,

W K LEE
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
State of Hawaii Department of
Transportation (Fred Nunes)
Edward K. Noda & Assoc. Inc.

9-IIX-6

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

November 6, 1989

Mr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 S. King Street, #104
Honolulu, HI 96813

Dear Mr. Miura:

Subject: Draft Environmental Impact Statement (DEIS) -
Ke'ehi Lagoon Recreation Plan, Honolulu, HI

We have reviewed the above-mentioned document as requested and offer the following comments:

The proposed construction of facilities on previously filled sites and on proposed landfill over reef and mud flats appears to us to place all of the facilities within the 100 year flood plain. If this is true, we suggest that the statement should address the need or desireblity of flood proofing any buildings included in the proposed facilities.

We would appreciate the opportunity to review the final EIS.

Sincerely,

Warren M Lee

WARREN M. LEE
State Conservationist

cc:
Mr. Fred Nunes, Project Manager, Department of Transportation, Harbors Division, 79 S. Nimitz Hwy., Honolulu, HI 96813
Mr. Edward K. Noda & Associates, Inc., 615 Piikoi St., #1000, Honolulu, HI 96814

XII-7

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN E. UCHIMA
RONALD N. HIRANO
DAN T. ROCHE
JEANNE K. SCHULTZE

IN REPLY REFER TO

December 26, 1989 HAR-ED 2104

Mr. Warren M. Lee
Soil Conservation Service
U. S. Department of Agriculture
P. O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 6, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

The proposed improvements will be constructed above the regulatory base flood elevations. As discussed on pages III-11 and III-12 of the Draft EIS, the 100-year flood elevations are +5 feet MSL or less within the project area. All fill areas for development will be constructed to grade elevations at or above +5 feet MSL.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project. A copy of the Final EIS will be sent to you for your information.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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

REPLY TO ATTENTION OF:

October 26, 1989

Planning Branch

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 South King St. #104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Thank you for the opportunity to review the Draft Environmental Impact Statement (DEIS) for the Ke'ehi Lagoon Recreation Plan, Honolulu, Hawaii. The following comments are provided as requested.

a. The statements on pages III-11 and III-12 concerning flooding and tsunami inundation zones are correct.

b. The DEIS indicates that the applicant is aware of the need and requirements for Department of the Army (DA) permits. For your information, enclosed is a letter, dated February 22, 1989, to the Deputy Director of the Office of Planning. The comments in that letter regarding permit actions and fills for non-water dependent activities should be given full consideration. For more information concerning the DA permit program, please contact the Operations Branch at 438-9258.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

Copy Furnished:

Department of Transportation
Harbors Division
79 S. Nimitz Highway
Attn: Fred Nunes, Project Manager
Honolulu, HI 96813

Edward K Noda & Associates, Inc.
615 Piikoi St. #1888
Honolulu, HI 96814

XII-8

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

REPLY TO ATTENTION OF:

February 22, 1989

Planning Branch

Mr. Murray E. Towill
Deputy Director
Office of State Planning
Office of the Governor
State Capitol, Honolulu, HI 96813

Dear Mr. Towill:

Thank you for sending us a copy of the Honolulu Waterfront Master Plan Pre-Final Report of January 1989 and asking us for comments. The efforts in preparing this plan have obviously been significant. The resulting ideas and concepts are stimulating and generally portend a more attractive and usable waterfront. Our congratulations to your staff and consultants.

The U.S. Army Corps of Engineers, as a major partner in the development of the commercial Honolulu Harbor, has a concern that we hope will be kept in mind as waterfront use is modified. That is, the commercial maritime facilities must be protected and future growth options of these facilities not be precluded. A case in point is the future potential for use of Piers 1 and 2. The concept of these being used by cruise ships is good. However, the existing backup area to these piers should probably be reserved for future maritime use options. The proposed "commercial mix" use of these back-up areas does not appear to be sufficiently unique to warrant losing the future maritime use option.

Another U.S. Army Corps of Engineers interest is in the permit actions needed to implement some of the proposed shoreline changes. All work in the coastal waters such as filling, dredging, and constructing new waterways or structures will require Department of the Army permits. Fills for non-water dependent activities, such as the proposed Keehi Lagoon Triangle, are generally discouraged. The Corps therefore recommends that full consideration be given to relocating these activities to existing fast lands. Where non-water dependent fills cannot be avoided, mitigation and/or compensation plans for the loss of aquatic resources must be developed. In this light, we suggest that environmental objectives to preserve and enhance aquatic areas be added to the overall waterfront goals.

Again, thank you for requesting our comments. We share your interest in this "dynamic vision" and look forward to future cooperative efforts with the State of Hawaii to implement a more efficient and attractive waterfront.

Sincerely,

F. W. Wanner
Colonel, U.S. Army
District Engineer

6-IIX

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. LUCHINA
RONALD N. MIRANO
DANI T. KOCH
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

December 26, 1989

HAR-ED 2105

Mr. Kisuk Cheung, Chief
Engineering Division
Department of the Army
U. S. Army Engineer District, Honolulu
Building 230
Port Shafter, Hawaii 96858

Dear Mr. Cheung:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of October 26, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

We are aware of the Department of the Army (DA) permit requirements and previous comments submitted to the Office of State Planning concerning the Honolulu Waterfront Master Plan Pre-Final Report of January 1989. Please be assured that full consideration has been given to alternatives for non-water dependent fills. Because we believe that fills for non-water dependent activities cannot be avoided, we are pursuing the development of mitigation and/or compensation plans for the loss of aquatic resources, as described in the Draft EIS. We will endeavor to resolve this issue within the context of the DA permit. We have undertaken significant pre-application consultation with the Corps' Operations Branch, and have submitted a DA permit application for the project.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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

REPLY TO ATTENTION OF

November 15, 1989

Operations Branch

SUBJECT: Keehi Lagoon Recreational Plan and Draft Environmental Impact Statement

Ms. Elaine Tamaye
Ed Noda and Associates, Inc.
615 Piikoi Street, Suite 1000
Honolulu, Hawaii 96814

Dear Ms. Tamaye:

Based upon the contents of the DEIS, we expect that the elements of the plan will be implemented as the State finds developers or State funds to construct those elements. We anticipate or envision that supplements to the DEIS could be prepared as each plan element nears detail design completion.

We generally find the subject Draft Environmental Impact Statement (DEIS) complete in identifying significant issues. The impact of the changes on nehu fishing in the lagoon was not readily evident. The use of water area as a comparative criteria in your site selection criteria would be useful.

In the Federal Laws in Chapter V, Section 402, Clean Water Act is not an issue of the Corps permit. With respect to 5.1.7 Federal Coastal Zone Management Program, the paragraph is repetitious of the discussion under the Corps of Engineers.

With respect to the triangle fill, the requirements of the U.S. Environmental Protection Agency practicable alternatives analysis are not fulfilled. The DEIS does not provide data supporting the State's claim that is triangle fill proposal is environmentally and economically superior to fill alternatives. Thus, the DEIS has not overcome the legal presumption that

another environmentally preferred alternative is available. The failure to resolve this federal issue may be a deterrent to a developer if the State decides to leave the permit requirement to the developer. At the least, the practicable alternatives analysis should address the alternative of no fill and an alternative that reduces the fill by half. The economic costs and benefits to the State of the two alternatives need to be addressed in the analysis.

Sincerely,

Stanley T. Arakaki

Stanley T. Arakaki
Chief, Operations Branch
Construction-Operations Division

Copy Furnished:

Chief, Harbors Division
Department of Transportation
State of Hawaii
79 S. Nimitz Highway
Honolulu, Hawaii 96813

XII-10

XII-11

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DANIEL T. KOCHI
JEANNE R. SCHULTZ

IN REPLY REFER TO

December 26, 1989

HAR-ED 2107

Mr. Stanley T. Arakaki, Chief
Operations Branch
Department of the Army
U. S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858

Dear Mr. Arakaki:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 15, 1989 to Ms. Elaine Tamaye, our consultant for the subject project. We offer the following clarification and responses to your review and comments:

With respect to the triangle fill, we are aware of the Federal requirements to accomplish a practicable alternatives analysis. We do not presume that the State EIS will fulfill this requirement. It is the State's intent to resolve this Federal issue within the context of the Department of the Army (DA) permit, and it is not intended to leave the Federal permit requirement to the developer. We have authorized our consultant, Edward K. Noda and Associates, Inc. (EKNA), to act as our agent and to apply for the DA permit on our behalf. The application was made on December 12, 1989.

Please contact Mr. Fred Nunes, our Project Manager, at 548-2505, to arrange a meeting to discuss the additional data or analysis that may be required to resolve Federal issues.

Very truly yours,

Edward Y. Hirata
Director of Transportation

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

NOV 22 1989

HARBORS DIVISION

Dr. Harvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Re: Keehi Lagoon Recreation Plan and Draft Environmental Impact Statement, Oahu

Dear Dr. Miura:

The U.S. Fish and Wildlife Service (Service) has reviewed the referenced Keehi Lagoon Recreation Plan and Draft Environmental Impact Statement (Plan and EIS) dated September 1989. We offer the following comments for your consideration.

General Comments

The Service commented on the Honolulu Waterfront Master Plan in February 1989 (Enclosure 1). In that letter, we raised concern over the loss of mudflat and reef flat habitats that are used by endangered Hawaiian Stilts (Himantopus mexicanus knudseni) and migratory shorebirds from development projects within Keehi Lagoon. The referenced Draft Plan and EIS focuses specifically on development proposals within Keehi Lagoon. Several of the proposed projects, principally the Hawaiian Canoe Center and the Triangle Development, would require extensive filling of mudflat and shallow reef flat habitats within Keehi Lagoon.

The shallow reef flat and mudflat habitats within Keehi Lagoon are identified as essential habitat for the recovery of the endangered Hawaiian Stilt (Hawaiian Waterbirds Recovery Plan, 1985. U.S. Fish and Wildlife Service). In addition, these habitats within Keehi Lagoon provide important foraging and loafing habitats for wintering migratory shorebirds. Construction of the proposed projects would eliminate most of the remaining available wetland habitats for endangered Hawaiian Stilts and various species of migratory shorebirds within Keehi Lagoon.

Specific Comments

a. 2.4.1. Hawaiian Canoe Center. pp. II-4 - II-5. This section states that "minor filling" would be necessary to straighten the shoreline, and to provide canoe launch ramps and automobile parking. The amount and dimensions of the fill areas should be included in the Final Plan and EIS.

avoidance
filling mud flats
redesign

b. 2.4.1. Hawaiian Canoe Center. p. II-5. A portion of the proposed 600-car parking area is on an unauthorized fill. This 10.2-acre fill dates back to the early 1970's. A November 1989 site inspection of this area by the Service indicated that portions of the fill area display wetland features. Portions of the fill area are flooded at high tide as evidenced by the debris line and salt crust, and the presence of hydrophytic plants such as pickleweed (Batis maritima) and sea purslane (Sesuvium portulacastrum). Several migratory Pacific golden plovers (Pluvialis dominica) were observed at this site during the site inspection. We recommend that the wetland boundaries at this site and other affected areas be delineated jointly by the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Soil Conservation Service, Hawaii Department of Land and Natural Resources, and the Service. For your information, in May 1975, the Service recommended to the U.S. Army Corps of Engineers that this fill be removed (Enclosure 2). We continue to recommend that this 10.2-acre unauthorized fill be removed and the wetland values at this site be restored.

c. 2.4.1. Hawaiian Canoe Center. pp. II-4 - II-5. A commercial facility is proposed for the peninsula between Kalihi and Hoanalua Streams. This would require the construction of a new vehicular bridge over Kalihi Stream from Hoonee Place and Sand Island Access Road, a new pedestrian access bridge, and parking facilities. Southeast from the mouth of Kalihi Stream, near the proposed access road and pedestrian bridge, are several abandoned salt evaporation ponds. During the November 1989 site visit, two Hawaiian Stilts were observed at this wetland. This wetland consists of shallow ponds separated by low berms, and apparently connected to Keehi Lagoon by a collapsed culvert. Pickleweed and red mangroves (Rhizophora mangle) grow on the banks and dikes. Wandering tattlers (Heteroscelus incanus) and a single black-crowned night heron (Nycticorax nycticorax hoactli) were also seen at this wetland. The Final Plan and EIS should discuss potential impacts to endangered Hawaiian Stilts, migratory shorebirds and their wetland habitat from the construction and operation of the access road, parking facilities, and pedestrian bridge.

d. 2.4.3. Lagoon Drive Marina. pp. II-6 - II-7. The shoreline along Lagoon Drive has been highly modified by filling for the expansion of the roadway and by dredging for the seaplane runway. The habitat along this section of shoreline does not provide significant habitat for endangered Hawaiian Stilts or for migratory shorebirds. However, the construction and operation of a marina at this site may disturb endangered Hawaiian Stilts and migratory shorebirds that use the adjacent reef flat. The Final Plan and EIS should discuss potential impacts to these avian resources from the construction and operation of the proposed marina.

e. 2.4.4. Triangle Development. pp. II-7 - II-13. Of particular concern to the Service is the proposal to develop industrial and commercial facilities, a marina and yacht racing complex, and park on the triangle-shaped reef flat and mudflat in Keehi Lagoon (Triangle). Approximately 165-acres of shallow reef flat and mudflat habitats would be eliminated by the construction of these facilities. The shallow-water habitats on the Triangle provide feeding and loafing habitats for endangered Hawaiian Stilts and migratory shorebirds. In addition, the reef flat may function as a staging area for migratory shorebirds in transit through Hawaii.

Keehi Lagoon has been significantly modified by man in recent times. The Draft Plan and EIS describes Keehi Lagoon as a very shallow bay lined with fishponds and salt marshes along the shoreline prior to 1940. Since then, deep channels have been dredged for ship channels, harbor facilities, and seaplane runways in Keehi Lagoon. Mudflats, salt marshes, reef flats, and fishponds were filled and converted into fastlands. The Draft Plan and EIS estimates that approximately one-third of Keehi Lagoon was filled by these developments. In 1977, approximately 1,240 acres of reef were dredged and filled for the construction of the Reef Runway. As part of the mitigation for habitat loss for the Hawaiian Stilt from the construction of the Reef Runway, three small islets were constructed on the Keehi Lagoon Triangle.

Very little of the original reef flat and mudflat habitats within Keehi Lagoon remain. The dramatic loss of wetland habitats within Keehi Lagoon is illustrative of the decline of wetland resources throughout the State of Hawaii and nation. We do not support any proposed development on the Keehi Lagoon Triangle that would adversely impact feeding and loafing habitats for endangered Hawaiian Stilts and migratory shorebirds. We recommend that the proposed development projects on the Keehi Lagoon Triangle be relocated to less-sensitive areas. We recommend that the Keehi Lagoon Triangle be managed as feeding and loafing habitat for endangered Hawaiian Stilts and migratory shorebirds in accordance with the Hawaiian Waterbirds Recovery Plan.

f. 4.4. Waterbirds. pp. III-6 - III-8 and IV-4 - IV-5. The Draft Plan and EIS suggest that the mudflat and shallow reef flat habitats of the Keehi Lagoon Triangle are not important because the endangered Hawaiian Stilt does not nest there. Nesting habitat is crucial for the recovery of these species; feeding habitat is equally important in supporting populations of these endangered species. Availability of feeding habitat is necessary to build the energy reserves needed for mating and nesting by adult stilts. Nest sites are often separate from feeding sites and the Hawaiian Stilt move between these areas daily (Hawaiian Waterbirds Recovery Plan, 1985).

Loss of the reef flat and mudflat at the Keehi Lagoon Triangle would reduce feeding, loafing, and staging habitat for migratory shorebirds. Some migratory shorebirds exhibit strong site fidelity. Loss of these traditional staging, loafing, and feeding areas may reduce local populations of these migratory shorebirds.

The factors that limit the use of the Keehi Lagoon Triangle for nesting by the endangered Hawaiian Stilt are not well understood. The Triangle is an island separated by wide deep channels, and is likely free from most terrestrial predators such as the mongoose. The islets are two to three feet above mean sea level, and generally would not be inundated at high tide. However, the Draft Plan and EIS notes that fishermen have used these islets as a base to cast their fishing lines into the seaplane channel. It is likely that a combination of human disturbances and availability of food resources are factors that limit nesting on the Keehi Lagoon Triangle by the Hawaiian Stilt.

The proposing agency (State Department of Transportation, Harbors Division), proposes to acquire and/or manage an existing wetland as mitigation for the loss of the 165-acres of mudflat and reef flat habitats. One of the wetlands under consideration (Ukoa Marsh, Heeia Marsh, or Pouhala Marsh) would be managed in coordination with the State Department of Land and Natural

Resources. The preferred site for wetland mitigation is the 57-acre Pouhala Marsh at Waipio Peninsula, Pearl Harbor. While Pouhala Marsh provides essential habitat for the recovery of the endangered Hawaiian waterbirds, the Service believes it is premature to identify and designate wetland sites as mitigation until less-damaging project alternatives have been fully analyzed. In addition, these wetlands have been previously identified for protection under separate mechanisms.

Summary Comments

The islets on the Keehi Lagoon Triangle were developed in part as mitigation for the loss of reef flat habitat from the construction of the Reef Runway. These islets have apparently not provided nesting habitat for the endangered Hawaiian Stilt as was originally intended. Thus, this portion of the mitigation for the Reef Runway project has not been fulfilled. As discussed in the Waterbird Recovery Plan, we recommend that the Keehi Lagoon Triangle and other mudflat and wetland habitats in Keehi Lagoon be managed as a preserve for the endangered Hawaiian Stilt. Such a preserve would also benefit migratory shorebirds. Increased management activities, such as controlling human disturbances and improving the existing islets, may improve the habitat value of the Keehi Lagoon Triangle for the endangered Hawaiian Stilt and migratory shorebirds. These measures would assist in the recovery of the endangered Hawaiian Stilt.

The proposed construction work within Keehi Lagoon would likely require authorization under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. Both of these permits are issued by the U.S. Army Corps of Engineers. Since permit issuance is considered a federal action that may affect a listed endangered species, the Corps would likely initiate consultation with the Service under Section 7 of the Endangered Species Act. In turn, the Service would evaluate both direct and cumulative project impacts, and would determine whether the proposed actions would jeopardize the continued existence of the endangered Hawaiian Stilt.

The Service considers the mudflat and shallow reef flat habitats within Keehi Lagoon to be of high value for migratory shorebirds, and these habitats are relatively scarce or becoming scarce in the ecoregion setting (U.S. Fish and Wildlife Service Mitigation Policy, 1981). Under the Service's Regional Wetland Protection Policy, development proposals adversely impacting important wetland resources shall be discouraged unconditionally by the field office.

The Service applies a hierarchical approach to mitigation when reviewing projects that may affect trustee resources. Under this approach, we first recommend that less-damaging alternatives that avoid adverse biological impacts be thoroughly analyzed. These alternatives include measures to avoid damage or loss to fish and wildlife resources, use of non-structural alternatives, or no project. If unavoidable impacts remain, we apply in sequence, measures that would minimize, rectify, reduce over time, and compensate these impacts. Avoidance of adverse impacts is the preferred approach. Therefore, the Service recommends the selection of project alternatives that avoid the discharge of fill material into the shallow reef flat and mudflat habitats within Keehi Lagoon, and the relocation of these proposed projects to less-sensitive areas.

We appreciate the opportunity to comment.

Sincerely,

William R. Kramer for
Ernest Kosaka
Field Supervisor
Pacific Islands Office

Enclosures

cc: Edward K. Noda and Assoc., Inc.
RD, EWS, Portland, OR (AFWE)
U.S. Army Corps of Engineers
U.S. EPA, San Francisco
DOT, Harbors Division
NOAA - Fisheries
DLNR, DOFAW
CZM

JOHN WAIHEE
GOVERNOR

EDWARD Y HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD M. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

December 22, 1989

HAR-ED 2100

Mr. Ernest Kosaka
Field Supervisor
U. S. Department of the Interior
Fish and Wildlife Service
Pacific Islands Office
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Ke'ehi Lagoon Recreation Plan Draft EIS

Thank you for your letter of November 22, 1989 to Dr. Marvin Miura, Director, Hawaii Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

We are aware of your previous comments submitted to the Office of State Planning on the Honolulu Waterfront Master Plan Pre-Final Report of January 1989. The Draft EIS acknowledges that Ke'ehi Lagoon was classified in the Recovery Plan, along with 25 other sites on Oahu, as a "primary" or "essential habitat" for the Hawaiian stilt and the other three endangered waterbirds. The Draft EIS further points out that the Recovery Plan states "...in the event that any of the identified essential habitat sites cannot be maintained, despite all efforts to preserve their value to waterbirds, it is possible that suitable substitutes could be used." Annual censuses of the stilt by the State Division of Forestry and Wildlife reveal that from 1980 to 1986 the stilt population in the State increased by approximately 47 percent, however, the stilt population in Ke'ehi Lagoon has significantly declined. The Draft EIS further notes that although only an estimated 20 percent of the feeding habitat was eliminated by the Reef Runway construction, the number of stilt using the area had decreased by over 70 percent (Walker, 1978). Present surveys by our avifaunal consultant confirm this downward trend in use of Ke'ehi Lagoon by the waterbirds. The National Wildlife Refuges established in Pearl Harbor as mitigation for the Reef Runway construction have successfully provided safe habitats

XII-14

for the endangered Hawaiian waterbirds, and serves as an excellent example of not only successful mitigation but also habitat enhancement for the waterbirds and migratory shorebirds. As described in the Draft EIS, it is our intent to provide similar mitigation for the loss of mudflats in Ke'ehi Lagoon due to the proposed plan. The specific mitigation plan will be developed during coordination efforts with your office within the context of the Department of the Army (DA) permit action.

Regarding your comments on the Hawaiian Canoe Center, the specific projects comprising the Recreation Plan are very conceptual at this stage, as stated in the Draft EIS. Therefore, the amount and dimensions of the proposed fill areas can only be approximated at this time. Certain portions of the Canoe Center are currently being planned and designed in more detail as State-funded improvements. Thus, the Final EIS will include the most current plans developed to date. Further actions regarding delineating the "wetland" areas and development of possible mitigation plans will be accomplished within the context of the Department of the Army (DA) permit action.

The proposed plan is not expected to impact the waterbirds in other adjacent reef flat areas in Ke'ehi Lagoon. The reef flats seaward of Seaplane Runway "B" are sufficiently removed from the proposed development sites. The Draft EIS quotes Mr. Ronald L. Walker of the State Division of Forestry and Wildlife as follows: "Contrary to commonly held opinion that resident and migratory waterbirds do not adapt well to habitat subjected to human disturbance, it has been our experience that the Hawaiian stilt and migratory shorebirds and waterfowl are highly tolerant of human activities in the vicinity of their feeding and resting areas." Although waterbirds and migrant shorebirds are not seriously affected by noise or by people when they are feeding or resting, nesting birds are greatly affected by people. There is no record of stilts nesting in Ke'ehi Lagoon. This points to the importance of creating mitigation areas which provide not only replacement feeding habitat but also safe nesting sites.

As you might know, the three small islets on the triangle mudflat that were developed during construction of the Reef Runway were only a small part of the mitigation for the project. These islets were not intended to provide nesting habitat for the stilt, but only on-site resting areas. Nesting habitat was provided by the refuges in Pearl Harbor. We are not aware of stilts nesting in oceanic water, as we believe that they prefer brackish water.

Mr. Ernest Kosaka
December 22, 1989
Page 3

As stated in the Draft EIS, the plan will require a DA permit, at which time your office will be consulted by the U. S. Army Corps of Engineers under Section 7 of the Endangered Species Act. The Draft EIS states that an unresolved issue is the waterbird habitat mitigation plan, which will be finalized in coordination with the appropriate governmental agencies within the context of the U. S. Army Corps of Engineers permit application for which was recently submitted for the project.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

US Department of Transportation
Federal Aviation Administration

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
Telephone: (808) 541-1230

November 20, 1989

Mr. Harvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street, #104
Honolulu, Hawaii 96813

Dear Mr. Miura:

We have reviewed the Keehi Lagoon Recreation Plan Draft Environmental Impact Statement dated September 1989 and have the following comments:

Page I-3. Designation of Keehi Lagoon as a park may impose obstacles to future airport development.

Page I-3. Constraints imposed by aircraft are more than just not permitting residential use. Parks spectator sports and public assembly are not compatible above 75 Ldn which encompasses most of Keehi Lagoon. Marine craft transport, parking, commercial, wholesale and retail buildings and utilities are only compatible above the 70 Ldn, if the proper Noise Level Reduction measures are taken to ensure a 25, 30, or 35 dB outdoor to indoor reduction.

Page I-4. How does the statement, "There are no rare and endangered species which are significantly affected by the proposed PLAN," account for the Hawaiian stilt?

Page I-6. If the Keehi Lagoon Master Plan is an element of the Honolulu Waterfront Master Plan, why wasn't putting some uses, e.g., slips, elsewhere on the waterfront considered? This could possibly move any potential residential use (live aboards) out of the aircraft noise impacted areas.

Page II-1. No mention is made that the majority of Keehi Lagoon is airport property.

Page II-2. Should include more information of the proposed ferry system in the Lagoon Drive Marina. Also, none of the Triangle Development details any airport related facilities, although they are noted on page II-8.

Page II-4. Since Keehi Lagoon is considered airport property, all revenue generated must be used for airport purposes not to support public recreation.

Page II-6. If the Lagoon Drive Marina only berths 200 boats, what is planned for the remaining 1500 on the waiting list? Also, what is the cost/benefit?

Page II-6. How will ferry passengers get to/from the terminal to other areas on or near the airport? Has any traffic analysis been done and/or considered for a public transportation system?

Page II-7. Why was planning carried forward for Keehi Lagoon despite Hawaii not being picked for the America's Cup race?

Page II-8. What priority will be given to aviation related facilities versus maritime?

Page II-9. The safety and cost considerations for locating the bridge should be defined and explained. Also, cost comparisons should be included.

Page II-12. A water theme park, golf course, tennis and Olympic pool facilities, theatrical stages and limited housing are not compatible uses for the Triangle area as noted for page I-3.

Page III-2. The Reef Runway was also built to reduce noise impact over the Kalihi, Kapalama and downtown areas, not just to alleviate aircraft capacity problems.

Page III-4. Comparisons to the reef flats of Pearl Harbor and Kaneohe Bay cannot be made without information on them.

Page III-8. If the decline of stilts in the mud flats is attributed to decline of food sources and increased human population throughout the lagoon, the proposed project could completely eliminate any stilts in the lagoon.

Page III-8. What are the sulfur dioxide levels?

Page III-12. The airport Airfield Rescue and Fire Fighting (ARFF) station is for aircraft and airport fires only and cannot be used for the lagoon area.

Page III-13. Bus service from Route 19 is on Nimitz Highway only and not into the Keehi Lagoon area.

Page III-13. Is there any schedule for completion of the ferry terminal?

Page III-27. Most of Keehi Lagoon is airport property which provides an effective buffer for the high aircraft noise impact.

Page III-29. Not all areas of Keehi Lagoon are suitable for outdoor recreation, or commercial and industrial uses as noted for page I-3. Residential use, especially live aboards, is not compatible in any of the lagoon.

Page III-29. Are there any current restrictions regarding live aboards that would affect the existing 140 vessels.

Page IV-3. Although the lagoon is "little" used by the Hawaiian stilts, won't this plan push the lagoon into no use?

Page IV-6. How would this plan improve the carbon monoxide concentrations? Also, how predictable is the statement that concentrations will drop as older vehicle models drop out of service? Won't the overall increase in vehicles more than account for any realized drop in concentrations?

Page IV-6. Keehi Lagoon is <u>not</u> acceptable for outdoor recreation, commercial and industrial uses without Noise Level Reduction as noted for page I-3.

Page IV-9. The height of proposed facilities will also be restricted by airport requirements including Federal Aviation Regulations Part 77 surfaces.

Page IV-10. What percentage of demand for marina facilities will be met by this plan and what plans exist for the remainder?

Page IV-10. If 119 acres of commercial and industrial land are developed for <u>water related activities</u>, this belies the reference to aeronautical activities on page II-8, particularly since Keehi Lagoon is airport property.

Page IV-11. Revenues derived from activities within Keehi Lagoon, since it is airport property, must be used for airport purposes. Also, what percentage would developers have in property and facilities.

Page IV-11. What relocation plans have been made for the concrete batch plant and industrial warehouses? Aren't these facilities eligible for relocation assistance?

Page VI-1. Explain the term "wind shadow" as it applies to Hilo Harbor.

Page VI-1. Is there any limit on length of wet storage for larger boat?

Page VI-3. Why wasn't Kewalo Basin considered in the Alternative Site Evaluation, possibly with some dredging of the Ft. Armstrong area?

Page VI-4. What is meant by the term "unspecified neighbor island site"?

Page VI-6. Is there a formal rejection of any plans to develop Pearl Harbor by the Department of Defense? Also, wouldn't mitigation measures reduce the environmental impacts on the waterbird sites?

Page VI-8. Couldn't the Hawaii Kai Marina in Maunalua Bay be developed as quick as the Pier 60 marina?

Page VI-9. Why wasn't the shoreline strip park developed along Lagoon Drive? Also, explain how the marina would be more compatible with traffic on Lagoon Drive. It seems that the airport related traffic would be derogated.

Page VI-9. Where are the dredging areas for the Triangle Development and where will the additional fill come from? Explain why reconfiguration of the land or water based plan components is not financially or environmentally feasible. How much space is devoted for aviation versus maritime uses? Also, revenues produced from activities on the triangle, since it is airport property, must be used for airport purposes. This issue is not resolved.

Page VI-10. Not fulfilling the planning goals are not a satisfactory reason for not selecting the No Action Alternative. Goals could be readjusted or provisions in existing facilities made to accommodate goals.

Page VII-1. There is no mention of improvements for aviation activities.

Page VII-1. What assurance is there that the nehu sites would be restored through natural flushing and resettling? Also, what mitigation measures are planned for construction impacts?

Page VII-1. How will unauthorized residents be displaced and illegally moored vessels moved? Why haven't they been required to do so already? Isn't the concrete batch plant and warehouse facilities eligible for relocation assistance? Also, where could they be moved to?

Page VII-2. What is the impact on existing aviation uses by new maritime, commercial and industrial uses? Also, why aren't new aviation uses noted?

Page VIII-1. What are the uses the land area could be utilized for if proposed uses are demolished?

Page IX-1. What about aircraft noise impacts (which are existing) on proposed new land uses (some of which are not compatible).

Page X-1. Since the current demand exceeds the proposed number of boat slips in the marines, what will be done about the remainder of the waiting list?

Page X-1. Another unresolved issue is the Release of Airport Property under Section 23 and the conditions imposed.

We appreciate the opportunity to review this Draft EIS. If you have any questions regarding our comments, please call us.

Sincerely,

Henry A. Sumida
Airports District Office Manager

cc:
DOT - Harbors
Ed Noda & Associates

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN R. LEOPARDI
RONALD N. HIRANO
CLAIRE K. HOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

January 5, 1990 HAR-ED 2146

Mr. Henry A. Sumida
Airports District Office Manager
Federal Aviation Administration
Airports District Office
Box 50244
Honolulu, Hawaii 96850

Dear Mr. Sumida:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 20, 1989 to Dr. Marvin Miura, Director, Hawaii Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

Page I-3. The plan does not propose designation of Ke'ehi Lagoon as a park. The plan provides for certain areas to be developed and dedicated to open space public and recreation areas.

Page I-3. Recreational uses in Ke'ehi Lagoon is a compatible land use as defined by the Part 150 Noise Compatibility Program. Part 150 allows local authorities to develop their own guidelines in response to locally determined needs.

Page I-4. As discussed in Chapters 3.1.3 and 4.4 of the Draft EIS, there has been a significant decline in the numbers of Hawaiian Stilts that use the area for feeding and resting. This, as well as the fact that there is no record of stilts nesting in Ke'ehi Lagoon, would substantiate the determination that the present habitat is of poor quality. It is the opinion of our avifaunal consultant that "...The mudflat Triangle between Seaplane Runways A & B is now of no importance for the endangered Hawaiian Stilt...."

XII-18

Page I-6. There is logically no other site within the Honolulu Waterfront Master Plan area that is suitable for expansion to accommodate the numbers of slips necessary to satisfy demand. The Draft EIS explicitly states that there will be no residential use (i.e., live aboards) within the proposed new developments in Ke'ehi Lagoon.

Page II-1. The majority of Ke'ehi Lagoon is under Governor's Executive Order to the Department of Transportation, Airports and Harbors Divisions, as shown in Figure 11-4.

Page II-2. The proposed Intra-island ferry system and ferry terminal in Ke'ehi Lagoon is further described in Chapters 2.4.3, 3.1.8, 3.3.9, and 4.7. The need for space on the Triangle to support airport related functions is mentioned throughout the document and specifically identified in the Goals and Plan Objectives.

Page II-4. The Governor's Executive Order 3202 sets aside Ke'ehi Lagoon for Airports and Harbors use. It is our opinion that the existing water areas and submerged lands are under the control of Harbors Division. The same rationale applies to the distribution of revenues.

Page II-6. Over 1,000 slips will be provided between the Lagoon Drive Marina and the Triangle development (page II-12). Another 200+ could be accommodated at the Pier 60 Marina. This will satisfy a major percent of the demand. The benefit to the State will be in the form of revenues from the lease of the area to a private developer.

Page II-6. Ferry passengers would be bused to/from the airport terminal(s) and the ferry terminal. No specific studies have been done as yet for a public transportation system.

Page II-7. There is still a need for a permanent yacht race/ocean sports center. While we have accommodated existing yacht races at Ala Wai Harbor in the past, it has become increasingly more difficult to do so in recent years due to the limited space within the harbor. A year-round facility will also foster other major yacht races here, such as the World 12-Meter Championships and a Pacific Basin Championship series for which Hawaii is centrally located. The planning for Ke'ehi Lagoon also includes other needed activities. As mentioned in the Draft EIS, implementation of the 1977 Ke'ehi Lagoon Recreation Plan has been slow. Because of changing needs and desires, the re-evaluation of the master plan for Ke'ehi Lagoon is timely.

Page II-8. We will address the priorities based on need.

Page II-9. The specific location for the bridge to the Triangle will be evaluated based on consideration of traffic, airport/airspace restrictions, safety and other impacts. A bridge from Lagoon Drive to the Triangle is the least expensive option, having the least vehicular and vessel traffic impacts. The exact location of the bridge to Lagoon Drive is not yet fixed, although it is recommended that the location be generally as shown in Figure II-8. Detailed planning and design will be accomplished by the developer based on his proposed development plan.

Page II-12. Refer to our response to your comment for page I-3.

Page III-2. Noted.

Page III-4. Comparisons to other areas are given as examples only.

Page III-8. Refer to our response to your comment for page I-4 regarding the stilts. The existing National Wildlife Refuges in Waiawa and Honouliuli assume a major habitat for providing safe nesting habitat for the endangered Hawaiian water birds and are of special importance for the Hawaiian Stilt.

Page III-8. Refer to referenced study.

Page III-12. Noted.

Page III-13. Noted.

Page III-13. Since the Ke'ehi Lagoon ferry terminal is part of the Lagoon Drive Marina, the schedule for completion is tied in to the approximate schedule for the completion of the Lagoon Drive/Triangle development. See Figure II-12.

Page III-27. Refer to our responses to your comments for pages II-1 and II-4.

Page III-29. Refer to our response to your comment for page I-3. As mentioned in the Draft EIS, no live aboards will be permitted in any of the newly developed marinas.

Page III-29. There are no current restrictions regarding the moored vessels in the lagoon. In response to legislative mandate, the department is in the process of implementing rules and regulations concerning the mooring of vessels in the lagoon.

Page IV-3. Refer to our response to your comments for pages I-4 and III-8.

Page IV-6. The Draft EIS states "With or without development of the PLAN, carbon monoxide concentrations in the area will likely improve during the next several years due to the overall reduction in emissions from the vehicle fleet as older model vehicles with less effective emission control devices drop out of service." See also Appendix I, Air Quality Study for the Proposed Ke'ehi Lagoon Recreation Plan.

Page IV-6. Refer to our response to your comment for page I-3.

Page IV-9. This is already mentioned in Chapter I.

Page IV-10. Based on the waiting list for Ala Wai Harbor, the Ke'ehi Lagoon development will satisfy approximately 80% of the present demand. Lack of acceptable sites for new marina development limits the options available. New private marinas on the west end of the island may serve to meet remaining demand.

Page IV-10. It is not intended to exclude aeronautical activities from the industrial/commercial lands on the Triangle. Refer to our response to your comment for page II-2.

Page IV-11. Refer to our response to your comment for page II-4. The appraisal to establish the lease rent takes into account the cost to the developer for providing the public components of the project.

Page IV-11. The concrete batch plant is not within State areas to be developed. Industrial tenants on State property who will be affected by the project are on month-to-month revocable permits as stated.

Page VI-1. The high mountains of Mauna Kea and Mauna Loa block the tradewind flow, thus creating a "wind shadow" effect due to stagnation of flows.

Page VI-1. Wet storage of boats refers to boat slips.

Page VI-3. Kewalo Basin and Honolulu Harbor (Fort Armstrong) are designated for commercial vessel operations and facilities. They are also at capacity, and even with the proposed expansion of Kewalo Basin, as described by the Honolulu Waterfront Master Plan, cannot satisfy the demand for recreational boating needs.

Page VI-4. The neighbor islands were generally surveyed to determine whether any specific site could be considered as an alternative. As the Draft EIS states, no site on the neighbor islands was identified as having any likelihood of being developed in a significant fashion.

Page VI-6. While there may not be any formal rejection by the Department of Defense of any specific plans to develop Pearl Harbor, it is our understanding that major public recreational boating use is not compatible with the defense use of the Pearl Harbor water areas. This is further evidenced by the Department of Defense maintaining the Pearl Harbor Defensive Sea Area. The National Wildlife Refuges in Pearl Harbor were created as mitigation sites for the Reef Runway construction, and serve as major habitats for water birds. These habitats are much more critical to the water birds than any area in Ke'ehi Lagoon.

Page VI-8. We plan to develop the Maunalua Bay ferry terminal as soon as possible.

Page VI-9. The need for airport support areas as described in the South Ramp Development Plan and the required widening of Lagoon Drive has precluded development of the strip park. However, a landscaped strip will be maintained between Lagoon Drive and the marina. Traffic impacts are mitigated since the marina traffic peaks during weekends when the South Ramp traffic is minimal.

Page VI-9. Figure II-9 shows the areas to be dredged. A present source for the additional fill is the stockpile at Barbers Point Harbor. The present concept plan minimizes fill requirements by siting filled areas on existing shallow mudflats and minimizes environmental impacts by restricting dredging to already dredged areas. Much greater costs and environmental impacts would otherwise result. The relative proportion of space to be used for aviation versus maritime uses will be determined based on need. Refer to our previous response to your comment concerning revenues.

Page VI-10. Taking no action would maintain the status quo with no positive public benefit. Existing facilities are inadequate to accommodate the desired needs.

Page VII-1. Noted.

Page VII-1. Ke'ehi Lagoon has been greatly disturbed by past dredging and filling activities and is continually stressed by discharges from Kalihi and Moanalua Stream. The presence of nehu in the lagoon substantiates the contention that flushing and resettling is sufficient to restore and maintain water quality conditions. Numerical circulation studies (Appendix G of the Draft EIS) indicates no significant adverse impacts due to the plan. Construction impacts will be mitigated through adherence to all local and Federal requirements related to construction activities.

Page VII-1. A recently enacted State law authorizes the Department of Transportation to issue mooring permits for all boats moored in State waters. The rules and regulations to implement this law are currently being formulated and will enable us to relocate existing vessels to the authorized mooring area. We are implementing a project to install buoy moorings in the authorized mooring area which will accommodate all of the vessels currently moored throughout Keehi Lagoon. The concrete batch plant is not within areas to be developed. Refer to our response to your comment for page IV-11.

Page VII-2. There will be no significant impact on existing aviation uses by the new maritime and recreational uses proposed within the lagoon. Commercial and light industrial space in the Triangle will be used to support aviation uses as well.

Page VIII-1. It would be presumptuous to speculate as to what other uses the filled lands could be put to in the future. Open space park is one potential use.

Page IX-1. Refer to our previous responses to your comment.

Page X-1. Refer to our previous response to your comment.

Page X-1. The conference report to the FY 1990 Transportation Appropriations bill which recently passed the Congress releases the Ke'ehi Lagoon submerged lands from the conditions imposed by Section 23. This became Public Law 101-164 when it was signed by President Bush on November 21, 1989.

HAR-ED 2146

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

DANIEL K. INOUYE
HAWAII

United States Senate
SUITE 722, HART SENATE BUILDING
WASHINGTON, DC 20510
(202) 224-3934
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October 31, 1989

Mr. Edward Hirata
Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Ed:

Thank you for your recent communication and enclosed copy of the Keehi Lagoon Recreation Plan Draft Environmental Impact Statement. I appreciate your efforts to keep me informed of developments on this matter.

Aloha,

DANIEL K. INOUYE
United States Senator

DKI:sed

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

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

November 14, 1989

MEMORANDUM

To: Dr. Marvin T. Miura, Director
Office of Environmental Quality Control

Subject: Draft Environmental Impact Statement (DEIS) for
Keehi Lagoon Recreation Plan
TMK: portions of 1-1, 1-2, 1-5
Area: approximately 1,360 acres

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

Thank you for the opportunity to comment.

Yukio Kitagawa
YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: Department of Transportation, Harbors Division
(attention: Mr. Fred Nunes)
Edward K. Noda and Associates, Inc.

JOHN WAIHEE
GOVERNOR

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

October 13, 1989

Engineering Office

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street, #104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Ke'ehi Lagoon Recreation Plan
Draft Environmental Impact Statement
Honolulu, Hawaii

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

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

Sincerely,

Jerry M. Matsuda
Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

cc: Mr. Fred Nunes, Project Manager, DOT
Edward K. Noda & Associates, Inc.

NATIONAL GUARD
Americans At Their Best

R/s 5244

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

November 20, 1989

Dec 5 3 15 PM 89
ENVIRONMENTAL QUALITY CONTROL

To: Marvin T. Miura, Director
Office of Environmental Quality Control

From: Director of Health

Subject: Keehi Lagoon Recreation Plan Draft EIS
State of Hawaii
Department of Transportation

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

Wastewater Disposal

We have reviewed the subject draft EIS and recommend that the existing county sewer line be rehabilitated and expanded to accommodate the additional flow from this state project. No IWS should be permitted. The State and City must cooperate to construct the necessary wastewater infrastructure required for the subject development.

Water Pollution

The "Keehi Lagoon Recreation Plan" proposes activities which will require the issuance of a U.S. Army Corps of Engineers Clean Water Act 404 permit, which in turn will require a Department of Health 401 certification.

The purpose of the 401 certification is to ensure that the issuance of a Corps of Engineers 404 permit to fill Waters of the United States will not result in a violation of State Water Quality Standards. The draft EIS correctly identifies Keehi Lagoon as a class A waterbody. (The draft EIS misidentifies the Ala Wai Yacht Harbor as class B, a designation which no longer exists. It is now designated class A.) An additional Water Quality Standards designation, not identified in the draft EIS, applies to the lagoon triangle reef, which is a class II marine bottom ecosystem. Section 11-54-03(d) of the Water Quality Standards states: "It is the objective of class II marine bottom ecosystems that their use for protection including propagation of fish, shellfish, and wildlife, and for recreational uses not be limited in any way."

XII-23

Figure II-8 of the draft EIS indicates that the majority of the remaining coral reef in the Keehi Lagoon triangle will be filled for commercial and light industrial development. This use is not consistent with the class II marine bottom ecosystem designation. The 119 acres of reef proposed for the industrial park constitute a significant portion of the remaining Keehi-Kapalama shallow reef. We recommend preservation of this large reef area.

The Department of Transportation must justify its proposal to fill the triangle reef area for commercial and light industrial development. The 401 certification process will require a Department of Health public hearing since the proposed filling will have a significant environmental impact. In order to avoid delaying implementation of those recreational portions of the Plan which will not have adverse environmental impacts, it might be advantageous to consider separating out the proposal for the industrial development.

JOHN C. LEWIN, M.D.

cc: Harbors Division, Department of Transportation
Edward K. Noda & Associates, Inc.

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN R. UCHIMA
RONALD N. HIRANO
DANY HOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

December 22, 1989 HAR-ED 2109

MEMORANDUM:

TO: The Honorable John C. Lewin, Director
Department of Health

FROM: Director of Transportation

SUBJECT: KE'EHI LAGOON RECREATION PLAN DRAFT EIS
JOB H. C. 2241

Thank you for your memorandum of November 20, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

The additional sewage flows from the proposed development will be accommodated by either upgrading of the County system or construction of a new system to carry flows directly to the Sand Island Sewage Treatment Facility. Possible sewer system improvements are described in the Utility Master Plan which is contained as Appendix F in the Draft EIS. We are in the process of further exploring sewage disposal options with the City and County Department of Public Works.

Your comment regarding the State Water Quality Standards designation of Class II Marine Bottom Ecosystem for the triangle reef area in the lagoon is duly noted. We intend to pursue a rules change to redesignate the area. Our marine environmental investigations reveal the triangle mudflat to be a depauperate aquatic resource area with no unique habitat value.

It is the Department of Transportation's intent to resolve the issue of filling in the triangle area within the context of the Department of the Army (DA) permit and the related Department of Health 401 certification. We have considered the option of separating the Triangle Development from the other plan

components for regulatory purposes. However, the Corps of Engineers has expressed their desire to review the Ke'ehi Lagoon master plan in entirety since impacts of individual projects may potentially have a cumulative area-wide impact on the lagoon. All major individual projects described in the Recreation Plan require DA permit approval.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

John D. Leuzinger
for Edward Y. Hirata

JOHN WAIHEE
GOVERNOR OF HAWAII

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

DEPUTIES
LIBERT K. LANDGRAF
MANABU TAGOMORI
RUSSELL M. FURUMOTO

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

REF:OCEA:CT

DEC 20 1989

File: 90-230
Doc.: 6993E

MEMORANDUM

TO: The Honorable Marvin T. Miura, Director
Office of Environmental Quality Control

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

SUBJECT: Ke'ehi Lagoon Recreation Plan Draft Environmental Impact Statement

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.

The Draft EIS implies that the mudflats within the Ke'ehi Lagoon area are no longer of importance to the Hawaiian Stilt as one of its feeding sites. This conclusion is apparently based on surveys done in March, April and May, 1989 by OI Consultants, Inc. and comparing the results with surveys done in 1971-1978 for the reef runway project by other consultants. The conclusion is also based on division of Forestry and Wildlife surveys and that Hawaiian stilts are not known to nest within Ke'ehi Lagoon.

It should be noted that Forestry and Wildlife surveys are done only twice a year and not always at the optimal tide level for bird useage of the mudflats. The time spent at each site is also very minimal. The results of these surveys are only indicators of use at a particular time and not as data to measure habitat quality or importance. An example is the sighting of eleven (11) stilts during the survey in July, 1985 which is not mentioned in this Draft EIS. OI Consultants, Inc. conducted 6 surveys covering a span of only three months and only three of the surveys were during low tide. The time spent monitoring each site is also not stated.

Since the mudflats at Ke'ehi Lagoon are considered necessary feeding habitat by the State and U.S. Fish and Wildlife Service as stated in the Hawaii Waterbird Recovery Plan and since the Hawaiian Stilt and other shorebirds feed on these mudflats, we feel that OI Consultants, Inc. surveys are not adequate and that their conclusion is premature.

On the matter of mitigation, we believe it is insufficient to simply state that planning and implementation will be carried out by the Department of Land and Natural Resources and the Department of Transportation. More substance is required to compare the loss and gain.

The sacrifice of an endangered species habitat to a use that would render it lost forever and simply state that another will be developed especially one that requires the least cost to acquire, develop and maintain is not acceptable.

We, therefore, feel that this Draft EIS does not completely address the concerns for the Hawaiian Stilt, other migratory shorebirds and their feeding habitat within Ke'ehi Lagoon.

Also, the Draft EIS states that upon completion of the proposed Canoe Center, aku and bait fishermen will be allowed continued access to baitfish stocks which occur near the streams. However, the Draft EIS does not discuss whether baitfishing activities will be allowed to continue in the water ski course area as well as the southeastern end of seaplane Runway D. A final or supplemental EIS should address this issue.

With regard to reef flats and fringes that would be destroyed by the proposed triangular development, the Draft EIS states that reef destruction would be mitigated through the creation of artificial reefs elsewhere within Mamala Bay. No further discussion is offered in regards to the number of, locations, size of, or types of artificial reefs to be constructed. Again, the final EIS should address this issue. We note that artificial reefs as presently maintained are located offshore and may not necessarily prove beneficial to nearshore fishermen.

In addition, the Draft EIS states that 1.6 million cubic yards of fill material would have to be imported from offsite. However, the source for this fill (760,000 cubic yards) for the proposed lagoon drive marina is not specified. Assuming that this amount would also have to be imported from offsite, almost 2.4 million cubic yards would be needed to meet fill volume requirements. We concur with the Department of Transportation that this volume should be imported from offsite, that no additional reef flat or fringe areas be sacrificed to make up this fill volume requirement. The existing reef/mud flat and fringe areas currently serve as nursery areas for transitory schools of important juvenile food fishes such as weke, mullet, aholehole, moi, and others. They also serve as habitat for octopus, and many edible forms of seaweed. Therefore, seasonal recreational fishery opportunities would be greatly diminished should additional reef flats be destroyed.

Finally, we believe, this project will have "no effect" on significant historic sites. The project area is largely fill, and the natural portions have been severely modified over recent years.

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

WILLIAM W. PATY

XII-26

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

EDWARD M. MIURA
DIRECTOR

DEPUTY DIRECTORS
JOHN E. KOMAYA
RONALD N. HIRANO
DANT. KOCH
JEANNE H. SCHULTZ

IN REPLY REFER TO:

January 4, 1990 HAR-ED 2134

MEMORANDUM:

TO: The Honorable William W. Paty, Chairperson
Board of Land and Natural Resources

FROM: Director of Transportation

SUBJECT: KE'EHI LAGOON RECREATION PLAN DRAFT EIS
JOB H. C. 2241

Thank you for your memorandum of December 20, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

We note your comments regarding the methodology for surveying the bird populations and your opinion that the results of these surveys are only indicators of use and not as data to measure habitat quality or importance. While the point you raise is technically correct, the survey methodology is a technique which is commonly used to obtain a relative understanding of the general patterns of temporal and spatial distribution of bird populations. It is the opinion of our avifaunal consultant that the historical data supports the conclusion that the mudflats are presently of no significant importance to the Hawaiian stilt. While this opinion may not be concurred with by other experts in the field, there has been no written opinion submitted in response to the Draft EIS that states otherwise.

The comments submitted by the USFWS indicate that their evaluation of project impacts and determination of whether the proposed actions would jeopardize the continued existence of the Hawaiian stilt, would be made during Section 7 consultation with

the U. S. Army Corps of Engineers. While they have offered no opinion as to the present habitat quality, they refer to their Hawaiian Waterbirds Recovery Plan of 1985 which identifies Ke'ehi Lagoon as essential habitat for the recovery of the Hawaiian stilt. The Draft EIS acknowledges that Ke'ehi Lagoon was classified in the USFWS Hawaiian Waterbirds Recovery Plan, along with 25 other sites on Oahu, as a primary habitat for the Hawaiian stilt and the other three endangered waterbirds. The Draft EIS further points out that the Recovery Plan states "in the event that any of the identified essential habitat sites cannot be maintained, despite all efforts to preserve their value to waterbirds, it is possible that suitable substitutes could be used."

It is our conclusion that substitute habitat can be created that is equal to or will provide a better habitat than the Ke'ehi triangle mudflat. The National Wildlife Refuges established in Pearl Harbor as mitigation for the Reef Runway construction have successfully provided safe habitat for the Hawaiian stilt and other endangered waterbirds, and serves as an excellent example of not only successful mitigation but also habitat enhancement for the waterbirds and migratory shorebirds. As described in the Draft EIS, it is our intent to provide similar mitigation for the loss of mudflats in Ke'ehi Lagoon due to the proposed plan. As we discussed in meetings with you and your staff, the specific mitigation plan will be developed during coordination efforts with the applicable Federal agencies within the context of the Department of the Army permit action. Any details regarding the mitigation habitat must be evaluated and designed in conjunction with specific input and requirements of the applicable federal agencies. It would be premature to provide details on the design of the mitigation habitat at this time. The Draft EIS makes no statement that the mitigation habitat will be one that requires the least cost to acquire, develop and maintain.

The Recreation Plan proposes no development that will prevent or prohibit baitfishing activities in the lagoon. In fact, the clean up and development of Ke'ehi Lagoon will aid baitfishing activities by making the areas more accessible. If detailed engineering and design for the developments indicate that any proposed development may affect current baitfishing activities, then a supplemental EIS will be prepared to address this issue.

Detailed mitigation for any loss of reef flats and fringes would be designed when more detailed plans for the development

are prepared which will indicate the exact losses due to the proposed development. As you know, artificial reefs have been designed and implemented in nearshore waters in Mamala Bay and have been shown to support juvenile populations of reef fish. The nearshore area fronting Kaka'ako is one possible location for artificial reef enhancement. As proposed in Appendix A to the Kaka'ako Makai Area Plan Draft Supplemental EIS, an "artificial reef sanctuary and research area" offshore Kaka'ako would complement and enhance the proposed Kaka'ako Park and offshore improvements recommended by the Honolulu Waterfront Pre-final Master Plan, and would also be consistent with the recent legislative resolution (H.R. No. 266, H.D.1) which mandated DLNR to designate a site as an Artificial Reef Zone and Marine Life Conservation District. Any proposed artificial reef mitigation for the Ke'ehi Lagoon Recreation Plan would certainly be complementary within such a designated site.

For your clarification, any dredging required for the project will not affect reef flats seaward of the triangle area. As shown in Figure II-9 of the Draft EIS, the dredging required for navigation is confined to Seaplane Runway "B" and areas previously dredged.

We note your determination that the project will have no effect on significant historic sites, and your concurrence that "the project area is largely fill, and that natural portions have been severely modified over recent years."

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

14

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT

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

KAMAMAMA BUILDING, 250 SOUTH KING ST., HONOLULU, HAWAII
MAILING ADDRESS: P.O. BOX 2359, HONOLULU, HAWAII 96804 TELEPHONE NO. 548-3048 FAX (808) 523-6417

November 28, 1989

DEPT. OF TRANSPORTATION
'89 DEC -4 P3:43
ENGINEERING

Department of Transportation
Harbors Division
79 S. Nimitz Highway
Honolulu, Hawaii 96813

Edward K. Noda & Associates, Inc.
615 Piikoi Street, Suite 1000
Honolulu, Hawaii 96814

Attn: Fred Humes, Project Manager

Re: Ke'ehi Lagoon Recreation Plan
Draft Environmental Impact Statement

Dear Gentlemen:

The Department of Business and Economic Development has the following comments to your application:

Figure II-2 This map is not quite accurate. There are no notations of boats moored in the South anchorage adjacent to Sand Island or of boats currently moored in the Keehi triangle. Jet skiing, windsurfing, and sailing areas off of Harris and Mokauea Islands are occurring only next to Harris Island as a commercial operation.

Page 11-4, 2.4.1 Hawaiian Canoe Center. The Canoe Center was originally proposed as a facility capable of accommodating international canoe regattas and as a year-round training facility capable of housing the needs of numerous canoe clubs, including storage facilities for their canoes and athletic training rooms. The present conceptual designs do not address these needs.

Figure II-2 Pier 60 Marina Conceptual Plan. This conceptual plan shows an authorized mooring area across from the proposed Pier 60. This authorized mooring area is not discussed in the text nor is there any discussion of what types of shoreside facilities will be developed to accommodate the boats in this authorized mooring area.

Page 11-6 Lagoon Drive Marina. In keeping with the goal of providing public access to the ocean recreation activities, it would appear that a small strip park or park-promenade would be appropriate as a part of the Lagoon Drive Marina development. The plans, as they are conceptually proposed, show only parking lots, boat slips, and buildings. Ideally, a few trees would provide for a more park-like environment.

XII-28

Page 11-9 The plans state that the "public parks will provide views on access to the water around most of the perimeter shoreline," why not around the entire perimeter shoreline? In the parking area adjacent to the triangle marina, the conceptual plan shows space allocated for parking stalls with no trees or greenbelt incorporated. It would not significantly alter the plan nor take away from the industrial acreage to add a strip park along this portion of the shoreline. Although we are not aware of any studies that have been done, people like to look at boats. A small strip park, half the size of the "ocean strip park" along the southern shore, is a strongly recommended addition to the plan.

Figure II-8 Triangle Use Development Plan. As conceptually drawn, the triangle strip parks do not provide for any type of promenade or pedestrian walkway, which could also be used as a jogging/bicycle path. This type of addition is recommended as an accessway to the shoreline, and ease of public viewing of water activities are the stated main purposes of the parks.

Page II-11 Yacht Race/Ocean Sports Complex. The stated objective of this facility is to provide permanent headquarters for year-round yacht racing regattas. This is a much needed facility, however, many of the events listed, i.e., Transpac and Kenwood Cup presently occur for one month every other summer. The original intent of this facility is to provide not only a staging area for seasonal races, but to additionally provide a year-round "olympic caliber" training facility for sailing and other ocean sports. This facility should be designed in such a way that the infrastructure is not too limiting and does provide options for numerous types of ocean-sports training. I think you will find that there is enough of a demand for this type of training facility and that it will not be able to accommodate transient vessels or short-term charter concessions. As a training complex, provisions should be made in the infrastructure to provide for a multi-fitness facility.

Page III-13 Public Transportation. If you have ever tried to ride a bus out to Keehi Lagoon or to the Sand Island area, you would not call the bus routes which currently service the area "in the immediate vicinity." It is currently a couple of miles from the bus line to the entrance of the Sand Island Park. Is there any type of coordinated effort to bring better public transportation services to the Keehi Lagoon Area once the development is initiated?

Page III-22 Recreation. Currently large off-shore federally designated anchorage areas exist along Seaplane Runway "D" and along the reef edge adjacent to Mokauea Island and Sand Island (often referred to as the "South Anchorage"). The vessel moorage

in the "South Anchorage" needs to be stated here even though this area is considered outside the scope of the plan. Vessels anchored within this zone will have to move. Although it is not part of the plan, where the vessels move to and what becomes of this waterway between Sand Island and the reef is under the jurisdiction of the Department of Transportation. No mention is made of the numbers of vessels in the anchorages.

Off the tip of the Sand Island adjacent to Kalihi channel, the University of Hawaii currently runs its Outdoor Recreational classes under a permit from DLNR. These classes include sailing instruction, boating safety, motor boat handling classes, windsurfing classes, and kayaking classes. On the shoreline along the underdeveloped portion of Sand Island, there is extensive fishing and boating activities during the weekends.

The map in Section II (Figure II-2) indicates existing conditions. This map would be more appropriately placed in the text in this section. There is no mention made in this section about the level of commercial ocean recreational activity presently occurring in Keehi Lagoon or the need to balance the growth of this commercial activity with public ocean recreational opportunities. Presently, there are numerous charter boat operations, water skiing charters, and two jet ski companies (one that also offers windsurfing) that operate regularly in or depart from Keehi Lagoon. As park facilities are developed, opportunities for recreational use of the area will expand. Competition for space will occur especially if exclusive use zones such as those designated for thrillcraft are not limited.

The first sentence, last paragraph is somewhat misleading. The Aotani and Associates document focused on ocean recreational conflicts exclusively. Ocean recreational conflicts do not necessarily threaten the public's health, safety and welfare, and these conflicts are not preventing Keehi Lagoon from achieving its most productive economic role. Lack of proper facilities, inadequate access to the shoreline, and a shoreline and waterway that have become a depository for derelict vessels and other trash are the main reason that have kept Keehi Lagoon from achieving its most productive economic role.

Page III-24 Canoe Facilities. Besides the numerous canoe paddling clubs, there is an even increasing interest in kayaking and the need to develop facilities for kayak training and competition as well as for canoeing. There are presently at least two kayaking events in which the participation is international, these are the Molokai to Oahu Kayaking race and the

Steinlarger Competition. Are the facilities at Keehi Lagoon designed solely for canoeing or is kayaking a part of this complex? If not, then why not, since the sports are mutually compatible.

Page III-25 Marina Facilities. The Keehi Small Boat Harbor owned and operated by the State provides limited amenities. Only four (4) piers have water and/or electricity. Many of the piers are designated for small vessels (under 30 feet). If the plan occurs, are there any plans to upgrade the State's facility in Keehi?

Page III-26 Presently, no sewage "pump-out" facilities currently exist for either boats moored at the marinas or off-shore.

Page III-29 Removal of Derelict and Abandoned Vessels. The estimates on the approximate number of vessels should total 350 boats with 165 liveaboards and 124 non-liveaboards. It should be noted that several of the boat owners live aboard their vessels because of a lack of secure facilities to safely moor their boats either in Keehi Lagoon or elsewhere. Additionally, a lack of housing on Oahu makes living aboard a vessel a preferred option for some people. Why are vessel numbers discussed in the section entitled "Removal of derelict and Abandoned Vessels?"

Page III-32 Oahu Intra-island Ferry System. The discussion of the Ferry System is written in such a manner as to indicate a final plan has been adopted. Isn't part of the Ferry system still in the conceptual stages? Additionally, during the public input process for the Honolulu Waterfront Master Plan, a ferry landing was proposed at Ala Wai Boat Harbor as one of the alternatives for this area. A ferry terminal at Ala Wai was vehemently opposed during these sessions. Are you sure you want to describe this concept in quite this level of detail?

Page III-30 Sand Island State Park Development. In a meeting held between the City and State in August 1989, there was still significant negotiations progressing about the proposed land exchange and subsequent development of the Sand Island Park. In the latest discussions, the approximately ten (10) acre parcel at the northwest corner of Sand Island next to the bridge is slated for maritime recreation development. The City has no desire to develop this area and has left the development of this ten (10) acre section up to DLNR and DOT-Harbors. Present plans for this site include a boat launching ramp and a comprehensive community based aquatic center. Even though this area is technically outside of the area described by this plan, it is to be partially developed by DOT-Harbors and may, therefore, be a good reference point

to add to assist in coordinating the various plans for the entire area.

Page IV-11 — Reference is made in the fourth paragraph to vessels presently illegally moored having to move into authorized mooring areas. No definition of these authorized mooring areas is given in the plan, and it is stipulated that these vessels will have to move prior to plan construction. If there are currently 2,300 vessels on waiting lists for marinas, where are the vessels which are currently illegally moored supposed to go? Additionally, it is stated that no liveaboards will be permitted in any of the new marina facilities. There is no justification given for this statement. Initially the question of "why" arises.

Page IV-1 — Site Selection Criteria (proximately to protected waters). The criteria for protected waters needs to be expanded to address not only winds but also waves. Using Haleiwa Harbor as an example is appropriate because it is not protected from normal tradewinds or storm winds, but the winter swell and surf conditions make this area and the harbor virtually undesirable for the entire winter months.

Page VII-1 — Short-term losses. If the illegally moored vessels must move prior to construction as sited in the plan, there are no marina facilities available. The only other protected authorized mooring is in Kaneohe Bay. Has there been any projection done on how this will affect activities in Kaneohe Bay or have any short-term solutions to where these vessels are suppose to go been proposed? During the development of the canoe racing facility, will the construction affect the race course during the time it is needed for racing? How will the construction of a bridge from Lagoon Drive to the triangle affect current navigable waterways? During the various phases of construction will activities presently occurring in the lagoon be affected, especially during filling-in of the triangle? The short-term and long-term losses sections need to be expended somewhat to answer these questions.

Sincerely,

for Roger A. Ulveling

RAU:dq

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

January 3, 1990

HAR-ED 2123

MEMORANDUM

TO: The Honorable Roger A. Ulveling, Director
Department of Business and Economic Development

FROM: Director of Transportation

SUBJECT: KE'EHI LAGOON RECREATION PLAN DRAFT EIS
JOB H. C. 2241

Thank you for your letter of November 28, 1989. Our responses to your itemized comments are as follows:

Figure II-2 — For your clarification, the anchoring of boats in Seaplane Runway "D" next to Sand Island as well as throughout the lagoon, except within the authorized mooring area opposite the existing marinas/small boat harbor, is not State-sanctioned. With implementation of mooring rules and regulations, the DOT will have authority to confine moorings to the authorized mooring area. This action is presently underway. HAR Title 19, Subtitle 3, Part 5, Chapter 86, Ocean Recreation Management Rules and Areas, Subchapter 6, designates commercial zones for thrill craft (jet skis) and windsurfing, sailing and diving, in the areas indicated in Figure II-2.

Page II-4 — The uses which you mention are desired within the Canoe complex. Please note that detailed plans have not yet been developed for this complex, nor for any other project described in the Recreation Plan. Further planning for the canoe improvements is presently underway. The Final EIS will include the most current plans developed to date.

Figure II-6 — The authorized mooring area opposite Pier 60, Keehi Boat Harbor, Keehi Marine Center, and La Mariana is an existing authorized anchorage, and is the only authorized anchorage area within Ke'ehi Lagoon. Recent legislative funding was obtained to install permanent mooring buoys within this area. The intent is to organize the existing vessels which are randomly anchored throughout the lagoon into the authorized area. Under a new law passed by last year's Legislature, the Harbors Division is authorized to relocate existing vessels into the authorized mooring area and to evict vessels that do not comply with our rules and regulations.

Page II-6 — A landscaped strip will be provided between the marina and Lagoon Drive, and landscaping will also be required within the marina complex.

Page II-9 — Public access must be restricted along the U. H. dockside frontage and the maritime commercial dockside frontage for safety and security reasons. Landscaping will be required for all parking areas. Because of the scale of the concept drawings (1"=500'), it is not possible to show any details. The design criteria requirements for the development will stress the use of tropical landscape to ensure an attractive "park-like" setting for all areas of the project.

Figure II-8 — There is sufficient space within the triangle and strip parks for a promenade or pedestrian walkway. The requirement for public walkways will be part of the design criteria requirements for the project.

Page II-11 — We concur with your comments. For your clarification, this facility will not be operated by the State but will be developed and operated by the private developer. Therefore, it behooves the developer to provide as much flexibility in the design of the facility to permit optimum use.

Page III-13 — If the proposed plan is implemented, there will be sufficient demand to possibly extend bus routes into the major development areas. The DOT will encourage the City to review this issue.

Page III-22 — The only federally designated anchorage area within Ke'ehi Lagoon is adjacent to the sand bar berm, across from the existing marinas and Ke'ehi Small Boat Harbor. The Seaplane Channel adjacent to Sand Island (which you refer to as "South Anchorage") is not an authorized anchorage area. As mentioned above, the DOT is in the process of implementing rules and regulations for moorings. It is our intent to install permanent mooring buoys and to move all vessels currently anchored randomly throughout the lagoon into the authorized mooring area. The Draft EIS mentions that there is presently about 300 vessels moored offshore in the lagoon waters.

Your comments relating to the use of Sand Island by the University of Hawaii are noted. We have been working with DLNR and the University to formalize water education facilities at the Kalihi Channel end of Sand Island as well as construct additional boat launching facilities at that location.

As mentioned above, HAR Title 19, Subtitle 3, Part 5, Chapter 86, Ocean Recreation Management Rules and Areas, Subchapter 6, designates commercial zones for thrill craft (jet skis) and windsurfing, sailing and diving within the lagoon. This will be clarified in the Final EIS.

Many of the conflicts identified by the Ocean Recreation Management Plan Study relate to conflicts resulting from the lack of facilities and improvements and management problems. The listed conflicts and problems on page III-23 were those identified by the referenced study in their Summary of Findings.

Page III-24 — The Canoe complex will also be able to accommodate kayaking. There is no mention of excluding other compatible uses.

Page III-25 — The Harbors Division must operate the existing State small boat harbor in Ke'ehi Lagoon as part of our boating program. Improvements are presently being designed to correct some of the problems at Ke'ehi Boat Harbor. Future potential improvements to this facility are dependent on the statewide priority of needs of our small boat harbors.

Page III-26 Noted.

Page III-29 The Harbors Division is presently in the process of updating our inventory of vessels anchored offshore in the lagoon. The text will be clarified with respect to the planned disposition of these vessels, as discussed above. While we recognize the reasons why living aboard vessels in Ke'ehi Lagoon is presently the preferred option for some people, sanitary problems with the live-aboards and noise constraints imposed by the airport preclude sanctioning of residential uses in the lagoon. The proposed marinas will alleviate the present demand for slips.

Page III-32 A Final EIS for the Oahu Intraisland Ferry System was accepted by the Governor on January 19, 1989. Detailed planning for the individual ferry terminals comprising the system is still underway.

Page III-30 An additional paragraph under Section 3.3.6 of the Final EIS will include details of the U. H. and DOT facilities proposed for the Kalihi Channel end of Sand Island.

Page IV-11 The text will be revised to clarify the present disposition of vessels anchored in the lagoon and the ongoing effort to develop rules and regulations for the mooring area, as discussed above. The Draft EIS states that the noise constraints within the lagoon preclude residential uses.

Page VI-1 Noted.

Page VII-1 Temporary relocation of vessels during construction can be accomplished within Ke'ehi Lagoon. It is intended that the installation of mooring buoys within the authorized mooring area and implementation of the mooring rules and regulations will eliminate much of this problem prior to construction. As mentioned in this section, access to portions of the lagoon and its shoreline will be temporarily limited during construction. This includes access to the canoe race course during construction of certain phases of the Canoe Complex improvements. Alternative canoe racing sites may have to be

used. Navigation access between the Kalihi Channel and existing boating facilities within the lagoon will not be obstructed during construction of the bridge to the Triangle Island. Obviously, access to all areas within the limits of construction will be precluded during construction activities.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Edward Y. Hirata

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT

JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA FINA STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUKARA
DEPUTY DIRECTOR

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

October 11, 1989

Mr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 S. King St., #104
Honolulu, Hawaii 96813

Dear Mr. Miura:

Subject: Ke'ehi Lagoon Plan Draft Environmental Impact Statement, Honolulu, Hawaii

In response to your request for comments regarding the subject environmental impact statement, please be advised that we have none to offer.

Also, as requested, we are returning the EIS to you as we have no further use for it.

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:if

cc: Department of Transportation, Harbors Division
Edward K. Noda & Associates Inc.

XII-33

Hawaii Community Development Authority

John Waihee
Governor
Kenneth K. Takenaka
Chairman
Rex D. Johnson
Executive Director

677 Ala Moana Boulevard, Suite 1001 Honolulu, Hawaii 96813
(808) 548-7180 FAX: (808) 599-2613

Ref. No.: PL TRANS 7.5

November 6, 1989

Mr. Fred Nunes
Harbors Division
Department of Transportation
79 South Nimitz Highway
Honolulu, Hawaii 96813

Dear Mr. Nunes:

Thank you for the opportunity to review the Ke'ehi Lagoon Recreation Plan and Draft Environmental Impact Statement. We have no comments at this time.

If you have any questions, please contact Mr. Milton Arakawa at 548-2200.

Very truly yours

Rex D. Johnson

RDJ/ST:qst
cc: Edward K. Noda & Associates, Inc.

STATE OF HAWAII
DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT
LAND USE COMMISSION
Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

JOHN WAIHEE
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Frederick P. Whittemore
ESTHER UEDA
Executive Officer

October 18, 1989

Dr. Marvin Miura
Acting Director
Office of Environmental
Quality Control
465 South King Street
Room 104
Honolulu, Hawaii 96813

Dear Mr. Miura:

Subject: Keehi Lagoon Recreation Plan and Draft Environmental Impact Statement

We have reviewed the subject Keehi Lagoon Recreation Plan and Draft EIS and have the following comments:

1) The subject project is designated within the State Land Use Urban and Conservation Districts. To clarify the State Land Use designations, a boundary interpretation may be requested in accordance with Section 15-15-22, Hawaii Land Use Commission Rules.

2) Page I-7, paragraph 2, states that "...A boundary change is not required if the land remains under State Authority." This statement should be clarified inasmuch as we are not aware of any rule or statute that specifically exempts projects from Chapter 205, HRS, if the land remains under State authority.

Thank you for the opportunity to comment.

Sincerely,

ESTHER UEDA
Executive Officer

EU:to

cc: Fred Nunes, DOT Harbors Division
Edward K. Noda & Associates, Inc.

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR
DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD M. FUKUMOTO
DANT. KOCAR
JEANNE K. SCHULTZ

IN REPLY REFER TO

December 26, 1989

HAR-ED 2103

MEMORANDUM:

TO: Ms. Esther Ueda, Executive Director
Land Use Commission

FROM: Director of Transportation

SUBJECT: KE'EHI LAGOON RECREATION PLAN DRAFT EIS
JOB H. C. 2241

Thank you for your letter of October 18, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

Your comments on land use designations are duly noted.

The statement on page I-7, paragraph 2, was intended to read: "...A boundary change is not required if the land remains in conservation district under State authority." As discussed in Chapter X of the EIS, one of the options under consideration for the proposed Triangle Development is to request designation as a Special Subzone in Conservation District which would retain land use regulatory authority by the State.

We will contact you shortly to discuss this further.

for Edward Y. Hirata

JOHN WAIHEE
GOVERNOR

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

MITSUO SHITO
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
89:PLNG/1563A

October 17, 1989

Mr. Marvin T. Miura, Director
Office of Environment Quality Control
465 S. King Street, Room 104
Honolulu, HI 96813

Dear Mr. Miura:

RE: KE'EHI LAGOON RECREATION PLAN DRAFT EIS

We have no comment on the above-referenced project at this time except to mention that you may wish to take into consideration speculation on raising sea levels in developing plans for Ke'ehi Lagoon.

If you should have any questions please contact me at 848-3221.

Sincerely,

HAROLD I. KURIHARA
Acting Executive Director

cc: DOT/Harbors Division/Fred Nunes
Edward K. Noda & Associates, Inc.

XII-35

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. MIRANO
DANT ROCHE
JEANNE K. SCHULTZ

IN REPLY REFER TO:
HAR-ED 2106

December 26, 1989

MEMORANDUM:

TO: Mr. Harold I. Kurihara
Acting Executive Director
Hawaii Housing Authority

FROM: Director of Transportation

SUBJECT: KE'EHI LAGOON RECREATION PLAN DRAFT EIS
JOB H. C. 2241

Thank you for your letter of October 17, 1989 to Dr. Marvin Miura, Director, Office of Environmental Quality Control. We offer the following clarification and responses to your review and comment:

The speculation on rising sea levels has previously been researched by our Consultant. Their findings, based on a two-year study effort by the Marine Board of the National Research Council, indicates that the risk of accelerated mean sea level rise is sufficiently established to warrant consideration in the planning and design of coastal facilities. However, the possible rate of sea level rise for Honolulu is relatively small over the next 50 years, with estimates between 0.71 to 1.75 feet by the year 2050. Thus, the relative rise in sea level above present levels can be considered in the planning and design for Ke'ehi Lagoon improvements, since most of the new development will be accommodated on filled lands.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Edward Y. Hirata

XII-36

OCT 12 1989

(P)2023.9

Dr. Marvin Miura
Director
Office of Environmental
Quality Control
465 South King Street
Honolulu, Hawaii

RECEIVED
OCT 1 3 1989
EDWARD K. NODA & ASSOCIATES

Dear Dr. Miura:

Subject: Keehi Lagoon Recreation Plan
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please contact Mr. Cedric Takamoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

CT:em
cc: DOT Harbors
Edward K. Noda & Associates, Inc.

University of Hawaii at Manoa

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

November 21, 1989
RE:0541

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Draft Environmental Impact Statement
Ke'ehi Lagoon Recreation Plan
Honolulu, Oahu

The above cited document proposes further development of recreational and boating facilities in Ke'ehi lagoon and vicinity. Several major projects are included in the overall PLAN. These are a Hawaiian Canoe Center in the northeast corner of the lagoon; marinas at Pier 60 and along Lagoon drive to provide about 1,200 additional boat slips and other boating amenities; creation of a 250-acre island in the middle triangle portion of the lagoon to provide recreational, educational/research, commercial and light industrial uses; and a sheltered swimming beach at the southwest tip of Sand Island. This review was prepared with the assistance of George Curtis, Joint Institute for Marine and Atmospheric Research; Edwin Murabayashi, Henry Gee, and Yu-Si Fok, Water Resources Research Center; and Carolyn D. Cook, Environmental Center. Concerns have been expressed regarding issues on biological analysis of water quality, traffic, utilities, need for airport expansion, parking, wildlife preservation, and Draft EIS preparation regulations.

Water Quality Analysis

The survey of water quality in Ke'ehi Lagoon as described on page III-3 and Appendix B presents the results of a single set of observations taken over a one day period. The results therefore, cannot provide any indication of seasonal or temporal water quality conditions. Furthermore, the analysis does not include BOD and Fecal Coliform data. This information would be important to the proposed uses of the waters. The Draft EIS indicates that the water quality conforms to class A waters and states that, "Higher bacteriological levels occur at the confluence of Kalihi and Moanalua Streams where they enter Ke'ehi Lagoon". However, we did not find specific reference to bacteriological

data to support this statement. The circulation studies (Appendix G) indicate that the major source of water to the Lagoon comes from Honolulu Harbor. We are particularly concerned with the water quality in the areas proposed for swimming and other water contact recreation uses. Appendix G also indicates that circulation in the swimming area and water ski area will be poor and that an additional channel through the reef will be needed to improve circulation. It would be helpful if estimates of present residence time vs. proposed residence times could be provided in the Final EIS particularly with regard to the water contact recreation areas, so as to permit a more informed evaluation of the water quality of these areas and their long term suitability for the recreational uses proposed.

Traffic

The section on access and traffic on page IV-7 lacks a statement about the predicted effects of this development on the existing traffic situation. A brief statement brought forward from Appendix E would be helpful here. For example, the projected traffic volumes are expected to increase by more than 50 percent along Aolele street during peak hours on week days and more than 70 percent along Lagoon Drive on Saturdays. The document does not indicate what those numbers equate to in terms of probable delays and wait times. For example, use of the Level of Service (LOS) criteria in describing the increased traffic would provide the reader with a better "picture" of the actual impacts of a 50% or 70% increase in volume. The suggestions for ritigation of traffic problems as proposed in Appendix E page 5-9 include the prohibition of parking on various streets leading to Ke'ehi Lagoon. Given the existing critical shortage of parking in the adjacent areas it seems likely that prohibition of parking on the access streets would only create additional impacts to the local businesses and thus not be a viable mitigating measure. The Draft EIS does not appear to address the parking situation in general. What provisions will be made for the increased parking needs for park users?

Utilities

Potable water storage facilities are referred to on page IV-8, but the water demand and cost are omitted from the body of the Draft EIS. According to Appendix F the total water demands for the marina are thus: average day demand, 109,200 gpd; maximum daily demand, 163,800 gpd; and peak hour flow, 544 gpm. Again, these figures and the importance or significance of their values in terms of cumulative impacts on existing sources, supplies, and distribution facilities to Honolulu and Oahu would be helpful in the text of the document.

Airport Expansion Needs

It is stated on page I-3 that the airport "desperately needs land for expansion", but no data is provided to support this statement. It was our understanding that concerns had once been expressed by the Federal Aviation Authority (FAA) with regard to safety and the development of an

industrial/commercial area so close to the flight path of the Honolulu International Airport runways. Have the plans for the Ke'ehi Lagoon Recreation Area and the industrial/commercial development been reviewed by the FAA?

Land Use and Fish and Wildlife Preservation

We are concerned about the impact of this project on the endangered water birds and other migratory water fowl in the Ke'ehi Lagoon area. In addition to the concern for avifauna, we note that the third largest bait fish (Nehu) spawning grounds on Oahu is located here and most certainly will be affected by the development. The Ke'ehi Lagoon area, according to existing federal/state agreements (April 13, 1972) was to be maintained as a State Wildlife Area, yet this agreement seems to have been disregarded in the interest of expansion of waterfront developments. What provisions have been or are being made to justify the fill of submerged lands under the requirements of federal protective statutes for such lands?

OEIS Regulations

According to Chapter 200 of Title II, Administrative Rules (II-200-17-P), the content requirements for a Draft EIS include reproduction of all substantive comments and responses made during the consultation process. Although mention is made that three letters of consultation and/or comments were received, they have not been reproduced in the Draft EIS hence reviewers are unable to evaluate the adequacy of the document to address the concerns or topics raised during the consultation process. This appears to be a definite breach in administrative procedure for fulfilling the requirements of HRS 343.

Thank you for the opportunity to comment on this document.

Yours truly,

Jacquelin N. Miller
Associate Environmental Coordinator

cc: Harbors Division, DOT ✓
Edward K. Noda & Assoc.
L. Stephen Lau
George Curtis
Carolyn D. Cook

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DAN Y. KOCHI
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

January 4, 1990

HAR-ED 2135

Ms. Jacquelin N. Miller
Associate Environmental Coordinator
University of Hawaii Environmental Center
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Ms. Miller:

Ke'ehi Lagoon Recreation Plan
Draft EIS - Job H. C. 2241

Thank you for your letter of November 21, 1989 to Dr. Marvin Miura, Director, Hawaii Office of Environmental Quality Control. We offer the following clarification and responses to your review and comments:

Water Quality

Table 3 of Appendix B provides summary water quality data for surveys performed in 1978, 1986 and 1988. These data provide a sufficient temporal coverage to reasonably compare mean values from the surveys to the water quality standards. No significant systematic temporal patterns were observed, and no parameters consistently exceeded the water quality standard criteria levels. The surveys were intended to address only those parameters included in the water quality standard regulations; BOD and fecal coliform are not included therein. According to the Department of Health (DOH) (Mr. Hori, Personnel Committee), the DOH does not measure BOD in marine waters, presumably since the levels are so low as to be unimportant. They measure fecal coliform in Ke'ehi Lagoon only in response to sewage spills. The only data available are from a single spill event in Moanalua Stream in late 1987. High coliform levels were found at the mouth of Moanalua Stream and nearby Ke'ehi Beach Park sometime after the actual spill, but numbers returned to baseline levels within one day. Low levels were consistently observed at a station along Lagoon Drive, downstream of the stream and park stations, reflecting the rapid die-off of coliform in salt water.

As part of the detailed planning and design for the canoe center improvements, samples will be collected and analyzed for both BOD and coliform.

The circulation studies show that the predominant flow now and after development will be for Honolulu Harbor water to exit directly to the ocean via the Kalihi Channel and Reef Runway Circulation Channel. In fact, the results indicate that the PLAN will improve conditions by causing more direct discharge of Honolulu Harbor waters through the Kalihi Channel during ebb tide flows as well as during strong tradewinds. Under all conditions, flow from Honolulu Harbor to the southeast along Sand Island to the proposed swimming beach area will be reduced after breakwater construction. Flows from Honolulu Harbor to the northwest toward the canoe racing course will remain small. The circulation through Seaplane Runway "D" is never projected as being "poor," only that flows would decrease due to construction of the breakwater for the swimming beach. If this proves to be a problem, then an existing depression in the reef can be further channelized to restore the circulation in Seaplane Runway "D" to existing conditions. The circulation in the swimming area is never stated to be "poor." Note that the swimming beach and breakwater would be constructed on the reef flat and not in the deep Seaplane Runway. Circulation within the swimming beach area should not be a problem because of the shallow depths on the reef and the location close to the seaward edge of the reef where oceanic waters provide good water quality. Appendix G states that the existing circulation in the water ski area is poor and that the PLAN may decrease circulation further. Pipes or culverts through the peninsula fill may be a necessary mitigation measure. Note that the water ski area is presently intensively used for water skiing, indicating that existing circulation, while poor, may be sufficient such as to not be a problem. Estimates of residence times for various sections of the Lagoon are provided in Appendix D.

Traffic

The proposed plan for Ke'ehi Lagoon would have significant impacts on traffic as indicated on page IV-7.

Because the impacts encompass the entire Ke'ehi Lagoon vicinity, the details relating to all the major intersections affected by the project would be cumbersome in the text of the document. A more accurate picture is obtained by review of the Appendix E Traffic Impact Study. Because of the uncertainty in future airport-related projects affecting Lagoon Drive and cross streets, it is premature to propose mitigative measures at this time. Major traffic changes would be imposed by proposed airport expansion projects, such as the new International Terminal Building. As described in the Draft EIS, a traffic study is presently underway to look at all of the future projects related to the Airport development to the year 2010 as well as the Ke'ehi Lagoon proposed development. Because of the ongoing planning efforts related to Department of Transportation projects within the vicinity, planning assumptions must be reevaluated and traffic mitigation measures revised, as necessary, at the time of implementation of any major project in the vicinity. All parking needs for the specific proposed developments will be accommodated on site, including increased parking needs for park users.

Utilities

Your comments are noted. It should also be noted that the Board of Water Supply makes no determination of system adequacy until plans or development schematics are submitted, and no commitments for water supply are extended until applications for building permits are requested. Thus, it is difficult at this time to determine whether the existing system is adequate to meet the water demands for the project. It is the State's intent to accomplish the major developments under lease agreements with private developers. While the Draft EIS conceptually describes the proposed development projects, the individual private developers will be responsible for preparing schematic plans and working drawings for the respective projects. Thus, the private developers will be required to bear the cost of water facilities development charges or to participate directly in water system improvement.

Airport Expansion Needs

Planning related to updating Honolulu International Airport's (HIA) Master Plan has brought forth the need for additional lands to implement the projects proposed. One such project is the new International Terminal Building (ITB) which will require the acquisition of private lands bounded by Ualena and Aolele Streets adjacent to the airport. The ITB project will also cause the dislocation of existing airport tenants who are located at the site of the proposed ITB. While we recognize the potential hardships on the businesses to be dislocated, no vacant lands are available for the required expansion of airport facilities. It is apparent from current HIA planning studies that the airport will require additional acreage by the year 2010.

It should be noted that the Triangle development is not situated under any approach zones to the airport runways, and is therefore safer than existing areas surrounding the airport that are situated directly under the runway flight paths. The proposed Ke'ehi Lagoon plan is included in the airport layout plan which is an FAA-approved plan.

Land Use and Fish and Wildlife Preservation

As described in the Draft EIS, there has been a significant decline in the numbers of Hawaiian stilts and other waterbirds that use the area for feeding and resting. There is also no record of stilts nesting in Ke'ehi Lagoon, which is the critical factor to their continued existence. While the desire to preserve the triangle mudflats for the waterbirds is well-intentioned, it is the opinion of our avifaunal consultant that "...The mudflat triangle between Seaplane Runways A & B is now of no importance for the endangered Hawaiian stilt..."

Your understanding of the importance of Ke'ehi Lagoon and Honolulu Harbor as baitfish collecting areas is based on data from over 20 years ago (Uchida, R. N. and R. F. Sumida, 1971. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August, 1967, Nat. Mar. Fisheries Serv. Spec. Sci. Rep. Fisheries No. 629, 25 p.). While we have been unable to specifically ascertain the current status of the Ke'ehi baitfish

population, none of the recent surveys in the area make mention of sighting baitfish in any great abundance. The assumption is that the changes in the Lagoon since the 1967 data were collected have resulted in decreased population levels.

It is our intent to resolve the Federal issues related to filling of submerged lands within the context of the Department of the Army (DA) permit. The basis for the previous Federal/State agreement concerning Ke'ehi Lagoon must be reevaluated in terms of the present conditions existing within the Lagoon. For your clarification, the specific agreement which you referred to, dated April 13, 1972, was made between the U.S. Department of the Interior, the FAA, and the State Department of Transportation. The agreement included the expressed understanding that Ke'ehi Lagoon would continue to be developed for recreational purposes. The agreement made no mention of maintaining the Lagoon as a "State Wildlife Area." The National Wildlife Refuges established in Pearl Harbor as mitigation for the Reef Runway construction have successfully provided safe nesting habitat for the endangered Hawaiian waterbirds. These habitats are now considered much more critical to the waterbirds than any area in Ke'ehi Lagoon. It is our intent to provide similar mitigation for the loss of mudflats in Ke'ehi Lagoon due to the proposed plan. The experience and example set by the Reef Runway mitigation would assure the success of our presently proposed mitigation.

DEIS Regulations

Your comments are duly noted.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

cc: Office of Environmental
Quality Control
Office of State Planning
Edward K. Noda and Associates

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

R/S 5115

November 15, 1989

Mr. Edward Y. Hirata
Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Subject: Ke'ehi Lagoon Recreation Plan Draft Environmental Impact Statement (DEIS), HAR-ED 1795

We have the following comments on the proposed project:

1. The DEIS should address the water demands for the development and specify the sources of water to meet the water demands.

2. The State shall be required to install all of the necessary expansion or improvements to existing Board of Water Supply facilities to accommodate the proposed development.

3. A water master plan for the Ke'ehi Lagoon Recreation Plan should be included in the overall Waterfront Project Master Plan.

If you have any questions, please contact Lawrence Whang at 527-6138.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

JOHN WAIHEE
GOVERNOR

EDWARD Y HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K UCHIMA
RONALD N HIRANO
DANT HOCH
JEANNE K SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU HAWAII 96813

December 22, 1989

HAR-ED 2101

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

Dear Mr. Hayashida:

Ke'ehi Lagoon Recreation Plan Draft EIS

Thank you for your letter of November 15, 1989. We offer the following clarification and responses to your review and comments:

The water demands for the project are described in the Utility Master Plan prepared by Wilson Okamoto and Associates, Inc., which is contained as Appendix F in the Draft EIS. The Board of Water Supply was contacted during the preparation of the Utility Master Plan to determine the adequacy of the existing system to handle the additional demand imposed by the proposed development plan. Because no determination of system adequacy is made by the Board of Water Supply until plans or development schematics are submitted, and no commitments for water supply are extended until application for building permits, it was difficult for our consultant to determine whether the existing system is adequate to meet the water demands for the project. We would certainly appreciate any input you may have at this preliminary stage.

It is the State's intent to accomplish the major developments under lease agreements with private developers. While the Draft EIS conceptually describes the proposed development projects, the individual private developers will be responsible for preparing schematic plans and working drawings for the respective projects. Thus, the private developers will be required to bear the cost of water facilities development charges or to participate directly in water system improvement.

I will refer your last comment to the Office of State Planning, regarding inclusion of the water master plan for the Ke'ehi Lagoon Recreation Plan into the overall Honolulu Waterfront Master Plan.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

R/S 5170

BUILDING DEPARTMENT

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

Nov 24 12 57 PM '89

TRANSPORTATION

PB 89-1040

November 22, 1989

Nov 27 3 15 PM 89
HIGHWAYS DIVISION

Edward Y. Hirata, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Subject: Ke'ehi Lagoon Recreation Plan
Draft Environmental Impact Statement (DEIS)

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

Thank you for the opportunity to review the DEIS.

Very truly yours,

HERBERT K. MURAOKA
Director and Building Superintendent

cc: J. Harada

733

R/S 5121

DEPARTMENT OF GENERAL PLANNING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

DONALD A. CLEGG
CHIEF PLANNING OFFICER

Nov 17 [illegible] '89

TRANSPORTATION

MH/DGP 10/09-3843

November 16, 1989

Honorable Edward Y. Hirata, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Ke'ehi Lagoon Recreation Plan
Draft Environmental Impact Statement (DEIS)

We have reviewed the subject DEIS and have the following comments to offer:

1. As presented on pages V-18 through V-23, the information with regard to the General Plan, Primary Urban Center Development Plan, Development Plan Land Use Map and Development Plan Public Facility Map is accurate.

2. According to page II-12, the interior of the Triangle will be used for light industrial and commercial purposes. Information on the potential development concepts for the Commercial/Light Industrial Park is stated as follows:

   "Redevelopment of the Honolulu Waterfront as envisioned by the Honolulu Waterfront Master Plan will result in displacement and/or relocation of some current activities and facilities. The Triangle is a possible relocation site for industrial and commercial tenants."

   Please clarify specifically who and what may be relocated; the range of the total relocation costs; and who will finance the possible relocation of industrial and commercial tenants?

3. As stated on page II-13, there would still be a need to import about 1.6 million cubic yards of fill material from off-site. Identify the source(s) and composition of the fill material.

4. We would like to call your attention to the fact that the U.S. Fish and Wildlife Service (USFWS) has gone on record in opposition to the proposal to fill the Ke'ehi Lagoon Triangle. In a comment letter (see attachment) on the Pre-Final Report for the Honolulu Waterfront Master Plan, the USFWS states as follows:

> "In our opinion, the proposal to fill the Keehi Lagoon Triangle for recreational, commercial, and light industrial facilities is inconsistent with the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines). It is likely that these facilities do not require the siting within the mudflat to fulfill their basic project function. Therefore, under the 404(b)(1) Guidelines, praticable alternatives that would result in less damage to mudflat and reef flat habitats within Keehi Lagoon are presumed to exist.
>
> In view of the important biological resources and habitats within Keehi Lagoon, non-compliance with Service policies regarding the conservation of wetland resources, and the inconsistency with the 404(b)(1) Guidelines, we recommend that the proposed project be redesigned to avoid dredging and discharging fill material into Keehi Lagoon."

5. According to page III-13, the Ke'ehi Lagoon area obtains its water service from the Board of Water Supply (BWS) Honolulu Water District Low Service System and the entire Low Service System has an average daily water demand of approximately 57.5 million gallons per day (mgd). Since water sources that serve the area are at capacity, what are the estimated cummulative average daily, maximum day and peak hour water demands for all of the developments/improvements associated with the Ke'ehi Lagoon Recreation Plan? In addition, information such as water source and availability should be disclosed in the Final EIS.

6. On pages III-13 and III-32, it should be clearly stated that the proposed ferry terminal in Hawaii Kai, Maunalua Bay has not been approved. In addition, Figure III-5 should indicate likewise.

7. After reviewing the physiography data on page III-1, we believe it would be useful to discuss the possibility of tsunami inundation in the FEIS, as well as a possible rise in sea level due to the greenhouse effect.

8. According to CHAPTER XI: CONSULTED PARTIES AND PARTICIPATION IN THE EIS PREPARATION, three letters were received. Section 11-200-17 (p) of Chapter 200 of Title 11, ("Environmental Impact Statement Rules") Administrative Rules, states as follows:

> "The draft EIS shall contain reproductions of all substantive comments and responses made during the the consultation process."

This is a procedural error which should be addressed by the accepting authority.

We hope these comments are helpful in preparing the Final EIS. If you have any questions regarding our comments, please contact Matthew Higashida at 527-6056.

Sincerely,

DONALD A. CLEGG
Chief Planning Officer

DAC:gmy

Attachment

cc: OEQC
Elaine Tamaye, Edward K. Noda and Associates, Inc.

ATTACHMENT

United States Department of the Interior

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

ES
Room 6307

RECEIVED FEB 2 8 1989

Mr. Murray E. Towill
Deputy Director
Office of State Planning
State Capitol
Honolulu, Hawaii 96813

Re: Pre-Final Report for the Honolulu Waterfront Master Plan, Oahu

Dear Mr. Towill:

The U.S. Fish and Wildlife Service (Service) has reviewed the referenced Master Plan dated January 1989 and offers the following comments for your consideration.

The Master Plan discusses several proposals to dredge and fill tidal reef flat habitats at Kewalo Peninsula, Kakaako Peninsula, Sand Island, and Keehi Lagoon. Of particular concern to the Service is the proposal to fill approximately 250 acres and dredge approximately 50 acres of mudflat and intertidal reef flat habitats within the Keehi Lagoon Triangle.

The shallow mudflat and reef flat habitats within Keehi Lagoon provide foraging and loafing habitat for the endangered Hawaiian Stilt (Himantopus mexicanus knudseni). These habitats within Keehi Lagoon are considered essential habitat for the recovery of this endangered species (Hawaiian Waterbirds Recovery Plan, 1985, U.S. Fish and Wildlife Service). Keehi Lagoon also provides important foraging and loafing habitat for migratory shorebirds. The proposed construction activities within the Keehi Lagoon Triangle would eliminate the available habitat for the endangered Hawaiian Stilt and various species of migratory shorebirds. The proposed mitigation to offset this habitat loss by constructing "nesting islands" near Sand Island or improving the waterbird habitat at the Pearl Harbor National Wildlife Refuge at Honouliuli is not acceptable.

The proposed construction work would likely require authorization under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act, both issued by the U.S. Army Corps of Engineers (Corps). Since permit issuance is considered a federal action that may effect a listed endangered species, the Corps would likely initiate consultation with the Service under Section 7 of the Endangered Species Act. In turn, the Service would determine whether the proposed action would jeopardize the continued existence of the endangered Hawaiian Stilt.

Under the Fish and Wildlife Coordination Act, the Service would review the Corps permits to insure that fish and wildlife conservation received full and equal consideration with other project features. The Service considers the mudflat and intertidal reef flat habitats to be of high value for migratory shorebirds and these habitats are relatively scarce or becoming scarce in the ecoregion setting (U.S. Fish and Wildlife Service Mitigation Policy, 1981). Under this policy, the Service would recommend ways to avoid or minimize habitat losses. If losses are likely to occur, mitigation measures to compensate for the habitat loss, such as restoration or rehabilitation of altered habitats or the acquisition and increased management of suitable replacement habitat, may be considered by the Service. The goal of the Service's Regional Wetland Protection Policy is to insure that no net loss of wetland habitat occurs. Development proposals that adversely affect wetland resources would be discouraged unconditionally. Therefore, to avoid adverse impacts to Hawaiian Stilt and migratory shorebird habitats, we would recommend to the Corps that no dredging or discharging of fill material within the Keehi Lagoon be permitted.

In our opinion, the proposal to fill the Keehi Lagoon Triangle for recreational, commercial, and light industrial facilities is inconsistent with the Guidelines for Specification of Disposal Sites for Dredged or Fill Material (404(b)(1) Guidelines). It is likely that these facilities do not require the siting within the mudflat to fulfill their basic project function. Therefore, under the 404(b)(1) Guidelines, practicable alternatives that would result in less damage to mudflat and reef flat habitats within Keehi Lagoon are presumed to exist.

In view of the important biological resources and habitats within Keehi Lagoon, non-compliance with Service policies regarding the conservation of wetland resources, and the inconsistency with the 404(b)(1) Guidelines, we recommend that the proposed project be redesigned to avoid dredging and discharging fill material into Keehi Lagoon.

We appreciate the opportunity to comment.

Sincerely,

Allan Hamelstein
Pacific Islands Administrator

cc: DLNR
EPA, San Francisco
U.S. Army Corps of Engineers
✓OEQC
CZM
NMFS - WPPO

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN E. LIZZA
RONALD N. HIRANO
DANI T. KOCH
JEANNE K. SCHULTZ

IN REPLY REFER TO

December 26, 1989 HAR-ED 2108

Mr. Donald A. Clegg
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 16, 1989. We offer the following clarification and responses to your review and comments:

1. Your concurrence as to the accuracy of the information on pages V-18 through V-23 is noted.

2. The Triangle will provide vacant space to accommodate possible light industrial or commercial businesses that may be displaced due to redevelopment of the Honolulu Waterfront as well as areas surrounding the Airport due to more recent needs identified by the Department of Transportation for expansion of Airport facilities. The paragraph on page II-12 regarding the Commercial/Light Industrial Park goes on to further describe:

> "...the intended type of commercial and light industrial use within the Triangle is both maritime and aviation related, including businesses who are dependent on the maritime or aviation sectors of the economy and who would benefit greatly by the proximity to Honolulu International Airport and Honolulu Harbor..."

We do not presume at this time that the State will bear the costs for any relocation effort. The intent is to provide additional available space according to the needs of the marketplace. There is a dire need for light industrial and commercial space in metropolitan Honolulu, especially adjacent to the Airport and the waterfront. As described in the Draft EIS, it is the intent of the State to lease the area to a private developer, who in turn will provide improvements and sublease the area to individual tenants.

3. A present source of additional fill for the Triangle development is the stockpile at Barbers Point Harbor. This material is coral limestone from the dredging of the deep-draft harbor. Only clean structural fill material will be used for filling of the submerged lands within the lagoon for the proposed development.

4. We are aware of the previous comments submitted by the U. S. Fish and Wildlife Service (USFWS) on the Honolulu Waterfront Master Plan Pre-Final Report of January 1989. We will endeavor to resolve the federal issues related to filling in the triangle area within the context of the U. S. Army Corps of Engineers permit.

5. The water demands for the project are described in the Utility Master Plan which is contained as Appendix F in the Draft EIS. The Board of Water Supply was contacted during the preparation of the Utility Master Plan to determine the adequacy of the existing system to handle the additional demand imposed by the proposed development plan. Because no determination of system adequacy is made by the Board of Water Supply until plans or development schematics are submitted, and no commitments for water supply are extended until application for building permits, it was difficult for our consultant to determine whether the existing system is adequate to meet the water demands for the project. It is the State's intent to accomplish the major developments under lease agreements with private developers. While the Draft EIS conceptually describes the proposed development projects, the individual private developers will be responsible for preparing schematic plans and working drawings for the respective projects. Thus, the private developers will be

required to bear the cost of water facilities development charges or to participate directly in water system improvement.

6. We will clarify the discussion on the proposed water transit system for Oahu's south shore, specifically in regards to the Hawaii Kai ferry terminal. Please note that while the specific plan for the Hawaii Kai Terminal in Maunalua Bay was not approved by the City and County, it is still the desire of the State to investigate a possible optional location for a terminal to serve the eastern end of Oahu.

7. The flooding potential due to tsunami inundation is discussed in Section 3.1.7 of the Draft EIS. We will expand the discussion to include consideration of the possibility of rising sea level.

8. Your comment regarding Chapter XI of the DEIS is duly noted.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

John D Hirata

Edward Y. Hirata
Director of Transportation

741

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU HAWAII 96813 • PHONE 523-4432

FRANK F. FASI
MAYOR

JOHN P. WHALEN
DIRECTOR

BENJAMIN B. LEE
DEPUTY DIRECTOR

LU10/89-6756(RF)

November 24, 1989

Mr. Edward Y. Hirata, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Draft Environmental Impact Statement (dEIS)
Keehi Lagoon Recreation Plan

We have reviewed the DEIS and offer the following comments:

1. Page I-8, 9: Development Plan designations and zoning are established by the City Council, pursuant to the review of the departments and the Planning Commission.

2. Hawaiian Canoe Center (pp. II-4, 5 and VI-7, 8): The basic recreation improvements are needed and desirable, as long as they do not displace current uses in Keehi Lagoon Park. We note, however, that proposed improvements to Keehi Lagoon Park are only briefly described in text and are not shown on Figure II-5. The EIS should describe these improvements and their impacts on the park.

   We are concerned about the poor vehicular access available on the Kalihi-Kai side of the site. To the extent that access is inconvenient, canoeing enthusiasts will tend to use the Keehi Lagoon Park facilities, thus overburdening that site.

   We are also concerned about use of the delta site for meeting facilities, restaurant(s), and "other commercial activities," since it will lack onsite parking and will have public vehicular access only from the poor Kalihi Kai approach. Given the problems with this site, we question whether it is an appropriate location for commercial uses. The EIS should consider other alternatives, such as (a) other sites for revenue-producing commercial activities and (b) supporting the canoe center with public funding.

3. Sheltered Swimming Beach (pp. II-13, 14 and VI-9): We concur that a swimming beach is much-needed as an improvement to Sand Island Park. The proposed site, however, is directly downwind of the Sand Island Wastewater Treatment Plant, and odors from the plant could seriously affect the desirability and use of the site. The EIS should consider alternative sites.

4. Water Quality: The sections on water quality and Appendixes B and D address neither bacteria counts, nor the discharge of debris into the lagoon. Both of these could affect the useability of the lagoon for recreation purposes.

5. Lagoon Circulation (p. IV-1, 2, Appendixes D & G): We question whether the studies contained in the EIS are sufficient to predict post-construction residence times for water in various parts of the lagoon. How were the residence times given in Appendix D calculated? What was the source of the data in Table 1 of Appendix D?

6. Construction of the Fill Triangle: The EIS does not adequately describe construction materials and methods for this major dredge and fill project.

7. Marine Life: Does Keehi Lagoon serve as a breeding ground for nehu, papio, mullet and other food/sport fish, and, if so, how might the proposed constructed affect fish populations in the area?

8. Traffic Impacts (p. IV-7): We are concerned about significant traffic impacts which may be generated by the project. Who will construct necessary improvements to City streets?

9. Regulation of Development in the Triangle Area: The EIS states that the Triangle Area may remain within the Conservation District or be placed under the control of the Hawaii Community Development Authority, after it has been filled. In such a case, what provision would be made for necessary offsite improvements to City infrastructure systems? What development regulations would apply? What agency would review and approve building plans?

We find many positive aspects to the Keehi Lagoon Recreation Plan. With appropriate modifications and mitigation of impacts, its implementation will result in substantial public benefit. Thank you for the opportunity to comment.

Very truly yours,

JOHN P. WHALEN
Director of Land Utilization

JPW:sl
0293N/33-34

cc: OEQC

XII-47

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

JOHN W. YOSHIMURA
RONALD N. HIRANO
DAN T. HIGUCHI
JEANNE K. SUMIDA
DEPUTY DIRECTORS

IN REPLY REFER TO

January 4, 1990

HAR-ED 2136

Mr. Donald Clegg, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

In response to former Director, John Whalen's letter of November 22, 1989, we offer the following clarifications to his review and comments:

1. Your comments regarding the Development Plan and zoning are noted.

2. Further detailed planning for the canoe improvements is presently underway. Improvements within Ke'ehi Lagoon Park are currently being planned and designed as State-funded improvements and are being coordinated with the City and County Department of Parks and Recreation. The Final EIS will include the most current plans developed to date. As noted in the Draft EIS, site plans for the project are preliminary in nature pending detailed engineering and design studies. Figure II-5 generally shows the major improvements to Ke'ehi Lagoon Park, which includes landscaped viewing mounds and improved vehicular access and parking along the shoreline.

   Vehicular access on the Kalihi-Kai side will be via Hoonee Place from Sand Island Access Road as indicated in the Draft EIS. Sufficient interior roadways and parking will be included in the plans for the canoe improvements as stated. Improvements on the Kalihi-Kai side will improve existing conditions by providing additional access to the canoe course which is not presently available. Ke'ehi Lagoon Park is

presently overburdened during canoe race events. The proposed improvements will alleviate the problem by providing additional on-site access and parking.

Current detailed planning efforts underway will evaluate other alternatives for funding the development and operation of the delta site including the use of public funds and management for the site.

3. The need for a swimming beach was first brought out over two years ago by the Kalihi-Palama community in our initial discussions with them regarding the development of Keehi Lagoon. As mentioned in the Draft EIS, there is no alternative location in Ke'ehi Lagoon which can provide the safety and ocean cleanliness required for the swimming beach. The current site for the beach was selected for several reasons including minimal disruption of water circulation and shallow water depth which enhances water safety, particularly with young children. The problem of odor from the Sand Island Wastewater Treatment site is one that requires broader consideration since other areas of existing and proposed Sand Island Park, and the proposed Honolulu Corporation Yard also lies down wind from the treatment plant. It is apparent that both State and City governments need to work together to solve the odor problem.

4. According to the Department of Health, bacterial concentrations in the lagoon are not a threat to public health. Detailed investigations to be undertaken during the planning and design for the Hawaiian Canoe Center will include sampling and analysis of bacteria levels. If it is revealed that this is a potential problem, then a Supplemental EIS will be issued for the project. I would emphasize that the water area adjacent to Ke'ehi Lagoon Park is presently being used by the public for canoe practice and racing events. The location of the proposed swimming beach is close to the seaward edge of the reef where oceanic waters provide good water quality. Consideration is being given to a debris catchment system for Kalihi and Moanalua Streams that discharge directly into the lagoon.

5. The source of data for the volume flows and calculation of residence times (Table 1 of Appendix D) is the numerical circulation model described in

Appendix G. From the numerical data printouts, the flows through various sections of the lagoon were averaged over a 24-hour period to obtain the daily volume flow. The residence time is calculated based on the volume of water within each section of the lagoon divided by the daily volume flow.

6. Construction of the Triangle fill will be accomplished similarly to the construction of the Reef Runway fill. As described by the Draft EIS, dredging for the navigation features will supplement the fill material requirements for the triangle. A present source of additional fill material is the stockpile of dredged coral material at Barbers Point Harbor.

7. A study by the National Marine Fisheries over 20 years ago indicated that Ke'ehi Lagoon and Honolulu Harbor were important baitfish (nehu) collecting areas (Uchida, R. N. and R. F. Sumida 1971. Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967, Nat. Mar. Fisheries Serv. Spec. Sci. Rept. Fisheries No. 629, 25 p.). We have been unable to specifically ascertain the current status of the Ke'ehi baitfish population, although none of the recent surveys in the area make mention of sighting baitfish in any great abundance. The assumption is that the changes in the lagoon since the 1967 data were collected have resulted in decreased population levels. The major filling on the triangle mudflats is not expected to impact fish populations in the vicinity. As indicated in Appendix B, the shallow water depths and the paucity of cover over the mudflat is an important limitation on the development of the resident fish fauna and value of the area as a nursery for juveniles of species populating the more seaward parts of the reef.

8. Necessary improvements to mitigate traffic impacts will be accomplished by the respective developer(s) at the time the projects are implemented. As mentioned in the Draft EIS, planning assumptions will be reevaluated and traffic mitigation measures revised, as necessary, at the time of plan implementation.

9. Necessary offsite improvements to City infrastructure systems will be made the responsibility of the developer(s), either through direct participation in system improvement or payment of system development charges levied by the City. If the area remains under

HAR-ED 2136

State land use authority, it is our intent to require all development to conform to City code as much as practicable. The mechanism for review and approval of building plans has not yet been determined. One possible option is to establish a review board comprised of individuals with the necessary expertise. I would also welcome joint City participation in this review process.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

In reply refer to:
ENV 89-220

November 21, 1989

Ms. Elaine Tamaye
Edward K. Noda and Associates, Inc.
615 Piikoi Street, Suite 1000
Honolulu, Hawaii 96814

Dear Ms. Tamaye:

Subject: Draft Environmental Impact Statement (DEIS)
Ke'ehi Lagoon Recreational Plan

We have reviewed the subject DEIS and have the following comments:

1. The City is planning to install a relief sewer for the existing 54-inch line on Nimitz Highway. However, this proposed line does not include the flows from the proposed Ke'ehi Lagoon Recreational Plan.

2. Should the flows from the proposed plan be considered, expansion to the sewer lines will be required.

3. Under the current practice, if the plan is to be implemented, the developer will be responsible for the expansion of the sewer lines.

Very truly yours,

SAM CALLEJO
Director and Chief Engineer

cc: OEQC
Dept. of Transportation, State of Hawaii

XII-50

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DANE K. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

HAR-ED 2102

December 22, 1989

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Ke'ehi Lagoon Recreation Plan Draft EIS

Thank you for your letter of November 21, 1989 (ENV 89-220) to Ms. Elaine Tamaye, our Consultant, for the subject project. We offer the following clarification and responses to your review and comments:

Pursuant to your comments regarding the planned relief sewer for the existing 54-inch line on Nimitz Highway, we have met with Mr. Jay Hamai of your Wastewater Planning Section to discuss the project. As a result of this meeting, we are undertaking a feasibility analysis of the possible options to handle the sewage requirements for the project. This analysis will consider all future requirements, which may not have been considered in the design flows for the relief sewer, related to Department of Transportation projects for the Honolulu International Airport as well as for the Ke'ehi Lagoon development. Two possible scenarios which we are considering are:

1. Cost sharing to upgrade the existing 54-inch line on Nimitz Highway and

2. Constructing a new line directly to your sewage treatment plant on Sand Island.

I will be contacting you to discuss the problem after we have completed our analysis.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

FRANK F. FASI
MAYOR

FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU
1455 S. BERETANIA STREET, ROOM 309
HONOLULU, HAWAII 96814

FRANK K. KAHOOHANOHANO
FIRE CHIEF
LIONEL E. CAMARA
DEPUTY FIRE CHIEF

November 2, 1989

Mr. Edward Y. Hirata
Director of Transportation
State Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

SUBJECT: Ke'ehi Lagoon Recreation Plan Draft Environmental Impact Statement

We have reviewed the subject material provided and have no comments or objections.

Very truly yours,

FRANK K. KAHOOHANOHANO
Fire Chief

MZ:ny

POLICE DEPARTMENT

R/S 5156

CITY AND COUNTY OF HONOLULU

FRANK F. FASI
MAYOR

DOUGLAS G. GIBB
CHIEF

WARREN FERREIRA
DEPUTY CHIEF

OUR REFERENCE SS-LK

November 17, 1989

Nov 24 2 55 PM 89
HARBORS DIVISION

Mr. Edward Y. Hirata
Director of Transportation
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Subject: Ke'ehi Lagoon Recreation Plan Draft
Environmental Impact Statement (EIS)

We have reviewed the EIS for the above project and offer the following comments.

The projected improvements for the Ke'ehi Lagoon and vicinity will definitely impact police services to the area.

There are several issues we feel must be addressed to ensure that the plan will be designed and implemented with careful consideration for traffic and public safety.

The major roadways affected by the project are the Sand Island Access Road and Nimitz Highway. Both of these are well-used by large container trucks and motorists traveling to and from work. During the construction phases of the project, we recommend that movement of construction trucks and equipment be prohibited during morning and afternoon rush-hour traffic.

Upon the project's completion, we expect an increase in traffic due to new employees, customers of businesses, and related business deliveries during the weekdays to this area. Weekend traffic is expected to increase significantly during spectator events. Adequate <u>free</u> parking should be provided to minimize illegal parking, traffic congestion, and associated motor vehicle accidents.

We have noticed that the issue of enforcement jurisdiction was not addressed. There are two enforcement elements affected by the project: the State Harbors Division and HPD's District 5, which also includes the Airport Detail. We project that there will be additional calls for police service which will require additional manpower and possible sector restructuring. The issue of jurisdiction is a major concern and needs to be addressed to ensure proper enforcement and cooperation between our department and the State.

Thank you for the opportunity to provide comments. We are very interested in the development of this project and would like to be informed of any changes or new information that would affect our service.

Sincerely,

DOUGLAS G. GIBB
Chief of Police

By Joseph Aveiro
JOSEPH AVEIRO
Assistant Chief of Police
Support Services Bureau

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU HAWAII 96813

EDWARD Y HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K UCHIMA
RONALD N HIRANO
DAN T KOCHI
JEANNE K SCHULTZ

IN REPLY REFER TO

January 4, 1990

HAR-ED 2126

Mr. Joseph Aveiro
Assistant Chief of Police
Support Services Bureau
Police Department
City and County of Honolulu
1455 South Beretania Street
Honolulu, Hawaii 96814

Dear Mr. Aveiro:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 17, 1989. Our responses to your comments are as follows:

Your recommendation to prohibit the movement of construction trucks and equipment during morning and afternoon rush-hour traffic will certainly be considered. While it may not be reasonable to prohibit movement of all construction vehicles, it would certainly be justified to prohibit movement of large dump trucks and oversized vehicles/equipment on Sand Island Access Road and Nimitz Highway during rush hour traffic.

All development projects will be required to provide for adequate onsite parking to meet the requirements for the specific uses. However, some uses may require that nominal parking fees be charged to recover the costs of construction, or to discourage long-term parking of vehicles by persons who are not patrons/users of the businesses or facilities.

The issue of enforcement jurisdiction is as yet an unresolved issue, and will be partly dependent on what level of government retains land use regulatory authority. We will coordinate with your department to resolve this issue when development plans are further refined.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project. We will keep you apprised of any significant changes that may affect the Police Department.

Very truly yours,

Edward Y. Hirata
Director of Transportation

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU

FRANCIS PASI
MAYOR

MICHAEL N. SCARFONE
DIRECTOR

RONALD B. NODA
DEPUTY DIRECTOR

November 29, 1989

Mr. Edward Y. Hirata, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

Subject: Draft Environmental Impact Statement
Proposed Ke'ehi Lagoon Recreation Plan

Thank you for the opportunity to review the Draft EIS for the Proposed Ke'ehi Lagoon Recreation Plan.

We have no comments at this time. We will retain a copy of the Draft EIS for our files.

Sincerely,

MICHAEL N. SCARFONE

cc: Edward Noda and Associates

XII-53

7394

November 22, 1989

STATE OF HAWAII
Dept of Transportation
869 Punchbowl Street
Honolulu, HI 96813

Attn: Ed. Hirata

Dear Sir:

This letter is in reference to the DEIS for the Development of KE'EHI LAGOON. We would like to let you know that we are severly concerned about the section of development that calls for the filling in of the triangle within the lagoon.

I am enclosing copies of various correspondence that relates to the development of Keehi Lagoon.

We don't feel that the study offers any alternatives to this part of the development or the impact in the community in relation to traffic. We find we would like this section of development studied more in depth.

Sincerely,

Carol J. Post

Carol J. Post

cc: Romy Cachola
Gary Gill
Donna Kim
Mayor Fasi
Gov Waihee

Enclosure

RECEIVED AS FOLLOWS

XII-54

Attachment -

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. LICHIMA
RONALD N. MIRANDA
DAN Y. KOCHI
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO:

HAR-ED 1795

Kalihi Palama Neighborhood Board No. 15
c/o Neighborhood Commission Office
City Hall, 4th Floor
Honolulu, Hawaii 96813

Gentlemen:

Ke'ehi Lagoon Recreation Plan Draft
Environmental Impact Statement

Enclosed for your information and comment is a copy of the KE'EHI LAGOON RECREATION PLAN DRAFT ENVIRONMENTAL STATEMENT, September 1989. The DEIS has been published in the October 8th OEQC Bulletin. We welcome any written comments on the DEIS no later than November 24, 1989.

Very truly yours,

Edward Y. Hirata
Director of Transportation

Enclosure

Attachment

[redacted]

Keehi Lagoon Development

During this session of the legislature the governor made a concerted effort to obtain a concurrent resolution that would authorize the filling and development of 300 acres of Keehi Lagoon. He got the resolution, and it authorized recreation and light industry. Trouble is that the State already had binding agreements with the Federal Fish and Wildlife Service and the Federal Aviation Agency to use the lagoon only for recreation and habitat of migratory birds like the Hawaiian stilt. We obtained three letter agreements that plainly showed this. The first was a letter agreement written by William Monroe, the Secretary of the Interior's Field Representative, to Phillip Swatek Director, Pacific Region, Federal Aviation Agency, and Fujio Matsuda Department of Transportation, State of Hawaii, on April 13, 1972, stating that the Department of the Interior had withdrawn its objections to the reef runway, and its destruction of habitat, on the groun that Keehi's estuarine and recreational values would be preserved. He states that in the preceding conference Matsuda cocurred in "the continued use and development of this lagoon for recreational purposes." Matsuda, says the letter, concurred that "his Department had primary responsibility and authority to develop bay facilities for recreational purposes and it was their intent to do so in Keehi Lagoon."

In a march 21, 1978 letter to Fish and Wildlife Service of the Federal government, Lieutenant Governor Jean King wrote: "This will confirm the basic understanding arrived at," that "The entire area of Keehi Lagoon will be for recreation and wildlife." And in the third letter of agreement the Pacific Islands Administrator, Dale Coggeshall of the Fish and Wildlife Service wrote on February 24, 19 to Susumo Ono, chairman of the state Board of Land and Natural resources as follows:

> The Service has been involved with Keehi Lagoon for nearly 10 years. On February 11, 1972, State and Federal representatives (Hawaii Department of Transportation, Federal Aviation Administration, Department of Interior and Corps of Engineers) met in order to resolve existing questions regarding resource and recreational losses caused by Reef Runway construction. At that time it was agreed that Keehi Lagoon would be set aside for recreational purposes.

This last letter goes on to state that Keehi Lagoon contains crucial habitat for migratory birds covered by international conventions with Canada and the Soviet Union, and that filling the lagoon would not be endorsed by them when the Army Corps of Engineers consulted them as they were bound to do, on the matter of filling parts of the lagoon.

Despite this startling and persuasive evidence that development of Keehi Lagoon was legally not within their power to authorize, the legislature inexplicably passed the enabling resolution. Therefore it is up to us at coming hearings before the Army Corps of Engineers the Fish and Wildlife Service, the State Department of Transportation and the Coastal zone management authoritie (City council) to insist that this important evidence be honored, and Keehi Lagoon spared.

[redacted]

Attachment

The Senate
The Ninth Legislature
of the
State of Hawaii
HONOLULU, HAWAII

March 22, 1978

MEMORANDUM

TO: U. S. Fish & Wildlife
Mokauea Fishermen's Association
State Wildlife Branch
Governor's Office

FROM: Jean King

RE: Meeting of March 21, 1978

Thank you all so very much for coming to the meeting. I really appreciate your patience and the spirit of understanding and air of wanting to work things out which pervaded the lengthy meeting.

This will confirm the basic understanding arrived at:

1. U. S. Fish & Wildlife will write a letter within a day or so to the Federal Aviation Administration stating they have no objection to the leases being granted to the current residents of Mokauea Island.

2. The State Wildlife Branch will include in their proposal to the Board of Land and Natural Resources the following provisos:

   a. The entire area of Keehi Lagoon will be for recreation and wildlife.

   b. There will be no structures on any of the islands other than Mokauea.

   c. There will be a Manana Island type of kapu prohibition for the mudflats facing Mokauea Village.

3. Further, the State Division of Wildlife will continue to work toward establishment of seabird wildlife sanctuaries on the Leeward side of Oahu.

4. The Mokauea Village residents pledge their support at the hearing before the Board of Land and Natural Resources on the proposal presented by the State Wildlife Branch.

The affirmation of shared concerns by the residents of Mokauea and the U. S. Fish and Wildlife was indeed heartening and heartwarming.

Again, many thanks to all of you.

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XII-56

Attachment

United States Department of the Interior

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

ES
Room 6307

FEB 24 1981

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

Dear Sus:

I appreciate your early advice on the proposal which has been made to the State to develop an industrial park in Kechi Lagoon. This type of exchange at the start of the planning process is most helpful in considering the involvement of others, making adjustments for related concerns, and in identifying differences early on. In this same spirit of cooperation, I am providing you with this preliminary view of Service concerns including past agreements, existing regulatory procedures, and biological factors.

The Service has been involved with Kechi Lagoon for nearly 10 years. On February 11, 1972, State and Federal representatives (Hawaii Department of Transportation, Federal Aviation Administration, Department of Interior and Corps of Engineers) met in order to resolve existing questions regarding resource and recreational losses caused by Reef Runway construction. At that time it was agreed that Kechi Lagoon would be set aside for recreational purposes. The details of the meeting are in the April 13, 1972 Letter of Understanding, documenting the agreement.

Subsequently, the State started planning for the Lagoon's recreational use. Draft plans were reviewed by various agencies, including the U.S. Fish and Wildlife Service. Basically, we pointed out that the proposals essentially turned the Lagoon into a marina with little or no provisions for resource protection, and recommended that they be modified to correct this deficiency.

Most recently we were involved with the controversial Mokauea Island Fishermen's Village issue. Service concerns regarding potential resource losses were satisfied at the March 21, 1978 meeting among Federal, State and Mokauea Island Fishermen's Association representatives. At that meeting, chaired by Lieutenant Governor Jean King, the following agreements were reached among the Department of the Interior, Federal Aviation Administration and the State Department of Transportation:

"1. U.S. Fish & Wildlife will write a letter within a day or so to the Federal Aviation Administration stating they have no objection to the leases being granted to the current residents of Mokauea Island.

2. The State Wildlife Branch will include in their proposal to the Board of Land and Natural Resources the following provisos:

   a. The entire area of Kechi Lagoon will be for recreation and wildlife.
   b. There will be no structures on any of the islands other than Mokauea.
   c. There will be a Hanauma Island type of laws prohibition for the mudflats facing Mokauea Village.

3. Further, the State Divison of Wildlife will continue to work toward establishment of seabird wildlife sanctuaries on the leeward side of Oahu.

4. The Mokauea Village residents pledge their support at the hearing before the Board of Land and Natural Resources on the proposal presented by the State Wildlife Branch."

The Service has fulfilled its obligations. We are unaware of that action has been taken by the State.

Regarding the proposed industrial park, regulatory procedures which will be involved include those provided by the Clean Water Act. In anticipation of the ultimate need for Federal permits, we find that as proposed, the project, while having ancillary water-dependant features, in and of itself, does not require on-the-water siting. Therefore, we are of the opinion that permit issuance would be contrary to 40 CFR 230.5(b)(8) which states:

"(8) Wetlands. (i) Discharge of dredged material in wetlands may be permitted only when it can be demonstrated that the site selected is the least environmentally damaging alternative; provided, however, that the wetlands disposal site may be permitted if the applicant is able to demonstrate that other alternatives are not practicable and that the wetlands disposal will not have an unacceptable adverse impact on the aquatic resources. Where the discharge is part of an approved Federal program which will protect or enhance the value of the wetlands to the ecosystem, the site may be permitted.

(ii) Discharge of fill material in wetlands shall not be permitted unless the applicant clearly demonstrates the following: (a) the activity associated with the fill must have direct access or proximity

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to, or be located in, the water resources in order to fulfill its basic purpose, or that other sites or construction alternatives are not practicable; and (b) that the proposed fill and the activity associated with it will not cause a permanent unacceptable disruption to the beneficial water quality uses of the affected aquatic ecosystem, or that the discharge is part of an approved Federal program which will protect or enhance the value of the wetlands to the ecosystem."

In order to evaluate conformance of the project to 40 CFR 230.5(b)(3) of the Clean Water Act, data on impacts of previous similar projects on aquatic resources needs to be reviewed. Should you have, or develop additional quantitative information on impacts of similar dredge and fill activities on water characteristics and aquatic resources such as fish, recovery of corals, etc., these data will greatly facilitate evaluation of project impacts on these resources.

Applicable Service policy states:

"Nonwater-dependent structures, facilities, or activities generally will be considered by the Service to be unacceptable uses of public waters unless it has been demonstrated that the proposed use is required in the public interest [see Sec. 2.28(1)] and no alternative site mutually acceptable to the Service and the applicant is available."

Of even greater significance than the above are the biological factors involved. Intertidal lands in Keehi Lagoon still serve as feeding habitat for migratory shorebirds and the endangered Hawaiian stilt. Although critical habitat for the stilt has not been determined, additional habitat losses could be detrimental to the stilts' continued existence. Since the project will require a Corps of Engineers permit (a Federal action) and would affect an endangered species, the Service will consult with the Corps as required by Section 7 of the Endangered Species Act of 1973, as amended. A major consideration in this consultation will be the impacts of this project on the stilt. The development of additional quantitative data on the use of the project area and its significance to stilts would be of mutual benefit in evaluating impacts of this project on this species. Such data gathering efforts should be expanded to include the density, abundance, and utilization of this area by migratory birds as well.

We are equally alarmed about the continuing statewide deterioration of migratory shorebird habitat. Keehi Lagoon is one of the two most important shorebird feeding habitats on Oahu. Since Reef Runway construction, bird use of the Lagoon has been reduced by about two-thirds of the levels observed in 1971. From the preliminary information we have, the proposed project will continue the trend of habitat destruction. This being the case, Federal approval of the project may be contrary to international agreements between the United States and Japan and the United States and Russia concerning the protection of certain species of migratory birds and their habitat.

In view of the above, it is my considered opinion that if the developers seek a Federal (Corps) permit on the basis of current plans and the biological data available, the Service would likely have cause to recommend permit denial to the Corps of Engineers.

I hope you will find our early input useful in your further dealings with this matter, and that it will further our common interest in resource protection.

Sincerely yours,

(Sgd) Dale T. Cogswell

Pacific Islands Administrator

cc: HDF&G
NOFS
EPA, San Francisco
CoE
Mokauea Island Fisherman's Association

HDHolmberg:pl:jfr:2/9/81

XII-57

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Attachment

XII-58

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION

PACIFIC SOUTHWEST FIELD COMMITTEE
BOX 36098 - 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102

DIRECTOR'S OFFICE
APR 17 2 26 PM '72
DEPT. OF TRANSPORTATION

April 13, 1972

Mr. Phillip H. Swatek
Director, Pacific Region
Federal Aviation Administration
U. S. Department of Transportation
Post Office Box 4009
Honolulu, HI 96813

Dr. Fujio Matsuda, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813

Dear Mr. Swatek and Dr. Matsuda:

Subject: Letter of Understanding Re Honolulu International Airport, Hawaii, Proposed Reef Runway 8R/26L Project

This letter is written to confirm the understandings and agreements reached during our joint meetings of February 11, 1972, in Honolulu, relative to the Department of the Interior's concerns arising out of the proposed Honolulu International Airport Reef Runway Project.

You will recall that there is a rather lengthy history of meetings and correspondence between our offices wherein certain specific objections were posed by Interior bureaus and officials to the proposed Reef Runway Project. These objections were predicated primarily upon what we deemed to be potentially serious detrimental consequences of this proposed project upon the estuarian and recreational values of Keehi Lagoon. The primary purpose of our meeting on February 11 was to attempt to resolve our differences on a policy level. For this purpose representatives to these meetings included not only yourselves and certain key

Attachment 5 (Page 1)

members of your respective staffs, but also the Regional Director of the Bureau of Outdoor Recreation, from San Francisco; the Deputy Regional Director of the Bureau of Sport Fisheries and Wildlife, from Portland; our Regional Solicitor, from Sacramento; and myself as the Secretary's representative. The Corps of Engineers was also represented.

After a general discussion of your current plans, it was agreed by the Interior representatives that, in substance, the amended proposals contained in the January 1972 final version of the environmental impact statement for this project resolved the major portion of Interior's objections. It was suggested, however, that one or two items on a policy level remained uncertain and should be clarified.

First, a question was raised as to whether Keehi Lagoon if it were to remain within the periphery boundaries of Honolulu International Airport, and thus within the jurisdiction and control of FAA, could continue to be utilized and developed for recreational purposes. Interior personnel were under the impression that FAA considered recreational use of the lagoon as incompatible with airport uses. Mr. Swatek assured us that our impression in this regard was erroneous. To the contrary, it is FAA's intent and policy to not only permit recreational use of Keehi Lagoon, but to actively encourage such use; acknowledging, of course, the limitation that any recreational use which might physically interfere with airport facilities could not be permitted. Mr. Swatek went on to note, however, that even though the lagoon is physically within the airport boundaries the lagoon is actually managed and controlled by the State Department of Transportation. He went on to say that it was his understanding that the Department of Transportation concurred in the continued use and development of this lagoon for recreational purposes. At a later meeting on the same day Dr. Matsuda concurred in Mr. Swatek's statement and stated that his Department had primary responsibility and authority to develop bay facilities for recreational purposes and it was their intent to do so in Keehi Lagoon. With this understanding, then, the Interior representatives agreed to withdraw their suggestion that the lagoon be deleted from the airport boundaries.

The second policy item discussed concerned the substitute stilt habitat areas which are to be set aside from lands

Attachment 5 (Page 2)

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controlled by the Navy in lieu of those which would be destroyed upon construction of this project. The Interior representatives inquired as to whether the Navy had actually committed itself to relinquish the substitute areas so that they will be available at or about the time destruction of the primary areas occurs. We were advised that in fact such commitment had been made, but not yet reduced to writing; however, neither FAA nor DOT anticipated any difficulty in this regard. Subsequently I met with Admiral Henry S. Morgan on February 14 and he confirmed this understanding. The only item then remaining from a policy point of view with respect to these substitute stilt areas was the question of who would assume jurisdiction and responsibility for this habitat. Interior's Bureau of Sport Fisheries and Wildlife has since stated in a memorandum to me that that agency will accept the responsibility to manage these areas as satellite refuges within the National Wildlife Refuge System.

The third major policy item raised during our meeting involved the Corps of Engineers permits. FAA and DOT requested that if at all possible they would prefer that the Corps issue one permit which would cover the entire project, rather than two permits covering the project in two increments. Interior representatives raised some question concerning the time span between initial construction and completion, the primary concern being that if a prolonged delay occurred certain desirable changes in environmental restraints and/or construction procedures might be precluded by virtue of the issuance of a complete permit at the preconstruction stage. After much discussion on this point it was generally agreed that the Corps could issue one permit covering the complete project with the proviso that the permit contain not only a clause requiring specific compliance with current environmental considerations, but should also provide for additional review at any future time prior to completion of the project if substantial changes in circumstances so warrant. It was further agreed that progress reports would be received on construction activities and wherever possible the Corps and the Department of the Interior would give final approval on specifications and procedures prior to the letting of contract bids for a particular stage or increment of construction. The precise terminology for the conditions of the Corps permit here concerned will be worked out between the parties.

The foregoing agreements and understandings are set forth based upon notes taken during our meetings. If these

understandings and agreements are not consistent with your recollection and intent I would very much appreciate a letter so stating. Since this exchange of letters represents a clarification and elaboration of certain points in the environmental statement, it would be appropriate, we believe, for the letters to be appended to the statement.

Once again, let me thank you for taking the time to meet with us to discuss this matter and I am extremely pleased that we were in fact able to resolve our differences and at the same time insure that completion of this project will be accomplished with minimum adverse impact upon the environmental and ecological values of Keehi Lagoon.

Sincerely,

William M. Monroe
Secretary's Field Representative

cc: Robert J. Hitt, Executive Assistant to the Secretary, USDI
Nathaniel P. Reed, Assistant Secretary for Fish and Wildlife and Parks, USDI
John W. Larson, Assistant Secretary--Program Policy, USDI
Admiral Henry S. Morgan, CO, Fourteenth Naval District
Colonel William D. Falck, District Engineer, CE, Honolulu
Charles Renda, Regional Solicitor, USDI, Sacramento
John D. Findlay, Regional Director, BSF&W, Portland
Frank E. Sylvester, Regional Director, BOR, San Francisco
Howard H. Chapman, Regional Director, NPS, San Francisco
Paul De Falco, Jr., Reg. Administrator, EPA, San Francisco

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XII-60

EDWARD Y. HIRATA
Director

DEPUTY DIRECTORS
JOHN E. UCHIYAMA
RONALD N. HIRANO
DANT HOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

January 4, 1990

HAR-ED 2128

The Honorable Carol Post
Kalihi Palama Neighborhood Board No. 15
c/o Neighborhood Commission Office
City Hall, 4th Floor
Honolulu, Hawaii 96813

Dear Ms. Post:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 22, 1989 regarding your concerns on the proposed development of the Triangle Island within Ke'ehi Lagoon.

We are aware of the past correspondence relating to the development of Ke'ehi Lagoon. Changed conditions, circumstances, and needs since the dates of the correspondence have justified the recent re-evaluation and update to the Ke'ehi Lagoon Recreation Plan. The letter dated April 13, 1972 from the U. S. Department of the Interior to the FAA and the State Department of Transportation, clarifies certain understandings reached with respect to the proposed construction of the Reef Runway. The agreements reached were based on the circumstances prevailing at that time with respect to the conditions within the lagoon and the mitigation for the Reef Runway construction. The memorandum dated March 22, 1978 from Senator Jean King clarifies certain understandings reached with respect to the lease of Mokauea Island to the Mokauea Fishermen's Association, which was contrary to the spirit of the 1972 agreement. Again, the 1978 agreements reached were based on the circumstances prevailing at that time and the mitigation for the lease action. Similarly, based on our present findings, we intend to pursue new agreements regarding mitigation for the proposed project. As stated in the Draft EIS, Federal regulatory issues will be resolved within the context of the Department of the Army permit action.

The Draft EIS provides substantial information on the present environmental conditions within the lagoon, analysis of probable impacts, and proposed mitigative measures. If you have any specific comments regarding any of the material described in the document, we would be pleased to discuss these with you.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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XII-61

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840 0001

William A. Bonnet
Manager
Environmental Department

ENV 2-1
JA/G

October 31, 1989

Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control
465 South King Street
Honolulu, Hawaii 96813

Dear Dr. Miura:

Subject: Draft Environmental Impact Statement for Ke'ehi Lagoon Recreation Plan

We have reviewed the above subject document and have no comments.

Sincerely,

JIM:gjy

cc: Fred Nunes, Project Manager
Department of Transportation

Edward K. Noda & Associates, Inc.

An HEI Company

Sierra, Mt. McKinley — Ansel Adams

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(206) 621-7100

SIERRA CLUB
LEGAL DEFENSE FUND, INC.

212 Merchant Street, Suite 202 Honolulu, Hawaii 96813 (808) 599-2436
FAX (808) 521-6841

November 21, 1989

Elaine Tamaye
Edward K. Noda & Associates, Inc.
Suite 1000
615 Piikoi Street
Honolulu, HI 96814

RE: Comments on the Keehi Lagoon Recreation Plan Draft Environmental Impact Statement

Dear Ms. Tamaye:

The Sierra Club Legal Defense Fund is submitting these comments on the Draft Environmental Impact Statement ("DEIS") for the Keehi Lagoon Recreation Plan ("Project") on behalf of Hawaii's Thousand Friends and the Sierra Club. Hawaii's Thousand Friends will be submitting additional comments under separate cover. These comments focus on that portion of the Project which involves filling 250 acres of intertidal mud and coral reef flat in the Keehi Lagoon triangle area for development -- of which approximately 119 acres will be for non-water dependent commercial and light industrial uses, to support the expansion of Honolulu International Airport. DEIS, p.I-3.

1. The DEIS Fails to Adequately Discuss Alternatives to the Project

Hawaii Admin. Rule § 11-200-17(f) ("EIS Rules") requires that each DEIS contain a discussion of alternatives to the proposed action. "[A]lternatives which could feasibly attain the objectives of the action--even though more costly--shall be described and explained ..." Ibid. In this case, the DEIS dismisses out of hand, at p.IV-9, the less environmentally damaging alternative of locating the non-water dependent airport expansion projects on fast land which is already zoned commercial and light industrial. Kapalama, Kalihi Kai,

Mapunapuna and other areas adjacent to or near the airport are already zoned for such uses. Although the DEIS claims that no other alternative can be considered because lease revenue from commercial development of the triangle area is needed to finance public development in the lagoon area, ibid., the EIS Rules expressly require that feasible alternatives which may not be as financially lucrative be discussed. It is therefore essential that the Final EIS ("FEIS") consider the alternative of locating the airport expansion projects outside of the Keehi Lagoon area.

Moreover, a thorough discussion of alternatives is required not only by the DEIS Rules, but also by the Environmental Protection Agency's guidelines for dredge and fill projects adopted pursuant to section 404 of the Clean Water Act. Compliance with the Section 404 guidelines, which are codified at 40 C.F.R. Part 230, is required as a condition for the issuance of a Department of the Army permit to discharge dredged or fill material into waters of the United States. If the site proposed to be filled is a "special aquatic site", which includes mud flats and coral reefs, i.e., the Keehi Lagoon triangle site, and if the activity to be performed thereon is non-water dependent, then under the Section 404 guidelines "practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise." 40 C.F.R. § 230.10(a)(3). Since the Project will require a Department of the Army permit (DEIS, p.I-6), alternative sites for the location of the non-water dependent activities proposed for the triangle site must be discussed in the FEIS.

2. The DEIS Fails to Analyze the Relationship of the Proposed Action to Plans and Policies Relating to the Use of Keehi Lagoon

The EIS Rules also require that each DEIS include a "[d]iscussion of how the proposed action may conform or conflict with objectives and specific terms of approved or proposed land use plans, policies, and controls ..." Haw. Admin. Rule § 11-200-17(h). On April 13, 1972, William M. Monroe, Field Representative for the Secretary of the Interior, wrote to the Directors of the Federal Aviation Administration and Hawaii Department of Transportation to memorialize in writing an agreement between the DOI, FAA and Hawaii DOT to the effect that the Hawaii DOT would limit the development of Keehi Lagoon to recreational purposes only. This policy to restore and enhance Keehi Lagoon for non-consumptive purposes was restated, this time by the State, in 1978. In a March 22, 1978 letter from the Lieutenant Governor to the U.S. Fish and Wildlife

Service, reference was once again made to "the basic understanding arrived at ... (that) the entire area of Keehi Lagoon will be for recreation and wildlife." Copies of these letters are enclosed with these comments. Accordingly, the FEIS must discuss the conflict between the Project and the expressly stated policy -- by both the federal and state governments -- that Keehi Lagoon will be developed only for recreational and wildlife uses.

3. The DEIS Fails to Address the Cumulative Impact of Habitat Loss

Subsection 17(i) of the EIS Rules requires each DEIS to consider the cumulative impact of the proposed action in relation to other projects: "The interrelationships and cumulative environmental impacts of the proposed action and other related projects shall be discussed in the draft EIS." Haw. Admin. Rule § 11-200-17(i). Although the DEIS concludes that the impact on Hawaiian waterbirds and migratory shorebirds resulting from the loss of habitat in the triangle area will be negligible, see, e.g., p.IV-4, it does not address the cumulative impact of the loss of 250 acres of intertidal habitat in relation to habitat loss resulting from other coastal development projects on Oahu, for example, West Beach, Magic Island, Kuapa Pond and Paiko Lagoon.

4. The DEIS Does Not Discuss Measures to Mitigate Loss of Foraging Habitat For Migratory Shorebirds

The DEIS does discuss proposed mitigation measures to compensate for loss of endangered Hawaiian waterbird habitat. See, e.g., DEIS, p.IV-5. However, there is no discussion on mitigating the impact on migratory shorebird foraging habitat, which will occur when the triangle area is filled. Although Dr. Andrew Berger states in his report (DEIS, Appendix C) that displaced migratory shorebirds will find other feeding and resting areas, his opinion is not supported by the findings of Bruner and Johnson (cited in text by reference to Johnson, et al. (1981)). They observed that golden plovers overwintering in the Hawaiian Islands are territorial and non-territorial in about equal numbers, and that territorial birds may reoccupy the same territory the following year. This writer has observed agonistic interactions among in foraging plovers at Paiko Lagoon, which raises the question of whether plovers may establish intertidal foraging territories.

The FEIS should discuss, based on the published literature, the impact of foraging habitat loss on golden plovers. The FEIS should also address the impact of filling in the triangle area in

light of the habitat requirements of the other species of migratory shorebirds which overwinter on a regular basis, including the ruddy turnstone, sanderling and wandering tattler.

Thank you for this opportunity to comment on the Keehi Lagoon Recreation Plan DEIS.

Very truly yours,

Arnold L. Lum

Enclosures
cc: Fred Madlener
Ed Stevens

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Attachment

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION

PACIFIC SOUTHWEST FIELD COMMITTEE
BOX 36098 - 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102

DIRECTOR'S OFFICE
Apr 17 2 26 PM '72
DEPT. OF TRANSPORTATION

April 13, 1972

Mr. Phillip M. Swatek
Director, Pacific Region
Federal Aviation Administration
U. S. Department of Transportation
Post Office Box 4009
Honolulu, HI 96813

Dr. Fujio Matsuda, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813

Dear Mr. Swatek and Dr. Matsuda:

Subject: Letter of Understanding Re Honolulu International Airport, Hawaii, Proposed Reef Runway 8R/26L Projec

This letter is written to confirm the understandings and agreements reached during our joint meetings of February 11, 1972, in Honolulu, relative to the Department of the Interior's concerns arising out of the proposed Honolulu International Airport Reef Runway Project.

You will recall that there is a rather lengthy history of meetings and correspondence between our offices wherein certain specific objections were posed by Interior bureaus and officials to the proposed Reef Runway Project. These objections were predicated primarily upon what we deemed to be potentially serious detrimental consequences of this proposed project upon the estuarian and recreational values of Keehi Lagoon. The primary purpose of our meeting on February 11 was to attempt to resolve our differences on a policy level. For this purpose representatives to these meetings included not only yourselves and certain key

members of your respective staffs, but also the Regional Director of the Bureau of Outdoor Recreation, from San Francisco; the Deputy Regional Director of the Bureau of Sport Fisheries and Wildlife, from Portland; our Regional Solicitor, from Sacramento; and myself as the Secretary's representative. The Corps of Engineers was also represented.

After a general discussion of your current plans, it was agreed by the Interior representatives that, in substance, the amended proposals contained in the January 1972 final version of the environmental impact statement for this project resolved the major portion of Interior's objections. It was suggested, however, that one or two items on a policy level remained uncertain and should be clarified.

First, a question was raised as to whether Keehi Lagoon if it were to remain within the periphery boundaries of Honolulu International Airport, and thus within the jurisdiction and control of FAA, could continue to be utilized and developed for recreational purposes. Interior personnel were under the impression that FAA considered recreational use of the lagoon as incompatible with airport uses. Mr. Swatek assured us that our impression in this regard was erroneous. To the contrary, it is FAA's intent and policy to not only permit recreational use of Keehi Lagoon, but to actively encourage such use; acknowledging, of course, the limitation that any recreational use which might physically interfere with airport facilities could not be permitted. Mr. Swatek went on to note, however, that even though the lagoon is physically within the airport boundaries the lagoon is actually managed and controlled by the State Department of Transportation. He went on to say that it was his understanding that the Department of Transportation concurred in the continued use and development of this lagoon for recreational purposes. At a later meeting on the same day Dr. Matsuda concurred in Mr. Swatek's statement and stated that his Department had primary responsibility and authority to develop bay facilities for recreational purposes and it was their intent to do so in Keehi Lagoon. With this understanding, then, the Interior representatives agreed to withdraw their suggestion that the lagoon be deleted from the airport boundaries.

The second policy item discussed concerned the substitute stilt habitat areas which are to be set aside from lands

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Once again, let me thank you for taking the time to meet with us to discuss this matter and I am extremely pleased that we were in fact able to resolve our differences and at the same time insure that completion of this project will be accomplished with minimum adverse impact upon the environmental and ecological values of Keehi Lagoon.

Sincerely,

William M. Monroe
Secretary's Field Representative

cc: Robert J. Hitt, Executive Assistant to the Secretary, USDI
Nathaniel P. Reed, Assistant Secretary for Fish and Wildlife and Parks, USDI
John W. Larson, Assistant Secretary--Program Policy, USDI
Admiral Henry S. Morgan, CO, Fourteenth Naval District
Colonel William D. Falck, District Engineer, CE, Honolulu
Charles Renda, Regional Solicitor, USDI, Sacramento
John D. Findlay, Regional Director, BSF&W, Portland
Frank E. Sylvester, Regional Director, BOR, San Francisco
Howard H. Chapman, Regional Director, NPS, San Francisco
Paul De Falco, Jr., Reg. Administrator, EPA, San Francisco

Attachment

The Senate
The Ninth Legislature
of the
State of Hawaii

HONOLULU, HAWAII

March 22, 1978

MEMORANDUM

TO: U. S. Fish & Wildlife
Mokauea Fishermen's Association
State Wildlife Branch
Governor's Office

FROM: Jean King

RE: Meeting of March 21, 1978

Thank you all so very much for coming to the meeting. I really appreciate your patience and the spirit of understanding and air of wanting to work things out which pervaded the lengthy meeting.

This will confirm the basic understanding arrived at:

1. U. S. Fish & Wildlife will write a letter within a day or so to the Federal Aviation Administration stating they have no objection to the leases being granted to the current residents of Mokauea Island.

2. The State Wildlife Branch will include in their proposal to the Board of Land and Natural Resources the following provisos:

   a. The entire area of Keehi Lagoon will be for recreation and wildlife.

   b. There will be no structures on any of the islands other than Mokauea.

   c. There will be a Manana Island type of kapu prohibition for the mudflats facing Mokauea Village.

3. Further, the State Division of Wildlife will continue to work toward establishment of seabird wildlife sanctuaries on the Leeward side of Oahu.

4. The Mokauea Village residents pledge their support at the hearing before the Board of Land and Natural Resources on the proposal presented by the State Wildlife Branch.

The affirmation of shared concerns by the residents of Mokauea and the U. S. Fish and Wildlife was indeed heartening and heartwarming.

Again, many thanks to all of you.

XII-66

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. LICHIDA
RONALD N. HIRANO
DANT. HOOM
JEANNE K. SCHULTZ

IN REPLY REFER TO

December 22, 1989

HAR-ED 2099

Mr. Arnold L. Lum
Sierra Club Legal Defense Fund, Inc.
212 Merchant Street, Suite 202
Honolulu, Hawaii 96813

Dear Mr. Lum:

Ke'ehi Lagoon Recreation Plan Draft EIS

Thank you for your letter of November 21, 1989 to Ms. Elaine Tamaye, our consultant for the subject project. We offer the following clarification and responses to your review and comments:

1. Alternatives to the Project: There is a dire need for additional light industrial/commercial space in metropolitan Honolulu, especially adjacent to the airport and the waterfront. The availability of commercial land next to the Honolulu International Airport will worsen because of our need to expand the airport. This expansion will require us to acquire lands bounded by Ualena and Aolele Streets, and at Hickam Air Force Base. There will be significant social and economic impacts befalling businesses to be dislocated. It is apparent that additional acreage will be needed by the year 2010 for the airport.

   Equally pressing is the need for adequate maritime facilities. However, constructing needed boat slips also requires fast lands upon which supporting facilities such as marine supplies and boat repair yards can be located. Other supporting facilities include comfort stations, fuel and ice stations, administration building, and marine sales. Except for Keehi Lagoon, areas for these activities are not currently available along the metropolitan Honolulu waterfront. Ke'ehi Lagoon is under Governor's Executive Order (G.E.O.) 3202 to the Department of Transportation, Airport and Harbors Divisions, as shown in Figure II-4 of the DEIS.

Development of the lagoon for airport and maritime uses is therefore consistent with the G.E.O. and would result in the least social and economic impacts to the community. In the long term, the Triangle Development will provide the needed aviation and maritime-related industrial lands required to keep our air and sea transportation facilities efficient and economical for the public.

The alternative of locating the light industrial and commercial uses on the Triangle Development to existing fast lands will be discussed in more detail in Chapter 6.4 of the Final Environmental Impact Statement as it relates to disaggregation of plan components.

The federal issues related to filling for the Triangle Development will be resolved within the context of the Department of the Army (DA) permit. We have recently filed a DA permit application and will coordinate the necessary Federal requirements with the U.S. Army Corps of Engineers.

2. Relationship to Plans and Policies: The letter which you referred to, dated April 13, 1972 from the U. S. Department of the Interior to the FAA and the State Department of Transportation, clarifies certain understandings reached with respect to the proposed construction of the Reef Runway. The understandings reached were based on the circumstances prevailing at that time with respect to the conditions within the lagoon and the mitigation for the Reef Runway construction. The basis for this 17-year-old understanding must be re-evaluated in terms of the present conditions existing within the lagoon and the proposed mitigation for the current plan. The National Wildlife Refuges established in Pearl Harbor as mitigation for the Reef Runway construction have enjoyed great success in providing safe nesting habitats for the endangered Hawaiian waterbirds. These habitats are now considered much more critical to the waterbirds than any area in Ke'ehi Lagoon. It is our intent to provide a similar habitat as mitigation for the loss of mudflats in Ke'ehi Lagoon due to the proposed plan. The experience and example set by the Reef Runway mitigation would assure the success of our presently proposed mitigation. We will resolve this issue during coordination efforts related to the DA permit.

3. Cumulative Impacts: The other projects which you refer to are not related to the proposed plan. The intent of the EIS rules which require that "the interrelationships and cumulative environmental impacts of the proposed action and other related projects...be discussed in the draft EIS" is to preclude fragmentation of a project because of possible cumulative impacts due to the entire project. For this reason, we have presented the entire Ke'ehi Lagoon master plan in the Draft EIS for review of area-wide impact on the lagoon and vicinity, rather than separating out the individual projects proposed under the master plan. For your clarification, of the 250 acres proposed for filling in the middle of the lagoon, less than 170 acres comprises the intertidal mudflats.

4. Measures to Mitigate Loss of Foraging Habitat for Migratory Shorebirds: There is no evidence to indicate that the carrying capacity of the other areas in the Ke'ehi Lagoon vicinity which provide foraging habitat for migratory shorebirds will be exceeded due to loss of the Ke'ehi Triangle mudflat. Surveys of the bird populations utilizing Ke'ehi Lagoon for feeding has shown a significant decline in the total numbers since the early 1970s, even though there was no net loss of habitat subsequent to the Reef Runway construction. The proposed mitigation habitat for the loss of the mudflat in Ke'ehi Lagoon is intended to provide feeding, resting and safe nesting sites for all waterbirds. As stated in Appendix C, the mitigation areas provided for the waterbirds by the Pearl Harbor National Wildlife Refuge are serving very well for nearly all of the endangered Hawaiian waterbirds, and the mitigation areas proposed by the State DLNR for this plan would benefit both the endangered Hawaiian waterbirds and the migrant shorebirds. A recent article in the paper headlines the little-known sanctuary at Pearl Harbor. "It's a place of peace for endangered Hawaiian shorebirds...Sharing the retreat are dozens of species of long-distance travelers...Dotting the flats are plovers, tattlers, sanderlings and other seasonal refugees from the arctic north." As stated previously, this sanctuary, which was created as mitigation for the Reef Runway construction, serves as an excellent example of not only successful mitigation but also habitat enhancement for the waterbirds and shorebirds.

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Please contact Mr. Fred Nunes at 548-2505 if you desire further information or updating on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

LIFE OF THE LAND

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R/6 51

HARBORS DIVISION

November 24, 1989

Edward Y. Hirata
Director of Transportation
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

SUBJECT: KEEHI LAGOON RECREATION PLAN DRAFT EIS

Thank you for the opportunity to comment on the Keehi Lagoon Recreation Plan and the Draft EIS concerning the Plan. We truly appreciate the effort which the State is making.

SUGGESTED ADDITIONS TO THE PLAN

We request three additions to the Keehi Lagoon Recreation Plan.

1. The State should dredge industrial and coral rubble immediately makai of the existing sand beach on the south shore of Sand Island. Additional sand should be placed on this beach. If necessary, short groins should be added to stabilize the wider beach.

Despite its popularity, the existing beach is fronted by underwater hazards which make wading dangerous. On the other hand, water and air quality are excellent, the beach is stable, and wave action naturally keeps the sand clean.

Please ask your consultants to include a conceptual plan and cost estimate for nearshore dredging and beach widening in the Final EIS. Provided that the scale of improvements is modest, so that offshore surf sites are not adversely affected, you will find that the benefits far outweigh the costs.

2. The State should select a site and set a timetable for relocation of the AT&T cable ship from Sand Island.

19 Niolopa Place, Honolulu, Hawaii 96817. Tel. 595-3903

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The entrance to Sand Island State Park will be fenced off to accommodate the cable ship and dry-stored cable. This is an inappropriate use of a popular and highly visible part of the park.

Please provide your consultants with appropriate information so that relocation of the AT&T cable ship can be addressed in the Final EIS.

3. The State should either fund or require necessary City improvements to contain all odors generated by Sand Island Wastewater Treatment Plant.

Parts of Sand Island State Park immediately downwind of the wastewater treatment plant are subject to highly offensive odors. Depending on wind direction, unpleasant odors can reach other parts of Keehi Lagoon. We think the problem needs to be dealt with to facilitate increased recreational use of Keehi Lagoon.

Please ask your consultants to include a cost estimate in the Final EIS for necessary improvements to Sand Island Wastewater Treatment Plant.

ADDITIONAL INFORMATION NEEDED IN THE FINAL EIS

There are a number of points we would like clarified about the Keehi Lagoon Recreation Plan and its environmental impacts. Please ask your consultants to include the necessary information in the Final EIS.

1. The Final EIS should address how frequently users of the proposed beach and more distant parts of Keehi Lagoon would be subjected to odors from Sand Island Wastewater Treatment Plant.

The Draft EIS does not address how odors from the existing wastewater treatment plant might affect viability of the Keehi Lagoon Recreation Plan.

2. The Final EIS should include numerical analysis of bacterial concentrations in Keehi Lagoon immediately offshore of the proposed Hawaiian Canoe Center and proposed swimming beach.

We would like confirmation that these waters are safe for body contact. No measurements of bacteria levels are included in the Draft EIS.

3. The Final EIS should include numerical analysis, for various parts of Keehi Lagoon, of the daily proportion of embayment volume exchanged with ocean water before and after proposed improvements.

We would like to know how much reduction in water exchange will occur because of various proposed improvements. We are unable to reach conclusions on the basis of the charts presented in Appendix G of the Draft EIS.

4. The Final EIS should indicate the clearance of the proposed bridge (to the proposed man-made island) and indicate the types of sailboats which have a small enough mast to sail under it.

We would like to know if trailerable sailboats and sailboats moored in proposed marinas along Seaplane Runway "A" will be able to sail beneath the proposed bridge. The Draft EIS does not address the height of the bridge.

5. The Final EIS should address whether oil and grease from boating in Keehi Lagoon will drift into the swimming area or onto the sand of the proposed new Sand Island beach.

The Draft EIS Appendix G suggests that under some conditions boating activities might pollute the proposed beach and swimming area. If there is potential for a problem, then it should be resolved before $3.3 million is spent to build a new beach.

6. The Final EIS should indicate how the State plans to keep the proposed new Sand Island beach clean.

The Draft EIS should but does not mention that neither tradewinds nor wave action will remove trash from the proposed beach. Although it is not State practice to contract for mechanical beach cleaning, there may be no alternative in this case.

7. The Final EIS should provide more information about the probable frequency and duration of yacht races/racing syndicate use at the proposed yacht race/ocean sports complex.

The Draft EIS suggests that this proposed $34 million complex is the primary justification for allowing development of a man-made island in Keehi Lagoon. However, it is unclear how much use the complex will have if not used for hosting America's Cup racers.

8. The Final EIS should include at least cursory analysis of the financial feasibility of spending over $40,000 per slip to develop new private marinas in Keehi Lagoon.

Parts of the Keehi Lagoon Recreation Plan will need rethinking if the marinas are not feasible. We would like to know roughly what slip fees new commercial marinas abutting Pier 60 and Seaplane Runway "A" would need to charge to recover their capital expenditures, recover their operating costs, and make

a profit. Given that live-aboards would not be allowed, we also would like to know roughly how many boat owners would be willing to pay such slip fees.

9. The Final EIS should indicate which proposed privately funded improvements will be publicly maintained and operated. The Final EIS should also address the long-term costs the State will need to incur to maintain and operate such improvements.

The Draft EIS does not contain enough discussion of proposed long-term commitment of State resources.

10. To the maximum extent practical, the Final EIS should clarify minimum requirements which will be imposed on private developers in exchange for the right to use public land for private gain.

Appropriate requirements should be publicly debated and resolved before any commitments are made. Otherwise, the private developers involved will try to minimize expenditures for amenities and impact mitigation measures that they consider unprofitable.

Sincerely,

Doug Meller

Douglas Meller
Vice President for
Coastal Zone Management

cc: Edward K. Noda and Associates, Inc.
Office of Environmental Quality Control
Office of State Planning

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN E. LICHAA
RONALD N. HIRANO
DANT. ROCHE
JEANNE K. SCHULTZ

IN REPLY REFER TO

December 26, 1989

HAR-ED 2110

Mr. Douglas Meller
Vice President for Coastal
Zone Management
Life of the Land
19 Niolopa Place
Honolulu, Hawaii 96817

Dear Mr. Meller:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 24, 1989. We offer the following clarification and responses to your review and comments:

Suggested additions to the plan:

1. Your comments regarding enhancement of the existing beach on the south shore of Sand Island will be taken under consideration. However, as indicated in the Draft EIS, Sand Island State Park is under the jurisdiction of the Department of Land and Natural Resources (DLNR). It is our understanding that the present master plan for the park does not include any major beach improvements. The swimming beach proposed as part of the Ke'ehi Lagoon Recreation Plan is a Department of Transportation proposed project, inasmuch as the proposed beach is located partially within the Ke'ehi Lagoon waters under the jurisdiction of the Department of Transportation. As indicated in the Draft EIS, during the public involvement process leading to the update of the Ke'ehi Lagoon Recreation Plan, the Kalihi-Palama community voiced desires for a safe swimming beach. The proposed swimming beach would not only satisfy this need, but would also provide sheltered waters within Seaplane Runway "D" for boating and other water recreation

activities, which is a desired component of the Ke'ehi Lagoon Recreation Plan. I will refer your comments to the Department of Land and Natural Resources (DLNR), and will coordinate further with them prior to developing further detailed plans for the swimming beach in Ke'ehi Lagoon.

2. The relocation of the AT&T cable ship on Sand Island is outside the scope of the Ke'ehi Lagoon Recreation Plan. For your information, the Department of Transportation is in the process of transferring lands set aside for Airport use to the DLNR for the Sand Island State Park to replace lands occupied by the AT&T ship landing.

3. Odors from the Sand Island Wastewater Treatment Plant (WTP) do not significantly impact recreational use of Ke'ehi Lagoon waters or any of the major improvements proposed within the interior areas of the lagoon as part of the Recreation Plan. However, the proposed swimming beach at the southwest corner of Sand Island is downwind of the treatment plant and may be subjected to odors from the plant. While the Department of Transportation has no jurisdiction over the Sand Island WTP, we will coordinate further with the DLNR prior to developing further detailed plans for the swimming beach.

<u>Additional information needed in the Final EIS:</u>

1. The present intensive recreational use of the lagoon, even in areas directly downwind of the Sand Island WTP, would indicate that odors from the treatment plant are not a serious problem. For example, numerous vessels presently moor within the lagoon waters adjacent to Sand Island, the Mokauea Island Fishing Community is nearby, and the University of Hawaii conducts recreational boating classes on the north tip of Sand Island next to Kalihi Channel. Except for the proposed swimming beach at Sand Island, the Recreation Plan proposes no major developments in the vicinity of Sand Island.

2. According to the Department of Health, bacterial concentrations in the lagoon are not a threat to public health. Detailed investigations to be undertaken during the planning and design for the Hawaiian Canoe Center will include sampling and analysis of bacteria levels. If it is revealed that this is a potential problem, then a Supplemental EIS will be issued for the project. As

indicated in the Draft EIS, detailed site investigations and studies for the individual projects have not yet been undertaken. Therefore, if during the course of detailed studies it is determined that a specific development action may result in significantly greater impacts than described by this EIS, then a Supplemental EIS will be prepared for the respective action. I would emphasize that the water area adjacent to Keehi Lagoon Park is presently being used by the public for canoe practice and racing events.

3. Appendix D of the Draft EIS provides information on the exchange rates and residence times for waters within Ke'ehi Lagoon, based on the results of the numerical circulation model included as Appendix G.

4. Detailed plans have not been developed as yet for the bridge to the Triangle island. However, it is the intent that the bridge be high enough to allow passage of only small boats. The larger vessels and sailboats within the new marinas in Seaplane Runway "A" will have to travel counter-clockwise around the Triangle to exit the lagoon. This is safer for navigation since it separates the vessel traffic of the new marinas in Seaplane Runway "A" from the vessel traffic in Seaplane Runway "D".

5. The numerical circulation model indicates little potential for water quality impacts to the swimming beach due to boating activities within the marinas. Existing "beach" shorelines such as the sand bar berm directly across the existing marinas and Mokauea Island have not experienced problems with oil and grease from the boating activities. While some hydrocarbons are released into the water by outboard motors, they evaporate quickly and should not cause serious water quality degradation in a marine environment with good flushing characteristics such as in Ke'ehi Lagoon. The direct discharge of oil or grease is prohibited.

6. Beach cleaning will be handled as routine Park maintenance, similar to the State's beach at Magic Island State Park.

7. The permanent yacht race/ocean sports complex is intended as a multi-purpose watersports complex. The complex will host existing yacht races as well as other ocean sports events, for example, open ocean kayaking and canoeing as well as competition water skiing. We anticipate that the development of a world class racing facility will also

foster other major yacht races here which cannot be accommodated in Hawaii because of lack of facilities. The campaign to bring the America's Cup Race to Hawaii has generated inquiries about holding other races here including the World 12 Meter Championships and a Pacific Basin Championship Series. While we have accommodated the Transpac and Kenwood Cup races at the Ala Wai Boat Harbor in the past, it has become increasingly more difficult to do in recent years. The development of facilities in Ke'ehi Lagoon will not only assure that we can continue to host these races, but will also encourage growth of other sports events in Hawaii.

8. The ratidnale for the multi-purpose Triangle development is that the light industrial/commercial development for maritime and aviation uses will generate financing for ocean recreation public improvements, which includes the marinas. In order to keep user fee costs for "recreational" improvements modest, the developer must be able to recover his costs from the lease of the industrial/commercial space. As summarized in Table II-3 of the Draft EIS, the commercial/light industrial component of the Triangle Development finances the other recreational components of the project.

9. The use of public funds is described in Chapter 2.3 of the Draft EIS. All of the privately-developed projects will be privately maintained. The only exception is the ferry terminal on Lagoon Drive, which is intended to be operated by the State as part of their Intra-Island Ferry System.

10. The developers will be bound by the EIS, the mitigation requirements that are imposed by the regulatory agencies through the applicable permits, and the terms of the lease. Design Criteria Requirements and standards will be imposed on the developer, and their plans will be reviewed and approved prior to any construction. All development will conform to standard City, State and Federal codes.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the status of the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

SAND ISLAND BUSINESS ASSOCIATION
P.O. BOX 17603
HONOLULU, HAWAII 96817
Telephone (808) 842-1359
FAX (808) 842-7682

November 7, 1989

Honorable Edward Y. Hirata
Director of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata,

Subject: Keehi Lagoon Recreation Plan
Draft E. I. S.

Thank you for forwarding to us a copy of the subject document. The D.E.I.S. prepared by Edward K. Noda and Associates, Inc. is very well done. The subject matters covered are quite comprehensive and are very systematically arranged. And the State Legislative mandate (HCR no. 386) has been adequately complied with.

Space allocation shows 300 plus acres of fast and submerged lands; of which, light industrial/commercial uses occupy 119 acres. Although we agree that these uses should be in keeping with the beauty of the site, the restriction for only maritime and aviation related, may negate many legitimate small businesses to locate there. Such restriction should be seriously reconsidered.

We support your consultant's proposal to dovetail so well the ocean recreation activities at Keehi Lagoon and those proposed for the western shoreline area of Sand Island. Although our organization is not necessarily oriented toward the recreation aspects, since we are currently in the process of making substantial improvement to Sand Island industrial area, we want to support your endeavor and we feel that the subject plan will highly enhance the Honolulu Waterfront area, including the Sand Island, when fully implemented.

Sincerely yours,

Walter Y. Arakaki
President

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JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN E. LICHIMA
RONALD N. MIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

January 4, 1990

HAR-ED 2133

Mr. Walter Y. Arakaki, President
Sand Island Business Association
P. O. Box 17603
Honolulu, Hawaii 96817

Dear Mr. Arakaki:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 7, 1989. I appreciate your positive perception and response to the Draft EIS document and your complimentary remarks.

The main reasons for imposing aeronautical and maritime limitations on the uses within the light industrial/commercial space on the Triangle Development are as follows:

1. Planning related to updating Honolulu International Airport's (HIA) Master Plan has brought forth the need for additional lands to implement the projects proposed. One such project is the new International Terminal Building (ITB) which will require the acquisition of private lands bounded by Ualena and Aolele Streets adjacent to the airport. The ITB project will also cause the dislocation of existing airport tenants who are located at the site of the proposed ITB. While we recognize the potential hardships on the businesses to be dislocated, no vacant lands are available for the required expansion of airport facilities. It is apparent from current HIA planning studies that the airport will require additional acreage by the year 2010.

2. Equally pressing is the need for adequate maritime facilities. However, constructing needed boat slips also requires fast lands upon which supporting facilities such as marine supplies and boat repair yards can be located. Other supporting facilities

include comfort stations, fuel and ice stations, administration building, and marine sales. Except for Keehi Lagoon, areas for these activities are not currently available along the metropolitan Honolulu waterfront.

3. Creation of the Triangle Island will require a permit from the U. S. Army Corps of Engineers. Fills for non-water dependent activities are generally discouraged. It is a Federal mandate that practicable alternatives to fills for non-water dependent activities be given full consideration, such as locating these uses on existing fast land. We believe that the need for additional space to support the airport (which is non-water dependent) justifies the need for the triangle fill in Ke'ehi Lagoon, since there is no vacant land adjacent to the airport for expansion. Uses which are not maritime or aviation related can be sited in vacant industrial/commercial areas distant from Ke'ehi Lagoon with possibly only minor economic consequences. However, businesses and activities which directly support the airport and harbor need to be situated adjacent to these facilities from a functional/operational standpoint.

4. Because Ke'ehi Lagoon is under Governor's Executive Order (G.E.O.) to the Department of Transportation, Airport and Harbors, development of the lagoon for airport and maritime uses is consistent with the G.E.O.

I appreciate your interest and support for the project. Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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Attachment

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

R/S 5.1.1

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN W. UCHIMA
RONALD N. HIRANO
DAN Y. KOCH
JEANNE K. SCHULTZ

IN REPLY REFER TO

HAR-ED 1795

Mr. Arnold Lum
Sierra Club Legal Defense Fund, Inc.
212 Merchant Street, Suite 202
Honolulu, Hawaii 96813

Dear Mr. Lum:

Ke'ehi Lagoon Recreation Plan Draft
Environmental Impact Statement

Enclosed for your information and comment is a copy of the KE'EHI LAGOON RECREATION PLAN DRAFT ENVIRONMENTAL STATEMENT, September 1989. The DEIS has been published in the October 8th OEQC Bulletin. We welcome any written comments on the DEIS no later than November 24, 1989.

Very truly yours,

Edward Y. Hirata
Director of Transportation

Enclosure

HARBORS DIVISION
'89 NOV 27 11:07

1823 Hleaumoku St.
Honolulu Hi 96822
11/22/89

Edward J. Hirata
Director of Transportation
869 Punchbowl St.
Honolulu Hi 96813

Dear Sir:

Please find enclosed our comments on the Ke'ehi Lagoon DEIS. We note they are due 11/24/89.

A.F. Madlener
A.F. MADLENER
Hawaii's Thousand Friends

XII-74

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XII-75

HAWAII'S THOUSAND FRIENDS

Ke aloha o ko kākou ʻāina, ʻŌ ia ka mana kū paʻa. Pānoanoa ka ʻāina, Mānoanoa ka poʻe.
The Love of our land, is the power for us to stand fast. Rare is the land, many are the people.

8/22/89

Subject: Ke'ehi Lagoon Recreation Plan and Draft Environmental Impact Statement

Hawaii's Thousand Friends has reviewed this DEIS and finds many defects in it which it now brings to the attention of the Department of Transportation. The following objections are not listed by order of importance and no inference should be drawn as to which ones we consider the most pressing, although we say that there is one overarching objection that affects the whole project, and that is that the project and its components could all be executed elsewhere and that the DEIS was duty bound to take note of this but did not and that is the most glaring deficiency of the DEIS.

The engine that is driving this project is the creation of new land in the middle of the lagoon which is to be used for light industrial purposes. The DEIS never explains the regulations that govern protected shorelines, and how activities near the water have to be water oriented. There are no regulations that give special consideration to aircraft related activities built on or near the shore. The DEIS is entirely defficient in reviewing the applicable regulations, city, state, and federal which might impinge on the project. The DEIS fails entirely to point out that the state is bound by letters of agreement with the FAA and the Fish and Wildlife Service of the Federal Government in its plans for Ke'ehi lagoon. These letters were widely disseminated at the legislature and to ignore them impugns the impartiality of the DEIS. The lagoon is used by birds covered by international treaty and this is entirely ignored. Before the reef runway was built there were more birds in the lagoon than there are now. The DEIS concludes that since no Hawaiian Stilts have been seen recently at the lagoon they can be ignored; the facts are that the new uses of the lagoon since the reef runway were built have driven off the wildlife and that SPECIAL care must now be exercised, including reconstitution of feeding and nesting grounds as a consequence. This sort of even-handed approach is absent from the DEIS making it impossible for decisionmakers using it to be fairly guided in the matters that pertain to the lagoon. The DEIS is not slanted towards development, it is entirely tipped towards it and that alone invalidates it as a planning document.

Only recreation projects are allowed for the Ke'ehi Lagoon area and yet, as we mention above, the designation "Light Industry" is everywhere included in your DEIS as if it was a permitted use. Further the study treats the to-be-created island as a feasible place to put airport related commercial support activities without mentioning that these cannot be allowed on a shoreline related development, that they are excluded from "recreational anything", and that they could be placed in other areas such as the largely undeveloped area on either side of Lagoon Drive. Further, the DEIS does not mention that these waters are Federal navigable waters and that the Army Corps of Engineers has not encouraged the filling of wetlands for industrial development in 20 years. The DEIS has no discussion of the issues to be raised with the Corps at all, and that is how it might come about that the State is to be shocked at the reception its plans will get there and by the suits that will accompany this essentially unreviewed proposal. Ignoring the issues as this DEIS does is NOT in the states best interests because it exposes the state to serious losses for wasted planning expenditures, and it shakes the faith of the public in the states competence.

A review of the PLAN OBJECTIVES on page 1-2 of the DEIS shows that every single one of the stated objectives can be met by locating the activities elsewhere other than at Ke'ehi.

Among the many rationals given by the DEIS for the use of the lagoon, none is more laughable or more ill-done than the matter of the America's Cup. The document talks of the Cup as if it were a viable proposition for Hawaii. Whoever wrote this EIS is not familiar with Cup realities. At the present time the Cup is in San Diego, and San Diego is to defend it against challengers. These, by definition, come from abroad, and were any to succeed, the Cup would go to the winner's country. Failing a successful challenge, San Diego is to defend the Cup indefinitely. So when could the Cup come to Hawaii? Only if a foreign club wins it, and Hawaii is the successful challenger. The chances of that are not discussed in your DEIS but we can tell you what they are: ZERO. As a reference, know that the Italian challenge against San Diego is to be mounted with an unlimited budget, 40 designers and experts full-time, including German Frers, and up to six trial Yachts, each costing at least two million dollars. So. the whole DEIS discussion of the Cup in Hawaii is a dangerous smoke-screen designed to hide the fact that the motor that is driving this development is the development of new land on which to mount light industry, and NOT SPORTS AT ALL.

A close second to this shabby treatment of reality is the matt of a world-class yachting center for Hawaiian Regattas. The DEIS does not choose to mention that setting up such a center directly under the take-off pattern of interisland jets is a failure-prone idea. DEIS statistics notwithstanding, when the jets go over the present KE'Ehi Marine Center all activity stops, the sound is so appalling. The sound boggles the mind; it is ear splitting; it is so intense it actually crackles. The study simply glosses over what it is. But the yachting public won't. The study assumes that there will be huge regattas (not possible in Hawaii

due to its isolation) and that the contestants will prefer Ke'ehi Lagoon to the Ala Wai Yacht Harbor, the traditional location for the boats. This has not been adequately thought out.

The waters of Ke'ehi are contaminated now, and are notably distasteful to all who use them. The DEIS does not reveal how this is to be overcome or how building an island in the middle of Ke'ehi will promote circulation and/or improve water quality.

The whole project calls for a mere 6' elevation above sea level and the study does not show how this will make it safe enough in the event of storms, nor is a single bridge inherently safe and no provisions are studied for evacuation of the proposed island or access to fire trucks in the event of fire. The security features of building and habiting an area directly under a take-off zone are not discussed.

The whole issue of Ke'ehi Lagoon as a wildlife area, or even as a recreation area, is inadequately covered.

The effects of the tremendous dredging and filling opperations contemplated are not properly discussed. The outside reefs must be kept free of silt or die, and this issue is glossed over.

The DEIS does not discuss the general effects of dramatically increasing the human activities of this area and literally packing it with persons, gear, and capital improvements. The changes in densities are glossed over and the matter of infrastructure not addressed in relation to this change.

The whole issue of mitigative actions to the extraordinary changes contemplated is glossed over. This is aggravated by the State's uncertainty about what it wants to do with the area; it is plain from the DEIS that the state is waiting for the developers to tell it what THEY want to do so that the state can fall into line. But if the state does not know what is exactly to happen in the area they are at a disadvantage in specifying what abatement measures they plan to take or even what projects they will allow. These uncertainties reduce the value of this study as its authors cannot guess what the developers will want to do, and the developers don't know what the state will allow because the state itself does not know what it can get away with. This study, which is supposed to alert the state to its limitations does not do so because the authors do not wish to alert the general public to the pitfalls the state is walking right into. It is a strain for the State to realize that it cannot do anything it wants when it wants. Other agencies have a say and there are legal criteria. When the DEIS addresses itself to these issues, the state will be on firmer ground.

An example of the weakness of the mitigative measures suggested by the DEIS is the one regarding proposed destruction of coral. There will be some, the DEIS avers, but this can be compensated for (see page 1-4) by throwing overboard some sort of structure in Waimea Bay, ten miles away. This matter-of-fact statement hides the great difficulties, legal and biological of exchanging the one thing for the other.

Another example of mitigative nonsense is the item (3) on page 1-5 which reads "Details of the waterbird habitat and reef mitigation plans will be finalized in coordination with appropiate government agencies within the context of the U.S. Army Corps of Engineers permit application." This implies that negotiations have begun and just need to be "finalized". But negotiations have NOT begun, nor has a permit been applied for. So what is being said here is that something is being done about something nothing is being done about. This is another example of bias in this DEIS.

Not only do we have mitigative problems, but the DEIS makes clear that in the matter of siltation there will be dredging, but in 11-4 in the matter of the Hawaiian Canoe Center to be built at the mouth of a stream, "Periodic maintenance dredging will be required. . . ." A continuous flow of silt out to the reef will be the result of this and new permits will be required everytime, and the whole matter much more complex than this over-simplification details. Elsewhere it is alleged that the reef will keep this area free of storm damage, and here it allows that damage to that reef will take place as a matter of maintenance.

It is said throughout this DEIS that this whole project must be financed (11-8) by the "island" development, and it is a defect of this study that the alternatives to this are not explored. We have to ask why the state cannot execute a modest recreational development with conventional government financing, amortized conventionally out of user fees of the facilities, as are the yacht harbors around the state. The answer to this question may lie on page 11-11 where the DEIS argues that when international regattas are not in session, then commercial vessels may use their assigned facilities. This explains the overblown plan to have a year-round regatta complex which is an impossibility and rivals third world grandiose plans for "sports complexes". The true purpose of all of this "grand" planning is to create commercial facilities, and planners using this DEIS should take note that this hidden agenda is actually driving this project and that this DEIS is attempting to gloss over this reality. And this is how this is being done: on page 11-12 it says "The activities should also be in keeping with the beauty of the site." This site is not beautiful now, and will grow increasingly less so as development proceeds. Words cannot remedy this deficiency, but they can deceive the unwary.

This review does not exhaust our objections. Please find attached the letter to the Governor from our attorneys, Sierra Club Legal Defense Fund for a rundown of the legal issues.

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XII-77

Attachment

SIERRA CLUB
LEGAL DEFENSE FUND, INC.

Joseph, Sr. McKinley Ansel Adams

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January 9, 1988

Honorable John D. Waihee, III
Governor
State of Hawaii
State Capitol
Honolulu, Hawaii 96813

Re: Honolulu Waterfront Master Plan

Dear Governor Waihee:

I write on behalf of Hawaii's Thousand Friends in regard to the State's recommendation, set forth in the Honolulu Waterfront Master Plan Preliminary Report, which proposes the filling of approximately 250 acres of intertidal mudflat and subtidal reef in Keehi Lagoon for industrial, commercial, recreational and boating-related activities.

Hawaii's Thousand Friends is particularly concerned about the filling of Keehi Lagoon for industrial and commercial development due to the fact that on March 21, 1978, representatives from the U.S. Fish and Wildlife Service, the DLNR and the Governor's Office entered into a Memorandum of Understanding that Keehi Lagoon was to be developed for recreational and wildlife purposes only, and that there would be no structures placed in the lagoon other than on Mokauea Island. See, Memorandum dated March 22, 1978 (copy enclosed). We wish to bring this Memorandum to your attention and would also like to take this opportunity to inform you that, in our opinion, it is likely that the State's proposal to fill in part of Keehi Lagoon is prohibited by Section 404 of the Clean Water Act and may violate the Endangered Species and Migratory Bird Treaty Acts.

The Clean Water Act, 33 U.S.C. § 1251 et seq., prohibits the discharge of any dredged or fill material into the nation's navigable waters, except as permitted under Section 404 of the CWA. Section 404 of the CWA, 33 U.S.C. § 1344, provides that the Army Corps of Engineers and EPA share responsibility for implementing the dredge and fill provisions of the Act. Section 404(a) authorizes the Secretary of the Army to issue permits for the discharge of dredged or fill material. 33 U.S.C. § 1344(a). Section 404(b) provides that, subject to § 404(c), permit issuance must be based on guidelines developed by the EPA in conjunction with the Secretary of the Army. 33 U.S.C. § 1344(b). These guidelines, commonly referred to as the "404 guidelines," are published at 40 C.F.R. Part 230. The 404 guidelines set forth requirements for the issuance of Corps permits allowing the discharge of dredged or fill material. 40 C.F.R. § 230.10(a) prohibits the discharge of dredged or fill material if there is a "practicable alternative" to the discharge. 40 C.F.R. § 230.10(a)(3) further specifies that if the site proposed to be filled is a "special aquatic site"[1] and the activity to be performed on the site is "non-water dependent" (i.e., the activity could take place on a non-wetland site) then practicable alternatives to filling the site are presumed to be available, unless clearly demonstrated otherwise.

Dredge and fill projects must also be evaluated by the Corps in light of the special and critical characteristics of the site, if any. 40 C.F.R. § 230.5(f). In this case, the USFWS has determined that Keehi Lagoon is "one of the two most important shorebird feeding habitats on Oahu." See, letter from Dale T. Coggeshall, Pacific Islands Administrator, USFWS, to Susumu Ono, Chairman, Board of Land and Natural Resources, dated February 24, 1981 (copy enclosed). USFWS also notes that Keehi Lagoon is a feeding habitat for the endangered Hawaiian stilt, and that loss of this habitat "could be detrimental to the stilts' continued existence." Ibid.

Reviewing the 404 guidelines in light of these special characteristics will require permit denial because the placement of fill on the site will clearly have a significant adverse effect leading to the loss of substantial shorebird foraging habitat. See, 40 C.F.R. § 230.10(c)(3), which prohibits the discharge of dredged or fill material where it would lead to loss of fish and wildlife habitat. Moreover, 40 C.F.R. § 230.10(b)(3) prohibits the

[1] The 404 guidelines include mudflats as one type of "special aquatic site." 40 C.F.R. § 230.42. The area of Keehi Lagoon proposed to be filled is made up of mudflat and submerged reef areas.

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XII-78

discharge of dredged or fill material where such discharge jeopardizes the continued existence of any species listed as endangered or threatened under the Endangered Species Act, 16 U.S.C. § 1531 et seq. A dredge and fill permit would therefore also have to be denied on the basis that filling in Hawaiian stilt feeding habitat could jeopardize the continued existence of that endangered species.

Placement of fill in stilt foraging habitat may also violate the "taking" prohibitions of the Endangered Species Act. Section 9 of the ESA makes it unlawful, among other things, for "any person" (including the State of Hawaii and its departments) to "take" any endangered species within the United States or its territorial sea. 16 U.S.C. § 1538(a)(1)(B). The ESA defines "take" to include actions which "harass" or "harm" such a species. 16 U.S.C. § 1532(19). Actions which "harass" include those which "create the likelihood of injury to wildlife by annoying to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering." Actions which cause "harm" include those which cause "significant habitat modification or degradation" which "significantly impair[s] essential behavioral patterns, including feeding, breeding or sheltering." 50 C.F.R. § 17.3.

Finally, the State's filling proposal may also violate the "taking" prohibitions of the Migratory Bird Treaty Act, 16 U.S.C. § 703 et seq.[2] There are four species of shorebirds which utilize the intertidal mudflats in Keehi Lagoon as a foraging habitat: the Pacific golden plover, ruddy turnstone, sanderling and wandering tattler. All of these species are listed as migratory birds under the MBTA, at 50 C.F.R. § 10.13. Eliminating foraging habitat for species such as the golden plover, which has feeding territories, could cause a "taking" of this protected species. Individual plovers excluded from their feeding territories may not establish new feeding sites, which can result in starvation.

"Takings" of migratory shorebirds are prohibited under the MBTA, except as authorized by USFWS regulation or pursuant to a valid permit issued by the USFWS. 50 C.F.R. § 21.11. Although state game departments are authorized by regulation to acquire by gift or purchase, without permit, migratory birds, 50 C.F.R. § 21.12(b), no such blanket exemption exists for the "taking" by

[2] The MBTA makes in unlawful "at any time, by any means or in any manner, to . . . take . . . [or] attempt to take . . . any migratory bird . . . [protected under the various migratory bird treaties]." 16 U.S.C. § 703.

the State of Hawaii's Department of Transportation of the four species of migratory shorebirds in Keehi Lagoon. While governmental agencies are not expressly held by the MBTA to be subject to the prohibitions against "takings," the federal district court for Minnesota recently held in Defenders of Wildlife v. Administrator, EPA, 688 F. Supp. 1334 (D. Minn. 1988), that federal agency action is subject to the "taking" prohibitions set forth in the MBTA (EPA's continued registration of strychnine, resulting in death to protected birds, violated the MBTA and should be enjoined).

Effective use should be made of Keehi Lagoon. However, any such use must be consistent with applicable laws and regulations and must honor the promise, made over ten years ago by representatives of your office and the DLNR, that the State of Hawaii would develop the Keehi Lagoon area for recreational and wildlife purposes.

Very truly yours,

Arnold L. Lum

ALL:sw/keehi
Enclosures

cc: Representative David M. Hagino
Edward Y. Hirata, DOT
William W. Paty, Jr., DLNR
Allan Harmelstein, FWS
Andy Yuen, FWS
Steve Holmes
Fred Madlener

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XII-79

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DANT. ROCHE
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

January 2, 1990

HAR-ED 2124

Mr. A. F. Madlener
Hawaii's Thousand Friends
1923 Keeaumoku Street
Honolulu, Hawaii 96822

Dear Mr. Madlener:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter of November 22, 1989. For your information, we received comments from Mr. Arnold Lum of the Sierra Club Legal Defense Fund, Inc. by letter dated November 21, 1989, and have responded to his comments. I note that our request for comments directed to Mr. Steve Holmes, Executive Director of Hawaii's Thousand Friends, was not referenced by your letter. I presume that your comments reflect the views of Hawaii's Thousand Friends, although the comments submitted under their letterhead was not signed by any representative of the organization.

We offer the following clarification and responses to the issues which you raise:

Ke'ehi Lagoon is under Governor's Executive Order (G.E.O.) 3202 to the Department of Transportation, Airports and Harbors Divisions, as described in the Draft EIS. As such, the lagoon is set aside for airport and maritime uses. The Draft EIS also describes the applicable land use plans, policies and controls for the area. The letters of agreement which you refer to do not legally "bind" the state. For your clarification, the April 13, 1972 letter from the U.S. Department of the Interior to the FAA and the State Department of Transportation, clarifies certain understandings reached with respect to the proposed construction of the Reef Runway. The agreements reached were based on the circumstances prevailing at that time with respect to the conditions within the lagoon and the mitigation for the Reef Runway construction. The memorandum dated March 22, 1978 from Senator Jean King clarifies certain understandings reached with respect to the lease of Mokauea Island to the Mokauea Fishermen's Association, which was

contrary to the spirit of the 1972 agreement. Again, the 1978 agreements reached were based on the circumstances prevailing at that time and the mitigation for the lease action. Similarly, based on our present findings, we intend to pursue new agreements regarding mitigation for the proposed project. Changed conditions, circumstances, and needs since the dates of the correspondence have justified the recent re-evaluation and update to the Ke'ehi Lagoon Recreation Plan. Federal regulatory issues will be resolved within the context of the Department of the Army permit action.

For your clarification, the National Wildlife Refuges in Pearl Harbor (headlined in the Sunday paper on December 10, 1989) were established as mitigation for the Reef Runway construction. These refuges are serving very well for nearly all of the endangered Hawaiian waterbirds and migrant shorebirds, and serve as an excellent example of not only successful mitigation but also habitat enhancement for the waterbirds and shorebirds. The proposed mitigation habitat for the Ke'ehi Lagoon Recreation Plan is intended to provide feeding, resting and safe nesting sites for all waterbirds, similar to the existing refuges in Pearl Harbor. The experience and example set by the Reef Runway mitigation would assure the success of our presently proposed mitigation. As described in the Draft EIS, the stilt population in the state from 1980 to 1986 increased by approximately 47%, however, the stilt population in Ke'ehi Lagoon has significantly declined. The Draft EIS further notes that although only an estimated 20% of the feeding habitat was eliminated by the Reef Runway construction, the number of stilt using the area had decreased by over 70%. Present surveys confirm this downward trend in use of Ke'ehi Lagoon by the waterbirds. I would also emphasize that there is no record of stilts nesting in Ke'ehi Lagoon. This points to the importance of creating mitigation areas which provide not only replacement feeding habitat but also safe nesting sites.

The Draft EIS discusses the necessary permits and approvals for the project. Nowhere in the document does it state that the filling for the Triangle Development is a permitted use. We are aware of the federal issues related to non-water dependent fills. Because we believe that fills for non-water dependent activities are necessary for the project, we are pursuing the development of mitigation and/or compensation plans for the loss of aquatic resources. There is a dire need for light industrial/commercial space in metropolitan Honolulu, especially adjacent to the airport and the waterfront. Contrary to your opinion that there is vacant space on either side of Lagoon Drive, there is no vacant space

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XII-80

for expansion of airport facilities. In fact, the Department of Transportation is presently in the process of acquiring lands adjacent to the airport bounded by Ualena and Aolele Streets. If the purchase price cannot be successfully negotiated, the lands will be acquired through eminent domain (condemnation). There will be significant social and economic impacts befalling businesses to be dislocated, because there is no vacant land available for the required expansion of airport facilities. The light industrial/commercial space on the Triangle is greatly needed, but unfortunately will not be developed in a timely manner to serve the airport's immediate needs. It is apparent that the airport will require additional acreage by the year 2010. Development of the lagoon for airport and maritime uses is consistent with the G.E.O. and would result in least social and economic impacts to the community.

While the bid for the America's Cup sparked renewed interest in Ke'ehi Lagoon, the updated master plan for Ke'ehi Lagoon is a much more visionary plan for a major marine-oriented development in Honolulu. The permanent yacht race/ocean sports complex is intended as a multi-purpose watersports complex. We anticipate that the development of a world class racing facility will also foster other major yacht races here which cannot be accommodated in Hawaii because of lack of facilities. The previous campaign to bring the America's Cup Race to Hawaii has generated inquiries about holding other races here including the World 12 Meter Championships and a Pacific Basin Championship Series for which Hawaii is centrally located. In addition, while we have accommodated the Transpac and Kenwood Cup races at the Ala Wai Harbor in the past, it has become increasingly more difficult to do in recent years. The development of facilities at Ke'ehi Lagoon will not only assure that we can continue to host these races, but will also encourage growth of other ocean sports events in Hawaii.

Water quality studies of Ke'ehi Lagoon do not reveal any contamination. The numerical model study of the water circulation in the lagoon indicates that the proposed plan will not significantly impact existing conditions.

As stated in the Draft EIS, 100-year flood elevations within the lagoon are five feet or less above MSL. The bridge access to the Triangle island will be similar to the bridge access to Sand Island. Note that Sand Island encompasses a larger area than the proposed Triangle island. For your clarification, the Triangle development is not situated under

any approach zones to the airport runways, and is therefore safer than existing areas surrounding the airport that are situated directly under the runway flight paths.

The dredging within Ke'ehi Lagoon for the Reef Runway construction and the massive 1,240 acres of filling for the runway have not caused long-term impacts to the adjacent reef areas. In fact, water quality conditions within the lagoon improved subsequent to the Reef Runway construction. The dredging and 250 acres of filling for the proposed Triangle Development is much less than that for the Reef Runway.

The studies which are included as Appendices to the Draft EIS describe the infrastructure improvements necessary for the plan.

The Draft EIS describes the intended uses and conceptual plan for development. The developers will be bound by the EIS, the mitigation requirements that are imposed by the regulatory agencies through the applicable permits, and the terms of the lease. Design criteria requirements and standards will be imposed on the developer, and their plans will be reviewed and approved prior to any construction. Because of the mix of uses within the lease area, the developer must be given some creative opportunity to develop his own master plan for the development. This maximizes the financial viability of the project, and maximizes public benefits since all of the public improvements within the Triangle lease area will be provided by the developer. The State is pursuing to obtain the major state and federal approvals for the project since no developer will enter into a lease with the State if there is no assurance that he will be able to do the project. As stated in the Draft EIS, if detailed planning and engineering studies indicate that the specific development action may result in significantly greater impacts than described by the EIS, then a Supplemental EIS will be prepared for the respective action.

Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

BILL PLUM, Spokesman for:
WATER SKIERS FOR A NEW KEEHI LAGOON
1000 Bishop St., Suite 800
Hon., HI 96813
(808) 526-9744

Mr. David Higa, Director
State of Hawaii, Dept. of Transportation
Harbors Division
79 South Nimitz Hwy.
Hon., HI 96813

XII-81

Re: KEEHI LAGOON ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Higa:

We have reviewed the Keehi Lagoon Environmental Impact Statement of September, 1989 and agree with your findings. We would also like to take this time to make a few comments with regards to the plan changes we suggested at our meeting in September (See our letter dated September 14, 1989). As you may recall, we had asked your department to consider making some modifications to the area within the triangle designated for Water Skiing competition and practice. Those suggestions included a center berm to divide the ski area into two usable sections and additional fill to connect the existing berm with the triangle so as to effectively enclose the area (See attachment). At that time concerns were raised as to water quality and were met by suggestions for

the use of culverts and/or offset openings to ensure adequete circulation. Small islands would also be placed at the ends of each length of water for boat turn arounds.

We feel that these suggestions would complement the existing plan and would have minor impact on the plan as a whole. Respectfully we submit that those suggestions be implemented as part of the overall plan.

Very Truly Yours,

Bill Plum
Water Skiers for a
New Keehi Lagoon

Enclosure

cc: Fred Nunes
Elaine Tamaye

a:\owscl

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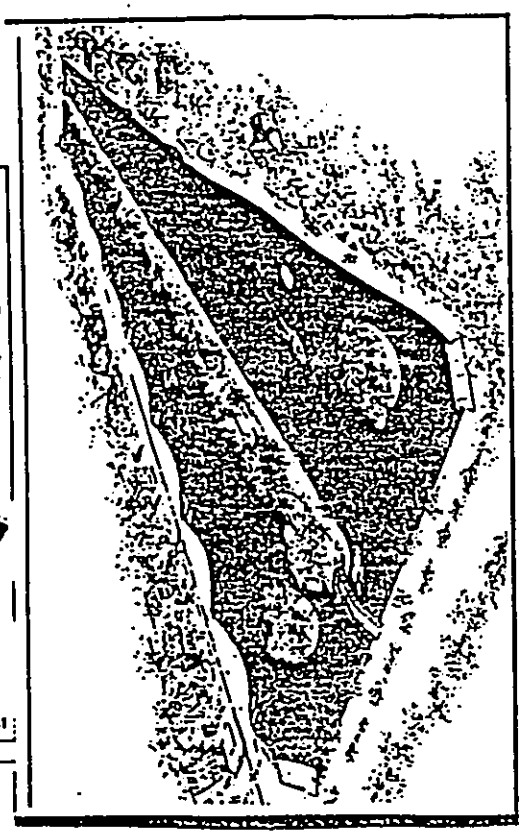
Oahu Water Ski Club
AFFILIATED WITH THE AMERICAN WATER SKI ASSOCIATION

SKI SITE SAMPLE



XII-82

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN W. UCHIMA
RONALD N. HIRANO
DAN Y. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

HAR-ED 2125

January 2, 1990

Mr. Bill Plum, Spokesman
Water Skiers for a New Keehi Lagoon
1000 Bishop Street, Suite 800
Honolulu, Hawaii 96813

Dear Mr. Plum:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter to Mr. David Higa, Harbors Division Chief, which was received on December 11, 1989. We offer the following clarification and responses to your review and comments:

We will certainly consider the suggestions which were presented during our meeting and summarized by your letter, regarding improvements to the water ski area. As we pointed out to you previously, the area designated for competition water skiing is not intended to be included in the area to be leased to the Triangle developer. Detailed planning and design of any additional potential improvements to the water ski area will be accomplished when more detailed plans are available for the Triangle Development.

We appreciate your interest and support for the project. Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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8/3 5128

HAR-ED 1795

17 Nov 89

Ke'ehi Lagoon Recreation Plan Draft.

Dear Sir:

I have reviewed Chapter I and II. The plan is excellent in overall ~~plan~~ concept and execution. In particular the canoe race facility will be well used as well as the marina slips. From my viewpoint the one big exception is (Pg II-10-11) "The Yacht Race Ocean Sports complex. Honolulu has successfully hosted the Kenwood or Transpac races each year. The Americas Cup happens, somewhere, every four years a chance of getting the americas cup is one in 100 chances every fourth year.

Both Transpac and Kenwood require 2 weeks plus of crowding in the Ala Wai. This situation has worked out for at least 20 years The crews want to be near the action - Waikiki not Keehi. These boats do not require storage buildings, administrative building, slips etc. These races cannot justify the space, costs and maintenance of the proposed facility Off-in the next 100 years, we do get the americas Cup, address the temporary situation at that time.

This portion of the plan needs rethinking. Since I criticize, I must be constructive. Put UofH/NOAA in the space and/or the commercial fishing fleet of Pier 16? and the fish auction house. Both functions, UofH and commercial fishing, are common interests and compliment each other. Use the Pier 16 area for transient asian long-liners.

Judge the needs of Ocean races in the terms of the Ala Wai gas station. a poorly used white elephant even during the races.

See how much AWM gets in boat yard business that is above its capability in transpac / Kenwood races -- Include these two experienced operations in your justification. Even with four Americas cup boats in Snug Harbor none of the existing facilities were overtaxed or stretched Boat slips for for state residents are needed badly.

Sincerely

Joe D

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JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

December 1, 1989

HAR-ED 2019

Mr. Joseph F. Dougherty
322 Aoloa Street, #905
Kailua, Hawaii 96734

Dear Mr. Dougherty:

Development of Boating Facilities in the
Airport, Keehi Lagoon and Sand Island Areas
Oahu, Job H. C. 2241

Thank you for your letter of November 17, 1989 giving your comments on our draft environmental impact statement for the subject project.

Your comments regarding the use of Keehi Lagoon for the America's Cup, Transpac, and Kenwood Cup Races are well taken. However, we anticipate that the development of a world class racing facility at Keehi Lagoon will foster other major yacht races here. The campaign to bring the America's Cup Race to Hawaii has opened the eyes of the world's yachting community to the excellent sailing conditions here. This had generated inquiries about holding other races here including the World 12 Meter Championships and a Pacific Basin Championship series for which Hawaii is centrally located. Many people feel that yacht races held in Hawaii would provide exciting prime time television back on the mainland.

Also, while we have accommodated the Transpac and Kenwood races at Ala Wai Boat Harbor in the past, it has become increasingly more difficult to do in recent years. As you pointed out in your letter, everyone wants "to be near the action" in Waikiki. Ala Wai Boat Harbor is already over crowded with a very long waiting list of residents seeking to moor their boats there. Moving the Transpac and Kenwood races to Keehi Lagoon will go a long way towards giving relief to the high demand for space at Ala Wai Boat Harbor.

XII-84

I hope the above information helps you to better understand our thinking on the Keehi Lagoon project. Your letter will be sent to our consultants for inclusion in the final environmental impact statement.

Very truly yours,

Edward Y. Hirata
Director of Transportation

cc: Edward K. Noda and Associates, Inc.

1190
c/s 6182
Nov 26 3 55 PM 89
HARBORS DIVISION

To: Ed Hirata, Director of State Transportation
From: Mel Kalahiki, President, Royal Hawaii International Sports, Inc.
Subject: "Keehi Lagoon Recreation Plan"

Dear Mr. Hirata:
On page 11-2, 2.3 use of Public Funds or Land. Hawaiian Canoe Center includes three sections. 1. Hawaiian Canoe Center 2. Ke'ehi Lagoon Beach Park and Industrial Subdivision 3. Sand Island Access Road

1. Hawaiian Canoe Center:
Figure 11-5: The Hawaiian Canoe Center, will provide a cultural, educational, and the economic base for the canoeing program here in Hawaii. 2.4.1. Direct access to this site from Nimitz Highway will be restricted to ingress of service vehicles only.
I hope this plan is not concrete, until the state had the input from its developer's. I am sure a workable plan can be found.
-Debris: Along the Kalihi stream tons of debris end up next to the site of the Center. The state or the county should install a catch-ment. One at King and Richard Lane, and on mauka of Dillingham Boulevard and the Kalihi Stream.

2. Ke'ehi Lagoon Beach Park and Industrial Subdivision:
Figure 11-3: The ramps for staging, viewing, and officiating was offered with great concerns for everone that will be participating in water sports activities.
a. Wind factor at Ke'ehi Lagoon:
The problem of dust blowing in your face all day, along the whole area is a major concern for having the ramp off the ground. I believe going ahead withe ramp concept would be the way to go. There by allowing more space for other usage in the beach area.
For the reasons stated, I do hope some consideration for change in the conceptual plans shown in figure 11-5.
-The staging area becomes parallel to race course.
-The viewing becomes more exciting.
-The officiating becomes more precise.
The official stand should be a two story building where judges of the race would be over the crowd in viewing the results of the event.

3. The Sand Island Access Road and Industrial Subdivision:
From the Canoe Center over the bridge to Hoonee Place. My question is the traffic from the center coming off the bridge, come down along side the race course down towards pier 60 and out to Sand Island road, as an alternate road?

Summary: "Hawaiian Canoe Center," A World Class Complex

Hawaii will become a major factor in staging World Class water sports events. In the total planning for this area, planners need to look at the future to the total water sports program and using the park area for native games. I invision hundreds of participants from all over the world coming here in the very near future. We need to plan for this area in terms of having what's best for the culture in Hawaii. This will be the first place the tourist will see, coming from the airport, the people of Hawaii will be very proud of its showcase.

Mel Kalahiki, President, R.H.I.S, Inc.
45-422 Koa Kahiko Street
Kaneohe, HI. 96744

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
ARNOLD N. HIRAKO
DANT KOCH
JEANNE K. SCHULTZ

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

January 4, 1990

HAR-ED 2127

Mr. Mel Kalahiki, President
Royal Hawaii International Sports, Inc.
45-422 Koa Kahiko Street
Kaneohe, Hawaii 96744

Dear Mr. Kalahiki:

Ke'ehi Lagoon Recreation Plan Draft EIS
Job H. C. 2241

Thank you for your letter which I received on November 24, 1989. Our responses to your itemized comments are as follows:

1. Based on the present highway configuration and traffic flow, our Highways Division will permit ingress of service vehicles only to the Canoe Center site adjacent to Nimitz Highway. However, we will certainly consider specific developer proposals for roadway improvements that will sufficiently address our concerns. Such mitigative measures will be the responsibility of the developer to provide.

   Consideration is being given to a debris catchment system for Kalihi and Moanalua Streams that discharge directly into the lagoon. The funding for implementation of such a system is unresolved at this time.

2. Detailed planning for the improvements at Keehi Lagoon Park is presently ongoing. The improvements within Keehi Lagoon Park are currently being planned and designed in more detail as State funded improvements. Because these improvements are situated within the existing park, the plans are being coordinated with the City and County Department of Parks and Recreation.

   This will insure that the improvements are consistent with the existing park uses, and with the operation and maintenance responsibilities of the county. Improvements presently planned within Keehi Lagoon Park are generally shown in Figure II-5, which includes landscaped viewing mounds, improved vehicular access and parking along the shoreline, a judges' stand, and comfort station. The improvements on the opposite Kalihi-Kai shore will provide the parallel staging area to the course and the necessary marine "stadium" facilities required for training and international caliber regattas offering media coverage.

3. An interior roadway from Hoonee Place along the Kalihi-Kai shoreline to the canoe race course facilities will be provided for local vehicular traffic to the canoe race course. While a secondary access from the canoe race course to Sand Island Access Road is available around the back side of the Pier 60 Marina site and La Mariana Sailing Club, this access is also an interior access roadway. This interior roadway provides access to the State's light industrial tenants situated within the unimproved areas makai of the improved privately-owned industrial subdivision. Traffic from the Canoe Center bridge to Hoonee Place, which is an improved City-standard street, is the most viable direct access route for the Canoe Center.

I appreciate your interest and support for the project. Please contact Mr. Fred Nunes at 548-2505 if you desire further information or update on the project.

Very truly yours,

Edward Y. Hirata
Director of Transportation

REFERENCES

REFERENCES

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APPENDICES

APPENDIX A

Preliminary Cost Estimates and
Construction Schedules

RECEIVED AS FOLLOWS

19-Jun-89

FPS ENGINEERING ASSOCIATES

FILE : PROJSUM

PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : PROJECT SUMMARY

SHEET 1 OF 1 PAGES

REV. NO. 1	03-Apr-89 12-Jun-89	COST 1989	ESCLATION %	TOTAL	ENGINEERING 6.50%	TOTAL PROJECT
				0	0	0
S U M M A R Y :						
1. HAWAIIAN CANOE CENTER						
PART 1a. CANOE CENTER PUBLIC FACILITY		8,336,646	12.00%	1,000,398	606,508	9,943,551
PART 1b. CANOE CENTER - PRIVATE PORTION		5,605,769	17.00%	952,981	426,319	6,985,068
		13,942,415		1,953,378	1,033,227	16,929,020
2. PIER 60 MARINA COMPLETE		5,313,531	10.50%	557,921	381,644	6,253,096
3. LAGOON DRIVE/TRIANGLE						
3a. LAGOON DRIVE MARINA		30,260,801	17.00%	5,144,336	2,301,334	37,706,471
3b. TRIANGLE BASIC INFRASTRUCTURE		91,894,845	17.00%	15,622,124	6,988,603	114,505,572
3c. TRIANGLE MARINA		5,926,304	35.00%	2,074,206	520,033	8,520,544
3d. YACHT RACE/OCEAN SPORT COMPLEX		23,436,776	35.00%	8,202,872	2,056,577	33,696,225
3e. PUBLIC PARK ON TRIANGLE ISLAND		1,650,812	35.00%	577,784	144,859	2,373,455
3f. MARITIME COMMERCIAL COMPLEX		9,650,886	35.00%	3,377,810	846,865	13,875,561
3g. SNUG HARBOR IMPROVMENTS		12,062,236	35.00%	4,221,783	1,058,461	17,342,480
		174,882,660		39,220,915	13,916,732	228,020,307
4. SHELTERED SWIMMING BEACH		2,820,116	10.25%	289,062	202,097	3,311,274
T O T A L I T E M 1 T O 4		196,958,722		42,021,276	15,533,700	254,513,697

FPS ENGINEERING ASSOCIATES

FILE : 1ACANOE PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : PART 1a. HAWAIIAN CANOE CENTER PUBLIC FACILITY SHEET 1 OF 6 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

SUMMARY :

	QUANTITY	Unit	UNIT	TOTAL
1 a.1.100 FILL AT SHORE LINE BOTH SIDES	200,000	CY	12.35	$2,567,781
1.105 REVETMENT	12,746	TNS	28.90	$368,314
1.120 RAMPS FOR CANOE STAGING	2	EA	52,408	$104,815
1.130 VIEWING STANDS	4,800	SEATS	35.00	$168,000
1.140 CANOE STORAGE AREA	LS		OPEN AREA - NO ADDED COST	
1.150 PARKING CANOE TRAILERS	4,869	SY	22.64	$110,632
1.151 PARKING PUBLIC	42,917	SY	22.50	$965,475
1.160 COMFORT STATION	LS			$95,000
1.170 IMPROVED ACCESS TO KEEHI PARK SIDE	700	LF	553.24	$387,268
1.171 IMPROVED ACCESS KKALIHI-KAI SIDE	1000	LF	554.00	$554,000
1.160 RACE COURSE DREDGING			MAINTANCE ITEM	
1.190 LANDSCAPE	10.30	ACRES	40386.14	$416,146
1.192 MISC. SITE WORK	LS			$156,900
1.193 EXTERIOR UTILITIES	LS			$297,550
TOTAL DIRECT COST				$6,191,941
FIELD OVERHEAD FILL 15%				$385,167
UTILITIES 15%				$44,633
OTHER 15%				$498,992
SUBTOTAL				$7,120,732
CONTRACT OH & P FILL 20%				$590,550
UTILITIES 17%				$51,464
OTHER 15%				$573,840
SUBTOTAL 1989 COST				$8,336,646
ESCLATION & CONTINGENCY 0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION				$8,336,646

FPS ENGINEERING ASSOCIATES

FILE : 18CANOE PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : PART 1b. HAWAIIAN CANOE CENTER - PRIVATE PORTION SHEET 1 OF 6 PAGES

03-Apr-89
12-Jun-89 REV NO. 1

S U M M A R Y :

			QUANTITY	Unit	UNIT	TOTAL
1b.	1.210	PEDESTRIAN ACCESS	8,800	SF	47.52	$418,159
	1.212	VEHILCULAR BRIDGE	160	LF	9,601	$1,536,110
	1.220	BUILDINGS				
	1.221	EXHABITION	3000	SF	90.00	$270,000
	1.222	MEETING ROOMS	2000	SF	80.00	$160,000
	1.223	CLUB HOUSE	1600	SF	100.00	$160,000
	1.224	ADMINISTRATION	2000	SF	85.00	$170,000
	1.225	RESTAURANT	3000	SF	140.00	$420,000
	1.225	MAINTANCE	2000	SF	65.00	$130,000
	1.232	SITE UTILITIES	LS			$258,350
	1.233	LANDSCAPING	12.66	ACRES	33,893	$435,726
	1.234	MISC.	LS			$89,500
	1.235	AC PAVING	9,178	SY	29.61	$271,748
	1.240	TENNIS COURTS	4	EA	25,000	$100,000

TOTAL DIRECT COST			$4,419,593
FIELD OVERHEAD	G.C.	15%	$624,186
	UTILITIES	15%	$38,753
SUBTOTAL			$5,082,532
CONTRACTOR OH & P G.C.		10%	$478,543
	UTILITIES	17%	$44,695
SUBTOTAL 1989 COST			$5,685,769
ESCLATION & CONTINGENCY		0.00%	$0
TOTAL WITHOUT ENGINEERING & INSPECTION			$5,685,769

FPS ENGINEERING ASSOCIATES

FILE : 2PIER60 PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : PIER 60 MARINA COMPLETE SHEET 1 OF 7 PAGES

SHEET NO.	03-Apr-89 12-Jun-89 REV NO. 1	QUANTITY	Unit	UNIT	TOTAL
SUMMARY :					
2 2.100	DEMOLITION & CLEAR	7	ACRES	2,714	$19,000
2.200	SHEET PILE BULKHEAD	800	LF	1,112	$889,940
2.300	SITE FILL	25000	CY	9.97	$249,242
2.400	FLOATING DOCKS	185	SLIPS	6,293	$1,164,231
2.500	BOAT HAUL OUT FACILITY	LS			$81,507
2.600	BUILDINGS COMFORT STATION	LS			$95,000
2.700	ADMINISTRATION/MARINE SUPPLY	LS			$350,000
2.800	RESTAURANT/CLUB HOUSE	LS			$780,000
2.900	SITE WORK PAVING	11367	SY	22.69	$257,859
2.910	UTILITIES	LS			$193,300
2.920	LANDSCAPING	2	ACRES	25,757	$51,513
2.930	MISC.	LS			$56,000
	TOTAL DIRECT COST.....				$4,187,592
	FIELD OVERHEAD OTHER 15%				$599,144
	UTILITIES 15%				$28,995
	SUBTOTAL				$4,815,731
	CONTRACTOR OH & P OTHER 10%				$459,344
	UTILITIES 17%				$38,457
	SUBTOTAL 1989 COST				$5,313,531
	ESCLATION & CONTINGENCY 0.00%				$0
	TOTAL WITHOUT ENGINEERING & INSPECTION				$5,313,531

FPS ENGINEERING ASSOCIATES

FILE : 3LAGOON PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : LAGOON DRIVE MARINA SHEET 1 OF 6 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

			QUANTITY	Unit	UNIT	TOTAL
SUMMARY :						
3 a. 3.100	CLEAR & FILL		851,400	CY	12.04	$10,250,428
3.101	REVETMENT		35,517	TNS	28.85	$1,024,645
3.102	FERRY PIER		3,000	SF	79.68	$239,050
3.103	FUEL \ SEWAGE PUMPOUT DOCK		3,650	SF	103.86	$379,100
3.104	LAUNCH RAMP & OUTFITTING DOCK			LS		$108,507
3.105	FLOATING DOCKS		678	SLIPS	5,995	$4,064,250
3.106	BUILDINGS	COMFORT STATIONS		LS		$570,000
3.107		ADMINISTRATION \ MAINTANCE		LS		$480,000
3.108		RESTAURANT		LS		$1,020,000
3.109		MARINE SUPPLY		LS		$500,000
3.110		FERRY TERMINAL		LS		$300,000
3.111		YACHT CLUB		LS		$680,000
3.112		CONCESSIONS		LS		$120,000
3.113	SITE WORK	PAVING		LS		$1,466,142
		UTILITIES				$697,050
3.114		LANDSCAPING		10 ACRES	27,656	$279,353
3.115		MISC.		LS		$220,000
TOTAL DIRECT COST.....						$22,498,565
FIELD OVERHEAD	FILL	15%				$1,537,564
	OTHER	15%				$1,732,663
	UTILITIES	15%				$104,558
SUBTOTAL.....						$25,873,350
CONTRACT OH & P	FILL	20%				$2,357,558
	OTHER	10%				$1,328,375
	UTILITIES	17%				$138,678
SUBTOTAL	1989 COST					$29,698,001
WATER FACILITIES CHARGE.....						$562,800
						$30,260,801
ESCLATION & CONTINGENCY		0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION.....						$30,260,801

RECEIVED AS FOLLOWS

18-Jun-89 FPS ENGINEERING ASSOCIATES

FILE : 3BASIC PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : TRIANGLE BASIC INFRASTRUCTURE SHEET 1 OF 8 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

SUMMARY :

	QUANTITY	Unit	UNIT	TOTAL
3 b.3.200 DREDGE FILL, INCLUDING LAND FILL MATERIAL	3791000	CY	10.48	$39,717,560
3.202 BIRD ISLETS RELOCATION	5.400	CY	21.35	$115,300
3.203 EXTERIOR REVETMENT	53,419	TNS	30.63	$1,635,978
3.204 BRIDGE	900	LF	7,361	$6,624,480
3.205 FINE GRADE, BASE & PAVEMENT - MAJOR ROADS	80,150	SY	27.82	$2,229,595
3.206 EXTERIOR UTILITIES ON SITE	LS			$9,591,550
3.207 EXTERIOR UTILITIES OFF SITE OPT. B SEW. FORCE MAIN				$2,537,500
3.208 SITE WORK MISC.	LS			$1,539,600

TOTAL DIRECT COST.....			$63,991,563
FIELD OVERHEAD	DREDGE	20%	$7,943,512
	BRIDGE	20%	$1,324,896
	UTILITIES	15%	$1,819,358
	OTHER	15%	$828,071
SUBTOTAL			$75,907,399
CONTRACT OH & P	DREDGE	20%	$9,532,214
	BRIDGE	20%	$1,589,875
	UTILITIES	17%	$2,413,074
	OTHER	15%	$952,282
SUBTOTAL 1989 COST			$90,394,845
OFFSITE WATER DEVELOPMENT COST			$1,500,000
SUBTOTAL 1989 COST			$91,894,845
ESCLATION & CONTINGENCY	0.00%		$0
TOTAL WITHOUT ENGINEERING & INSPECTION			$91,894,845

FPS ENGINEERING ASSOCIATES

FILE : 3TRIMARN PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : TRIANGLE MARINA SHEET 1 OF 4 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

SUMMARY :

			QUANTITY	Unit	UNIT	TOTAL
3 c.	3.300	SLOPE PROTECTION - GRADE SHORELINE			SEE MAIN ISLAND CONSTRUCTION	
	3.310	FLOATING PIERS	350	SLIPS	6801	$2,380,275
	3.320	BUILDINGS COMFORT STATIONS	3	EA	95,000	$285,000
	3.330	SITE WORK FINE GRADE & PAVING	45,139	SY	23.19	$1,046,556
	3.331	UTILITIES		LS		$528,000
	3.332	LANDSCAPEING	2.30	ACRES	40,350	$92,806
	3.333	MISC.		LS		$148,500

TOTAL DIRECT COST		$4,481,137
FIELD OVERHEAD	15.00%	$672,171
SUBTOTAL		$5,153,308
CONTRACTORS OH & P	15.00%	$772,996
SUBTOTAL 1989 COST		$5,926,304
ESCLATION & CONTINGENCY	0.00%	$0
TOTAL WITHOUT ENGINEERING & INSPECTION		$5,926,304

RECEIVED AS FOLLOWS

FILE : 3YACHT PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : YACHT RACE/OCEAN SPORT COMPLEX IMPROVEMENTS SHEET 1 OF 7 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

SUMMARY :

			QUANTITY	Unit	UNIT	TOTAL
3 d.3.400	CHANNEL EXCAVATION		SEE MAIN TRIANGLE DREDGING			
3.401	INTERIOR REVETMENT		27,871	TNS	28.64	$798,096
3.402	FIXED PIERS 100 FT X 30 FT		30,000	SF	96.00	$2,880,000
3.403	FIXED PIERS 30 FT X 3 FT FINGER PIER & TRESTLE		4,770	SF	40.00	$190,800
3.404	FLOATING BREAKWATER		1,400	LF	75.00	$105,000
3.405	MOORING AREA ANCHORAGES		20	EA	1,200	$24,000
3.406	FUEL PIER		2,000	SF	121.45	$242,900
3.407	MAINTANCE PIER		360	SF	51.67	$18,600
3.408	BUILDINGS	SAN DIEGO YACHT CLUB ANNEX	23,040	SF	80	1,843,200
3.409	|	SNAK BAR & KITCHEN	8,064	SF	60	483,840
3.410	|	SHOP & MAINTANCE BLDG.	8,064	SF	65	524,160
3.411	|	RACE COMMITTEE EQUIPT. STORAGE	6,912	SF	40	276,480
3.412	|	SOUVENIR MERCHANDISE SALES	6,912	SF	60	414,720
3.413	|	MEN & WOMANS SHOWERS AND LOCKERS	11,520	SF	120	1,382,400
3.414	|	CHALLENDER ADMINISTRATION BLDG.	5,760	SF	80	460,800
3.415	|	CHALLENDER ADMINISTRATION BLDG.	5,760	SF	80	460,800
3.416	|	PUBLIC INFORMATION CENTER	5,760	SF	50	288,000
3.417	|	BROADCAST CENTER	11,520	SF	90	1,036,800
3.418	BUILDINGS	MEDIA CENTER	20,000	SF	115	2,300,000
3.413	SITE WORK	PAVING	94,694	SY	23.47	$2,222,864
3.414	|	UTILITIES	LS			$1,517,000
3.415	|	LANDSCAPEING	1.27	ACRES	31,538	$40,110
3.416	|	MISC.	LS			$211,000
TOTAL DIRECT COST						$17,721,570
FIELD OVERHEAD		15.00%				$2,658,236
SUBTOTAL						$20,379,806
CONTRACTORS OH & P		15.00%				$3,056,971
SUBTOTAL		1989 COST				$23,436,776
ESCLATION & CONTINGENCY		0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION						$23,436,776

RECEIVED AS FOLLOWS

15-Jun-89 FPS ENGINEERING ASSOCIATES

FILE : 3PARK PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : PUBLIC PARK ON TRIANGLE ISLAND SHEET 1 OF 3 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

	QUANTITY	Unit	UNIT	TOTAL
SUMMARY :				
3e. 3.500 LANDSCAPE	20.81	ACRES	46,399	$965,371
3.510 COMFORT STATION	LS			$55,000
3.520 SITE WORK AC PAVING	2,556	SY	25.49	$65,130
3.521 SITE WORK UTILITIES	LS			$83,750
3.522 SITE WORK MISC.	LS			$39,000
TOTAL DIRECT COST				$1,248,251
FIELD OVERHEAD 15.00%				$187,238
SUBTOTAL				$1,435,489
CONTRACTORS OH & P 15.00%				$215,323
SUBTOTAL 1989 COST				$1,650,812
ESCLATION & CONTINGENCY 0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION				$1,650,812

FPS ENGINEERING ASSOCIATES

FILE : 3MARITIME PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : MARITIME COMMERCIAL COMPLEX SHEET 1 OF 4 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

SUMMARY :

		QUANTITY	Unit	UNIT	TOTAL
3f. 3.600 FIXED PIERS		19	EA	144,225	$2,740,275
3.602 SHEET PILE BULKHEAD		2500	LF	1,426	$3,565,903
3.610 SITE WORK	AC PAVING	13,333	SY	22.67	$302,278
3.611 SITE WORK	UTILITIES		LS		$550,000
3.612 SITE WORK	MISC.		LS		$99,000

TOTAL DIRECT COST			$7,297,456
FIELD OVERHEAD	15.00%		$1,094,618
SUBTOTAL			$8,392,074
CONTRACTORS OH & P	15.00%		$1,258,811
SUBTOTAL	1989 COST		$9,650,886
ESCLATION & CONTINGENCY	0.00%		$0
TOTAL WITHOUT ENGINEERING & INSPECTION			$9,650,886

FILE : 3SNUG PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : SNUG HARBOR IMPROVMENTS SHEET 1 OF 3 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

		QUANTITY	Unit	UNIT	TOTAL
SUMMARY :					
3g. 3.700 DEMOLITION @ EXISTING SITE		LS			$15,000
3.701 RELOCATION COST UH FACILITY		LS			$100,000
3.710 CONCRETE DOCK		84,500	SF	95.00	$8,027,500
3.720 BUILDINGS		LS			$153,000
3.730 SITE WORK	AC PAVING	25,000	SY	24.66	$616,983
3.731 SITE WORK	UTILITIES	LS			$134,000
3.732 SITE WORK	MISC.	LS			$74,300
TOTAL DIRECT COST					$9,120,783
FIELD OVERHEAD	15.00%				$1,368,117
SUBTOTAL					$10,488,900
CONTRACTORS OH & P	15.00%				$1,573,335
SUBTOTAL	1989 COST				$12,062,236
ESCLATION & CONTINGENCY	0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION					$12,062,236

RECEIVED AS FOLLOWS

FILE : 4SWIM PROJECT : KEEHI LAGOON RECREATION PLAN

ITEM : SHELTERED SWIMMING BEACH SHEET 1 OF 3 PAGES

03-Apr-89
12-Jun-89 REV. NO. 1

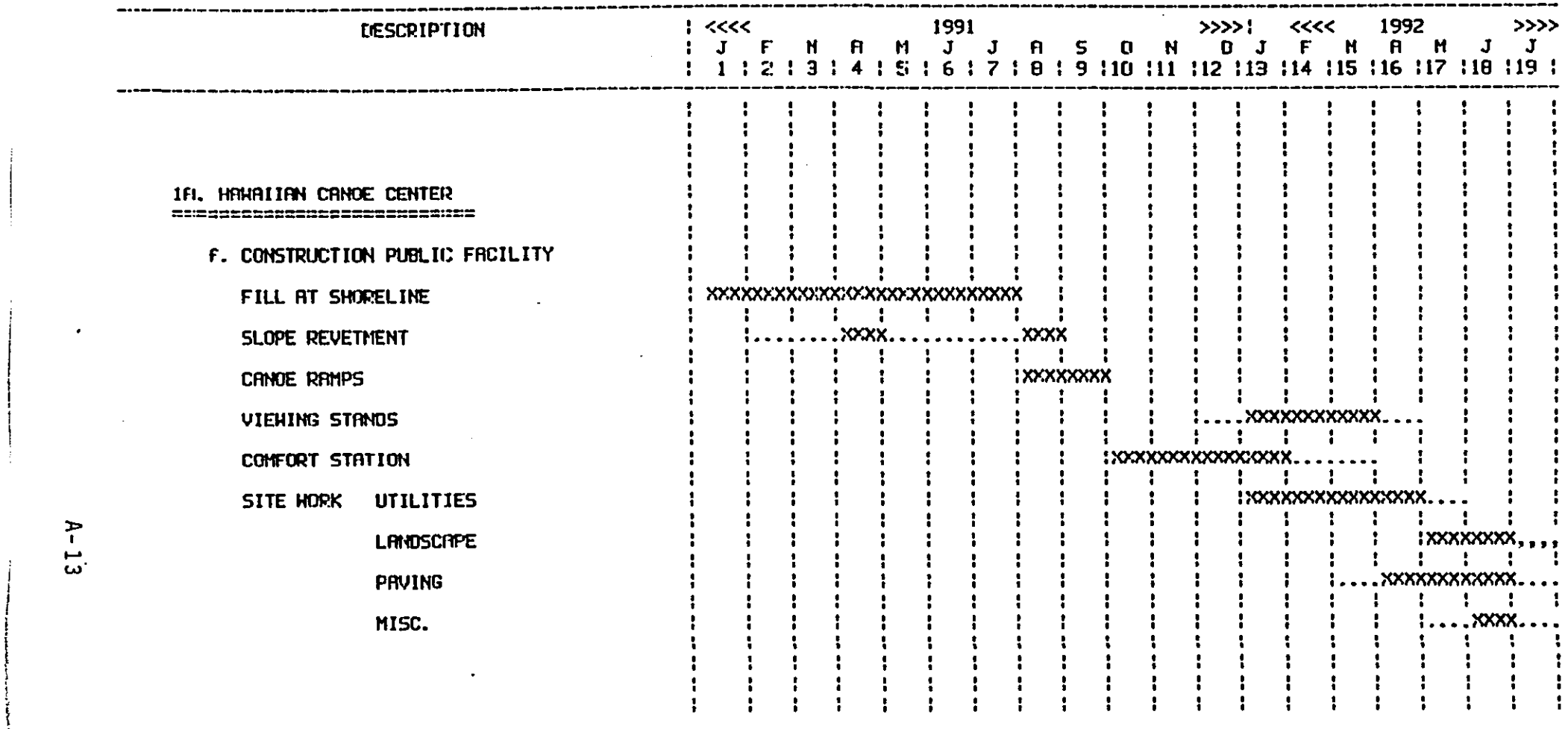
S U M M A R Y :

	QUANTITY	Unit	UNIT	TOTAL
4 . 4.100 DREDGING	21,500	CY	14.23	306,000
4.200 BREAKWATER	50,274	TNS	23.34	1,173,263
4.300 PERIMETER BOULDERS	300	TNS	25.67	7,700
4.400 BEACH SAND	22,200	CY	29.07	645,450
TOTAL DIRECT COST				$2,132,413
FIELD OVERHEAD 15.00%				$319,862
SUBTOTAL				$2,452,275
CONTRACTORS OH & P 15.00%				$367,841
SUBTOTAL 1989 COST				$2,820,116
ESCLATION & CONTINGENCY 0.00%				$0
TOTAL WITHOUT ENGINEERING & INSPECTION				$2,820,116

FIPS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

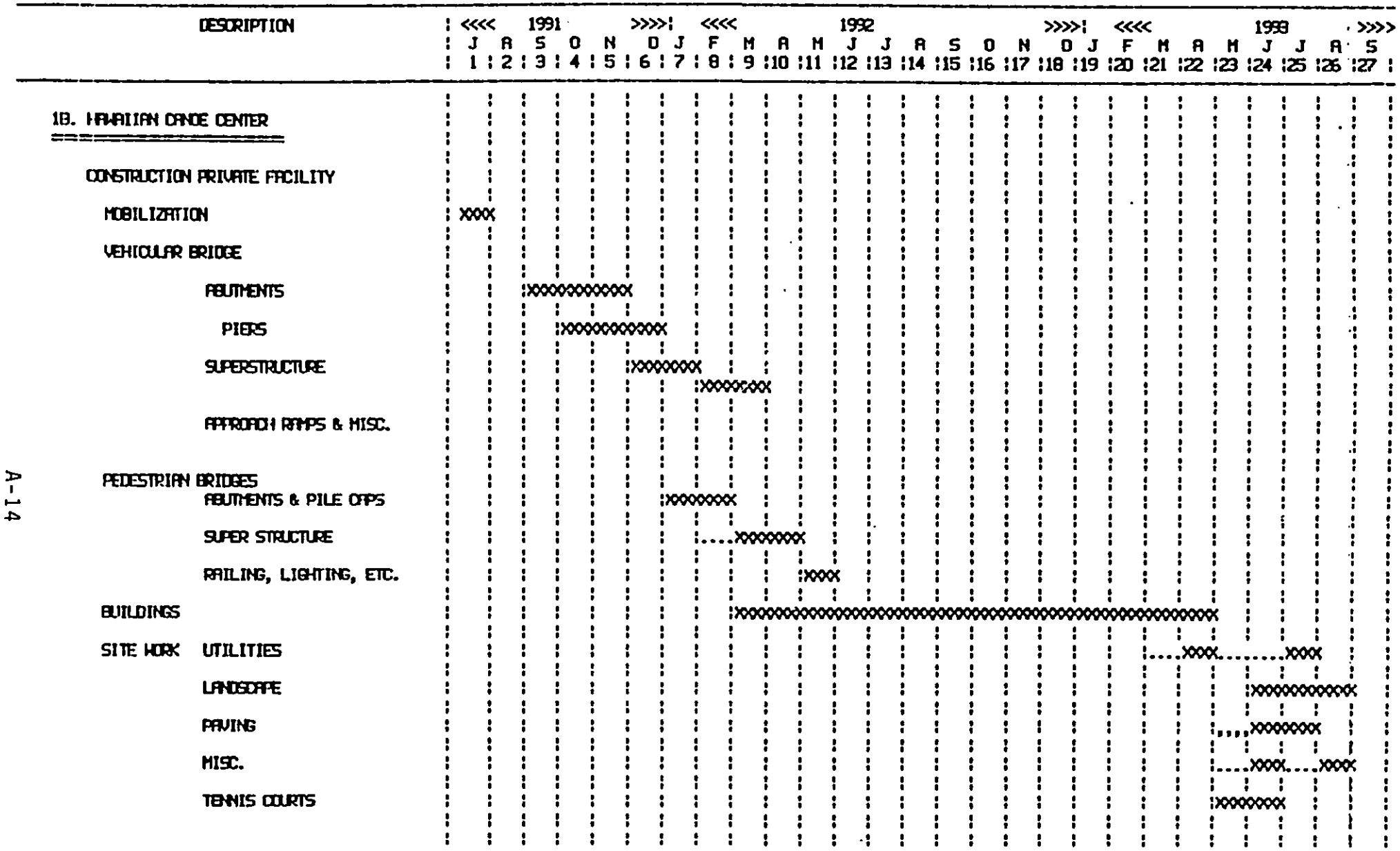
FILE : SCHIA
PROJECT KEEHI LAGOON RECREATION PLAN



FPS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

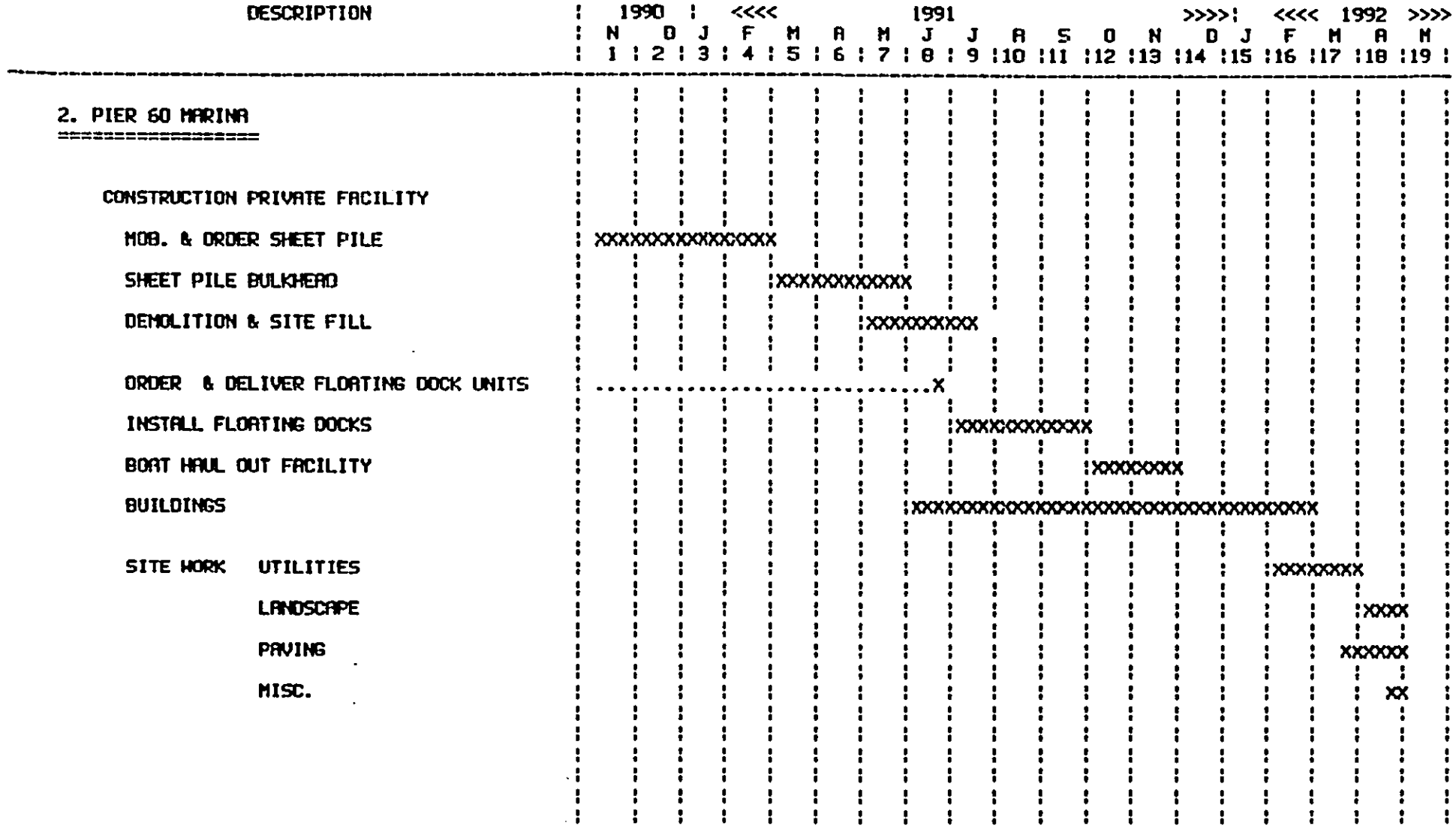
FILE : SCHIB
PROJECT KEEHI LAGOON RECREATION PLAN



FPS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

FILE : SCH2
PROJECT KEEHI LAGOON RECREATION PLAN

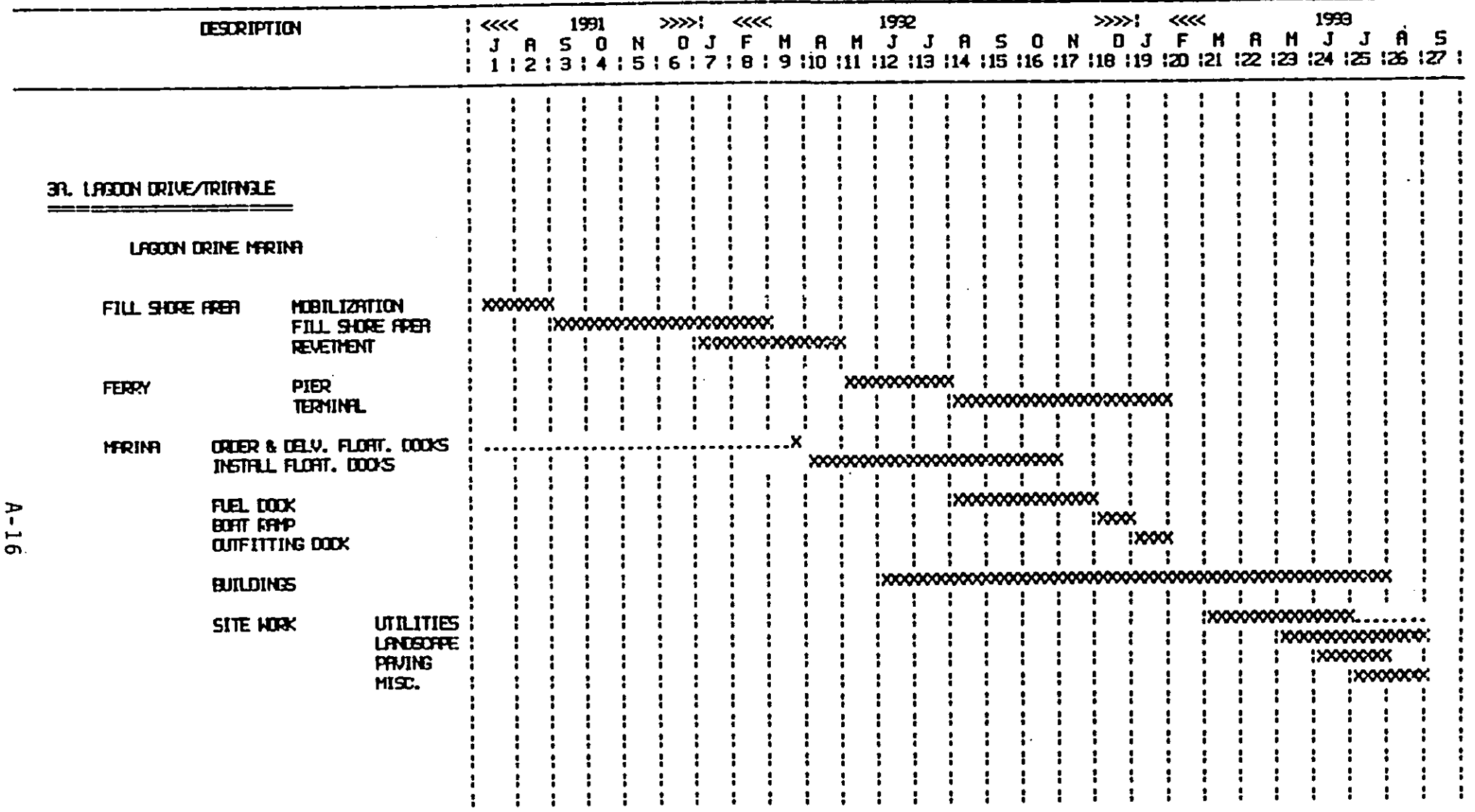


FPS ENGINEERING ASSOCIATES, INC.

FILE : SCHBR
PROJECT

CONSTRUCTION SCHEDULE

KEEHI LAGOON RECREATION PLAN

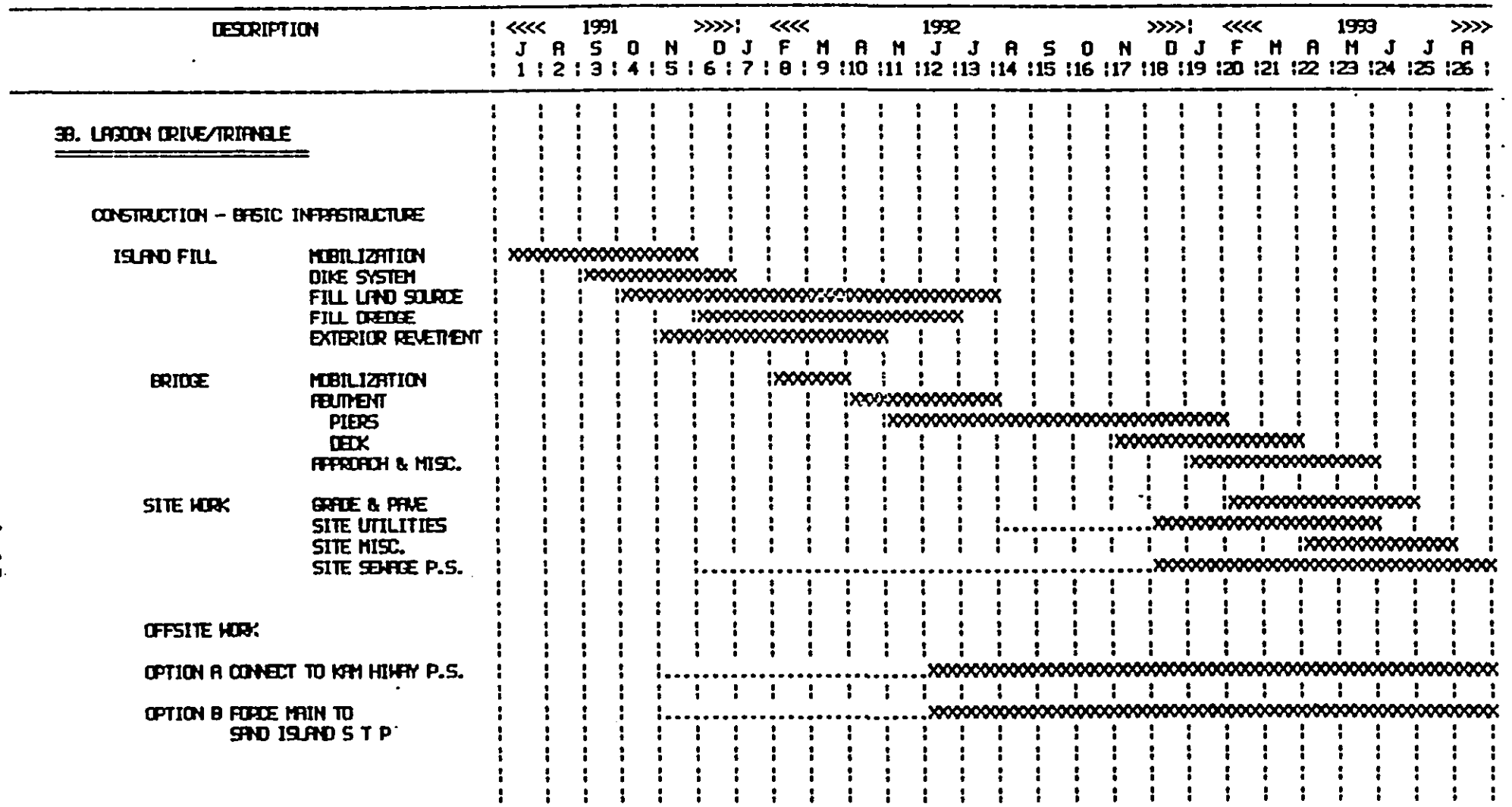


RECEIVED AS FOLLOWS

FPS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

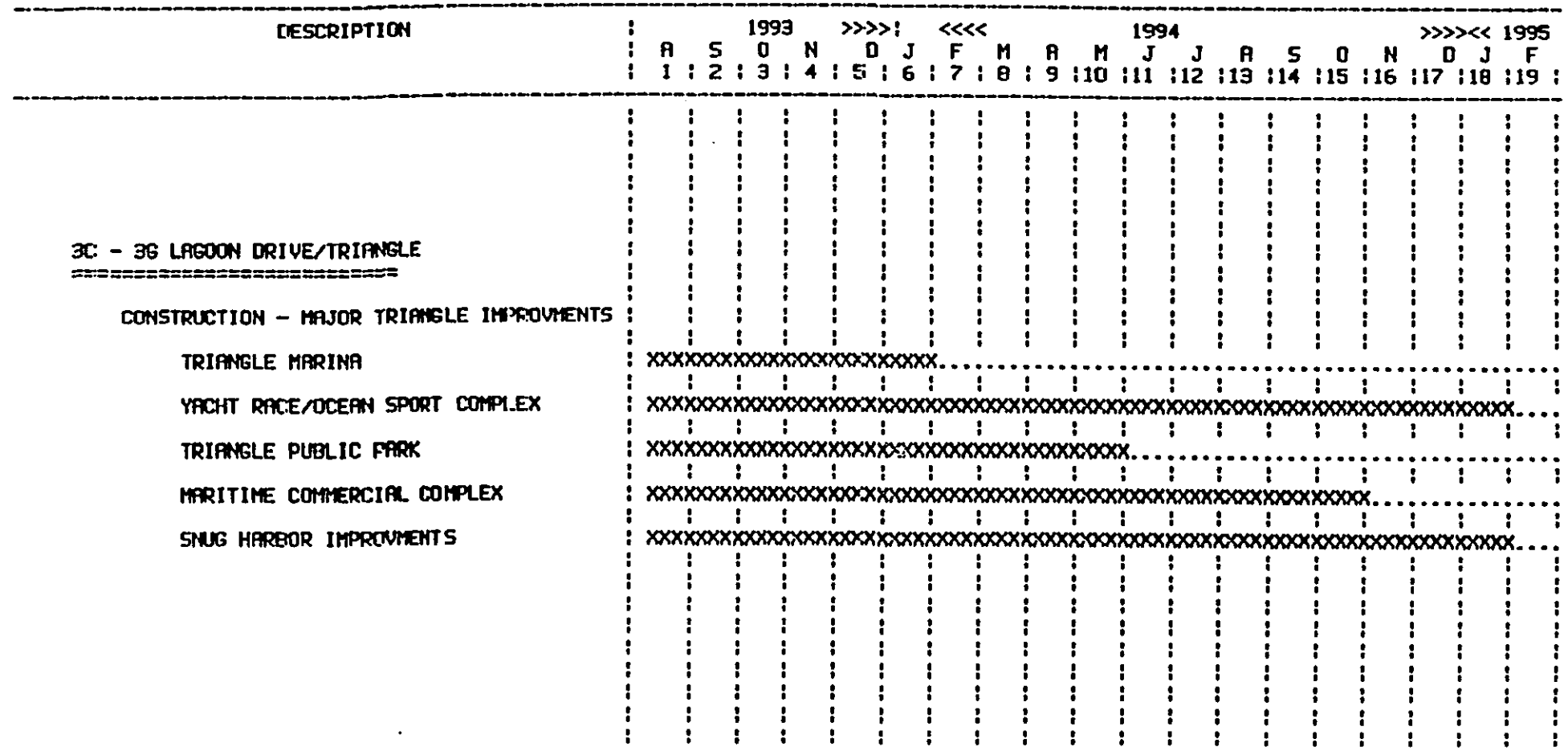
FILE : SCHSB
PROJECT KEEHI LAGOON RECREATION PLAN



FFS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

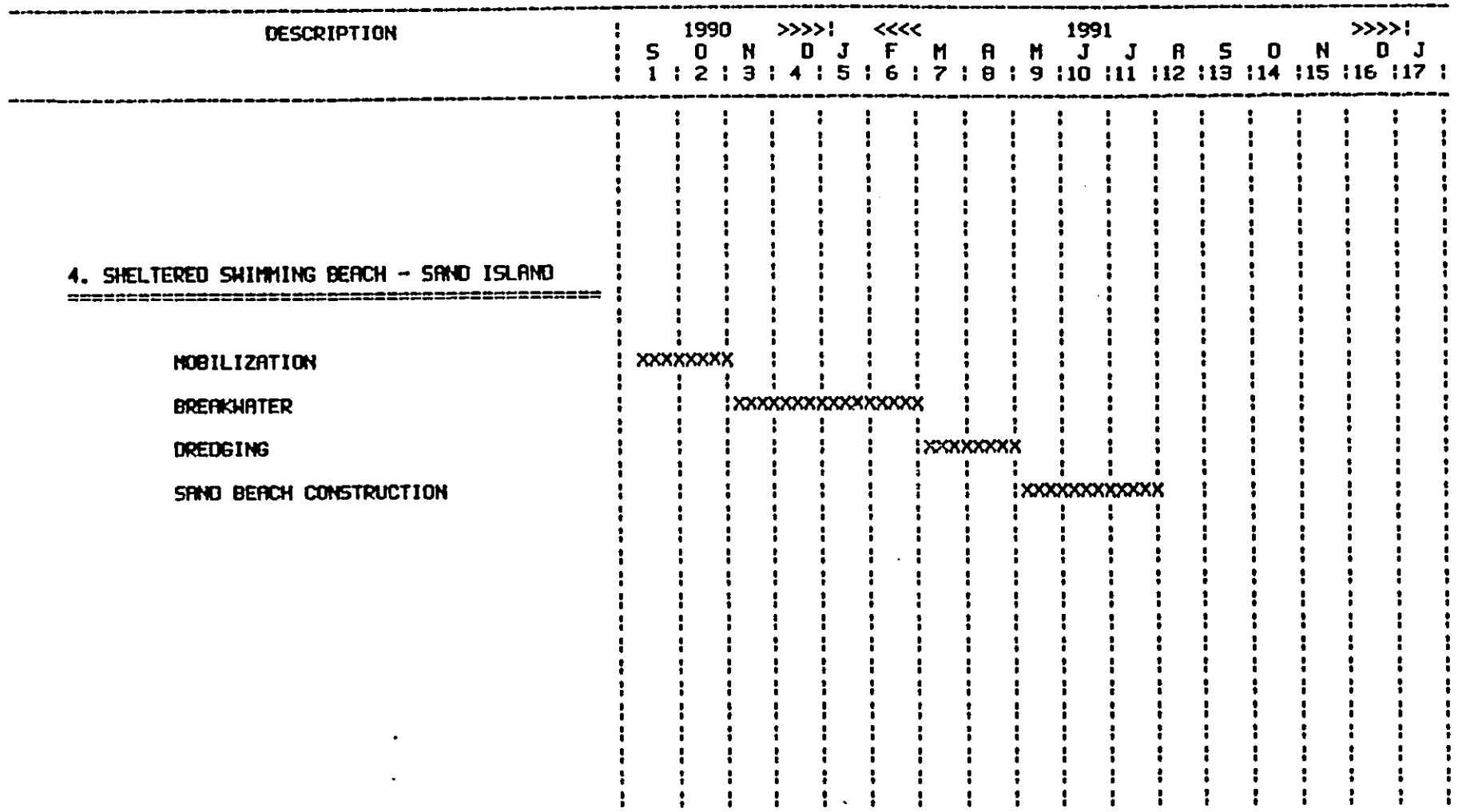
FILE : SCH3CG
PROJECT KEEHI LAGOON RECREATION PLAN



PPS ENGINEERING ASSOCIATES, INC.

CONSTRUCTION SCHEDULE

FILE : SCH4
PROJECT KEEHI LAGOON RECREATION PLAN



APPENDIX B

Survey of Water Quality, Benthic Communities and Avifaunal Populations of Ke'ehi Lagoon

OI CONSULTANTS, INC.

SURVEY OF THE WATER QUALITY, BENTHIC COMMUNITIES AND AVIFAUNAL POPULATIONS OF KE'EHI LAGOON, HONOLULU, HAWAII

Prepared for:

KFC Airport, Inc.
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November, 1988

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EXECUTIVE SUMMARY

Surveys of water quality conditions, benthic communities and avifaunal populations of Ke'ehi Lagoon were performed between September, 1987 and April, 1988. Water quality conditions in the study area during the time of sampling were not, with a few exceptions, different from the conditions described in the 1977-1978 post-construction survey or a recent (1986) survey of Ke'ehi Lagoon and Hickam Harbor. In all cases, the mean parameter values were within the range of values observed in previous studies. Mean concentrations of nitrate, total nitrogen and total phosphorus were lower then the State water quality standard mean levels; concentrations of ammonium and turbidity levels were greater than the mean standards level but less than the Not to Exceed 10% levels.

The Ke'ehi Lagoon benthic environments are generally poorly populated by macro-algae, invertebrates and demersal fishes. The triangular reef remnant is not a particularly diverse marine ecosystem. The fauna and flora resembles that of the fringing reef flats in more protected parts of Kane'ohe Bay and Pearl Harbor. The fauna is most diverse and the ecosystem more interesting from a biological perspective along the south margin (east-west seaplane channel). Also significant in this area are the limestone outcrops along the upper edge of the channel margin which provide substratum for the variety of attached invertebrates as well as cover for fishes and cryptic invertebrates. At higher tides, fishes residing in the deeper surrounding waters of the channels probably feed over the reef flat, but the paucity of cover is an important limitation on the development of the resident fish fauna and value of the reef flat as a nursery area for juveniles of species populating the more seaward parts of the reef or open water areas around Oahu.

Some recreational fishing does occur in inner lagoon areas, although mostly limited to crabbing for Hawaiian crab (Podophthalmus vigil) and collecting of small shrimp (Paneaus), worms, and fishes to be used for bait. Samoan crab (Scylla serrata) is reportedly caught in the estuaries of Moanalua and Kalihi Streams. Pole fishermen at Ke'ehi Lagoon Beach Park report catches of juvenile palani and hammerhead shark. The basin around the mouth of the streams has been a productive bait fish area for nehu (Stolephorus purpureus) used by the commercial skip-jack tuna fleet. In the late 1960's, this area accounted for 85% of all night-baiting catch on Oahu (Uchida and Sumida, 1971). The southern part of seaplane runway "D" is presently used as a mooring area and by a commercial, water recreation operation which offers skin and scuba-diving, among other activities, to tourists. The diving area used by this operation is the reef area along the west side of the channel. The Sand Island shoreline is used on weekends for family picnics and nearshore wading.

The islets and mudflats of Ke'ehi Lagoon are of little importance for the endangered Hawaiian waterbirds. Of these, only the Hawaiian stilt uses these areas for feeding and resting, and there has been a great reduction in the number of stilt that use these areas since the construction of the reef runway. We have found no records of stilt ever nesting there.

The mitigation areas provided by the Pearl Harbor National Wildlife Refuge are serving very well for most of these endangered waterbirds for feeding, resting, and for safe nesting sites. The mudflats and shores of the Ke'ehi Lagoon are used by a variety of migratory shorebirds for feeding and resting, and these birds are little affected by motorboats, airplanes, or people. Ducks and geese, however, apparently now avoid the lagoon area.

None of the 18 species of introduced or alien birds found in the general area is an endangered species and a number have proven to be serious pests in Hawaii. Most of these species inhabit both urban and rural areas and they will continue to be present in the Ke'ehi Lagoon region regardless of what changes are made around the lagoon.

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INTRODUCTION

Ke'ehi Lagoon is located on the south coast of Oahu between Honolulu Harbor and the Honolulu International Airport. Prior to the extensive development of this coastal area, the lagoon was an open embayment which included Honolulu Harbor. Most of this embayment was shallow reef and mud flat, with the deep areas confined to stream outlets through the reef. Salt marsh and traditional Hawaiian fishponds lined the shore and extended inland around the lower reaches of several major streams (Moanalua, Kalihi, Kapalama, and Nuuanu) that flow to the sea in this area. These perennial streams determined the brackish character of the inner portions of the embayment. The well-developed reef provided physical protection, producing a sheltered or quiet water lagoon environment. Wave-built, sand and rubble islets occurred at various points on the shallow reef.

Between the turn of the century and the 1950's, marsh land, salt marsh, fishponds, and shallow mud flats around the perimeter of Ke'ehi Lagoon were filled to create fast land, substantially reducing the area of the former embayment. Honolulu Harbor developed around the mouth of Nu'uanu Stream at the eastern end of this feature. Major landfills which were developed over time included the expansion of Sand Island on the east and the development of the Honolulu International Airport on the northwest shore. In the late 1970's, the reef off Ahua Point (former western end of the lagoon) and a substantial portion of the western part of the outer lagoon were filled for the Reef Runway project. Virtually all of the land surrounding the present day Ke'ehi Lagoon is fill-land (see Dames & Moore, 1968).

In 1940, the Federal government authorized construction of a major airport facility in and adjacent to Ke'ehi Lagoon for both sea and land based aircraft. Three seaplane runways, each 1000 feet wide, and mooring basins were dredged to a depth of 10 feet between 1941 and 1944. The dredging of a channel (Kalihi Channel) west of Sand Island to connect Kapalama Basin in Honolulu Harbor and the open ocean was started in 1943 as a military project. This channel, dredged to a depth of 35 feet, partly followed the natural channel of Kalihi Stream through the reef. In connection with the fill activities for the Reef Runway, a new channel (Circulation Channel B) was dredged through the reef west of the Kalihi Channel. Also, portions of the former seaplane channels and a borrow area were dredged to 40 feet or more depth to provide fill material and improve water circulation in the lagoon. The various channels increased the average depth of the lagoon and created shallow, isolated reef remnants between the various channels. Thus, the character of the lagoon is today vastly different from the feature which existed a century ago, and recovery of diverse marine communities on dredged surfaces since the 1940's has not occurred in the inner portion of the lagoon (inside a line drawn between the reef runway and Sand Island).

The Honolulu International Airport (HIA) Reef Runway was proposed in 1967 to alleviate potential serious aircraft operation capacity problems at HIA, and to reduce the aircraft overflights and noise levels in downtown Honolulu and surrounding residential areas. The Reef Runway was constructed between 1973 and 1977, seaward of Ke'ehi Lagoon in Malama Bay. The project required 19,000,000 cubic yards of dredged coral fill material, which was obtained through hydraulic suction dredging in areas adjacent to the fill area. Pre-construction studies determined that circulation channels would be required to avoid retarding flushing in Hickam Harbor and Ke'ehi Lagoon.

The Final Environmental Impact Statement for the Reef Runway made several predictions of post-construction conditions regarding circulation, water quality, and marine habitat. In general, the EIS predicted that water quality in Hickam Harbor and Ke'ehi Lagoon would improve compared to pre-construction conditions. A post-construction survey program was initiated approximately ten months after completion of the major dredging effort for the runway, and continued for one year. The conclusions of this survey were that water quality in most areas surrounding the Reef Runway had improved compared with typical pre-construction conditions, and that continued improvement of turbidity and suspended solids load could be expected.

The greatest impact of the Reef Runway construction on the biological characteristics of Ke'ehi Lagoon was the loss of a large area of shallow reef flat by both dredging and filling. New marine habitats created by the dredging operations were thought to hold the potential for overall environmental enhancement. Changes in fish populations were minor and believed to be transitory in nature.

Ke'ehi Lagoon is a protected body of water ideally suited for marine recreation and offers a magnificent potential for creating a first-class maritime and recreational complex. Development of this area could be coupled with the construction of a small industrial park which would provide support for several economic growth areas in the State: Honolulu International Airport; commercial fishing and export transshipment; yacht racing and recreational craft facilities; and ocean recreation. In addition, a major ocean recreation center should be an integral part of development at Ke'ehi Lagoon. Such a center, which could be used by Hawaii's residents and by visitors, has been suggested.

This report presents the results of water quality, benthic community and avifaunal surveys conducted in support of an Environmental Impact Statement for the Ke'ehi Lagoon Recreational Plan. Water quality analyses were performed by OI Consultants, Inc; surveys of benthic organisms and infauna by AECOS, Inc; and avifaunal surveys by Dr. Andrew Berger.

METHODS

Surveys of water quality conditions of Ke'ehi Lagoon were performed on March 29, 1988. On that day, the tide was at approximately +0.1 foot at the start of sampling at 8:00 am, rose to a peak of +1.0 foot by noon, and fell to a low of +0.2 foot by the end of sampling at 6:00 pm. Water quality samples were taken at various depths at eight stations within Ke'ehi Lagoon (Fig. 1). At each station, the boat was anchored and a depth sounding using a line marked off in meters determined bottom depth. Water samples for chemical and biological analyses were taken from three depths at each station: 0.5 m below the surface, at mid-depth, and 1.0 m above the bottom. Samples were taken with a 5 l capacity General Oceanics Niskin bottle. After the bottle had been closed at the desired sample depth, it was retrieved and water samples were withdrawn through a silicone tube attached to a sample port. Water samples for dissolved oxygen determinations were drawn first, then samples for the remaining analyses.

Oxygen samples were drawn into 60 ml capacity glass BOD bottles for subsequent chemical analysis (Strickland and Parsons, 1972). Manganous sulfate and alkaline iodide solutions were added immediately after sampling to preserve the samples and prevent oxygen level changes during transport; the analysis was completed at the lab on shore.

Water samples for the remaining analyses were drawn into 2 l capacity polyethylene bottles. The temperature in each sample was determined with a calibrated thermometer; the samples were then placed on ice in coolers for transport. At the lab on shore, subsamples of each sample were taken for individual chemical analyses. Salinity was determined on a presision induction salinometer. Determinations of pH were made according to the methods described in Strickland and Parsons (1972). Turbidity was measured in a Turner Designs Model 40 Nephalometer calibrated against a 20 NTU latex suspension standard. Suspended solids samples were filtered onto tared Whatman GF/C glass fiber filters, dried to constant weight at 60°C, and weighed on a Mettler analytical balance.

Dissolved nitrate-nitrite, ammonium and orthophosphate analyses were performed on water samples filtered through Whatman GF/C glass fiber filters. Analyses were done on a Technicon AutoAnalyser II system interfaced with an Apple //e computer and MCI analog-digital converter. Chemical analyses followed the procedures described in Solorzano (1969:ammonium), Technicon (1977:nitrate-nitrite), and Schell (1978:phosphate).

Total nitrogen and total phosphorus persulfate digestion analyses were performed according to D'Elia et al, (1977) and Koroleff (1977), respectively. After digestion, samples were analyzed for nitrate and phosphate as described above.

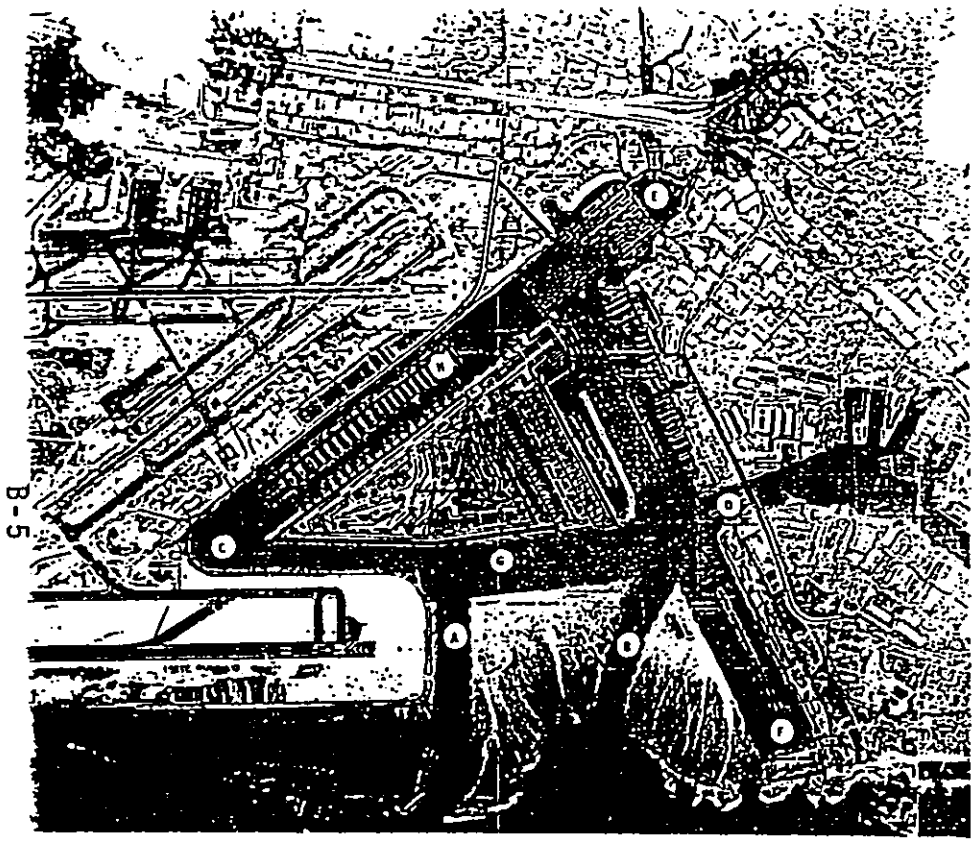

Figure 1. Location of water quality sampling stations within Ke'ehi Lagoon.

Benthic community surveys were performed at various points throughout Ke'ehi Lagoon (Fig. 2 and 3). At each of the benthic community sites studied, a reconnaissance survey was conducted and general notes taken on the nature of the environment and benthic organisms present.

Avifaunal field studies were conducted on September 1 and 7, 1987, March 29 and April 2 and 5, 1988. Observations were made both from boats and on foot along the shoreline of Ke'ehi Lagoon. Particular attention was paid to the habitats near the Reef Runway, Mokuo'eo Islet, Kahaku'aulana Islet and Mokauea Islet (Fig. 2).

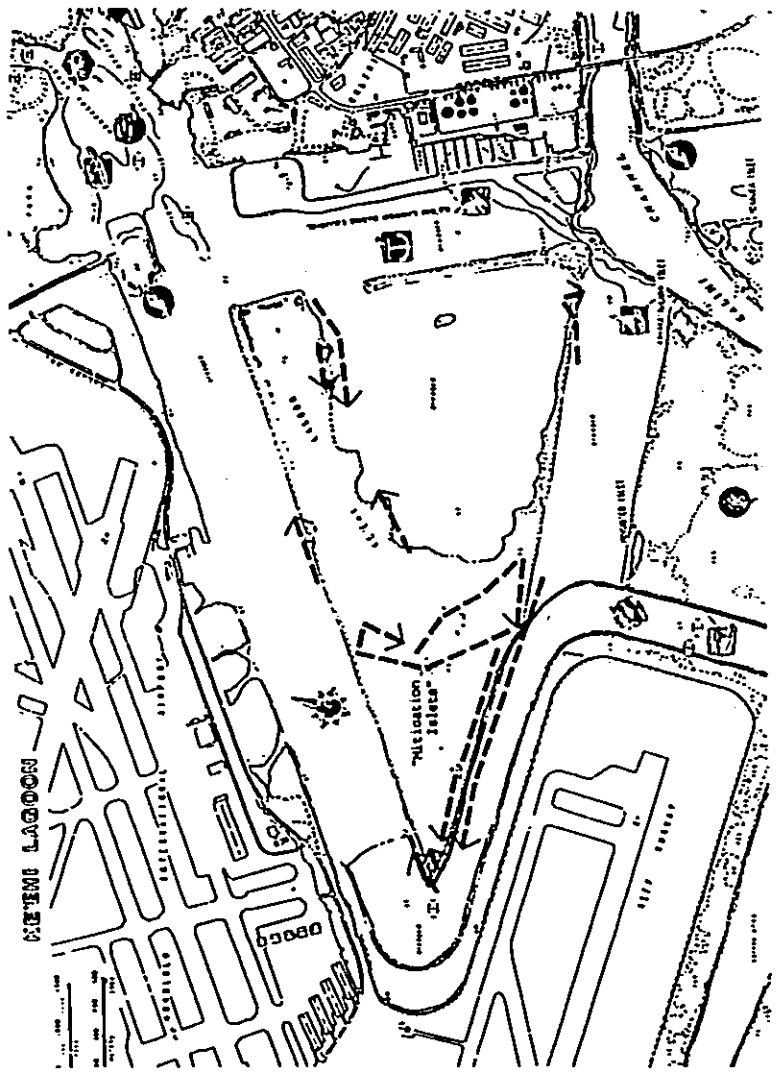

Figure 2. The inner part of Ke'ehi Lagoon showing approximate diving and walking routes (heavy dashed lines) of March 29, 1988 survey. Numbers in ovals locate earlier survey stations: (1) = AECOS, 1979a; (2) = AECOS, 1979b; (66) = ECI, 1978. (Base map from AECOS, 1981).

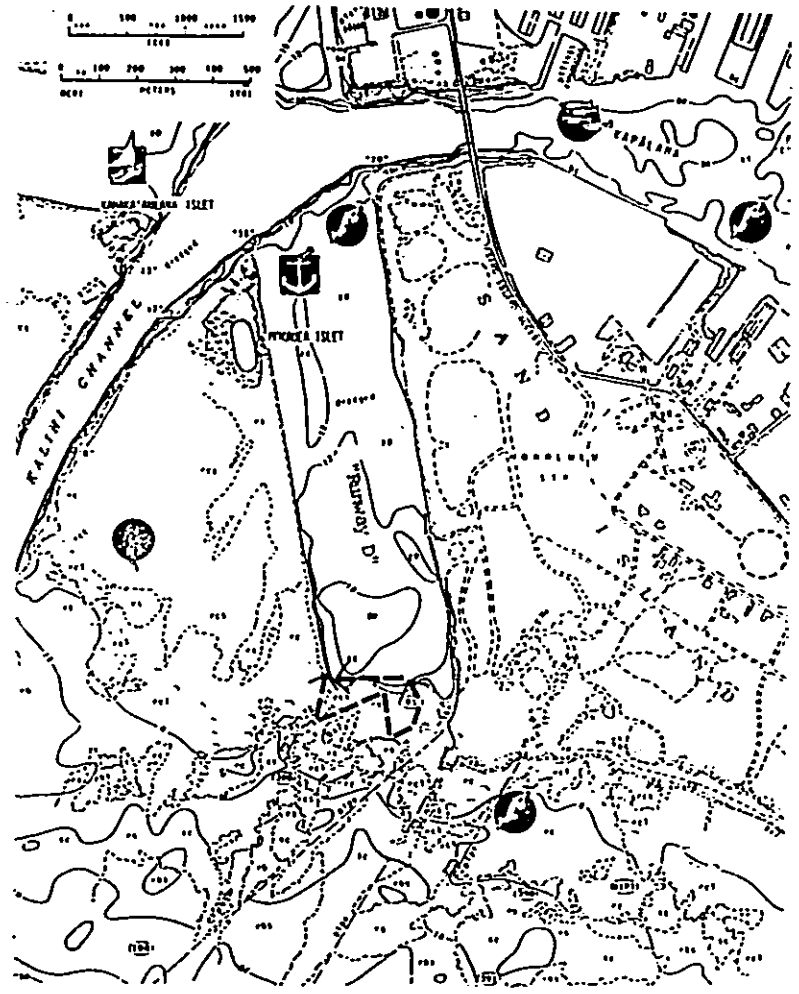

Figure 3. The outer part of Ke'ehi Lagoon showing approximate diving routes (heavy dashed lines) of March 29, 1988 survey off Sand Island. Numbers in ovals locate earlier survey stations: (81B1) = AECOS, 1979c; (95) = Hoyle, 1976; (198) = Div F&G, 1973; (390) = SE, Inc., 1973; (391) = Dollar, 1979. (Base map from AECOS, 1981).

RESULTS

Water Quality

The results of the chemical and biological analyses of water samples taken from the twelve sampling stations are presented in Table 1. Little difference in temperature or salinity was observed between stations. Most stations showed a pattern of decreasing temperature with depth; many of the stations showed a pattern of increasing salinity with depth, or uniform salinity. No evidence of extensive freshwater influence was observed in the data, except at Station E, at the mouth of Kalihi Stream. The pH of water samples was lowest in samples from Station E and uniform in samples from the other areas of Ke'ehi Lagoon. Variations in pH (range 7.8-8.2) were too small to be biologically significant, however.

Suspended solids levels in Ke'ehi Lagoon were generally similar, although lower levels were observed at the station located near Sand Island (Station F), and highest levels were observed at the mouth of Kalihi Stream (Station E).

Levels of dissolved nitrate-nitrite were low, occasionally non-detectable, at all stations. Orthophosphate levels were non-detectable at all stations. Dissolved ammonium levels were lowest at stations nearest the ocean (Station A, B, F). Levels of total (dissolved + particulate, organic + inorganic) nitrogen and phosphorus were generally similar for all stations.

Benthic Communities

Ke'ehi Lagoon has been the subject of several biological surveys, mostly conducted during the last fifteen years in conjunction with dredge and fill projects, particularly the Honolulu International Airport reef runway project. Details on the nature of the flora and fauna inhabiting the lagoon prior to the extensive changes after the 1930's are not known and, indeed, no studies appear to have been conducted much prior to the 1970's, by which time many of the natural resources that had originally existed were lost or compromised. A number of diferent biological surveys have been conducted in conjunction with the Sand Island WWTP effluent pipe extending offshore of Sand Island.

A triangular reef remnant (Fig. 2) in what was at one time about the middle of the lagoon resulted from the dredging of intersecting seaplane channels in the 1940's. About half of this feature is a borrow area dredged to between 3 and 10 feet deep for fill material. The remainder of the reef is a vast expanse of mostly silty sand at an elevation near low water, so that parts of the flat expose at low tides. Chunks of limestone rock and rubble, and areas of sorted, coarse-grained sand occur in some areas, particularly along the southern margin which is

Table 1. Results of chemical analysis of samples taken at various depths at eight stations within Ke'ehi Lagoon on March 29, 1988.

STATION	DEPTH (m)	TEMP (deg C)	SAL (ppt)	pH (units)	DISS O2 (mg/l)	TURB (NTU)	S.S (mg/l)	NO3 (uM)	NH4 (uM)	T N (uM)	PO4 (uM)	T P (uM)
A	1.0	26.0	34.65	8.2	6.93	1.4	3.6	0.10	0.61	9.85	ND	0.27
A	7.0	26.0	34.76	8.2	7.74	1.0	5.4	0.07	0.27	10.19	ND	0.35
A	14.0	25.5	34.87	8.2	6.48	2.0	5.0	0.12	0.29	8.98	ND	ND
B	1.0	26.0	34.67	8.1	7.81	1.9	3.6	ND	0.38	13.55	ND	0.30
B	5.0	26.0	34.75	8.1	7.63	1.7	5.4	0.09	0.23	13.07	ND	ND
B	10.5	25.5	34.84	8.2	6.50	2.3	5.0	0.12	0.20	11.09	ND	0.50
C	1.0	26.0	34.41	8.2	7.17	2.5	5.4	0.19	0.61	15.23	ND	0.24
C	6.5	26.5	34.50	8.2	7.29	3.0	4.4	ND	0.55	15.74	ND	0.32
C	13.0	25.0	34.90	8.1	6.12	1.3	3.8	0.08	0.57	11.77	ND	ND
D	1.0	26.0	34.75	8.0	6.69	2.2	3.6	0.12	0.59	12.15	ND	0.24
D	5.0	26.0	34.79	8.2	7.95	2.0	1.6	0.08	0.27	10.67	ND	0.32
D	11.0	25.0	34.81	8.1	7.05	2.0	4.6	0.20	0.70	10.96	ND	ND
E	1.0	26.5	34.60	7.9	6.93	4.8	8.4	0.16	0.65	16.54	ND	0.60
E	2.5	26.5	34.65	7.8	6.43	5.6	7.2	0.18	0.85	16.76	ND	0.68
F	1.0	25.0	34.84	8.0	7.07	0.8	2.0	0.26	1.04	9.31	ND	ND
F	3.0	25.5	34.84	8.1	6.95	0.8	5.2	0.21	0.84	12.98	ND	0.24
F	5.0	25.5	34.84	8.1	7.40	0.7	5.0	1.02	0.68	8.23	ND	ND
G	1.0	26.0	34.64	8.2	7.29	1.8	3.2	0.08	0.79	11.09	ND	0.24
G	2.0	26.0	34.64	8.1	7.05	1.6	3.0	0.10	0.97	11.92	ND	0.36
G	3.5	26.0	34.66	8.1	6.46	2.1	5.4	0.03	0.65	12.85	ND	0.32
H	1.0	25.0	34.67	7.8	7.04	5.6	5.8	0.17	1.17	14.35	ND	0.50
H	2.0	25.5	34.68	7.8	6.92	5.4	9.2	0.07	1.04	14.20	ND	0.75
H	4.0	26.5	34.69	8.0	7.12	5.4	9.2	0.10	0.71	13.27	ND	0.80

DETECTION LIMITS (ND = NOT DETECTABLE)

NO2 + NO3 = .03 uM
PO4 = .15 uM
TOTAL N = 1.65 uM
TOTAL P = .23 uM

occasionally subjected to some wave action. The sand on the reef flat appears to vary in thickness from place to place, being only a thin veneer over limestone in some areas. Outcrops of reef rock are prominent along the southern edge as well as around the margins of the borrow area.

The southern margin of the reef is a dredged slope of mostly sand and silt which descends at a steep angle to depths of between 10 and 30 feet. The upper portion of the slope is marked by the outcrops of limestone noted above. The northern and eastern margins are more gently sloped, covered by a layer of silt, and without much hard substratum present. Metal pilings, old ship hulls, tires, and other jetsam provide attachment for benthic organisms and some cover for small fish. Scattered at various locations on the reef flat, but mostly near the margins, are mounds of coral sand and rubble which extend above the high tide mark. These islets are figured in a map by Walker (1978). Clusters of mangroves cover some of these islets, whereas in other areas, mangroves appear to have become established on the reef flat without an islet having been present. Some of these islets are occasionally occupied by squatters, fishermen, or in the case of the Berm along the eastern margin, used as a shore base by water ski groups. One cluster of islets towards the western end of the reef flat was designed and built to serve as sea bird habitat. These islets are covered with a sparse strand vegetation, and partly surrounded by mangroves. The islets have not eroded greatly since their formation, indicating the lack of influence from waves and currents in the protected lagoon environment. Much of the eastern half of the triangular reef remnant is a former borrow area, dredged to a depth of around 6 to 10 feet. The bottom is a silty sand.

The soft bottom of the dredged areas supports mostly infaunal polychaetes and crustaceans. This fauna was surveyed by AECOS for the Corps of Engineers in 1978 (Environmental Consultants, Inc., 1978) and as part of the post-construction environmental studies for the Honolulu International Airport, Reef Runway in 1977-78 (AECOS, 1979b). A during-construction monitoring program for the reef runway project included (Bowers, 1976) one station in the northern seaplane channel. However, samples of the mud bottom were not collected during this study, which included observations on larger benthic organisms and zooplankton tows. A study of the northeast corner of Ke'ehi Lagoon close to the mouths of Kalihi and Moanalua Streams (Environmental Consultants, Inc., 1978) enumerated organisms in mud samples sieved through a 0.25 mm mesh screen. This fine mesh retains most of the meiofaunal annelids (very small worms) which were found to be not particularly abundant in these muds, an exception being the meiofaunal oligochaetes in the stream beds immediately upstream of the mouths.

During the March 1988 survey, as well as previously, it was noted that burrows of the snapping shrimp, Alpheus malabaricus mackayi, are numerous in the mud bottom of the channel and channel margin. Larger holes, resembling the burrows of Lysiosquilla sp., are common, but the inhabitants were not seen. In general, the attached fauna and flora of algae, sponges, tunicates, oysters, and the like is relatively sparse along the northern margin of the triangular reef. This fact is no doubt due to the paucity of hard substrata -- silt covers most of the bottom -- and the sluggish circulation in this part of the Lagoon. Pilings are inhabited by oysters (Ostrea sandvicensis) and barnacles (Balanus sp.). It was noted in AECOS (1979b) that many occurrences of hard bottom in this area consisted of cemented masses of Ostrea sandvicensis and Pomatoleios kraussi (a tube worm) skeletons, rather than the usual coral/coralline algae limestone which dominates reef rock material.

Very few fishes were seen during the March 1988 reconnaissance along the northern margin. Transect surveys were conducted in 1977-78 (AECOS, 1979b) along the slope in less than one meter of water. Only five species of fishes were enumerated in four surveys: Foa brachygramma, Dascyllus albisella, Acanthurus xanthopterus, A. sandvicensis, and Asterropteryx semipunctatus. Abundances were 9 or less in a 4 by 20 meter area. One other species noted in the area was small aholehole, Kuhlia sandvicensis. Close to the stream mouths, juvenile reef fishes, schooling bait-fishes, and adult and juvenile tilapia, Sarotherodon mossambica, were noted in 1978 (Environmental Consultants, Inc. 1978). Hammerhead sharks (Sphyrna sp.) are reported to be common in these waters at certain times.

The fauna at the shoreline in the northeast corner of Ke'ehi Lagoon was dominated by barnacles (Balanus amphitrite hawaiiensis), mollusks (Siphonaria normalis and Ostrea sandwicensis), and crabs (Metopograpsus thukuhar) in the survey by Environmental Consultants (1978). The sponge, Halichondria sp., was common below the water line, and the glass shrimp, Palaemon debilis, is common in the shallows. This fauna is probably typical of shoreline areas across the entire back of the lagoon wherever boulders or other hard substrata are present.

On the south side of the triangular reef, the benthic fauna is fairly diverse, although dominated by sponges, tunicates (Ascidia sp.), a large colonial bryozoan (probably Schizoporella unicornis, forming large, branching colonies or heads resembling corals), oysters (Ostrea sandwicensis), and the fan-worm, Sabellastarte sanctijosephi. One small head of the coral, Leptastrea purpurea, and a larger head of Pocillopora damicornis, were recorded along the south margin. Hydrozoans (Halocordyle disticha and others), anemones (Aiptasia pulchella), and vermetid mollusks (Vermetus alii) are present. Algal growth is sparse along the cut edge of the reef. Only Dictyosphaeria versluysi and Acanthophora spicifera were recorded.

Fishes are more abundant and the fish fauna more diverse along the southern margin than elsewhere on or around the triangular reef remnant. Nonetheless, fishes are not particularly abundant here as compared with most shallow marine areas in Hawaii. Schools of juvenile Dascyllus albisella occur around isolated limestone outcrops on the steep-sloping bottom. Species seen in spot dives along this margin include an eleotrid (Asterropteryx semipunctatus), weke (Mulloidichthys flavolineatus), aholehole (Kuhlia sandvicensis), porcupine fish (Diodon hystrix), an acanthurid (Acanthurus leucopareius), and a wrass (Thalassoma duperrey). These species were encountered individually or in small schools, and no doubt many more species would be recorded if the observation time were extended.

Algal growth on the reef flat is scattered, with Acanthophora spicifera, the most abundant form. Also noted as present are Spyridia filamentosa, Lyngbya majuscula, and Centroceras sp. Acanthophora and Spyridia are the only algal species noted from the reef flat in an earlier survey by Harvey (1970). One of the most abundant invertebrates on the reef flat is the burrowing crab, Macrophthalmus telescopicus. Common are portunid crabs (Thalamita spp.); mantis shrimp (Gonodactylus falcatus), and in shallow areas adjacent to the islets and sand bars, hermit crab (Calcinus latens). Several species of sponges (including Zygomycale parishi, Terpios zeteki, Halichondria sp., and others) are common on the shallow flat. Also noted as present are a holothurian (Holothuria pervicax), a box crab (Calappa hepatica), and tubeworm (Mesochaetopteris sagittarius). The only fishes seen (at low tide) are small eleotrids, gobies, and blennies (Asterropteryx semipunctatus, Psilogobius mainlandi, and others).

The large borrow area comprising much of the eastern portion of the triangular reef is almost without hard substrata on the deeper bottom. Along parts of the margin there occur outcrops of reef limestone exposed by the dredging. The soft bottom is extensively pocked and mounded with the burrows of small infaunal invertebrates. The marine angiosperm, Halophyla ovalis is very common here, growing in large patches over much of the bottom. On limestone outcrops along the western margin, the attached fauna is similar to that observed along the southern margin of the triangular reef remnant: dominated by a variety of sponges, with tunicates, oysters (Ostrea), and small colonies of the coral, Leptastrea purpurea, present. A few fishes occur around these rocks: Asterropteryx semipunctatus, Apogon sp., and juvenile manini and maiko (Acanthurus sandvicensis and Acanthurus leucopareius).

The American mangrove, Rhizophora mangle, has become established and covers much of the islets closest to Moanalua and Kalihi Streams, and at scattered locations elsewhere. This plant lines much of the shoreline at the mouth of these two streams (ECI, 1978). The vegetation observed on the islets in March 1988

included pickleweed or Batis maritima, Sesuvium portulacastrum, Pluchea indica, Pluchea odorata, small kiawe or Prosopis pallida, small ironwood or Casuarina equisetifolia, kolu or Acacia farnesiana, sea mulberry or Conocarpus erecta, milo or Thespesia populnea, seaside heliotrope or Heliotropium curassavicum, saltmarsh sand spurry or Spergularia marina, and weedy species of grasses and euphorbs (e.g., Euphorbia glomerifera).

The vascular plants of the Ke'ehi Lagoon islets were surveyed by Herbst (1979). Few indigenous and no endemic species were recorded. Most of the indigenous species were found on Kahaka'aulana (Harris), Mokauea, and Mokuo'eo islets (islets on the reef flats south of the triangular reef). The only indigenous species recorded from islets located on the triangular reef were Sesuvium portulacastrum and Heliotropium curassavicum. Our survey added only one new species (klu or kolu) to the list developed by Herbst, and a few of the exotic species he recorded from elsewhere on lagoon islets are now also found on the mitigation islets.

The outer portion of the reef flat which extends across the front of Ke'ehi Lagoon is a vast shallow feature composed of a complex mixture of consolidated limestone, rubble, and sand. The front of this reef is in the form of limestone fingers (called spurs) separated by grooves, and these spurs rise upwards, coalescing into a continuous reef margin at depths shoaler than 6 feet and mostly less than 3 feet. The outer margin is broken by the Circulation Channel B and the Kalihi Ship Channel. Behind the reef margin, continuous consolidated limestone gives way to sand and rubble, with limestone outcrops. These bottom types are arranged in linear patterns extending inward back across the reef from the seaward margin.

The northwest-southeast seaplane channel, designated "Runway D", was completed in November 1944, and extended at its southerly end into the consolidated limestone of the reef margin close to the southern tip of Sand Island (Figure 2). Because of the proximity of this deep water immediately behind the reef, sand generated on the reef by the growth and destruction of limestone secreting organisms (particularly corals and coralline algae), is moved landward by waves breaking against the reef front, forming sand spits and sand flats on the reef remnant. A steep sand slope is found at the edge of the dredged channel. The sand on the reef flat is moving inwards and accumulating in the channel, but is not entirely swept off the reef remnant by storm waves because of a breakwater of large boulders and concrete bunkers which extends out from the Sand Island shore more or less parallel to the reef margin over a distance coinciding with the width of the dredged channel. This discontinuous barrier breaks the force of the waves, but allows the water to flow past and into the lagoon. This is an area where the shoreline and nearshore deposits have undergone substantial changes in form over the years (Sea Engineering Services, Inc., 1973).

The bottom directly behind the concrete revetment is mostly limestone outcrops, with sand and rubble at a depth of 6 to 10 feet. The bottom shoals rapidly inward, and limestone rubble with scattered reef rock blocks cover an area mostly under three or four feet in depth. This bottom grades to sand, becoming a thick sand deposit which is gradually filling the end of the old seaplane runway "D".

West of the channel and just beyond the breakwater, the bottom is more typical of an outer reef flat. Limestone ridges rising three to four feet above narrow, sand-bottom channels give considerable relief to the bottom. This relief is enhanced along the channel margin where the limestone was dredged.

The several marine biotopes found at the southern end of seaplane channel "D" each harbor distinct assemblages of organisms. On the day of the survey, the breakwater area could only be approached from the inside and not surveyed in any detail because of the rough surf conditions. Biological survey results reported in Bowers (1976), State of Hawaii, Div. of Fish & Game (1973), Dollar (1979), AECOS (1979b), and Brock (1986) for stations seaward of the reef runway provide descriptions of the biota that can be anticipated to occur on the reef margin and reef front off the breakwater. Field studies undertaken for OCRI (AECOS, 1979c) indicated that the diversity of the reef front biota increases from east to west in front of Ke'ehi Lagoon, and coral cover is sparse fronting Sand Island.

A few scattered heads of the coral, Pocillopora meandrina, occur behind the large concrete bunkers placed here, and a variety of reef fishes are present around these structures. However, from behind this feature to the sand bottom at the seaplane channel margin, the shallow bottom is dominated by macroalgae. The more conspicuous species are Padina australis, Acanthophora spicifera, Asparagopsis taxiformis, Spyridia filamentosa, Dictyota divaricata, Giffordia breviarticulata, Laurencia sp., Dictyosphaeria versluysi, Symploca hydnoides, Caulerpa sertularioides, Sphacelaria furcigera, Dasyopsis sp., and Cladophora fascicularis. Hoyle (1976) utilized this area for studies on algae of the genus, Gracilaria, which includes the popular edible limu known as ogo.

A number of macro-invertebrates are present, including large mounds of the tube-worm (Mesochaetopteris sagittarius), sea-urchin (Echinometra mathaei), sea cucumber (Actinopyga mauritiana), and sparse growth of corals (Cyphastrea ocellina and Pocillopora damicornis). Fishes are not common in this area, which lacks vertical relief and protective cover. Sand-bottom areas harbor algae (mostly Acanthophora spicifera and Spyridia filamentosa) and an abundant growth of the marine angiosperm, Halophyla ovalis. A flounder (Bothus sp.) was observed on the sand bottom. Few burrows of invertebrates occur in the sand near the margin and on the slope, suggesting this bottom is unstable.

Immediately west of the channel, the character of the bottom changes substantially. As noted above, this area is characterized by significant benthic relief in the form of limestone ridges along the channel margin. Coral growth is conspicuous. Although coral cover is not high, many of the heads are large. Species noted as present include Pocillopora damicornis, P. meandrina, Porites lobata, Montipora verrucosa, and M. patula. The benthic algae are less conspicuous in this area, presumably because abundant herbivorous fish populations keep the thalli cropped down. Only Spyridia was noted as present during the reconnaissance, although numerous micro-species coat the limestone.

The fish fauna in this area is notably diverse and many of the species occur in large schools of adults. A list of the species observed on March 29, 1988, is presented below.

List of fishes noted on the reef at the southwest corner of Seaplane Runway "D", Ke'ehi Lagoon

Kuhlia sandvicensis	Thalassoma fuscum
Upeneus arge	Labroides phthirophagus
Mulloidichthys flavolineatus	Gomphosus varius
Parupeneus multifasciatus	Coris gaimardi
Forcipiger flavissimus	Scarus sordidus
Chaetodon fremblii	Zanclus cornutus
Chaetodon millaris	Acanthurus sandvicensis
Chaetodon ornatissimus	Acanthurus leucopareius
Chaetodon trifasciatus	Acanthurus dussumieri
Abudefduf abdominalis	Acanthurus olivaceus
Dascyllus albisella	Ctenochaetus strigosus
Plectroglyphidodon johnstonianus	Zebrasoma flavescens
Stegastes fasciolatus	Zebrasoma veliferum
Thalassoma duperrey	Pervagor spilosoma
Aulostomus chinensis	

Avifauna

The great importance for the endangered Hawaiian waterbirds of the National Wildlife Refuges at Pearl Harbor makes it pertinent to discuss the birds of the general region.

Ke'ehi Lagoon itself has been dredged in the past. The original vegetation, both around the lagoon and around West Loch of Pearl Harbor, has been greatly disturbed for more than a century and has been largely replaced by exotic vegetation: American mangrove (Rhizophora mangle), kiawe (Prosopis pallida), hau (Hibiscus tiliaceus), Indian pluchea (Pluchea indica), pickleweed (Batis maratima), Australian saltbush (Atriplex semibaccata). There is no semblance of an endemic ecosystem anywhere near the region.

Three groups of birds are found in the Hawaiian Islands: endemic, indigenous, and introduced or alien.

Endemic Birds: These are birds that are unique to the Hawaiian Islands. They do not occur naturally anywhere else in the world. Many endemic birds are cla-sified by the U.S. Fish & Wildlife Service and by the State Division of Forestry and Wildlife as endangered or threatened by extinction. Most of these endangered species are forest birds. Few of them still exist on Oahu, and there is no suitable habitat for them on or anywhere near Ke'ehi Lagoon.

Four species of endangered Hawaiian waterbirds do occur on Oahu: koloa or Hawaiian duck (Anas wyvilliana), Hawaiian gallinule or 'alae'ula (Gallinula chloropus sandvicensis), Hawaiian coot or 'alae ke'oke'o (Fulica americana alai), and Hawaiian stilt or ae'o (Himantopus mexicanus knudseni).

The present study is addressed to the question of the use by these endangered waterbirds of the remaining islets in Ke'ehi Lagoon and to their use of the mitigation areas established by the U.S. Fish & Wildlife Service at Pearl Harbor: Waiawa Unit and Honouliuli Unit of the Pearl Harbor National Wildlife Refuge.

1. Koloa or Hawaiian duck. To the best of our knowledge, this duck became extinct on Oahu during the 1950s. A koloa restoration project was initiated by the State Division of Fish & Game in 1972. As of April, 1979, 347 Hawaiian ducks had been released on Oahu in an attempt to re-establish the species on the island. One hundred ninety-nine birds were released in Kawainui Swamp; 103 at Waimea Falls Park; and 45 at Nuupia Pond on the Kaneohe Marine Corps Air Station. Although release of cage-reared koloa began on the Windward side of Oahu in 1969, we can find no reports of the species in the Pearl Harbor areas until July 18, 1976, when two birds were counted on the ponds on Waipio Peninsula. Since then, they have been observed at the Honouliuli refuge unit as well. Because of the distance involved, it is questionable whether or not birds from the Windward side will successfully disperse in greater numbers in this area (Shallenberger, 1977). Much more is involved, however, than great dispersal. It seems doubtful that the Pearl Harbor habitat offers the necessary food and safe nesting sites required by this ground-nesting duck. We know of no documented records of this duck resting in the vicinity of saltwater. Berger and Walker (1976) and Walker (1978) saw no koloa at Ke'ehi Lagoon. On one census of seven between February 20 and July 29, 1987, Berendzen and Fefer (1987) saw nine koloa at the Honouliuli Unit, but none during their other censuses. Two koloa were seen on two occasions on the Waiawa Unit. No koloa were seen in Ke'ehi lagoon during the present survey.

2. Hawaiian gallinule. The Pearl Harbor area does not provide good habitat for the Hawaiian gallinule. Shallenberger (1977) wrote that "Hawaiian gallinule are even less common in Pearl Harbor areas than are coots. No more than two birds have been reported in the Honouliuli refuge in recent years." Walker et al. (1986) reported no birds there during the summer census of 1985. Shallenberger did find the gallinule nesting at the prawn farm at Honouliuli. However, gallinules prefer fresh or brackish water to saltwater so it is doubtful that the Pearl Harbor habitat can ever be changed to provide optimal habitat for any large numbers of gallinules. Walker et al. (1985) point out that Hawaiian gallinule habitat consists "of thickly vegetated marsh interspersed with fresh water ponds, taro patches, lagoons, reedy margins or water courses (streams, irrigation ditches, etc.), reservoirs, and wet pastures...The key features of these areas for gallinules are 1) dense stands of robust emerging vegetation near open water, 2) floating or barely emergent mats of vegetation, 3) water less than three feet deep, and 4) fresh water as opposed to saline or brackish." The ecology of nesting of the gallinule has been discussed by Byrd and Zeillemaker (in press). The gallinule does not inhabit Ke'ehi Lagoon.

3. Hawaiian coot. According to Shallenberger (1977: 298), "Coots find far less suitable habitat in the Pearl Harbor wetlands than do stilt. No more than 3 coots have been reported on individual counts at Honouliuli refuge unit...Greatest numbers in the Pearl Harbor area have generally been found in small fish ponds in the Waikele areas." Walker et al. (1985: 11) state that the Hawaiian subspecies of the coot "is not known to nest adjacent to salt water." Berendzen and Fefer (1987) found coots at both the Waiawa Unit and the Honouliuli Unit of the Pearl Harbor Refuge. The coot does not inhabit Ke'ehi Lagoon.

4. Hawaiian stilt. This is a subspecies of the North American black-necked stilt. The largest populations now occur on Maui and Oahu. Personnel of the State Division of Forestry and Wildlife take censuses of the waterbirds during the winter and the summer. The number of stilts in the state has varied from 523 birds during the winter of 1979 to 1,492 during the summer of 1986 (after the breeding season; see Walker et al., 1986).

Indigenous Birds: These are species that occur naturally in Hawaii and also in other parts of the world. These birds are native to the Hawaiian Islands but are not unique to them. In this category are 22 species of seabirds, the Hawaiian black-crowned night heron, and a number of migratory species that spend their winter or nonbreeding season in the islands.

1. Seabirds. No seabirds nest anywhere near Ke'ehi Lagoon, but several species including the brown booby (Sula leucogaster), common noddy (Anous stolidus), great frigatebird (Fregata minor palmerstoni), and the white tern (Gygis alba), have been seen flying over the general area.

2. Black-crowned night heron (Nycticorax n. hoactli). The 'auku'u is considered an indigenous subspecies rather than an endemic subspecies because the Hawaiian birds are not recognized as subspecifically distinct from the North American birds. Hence, it is not classified as threatened or endangered even though its fate depends on the preservation of suitable wetlands as for the endangered Hawaiian waterbirds. Although these herons feed predominantly on aquatic insects, fish, frogs and mice, they also sometimes prey on the downy young of terns and undoubtedly on the other marsh birds. They also have a liking for 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 Oanu's Kahuku prawn farm as well as other aquaculture farms statewide" (Honolulu Star-Bulletin, October 26, 1985, page A-8; October 30, 1985, front page). This heron has been seen in the Ke'ehi Lagoon and Fort Kamehameha areas but now is far more common at the Pearl Harbor refuges.

3. Winter residents. The most conspicuous of these birds is the lesser golden plover (Pluvialis dominica fulva), which occurs from sea level to about 10,000 feet elevation on Hawaii and Maui. The birds frequent lawns in residential areas, golf courses, weedy pastures, open areas in the mountains, and mud flats along the shore. A flock of seven golden plovers was sighted along the shore of Ke'ehi Lagoon at the park area on September 1, 1987, and approximately 12 birds were sighted on the mud flats of Kahaka'Aulana islet on September 7, 1987. On April 5, 1988, 53 plovers were in Ke'ehi Park, feeding on the lawns; many of these birds were beginning to get their breeding plumage. Pyle (1988) reported plovers but no other shorebirds in the Ke'ehi Park region on the annual Christmas Count of the Hawaii Audubon Society.

Berger and Walker (1976) and Walker (1978) reported wintering populations of the following additional shorebirds at Ke'ehi Lagoon: wandering tattler (Heteroscelus incanum), ruddy turnstone (Arenaria interpres), sanderling (Calidris alba), and black-bellied plover (Pluvialis squatarola). Pratt (1987) said that there were 30 shoveler ducks (Anas clypeata) at the Honouliuli Unit at Pearl Harbor on April 20, 1987. These ducks are common winter residents in the Hawaiian Islands.

4. Stragglers In addition to the normal migrant species, individuals of a wide variety of species whose migratory paths do not bring them near the Hawaiian Islands have reached the islands one or more times. These birds are called stragglers, accidentals, or chance arrivals. It is assumed that most of these birds reach the islands because of storms and accompanying high winds. They are of little significance and are of interest primarily to some ornithologists. Table 2 lists the stragglers that have been seen in the Ke'ehi Lagoon region.

Table 2. Stragglers That Have Been Reported at Ke'ehi Lagoon, Fort Kamehameha, and Pearl Harbor National Wildlife Refuges.

Order Ciconiformes
Family Ardeidae
1. Great Blue Heron, Ardea herodias

Order Anseriformes
Family Anatidae
2. Black Brant, Branta nigricans
3. Bufflehead, Bucephala albeola

Order Falconiformes
Family Accipitridae
4. Osprey, Pandion haliaetus

Order Charadriiformes
Family Scolopacidae
5. Whimbrel, Numenius phaeopus
6. Lesser Yellowlegs, Tringa flavipes
7. Willet, Catoptrophorus semipalmatus
8. Spotted Sandpiper, Actitis macularia
9. Long-billed Dowitcher, Limnodromus scolopaceus
10. Western Sandpiper, Calidris mauri
11. Little Stint, Calidris minuta
12. Roufous-necked Stint, Calidris ruficollis
13. Least Sandpiper, Calidris minutilla
14. Baird's Sandpiper, Calidris bairdii
15. Pectoral Sandpiper, Calidris melanotos
16. Dunlin, Calidris alpina
17. Buff-breasted Sandpiper, Tryngites subruficollis
18. Ruff, Philomachus pugnax

Family Charadriidae
19. Semipalmated Plover, Charadrius semipalmatus
20. Northern Phalarope, Lobipes lobatus

Family Laridae
21. Glaucous Gull, Larus hyperboreus
22. Western Gull, Larus occidentalis
23. Herring Gull, Larus argentatus
24. California Gull, Larus californicus
25. Ring-billed Gull, Larus delawarensis
26. Francolin's Gull, Larus pipixcan
27. Bonaparte's Gull, Larus philadephia
28. Arctic Tern, Sterna paradisaea
29. Least Tern, Sterna albifrons
30. Black Tern, Chlidonias niger

Based on the following sources: Berger (1981), Berger and Walker (1976), Clapp (1975), David (1988), Pratt (1987, 1988), Pyle (1988), Walker (1978).

The chance arrival of seven species of gulls in the Ke'ehi Lagoon region is interesting because, of the 11 species of gulls that have been recorded in the Hawaiian Islands, none has established a breeding population. The gulls are seen for a short time, after which they disappear. Many gulls are scavengers, and our beaches and shallow water are relatively clean. We do not know whether the gulls die or move on to other islands in the Pacific. There are, therefore, no resident gulls in the Hawaiian Islands. Gulls are primarily inhabitants of the interior lakes of continents or along the shores of continents with a well developed continental shelf (Terres, 1980).

Introduced Birds: More than 170 species of alien birds have been intentionally introduced to the Hawaiian Islands (Berger, 1981). If, in addition to the Ke'ehi Lagoon area proper, we add birds that have been recorded at the West Loch/Waipio regions we find that 18 species of alien birds inhabit this region.

A. Order Ciconiiformes

a. Family Ardeidae, Herons and Egrets

1. Cattle Egret (Bubulcus ibis). This egret was imported to Hawaii "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). Most of the funds were provided by ranchers in order to have the birds released on their land. Cattle egrets were released on Oahu in 1959 and 1961. Thistle (1962) reported that the population of egrets on Oahu exceeded 150 birds by July 1962; 621 egrets were counted by personnel of the State Division of Forestry and Wildlife during January 1986 (Walker, et al., 1986); 116 egrets were counted in the Waipio region on December 22, 1976, (Bremer, 1987); and 1,009 birds were tallied on December 27, 1987, during the annual Christmas Count of the Hawaii Audubon Society (Pyle, 1988). Thus, the cattle egret is a common species in the Pearl Harbor Region, and occurs at times in the Ke'ehi Lagoon area, Fort Kamehameha, and in other parts of the Ke'ehi Lagoon complex.

B. Order Anseriformes

a. Family Anatidae, Ducks and Geese

2. Mallard (Anas platyrhynchos). This marsh duck is native to the northern parts of the Northern Hemisphere. Caum (1933) wrote that this species "has been introduced into Hawaii at various times but has not become established in the wild." However, there are migrant mallards and domesticated mallards that often escape (or are released) in Hawaii, and Lewin (1971) suggested that the release of mainland mallards might pose "a distinct genetic threat to the endemic form [Hawaiian duck or Koloa] through hybridization." Later, Ah Fat Lee placed "Koloa drakes with Mallard hens and Mallard drakes with Koloa hens. He proved

that the crosses were fertile and produced ducklings, thus demonstrating again the unforeseen problems that can result from indiscriminate introduction of exotic birds" (Berger, 1981: 75). Walker (1978: Table 8) saw a feral mallard at the Honouliuli refuge during his studies.

C. Order Columbiformes

a. Family Columbidae, Pigeons and Doves

3. Rock dove or feral pigeon (Columba livia). The pigeon was probably the first exotic bird introduced to the Hawaiian Islands; its importation has been traced back to 1796. Schwartz and Schwartz (1949) wrote 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." These authors also found heavy parasitism by tapeworms, which they stated retards proper nutrition and "occludes the intestine, produces undesirable toxins, and hinders breeding." Kishimoto and Baker (1969) reported finding the fungus Cryptococcus neoformans in 13 out of 17 samples of pigeon droppings on Oahu. The full significance of their findings has not yet been determined, but, in humans, this fungus causes a chronic cerebrospinal meningitis; Hull (1963: 468) remarked that "in all but the cutaneous form the prognosis [in humans] is very grave." The rock dove is found in the Ke'ehi Lagoon area.

4. Lace-necked or spotted dove (Streptopelia chinensis). This Asian dove was introduced to the islands at an early date; the exact date is unknown, but the birds are said to have been common by 1879. Now common to abundant on all islands, like the other doves in Hawaii, it is classified as a game bird. Although this dove occurs where the rainfall exceeds 100 inches per year, the highest densities are found in drier areas where the introduced kiawe is one of the dominant plants. Schwartz and Schwartz (1949) estimated densities as great as 200 birds per square mile on Molokai. It is common in fallow cane fields, along cane haul roads, and in residential areas.

5. Barred or zebra dove (Geopelia striata). This dove is said to have been introduced to Hawaii sometime after 1922 (Bryan, 1958). It has been a remarkably successful species and is now abundant on all islands. The zebra dove also prefers drier areas where seeds are abundant. The Schwartzes estimated densities as high as 400 to 800 birds per square mile in certain areas of Oahu (e.g., from Barber's Point to Makaha) and on Molokai. One study of the food habits of this dove revealed that the diet consists of 97% seeds and other plant materials; the 3% animal matter included several species of beetles, weevils and wireworm larvae. Kocan and Banko (1974) reported on barred doves on Hawaii that were infected with trichomonas; this parasite has catastrophic effects on doves in North America. The zebra dove is very common in the Ke'ehi Lagoon area.

D. Order Passeriformes

a. Family Pycnontidae, Bulbuls

6. Red-vented bulbul (Pycnonotus cafer). Although all members of this Old World family are listed as "prohibited entry" by the State Quarantine Division of the Department of Agriculture, two species are now well established on Oahu. This history of the spread of this species since the mid-1960s has been discussed by Berger (1975, 1981). Bulbuls are a scourge to both fruit and flower growers. The birds eat buds, flowers and ripe fruits of all kinds. They are common throughout the region.

b. Family Mimidae, Mockingbirds and Thrashers

7. Mockingbird (Mimus polyglottos). This species is a member of a New World family being distributed in both North and South America. The Hui Manu released birds on Oahu in 1931, 1932 and 1933, and on Maui in 1933 (Elepaio, 21: 81). I have found no additional records of introductions. The mockingbird has a spotty distribution on Oahu, being absent from many areas and being common in others, for example, Diamond Head, Fort Shafter, Radford Terrace and Barber's Point. It also inhabits the Fort Kamehameha region. The mockingbird is noted for imitating the songs and calls of other birds. A bird that I hand-raised in Michigan had in its repertoire the songs and/or callnotes of 15 species of birds (Berger, 1966).

c. Family Turdidae, Thrushes and Bluebirds

8. White-rumped shama (Copsychus malabarica). Shama is the Indian name for this thrust that is native to India, Nepal, Burma, Malaysia and throughout Indochina. The Hui Manu imported shamas in 1940 and released them in Nuuanu Valley "and at some homes in the 2400 block on Makiki Heights Road" (Harpham, 1953). The shama is now common on both the windward and leeward slopes of the Koolaus. Walker (1978) recorded this species in the Ke'ehi Lagoon/Fort Kamehameha area.

d. Family Sturnidae, Starlings and Hynas

9. Common Indian myna (Acridotheres tristis). This myna is native to Sri Lanka, India, Nepal and adjacent regions. It "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...reported to be abundant in Honolulu by 1879, it now is extremely common throughout the territory" (Caum, 1933). The myna continues to be common on Oahu, and it occurs in the vicinity of man and his buildings, on golf courses, and throughout the Honolulu region. In the Ke'ehi area, they inhabit the lawns as well as parking lots, searching for food.

e. Family Zosteropidae, White-eyes and Silver-eyes

10. Japanese White-eye (Zosterops japonicus). This race of the white-eye is native to the main islands of Japan, from Honshu to Kyushu and to the islands lying between Japan and Korea. Long a favorite cage bird in the Orient, this species was first imported for release by the Territorial Board of Agriculture and Forestry in 1929 (Caum, 1933). Later introductions were made by the Hui Manu. The Japanese name is Mejiro and Mejiro Clubs held singing competitions with these birds. The white-eye has been a remarkably successful species in Hawaii and it undoubtedly is the most abundant song bird in the Hawaiian Islands. It occurs from sea level to about 10,000 feet elevation on Hawaii, and it occupies near-desert areas (e.g., Barking Sands, Kauai) and those with an annual rainfall of more than 300 inches. The white-eye is common everywhere on Oahu, including the Ke'ehi area.

f. Family Ploceidae, Weaverbirds and Their Allies

11. Red munia or Red avadavat (Amandava amandava). Known as the strawberry finch in the pet store trade, Caum (1933) wrote that "it is not known with certainty just when these birds came to Hawaii, but it probably was sometime between 1900 and 1919. Many were imported as cage birds during this period, and it is supposed that the present population is derived from individuals escaped from captivity." Ord (1967) wrote that the strawberry finch "can usually be found near grassy open areas around sugar cane fields...in the lowlands around Pearl Harbor." The birds still inhabit this area where 57 birds were counted during the December 1986 Hawaii Audubon Society Christmas Count (Bremer, 1987). The birds also have spread into the Ewa area and to the West Beach sugarcane fields, and may appear in the West Loch area of Pearl Harbor.

12. Nutmeg mannikin or ricebird (Lonchura punctulata). Also known as the spotted munia, this Asian species was released in Hawaii by Dr. William Hillebrand about 1865 (Caum, 1933). Caum wrote that the ricebird "feeds on the seeds of weeds and grasses and does considerable damage to green rice." Although rice is no longer grown in Hawaii, the ricebird becomes a serious pest by eating the seeds of sorghum (see under house finch). I saw flocks of up to 25 birds in the Ke'ehi Lagoon area.

13. Black-headed munia (Lonchura malacca atricapilla). This bird is also called the chestnut mannikin and the black-hooded nun. The species was first reported in the wild by Udvardy (1960), who observed 10 adults and 15 juvenile birds near West Loch, Pearl Harbor on April 26, 1959. Ord (1967) reported the species to be abundant "in open grassy areas around Middle Loch and West Loch of Pearl Harbor." The species has spread since that time, and still is abundant in the Waipio/West Loch region and eastward to the Fort Kamehameha region. More than 200 birds were counted in the Waipio Peninsula area during the Audubon Christmas Count during December, 1986 (Bremer, 1987).

14. Java Sparrow (Padda oryzivora) Caum (1933) wrote that this species may have been introduced to the islands by Dr. William Hillebrand about 1865, and others may have been brought in about 1900. These birds did not survive, however. Throp (1969) reported that Java sparrows nested and raised young on Diamond Head during late 1968 or early 1969. The increase in numbers and the spread in range since that time have been impressive (Berger, 1975). Pyle (1987) reported that 754 Java sparrows were counted in the December 1986 Audubon Society count, which covered only a small part of Oahu; 752 birds were counted on December 27, 1987 (Pyle, 1988). This seed eater also has spread into the Ewa Beach area and to the Ke'ehi Lagoon complex.

15. House sparrow (Passer domesticus). Also, erroneously, called the English sparrow (it has a wide distribution in Europe and Asia, as well as England), was first introduced to Oahu in 1871 when nine birds were brought from New Zealand. Caum (1933) wrote that "whether or not there were further importations is not known but the species was reported to be numerous in Honolulu in 1879." The house sparrow in North America (first introduced to 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). In India, as well, the house sparrow still "causes colossal damage to the food-grains in standing crops and in storage" (Rana and Idris, 1986). The house sparrow apparently never became a pest in Hawaii. It is omnivorous in diet, eating weed seeds as well as insects and their larvae. House sparrows are very common around man's buildings and in outlying areas, and it is a common bird in the Ke'ehi Lagoon complex.

f. Family Fringillidae, Sparrows, Cardinals And Buntings

16. Red-crested cardinal (Paroaria coronata). This species traditionally has been called the Brazilian cardinal in Hawaii, but the native range includes Uruguay, Paraguay, Brazil and parts of Bolivia and Argentina. This species was released in Hawaii several times between 1928 and 1931 (Caum, 1933). This cardinal is a common species in urban and residential areas as well as in the introduced vegetation of leeward Hawaii and Honolulu. It is widespread throughout the Ke'ehi Lagoon region.

17. Cardinal (Cardinalis cardinalis). This species has a number of vernacular names: Virginia cardinal, Kentucky cardinal, Kentucky red bird. Its native range is the eastern part of North America east of the plains and northward into Ontario. The cardinal was released several times in Hawaii between 1929 and 1931 (Caum, 1933). The species is fairly common in some lowland areas, and is a characteristic bird of the leeward parts of Oahu. The birds visit the edges of cane fields but spend most of their time in kiawe and other thickets whether inland or along the shore, and they occur in residential areas. They are found throughout the Ke'ehi Lagoon complex.

18. House finch (Carpodacus mexicanus frontalis). Also known as the papaya bird in Hawaii, this finch was introduced from California "prior to 1870, probably from San Francisco" (Caum, 1933). The house finch is now an abundant species in both urban and rural areas on all of the islands, and probably is the second most common land bird species in the islands. Although house finches do at times eat overripe papaya and other soft fruits, the species is predominantly a seed eater. House finches and ricebirds caused substantial damage to experimental crops of sorghum on Kauai and Hawaii during 1971-1972. "A report by the Senate Committee on Ecology, Environment and Recreation says rice birds and linnets [house finches] 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, B-2). The house finch is a very common species in all parts of Oahu, including the Ke'ehi Lagoon complex.

Table 3. Comparison of geometric mean water quality parameter values for 1977-1978 post-construction study, the 1988 study, the present study (1988), and water quality standard geometric mean (WQS Mean) and not to exceed more than 10% (WQS 10%) values for "wet embayments" for eight stations within Keehi Lagoon.

Station	Study	Turbidity (NTU)	Suspended Solids (mg/l)	Nitrate+ Nitrite (ug N/l)	Ammonium (ug N/l)	Total-N (ug N/l)	Ortho-P (ug P/l)	Total-P (ug P/l)
A	1978	1.7	5.1	3.22	3.22	112.00	7.36	41.92
	1986	3.1	5.2	0.70	21.00	118.02	3.20	15.36
	1988	1.4	2.3	0.98	3.64	175.28	4.80	8.96
B	1988	2.0	6.3	1.26	5.04	135.24	4.80	7.68
C	1978	2.1	5.4	1.40	2.38	116.20	5.76	41.60
	1986	2.6	3.5	0.84	16.94	220.08	1.60	26.88
	1988	2.1	4.5	1.12	7.00	184.38	4.80	7.36
D	1978	1.6	5.6	2.94	4.06	114.80	6.72	40.64
	1986	2.1	5.3	1.40	15.68	234.64	1.60	4.16
	1988	2.1	3.0	1.68	8.12	157.36	4.80	7.04
E	1978	2.9	8.3	4.06	3.64	151.20	7.36	46.40
	1986	4.9	5.7	2.24	15.82	214.76	1.60	6.72
	1988	5.2	7.8	2.38	10.36	253.12	4.80	20.48
F	1988	0.8	3.2	5.32	11.76	139.72	4.80	5.76
G	1988	1.8	5.4	0.98	11.06	167.02	4.80	9.60
H	1988	5.5	7.9	1.54	13.30	195.02	4.80	21.44
1988 Mean		2.2	4.6	1.61	8.11	172.73	4.80	9.82
WQS Mean		1.5	*	8.00	6.00	200.00	*	25.00
WQS 10%		3.0	*	20.00	13.00	350.00	*	50.00

* Parameter no longer included in Water Quality Standards

DISCUSSION

Water quality conditions in the study area during the time of sampling were not, with a few exceptions, different from the conditions described in the 1977-1978 post-construction survey (AECOS, 1979c). Table 3 presents the range of observed values and geometric mean of values for water quality parameters at eight stations in Ke'ehi Lagoon , the geometric mean of the values generated by this study, The "Geometric Mean" and the "Not To Exceed 10% of the Time" values for those parameters as established in the current State Water Quality Standards. The differences between the values determined in previous surveys and those determined in the present survey were not large, and were not indicative of any pattern of degradation in overall water quality; rather, the data represent an expansion of the range of natural conditions.

No parameters were found to exceed the 10% water quality standard criteria. Nitrate, total nitrogen and total phosphorus levels were lower than the "Mean" criterion level, while turbidity and ammonium levels were between the "Mean" and the 10% criterion levels. Suspended solids and orthophosphate are no longer included in the State water quality standards.

As was noted at the conclusion of the post-construction environmental studies for the reef-runway (AECOS, 1979a), the inner lagoon environments are generally poorly populated by macro-algae, invertebrates and demersal fishes. The circulation sluggish, cover for fishes is sparse, and the bottom is dominated by silt.

Some recreational fishing does occur in inner lagoon areas, although mostly limited to crabbing for Hawaiian crab (Podophthalmus vigil) and collecting of small shrimp (Paneaus), worms, and fishes to be used for bait. Samoan crab (Scylla serrata) is reportedly caught in the estuaries of Moanalua and Kalihi Streams. Pole fishermen at Ke'ehi Lagoon Beach Park report catches of juvenile palani and hammerhead shark. The basin around the mouth of the streams has been a productive bait fish area for nehu (Stolephorus purpureus) used by the commercial skip-jack tuna fleet. In the late 1960's, this area accounted for 85% of all night-baiting catch on Oahu (Uchida and Sumida, 1971).

The triangular reef remnant is not a particularly diverse marine ecosystem. The fauna and flora resembles that of the fringing reef flats in more protected parts of Kane'ohe Bay and Pearl Harbor. The fauna is most diverse and the ecosystem more interesting from a biological perspective along the south margin (east-west seaplane channel). Presumably water circulation is somewhat better here than elsewhere around the reef remnant and wave energies are slight, thus encouraging the diverse growth of sponges, bryozoans, tunicates, and tube-worms. Also significant

in this area are the limestone outcrops along the upper edge of the channel margin which provide substratum for the variety of attached invertebrates as well as cover for fishes and cryptic invertebrates. At higher tides, fishes residing in the deeper surrounding waters of the channels probably feed over the reef flat, but the paucity of cover is an important limitation on the development of the resident fish fauna and value of the reef flat as a nursery area for juveniles of species populating the more seaward parts of the reef or open water areas around Oahu.

The southern part of seaplane runway "D" is presently used as a mooring area and by a commercial, water recreation operation which offers skin and scuba-diving, among other activities, to tourists. The diving area used by this operation is the reef area along the west side of the channel. The Sand Island shoreline is used on weekends for family picnics and nearshore wading.

The proposed improvements, including construction of a beach behind the existing man-made revetment will not destroy a productive area if the beach is extended only as far as the limestone west of the seaplane channel. In order to maintain a beach here, the existing revetment would have to be substantially improved to prevent waves from eroding the new beach. Thus, water circulation, particularly the mass transport into the lagoon from waves penetrating the existing somewhat open revetment, will be decreased. The biologically diverse community along the western margin of the channel should not be adversely impacted if the beach and improved revetment is constructed as proposed with a shallow channel at the western end connecting to the southwest corner of the seaplane channel. The beach as designed will provide better access to a potentially valuable resource for recreational skin and scuba diving. Indeed, this area is likely to become popular with dive schools for teaching novice divers.

The endangered status of all of the Hawaiian waterbirds results from a number of factors. Eggs and newly hatched young are easy prey for mongoose, cats and dogs. The downy young also enter the water shortly after hatching, where they serve as prey for bass, bullfrogs and black-crowned night herons (Berger, 1981). Sudden changes in water level also cause the destruction of some nests. Of equal importance is the historical destruction of so many lowland marsh areas. A potential problem that has been little studied in Hawaii is that of the effects of herbicides and pesticides on birds and their reproduction, although the U.S. Fish and Wildlife Service has been studying this problem on the mainland for the past 40 years (Hall, 1987).

Construction of the Reef Runway caused the loss of more than 200 acres of mudflat areas where migratory shorebirds and the Hawaiian stilt foraged for food. Walker (1978: 9) reported that his censuses revealed that the numbers of stilts using the Ke'ehi Lagoon region decreased from 114 in 1971 to 33 in 1978. He added

that "although only an estimated 20% of the feeding habitat was eliminated, the number using the study area decreased by up to 75%." He thought it possible that "in the case of the stilt, the decrease could be accounted for by low reproduction in 1978 or perhaps stilts missed which may have been using the reef runway proper (which was not censused) or adjacent areas." It now seems certain, however, that the decrease in use of the Ke'ehi Lagoon islets is, in fact, true. No stilts were seen in the two-day survey made in September, 1987, or the three day survey in March and April, 1988.

The critical factor for the stilt and the other endangered waterbirds, however, is not feeding areas but safe nesting sites. These are lacking on the Ke'ehi Lagoon islets and there are no records of the stilt nesting there.

Walker (1978: 13) admirably summarized the effects of reef runway construction on the habitat and its use by waterbirds in Ke'ehi Lagoon:

"With the completion of the reef runway and its opening to aircraft, a new element of disturbance to migratory, native and introduced birdlife was presented in and near Ke'ehi Lagoon. The aircraft flight lanes for both landings and take-offs pass directly over important mud flats used for feeding by native waterbirds and migratory shorebirds and islands used for resting by these birds. The results of the current study indicate that there was little change in the species composition or the use of these areas by these species as a result of aircraft traffic. However, the numbers of each species (with some exceptions) decreased markedly as compared with previous surveys. This includes the endangered Hawaiian stilt which once occurred in numbers up to and over 100 but which during 1978 was never seen in numbers exceeding 33. Larger migratory species such as ducks, geese and gulls were not seen at all in Ke'ehi Lagoon in 1978 whereas they were occasionally seen during the winter in previous years."

Seasonal changes in abundance of the migratory shorebirds and ducks is very obvious, of course. During the summer months there are, typically, none of these species present in the Hawaiian Islands. To be sure, an occasional bird does sometimes fail to migrate and, therefore, remains in the islands for the summer period; the exact reason for this failure to migrate is not known.

The first golden plovers, turnstones, sanderlings, tattlers, and ducks arrive in the islands during August; for the plovers, at least, the adult birds arrive several weeks ahead of the young birds of the year. The number of returning birds increases considerably during September.

Some of these migrants leave the Hawaiian Islands for their breeding ground in Alaska or Siberia during April. "Studies by personnel of the State Division of Fish and Game have shown that from 80 to 90 percent of all wintering Golden Plovers leave for the breeding grounds by May 2" (Berger, 1981: 231).

On March 29, 1988, there was little or no recreational use of the waters of the lagoon. On September 7, 1987, however, jet skiers, powerboats, water skiers, sail boats, and fishermen were conspicuous in Ke'ehi Lagoon. The birds, however, do not use the open water of the lagoon, but forage on the islands and mud flats.

To the best of our knowledge, the only extensive published results of research on the effects of noise on birds are those of the U. S. Environmental Protection Agency (1971, 1980). The two reports give the results of research on a number of bird species that show that birds are little affected by artificially produced noises, airplanes and sonic booms. "It was reported that to scare birds a noise level approximately 85 dB SPl at the bird's ear was required" (1971: 36). The two reports cite many other examples of research dealing with behavior and reproduction in relation to both airplanes and construction noises. In Hawaii, Berger (1973) in writing about the Hawaiian stilt, said that "all of the bird species that inhabit Kanaha Pond ignore automobile traffic on the highway as well as airplanes that fly over the Pond." Kridler (in Doty, 1969), also writing about Kanaha Pond, reported that "we did not notice one instance when planes frightened ducks or any other waterbird into flight." Finally, speaking on behalf of the Board of Land and Natural Resources in testimony before the State Senate Committee on Ecology, Environment and Recreation on February 10, 1976, Mr. Ronald L. Walker of the State Division of Forestry and Wildlife said:

"Contrary to commonly held opinion that resident and migratory waterbirds do not adapt well to habitat subjected to human disturbance, it has been our experience that the Hawaiian stilt and migratory shorebirds and waterfowl are highly tolerant of human activities in the vicinity of their feeding and resting areas. This has been demonstrated not only at Paiko Lagoon...but at Ke'ehi Lagoon off the International Airport, which is subjected to daily disturbance by aircraft, motorboats, vehicles and recreationists on foot."

The significant point about the "mitigation" islets and mudflats in Ke'ehi Lagoon, however, is that some Hawaiian stilts still use these areas for feeding and resting. They do not, however, nest there, and a critical factor for all of the endangered Hawaiian waterbirds is the presence of safe nesting sites. The other waterbirds do not use the lagoon or its islets.

Hence, because of the loss of habitat and the lack of safe nesting sites at Ke'ehi Lagoon, the Waiawa and Honouliuli units of the Pearl Harbor National Wildlife Refuge assume major significance for providing safe nesting habitat. Steve Berendzen, Refuge Manager for the Pearl Harbor National Wildlife Refuge, reported on September 14, 1987 that all four of the endangered Hawaiian waterbirds have nested there. Both the Waiawa and Honouliuli units are of special importance for the Hawaiian stilt, of less importance for the other waterbirds but Berendzen has recorded the successful nesting of the koloa at the Honouliuli unit. These protected areas are of critical importance because of the safe nesting sites that they provide and because recreationists are excluded. Although waterbirds and migrant shorebirds are not seriously affected by noise or by people when the birds are feeding or resting, nesting birds are greatly affected by people. Thus, the Pearl Harbor Refuge is important to these endangered Hawaiian waterbirds.

The islets and mudflats of Ke'ehi Lagoon are of little importance for the endangered Hawaiian waterbirds. Of these, only the Hawaiian stilt uses these areas for feeding and resting, and there has been a great reduction in the number of stilt that use these areas since the construction of the reef runway. We have found no records of stilt ever nesting there.

The mitigation areas provided by the Pearl Harbor National Wildlife Refuge are serving very well for most of these endangered waterbirds for feeding, resting, and for safe nesting sites. The mudflats and shores of the Ke'ehi Lagoon are used by a variety of migratory shorebirds for feeding and resting, and these birds are little affected by motorboats, airplanes, or people. Ducks and geese, however, apparently now avoid the lagoon area.

Some 30 species of stragglers or chance arrivals have been recorded in the vicinity of Ke'ehi Lagoon thus far. They are only of academic interest.

None of the 18 species of introduced or alien birds found in the general area is an endangered species and a number have proven to be serious pests in Hawaii. The destruction to sorghum crops by the ricebird and the house finch has been mentioned. The doves and the myna have been implicated in the spread of such noxious plants as Lantana camara. The red-vented bulbul and the Japanese white-eye cause considerable damage to ornamental flowers and to fruit crops. Some of the introduced birds apparently cause no damage to crops or to the endemic forest birds, and they do provide pleasure for many people. Most of these species inhabit both urban and rural areas and they will continue to be present in the Ke'ehi Lagoon region regardless of what changes are made around the lagoon.

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APPENDIX C

Ke'ehi Lagoon Avifaunal Surveys, 1989

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KE'EHI LAGOON AVIFAUNAL SURVEYS, 1989

FROM: OI CONSULTANTS, INC.
ANDREW BERGER, CONSULTANT

TO: EDWARD K. NODA & ASSOCIATES

JULY, 1989

BACKGROUND

The "Scope of Work" includes performing an avifaunal survey "with particular emphasis to be placed on the bird habitats located near the Reef Runway, Mokuo'eo Islet, Kahaka'aulana Islet and Mokauea Islet" and to prepare a report summarizing the avifaunal surveys "and discussing significant seasonal changes in population." Field studies were conducted at low and high tides on March 14 and 27, April 3 and 17, and May 2 and 24, 1989.

Kahaka'aulana Islet is called Harris Islet by Walker (1978) and in the map prepared by Edward K. Noda & Associates of Honolulu, January 12, 1989. At no time during my field studies did I see any shorebirds on this islet. The coral rubble that predominates along the edges does not provide suitable habitat for the shorebirds. Of considerable importance for the shorebirds, however, is the area called the "Mud triangle" by Walker (1978) and which is bounded by Seaplane Runways A and B (Noda map).

I want to express my sincere appreciation to Mr. Keith S. Oda, Sea Engineering, Inc., for his skillful operation of the Boston Whaler on our surveys. His dependability was noteworthy.

HISTORICAL OVERVIEW

The Ke'ehi Lagoon complex undoubtedly is the most-studied marine habitat for migrant birds in the Hawaiian Islands. From December 12, 1970 until August 14, 1976, 177 bird surveys were made in this habitat (Berger & Walker, 1976). An additional 36 surveys were conducted between January 28 and September 8, 1978 (Walker, 1978). This was followed by Berger's (1987) report on the "Birds of Ke'ehi Lagoon and the Pearl Harbor

Region," with field studies made in September, 1987 and subsequently, Berger's (1988) study conducted on March 29, April 2 and 5, 1989.

The years of available data make one thing clear. There has been a significant decrease in the numbers of wintering shorebirds and the Hawaiian stilt (*Himantopus mexicanus knudensi*) in the area since the construction of the Reef Runway, and there has been a continuing decline in recent years. A notable example is that I did not see a single Hawaiian stilt during September, 1982, September, 1987, April, 1988, nor during my March/May 1989 field studies.

Walker (1978) wrote about the decline in numbers of stilts and migrant shorebirds for the period 1970 - 1978:

> *With the completion of the runway and its opening to aircraft, a new element of disturbance to migratory, native and introduced birdlife was presented in and near Ke'ehi Lagoon. The aircraft flight lanes for both landings and take-offs pass directly over important mud flats used for feeding by native waterbirds and migratory shorebirds and islands used for resting by these birds. The results of the current study indicate that there was little change in the species composition of the use of these areas by these species as a result of aircraft traffic. However, the numbers of each species (with some exceptions) decreased markedly as compared with previous surveys. This includes the endangered Hawaiian stilt which once occurred in numbers up to and over 100 but which during 1978 was never seen in numbers exceeding*

> *33. Larger migratory species such as ducks, geese, and gulls were not seen at all in Ke'ehi Lagoon in 1978, whereas they were occasionally seen during the winter in previous years.*

Eight years later, Bachman *et al.* (1986) noted that:

> *The populations of migratory waterfowl wintering in Hawaii was once again quite low. An increase of 823 to 1,210 only reflects the 395 birds counted on Ni'ihau this year. The low numbers of mainland migratory waterfowl counted this year is a continuation of a trend that began in the late 1970s. This is possibly due to a decade of poor productivity or poor survival during the breeding season but more likely reflects a downward trend of migratory waterfowl nationwide.*

Similarly, Engilis *et al.* (1988) wrote that:

> *The Summer 1987 count was conducted on Oahu during clear weather. In general, counts of all waterbird species were lower than last summer's totals. Concentrations of coot and stilt were noted at Kahuku, Waipio Peninsulua, and Nuupia Ponds (stilt only)...The winter survey was conducted during locally heavy rains which hindered count efforts. Only 239 coot were counted, the lowest Oahu total since 1979. Stilt also were down in numbers (640) compared to last year. Low numbers reported for these species may be attributed to dispersal into seasonal wetlands.*

A potentially serious problem that has received almost no study in Hawaii is that of the effects of herbicide and pesticide residues on birds and their reproduction. The U.S. Fish and Wildlife Service has been studying this problem on the mainland U.S. for the past 40 years (see Hall, 1987; White *et al.*, 1988; Ohlendorf & Fleming, 1988; Hoffman & Heinz, 1988). Ohlendorf and Harrison (1986) did make a study of mercury, selenium, cadmium, and organochlorides in the eggs of the red-footed booby (*Sula sula*), wedge-tailed shearwater (*Puffinus pacificus*), and sooty tern (*Sterna fuscata*) on Manana Island (Oahu), as well as on Tern Island of French Frigate Shoals, Laysan Island, and Midway Islands.

Berger wrote in 1977 in a Conservation section for *The Wilson Bulletin*:

> *Nor has any study been made of potential chemical poisoning of the few wetland areas still extant, even though the Chairman of the State Department of Agriculture stated in a public lecture (45th Annual Meeting of the Hawaiian Academy of Science, December 11, 1969) that Hawaiian agriculturists apply 10 times the amount per square mile of chemical pesticides and herbicides than is used on the Mainland U.S.A. and that local exterminators use 500 to 1,000 times the amount of poison used in Mainland applications.*

Another detrimental problem for the endangered Hawaiian waterbirds, as well as for the migratory shorebirds, is that of the accidental spill of oil into the habitat. For example, when a Chevron Oil Company jet fuel line ruptured on May 13, 1987, some 1,000 gallons of fuel were pumped into Waiawa spring, from which it was pumped into the Waiawa National Wildlife Refuge in Middle Loch of Pearl Harbor. This pollution caused the death

of several waterbirds and caused the desertion of at least six Hawaiian stilt nests (Berendzen, 1987; Honolulu Star-Bulletin, May 14, 1987, page 1, and May 15, 197, page A-3).

NOISE AND THE WATERBIRDS

On September 7, 1987, and during my March/May, 1989 field surveys, there was considerable recreational use of the waters of the lagoon. Jet skiers, water skiers, powerboats, sail boats and fishermen were conspicuous in many parts of Ke'ehi Lagoon. The birds, however, do not use the open water of the lagoon, but forage and rest primarily on the mud flats that are exposed at low tide.

The only extensive published results of research on the effects of noise on birds are those of the Environmental Protection Agency (1971, 1981). The two reports give the results of research on a number of bird species that show that birds are little affected by artificially-produced noises, airplanes and sonic booms. "It was reported that to scare birds a noise level of approximately 85 dB SPI at the bird's ear was required" (1971: 36)
The two reports cite many examples of research dealing with behavior and reproduction in relation to both airplanes and construction noises.

In Hawaii, Berger (1973), in writing about the Hawaiian stilt, said that, "all of the bird species that inhabit Kanaha Pond ignore automobile traffic on the highway as well as airplanes that fly over the Pond." Kridler (in Doty, 1962), also writing about Kanaha Pond, reported that "we did not notice one instance when planes frightened ducks or any other waterbird into flight."

Finally, speaking on behalf of the Board of Land and Natural Resources in testimony before the State Senate Committee on Ecology, Environment and Recreation on

February 10, 1976, Mr. Ronald L. Walker of the State Division of Forestry and Wildlife said:

> *Contrary to commonly held opinion that resident and migratory waterbirds do not adapt well to habitat subjected to human disturbance, it has been our experience that the Hawaiian stilt and migratory shorebirds and waterfowl are highly tolerant of human activities in the vicinity of their feeding and resting areas. This has been demonstrated not only at Paiko Lagoon...but at Ke'ehi Lagoon off the International Airport, which is subjected to daily disturbance by aircraft, motorboats, vehicles and recreationists on foot.*

However, low flying helicopters of tour companies have been reported to cause stress to the waterbirds at the Ki'i unit of the James Campbell Wildlife Refuge on the north shore of Oahu (Chang, 1988).

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MITIGATION ISLETS AND SAFE NESTING SITES

The significant point about the "mitigation" islets and the mud flats of Ke'ehi Lagoon is that although a greatly reduced number of stilts now use these areas for feeding and resting, they do not nest there. And, significantly, the critical factor for all the endangered Hawaiian waterbirds is the presence of safe nesting sites. The other Hawaiian waterbirds do not use Ke'ehi Lagoon and its islets and mud flats; they require a different type of habitat.

Hence, because of the absence of safe and appropriate nesting sites at Ke'ehi Lagoon, the Waiawa NWR in Middle Loch and the Honouliuli NWR in West Loch of

Pearl Harbor assume a major habitat for providing safe nesting habitat for the endangered Hawaiian waterbirds. Mr. Steve Berendzen, Refuge Manager for the Pearl Harbor National Wildlife Refuge, told me (September 14, 1987) that all four of the endangered Hawaiian waterbirds have nested there.

Both the Waiawa and Honouliuli units are of special importance for the Hawaiian stilt. These protected areas are critical for the waterbirds because of the safe nesting sites and because recreationists are excluded. The latter is important because, although waterbirds and migrant shorebirds are not seriously affected by noise or by people when they are feeding or resting, nesting birds are greatly disturbed by the presence of people.

BIRD SURVEYS MARCH, APRIL AND MAY, 1989

Tables 1, 2, 3 and 4 present the results of the waterbird surveys during this three month period. Only five species of wintering shorebirds were recorded plus the native black-crowned night heron (*Nycticorax n. hoactli*). Not a single Hawaiian stilt was seen during the surveys at low tide or high tide. Comparison with Table 5 and 6 from Berger and Walker (1976) clearly demonstrates the drastic decline in number of birds using the mud flats at low tide. Table 7 from Walker (1978) shows a continual decrease in the numbers of waterbirds using the lagoon.

No accidental visitors or stragglers were seen during the three month period. Table 8 (from Berger, 1988) tabulates the stragglers that have been recorded at or near Ke'ehi Lagoon during the past 20 years.

SEASONAL CHANGES IN MIGRANT SHOREBIRD POPULATIONS

More than 25 species of ducks and shorebirds spend their winter season in the Hawaiian Islands. These include such birds as the pintail duck (*Anas acuta*), greater scaup

Table 1
Numbers of Shorebirds Seen at Ke'ehi Lagoon, March - May 1989

	DATE 3/14	3/27	4/3	4/17	5/24	5/2
	TIDE Low	High	Low	High	Low	High
Golden plover	82	0	263	0*	52	4**
Ruddy turnstone	35	6	90	0	0	0
Sanderling	19	0	18	0	0	0
Wandering tattler	6	0	6	0	0	0
Night heron	1	1	0	0	0	0

* 12 plovers resting on small barge covered with astroturf.
** Birds in flight over the lagoon.

Table 2
Numbers of Birds Seen at the Mokuo'eo Mudflats, March - May 1989

	DATE 3/14	3/27	4/3	4/17	5/24	5/2
	TIDE Low	High	Low	High	Low	High
Golden plover	6	0	41	2	26	0
Ruddy turnstone	12	2	10	0	0	0
Sanderling	10	0	1	0	0	0
Wandering tattler	1	1	0	1	0	0
Night heron	1	1	0	0	0	0

Table 3
Numbers of Birds Seen at the Mokauea Mudflats, March - May 1989

	DATE 3/14	3/27	4/3	4/17	5/24	5/2
	TIDE Low	High	Low	High	Low	High
Golden plover	55	0	48	0	8	0*
Ruddy turnstone	13	0	9	0	0	0
Sanderling	0	0	7	0	0	0
Wandering tattler	6	0	0	0	0	0
Night heron	0	0	0	0	0	0

* One plover in flight over the edge of the islet.

Table 4
Numbers of Birds Seen at the "Mud Triangle" Mudflats, March - May 1989

	DATE 3/14	3/27	4/3	4/17	5/24	5/2
	TIDE Low	High	Low	High	Low	High
Golden plover	21	0	174	0	18	3*
Ruddy turnstone	10	4	71	0	0	0
Sanderling	9	3	10	0	0	0
Wandering tattler	0	0	6	0	0	0
Night heron	0	0	0	0	0	0

* Three plovers flew off the small islet nearest to Reef Runway.

Table 5
Maximum and Average Total Number Seen, All Species, On Stations By Quarter
(From Berger and Walker, 1976)
Ke'ehi Lagoon, Oahu, Hawaii, 1971-1976*

	1st Quarter (January)		2nd Quarter (April)		3rd Quarter (July)		4th Quarter (October)	
Year	Max.	Ave.	Max.	Ave.	Max.	Ave.	Max.	Ave.
1971	780	454	586	338	***	***	777	691
1973	**	**	**	**	**	**	549	376
1974	744	434	559	283	430	207	656	376
1975	622	407	634	308	130	101	503	357
1976	442	292	388	228	326	145	**	**

* No censuses made in 1972
** No censuses made
*** No comparable data

Table 6
Maximum Number Seen, Selected Species on Stations Ke'ehi Lagoon, Oahu, Hawaii
January 1, 1971 - August 12, 1976
(From Berger and Walker, 1972)

	Maximum # Seen On Single Station		Year		Maximum # Seen On Single Station	
Species	Station	# Seen	Date	# Stations	# Seen	Date
	2	105	12-11-71	4	114	10-16-71
	13	93	10-06-73	4	124	10-06-73
Stilt	16	87	8-02-74	8	116	8-02-74
	14	68	10-14-75	3	85	10-14-75
	13	52	8-05-76	3	55	7-28-76
	19	192	2-14-71	11	385	2-14-71
	22	46	10-08-73	12	153	10-08-73
Plover	13	82	1-05-74	10	235	1-05-74
	2	82	1-18-75	12	217	1-20-75
	2	44	1-07-76	8	115	1-25-76
	22	138	4-10-71	6	268	2-28-71
	15	56	10-22-73	4	110	10-06-73
Sanderling	2	144	1-05-74	2	211	4-17-74
	18	132	4-21-75	4	175	1-16-75
	18	108	4-22-76	3	157	4-22-76
	22	206	10-30-71	8	422	2-28-71
	22	135	10-06-73	11	229	10-08-73
Turnstone	18	176	10-16-74	8	311	10-16-74
	18	318	4-04-75	7	381	4-04-75
	18	248	1-04-76	2	252	1-04-76
	13	16	1-30-71	5	30	1-30-71
	13	5	10-06-73	7	14	10-08-73
Tattler	18	17	4-30-74	3	19	4-30-74
	18	22	4-18-75	5	26	4-18-75
	15	8	4-09-76	5	17	4-09-76

Table 7
Maximum Number Seen, Selected Species on Stations Ke'ehi Lagoon, Oahu, Hawaii
January 1, 1971 - November 8, 1978
(From Walker, 1978)

	Maximum # Seen On Single Station		Year		Maximum # Seen On Single Station	
Species	Station	# Seen	Date	# Stations	# Seen	Date
	2	105	12-11-71	4	114	10-16-71
	13	93	10-06-73	4	124	10-06-73
Stilt	16	87	8-02-74	8	116	8-02-74
	14	68	10-14-75	3	85	10-14-75
	13	52	8-05-76	3	55	7-28-76
	15	22	2-25-78	3	33	2-19-78
	19	192	2-14-71	11	385	2-14-71
	22	46	10-08-73	12	153	10-08-73
Plover	13	82	1-05-74	10	235	1-05-74
	2	82	1-18-75	12	217	1-20-75
	2	44	1-07-76	8	115	1-25-76
	18	37	10-01-78	6	69	10-14-78
	22	138	4-10-71	6	268	2-28-71
	15	56	10-22-73	4	110	10-06-73
Sanderling	2	144	1-05-74	2	211	4-17-74
	18	132	4-21-75	4	175	1-16-75
	18	108	4-22-76	3	157	4-22-76
	2	28	2-19-78	5	60	2-04-78
	22	206	10-30-71	8	422	2-28-71
	22	135	10-06-73	11	229	10-08-73
Turnstone	18	176	10-16-74	8	311	10-16-74
	18	318	4-04-75	7	381	4-04-75
	18	248	1-04-76	2	252	1-04-76
	18	97	10-01-78	5	136	10-01-78
	13	16	1-30-71	5	30	1-30-71
	13	5	10-06-73	7	14	10-08-73
Tattler	18	17	4-30-74	3	19	4-30-74
	18	22	4-18-75	5	26	4-18-75
	15	8	4-09-76	5	17	4-09-76
	15	6	10-22-78	7	15	10-22-78

Table 8
Stragglers Reported at Ke'ehi Lagoon, Fort Kamehameha, and the Pearl Harbor National Wildlife Refuges
(From Berger, 1988)

Order Ciconiiformes
Family Ardeidae
1. Great Blue Heron, *Ardea herodias*
Order Anseriformes
Family Anatidae
2. Black Brant, *Branta nigricans*
3. Bufflehead, *Bucephala albeola*
Order Falconiformes
4. Osprey, *Pandion haliaetus*
Order Charadriiformes
Family Scolopacidae
5. Whimbrel, *Numenius phaeopus*
6. Lesser Yellowlegs, *Tringa flavipes*
7. Willet, *Catoptrophorus semipalmatus*
8. Spotted Sandpiper, *Actitis macularia*
9. Long-billed Dowitcher, *Limnodromus scolopaceus*
10. Western Sandpiper, *Calidris mauri*
11. Little Stint, *Calidris minuta*
12. Roufous-necked Stint, *Calidris ruficollis*
13. Least Sandpiper, *Calidris minutilla*
14. Baird's Sandpiper, *Calidris bairdii*
15. Pectoral Sandpiper, *Calidris melanotos*
16. Dunlin, *Calidris alpina*
17. Buff-breasted Sandpiper, *Tryngites subruficollis*
18. Ruff, *Philomachus pugnax*
Family Charadriidae
19. Semipalmated Plover, *Charadrius semipalmatus*
Family Phalropodidae
20. Northern Phalarope, *Lobipes lobatus*
Family Laridae
21. Glaucous Gull, *Larus hyperboreus*
22. Western Gull, *Larus occidentalis*
23. Herring gull, *Larus argentatus*
24. California gull, *Larus californicus*
25. Ring-billed Gull, *Larus delawarensis*
26. Francolin's Gull, *Larus pipixcan*
27. Bonparte's Gull, *Larus philadelphia*
28. Arctic Tern, *Sterna paradisaea*
29. Least Tern, *Sterna albifrons*
30. Black Tern, *Chlidonias niger*

[Based on: Berger (1981), Berger and Walker (1976), Clapp (1975), David (1988), Pratt (1987, 1988), Pyle (1988), Walker (1978)]

(*Aytha marila*), wandering tattler (*Heteroscelus incanus*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), and the lesser golden plover (*Pluvialis dominica fulva*). Nearly all of these species spend their time on freshwater or brackish pond, along the seashore and reef flats, or along mountain streams.

Seasonal changes in abundance of the migratory shorebirds are very obvious. During the summer months, typically none of these species is present in the Hawaiian Islands. An occasional bird does sometimes fail to migrate and, therefore, remains in the islands for the summer period. The reason for this failure to migrate is unknown.

The first golden plovers, turnstones, sanderlings, tattlers and ducks arrive in the Islands during August. For the plovers at least, the adult birds arrive several weeks to a month ahead of the young birds of the year. The numbers of returning birds increases considerably in September.

The lesser golden plover occurs from sealevel to tree line on Maui and Hawai'i. These birds winter on lawns in residential areas, the lawn around the State Capital, golf courses, weedy pastures, cane haul roads, open areas in the mountains, and reef flats along the shore. Johnson *et al.* (1981) studied the wintering of plovers on Oahu. They reported that the birds begin to arrive in Hawaii beginning in August, but that the juvenile birds hatched that year did not arrive until late September. They found that the wintering population was composed of territorial and non-territorial birds in approximately equal numbers. Each of the territorial birds "reoccupied the same territory it had defended previously."

Johnson and Nakamura (1981) also studied the roosting behavior of plovers on the flat roofs of buildings on Oahu. At the Pacific Palisades Elementary School in Honolulu,

they found 125 plovers roosting on the roof at 2230 on April 17, 1980.

Some of these migrants leave the Hawaiian Islands for Alaska or Siberia during April. According to Berger (1981),

> *Studies by personnel of the State Division of Forestry and Wildlife have shown that from 80 to 90 percent of all wintering golden plovers leave for the breeding grounds by May 2.*

There is no information on whether the golden plovers that winter in the Hawaiian Islands nest in Siberia or Alaska. Oscar Johnson and Phillip Bruner are attempting to answer this question by color-banding and by using a yellow dye on white feathers of golden plovers in Hawaii in the hope that biologists in Siberia and Alaska will find some of these birds during the breeding season of 1989 and later years (*Elepaio*, 1989, 49:31).

SUMMARY AND CONCLUSIONS

Because of the impressive amount of data available on the waterbirds of the Ke'ehi Lagoon region from 1970 to 1989, I find it difficult to summarize this report. That is, I do not understand what any additional information would add to what is already known about these shorebirds. Nor do I understand what legitimate objection could be made to any changes that are contemplated. Any changes would have absolutely no detrimental effect on any of the wintering shorebirds or on the Hawaiian stilt.

1. Neither at high tide nor low tide did I find any shorebirds along the edges of the lagoon that extends to Nimitz Highway and the entrance into the lagoon of Moanalua Stream and Kalihi Stream. The water apparently is too deep and there is too much dense vegetation along much of the margins of the lagoon to provide suitable habitat for the shorebirds. On April 3 (low tide),

I found 16 golden plovers feeding on the lawn of Ke'ehi Lagoon Park, but I did not find any there on my other field surveys.

2. The islets and mudflats at low tide of Ke'ehi Lagoon are of no importance for most of the endangered Hawaiian waterbirds. There is no suitable habitat there for them. Only the Hawaiian stilt occasionally forages for food and rests there, but there has been a great reduction in the use of these mudflats by the stilt since the construction of the Reef Runway, and I did not see any birds during the March to May, 1989 surveys. I know of no records of the stilt ever nesting on the islets of Ke'ehi Lagoon. The "Mudflat Triangle" between Seaplane Runways A & B is now of no importance for the endangered Hawaiian stilt. The mudflats at low tide now are used extensively by the migrant shorebirds, but when these species return to Hawaii in August and September, they go to areas that are suitable for feeding and resting. If the mudflat triangle is not there when they return, they will find other areas.
3. The "mitigation" areas provided for the waterbirds by the Pearl Harbor National Wildlife Refuge are serving very well for nearly all of these endangered Hawaiian waterbirds for feeding, resting and for providing safe nesting sites. Three mitigation areas have been proposed by the State Department of Land and Natural Resources. All would benefit both the endangered Hawaiian waterbirds and the migrant shorebirds. The Division of Forestry and Wildlife believes that the Poohala wetlands would be especially valuable for these waterbirds. These wetlands are in the Pearl Harbor area, and the land is owned by the State, although now on lease to

the city. The Division of Forestry and Wildlife and the Hawaiian Waterbirds Recovery Plan have proposed two other areas as "Primary Habitats" that should be developed for the welfare of Hawaiian waterbirds: Ukoa Marsh and Heeia Marsh. Both would provide excellent habitat for the migrant shorebirds as well.

4. The mudflats at low tide at Ke'ehi Lagoon are used by a variety of migratory shorebirds for feeding and resting. These birds are little affected by jet skiers, motorboats, airplanes or fishermen. Migratory ducks and geese now apparently avoid the lagoon area , however, primarily because it does not provide adequate habitat for them. The still unanswered question is: Where do the migrant shorebirds go during periods of high tide when they are gone from Ke'ehi Lagoon? This is the period when the mud flats are covered by water too deep for the birds to forage for food or to rest.

5. Some 30 species of "stragglers" or "chance arrivals" have been recorded in the vicinity of Ke'ehi Lagoon (Table 8). They are only of academic interest.

6. The black-crowned night heron is classified as a subspecies which has a breeding range that includes Hawaii and the Western Hemisphere, extending from Washington and Oregon southward to northern Chile and south central Argentina. Because the Hawaiian birds are classified as the same subspecies as the mainland birds, the birds are not considered to be endangered in Hawaii. The future of this subspecies in Hawaii does depend on the preservation of suitable wetland habitat that is essential for the endangered endemic Hawaiian waterbirds. Heron inhabit marshes, swamps, rivers and

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streams. They feed on a wide variety of aquatic and terrestrial life, e.g., fish, frogs, crayfish, mice and insects. In Hawaii, however, this heron is also known to eat the downy young of seabirds and endangered endemic waterbirds. They also relish prawns and the State Land Board gave prawn producers a 120-day permit "to destroy black-crowned night herons 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). Consequently, although these herons sometimes feed at Ke'ehi Lagoon, their presence there is irrelevant to any impact assessment.

7. Therefore, to be brief, I assert positively that there is no legitimate biological reason for objecting to any changes, including construction, around the margins of Ke'ehi Lagoon. The only proviso would be that contamination of the water by oil and other chemicals should be avoided.

The lagoon was dredged many years ago for seaplane use and others since then, so there can be no legitimate assertion that there is anything close to an endemic, undisturbed marine environment in the lagoon.

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APPENDIX D

Marine Environmental Impacts of Implementation of the Ke'ehi Lagoon Recreation Plan

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MARINE ENVIRONMENTAL IMPACTS
OF IMPLEMENTATION OF THE
KE'EHI LAGOON RECREATION PLAN

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May 1989

Marine Environmental Impacts of Implementation of the Ke'ehi Lagoon Recreation Plan

Project Location: Ke'ehi Lagoon is situated on the south shore of Oahu between Honolulu International Airport and Honolulu Harbor. Mauka of a line drawn between the Reef Runway and Sand Island shorelines, the water area within the lagoon encompasses about 2.12 square miles (1,360 acres). The lagoon is a sheltered triangle-shaped body of water bordered by shallow fringing reef flats to the south, Honolulu International Airport to the west, and the Kalihi Kai and Sand Island industrial areas to the east. The lagoon and all of the perimeter shoreline areas are under the jurisdiction of the State of Hawaii.

Project Improvements: Five primary improvement activities are planned for Ke'ehi Lagoon under the Ke'ehi Lagoon Recreation Plan Update.

1. Hawaiian Canoe Center recreational and commercial improvements in the northeast corner of the lagoon at the mouth of Kalihi Stream. The basic recreational portion of this project consists of minor filling to straighten the shoreline on both sides of the race course; ramps for staging and launching of canoes; viewing stands; canoe storage areas; public and canoe trailer parking; a comfort station; and improved access to the Kalihi Kai shoreline. Minor dredging near the shore and towards the mouths of Moanalua and Kalihi streams may be required to provide sufficient water depths. Commercial, recreational and cultural and educational activities are planned for the land area

between Moanalua and Kalihi Streams and Nimitz Highway.

2. Pier 60 Marina located off Sand Island Access Road adjacent to La Mariana Sailing Club. Pier 60 is an existing barge dock used to offload sand and gravel. The conceptual plan for the Pier 60 improvements includes about 185 slips with an average slip size of 42 feet. Other possible activities may include a boat building/repair yard, marine supply store, snack bar/restaurant, boat dry storage racks, and other related facilities. Water depths in the barge basin average 20-30 feet, sufficient for the planned recreational boating needs. Pier 60 currently consists of an approximately 450 foot long lowlying bulkhead earthfill dock. New stabilization may be required, as well as improved stabilization for an additional 300 feet of shore frontage. Three existing fuel oil pipeline easements cross the waterside portion of the area. For this reason, floating piers and slips will be the preferred type of construction for the boat berths. No live aboards will be permitted within the marina, and sewage pump-out facilities will be provided.

3. Lagoon Drive Marina located along Lagoon Drive adjacent to the Honolulu International Airport South Ramp area. To meet the present demand for boat slips, the conceptual plan for this area includes a marina with accommodations for approximately 680 boats with an average slip size of 42 feet. At present, only a narrow strip of shoreline exists between Lagoon Drive and the water. Major filling of about 300 feet of shoreline extension into the

seaplane runway will be required to provide adequate back-up space for parking, harbor support facilities and ancillary facilities. This development includes a ferry transit terminal that will be part of the intra-island ferry system. Water depth in the seaplane runway within the limits of the proposed development exceeds 12 feet, which is sufficient for recreational small craft; thus, no dredging will be required for this marina development. No live aboards will be permitted within the marina, and sewage pump-out facilities will be provided.

4. Triangle Development located in the approximately 300 acre central triangle portion of the lagoon bordered by the former seaplane runways. The mixed use development will consist of an approximately 350 slip marina, parks, yacht race/ocean sports complex, maritime commercial facilities, industrial/commercial space, and the proposed relocation of the University of Hawaii Marine Expeditionary Center (Snug Harbor). Land reclamation for the Triangle Development will require major filling of the shallow reef and mud flats in the center of the lagoon to create up to 250 acres of fast lands. Dredging will be required to provide sufficient water depths within the berthing basin as well as within the southern seaplane runway to accommodate the University of Hawaii oceanographic research vessels. Approximately 3.8 million cubic yards of fill material will be required, and approximately 2.2 million cubic yards of dredging will be required. The dredge spoils can be used to fulfill part of the fill material requirements, but an additional 1.6 million

cubic yards of fill material from off site would be needed.

5. Sheltered Swimming Beach adjacent to Sand Island State Park at the southwest tip of Sand Island. The conceptual plan for this area calls for a 1,000 foot long, 150 foot wide beach protected by a shore-connected breakwater. The breakwater would be constructed at the reef edge, with beach sand placed on the lagoon side of the breakwater. Minor dredging of the reef flat in front of the beach will be necessary to provide adequate water depth for swimming.

Marine Impacts: Impacts of the proposed development activities on the Ke'ehi Lagoon marine environment will be of two types: direct impacts of dredging, filling and construction; indirect impacts as the result of alterations in existing water flow patterns and residence times, and alterations in land use patterns.

Impacts to Marine Biota: Direct impacts of development on the benthic and fish communities of Ke'ehi Lagoon appear likely to be minimal. Dredging activities result in marine impacts primarily through removal of substrate and infaunal and attached sessile organisms, while filling results in the covering over of existing communities. Most of the Ke'ehi Lagoon area has been previously dredged, either in construction of the seaplane runways or in association with the construction of the Reef Runway. Surveys (OI Consultants, 1988) of the benthic communities in areas proposed for dredging and/or filling found sparse populations of

organisms, primarily common species of macroalgae, invertebrates (infaunal polychaete worms and crustaceans) and fish. Individual coral heads are found only along the southern side of the triangular reef flat. Proposed dredge activities would remove material primarily from areas dredged in the past. Organisms inhabiting these areas typically are motile and able to avoid construction disturbances, or are common throughout the soft bottom areas of the lagoon and rapidly repopulate new substrate. Areas to be filled are also those dredged in the past, or the shallow triangular reef flat. The reef flat contains only scattered macroalgal growths, with some common burrowing crustaceans (crabs, mantis shrimp); fish are scarce and primarily shallow muddy bottom species (eleotrids, blennies and gobies). None of the areas to be dredged or filled comprise unique habitat or contain rare, threatened or endangered marine species.

Lagoon Water Quality and Circulation: Water quality within Ke'ehi Lagoon is not projected to be permanently degraded as the result of the proposed development activities. Some temporary degradation of water clarity can be expected as the result of the dredge and fill operations, but such degradation will be temporary and rapidly dispersed. Mitigation of such degradation may be achieved by utilizing temporary silt curtains. The planned triangular reef flat development will not significantly alter the current patterns within the lagoon (EKNA, 1989), and the presence of the Lagoon Drive and reef flat marinas, while restricting the width of the seaplane runway fronting Lagoon

Drive, will not significantly alter the volume flows. The marina management calls for restrictions on live aboard boats, and includes sewage pump out stations at each marina; increased bacteriological levels in marina waters, as has been observed in other marinas around the state, should therefore not be a concern in Ke'ehi Lagoon.

Water quality parameter levels in any area are the result of the dynamic processes of supply from run-off and stream input, flushing by tidal and wind-driven flows, sedimentation, and biological activity. During surveys of the water quality of Ke'ehi Lagoon (OIC 1986; 1988) only the area of the proposed canoe racing site was found to have water quality levels in excess of those presented in the State water quality regulations, and this only for levels of turbidity. These high levels are the result of constant influx of terrigenous material from Moanalua and Kalihi streams and the long residence time (slow flushing rate) of the area. Areas downstream of the racing site generally exhibited turbidity levels within the standard criteria.

Volume flows through the channels of Ke'ehi Lagoon will be altered by the proposed construction, but not adversely. The daily flow through each of nine areas of the lagoon under normal trade wind conditions, before and after proposed construction, are presented below. Residence times (the time an average particle of water remains within each area, calculated as volume/volume flow) are also presented for pre- and post-construction conditions.

Table 1. Volume flow and residence time for nine sections of Ke'ehi Lagoon under normal trade wind conditions, before and after proposed Ke'ehi Lagoon Recreational Plan construction.

	Pre-Construction		Post-Construction	
	Daily Volume Flow (10^6 cu ft)	Residence Time (day)	Daily Volume Flow (10^6 cu ft)	Residence Time (day)
1. Seaplane Runway D	744	0.20	602	0.25
2. Sand Island	415	0.09	100	0.39
3. Kalihi Channel	515	0.10	247	0.22
4. Circulation Channel	718	0.08	476	0.13
5. Ssaplane Runway B	260	0.17	368	0.12
6. Reef Runway	306	0.35	144	0.75
7. Keehi Marine	246	0.25	189	0.30
8. Seaplane Runway A	282	0.29	150	0.18
9. Kalihi Stream	5	8.04	5	8.04

The nine sections for which daily flows and residence times were calculated are shown in Figure 1. The volume flow data were obtained from the results of the numerical circulation model described in Appendix G.

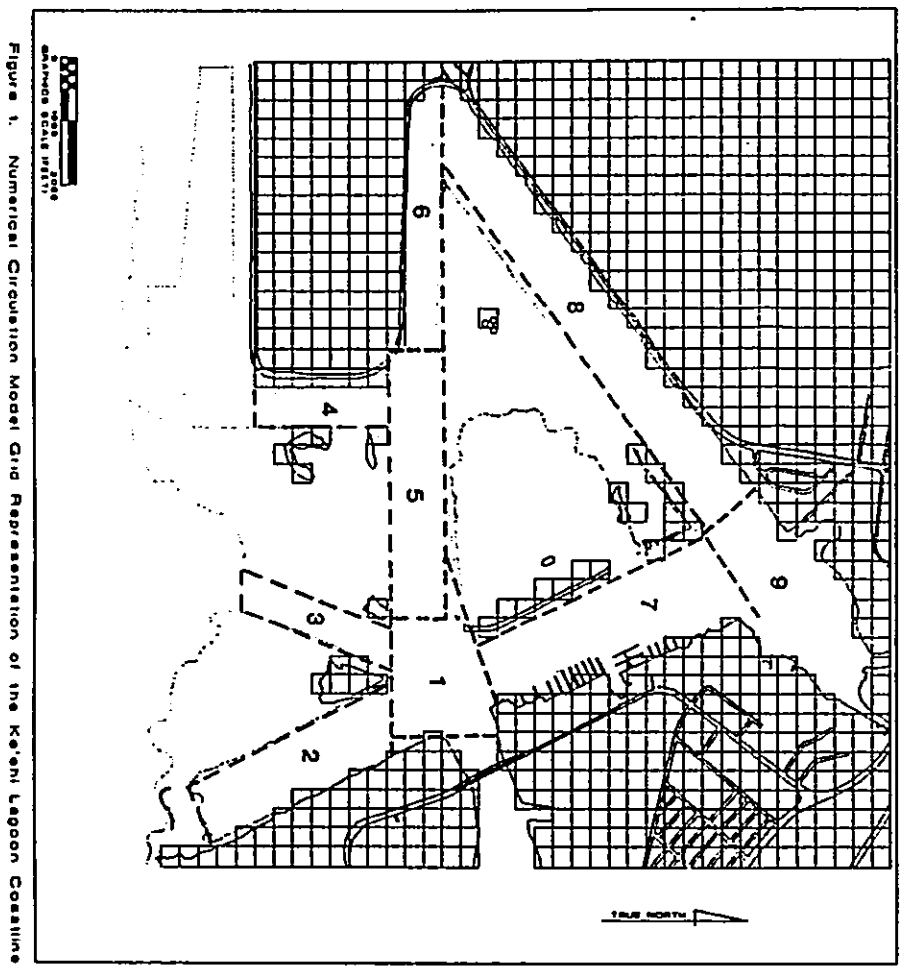

Figure 1. Numerical Circulation Model Grid Representation of the Ke'ehi Lagoon Coastline Sectional Areas for Calculation of Residence Time

In general, the changes in circulation result in a more direct discharge of water exiting Honolulu Harbor through the Kalihi Channel to the ocean. Some decrease in flow is projected for the channel fronting Sand Island, the result of the beach breakwater. Post-construction residence times for that area are still projected to be short enough that no water quality problems are likely to arise.

Terrestrial Flora and Fauna: The development of the triangular reef flat will result in the loss of feeding and resting habitat for the endangered Hawaiian stilt and for several species of migratory water shorebirds. However, the predominant Hawaiian stilt habitat is that of the Pearl Harbor National Wildlife Refuge; Ke'ehi Lagoon has not been an important part of the stilt habitat since the completion of the reef runway. Surveys of bird populations in and around Ke'ehi Lagoon have been taken at both high and low tides during winter, spring and summer seasons of 1988 and 1989 (OIC, 1988; 1989); no stilt were observed during any of these surveys.

APPENDIX E

Traffic Impact Study

KE'EHI LAGOON RECREATION PLAN
TRAFFIC IMPACT STUDY

Prepared for

Wilson Okamoto & Associates

Prepared by

Wilbur Smith Associates

May 23, 1989

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ILLUSTRATIONS

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SUMMARY

The Ke'ehi Lagoon Recreation Plan encompasses a number of projects located along the shoreline and within the central triangle area of the lagoon. The Recreation Plan includes the following projects:

- o A Hawaiian Canoe Center, including expansion of facilities to accommodate canoe races;
- o Pier 60 marina with approximately 200 boat slips;
- o Lagoon Drive Marina with approximately 700 boat slips; and
- o Mid-lagoon Triangle mixed-use development with a 300-berth marina, parks, Yacht Race/Ocean Sports complex, maritime commercial facilities, relocated Snug Harbor facility, and a light industrial-commercial area of approximately 120 acres.

Full development and occupancy of the projects could occur by the Year 1998, which is used as the analysis year for this traffic impact study.

Access to the Triangle area and Lagoon Drive Marina is planned from Lagoon Drive; access to the Hawaiian Canoe Center, expanded canoe race spectator area, and Pier 60 Marina is planned from Sand Island Access Road.

Existing Conditions

The heavily-travelled Nimitz Highway currently experiences congested traffic conditions during the weekday peak commute

periods. Particular problem locations are the intersections with Waiakamilo Road, Kalihi Street, and Sand Island Access Road. The Nimitz Highway-Lagoon Drive intersection currently operates at acceptable service levels, with the exception that the capacity constraint at the downstream bottleneck (generally Waiakamilo Road) stacks traffic back to and through this intersection during the morning peak hour.

Weekend peak traffic volumes amount to only 50 to 70 percent of weekday peak hour volumes, with free flow traffic conditions continuing throughout the day.

Future Without the Ke'ehi Lagoon Project

Traffic volumes are expected to increase on Ke'ehi Lagoon area roadways as a result of continued growth of Airport and harbor-related activities, as well as travel through the area on Nimitz Highway. The expansion of facilities in the Airport's South Ramp area along Lagoon Drive and the construction of the City Corporation Yard facility on Sand Island will both affect traffic conditions on area roadways. Peak hour traffic volumes by 1998, without the Ke'ehi Lagoon recreation projects, are expected to increase by about 15 percent on Nimitz Highway and by 20 to 30 percent on other Airport and Kalihi Kai area streets.

The State Department of Transportation (State DOT) plans to implement a series of intersection improvements along Nimitz Highway, and construct a two-lane viaduct above Nimitz Highway for high occupancy vehicles (HOVs). These roadway projects will provide additional capacity to accommodate much of the anticipated traffic growth over the next 10 years, particularly at the current "bottleneck" location along Nimitz Highway at Waiakamilo Road.

At most intersections along Nimitz Highway, and along Lagoon Drive and Sand Island Access Road, traffic conditions are expected to continue deteriorating from current levels.

Project Traffic Increases and Impacts

The estimates of vehicle trips generated by the Triangle area are based on the very general description of the development land uses available at this point of the planning process. The traffic estimated for the large Triangle commercial-industrial area are based on use of vehicle trip generation rates typical of light industrial uses.

On a weekday, an estimated 17,900 vehicles would enter or exit the projects. For a Saturday with a major canoe regatta, the estimated vehicle trips total 21,000 including an estimated 1,350 vehicles travelling to and an equal number leaving the canoe race event. Peak hour vehicle trips are estimated as:

PEAK HOUR	VEHICLES ENTERING PROJECT	VEHICLES EXITING PROJECT
Weekday Morning	1,350	320
Weekday Afternoon	610	1,570
Saturday Afternoon with Canoe Race Regatta	1,000	1,980

On weekdays, approximately 95 percent of the peak hour trips would use Lagoon Drive to reach the project sites. On Saturday, approximately 75 percent would use Lagoon Drive and 25 percent would use Sand Island Access Road.

The project traffic would significantly increase travel along Lagoon Drive and Aolele Street. Representative weekday afternoon peak hour increases are:

LOCATION	1998 VOLUME WITHOUT PROJECT	PROJECT TRAFFIC	TOTAL
Lagoon Drive			
Makai of Nimitz Highway	2,650	1,080	3,730
Makai of Aolele Street	1,330	1,960	3,290
Aolele Street	1,270	830	2,100
Nimitz Highway			
Diamond Head of Lagoon Dr.	4,770	740	5,510
Diamond Head of Sand Island Access Rd.	6,490	320	6,810
Sand Island Access Road	2,260	180	2,440

The estimated peak hour traffic volumes would exceed the capacity of the Lagoon Drive intersections with Nimitz Highway and Aolele Street in both weekday peak hour periods, and would exceed the capacity of Aolele Street between Lagoon Drive and the H-1 Freeway ramps. The project traffic would slightly worsen conditions at the Nimitz Highway intersections in the Kalihi Kai area and at the Sand Island Access Road intersections with Auiki Street, all of which are expected to have peak hour volumes nearing or in excess of the intersection capacities by 1998.

Potential Mitigation Measures

Based on the assumptions and resultant analyses of this study, the following measures appear appropriate to mitigate the impacts of the Ke'ehi Lagoon projects:

- Triangle Bridge

  1. Provide a single bridge four lanes wide to Lagoon Drive to serve the anticipated intensity of development.

- Lagoon Drive - Nimitz Highway Intersection

  1. Add a second mauka direction right-turn lane.

  2. Add an additional makai direction through lane to the Puuloa Road leg.

- Lagoon Drive Intersections with Koapaka and Ualena Streets and Waiwai Loop

  1. Restrict the mauka end of Waiwai Loop to right-turn-in/right-turn-out movement.

  2. Prohibit left-turns from Koapaka Street.

  3. Remove parking on Ualena Street and makai leg of Waiwai Loop approaches to provide separate right-turns lanes.

  4. Remove parking from Lagoon Drive between Koapaka and Ualena Streets to improve traffic flow and provide right-turn lane to Ualena Street.

- Lagoon Drive Intersection with Aolele Street

  1. Install traffic signal.

  2. Add left-turn lanes to all four approaches.

- Aolele Street

  Widen to four lanes from Lagoon Drive to the H-1 Freeway ramps.

- Ohohia Street

  In the future, if the Triangle area is developed with high-activity uses, extend Ohohia Street makai to Aolele Street as an alternative to using Lagoon Drive to reach Aolele Street.

- Hoonee Place

  Provide police traffic control at the intersection with Sand Island Access road when major events are held at the Hawaiian Canoe Center facility or the canoe race course area.

The access requirements of the Triangle development should be studied in further detail as more specific information is available on the types and intensity of the uses for the 300-acre area.

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INTRODUCTION

The State of Hawaii Department of Transportation has prepared an update plan for the expansion of recreation-oriented facilities for the Ke'ehi Lagoon area. The update plan has been based on the legislative response to the Ke'ehi Lagoon Recreation Plan Update report.[1] The update plan encompasses the two square mile area of water and tidal flats within the lagoon; and the shoreline areas which extend from the South Ramp area of Honolulu International Airport on the ewa side of the lagoon to the Pier 60 area in the Kalihi Kai industrial area on the diamond head side of the lagoon.

The update plan includes facilities to accommodate a broad range of water-oriented recreation activities, and also incorporates areas for use by maritime and airport-oriented commercial uses. The major elements of the plan update, as depicted in Figure 1, are:

- Hawaiian Canoe Center recreation and commercial improvements in the northeast corner of Ke'ehi Lagoon, including expansion of facilities to accommodate canoe club races;
- Pier 60 Marina located off Sand Island Access Road adjacent to La Mariana Sailing Club;
- Lagoon Drive Marina located along Lagoon Drive adjacent to the Airport South Ramp area; and

[1] State of Hawaii, Department of Transportation, Harbors Division, Ke'ehi Lagoon Recreation Plan Update, Final Draft to Fourteenth State Legislature, by Edward K. Noda & Associates and Eugene P. Dashiell, December 1987.

- Triangle Development located in the central triangle land reclamation portion of the lagoon. This mixed use development will consist of a marina, parks, yacht race/ocean sports complex, maritime commercial facilities, industrial/commercial space, and the proposed relocation of the University of Hawaii Marine Expeditionary Center (Snug Harbor).

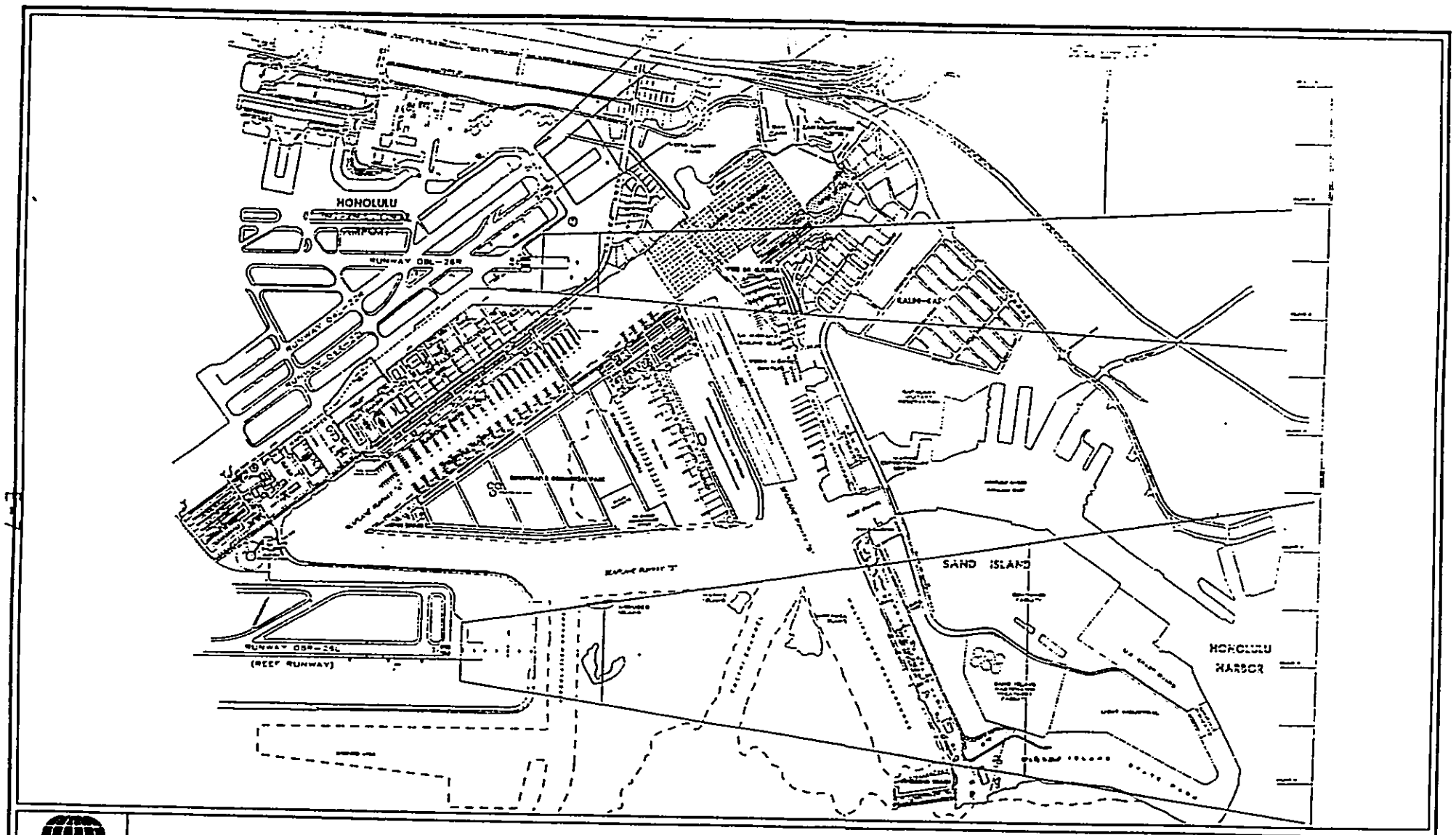
Figure 1 depicts the locations of these proposed major improvements within the lagoon.

Study Purpose and Scope

This report presents the findings of the transportation study conducted to evaluate the travel demands and traffic impacts of the proposed elements of the Ke'ehi Lagoon Recreation Plan. Descriptions of existing and future transportation facilities and conditions without the proposed recreation plan project are presented as a basis for identifying travel impacts and needs of the project.

An analysis of traffic increases and impacts on roadway conditions is included. The analysis of the impact on roadway conditions focuses on those key intersections located adjacent to or near the project area and which are likely to experience the largest increase in traffic volumes.

The location and sizing of proposed access to the project is evaluated relative to the estimated future travel demands associated with completion of all project elements. Where appropriate, measures are proposed to mitigate the impact of project traffic increases, or to improve access to the project.



WSA

PROPOSED MAJOR PROJECTS

Ke'ehi Lagoon Recreation Plan Traffic Impact Study

1

Key Analysis Assumptions

The impact analysis and proposed transportation improvements reflect several key inputs and assumptions. These include the following:

1. All elements of the Ke'ehi Lagoon Recreation Plan project will be completed and fully occupied by 1998, which is used as the future analysis year;

2. The development of the Airport's South Ramp project will be completed and fully occupied by 1998;

3. The development of the City and County of Honolulu's Corporation Yard on Sand Island will be completed and fully occupied by 1998;

4. Traffic growth from other developments will generally continue in line with the historical trends for the area; and

5. The State Department of Transportation's (State DOT) proposed intersection improvements along Nimitz Boulevard, from Puuhale Road to Waiakamilo Road, and the proposed Makai Boulevard viaduct roadway above Nimitz Highway will be completed and available for use by 1998. The State DOT is seeking to implement all of these improvements by 1998 to meet the increasing traffic needs in this congested travel corridor, although the State Legislature has not yet approved funding for all of these improvements, particularly the viaduct roadway.

EXISTING CONDITIONS

Ke'ehi Lagoon is located between the Honolulu International Airport and Honolulu Harbor areas. This location has resulted in a mix of recreational and industrial/commercial uses in or adjacent to the lagoon.

The Ke'ehi Lagoon Beach Park and the Disabled American Veterans Park recreational facilities are located at the north-east corner of the lagoon. Major canoe club race regattas are held several weekends each year offshore of the Ke'ehi Lagoon Beach Park.

Three marinas are located along the Kalihi Kai shoreline: La Mariana Sailing Club, Ke'ehi Marine Center, and Ke'ehi Small Boat Harbor. Additionally, several hundred small boats anchor in the shallow lagoon waters. These include some transient boats, but most are temporarily moored here while on waiting lists for berths at the adjacent Ke'ehi marinas or the Ala Wai marinas.

The remaining areas are occupied primarily by commercial/industrial uses. The ewa side of the lagoon includes the Airport South Ramp area which includes air cargo and general aviation activities, and the airport services area. The areas ewa of the Ke'ehi Lagoon Beach Park include industrial/warehousing/commercial areas along Waiwai Loop, Aolele Street, Ualena Street, and Koapaka Street. Many of these businesses have airport-oriented uses such as flight kitchens, freight forwarders, and rental car support facilities.

The Kalihi Kai and Sand Island areas are largely occupied by harbor-oriented uses, warehousing, construction industries, and government facilities. A mix of residential uses is also present in the Kalihi Kai area.

The areas on which the proposed projects will be developed are largely vacant or underutilized parcels in or adjacent to the industrial areas, or on proposed fill areas.

Existing Roadways

Regional access to the Ke'ehi Lagoon area is provided primarily by the Nimitz/Kamehameha Highway and by the H-1 Freeway. The project sites on the ewa side of the lagoon are connected to these regional arteries by Lagoon Drive, and those located on the diamond head side by the Sand Island Access Road. (See Figure 1.)

Nimitz Highway - The Nimitz Highway is the major arterial roadway providing east-west traffic movement adjacent to the Airport and Honolulu Harbor areas. This roadway provides an important link from these areas to the Downtown area, and its continuation as Ala Moana Boulevard extends eastward to serve the Kaka'ako, Ala Moana and Waikiki areas. To the west, the Nimitz Highway provides access to the Pearl Harbor complex of military installations, and connects to the Kamehameha Highway, which provides access to the Pearlridge, Central Oahu, and Ewa area communities. The H-1 Freeway is elevated above the Nimitz Highway near the Ke'ehi Lagoon.

The Nimitz Highway is a divided roadway, generally with three through lanes in each direction in the Ke'ehi Lagoon area. Between the Ke'ehi interchange with the H-1 Freeway and the Sand Island Access Road, the Nimitz Highway has four lanes in each direction. A one-way eastbound frontage road is provided to serve businesses along the makai side of the Nimitz Highway from the Airport terminal area to Lagoon Drive.

Traffic signal controls and exclusive left-turn lanes are provided at the major intersections. Within the Ke'ehi Lagoon adjacent areas, traffic signals are provided at Waiakamilo Road, Kalihi Street, Mokauea Street, Puuhale Road, Sand Island Access Road, Ahua Street, Lagoon Drive, Peltier Avenue, and Ohohia Street.

H-1 Freeway - The H-1 Freeway serves east-west traffic movement through the Central Honolulu area, and extends from the Kahala area to the east, to the Ko Olina-Makakilo area to the west. The freeway has from three to five lanes in each direction along the section adjacent to Ke'ehi Lagoon.

Access to/from the H-1 Freeway is provided via a number of on- and off-ramps located within the Airport or Ke'ehi interchanges. These include:

- Freeway access for the Lagoon Drive area to/from the west is provided by a special Airport interchange ramp connections to Aolele Street near the main terminal building;
- Freeway access for the Lagoon Drive area to/from the east is via the Ke'ehi interchange westbound off-ramp to and eastbound on-ramp from the Nimitz Highway;
- Freeway access to the Kalihi Kai area to/from the west is via the Ke'ehi interchange eastbound off-ramp to and westbound on-ramp from the Nimitz Highway; and
- Freeway access to the Kalihi Kai area to/from the east is via Kalihi Street, and Waiakamilo Road/Houghtailing Street, respectively.

Lagoon Drive - This major street provides access to the ewa side shoreline area of Ke'ehi Lagoon, the Airport South Ramp area, and the industrial/commercial area on the makai side of the Nimitz Highway. Lagoon Drive has two makai and three mauka direction lanes, separated by a raised median, between the Nimitz Highway and Aolele Street. Left-turn lanes are provided on Lagoon Drive at each cross street with the exception of the makai direction left-turn movements onto the mauka intersection of Waiwai Loop (opposite Koapaka Street) and the Ke'ehi Lagoon Beach Park road (opposite Aolele Street). A separate makai direction right-turn lane is provided at Aolele Street. Parking is permitted along the ewa side street curb between Koapaka and Ualena Streets.

Makai of Aolele Street, Lagoon Drive is a four-lane street to the vicinity of Mokuea where it narrows to two lanes. The median divider extends to just mauka of Iolana Place.

With the exception of the Nimitz Highway intersection, all intersections along Lagoon Drive have STOP-sign controls for the cross streets. The mauka bound approach left-turn lane on Lagoon Drive at Aolele Street is also controlled by a STOP sign.

Lagoon Drive extends mauka of the Nimitz Highway, as Puuloa Road, to the Moanalua Road freeway corridor. Puuloa Road is a two-lane roadway along the section mauka of the Nimitz Highway and widens to four lanes at the Salt Lake Boulevard intersection.

Because of the heavy volume of both through and turning traffic at the Nimitz Highway intersection, all four approaches have been widened to provide separate right- and left-turn lanes. Two left-turn lanes and special left-turn signal phases are provide on each Nimitz Highway approach. The Puuloa Road approach has a left-turn, a combination through/left-turn, a through, and a right-turn lane. The Lagoon Drive right-turn lane

onto the Nimitz Highway is a "free flow" movement that continues as an additional lane to the Waikiki turn-off of the Nimitz Highway at the Ke'ehi interchange.

Aolele Street - Aolele Street is a two-lane roadway connecting Lagoon Drive with the H-1 Freeway ramps and the Honolulu International Airport terminal complex. No driveway access is provided to the industrial uses along the mauka side of the street. Driveways are provided along the makai side to various Airport support functions and to the airside area for use by aircraft servicing vehicles and airport maintenance vehicles.

At Lagoon Drive, Aolele Street widens to provide a separate left-turn lane. The 24-foot wide driveway to the Ke'ehi Lagoon Beach Park parking areas intersects Lagoon Drive opposite Aolele Street.

Other Airport Area Streets - Koapaka and Ualena Streets and Waiwai Loop serve the industrial/commercial areas on either side of Lagoon Drive. Each is a two-way, 40-foot street with parking permitted along each curb.

Ohohia Street provides access for Koapaka and Ualena Streets to the Nimitz Highway, but does not extend through to Aolele Street. This is a 40-foot wide street with parking. At the Nimitz Highway, left-turn lanes are provided for turns onto or from Ohohia Street.

Sand Island Access Road - The Sand Island Access Road provides access to the Kalihi Kai area and to Sand Island. The roadway is currently a four-lane divided roadway from the Nimitz Highway to Auiki Street, with left-turn lanes provided at intersections and major driveways. Cross streets are STOP sign-controlled, with the exception of the traffic signal control at Auiki Street.

At the Nimitz Highway, double left-turn lanes are provided for the left-turn movements to and from the Sand Island Access Road to accommodate the heavy left-turn volumes.

Kalihi Street - Kalihi Street provides access from the Kalihi Kai area mauka to the Kalihi area, H-1 Freeway, and the Likelike Highway. The street is 56 feet wide with two lanes in each direction, plus parking along each curb, makai of the Nimitz Highway. Kalihi Street narrows to a two-lane roadway from the Nimitz Highway mauka to Dillingham Boulevard, where it widens to four lanes.

Waiakamilo Road - This roadway provides access to the Kalihi area mauka of the Nimitz Highway. Its intersection with the Nimitz Highway is currently a traffic "bottleneck" location. The Waiakamilo Road approach provides a combination left/through lane and a right-turn lane; the private roadway opposite Waiakamilo Road provides similar approach lanes.

Existing Traffic Volumes

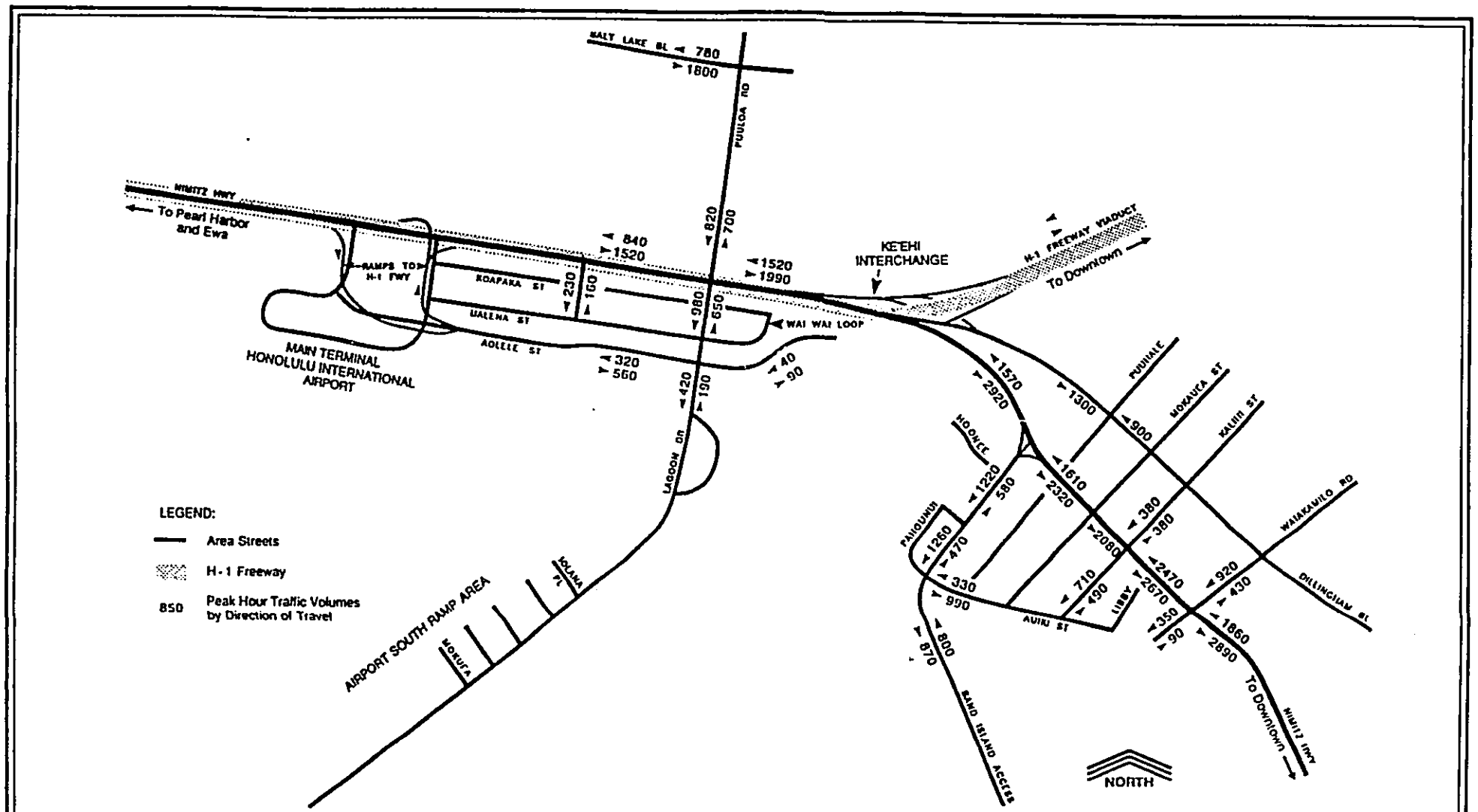
Current traffic volumes were estimated at most locations from previous traffic counts made by the State Department of Transportation, Wilson Okamoto & Associates, and Wilbur Smith Associates. These were supplemented, where necessary, by turning movement counts made by Wilbur Smith Associates, particularly for the weekday counts at the Lagoon Drive intersections and the Saturday counts at the Nimitz Highway intersections with Lagoon Drive and Sand Island Access Road.

Typical weekday traffic volumes on the major roadways in the vicinity of Ke'ehi Lagoon are as follows:

Nimitz Highway at Lagoon Drive	53,000
Nimitz Highway at Sand Island Access Road	52,000
Lagoon Drive, makai of the Nimitz Highway	27,000
Lagoon Drive, makai of Aolele Street	13,000
Aolele Street	13,000
Sand Island Access Road	22,000
Kalihi Street	13,000
Auiki Street	11,000
Ke'ehi Lagoon Beach Park Road	1,500

The weekday peak traffic periods on area streets extend from about 6:00 AM to 8:30 AM and 3:00 PM to 5:30 PM, with the maximum one-hour volumes typically occurring between 6:30 AM and 7:30 AM and 3:30 PM and 4:30 PM. The peak one-hour volume periods may vary by 15 to 30 minutes at different locations within the area and on different days. The present peak one-hour traffic volumes for the morning and afternoon periods are presented in Figures 2 and 3, respectively. Key features include the following:

1. Afternoon peak hour volumes are generally 10 to 20 percent larger than morning peak hour traffic volumes on most major streets in the area. The principal exceptions are the Kalihi Kai streets, where morning volumes equal or exceed afternoon volumes, and the portion of Lagoon Drive between the Nimitz Highway and



EXISTING MORNING PEAK HOUR TRAFFIC VOLUMES

Ke'ehi Lagoon Recreation Plan Traffic Impact Study

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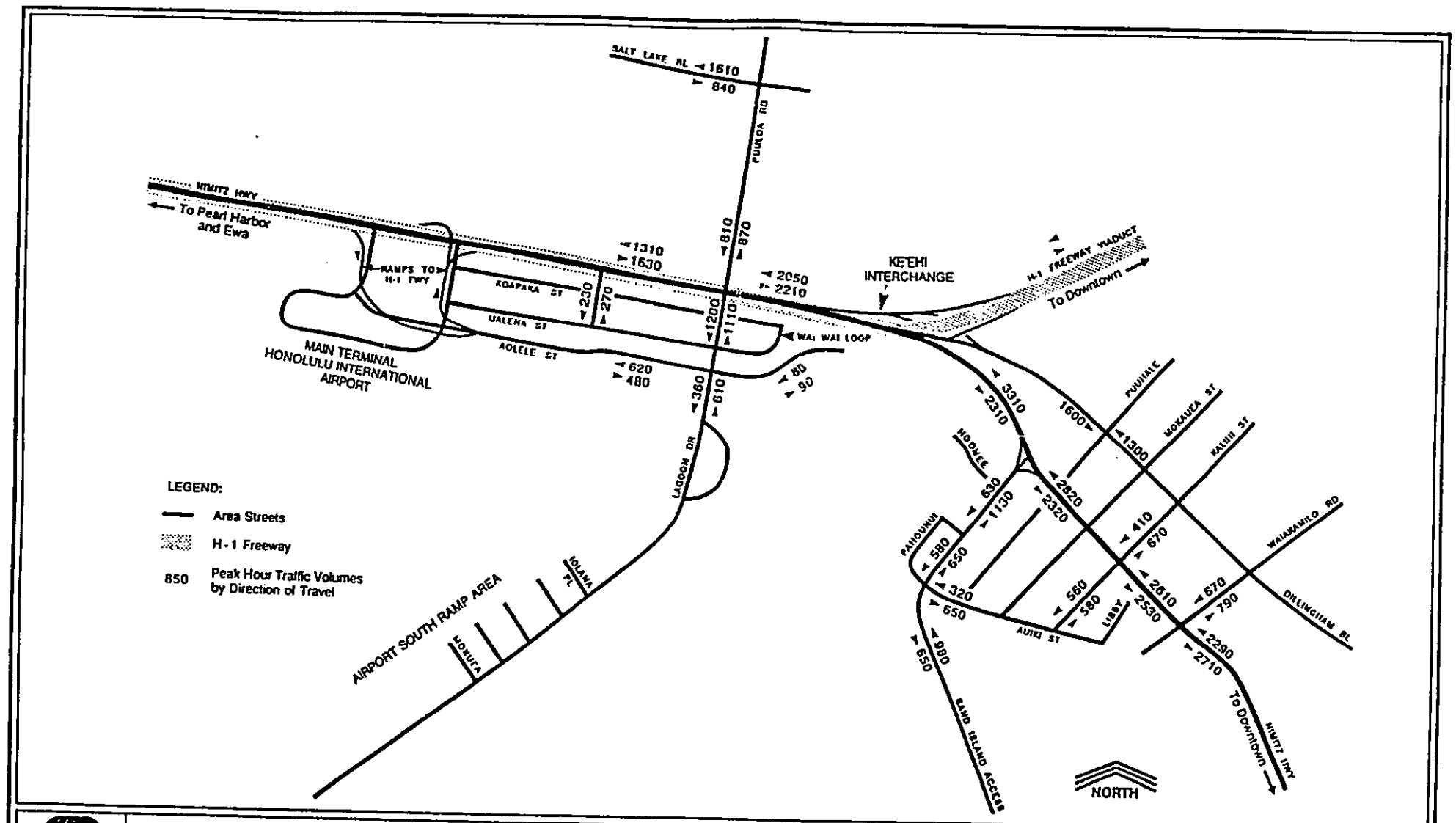


EXISTING AFTERNOON PEAK HOUR TRAFFIC VOLUMES
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

3

Aolele Street, where afternoon volumes are 50 percent higher than the morning peak hour.

2. The Nimitz Highway volumes are significantly larger on the downtown side of the Ke'ehi interchange than on the ewa side during both peak hour periods.

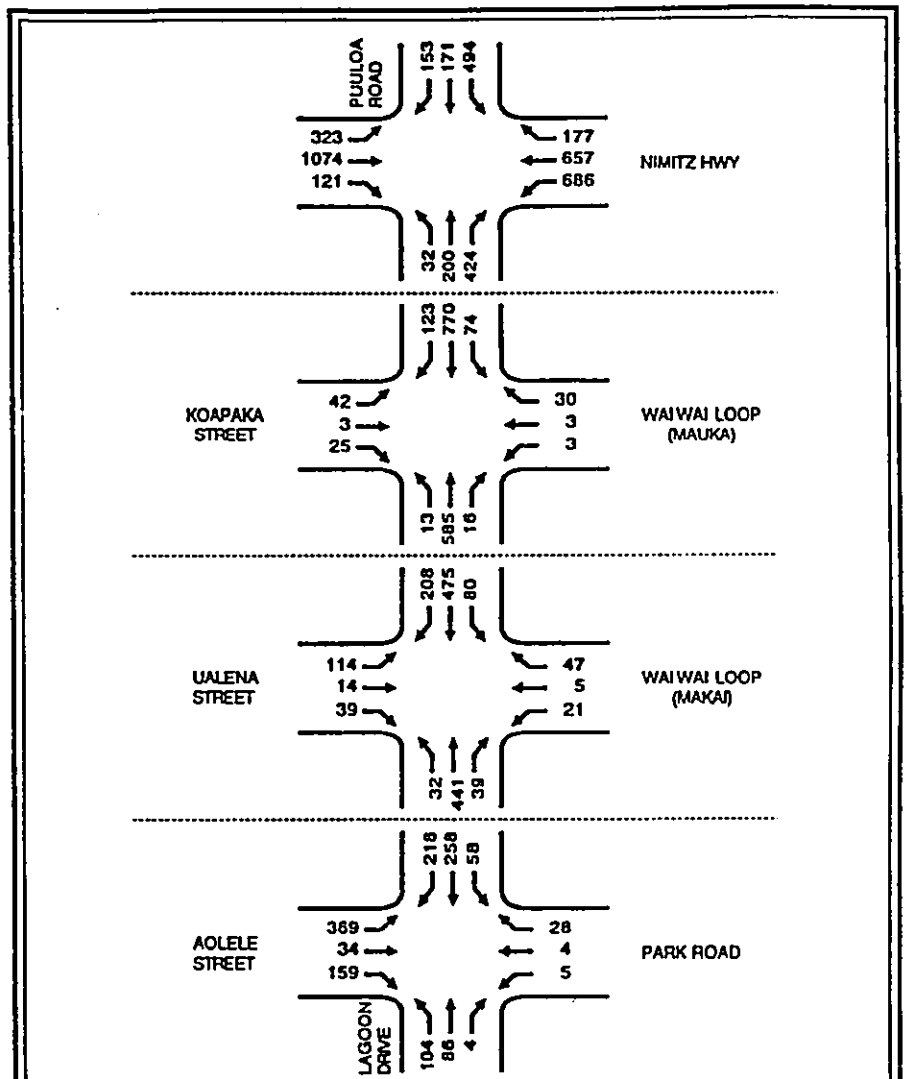
   On the diamond head side of the Ke'ehi interchange, the traffic volumes on the Nimitz Highway are heavier in the downtown direction in the morning peak hour, and in the ewa direction during the afternoon. On the ewa side of the interchange, the volumes are heavier towards downtown during both peak periods.

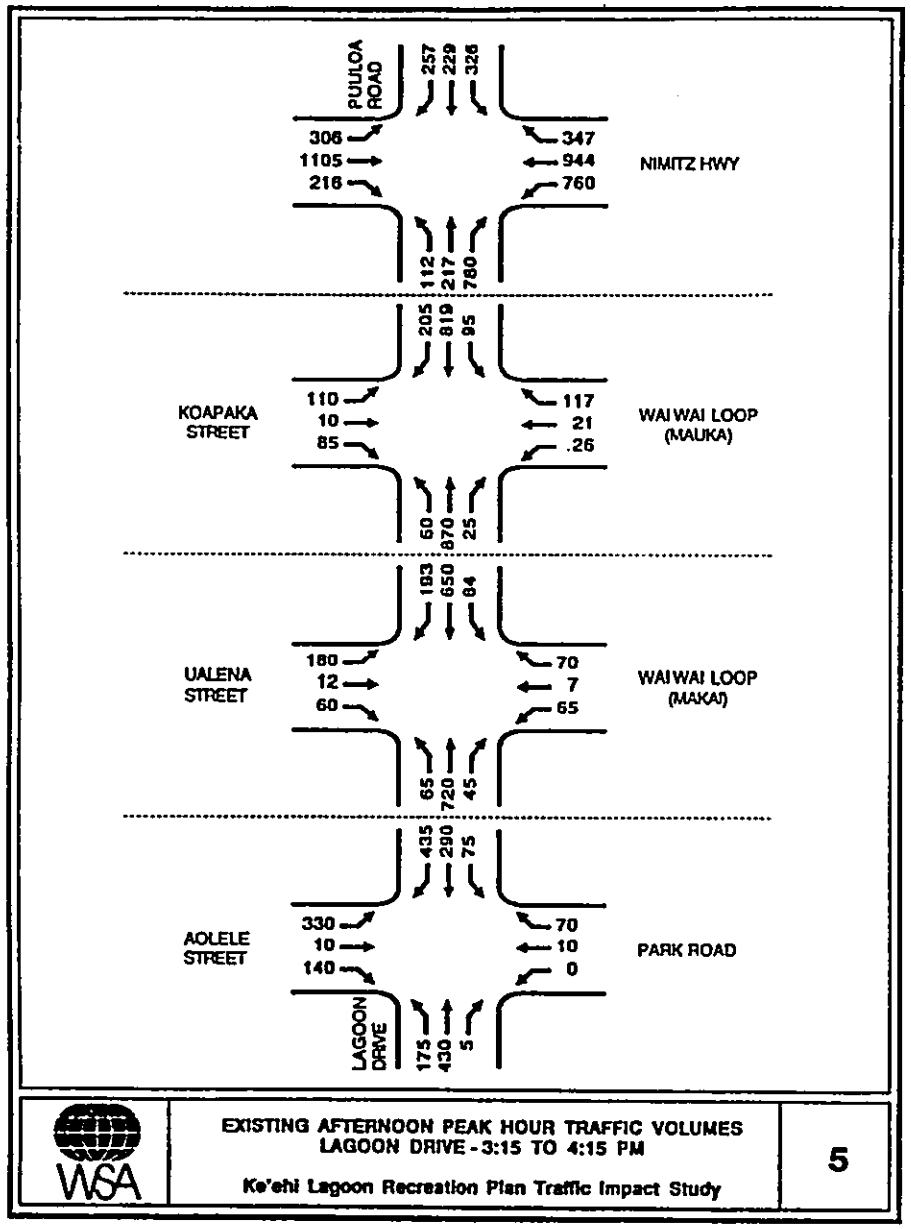
3. Each of the major street intersections with the Nimitz Highway experience large volumes of left-turn vehicles from the ewa direction on the Nimitz Highway to the makai direction of the cross street.

Special turning movement counts were made by Wilbur Smith Associates at the Lagoon Drive intersections with the Nimitz Highway, Koapaka Street, Ualena Street, and Aolele Street on January 18 and 23, 1989. Lagoon Drive serves as the key access route to most of the project elements of the Ke'ehi Lagoon Recreation Plan, and currently serves a large portion of the traffic to the industrial/commercial areas along Koapaka Street, Ualena Street, and Waiwai Loop.

The morning and afternoon traffic volumes presently using these Lagoon Drive intersections are depicted in Figures 4 and 5, respectively. Key features of the existing traffic patterns along Lagoon Drive include:

1. The Nimitz Highway intersection experiences very large volumes of ewa direction vehicles turning left onto





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Lagoon Drive, and mauka direction vehicles turning right onto the Nimitz Highway during both peak periods;

2. Aolele Street has approximately twice the peak hour traffic volumes as Koapaka and Ualena Streets; and

3. Koapaka, Ualena, and Aolele Streets each have large left-turn movements onto the mauka direction of Lagoon Drive, and large right-turn movements from the makai direction of Lagoon Drive during both peak traffic periods.

Traffic Conditions

Congested traffic conditions occur along the Nimitz Highway during the morning and afternoon commute periods of each normal workday. The source of this congestion and resultant travel delays is the heavy commute traffic volumes and the capacity limitations of the intersections along the section of the Nimitz Highway between the Sand Island Access Road and Waiakamilo Road intersections.

Traffic volumes through this section are also heavy during midday periods, but traffic experiences only minimal delays. The much lower traffic volumes on Saturdays and Sundays generally permit free flow traffic conditions through this area.

This analysis focuses primarily on traffic conditions during the weekday peak commute hours since these are a regular occurrence and have the greatest effect on access to or from the Ke'ehi Lagoon area. Saturday afternoon traffic conditions were considered at two key locations to assess the effect of a major weekend event at the Hawaiian Canoe Center and Race Course.

The key intersections along the access routes to the Ke'ehi Lagoon area were analyzed using the "Planning Method" outlined in the 1985 Highway Capacity Manual. This method calculates the average volume per lane for the different traffic movements at an intersection and then identifies the critical conflicting traffic movements at the intersection. The summation of the critical lane volumes is then compared to the theoretical capacity of 1,400 vehicles per hour for the conflicting movements.

For the purpose of this analysis, the summation of critical lane movements has been divided by the 1,400 vehicles per hour capacity to provide a "volume-to-capacity" ratio. A ratio of 1.00 indicates that the intersection is operating at its theoretical capacity; ratios above 1.00 indicate that the present (or future) volume exceeds the hypothetical capacity. An intersection with a ratio of about 0.85 or greater is approaching a problem condition, while a ratio of 0.91 or greater implies that intersection modifications or other measures are desirable to improve traffic flow.

Table 1 summarizes the results of the capacity analysis using the present traffic count data. Current traffic conditions indicated by the analysis and/or field observations include the following:

1. The capacity of the Waiakamilo Road intersection, and to a lesser degree the Kalihi Street intersection, is the primary constraint to morning and afternoon peak period traffic flow along this section of the Nimitz Highway, as indicated by the ratios of their current peak hour volumes to their empirically estimated intersection capacity.

   In the morning peak period, the Waiakamilo Road capacity constraint results in the delays to diamond-

Table 1

KEY INTERSECTION VOLUME-TO-CAPACITY RATIOS[1]
EXISTING CONDITIONS
Honolulu Ke'ehi Lagoon Recreation Plan

INTERSECTION	MORNING PEAK HOUR SUM OF CRITICAL VOLUMES	MORNING PEAK HOUR VOLUME/ CAPACITY RATIO	AFTERNOON PEAK HOUR SUM OF CRITICAL VOLUMES	AFTERNOON PEAK HOUR VOLUME CAPACITY RATIO
Weekday Condition				
Lagoon Drive at:				
Nimitz Highway	1,048	0.75	1,046	0.75
Aolele Street[2]	672	0.48	805	0.58
Sand Island Access Road at:				
Nimitz Highway	1,174	0.84	1,225	0.88
Auiki Street	1,224	0.87	927	0.66
Nimitz Highway at:				
Kalihi Street	1,498	1.07	1,304	0.93
Waiakamilo Road	1,522	1.09	1,500	1.07
Saturday Conditions[3]				
Nimitz Highway at:				
Lagoon Drive	--	--	662	0.47
Sand Island Access Rd.	--	--	819	0.59

1 Ratios exceeding 1.00 indicate traffic volumes exceed estimated capacity of intersection, based on a theoretical capacity of 1,400 vehicles for summation of critical conflicting traffic movements per lane.

2 Represents conditions if intersection is traffic signal-controlled.

3 Represents 2:00 PM to 3:00 PM period.

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head direction traffic on the Nimitz Highway, with the formation of lengthy traffic queues which extend to the Ke'ehi interchange, and at times extend to and through the Lagoon Drive intersection. Relatively free-flow conditions exist for diamond head direction traffic outside of this queuing area.

In the afternoon peak period, the Waiakamilo Road intersection causes queuing of traffic in both directions on the Nimitz Highway, but of significantly shorter lengths and with less overall delay than the morning problem.

Extensive queuing and delays also occur on the Waiakamilo Road and Kalihi Street approaches at the Nimitz Highway.

2. Traffic volumes at the Sand Island Access road intersection with the Nimitz Highway are currently within but approaching the intersection's capacity. However, traffic flow through this intersection is constrained by the nearby Waiakamilo Road and Kalihi Street intersections.

3. Traffic volumes at the Auiki Street intersection with Sand Island Access Road are approaching a problem level in the morning period. The principal contributors are the very large volume of left-turn vehicles from the mauka approach onto Auiki Street (500 vehicles) and from Auiki Street towards Sand Island (230 vehicles).

4. The Lagoon Drive intersection with the Nimitz Highway operates at an acceptable service level except for short periods in the morning when the downstream problems (item 1) result in traffic queues extending

back through this intersection. This was observed to occur primarily around 6:45 AM to 7:15 AM and generally results in delays to the diamond head direction traffic on the Nimitz Highway and to the left-turn vehicles from Puuloa Road, with some delays to through traffic on Lagoon Drive and Puuloa Road.

5. There is a large right-turn volume of vehicles from Lagoon Drive onto the Nimitz Highway throughout the day. This movement is provided with an exclusive right-turn lane on Lagoon Drive, and channelization is present to provide a protected "free" movement into the makai-side lane on the Nimitz Highway. However, the makai lane continues to Waikiki at the Ke'ehi interchange. Right-turn traffic seeking to cross over to the middle or mauka lanes to reach Dillingham Boulevard or the eastbound H-1 Freeway must weave across two to four lanes. During heavy traffic periods, some of these H-1 or Dillingham Boulevard-bound vehicles will stop at the channelization to wait for the traffic signal to change and create a gap in traffic rather than weaving through the moving vehicles.

6. The left-turn movement from makai-direction Lagoon Drive onto the mauka segment of Waiwai Loop, is permitted from a through lane. Because of the short distance between the Nimitz Highway and Waiwai Loop, vehicles stopped to make this left turn frequently disrupt the heavy left turn movement from the Nimitz Highway onto Lagoon Drive, both stacking vehicles into the Nimitz Highway intersection and posing a traffic hazard.

7. The STOP sign-controlled approaches of Koapaka Street, Ualena Street, Waiwai Loop, and Aolele Street were

observed to generally operate without excessive queuing or delays. The median shelter area on Lagoon Drive permits through and left-turn vehicles on these side streets to cross to the median area and wait in the median shelter area for a gap in traffic to complete their maneuver. Side street traffic also was observed to force their way across the Lagoon Drive lanes, sometimes interfering with through traffic flow.

Public Transit Access

TheBus service is primarily provided along the Nimitz Highway and Dillingham Boulevard. Route 19 operates through the area on the Nimitz Highway and connects to the Airport, Downtown, Ala Moana Center and Waikiki. Route 20 operates on Dillingham Boulevard and Nimitz Highway and serves the Waikiki, Ala Moana, and Downtown areas to the east, and the airport and Pearlridge Center to the west. Route 3 operates along Dillingham Boulevard and Nimitz Highway (ewa of Ke'ehi interchange) and serves the Kaimuki, Kapiolani, and Downtown areas to the east, and Pearl Harbor to the west.

Several suburban trunk routes operate from the Ala Moana Center and Downtown area along Dillingham Boulevard to Nimitz Highway and continue westward. These include Route 50 (Waipahu-Makakilo - Ewa Beach), 51 (Waianae), and 52 (Wahiawa).

1998 CONDITIONS WITHOUT THE KE'EHI LAGOON RECREATION PLAN PROJECTS

Several significant development projects and transportation improvements are expected to be implemented in the area that will affect traffic conditions in the Ke'ehi Lagoon area over the next ten years. These include:

- Completion of the Airport South Ramp Development Project;
- Construction of the City Corporation Yard on Sand Island;
- Continued expansion of the Airport Terminal facility;
- Continued expansion of the harbor-oriented uses, particularly in the Kalihi Kai area;
- Major intersection improvements along Nimitz Highway; and
- Construction of the Makai Boulevard viaduct along the Nimitz Highway.

Future traffic volumes have been estimated for the year 1998 to reflect the anticipated growth in the area, and the roadway projects incorporated into the analysis of future traffic conditions. The resultant analysis provides a "baseline" condition from which the impacts can be measured for the Ke'ehi Lagoon Recreation Plan projects.

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Travel Growth Assumptions

Specific trip generation and distribution analysis was made for the Airport South Ramp and City Corporation Yard developments. Other area development was reflected by general corridor growth factors.

Airport South Ramp - Facilities at the South Ramp area of the Honolulu International Airport are currently being expanded to include additional facilities for air cargo, freight forwarders, aircraft maintenance, aircraft tie-downs and hangers, and other supporting services for aviation activities. Most of these activities will be located on areas that are currently vacant.

Vehicle trip generation rates and estimated trips for the new South Ramp development are summarized in Table 2. The trip rates were determined as follows:

- Air Cargo Forwarders - Estimated from discussions with United Parcel Service and Federal Express, who will occupy two of the four facilities;
- General Aviation - Based on ITE standard trip rates;[1] and
- Aircraft Maintenance and Aviation Maintenance School- Based on ITE trip rates[2] for industrial parks and community colleges, respectively.

The additional South Ramp development will generate an estimated 760 and 480 vehicle trips to or from the area in the

[1] "Trip Generation, Fourth Edition", Institute of Transportation Engineers, 1988.

[2] Ibid.

Table 2
VEHICLE TRIP GENERATION RATES AND ESTIMATED TRIPS
AIRPORT SOUTH RAMP EXPANSION
Ka'ohi Lagoon Recreation Plan Traffic Impact Study

LAND USE	RATE BASIS	MORNING PEAK HOUR TO PROJECT	MORNING PEAK HOUR FROM PROJECT	AFTERNOON PEAK HOUR TO PROJECT	AFTERNOON PEAK HOUR FROM PROJECT	DAILY TRIPS TO/FROM PROJECT
WEEKDAY TRIP RATES:						
Air Cargo, Forwarders(a)	Per Facility	90	10	10	30	900
General Aviation(b)	Per Based Aircraft	.60	.07	.20	.42	6.6
Aircraft Maintenance(b)	Per Acre	8.40	1.80	2.20	8.50	63.0
AVMAT School(b)	Per 1,000 SF	2.20	0	.30	.80	12.9
SATURDAY TRIP RATES:						
Air Cargo, Forwarders(a)	Per Facility	---	---	Minimal		150
General Aviation(b)	Per Based Aircraft	---	---	.21	.21	4.1
Aircraft Maintenance(b)	Per Acre	---	---	Minimal		12.5
AVMAT School(b)	Per 1,000 SF	---	---	0	0	0
WEEKDAY VEHICLE TRIPS:						
Air Cargo, Forwarders(a)	Four Facilities	360	40	40	120	3,600
General Aviation(b)	200 Aircraft	120	20	40	80	1,350
Aircraft Maintenance(b)	15 Acres	120	30	30	130	950
AVMAT School(b)	32,000 SF	70	0	10	30	400
TOTAL		670	90	120	360	6,300
SATURDAY VEHICLE TRIPS:						
Air Cargo, Forwarders(a)	Four Facilities	---	---	10	10	200
General Aviation(b)	200 Aircraft	---	---	40	40	800
Aircraft Maintenance(b)	15 Acres	---	---	10	10	200
AVMAT School(b)	32,000 SF	---	---	0	0	0
TOTAL				60	60	1,200

SOURCES: (a) Wilbur Smith Associates
(b) Institute of Transportation Engineers Trip Generation Handbook - 4th Edition.

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weekday morning and afternoon peak hours, respectively, and 120 vehicle trips during the Saturday afternoon analysis period.

However, by 1998 additional airport employee parking is planned for the main terminal complex, which will replace the current satellite employee parking lots in the South Ramp area. Approximately 600 day shift employees of the main terminal currently park in these lots on a typical weekday. Relocation of these parkers from South Ramp will reduce the makai-direction morning and mauka-direction afternoon traffic along Lagoon Drive by about 300 vehicles in each peak hour. This reduces the net South Ramp development increase in weekday traffic to 460 and 180 vehicle trips for the morning and afternoon peak hours, respectively.

Distribution of the additional South Ramp trips was based on the preliminary Hali 2005 travel forecasts for the Airport area.

The South Ramp development travel forecasts do not reflect the potential location of an aviation museum in the South Ramp area. Such a facility could significantly increase South Ramp traffic.

Honolulu City Corporation Yard - This facility will consolidate many of the City's vehicle storage and maintenance facilities on Sand Island. Travel characteristics and traffic increases for this facility were obtained from the project's traffic impact study.[3] The facility will generate an estimated 2,986 weekday vehicle trips when completed, with a total of 430 and 678 vehicles in the morning and afternoon peak hours, respectively.

[3] "Traffic Impact Study for Honolulu Corporation Yard and Sand Island Part E.I.S.," prepared for City and County of Honolulu Building Department by Wilson Okamoto & Associates and Wilbur Smith Associates, 1989.

General Corridor Increases - Continued growth of activity in the airport and harbor areas is expected to further increase traffic volumes on area streets in addition to the South Ramp and Corporation Yard projects. Average annual traffic growth rates were developed from historical data and used to adjust existing volumes to reflect the traffic increases from other area activities or from increased travel through the area. The estimated traffic volumes for 1998 reflect the following assumptions regarding traffic growth on area streets:

- Peak hour volumes on the Nimitz Highway and on airport area streets are estimated to increase by one percent annually (10.5 percent by 1998); and
- Peak hour volumes on Kalihi Kai streets are estimated to increase by 1.75 percent annually (19 percent by 1998).

These amounts are in addition to the increases from the South Ramp and Corporation Yard projects.

Roadway Improvements

The State Department of Transportation (DOT) expects to implement a series of roadway improvements along the Nimitz Highway within the next ten years.

Nimitz Highway Intersection Improvements - The major intersection modifications which affect the intersections considered in the analysis include:

Kalihi Street

State DOT plans to add one mauka direction lane to Kalihi Street through the Nimitz Highway intersection.

Libby Street (located between Kalihi Street and Waiakamilo Road

State DOT plans to provide a median crossing, left-turn lane and traffic signal at this location to allow the left-turn movement from ewa direction of Nimitz Highway to Libby Street.

Waiakamilo Road

State DOT plans to provide a short "queue-jumpers" through lane in the diamond head direction, and additional (second) left-turn lanes for the left-turn movements from Waiakamilo Road towards Downtown and from Nimitz Highway to Waiakamilo Road.

Makai Boulevard Viaduct - Current State DOT plans are to construct a two-lane viaduct above the Nimitz Highway from the Ke'ehi interchange to Pacific Street for use by high occupancy vehicles (HOV). The viaduct will operate with both lanes inbound towards Downtown in the morning and outbound in the afternoon.

The State DOT seeks to implement this project by 1998 to relieve the already congested traffic conditions along Nimitz Highway, and to provide additional capacity in the Middle Street-to-Downtown corridor prior to reconstruction of the H-1 Freeway/ Middle Street interchange. Although the State Legislature has not yet approved funding for the viaduct project, the project has been included in the 1998 roadway network given the high priority placed upon this project by the State DOT in meeting the critical need for additional capacity in this corridor.

1998 Traffic Volumes Without the Ke'ehi Lagoon Project

The annual growth adjustments and trips generated by the South Ramp and Honolulu City Corporation Yard were added to existing volumes to estimate the 1998 traffic volumes on area streets. Figures 6 and 7 depict the estimated volumes for the morning and afternoon peak hours, respectively.

Note that the traffic volumes shown along the Nimitz Highway do not reflect those vehicles using the Makai Boulevard viaduct. The Nimitz Highway volumes reflect a reduction of 8 to 10 percent of the peak direction vehicles through diversion to the HOV facility. This amounts to 240 diamond head direction vehicles in the morning peak hour, and 290 ewa direction vehicles in the afternoon peak hour.

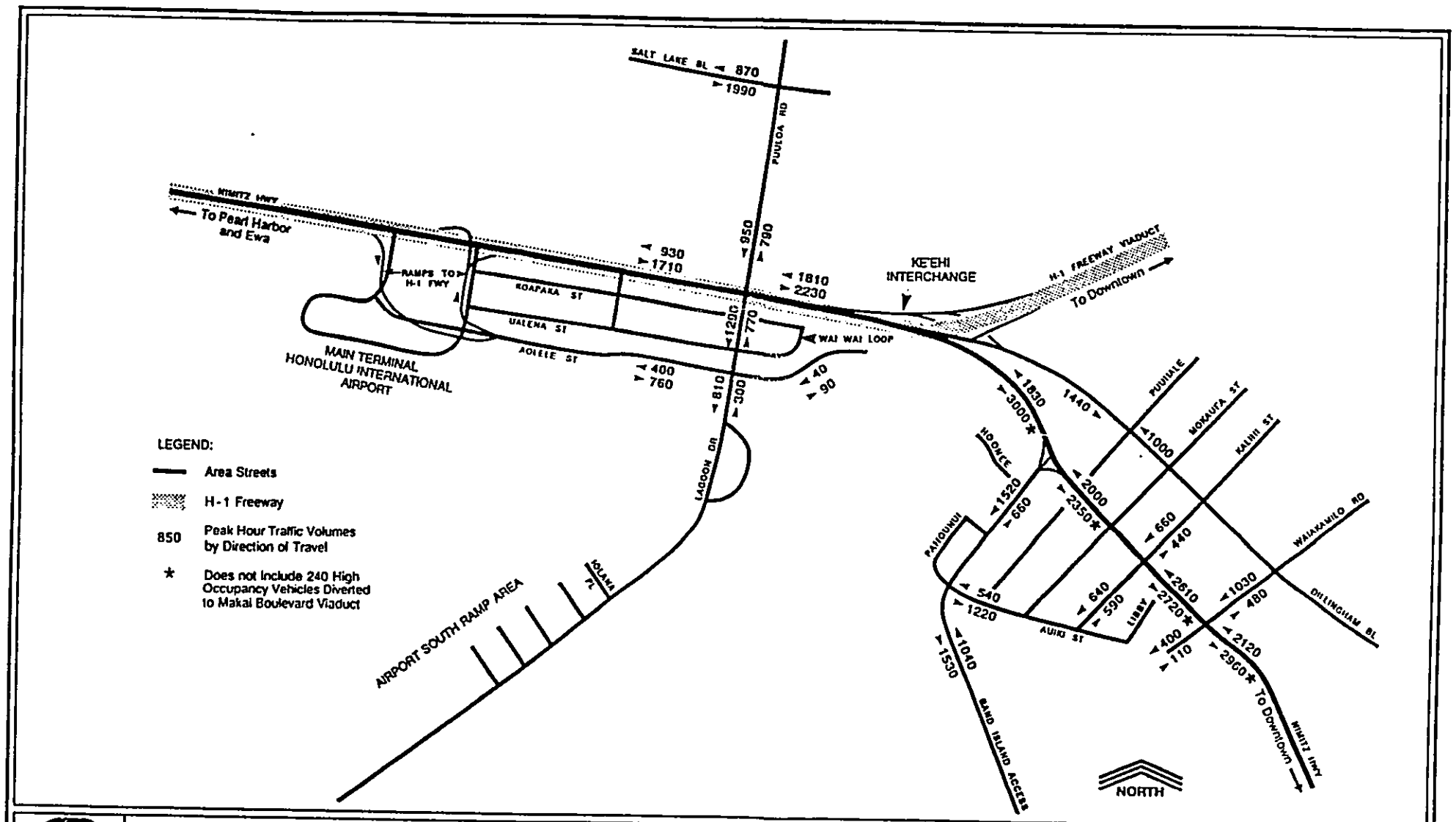
The relative proportional increase of peak hour traffic on area roadways is as follows:

	Morning	Afternoon
Nimitz Highway at Lagoon Drive	+15%	+12%
Nimitz Highway at Sand Island Access Road	+17%	+14%
Lagoon Drive at Nimitz Highway	+26%	+15%
Sand Island Access Road at Nimitz Highway	+21%	+28%
Kalihi Street mauka of Nimitz Highway	+45%	+27%

Traffic Conditions

Table 3 indicates the estimated volume-capacity ratios for key intersections in the Ke'ehi Lagoon area.

The analysis indicates that the planned Nimitz Highway improvements at Waiakamilo Road would result in improved condi-



MORNING PEAK HOUR TRAFFIC VOLUMES 1998 WITHOUT PROJECT
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

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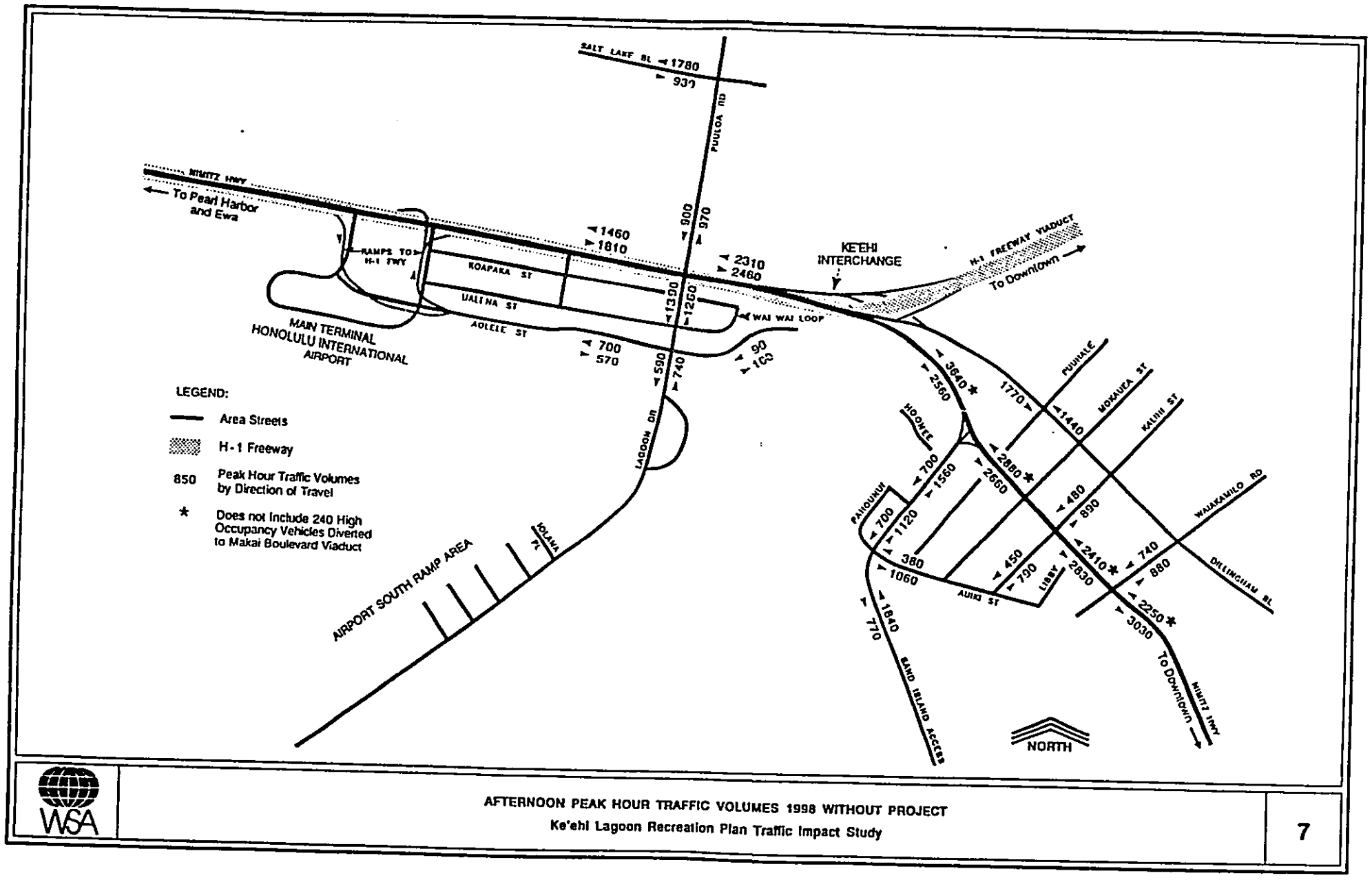

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AFTERNOON PEAK HOUR TRAFFIC VOLUMES 1998 WITHOUT PROJECT
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

Table 3

KEY INTERSECTION VOLUME-TO-CAPACITY RATIOS[1]
1998 WITHOUT KE'EHI LAGOON PROJECTS
Honolulu Ke'ehi Lagoon Recreation Plan

INTERSECTION	MORNING PEAK HOUR SUM OF CRITICAL VOLUMES	MORNING PEAK HOUR VOLUME/ CAPACITY RATIO	AFTERNOON PEAK HOUR SUM OF CRITICAL VOLUMES	AFTERNOON PEAK HOUR VOLUME CAPACITY RATIO
Weekday Conditions				
Lagoon Drive at:				
Nimitz Highway	1,229	0.88	1,184	0.85
Aolele Street[2]	878	0.63	945	0.68
Sand Island Access Road at:				
Nimitz Highway	1,329	0.95	1,385	0.99
Auiki Street	1,683	1.20	1,451	1.04
Nimitz Highway at:				
Kalihi Street	1,550	1.11	1,290	0.92
Waiakamilo Road	1,122	0.80	1,247	0.89
Saturday Conditions[3]				
Nimitz Highway at:				
Lagoon Drive	--	--	749	0.54
Sand Island Access Rd.	--	--	927	0.66

1 Ratios exceeding 1.00 indicate traffic volumes exceed estimated capacity of intersection, based on a theoretical capacity of 1,400 vehicles for summation of critical conflicting traffic movements per lane.

2 Represents conditions if intersection is traffic signal-controlled.

3 Represents 2:00 PM to 3:00 Pm period.

tions at that intersection. The "bottleneck" location along the Nimitz Highway would shift to Kalihi Street in the morning and Sand Island Access Road in the afternoon. Morning conditions would likely remain at levels of congestion similar to the present conditions, while afternoon conditions would be slightly improved.

Traffic conditions in the Lagoon Drive area would likely deteriorate by a slight but noticeable degree, but still be within acceptable levels.

1998 CONDITIONS WITH KE'EHI LAGOON RECREATION PLAN PROJECTS

The travel forecasts and analyses focus on the weekday peak commute traffic periods since area roadways are most heavily travelled at these times, and the Ke'ehi Lagoon Recreation Plan includes projects that will add a substantial number of trips during these peak traffic periods. Weekend conditions were assessed at the key Nimitz Highway intersections with Lagoon Drive and with Sand Island Access Road, and for the access driveway intersections to the recreational components.

For comparison purposes, traffic volumes during the peak traffic hours on Saturdays generally range from 50 to 70 percent of weekday peak hour volumes.

Description of Projects and Planned Access

The access for the major portion of the projects proposed in the Ke'ehi Lagoon Recreation Plan, including most of the commercial-industrial uses, is planned from Lagoon Drive. The projects with access to Sand Island Access Road are primarily recreational in character. The major projects and the planned access for each is described in the following paragraphs.

Hawaiian Canoe Center - The Hawaiian Canoe Center development in the northern portion of the lagoon area is intended to provide facilities to accommodate major local and international canoe regattas. Canoe races are presently held in this area using the limited facilities and viewing areas available in the Ke'ehi Lagoon Beach Park.

The project will provide viewing areas, including stands, on the Kalihi Kai side of the lagoon as well as the ewa side. Canoe

launch ramps and storage areas will be provided on both sides. The ewa side will be provided with parking for 40 additional cars and 25 canoe trailers, to bring total parking in the park area to approximately 600 spaces. On the Kalihi Kai side, parking will be provided for 600 cars and 25 canoe trailers in the area adjacent to the viewing stands.

A Hawaiian Canoe Center building complex is proposed in the area adjacent to the Nimitz Highway between the Kalihi and Moanalua Streams. This facility will likely provide clubhouse-type facilities for canoe club members and visitor-oriented exhibits and entertainment. Access will be via a bridge over Kalihi Stream to Hoonee Place, with ingress for service vehicles from Nimitz Highway.

Access to the ewa side facilities will be via the existing 24-foot wide park road. Primary access to the Kalihi Kai side is planned via the 40-foot wide Hoonee Place which intersects Sand Island Access Road approximately 600 feet makai of the Nimitz Highway, with secondary access through the State right-of-way which intersects Sand Island Access Road about 500 feet makai of the Auiki Street intersection.

Pier 60 Marina - This proposed marina facility, located adjacent to the existing La Mariana Sailing Club, could accommodate 185 to 200 boats, depending upon the mix of the boat sizes. The facility may also include a marine supply store, snack bar/restaurant, repair facilities, other support functions, and about 200 parking spaces. Access is planned via the current driveway serving the La Mariana Sailing Club and Keehi Marine Center, which intersects Sand Island Access Road approximately 500 feet makai of Auiki Street/Pahounui Drive.

Lagoon Drive Marina - A marina is planned for the shoreline along Lagoon Drive adjacent to the Airport's South Ramp area.

The plan envisions major filling to extend the land area along Lagoon Drive to provide boat slips plus ancillary facilities such as a marine supply store, snack bar/ restaurant, yacht club and fishing charter kiosks. A total of about 1,000 boat slips is planned within the Seaplane Channel "A", divided between the Lagoon Drive Marina and the Triangle Development. For the purpose of this traffic impact analysis, 700 boat slips are assumed to be located in the Lagoon Drive Marina and 300 on the Triangle Development side of the channel.

The plan also includes a ferry transit terminal and landing in this area that will be part of the intra-island ferry system. This terminal would serve both visitors deplaning at the Airport and workers commuting to the Airport or adjacent areas.

Triangle Development - The plan envisions the filling in of approximately 250 acres within the 300-acre triangular shaped area in the central portion of the lagoon to provide an aeronautical and maritime oriented development. The planned uses for this Triangle Development area are as follows:

- A marina with approximately 300 boat slips. (This number could increase with a corresponding decrease in the number in the Lagoon Drive Marina.).
- A Yacht Race/Ocean Sports complex which encompasses 20 racing syndicate compounds, 10 piers, shop and maintenance building, classroom building for Pacific Maritime Academy, restaurant, concessionaire facilities, administration building, 1,000 parking spaces, and other ancillary uses. Between yacht racing events, the compounds could be used to accommodate transient vessels and for charter or water sports concessions.

- A Maritime Commercial waterfront area to serve light draft commercial vessels such as dinner cruise and tour boats, fishing vessels, submarine tour vessels, and temporary berthing of transient vessels.
- A 15-acre site for relocation of the University of Hawaii Marine Expeditionary Center (Snug Harbor), which is currently located in the Kalihi Kai portion of Honolulu Harbor.
- Open space and park areas along the shoreline.
- A commercial/light industrial development within the interior of the Triangle. This area may include maritime and aviation-related light industrial and commercial uses, or theme parks or other recreational uses.

Proposed access to the Triangle Development is via a 900-foot long bridge from Lagoon Drive, near the mauka end of the Airport South Ramp, to the ewa side of the Triangle Development area.

Project Trip Generation

Daily and peak hour trips to and from the Ke'ehi Lagoon Recreation Plan projects, as presented in Table 4, were estimated using either standard trip rates, or by development of trips rates for similar uses on Oahu. The daily and peak hour trip rates for the marinas and the light industrial uses were based on standard trip rates.[1] The daily rate for the park use was based on standard trip rates, but with traffic count data from the

[1] "Trip Generation," Institute of Transportation Engineers, Fourth Edition, 1988.

Table 4
VEHICLE TRIP GENERATION RATES
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

LAND USE	RATE BASIS	MORNING PEAK HOUR TO PROJECT	MORNING PEAK HOUR FROM PROJECT	AFTERNOON PEAK HOUR TO PROJECT	AFTERNOON PEAK HOUR FROM PROJECT	DAILY TRIPS TO/FROM PROJECT
WEEKDAY:						
Marina[1]	Per Boat Slip	0.09	0	0.100	0.10	3.00
Light Industrial[1]	Per Acre	8.40	1.80	2.200	8.50	63.00
Maritime Commercial[2]	Per Acre	2.50	1.60	2.500	5.00	75.00
Yacht/Ocean Sports[2]	Per Acre	2.50	1.60	2.500	5.00	75.00
Park, Open Space[1]	Per Acre	0.30	0.02	1.300	1.20	29.10
SATURDAY:						
Marina[1]	Per Boat Slip	---	---	0.250	0.25	5.00
Light Industrial[1]	Per Acre	---	---	2.300	2.40	40.00
Maritime Commercial[2]	Per Acre	---	---	3.000	6.00	90.00
Yacht/Ocean Sports[2]	Per Acre	---	---	3.000	6.00	90.00
Park, Open Space[1]	Per Acre	---	---	1.500	1.50	34.10
Canoe Race Course[3]	Per Attendee	---	---	0.033	0.22	0.67

SOURCES: [1] Institute of Transportation Engineers Trip Generation Handbook - 4th Edition.

[2] Wilbur Smith Associates estimate based on Kewalo Basin counts.

[3] Wilbur Smith Associates estimate.

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present Sand Island State Park used to estimate peak hour characteristics.

Trip rates for the Maritime Commercial area was developed from data for Kewalo Basin. These rates are also applied to the Yacht Race/Ocean Sports area to reflect the more typical activity levels between the several major race events each year.

Trip rates for the Canoe Race Course are based on an average of three persons per vehicle for participants and attendees. The afternoon peak hour reflects two-third of the total daily attendees leaving in a one-hour period, which is a conservatively high proportion for this type of day-long event.

Estimated vehicle trips for the Snug Harbor facility were obtained directly from discussions with facility staff.

Based on these trip rates, the planned projects would generate approximately 17,900 weekday vehicle trips to or from the various projects, as summarized in Table 5. The weekday afternoon peak hour period, with 1,570 vehicles exiting and 610 vehicles entering the projects, would produce approximately one-third more vehicle trips than the morning peak hour.

The light industrial - commercial uses in the Triangle Development is the major traffic generator on weekdays. Vehicle trips from these uses comprise 73 percent, 58 percent, and 42 percent of the total trips estimated for the morning peak hour, afternoon peak hour, and daily total, respectively.

The weekday traffic increases would be focussed on the Lagoon Drive corridor, and particularly the bridge crossing to the Triangle Development.

Table 5
1998 WEEKDAY VEHICLE TRIPS
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

AREA/LAND USE	UNITS	MORNING PEAK HOUR TO PROJECT	MORNING PEAK HOUR FROM PROJECT	AFTERNOON PEAK HOUR TO PROJECT	AFTERNOON PEAK HOUR FROM PROJECT	DAILY TRIPS TO/FROM PROJECT
TRIANGLE ISLAND:						
Marina	350 Boat Slips	30	0	35	35	1,050
Light Industrial	119 Acres	1,000	215	260	1,010	7,500
Maritime Commercial	16 Acres	40	25	40	50	1,200
Ocean Sports Complex	48 Acres	120	70	120	240	3,600
Snug Harbor	15 Acres	40	10	10	40	300
Park	19 Acres	10	0	25	25	550
Subtotal		1,240	320	490	1,430	14,200
LAGOON DRIVE:						
Marina	200 Boat Slips	60	0	70	70	2,300
Canoe Race Area	No Activity	0	0	0	0	0
Subtotal		60	0	70	70	2,300
SUBTOTAL LAGOON DRIVE CORRIDOR		1,300	320	560	1,500	16,500
KALIHI KAI AREA:						
Marina	200 Boat Slips	20	0	20	20	600
Canoe Race Area	No Activity	0	0	0	0	0
Canoe Center	20 Acres	5	0	20	40	600
Park, Open Space	6 Acres	25	0	10	10	200
SUBTOTAL KALIHI KAI		50	0	50	70	1,400
TOTAL PROJECT		1,350	320	610	1,570	17,900

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The estimated number of daily and peak hour trips are both larger for Saturday (Table 6) than for a weekday. This is because the Saturday condition reflects one of the five or six weekends per year when a major canoe regatta is scheduled at the lagoon. The vehicle trip estimates in Table 6 are based on attendance by 4,000 persons, with the attendance split 60 percent on the Kalihi Kai side of the lagoon and 40 percent on the Lagoon Drive side. The canoe races contribute one-third of the estimated peak hour trips, and 13 percent of the daily trips for the Saturday analysis condition.

Trip Distribution

Estimates of the directional distribution of trips to and from the project were based upon preliminary Hali 2005 Study forecasts for the origin location of trips to this area. These were then used to estimate the proportional distribution of trips to and from the area using the major roadways:

	To Project	From Project
H-1 West of Area	27%	31%
Nimitz Highway West of Area	9%	5%
Puuloa Road	10%	10%
H-1 East of Area	12%	10%
Dillingham Boulevard	7%	8%
Nimitz Highway East of Area	9%	11%
Other and Local	26%	25%

1998 Traffic Volumes With the Project

Comparison of the forecasted traffic for the Ke'ehi Lagoon Recreation Plan projects to the baseline conditions described in Chapter 3 indicates that the project would substantially increase

Table 6
1998 SATURDAY VEHICLE TRIPS
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

AREA/LAND USE	UNITS	AFTERNOON[1] ANALYSIS HOUR TO PROJECT	AFTERNOON[1] ANALYSIS HOUR FROM PROJECT	DAILY TRIPS
TRIANGLE ISLAND:				
Marina	350 Boat Slips	90	90	1,750
Light Industrial	110 Acres	270	290	4,750
Maritime Commercial	16 Acres	50	120	1,450
Ocean Sports Complex	48 Acres	150	290	4,300
Snug Harbor	15 Acres	10	10	50
Park	10 Acres	30	30	600
Subtotal		600	830	12,900
LAGOON DRIVE:				
Marina	700 Boat Slips	180	180	3,500
Canoe Race Area	1,600 Persons	50	350	1,100
Subtotal		230	530	4,600
SUBTOTAL LAGOON DRIVE CORRIDOR		830	1,360	17,500
KALIHI KAI AREA:				
Marina	200 Boat Slips	50	50	1,000
Canoe Race Area	2,400 Persons	80	530	1,600
Canoe Center	20 Acres	30	30	700
Park, Open Space	6 Acres	10	10	200
SUBTOTAL KALIHI KAI		170	620	3,500
TOTAL PROJECT		1,000	1,980	21,000

1 Analysis hour represents midafternoon, about 2:00 PM to 3:00 PM.

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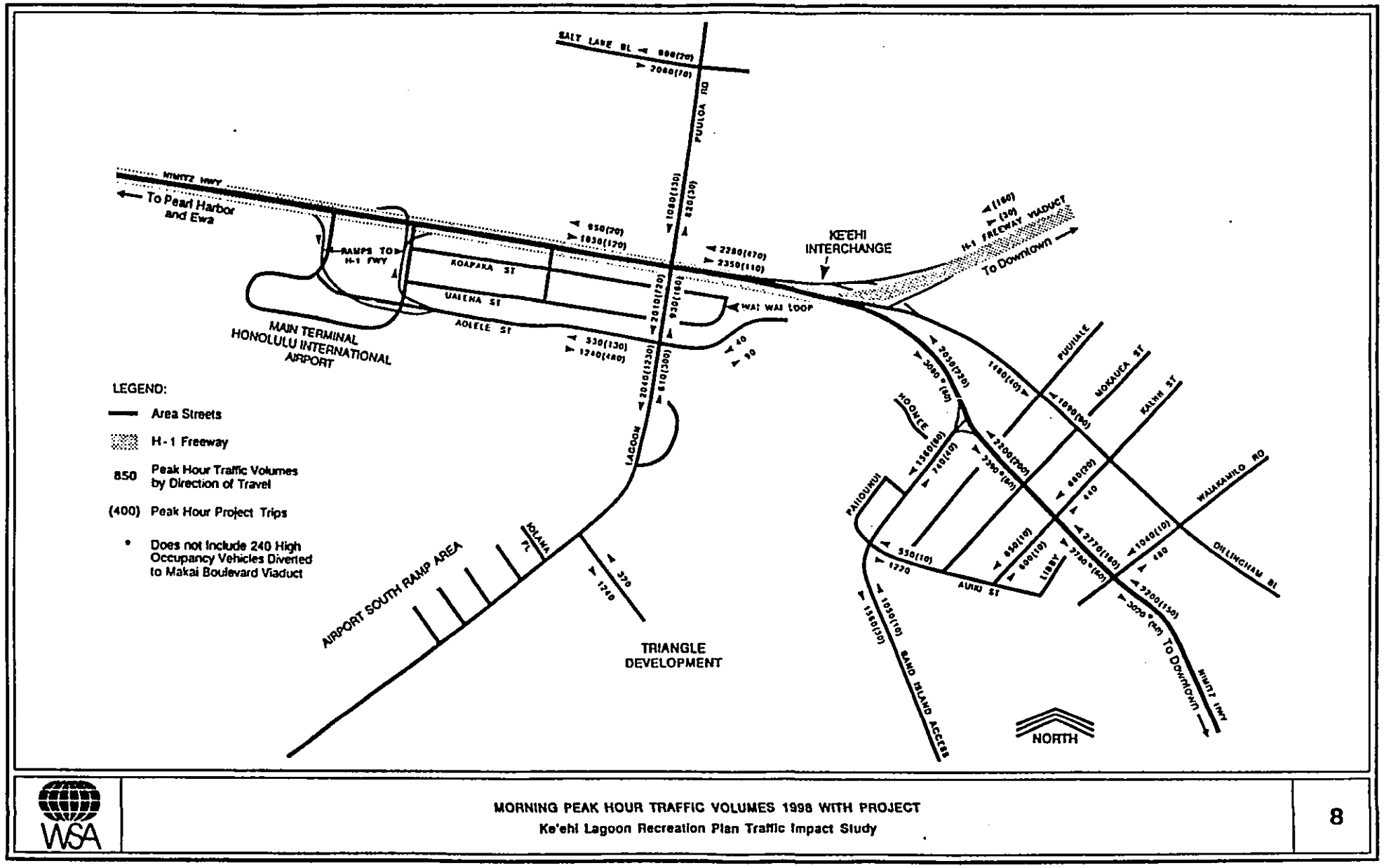
area traffic volumes on Lagoon Drive but only moderately on the Nimitz Highway and Sand Island Access Road.

Forecast Weekday Traffic - Projected weekday peak hour traffic volumes on the major streets in the Ke'ehi Lagoon area are depicted in Figures 8 and 9 for the morning and afternoon periods, respectively. The figures indicate both the total peak hour volume, including project trips, and the number of project trips included with the total volume. The largest traffic increases, and most likely location of significant impacts would occur on Lagoon Drive, the portion of the Nimitz Highway between Lagoon Drive and the Ke'ehi interchange, and on Aolele Street between Lagoon Drive and the ramps to and from the H-1 Freeway.

On Lagoon Drive, project traffic is estimated to more than double future peak hour traffic volumes makai of Aolele Street, and increase volumes by 40 percent to 50 percent between Aolele Street and the Nimitz Highway. The project is estimated to increase peak direction traffic on Lagoon Drive makai of Aolele Street by 1,230 makai-direction and 1,430 mauka-direction vehicles during the morning and afternoon peak hours, respectively.

Project traffic would also increase peak hour volumes along Aolele Street by more than 50 percent. Estimated peak direction trips to and from the project site amount to 480 and 620 vehicles in the morning and afternoon peak hours, respectively. These trips include both trips to and from the H-1 Freeway ramps along Aolele Street, and trips to the airport terminal complex.

The project would add approximately 500 ewa-direction vehicles in the morning and 500 diamond head vehicles in the afternoon to the segment of the Nimitz Highway between Lagoon Drive and the Ke'ehi interchange convergence of Nimitz Highway, Dillingham Boulevard, and the H-1 Freeway. These vehicles would



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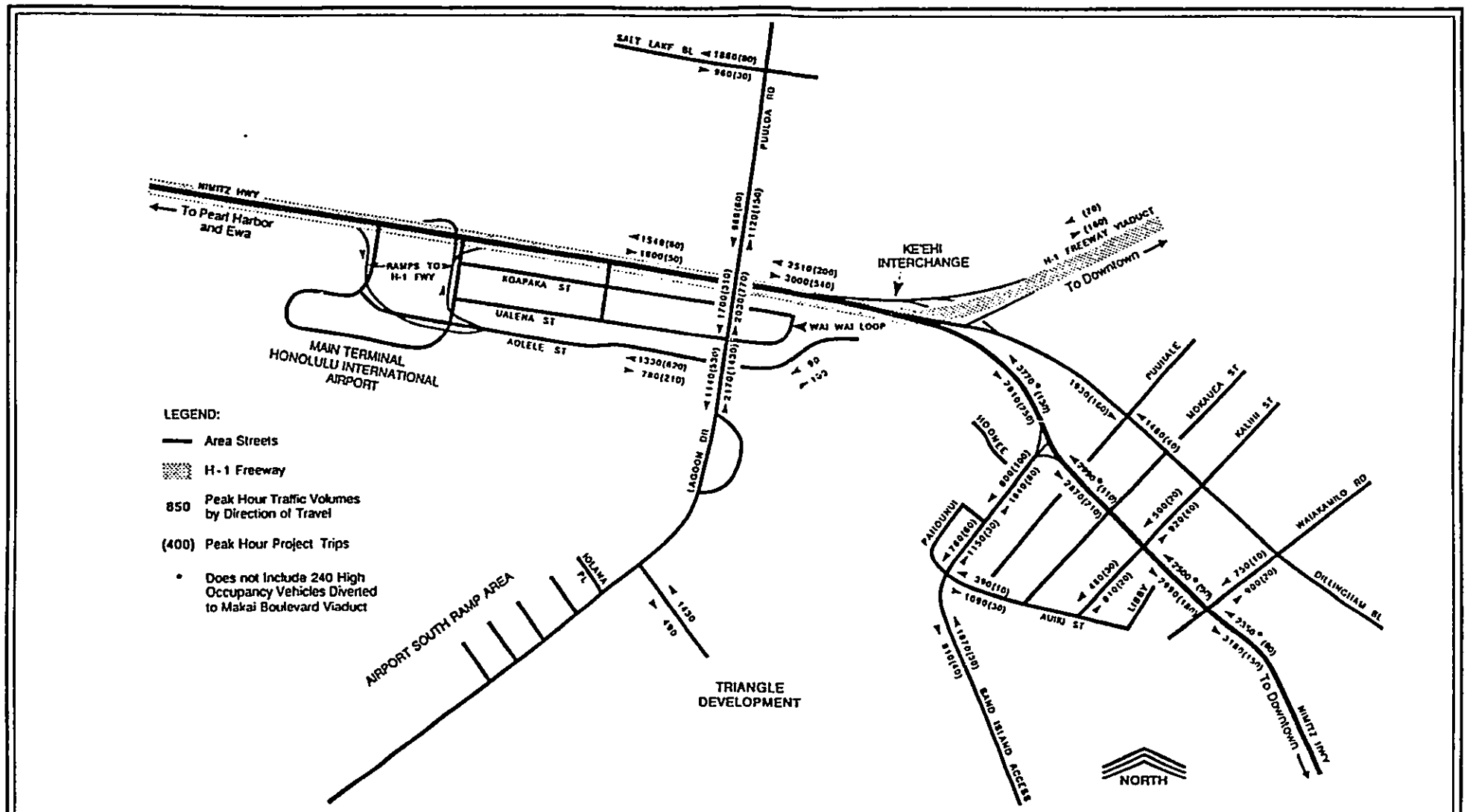
MORNING PEAK HOUR TRAFFIC VOLUMES 1998 WITH PROJECT
Ke'ehi Lagoon Recreation Plan Traffic Impact Study

8



AFTERNOON PEAK HOUR TRAFFIC VOLUMES 1998 WITH PROJECT

Ke'ehi Lagoon Recreation Plan Traffic Impact Study

9

add to the heavy left-turn and right-turn movements between Lagoon Drive and this segment of the Nimitz Highway.

Beyond these roadway segments, project traffic would be dispersed onto many roadways with resultant small proportional traffic increases. The largest increases would be along the Nimitz Highway between the Ke'ehi interchange and the Downtown area.

The project sites on the Kalihi Kai side of the lagoon would add very limited numbers of trips to the major streets serving this area.

Forecast Saturday Traffic - For the Saturday analysis peak hour, the project with a major canoe regatta event is estimated to increase peak hour traffic volumes as follows:

Lagoon Drive	+70%
Sand Island Access Road	+30%
Nimitz Highway, diamond head of Lagoon Drive	+25%
Nimitz Highway, diamond head of Sand Island Access Road	+13%

Traffic Conditions

The large increases in traffic volumes projected for the Lagoon Drive corridor would result in a significant deterioration in peak period traffic conditions with the planned roadway system. In the Kalihi Kai area, the much smaller increases in traffic from the project would contribute to the problem conditions anticipated for several key locations.

The impact of project traffic on key intersections is summarized in Table 7 (Morning Peak Hour) and Table 8 (Afternoon Peak Hour) which present the critical movement volumes and

Table 7
KEY INTERSECTION VOLUME-TO-CAPACITY RATIOS[1]
WEEKDAY MORNING PEAK HOUR
Honolulu Ke'ehi Lagoon Recreation Plan

INTERSECTION	1998 EXISTING		1998 WITHOUT PROJECT		1998 WITH PROJECT	
	CRITICAL VOLUMES	VOLUME-CAPACITY	CRITICAL VOLUMES	VOLUME-CAPACITY	CRITICAL VOLUMES	VOLUME-CAPACITY
Lagoon Drive at:						
Nimitz Highway	1,048	0.75	1,229	0.88	1,507	1.08
Aolele Street[2]	672	0.48	878	0.63	1,520	1.09
Sand Island Access Rd. at:						
Nimitz Highway	1,174	0.84	1,329	0.95	1,372	0.98
Auiki Street	1,224	0.87	1,683	1.20	1,703	1.22
Nimitz Highway at:						
Kalihi Street	1,498	1.07	1,550	1.11	1,590	1.14
Waiakamilo Rd.	1,522	1.09	1,122	0.80	1,139	0.81

1 Ratios exceeding 1.00 indicate traffic volumes that exceed estimated capacity of the intersection, based on a theoretical capacity of 1,400 vehicles for summation of critical conflicting traffic movements per lane.

2 Represents conditions if intersection is traffic-signal controlled.

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Table 8
KEY INTERSECTION VOLUME-TO-CAPACITY RATIOS[1]
WEEKDAY AND SATURDAY AFTERNOON PEAK HOURS
Honolulu Ke'ehi Lagoon Recreation Plan

INTERSECTION	EXISTING SUM OF CRITICAL VOLUME	EXISTING VOLUME/ CAPACITY RATIO	1998 WITHOUT PROJECT SUM OF CRITICAL VOLUME	1998 WITHOUT PROJECT VOLUME/ CAPACITY RATIO	1998 WITH PROJECT SUM OF CRITICAL VOLUME	1998 WITH PROJECT VOLUME/ CAPACITY RATIO
Weekday Conditions						
Lagoon Drive at:						
Nimitz Highway	1,046	0.75	1,184	0.85	1,827	1.31
Aolele Street[2]	805	0.58	945	0.68	1,770	1.26
Sand Island Access Rd. at:						
Nimitz Highway	1,225	0.88	1,385	0.99	1,460	1.04
Auiki Street	927	0.66	1,451	1.04	1,496	1.07
Nimitz Highway at:						
Kalihi Street	1,304	0.93	1,290	0.92	1,387	0.99
Waiakamilo Road	1,500	1.07	1,247	0.89	1,285	0.92
Saturday Conditions[3]						
Nimitz Highway at:						
Lagoon Drive	662	0.47	749	0.54	999	0.71
Sand Island Access Rd.	819	0.59	927	0.66	1,165	0.83

1 Ratios exceeding 1.00 indicate traffic volumes that exceed estimated capacity of the intersection, based on a theoretical capacity of 1,400 vehicles for summation of critical conflicting traffic movements per lane.

2 Represents conditions if intersection is traffic signal-controlled.

3 Represents 2:00 PM to 3:00 PM period.

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volume-capacity ratios for existing conditions, and anticipated 1998 conditions both with and without the proposed project. Key findings regarding impacts at these and other locations are as follows:

o Lagoon Drive-Nimitz Highway Intersection

1. The project would substantially increase the left-turn traffic volume from Nimitz Highway to Lagoon Drive. For the morning peak hour, the future left-turn volume is estimated at 1,360 vehicles, double the 690 vehicles at present. This increase is largely responsible for increasing morning peak hour volumes above the intersection's theoretical capacity.

2. The project would substantially increase the volume of right-turn vehicles from Lagoon Drive onto the Nimitz Highway. In the afternoon peak hour, the right-turn volume is estimated to increase from 780 vehicles at present, to 1,420 vehicles with the project. This right-turn volume exceeds the capacity of the current "free" right-turn lane, particularly since one-half or more of these vehicles must weave across the two makai lanes on Nimitz Highway to reach the lanes continuing onto Dillingham Boulevard and H-1 Freeway.

Without this right-turn problem, the volume-capacity ratio in the afternoon period is 0.99, which represents congested conditions with traffic volumes approximating the intersection's capacity.

3. The left-turns from the through lane of Lagoon Drive onto the mauka segment of Waiwai Loop (opposite Koapaka Street) would likely become extremely disruptive to intersection operations with frequent blocking of the

heavy left-turn movement into Lagoon Drive and stacking vehicles through the Nimitz Highway intersection. The problem would worsen as increased mauka-direction traffic on Lagoon Drive requires longer waits for gaps by vehicles turning left into Waiwai Loop, and thus longer periods when one of the two makai direction lanes is blocked.

- Lagoon Drive - Aolele Street Intersection

  1. The large increases in traffic volumes on these two streets would result in extensive delays to Aolele Street traffic and necessitate installation of traffic signal controls.

  2. With traffic signal controls, the projected volumes exceed intersection capacity for both the morning and afternoon peak hours. This is largely a result of the heavy left-turn movements from Aolele Street, with approximately 400 vehicles in each peak hour, and from Lagoon Drive onto Aolele Street, which is estimated at over 800 vehicles in the afternoon peak hour.

- Aolele Street

  1. The projected peak hour volumes on Aolele Street exceed volume levels that can generally be accommodated by a two-lane roadway, even with the large degree of access control along this street.

  2. Left-turn movements by airport-related traffic to the driveways on the airport side of the road would likely result in significant delays to ewa-direction traffic.

- Koapaka and Ualena Streets

  Left-turn movements from these two streets would likely experience lengthy delays in turning onto Lagoon Drive, particularly in the afternoon periods when traffic on these streets occurs in surges as employees leave work. Installation of a traffic signal at Aolele Street may provide gaps in Lagoon Drive traffic to assist in making these left-turn movements.

- Triangle Bridge and Roads

  1. The estimated numbers of trips generated from the Triangle Development would require two travel lanes to serve peak direction traffic. A single four-lane bridge should be provided for access. However, a single two-lane bridge might be sufficient if a much small development area or less intensive land uses, such as a golf course, are placed on the Triangle.

  2. Given the estimated traffic volumes and patterns, the Triange Bridge connection should be made to the ewa side of the lagoon and connect to Lagoon Drive. This connection provides excellent access to the H-1 Freeway via Aolele Street (to/from the west) and Nimitz Highway (to/from the east). Also, it is expected that much of the Triangle land uses will be airport-oriented and thus more efficiently served by a bridge to the ewa side of the lagoon.

     The resultant large increases of traffic would require significant roadway improvements on Lagoon Drive and on Aolele Street. Even with these improvements, the estimated traffic volumes would likely approximate the

capacity of the Lagoon Drive - Nimitz Highway intersection.

3. The key Kalihi Kai area intersections are expected to be operating at or near capacity by 1998 even with the planned Nimitz Highway improvements. Therefore, a crossing from the Triangle Development to the Kalihi Kai shoreline could not be effectively utilized for access unless there is a major increase in roadway capacity through the Kalihi Kai area. Such a capacity increase could be provided by the Sand Island Freeway-Harbor Tunnel as discussed in the Honolulu Waterfront Master Plan. However, it is unlikely that the Sand Island Freeway could be constructed within the 5 to 10-year time frame needed to serve the Triangle Development.

   If the Triangle Development bridge should be constructed to the Kalihi Kai side, the most likely connection would be from the northernmost point of the Triangle to the Ameron Plant - Pier 60 area to connect with Pahounui Drive and Auiki Street. This would require acquisition of right-of-way to connect to Pahounui Drive, and the widening of a short section of Pahounui Drive and all of Auiki Street to a major street cross section.

4. Estimated traffic volumes to and from the Triangle are approximately double those projected for the Airport South Ramp area along Lagoon Drive (without an air museum). The large volume of turning traffic to and from the Triangle Bridge roadway would require special locational and design considerations for the intersection with Lagoon Drive.

- Nimitz Highway - Sand Island Access Road

  The increase of project traffic would result in a slight deterioration of traffic conditions. However, the intersection would be operating at its theoretical capacity and would require further improvements, with or without the Ke'ehi Lagoon projects.

- Nimitz Highway - Kalihi Street

  Even with the planned improvements, projected traffic volumes at this intersection would equal or exceed its theoretical capacity. Project traffic could substantially impact intersection conditions during the afternoon peak hour. This intersection requires further improvements with or without addition of Ke'ehi Lagoon project traffic.

- Nimitz Highway - Waiakamilo Road

  The extensive improvements planned for this intersection would accommodate the estimated increase in traffic volumes.

- Sand Island Access Road - Auiki Street

  The projected 1998 traffic volumes exceed this intersection's theoretical capacity, both with and without the project. The project would result in a minimal impact on conditions at the intersection.

o Hoonee Place

1. Use of this street by traffic exiting the Hawaiian Canoe Center could significantly lengthen the delays currently experienced by traffic turning left from Hoonee Place onto Sand Island Access Road during the afternoon peak traffic period.

2. When a major canoe regatta is being held at Ke'ehi Lagoon, large volumes of traffic exiting this street during Saturday and Sunday afternoon hours may require special control of the intersection with Sand Island Access Road.

POTENTIAL MEASURES TO IMPROVE AREA TRAFFIC CONDITIONS

Potential measures were identified to mitigate the anticipated impacts of project traffic, and to improve access to the project sites. These measures reflect the expected land uses, travel growth, and impacts as identified in the earlier section of this report. Additional mitigation measures may be necessary if activities which generate higher traffic volumes are located within the area, such as the proposal for an air museum in the Airport's South Ramp area.

The following section discusses the principal measures proposed to mitigate traffic impacts primarily attributable to the Ke'ehi Lagoon Recreation Plan projects. A second section follows which outlines other measures which could improve conditions at other problem locations on access routes, but where the need for the improvement is not primarily attributable to the Ke'ehi Lagoon Recreation Plan. Volume-capacity ratios with the roadway modifications are summarized in Table 9.

I. PROPOSED MEASURES TO MITIGATE PROJECT IMPACTS

Triangle Bridge to Lagoon Drive

Given the estimated travel volumes and patterns, a single bridge crossing to Lagoon Drive is proposed as the most cost-effective means of serving the Triangle Development area. The resultant large increase of traffic on Lagoon Drive would require significant roadway improvements in the section near Nimitz Highway. Even with improvements, much of the traffic that would desire to use Lagoon Drive for access to the Koapaka Street-Ualena Street area during the morning peak hour may be forced to seek alternative routes via Ohohia and Paiea Streets, or

Table 9

KEY INTERSECTION VOLUME-TO-CAPACITY RATIOS[1]
1998 WITH PROJECT AND ROADWAY IMPROVEMENTS
WEEKDAYS
Honolulu Ke'ehi Lagoon Recreation Plan

INTERSECTION	MORNING PEAK HOUR SUM OF CRITICAL VOLUMES	MORNING PEAK HOUR VOLUME/ CAPACITY RATIO	AFTERNOON PEAK HOUR SUM OF CRITICAL VOLUMES	AFTERNOON PEAK HOUR VOLUME CAPACITY RATIO
Lagoon Drive at:				
Nimitz Highway	1,479	1.06	1,327	0.95
Aolele Street	1,137	0.81	965	0.69
Triangle Bridge Rd.	N/A	N/A	980	0.70
Sand Island Access Road at:				
Nimitz Highway	1,279	0.91	1,280	0.91
Auiki Street	940	0.67	1,025	0.73
Nimitz Highway at:				
Kalihi Street	1,300	0.93	1,292	0.92

1 Ratios exceeding 1.00 indicate traffic volumes exceed estimated capacity of intersection, based on a theoretical capacity of 1,400 vehicles for summation of critical conflicting traffic movements per lane.

N/A = Not available.

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experience increased congestion along the mauka end of Lagoon Drive.

The following features are proposed regarding the bridge to Lagoon Drive:

1. Given the proposed Triangle development land uses and estimated volumes, a four-lane bridge appears to be necessary.

2. The bridge should intersect Lagoon Drive at either:

   1) Iolana Place; or
   2) At a location 350 feet (minimum) to 700 feet (preferable) mauka of Iolana Place.

   Location #2 is preferable if it would result in a "T" intersection.

3. Two left-turn lanes from Lagoon Drive and two right-turn lanes from the bridge road would be necessary at their intersection to accommodate the forecast volumes. A traffic signal would be required.

4. On the Triangle Island, the bridge should "line up" with a roadway extending across to the makai side of the Triangle area in order to minimize the traffic "forced" onto the waterfront roadway adjacent to the Triangle marina.

5. A major east-west "spine" roadway should be added to the interior of the Triangle to assist in dispersal of traffic away from the waterfront roadways.

Lagoon Drive

The Ke'ehi projects are expected to significantly increase traffic volumes along Lagoon Drive, with the projected volumes exceeding the capacities of the Nimitz Highway and the Aolele Street intersections. Roadway modifications to mitigate impacts include the following:

At Nimitz Highway - Intersection operations could be improved by:

1. Widen Lagoon Drive to provide an additional right-turn lane onto the Nimitz Highway. The two right-turn lanes would turn between the same viaduct columns as at present with the new lane continuing as a "free-flow" into the existing makai-lane on the Nimitz Highway, while the current right-turn lane would be controlled by the traffic signal. If the curb radius and column separation do not permit a "free-flow" movement, then both right-turn lanes may have to be signal-controlled, with a "right-turn-on-red" permitted from the curb lane.

2. Widen the Puuloa Road approach by one lane to provide two exclusive left turn lanes and two exclusive through lanes, plus the right-turn lane.

3. Prohibit the left-turn movement from Lagoon Drive onto the mauka end of Waiwai Loop.

4. Prohibit the left-turn and through movements from the mauka end of Waiwai Loop, restricting this end to right-turn-in/right-turn-out with raised channelization.

5. Prohibit left-turn and through movements (to Waiwai Loop) from Koapaka Street at Lagoon Drive.

Items 3, 4 and 5 are needed to reduce blockage of Lagoon Drive lanes by vehicles making these movements at the Waiwai Loop - Koapaka Street intersection. Vehicles turning left from or continuing straight across these cross streets often cross to the middle of Lagoon Drive and wait for a gap in the traffic to complete their maneuver. While stopped in the middle of the street, these vehicles block one lane due to the narrow median width at this location.

These modifications would result in a morning condition with volumes still above the theoretical capacity of the Nimitz Highway-Lagoon Drive intersection. Further improvement (to 0.90) could be obtained by permitting left-turns from the inner-most ewa direction through lane of Nimitz Highway. However, this would require widening Lagoon Drive by one lane on the ewa side from Nimitz Highway to Koapaka Street, and utilize the less than desirable practice of three left-turn lanes at a four-way, right-angle intersection.

Therefore, the morning condition will likely require longer delays for most vehicles at this intersection, or require that some of the motorists use an alternative route, such as Ohohia Street to reach the area makai of Nimitz Highway.

At Valena Street - Traffic operations could be improved at this intersection by:

1. Removing parking from the ewa side of Lagoon Drive to improve sight distances, and to provide a right-turn lane:

2. Removing parking along the curb of Ualena Street and Waiwai Loop (makai end) to provide a right-turn lane, and a combined through/left-turn lane on these approaches; and

3. If the installation of a traffic signal at Aolele Street does not provide sufficient gaps in Lagoon Drive traffic, then a traffic signal may eventually be required at this intersection.

At Aolele Street - The following modifications, in order of importance/ease of implementation, would improve operations at this intersection:

1. Provide a makai-direction left-turn lane into the park roadway.

2. Install traffic signal controls, and widen the Aolele Street approach to provide two left-turn lanes, with the through movement to the park made from the left-turn lane instead of from the right-turn lane as at present.

3. Widen the mauka-direction approach of Lagoon Drive to provide two left-turn lanes for the movement onto Aolele Street.

Present traffic volumes at Aolele Street currently satisfy the "Minimum Vehicular Volume" warrant for permitting installation of a traffic signal.

Aolele Street

The projected traffic volumes indicate that Aolele Street should be widened to a four lane roadway from Lagoon Drive to the H-1 ramp/Paiea Street area.

Ohohia Street

Extension of Ohohia Street through to Aolele Street would provide an alternative route for some traffic that would otherwise use Lagoon Drive. This extension could divert traffic from Lagoon Drive that is either traveling between Koapaka/Ualena Street and the Airport areas, or between Nimitz Highway and the airport activities along Aolele Street. This extension may be necessary at some future date when the traffic generated by the Triangle Development, South Ramp, and other Lagoon Drive activities reach or exceed the volumes projected in this analysis.

If Ohohia Street is extended to Aolele Street, it would be desirable to locate a major entrance to the Airport support activity area opposite Ohohia Street.

Hoonee Place

The traffic to/from the Hawaii Canoe Center and canoe race course spectator area would result in a significant increase in delays for traffic turning left from Hoonee Place onto Sand Island Access road. These delays would likely reach unacceptable levels on days when races or special events are being held at these facilities.

This intersection is located too close to the Nimitz Highway intersection to permit installation of traffic signal controls. Therefore, police traffic control of the intersection would be necessary when major canoe races or other events are being held.

A future roadway connection from the canoe race course spectator area to Pahounui Drive is desirable to enable spectator traffic to exit at the Pahounui Drive intersection with Sand Island Access Road and Auiki Street, which is controlled by a traffic signal. The State should monitor any redevelopment of the private properties between the waterfront area and Pahounui Drive and seek to obtain a right-of-way or easement to provide such a roadway connection, if feasible.

Public Transportation

The proposed Triangle and South Ramp land uses would be major employment areas, and may attract sizeable numbers of visitors. These areas should be served by a public bus service to avoid dependance on the private automobile.

A shuttle service could be provided to connect to TheBus trunk route system serving the Nimitz Highway-Dillingham Boulevard corridor, and to a station of a regional transit gateway when such a system is developed to serve this corridor ewa of Downtown Honolulu. The shuttle bus service could connect to TheBus system via either the Airport terminal (Routes 19 and 20) or at Middle Street (Routes 1, 2, 3, 13, 19, 20 50, 51, and 52).

Opportunities for providing commuter express bus service from outlying suburban communities should be tested to determine those areas with sufficient demand to merit such services.

Staggered Work Hours

The trip forecasts represent a conservative estimate of travel to and from the new developments since this analysis assumes that the peak travel requirements will occur during the same one-hour period. Area business and public agencies should

be encouraged to adopt flexible hours where possible, or schedule shift hours to avoid the most congested time periods.

II. OTHER MEASURES TO IMPROVE ACCESS TO PROJECT AREA

Sand Island Access Road

Although the Ke'ehi Lagoon project would add minimal weekday traffic to this roadway, the congested conditions will likely affect access to the project. Several improvements are possible to ameliorate conditions.

At Nimitz Highway - Long-term improvement at this intersection is dependent upon major grade-separation of a portion of the conflicting traffic. This could be through the currently planned grade-separation of the eastbound lanes over the left-turn movements to and from Sand Island, or through a Sand Island Freeway-Harbor Tunnel facility which would be elevated on a viaduct facility through this area. Such roadway projects are not likely to occur for 10 to 20 years.

A nearer-term improvement could be obtained by widening mauka-direction Sand Island Access Road to provide three left-turn lanes. This would require signing of the rightmost of the three lanes for traffic to Nimitz Highway to reduce weaving in the short distance to the Ke'ehi interchange.

This would improve the intersection volume-capacity ratio from 0.98 to 0.91 and 1.04 to 0.91 for the morning and afternoon peak hours, respectively.

At Auiki Street - This intersection could be improved by the following measures:

1. Prohibit parking along the makai curb of Pahounui Drive to provide a separate left-turn lane.

2. Prohibit parking along the mauka curb of Auiki Street to provide two approach lanes, one for left-turns and the second for through traffic, left turns, or right turns.

3. Widen the makai leg of Sand Island Access Road to provide a right-turn lane for mauka-direction traffic to turn onto Auiki Street.

4. Widen the mauka leg of Sand Island Access Road to provide a second left-turn lane, for makai-direction vehicles to turn left onto Auiki Street. Parking would have to be restricted along the makai-side curb of Auiki Street to receive the two lanes of left-turning traffic.

It is desirable to prohibit parking along the makai-side curb the length of Auiki Street in order to allow through traffic to pass vehicles stopped to make left-turns.

Nimitz Highway - Kalihi Street Intersection

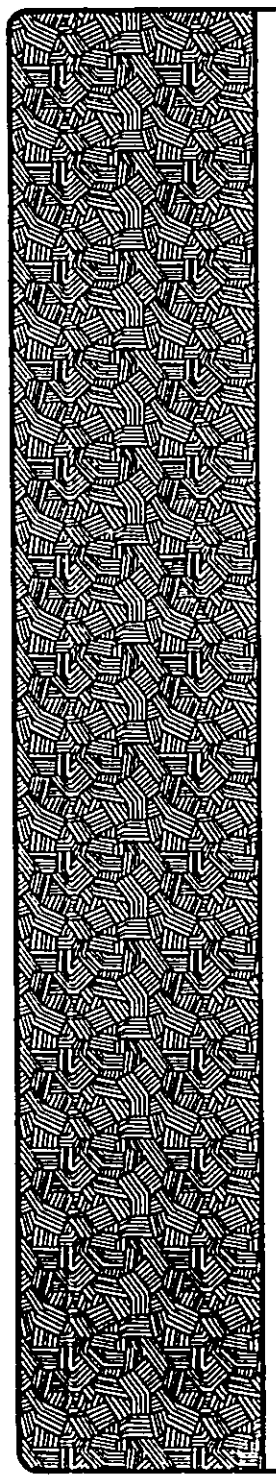
The mauka leg of Kalihi Street could be widened to provide an additional lane for makai-direction traffic travelling straight through or turning right at this intersection. Kalihi Street is planned for eventual widening to four lanes. However, the widening of a short section at this intersection could provide a 15 percent improvement on overall traffic conditions at this intersection.

Auiki Street Extension

Auiki Street could be extended northeastward from its present terminus at Libby Street to intersect Nimitz Highway at Waiakamilo Road. This connection would reduce left-turn movements from the ewa direction on Nimitz Highway onto the Kalihi Kai streets makai of the highway. This connection would also improve access to the Kapalama Military Reservation area to accommodate more intensive future usage of this area.

APPENDIX F

Utilities Master Plan



UTILITY MASTER PLAN

FOR

KE'EHI LAGOON RECREATION DEVELOPMENT PLAN

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May, 1989

UTILITY MASTER PLAN

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May, 1989

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

This report is prepared for Edward K. Noda and Associates and considers utility requirements for proposed developments in or along Ke'ehi Lagoon. Utility requirements investigated include sewer, water, drainage, electrical and telephone utility systems. Utility requirements for each area were calculated separately according to proposed uses and appropriate agency standards. Where possible, utility data from existing land areas under uses similar to those proposed was obtained and used to generate projected demands.

The developments are proposed to be sited a four locations: along the Ke'ehi Lagoon shoreline fronting Lagoon Drive, a new lagoon island to be created by dredged fill within the Lagoon; a site between the confluence of Moanalua and Kalihi Streams including additional public amenities on the Kalihi Kai shoreline of Ke'ehi Lagoon, and a fourth site at the existing Pier 60 facility. The sites are referred to as the Lagoon Marina, Lagoon Island, Hawaiian Canoe, and Pier 60 sites respectively.

The scope and background of the improvements is covered in greater detail in the December 1987 report entitled "Ke'ehi Lagoon Recreation Development Plan" prepared by Edward K. Noda and Associates for the Fourteenth State Legislature. The general parameters of each site are reviewed briefly herein.

Water service for the Lagoon Marina Site may be made available from the Department of Transportation, Airports Division system within the South Ramp area. The Hawaiian Canoe Center, and Pier 60 sites may be serviced from existing local water mains. Water to serve the Lagoon Island site may be made available from the City Board of Water Supply system, however due to the quantity which will be required, the developer of this site will be called upon to participate directly or indirectly in expansion of BWS water storage facilities.

Sewer connection to the existing City sewage collection system is presently unavailable for all sites. The four sites considered lie within the service area of an aging sewer interceptor along Nimitz Highway which has reached capacity. Relief line construction will not be possible with City funding for several years. Potential developers of any of the four sites may consider privately funding the needed relief line in exchange for future compensation by the City.

Alternatively, it may be considered to establish a new submarine force main from the largest development site, the Lagoon Island, to cross Ke'ehi Lagoon to the Pier 60 site and continue to the Sand Island Sewage Treatment Plant. Construction of this line will be somewhat more costly than connection to the existing City system, assuming that the City funds the relief line along Nimitz Highway. Additionally, the coordination between City and State agencies and private developers benefitting from the construction will be complex. Private construction

of a new relief line along Nimitz Highway or submarine line crossing Ke'ehi Lagoon appears to be the only immediate means of obtaining a sewer connection at the four development sites.

Electrical and telephone utilities will be available to the four development sites.

PROPOSED KE'EHI LAGOON RECREATION DEVELOPMENT PLAN

The overall plan for Ke'ehi Lagoon has been finalized as part of the "Ke'ehi Lagoon Recreation Development Plan" and coordinated with ongoing Honolulu Waterfront Master Plan efforts. The major planned improvements will occur at four sites described below. In that the sites are to be developed through the private sector to the maximum extent possible, with the exception of a portion of the Hawaiian Canoe Center, the site descriptions are general in nature and provide a framework for the intended use of the sites. The determinations for water, sewer and drainage utility requirements are based on the conceptual descriptions provided, and form an envelope for the utilities considered. Phasing and market considerations, lease agreements with the State of Hawaii, and other requirements which are imposed on private developers and individual tenants may all serve to modify utility infrastructure requirements.

PROPOSED DEVELOPMENT

The proposed extensive development of Ke'ehi Lagoon includes a large marina, space for commercial and light industrial development, extensive yacht racing and ocean sports facilities, maritime commercial uses, a terminal for the proposed intra-island ferry system, extensive canoe racing facilities, and park lands. It is also proposed to relocate the University of Hawaii Marine Expeditionary Center (Snug Harbor). The proposed improvements are distributed along the west shoreline of Ke'ehi Lagoon, along the northeast shoreline at the existing Ke'ehi Park to the existing Ke'ehi marina and on an island to be constructed in the Lagoon. An overall view of the proposed improvements is shown in Figure 1.

Proposed land use areas are identified as the Lagoon Drive Marina, Lagoon Island, Hawaiian Canoe Center, and Pier 60 Marina in the Ke'ehi Lagoon Recreational Development Plan. Each site is described in it's existing and developed condition and a schematic of the conceptual site presented below.

LAGOON DRIVE MARINA SITE

The Lagoon Drive Marina site consists of a strip of land between Lagoon Drive and the former Seaplane Runway, now simply a part of Ke'ehi Lagoon. The existing strip of land is approximately 4,000 feet long and up to 50 feet wide. A marina of approximately 680 slips is proposed, with filling along the shoreline to increase the fast land width to about 300 feet. At the seaward end, a landing site for the intra-island ferry is identified. Auxiliary structures consisting of administration buildings, comfort stations, a boat launch facility, fuel dock, restaurant/snack bar, retail marine supplies, and other concessions are proposed. A schematic layout of the Lagoon Drive Marina is shown in Figure 2.

LAGOON ISLAND SITE

The Lagoon Island is proposed to be created over a shallow reef area within the Lagoon. Surrounding dredged areas are to be deepened and fill material used to create approximately 250 acres of land area. A four-lane bridge will connect the island to Lagoon Drive.

House Concurrent Resolution Number 386 has authorized private lease development of the lands and specified certain uses and their relative proportions. Figure 3 depicts the proposed land uses for the Lagoon island under the Ke'ehi Lagoon Recreation Development Plan.

Approximately 19 acres on the south and east shores of the island are designated for park use. The park will provide an attractive greenbelt to the island and may serve as a viewing area for water sports and maritime activities as well as general recreation and relaxation.

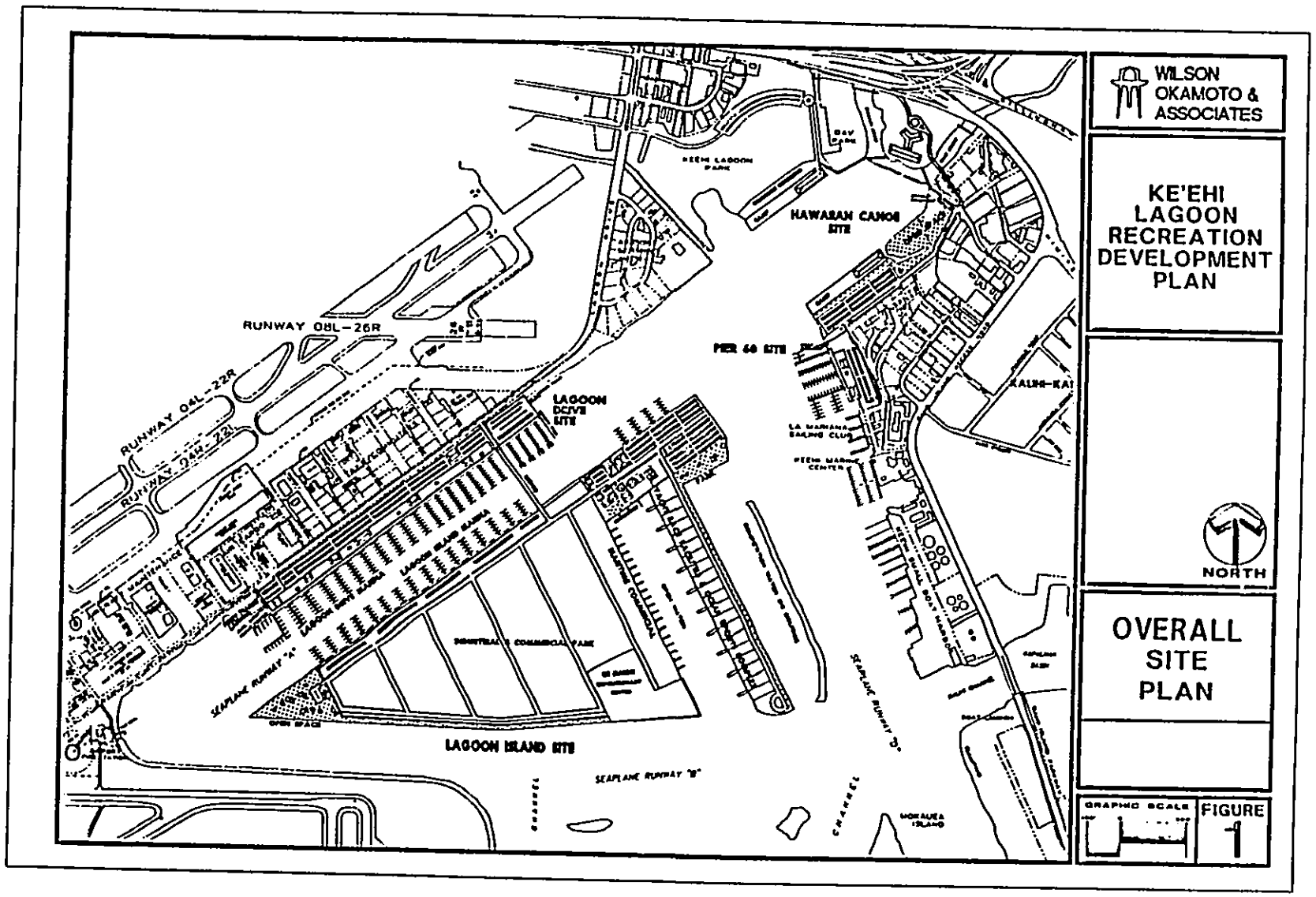
A 350-slip marina is planned for the west shore of the lagoon island, with approximately 14 acres of boat slips and a similar area allocated to onshore parking and support facilities including comfort stations, administration and utility storage structures.

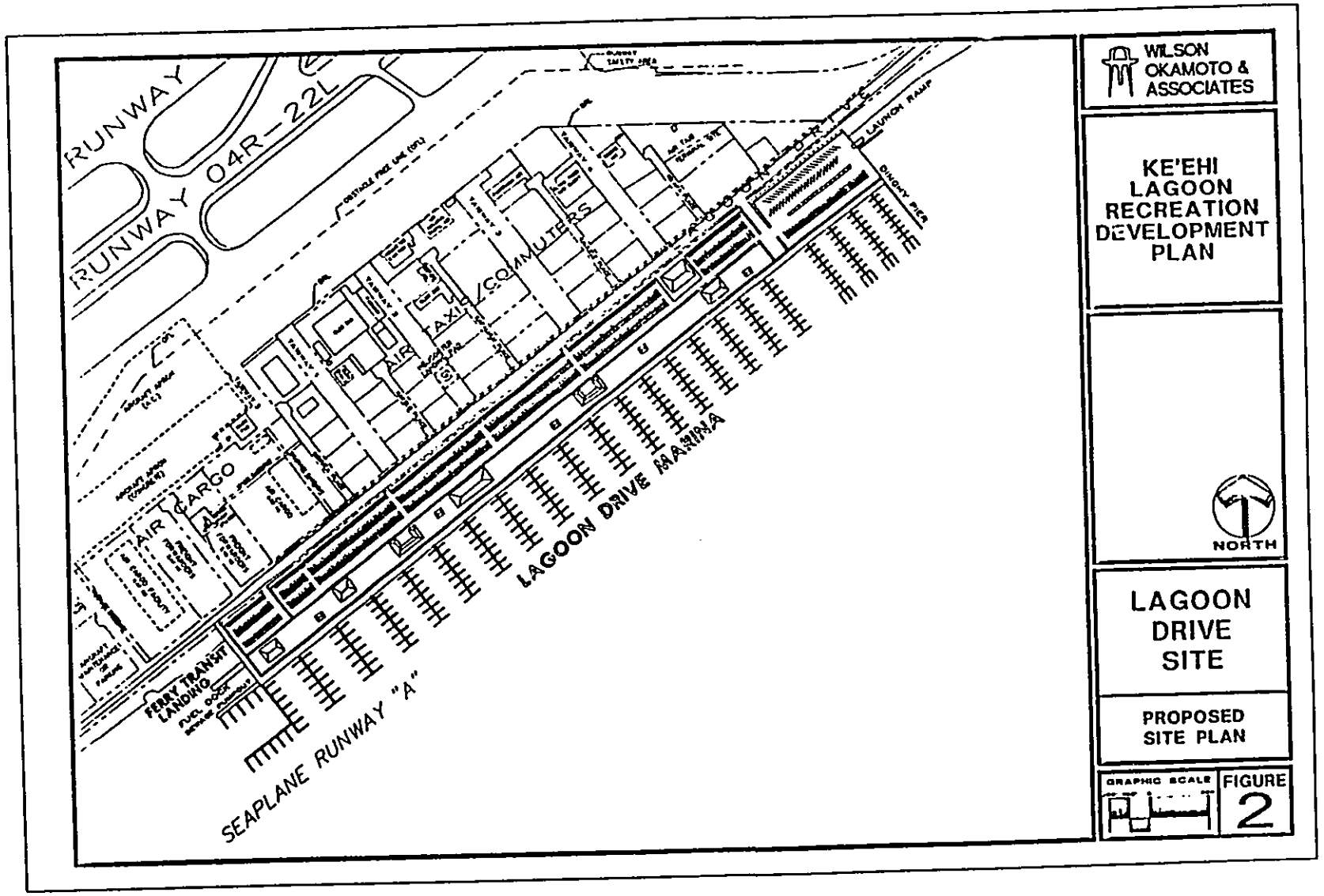
A 48-acre yacht race/ocean sports complex with 13 acres of berthing is identified for the east shore of the lagoon island. This facility enables Hawaii to remain in contention for hosting major international yacht racing events, and will relieve the influx of race boats and provide better facilities for established events including the Transpacific Race and Kenwood Cup.

Opposite the yacht race complex, 16 acres are designated for maritime commercial use, including cruise and tour boat operations, commercial fishing and catch transshipment, and other commercial operators requiring shallow draft vessel operations. Seven acres are devoted to berthing.

Approximately 15 acres of the Lagoon island are allocated for relocation of the University of Hawaii Marine Expeditionary Center.

Approximately 119 acres of the Lagoon island interior is designated for commercial and light industrial development. Typical occupants of this space may be aviation-related depending on proximity to the airport, ocean related in conjunction with the extensive marina and berthing spaces provided on the island, or other light industrial uses. The area lies inside a perimeter road and may be divided into five blocks by interior roadways as shown in Figure 3.


WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
OVERALL SITE PLAN
GRAPHIC SCALE
FIGURE 1
RUNWAY 08L-26R
RUNWAY 04L-22R
RUNWAY 04R-22L
HAWAIIAN CANOE SITE
PIER 44 SITE
LAGOON DRIVE SITE
KALIH-KAI
LAGOON ISLAND SITE
SEAPLANE RUNWAY "A"
SEAPLANE RUNWAY "B"
SEAPLANE RUNWAY "D"
CHANNEL
MOKAUEA ISLAND


RUNWAY 04R-22L
AIR TAXI/COMMUTERS
AIR CARGO
FERRY TRANSIT LANDING
LAGOON DRIVE MARINA
SEAPLANE RUNWAY "A"
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
LAGOON DRIVE SITE
PROPOSED SITE PLAN
GRAPHIC SCALE
FIGURE 2

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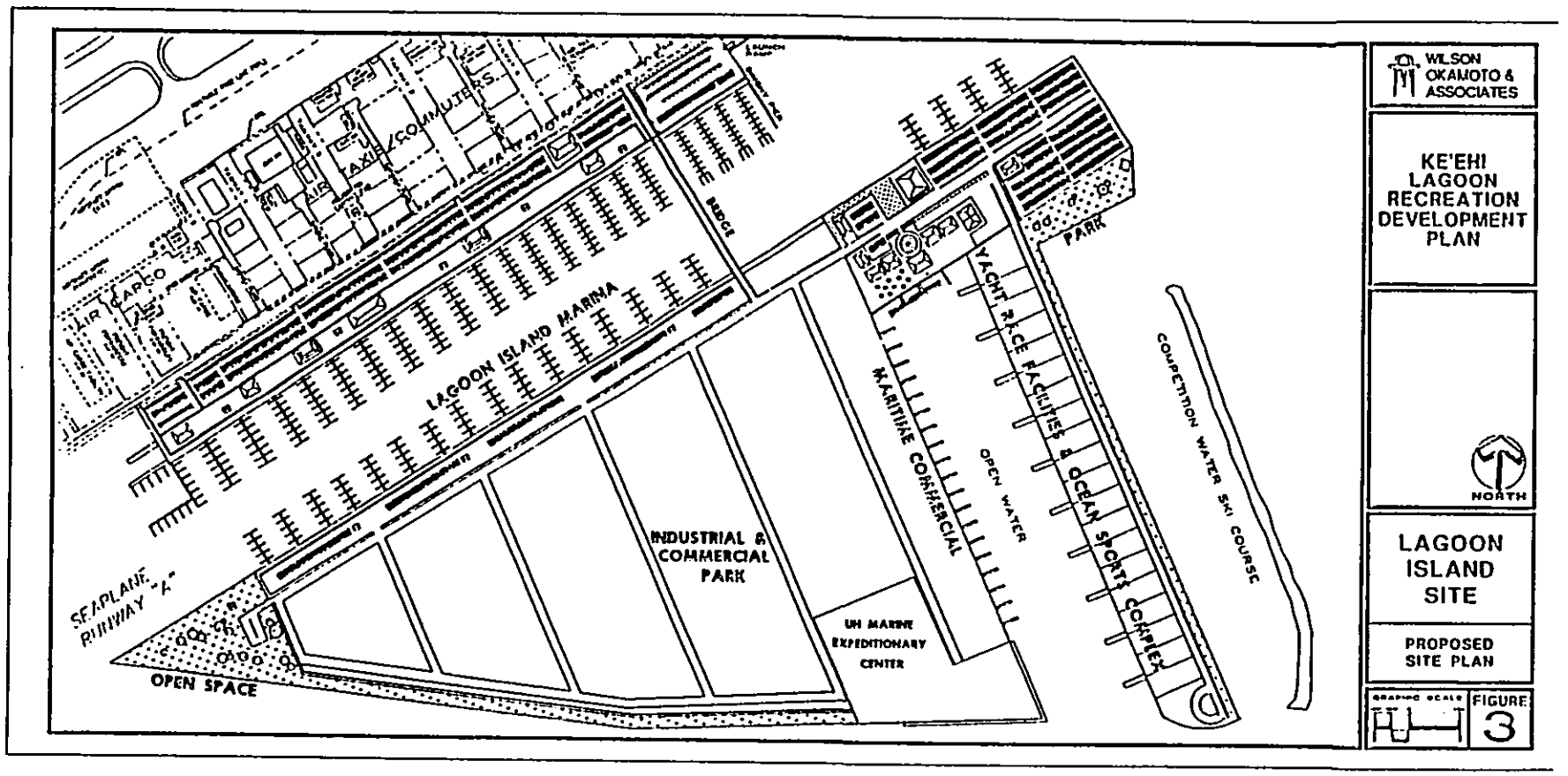
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
LAGOON ISLAND SITE
PROPOSED SITE PLAN
GRAPHIC SCALE
FIGURE 3
LAGOON ISLAND MARINA
AIR CARGO
AXI/COMMUTER AS.
MARINE BRIDGE
PARK
YACHT RACE FACILITIES & OCEAN SPORTS COMPLEX
MARITIME COMMERCIAL
OPEN WATER
COMPETITION WATER SKI COURSE
INDUSTRIAL & COMMERCIAL PARK
UH MARINE EXPEDITIONARY CENTER
SEAPLANE RUNWAY "A"
OPEN SPACE

HAWAIIAN CANOE CENTER SITE

The northeast shore comprises an area of approximately 16 acres of reclaimed and fill land bounded by Kalihi and Moanalua Streams, and Kamehameha Highway. The site currently consists of roughly level land at elevations ranging from three to ten feet above sea level. Additional improvements are planned to fill and straighten the shoreline along Ke'ehi Park and the opposite Kalihi Kai shore to provide improved access and use of the canoe race course. A canoe race course is proposed for the bay of the Lagoon fronting Ke'ehi Park. Facilities accompanying the race course include an Hawaiian Canoe Center between the confluence of the two streams, canoe ramps, canoe sheds, viewing stands, comfort stations and parking on the Park and Sand Island side shores. Improved access via pedestrian bridges between the Park, central portion, and Kalihi Kai shorelines is also proposed. A schematic layout of the facility is shown in Figure 4.

PIER 60 SITE

The expansion of small boat harbor facilities along the entire east shore of Ke'ehi Lagoon was recommended in the 1977 Recreational Plan. Development of a new marina (or expansion of the existing privately developed Ke'ehi Marine Center and La Mariana) would fulfill the plan. The site is flat, with a bulkhead at the Lagoon edge, and is currently used by Ameron to offload sand and gravel for it's nearby concrete batch plant. The site consists of approximately 450 feet of lowlying earthfill dock behind an existing bulkhead. It is proposed to develop approximately 185 slips at the Pier 60 site, and provide for shoreside amenities. The actual number of slips may vary with the developer's final site plan. Ashore, facilities may include a boatyard, marine supply store, eatery, or dry storage area. Figure 5 shows the schematic layout of the proposed Pier 60 site development.

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CHAPTER I UTILITY REQUIREMENTS - WATER

Water requirements for the different areas are determined in accordance with the "Water System Standards", Volume 1, of the Hawaii, Maui and Kauai County Departments of Water Supply, and the Honolulu City and County Board of Water Supply. The Standards outline three means of calculating water demand for new developments. A basic rate of 80 gallons per capita per day is assumed. Where occupancy is unknown but a land use type may be identified, per acre consumption rates are given. If appropriate, established water use rates for comparable facilities may be used.

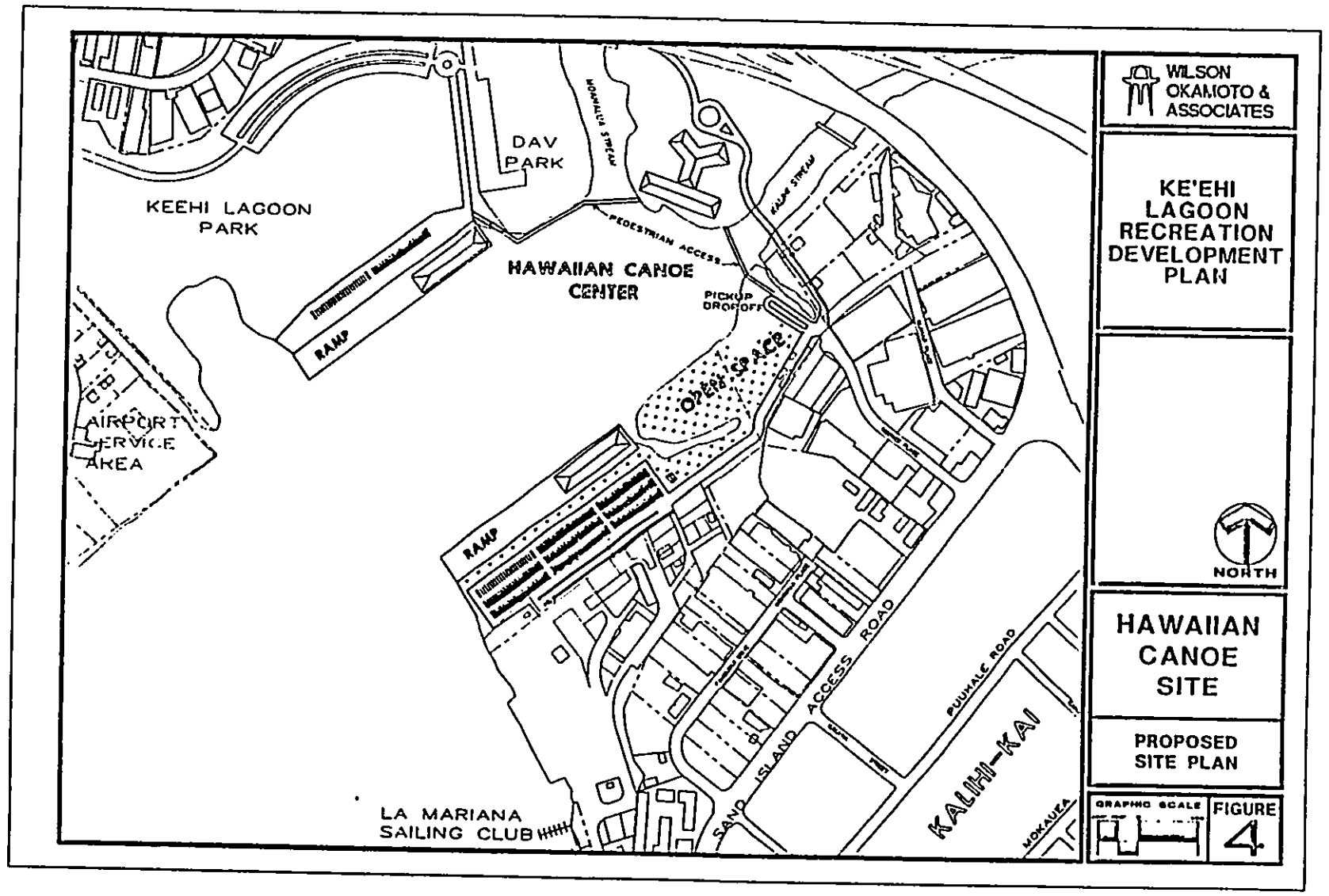
For calculation of water demand for marina developments, metered consumption at Ala Wai, Haleiwa, and Kewalo harbors determined from Board of Water Supply billing data were used. Water demand rates used are listed below in Table 1.

Water system design and sizing parameters for quantity of flow, pipeline sizing, and fire protection are given in the Standards. The average daily water usage is the product of flowrate and area under each proposed use. The maximum daily usage is one and a half times the average daily demand, and the peak hour flow rate is three times the average daily rate. Required fire flows, minimum flowrate, fire duration, and hydrant spacing are related to development type. Waterlines are sized to convey maximum daily flow plus fire flow with a residual pressure of 20 psi at the critical fire hydrant, and carry peak hour flow with a minimum residual pressure of 40 psi. Maximum velocity in mains without fire flow is 6 feet per second. Maximum pressure, static or pumping, whichever is greater, shall not exceed 125 psi.

LAGOON DRIVE MARINA SITE

The existing water system serving the South Ramp area consists of a 16-inch water main drawing through one of the three 8-inch meters serving the Honolulu International Airport. Water service for the Lagoon Drive Marina may be provided by a new 12-inch main tapping the existing main, traversing the length of the marina and returning to Lagoon Drive. The new main will provide adequate water and fire protection for accessory buildings within the marina and intra-island ferry terminal, fire hydrants and fire cabinets at the marina. Figure 6 depicts the water system for the proposed Lagoon Marina development, including fire protection hydrants for the mooring area.

The Lagoon Drive Marina development presented in the Recreation Development Plan provides approximately 680 slips, with amenities and supporting facilities ashore. Water demand calculations for the marina slips were calculated from Ala Wai Harbor water use data. The average daily water demand for the slips is 44,200 gallons per day (gpd). Maximum daily demand is 66,300 gpd, and peak hour flow 138 gallons per minute (gpm) based on an 8-hour day. Water demand for concession and


WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
DAV PARK
MOANALUA STREAM
KEEHI LAGOON PARK
PEDESTRIAN ACCESS
HAWAIIAN CANOE CENTER
KALIA STREAM
PICKUP DROPOFF
RAMP
OPEN SPACE
AIRPORT SERVICE AREA
RAMP
NORTH
HAWAIIAN CANOE SITE
PROPOSED SITE PLAN
LA MARIANA SAILING CLUB
SAND ISLAND ACCESS ROAD
PUUMALE ROAD
KALIHI-KAI
MOKAUEA
GRAPHIC SCALE
FIGURE 4

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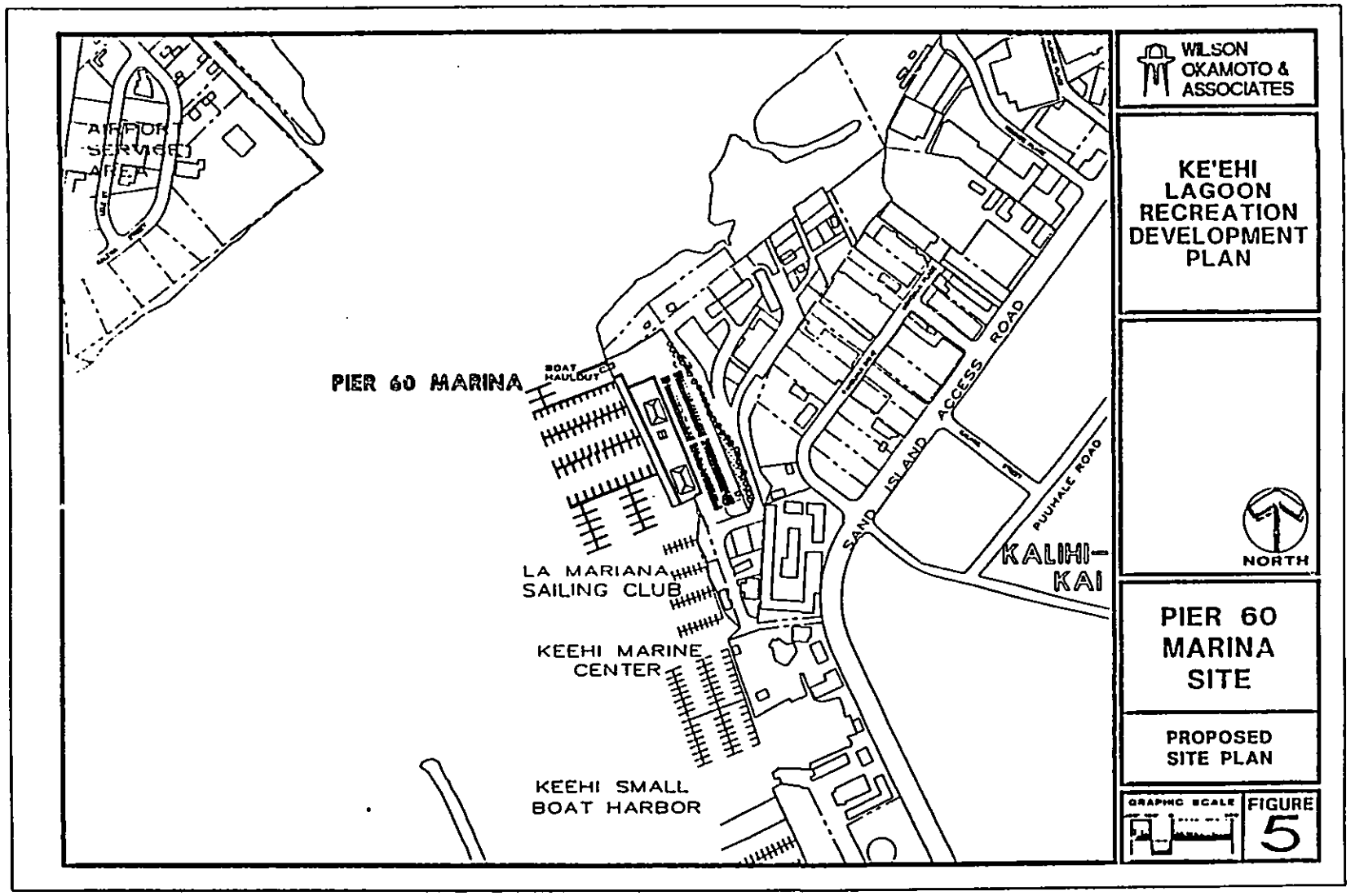

AIRPORT SERVICES AREA
PIER 60 MARINA
BOAT HAULOUT
LA MARIANA SAILING CLUB
KEEHI MARINE CENTER
KEEHI SMALL BOAT HARBOR
SAND ISLAND ACCESS ROAD
PUUHALE ROAD
KALIHI-KAI
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
PIER 60 MARINA SITE
PROPOSED SITE PLAN
GRAPHIC SCALE
FIGURE 5

administrative structures in six shoreside buildings totalling approximately 60,000 square feet is based on the BWS average daily demand of 56,000 gpd, a maximum day demand of 84,000 gpd, and a peak hour flow requirement of 350 gpm. The intra-island ferry terminal will serve vessels of approximately 300 persons capacity, making perhaps 6 visits per day. Average daily water consumption for the ferry terminal is calculated to be 9,000 gpd, maximum day demand 13,500 gpd, and peak hour demand 56 gpm.

Total water demands for the marina are thus: average day demand, 109,200 gpd; maximum daily demand, 163,800 gpd; and peak hour flow, 544 gpm.

Fire flow requirements for marinas are not specifically identified in the Board of Water Supply Standards. Vessels berthing within the Ala Wai Yacht Harbor are required to have fire fighting apparatus aboard for their own protection, and may be denied berthing for lack or inadequacy of equipment. Hose cabinets on each pier are included to provide protection for vessels and assist in fire control and suppression. Hydrants are located along the marina access roadway for protection of concessions and harbor associated structures.

Buildings along the marina may be individually metered and water usage apportioned to individual occupants. This scheme is currently used for existing South Ramp tenants, with Department of Transportation, Airports Division issuing monthly billings to individual leaseholders.

TABLE 1 - WATER DEMAND RATES

DEVELOPMENT TYPE	AVERAGE WATER DEMAND RATE (BWS STANDARDS)
Commercial/Industry Mix	100 gal./1,000 square feet
Light Industry	4,000 gal./acre
Parks	4,000 gal./acre
Resort	4,000 gal./acre
* University of Hawaii, Marine Expeditionary Center	90,000 gallons per month
* Ke'ehi Marina (recreational boats, trailer washdown, comfort station, administrative office)	43 gal/slip/day
* Ala Wai Harbor (recreational boats, Hawaii Yacht Club, fuel dock, comfort station, trailer washdown and administrative office)	63 gal/day/slip
* Haleiwa Harbor (mixed fishing and recreational boats, administrative office, comfort station, irrigation)	170 gal/day/slip
* Kewalo Boat Harbor (commercial fishing and tourist cruise boats, transient commercial vessels, landbound tenants along Diamond Head edge, comfort station, cruise and charter boat offices)	300 gal/day/slip

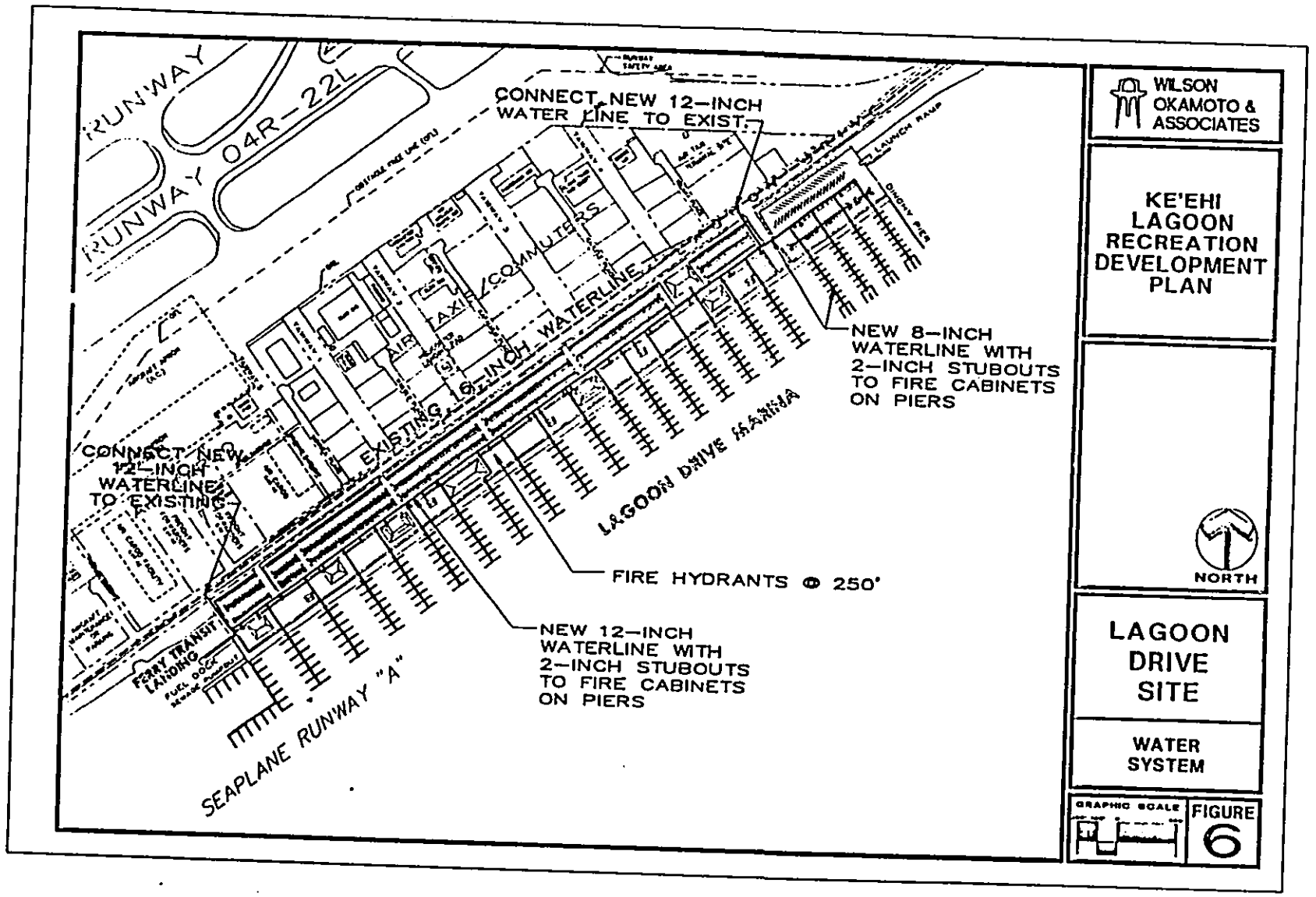
* Source: Board of Water Supply meter records.

WATER DEMAND FACTORS

Maximum Daily Demand = 1.5 times Average Day Demand
Peak Hour Flow = 3.0 times Average Day rate

FIRE FLOW REQUIREMENTS

LAND USE	FLOW REQUIREMENT FLOW(GPM)/DURATION(HRS.)/SPACING(FT.)
Light Industry, Downtown Business	4,000/3/250
Single Family Residential	1,000/1/350


RUNWAY 04R-22L
RUNWAY
CONNECT NEW 12-INCH WATER LINE TO EXIST.
COMMUTERS
TAXI
AIR
EXISTING 16-INCH WATERLINE
NEW 8-INCH WATERLINE WITH 2-INCH STUBOUTS TO FIRE CABINETS ON PIERS
LAGOON DRIVE
CONNECT NEW 12-INCH WATERLINE TO EXISTING
FIRE HYDRANTS @ 250'
NEW 12-INCH WATERLINE WITH 2-INCH STUBOUTS TO FIRE CABINETS ON PIERS
FERRY TRANSIT LANDING
SEAPLANE RUNWAY "A"
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
LAGOON DRIVE SITE
WATER SYSTEM
GRAPHIC SCALE
FIGURE 6

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LAGOON ISLAND SITE

Individual land use water demands are considered separately for each land use type and resulting requirements totalled to produce the design parameters for a water system to service the new Lagoon Island development.

The park lands consist of 19 acres with an average daily demand of 4,000 gallons per acre, or 76,000 gpd. Maximum day demand is 114,000 gpd and peak hour flow 475 gpm.

The 350 slips at the marina have average water demand similar to the Ala Wai Harbor, at 22,750 gpd; maximum day demand 34,125 gpd, and peak hour flow 142 gpm. Water requirements for comfort stations, administrative facility and utility storage sheds with an area of perhaps 5,000 square feet are: average daily demand, 4,700 gpd; maximum day demand, 7,050 gpd; peak hour flow, 30 gpm.

The yacht race/ocean sports facility on the east shore of the Lagoon Island comprises a 48 acre site. The site will be suited to large race yacht operations such as would be occupied by an America's Cup racing syndicate. Such an operation would erect several sheds and covered storage areas for it's operations and while in residence use a large amount of water in washdown, repair and boat tuning. The water demands for the 48 acre site are therefore computed on the basis of a light industry occupancy, using 4,000 gallons per acre. Average daily water demand is 192,000 gpd, maximum day demand is 288,000 gpd, and peak hour flow 1200 gpm.

Water billing information for the relocation of the University of Hawaii Marine Expeditionary Center was obtained from the Board of Water Supply. Meter records indicate the Center uses an average of 90,000 gallons per month, subject to large fluctuations. Average daily demand on the basis of recorded information is 3,000 gpd, maximum day demand 4,500 gpd, and peak hour flow about 20 gpm based on an 8-hour workday.

Area is provided adjacent to the Expeditionary Center for maritime commercial uses. Typical of users in this space would be commercial fishing operations, transshipment of ocean products, or processing industry. Water usage is considered typical of the light industry designation at 4,000 gallons per acre per day. Average daily demand for the 16 acre site is thus 64,000 gpd, maximum daily demand 96,000 gpd, and peak hour flow 400 gpm.

The maritime commercial shoreside facilities are adjoined by a berthing area for trade, transient fishing, research, and other commercial vessels. As many as 40 of these craft may be accommodated within the space proposed to be allotted. Water demand is taken as typical for Kewalo Basin, which serves these uses at present. The average water demand is 12,000 gpd, maximum day demand 18,000 gpd, and peak hour flow 75 gpm.

The interior of the Lagoon Island is appropriate to development not requiring direct water frontage, but appropriate to nearshore or airport related activities. The Ke'ehi Recreation Development Plan relegates approximately 119 acres to light industrial and commercial usages. Light industrial areas may typically be considered to have approximately eighty percent of their total area devoted to actual buildable space, with the remainder going into roadways, parking, and landscaping. This relative land use intensity acts to reduce the actual area from 119 acres to 95. Water demand calculations for the island interior area, based on 4,000 gpd per acre, yields an average day flow of 380,000 gpd, maximum day flow of 570,000 gpd, and a peak hour flow of 2,375 gpm.

A summary of the water demands of land use types on the Lagoon Island follows. The total flow must be met through a main accessing the island either on the connecting bridge or by a submarine main across the old seaplane runways. In consideration of the large amount of vessel traffic the proposed development may generate, and a number of craft currently using Ke'ehi Lagoon and existing marinas, the risk of fouling anchor lines on a submarine water main is high. Water service for the Lagoon Island is recommended to pass over the vehicle access bridge.

TABLE 2 - SUMMARY OF LAGOON ISLAND WATER DEMAND

DEVELOPMENT AREA	TOTAL AREA	WATER DEMAND AVERAGE DAILY GPD	WATER DEMAND MAXIMUM DAY GPD	WATER DEMAND PEAK HOUR GPM
PARK LANDS	19 acres	76,000	114,000	475
MARINA SLIPS	350 slips	22,750	34,125	142
SHORESIDE	5,000 SF	4,700	7,050	30
YACHT RACE	48 acres	192,000	288,000	1200
MARINE EXPEDITIONARY	15 acres	3,000	4,500	20
MARITIME COMMERCIAL	16 acres	64,000	96,000	400
BERTHING	40 vessels	12,000	18,000	75
LIGHT INDUSTRIAL/ COMMERCIAL	119 acres	380,000	570,000	2,375
TOTAL LAGOON ISLAND WATER DEMAND =		754,450	1,131,675	4,717

The conceptual water system to service the Lagoon Island is illustrated below in Figure 7. Future development already planned for Lagoon Drive/South Ramp area will utilize a large percentage of available capacity of the meter and main. In consideration of the large water demands generated by extensive development proposed for the Lagoon Island, and the expansion of airport-related facilities proposed for the South Ramp area, a new 24-inch main is proposed to service the Lagoon Drive Island site. The new main may link to the Board of Water Supply 42-inch main on Kilihau Street. The main will lead along Lagoon Drive and cross to the island via the new access bridge. Within the island.

the main will branch right and left to a 20-inch line on the island perimeter. Water supply along interior roadways will be through 12-inch mains to minimize friction and pressure losses. An 8-inch loop line across the three widest blocks is provided to minimize effects of possible interruptions and enhance maintenance activities. A 12-inch main will lead down the yacht race and ocean sports facilities peninsula on the east side of the island.

It may be considered to connect the Lagoon Drive Marina to the new 24-inch main, thus removing the marina demands from the existing Airport water system.

Fire protection for Lagoon Island improvements will be provided to the standards of the Board of Water Supply, with hydrants located at 250-foot intervals on opposite sides of interior roadways and on the interior side of the perimeter road.

HAWAIIAN CANOE CENTER SITE

A specific site plan for the Canoe Center proposed to be located between the confluence of Moanalua and Kalihi Streams is not available. Conceptually, the facility will be of two-level structure housing exhibition areas, meeting rooms, club house amenities, offices, and perhaps commercial concessionaires such as a snack bar. Appropriate irrigated landscaping may be provided around the grounds. Based on an estimated structure of approximately 80,000 square feet, the calculated average daily water demand is 8,000 gpd, maximum day demand 12,000 gpd, and peak hour flow 50 gpm.

A comfort station for the proposed canoe ramp area on the Kalihi Kai shoreline. The station may be connected to the Canoe Center water lines.

A schematic water service plan for service to the Canoe Center and shoreline comfort station is presented in Figure 8. An 8-inch diameter water line may be led from an existing 12-inch main on Hoonee Place to the site. The comfort station may be serviced by a lateral from the 8-inch line, which will continue to a point on the common boundary with the Pier 60 site as shown in the figure.

Fire protection for the conceptual Canoe Center site structure and parking lot may be afforded by three hydrants located around the structure.

PIER 60 SITE

Development suggested for this site in conformance with the previous Recreational Plan includes a marina and shoreside amenities. Water demand for approximately 185 new slips is determined from usage rates recorded for the adjacent Ke'ehi Marina. Average daily water demand for the Pier 60 Marina is 8,000 gpd; maximum day demand 12,000 gpd, and peak hour flow 50 gpm.

Shoreside facilities water demands may vary from high water use food establishments to zero-demand parking lots. As suggested in the Recreation Development Plan, perhaps two buildings and a comfort station for the moorings may be constructed. Development in the surrounding lots may consist of marine supply stores, boat repair and construction, and other general waterfront industry. Shoreside land area is approximately 3 acres. Average daily demand on this basis is 12,000 gpd, maximum daily demand 18,000 gpd, and peak hour flow 75 gpm.

Total water demands for mooring and shore facilities for the conceptual Pier 60 site are: average day demand, 20,000 gpd; maximum day demand, 30,000 gpd; and peak hour flow 125 gpm.

The conceptual water system to service the Pier 60 site, interconnected to the Hawaiian Canoe Center, is presented in Figure 9.

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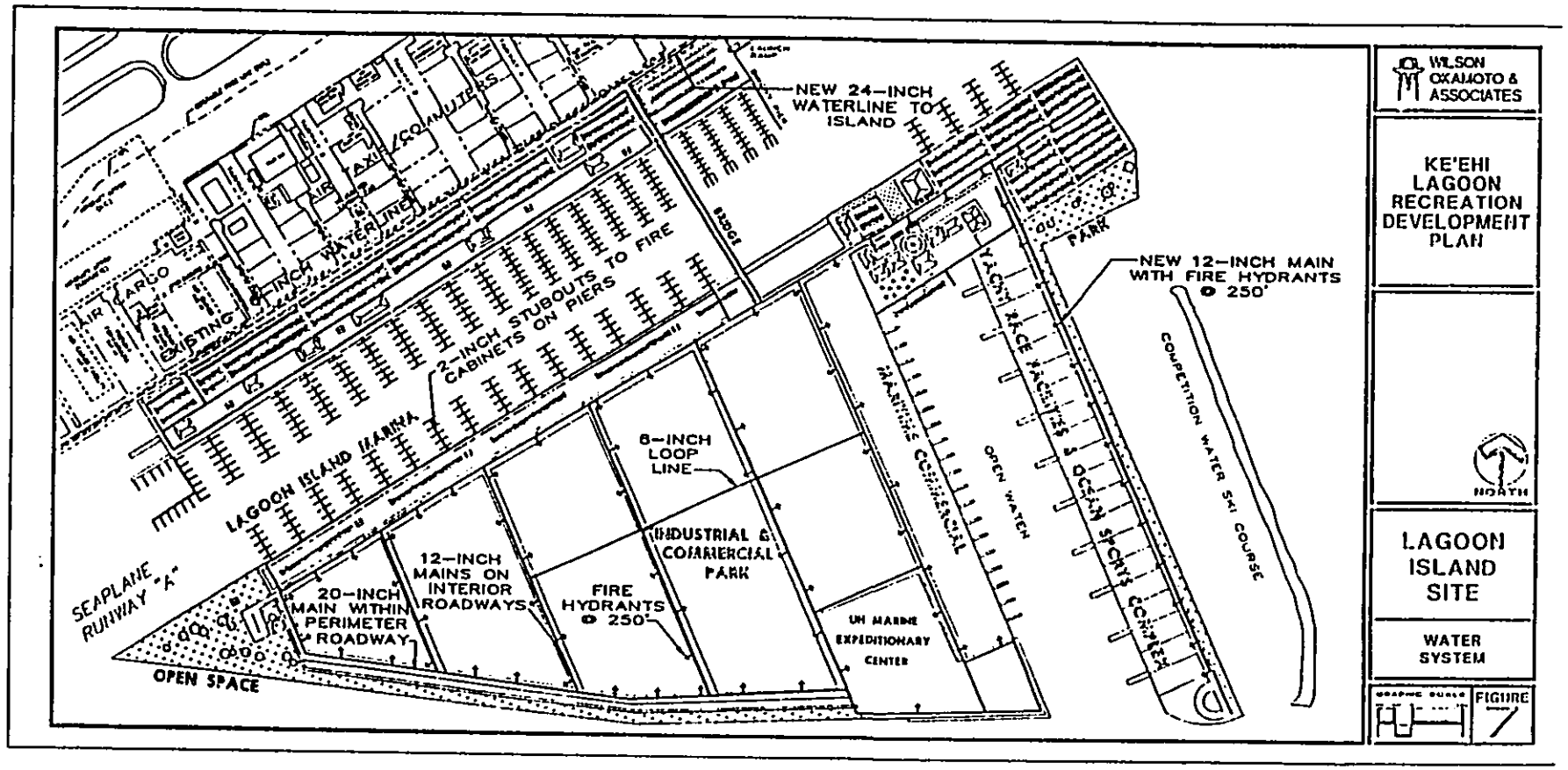
NEW 24-INCH WATERLINE TO ISLAND
NEW 12-INCH MAIN WITH FIRE HYDRANTS @ 250'
PARK
COMPETITION WATER SKI COURSE
OPEN WATER
MARITIME COMMERCIAL
YACHT RACE FACILITIES
OCEAN SPORTS CENTER
8-INCH LOOP LINE
INDUSTRIAL & COMMERCIAL PARK
UH MARINE EXPEDITIONARY CENTER
FIRE HYDRANTS @ 250'
12-INCH MAINS ON INTERIOR ROADWAYS
20-INCH MAIN WITHIN PERIMETER ROADWAY
SEAPLANE RUNWAY "A"
OPEN SPACE
LAGOON ISLAND
2-INCH STUBOUTS TO FIRE CABINETS ON PIERS
8-INCH WATER LINE
AIR CARGO
EXISTING
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
LAGOON ISLAND SITE
WATER SYSTEM
GRAPHIC SCALE
FIGURE 7

The waterline from the Canoe Center will continue through the Pier 60 area and connect to the existing 8-inch main on Sand Island Road.

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ADEQUACY OF EXISTING WATER INFRASTRUCTURE
TO SUPPORT PROPOSED DEVELOPMENTS

The Board of Water Supply, Planning Branch, was contacted to determine the adequacy of the existing system to handle additional demand loads imposed by the conceptual developments. In general, no determination of system adequacy is made until plans or development schematics are submitted. A commitment for water supply is only extended at the time of application for a building permit.

General water facilities development charges are assessed prior to construction, consisting of source and transmission, and daily storage charges. The charges are levied on projects whose daily water requirement is less than a quarter of a million gallons, and the amount is keyed to the size of meter granted to serve the project. Developers of projects with projected daily water requirements above a quarter of a million gallons per day are asked to participate directly in water system improvement. The cost of such participation is determined at the time the charges are levied and is greater than if a facilities charge is levied.

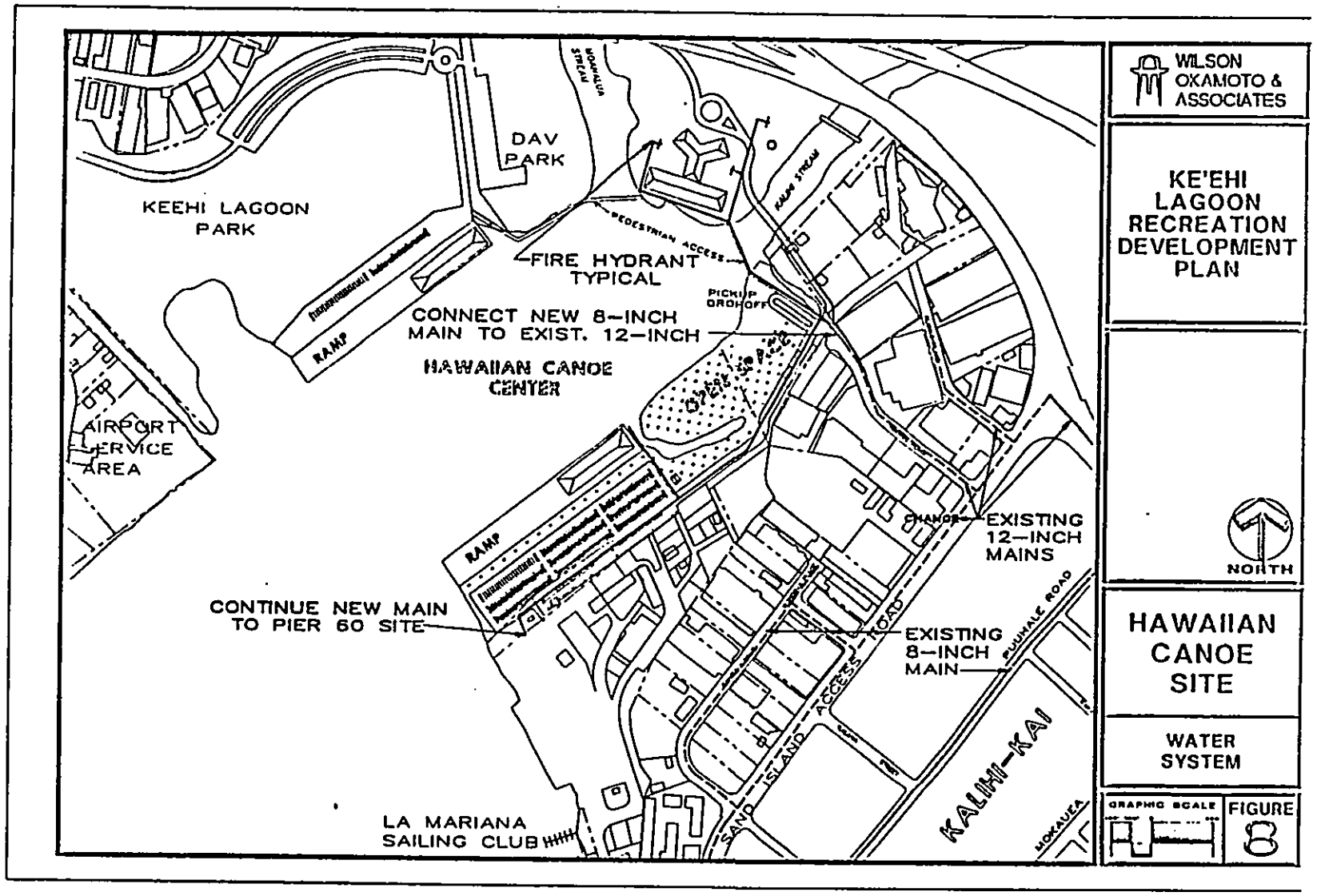
The currently effective facilities charge schedule lists water system facilities charges effective in increments beginning in the month of July of each year. The last published charge schedule commences in July of 1990 and is listed below. The charges are for water consumed in daily operations and exclude fire flows. Fire protection water is metered separately; no facilities charge is assessed for fire meters.

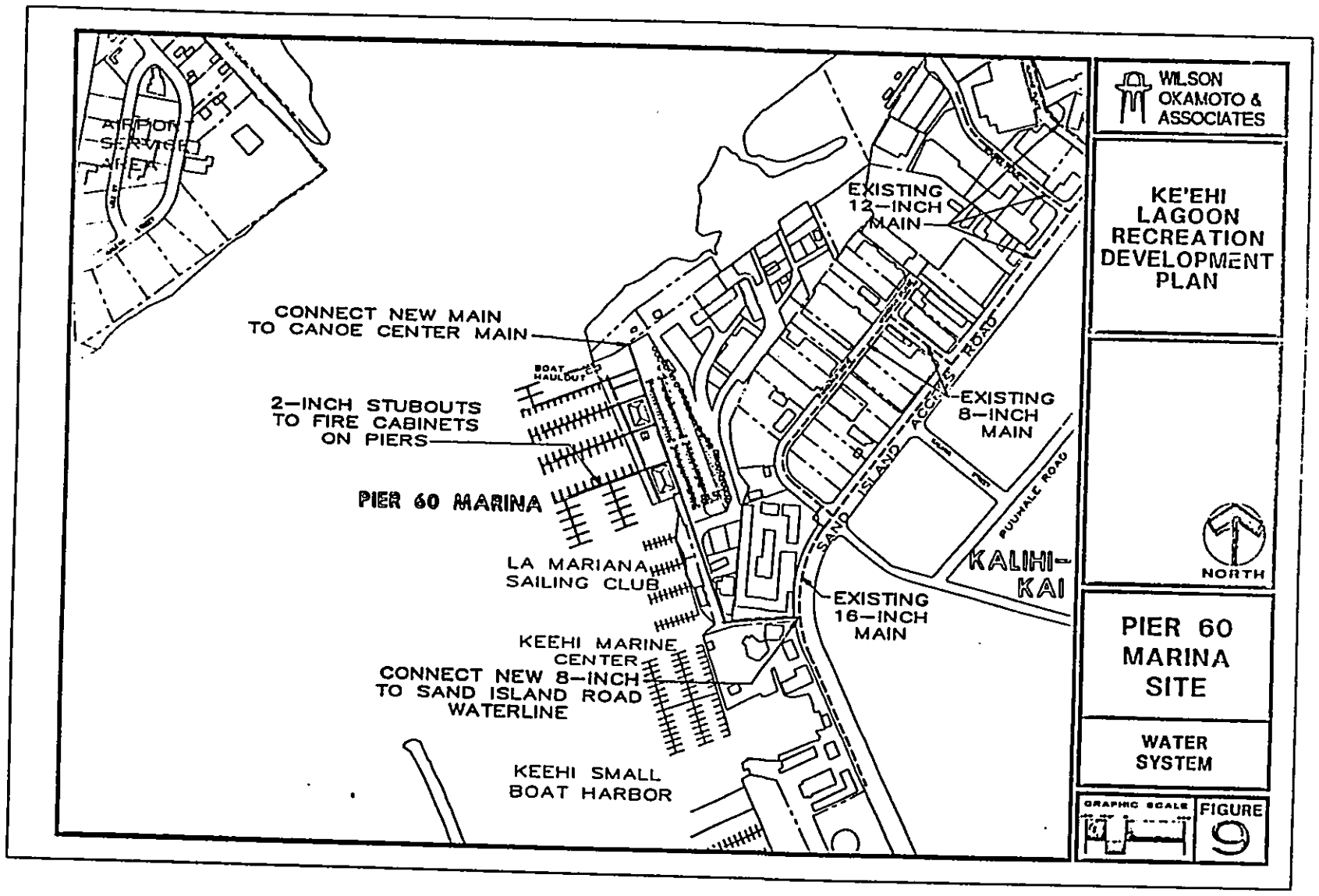
TABLE 3 - WATER SYSTEM FACILITIES DEVELOPMENT CHARGES
EFFECTIVE JULY 1, 1990 (SUBJECT TO CHANGE)

Category	Basis of Charge	Source and Transmission	Daily Storage	Total
Commercial,	Meter Size			
Industrial	5/8"	$ 6,745	$ 4,555	$ 11,300
Parks	3/4"	10,090	6,810	16,900
	1"	16,778	11,322	28,100
	1-1/2"	33,611	22,689	56,300
	2"	53,734	36,266	90,000
	3"	107,522	72,578	180,100
	4"	168,000	113,400	281,400
	6"	336,000	226,800	562,800
	8"	537,612	362,888	900,500
	10" and above	negotiated		

Source: "Schedule of Rates and Charges for the Furnishing of Water and Water Service", Board of Water Supply, City and County of Honolulu.

Connection to the BWS system for all development sites will be through a master meter. At the Lagoon Drive Marina and Lagoon Island sites, metering for individual parcels may be instituted.


KEEHI LAGOON PARK
DAV PARK
MOANALUA STREAM
KALIA STREAM
PEDESTRIAN ACCESS
FIRE HYDRANT TYPICAL
PICK-UP DROP-OFF
CONNECT NEW 8-INCH MAIN TO EXIST. 12-INCH
HAWAIIAN CANOE CENTER
RAMP
AIRPORT SERVICE AREA
CHANGE
EXISTING 12-INCH MAINS
CONTINUE NEW MAIN TO PIER 60 SITE
EXISTING 8-INCH MAIN
FUJIHALE ROAD
SAND ISLAND ACCESS ROAD
KALIHI-KAI
MOKAUEA
LA MARIANA SAILING CLUB
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
NORTH
HAWAIIAN CANOE SITE
WATER SYSTEM
GRAPHIC SCALE
FIGURE 8


WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
AIRPORT SEAWALL
EXISTING 12-INCH MAIN
CONNECT NEW MAIN TO CANOE CENTER MAIN
BOAT HAULOUT
2-INCH STUBOUTS TO FIRE CABINETS ON PIERS
EXISTING 8-INCH MAIN
SAND ISLAND ACCESS ROAD
PUUHALE ROAD
PIER 60 MARINA
KALIHI-KAI
LA MARIANA SAILING CLUB
EXISTING 16-INCH MAIN
KEEHI MARINE CENTER
CONNECT NEW 8-INCH TO SAND ISLAND ROAD WATERLINE
KEEHI SMALL BOAT HARBOR
NORTH
PIER 60 MARINA SITE
WATER SYSTEM
GRAPHIC SCALE
FIGURE 9

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The calculated average daily demand for the Lagoon Drive Marina is 109,200 gallons per day, and peak hour flow is calculated at 544 gallon per minute. A 6-inch master meter will be required for a total facilities charge of $562,800. Submetering of individual amenities structures may be implemented.

The size of water demand for the Lagoon Island site will require the developer to participate directly in financing water system improvements. The scope and magnitude of the participation will depend on the ongoing and planned projects of the Board of Water Supply at the time application is made for water.

The Hawaiian Canoe Center 50 gpm peak hour water demand calculated above may be serviced through a 1-inch meter with an associated facilities charge of $28,100. The cost is allocated to the private portion of the development.

The calculated Pier 60 development peak hour rate is 75 gallons per minute. A 1-1/2-inch meter is sufficient to supply this requirement. The facilities charge will be $56,300.

CHAPTER II UTILITY REQUIREMENTS - SEWER

Sewage flows generated by proposed developments were derived in accordance with procedures given in Volume 1 of the "Design Standards of the Division of Wastewater Management", published by the City and County of Honolulu Department of Public Works.

The equivalent population method was used to determine average daily sewage generation quantities. In this method, an equivalent population for a development site is found as the product of the development area and population density. The average daily sewer flow is computed as the product of generation rates (dependent on development type) and equivalent population. Where no appropriate sewage generation rates were readily identified for the conceptual development, rates were excerpted from Table 1 of Chapter 62, "Wastewater Systems" Title 11, Hawaii Administrative Rules, of the Department of Health. Rates from both sources are listed in Table 4 below.

A flow factor dependent on population is applied to determine maximum flow. Dry and wet weather infiltration flows are determined based on whether mains could be expected to lie above or below the water table; dry weather infiltration is summed with average daily flow to determine design average and design maximum flow rates. Design peak flow, which must be passed by sewer lines without surcharging, is calculated as the sum of the design maximum and wet weather infiltration flows.

Design peak flow is the driving calculation behind sizing of sewer collection system design and will be the recorded figure for each of the conceptual developments proposed in the Ke'ehi Recreation Development Plan. The flow figure is calculated on gallons per minute rate by dividing the daily peak hour flow figure by the number of minutes in the 8-hour flow day. This produces approximately correct flow rates for business type uses which adhere relatively closely to the 8-hour workday schedule; the results may err conservatively for development types which spread their flow generation over a longer period.

TABLE 4 - SEWAGE GENERATION RATES

Basic rate: 80 gallons per person per day. Average flow rate shall be based on land use or best available data, whichever is higher.

Land Use	Equivalent Population
Waterfront Industry	40 cpa*
General Industry	100 cpa

* = capita per acre, rates from Design Standards of the Division of Wastewater Management.

Land Use	Sewage Generation Rate
Airports, per passenger	5 gpcd**
Restaurants (toilet and kitchen wastes per patron)	10 gpcd

** = gallons per capita per day, rates from Chapter 62, Department of Health.

Average Wastewater Flow = product of equivalent population and basic rate, or product of users and per capita generation rate.

Maximum Wastewater Flow = Average flow times flow factor given in Design Standards of the Division of Wastewater Management.

Dry Weather Infiltration/Inflow = 5 gcd for sewers above the normal ground water table, 35 gcd for sewers below normal ground water table.

Design Average Flow = Sum of Average Flow and Dry Weather Infiltration/Inflow rate.

Design Maximum Flow = Sum of Maximum flow and Dry Weather Infiltration/Inflow rate.

Wet Weather Infiltration/Inflow = 1250 gallons/acre/day for sewers above the normal ground water table, 2750 gallons/acre/day for sewers below the normal ground water table.

Design Peak Flow = Sum of Design Maximum Flow and Wet Weather Infiltration/Inflow.

ADEQUACY OF EXISTING SEWER INFRASTRUCTURE
TO SUPPORT THE PROPOSED DEVELOPMENTS

Serious deficiencies are presented in consideration of sewage collection and disposal. Sewage from the Lagoon Drive area is presently collected at Pump Station "C", a State facility, within the South Ramp area. A force main leads to a transition manhole near the intersection of Lagoon Drive and Aolele Street, and sewage flows by gravity to the City's Kamehameha Highway Pump Station. A 36-inch force main leads along the Highway and across the Hawaiian Canoe Center site to the Kalihi Kai shoreline, where it transitions to a 54-inch gravity main.

The 54-inch gravity line is flowing at capacity and no new sewer connections which contribute flow to it are being approved. Installation of a City-funded relief line will not be possible at least until 1992. All sites are faced with the prospect of delayed development until such time as the City will upgrade the 54-inch line, or must consider alternative means of sewage disposal.

It may be considered, in the interest of expediting construction of the needed relief line, that all or some of the site master developers may contribute to the cost of the City's collection system upgrade. It may be possible to draft an arrangement whereby future sewer system connections will partially reimburse the original contributors. Such an arrangement has been made on other islands for utility improvements.

Development of the Lagoon Drive Marina, Hawaiian Canoe Center and Pier 60 sites will not likely generate sufficient revenue or sewage to enable consideration of alternate means on sewage disposal by themselves. Unless developers of all sites contribute to relief line construction it is expected that the these three sites will await City-funded construction of relief improvements to obtain sewage connection.

The Lagoon Island site will require a lift station of 12.4 million gallons per day capacity in its fully developed condition. The flow quantity will also require upgrading of the Kamehameha Highway Pump Station and 54-inch gravity main if it is considered to transport sewage in that direction. Alternatively, it may be considered to construct a new submarine force main from the island across the Seaplane Runway to the vicinity of the State's existing Ke'ehi Marina, then across or under the Sand Island Access bridge. A cost estimate for this proposal is presented in Chapter V.

Wastewater generation from the conceptual land use types at each site is discussed below. The schematic layouts of the collection system for each of the projects is based on the assumption that the existing City collection system will be upgraded to accommodate the additional flows.

LAGOON DRIVE MARINA SITE

Sewage flows from the Lagoon Drive Marina site will originate from comfort stations, administration building, marine supply store, restaurant/bar/clubhouse, intra-island ferry transit terminal accessory and concessionaire structures accompanying marina development. Flows may not correspond closely with water use in that wastewater from moored vessels will not be collected. Vessels having holding tanks for onboard plumbing are free to dump such wastes offshore. A holding tank pumpout facility is provided for boaters at the Ala Wai Harbor, however inquiry with the operators indicates the service is little used. While a pumpout facility will be part of development at the new Lagoon Drive Marina, sewage flows from it will be very light and pose no significant problem for disposal.

Design peak flow from Lagoon Drive marina associated structures is the sum of flows from the various assumed uses. At the ferry terminal, assuming six full capacity vessel trips per day, the calculated design peak flow is 103 gpm. The occupancy-based peak flow of an administrative office (5 persons), fuel station (3 persons), marine supply store (5 persons) and other concessionaires (15 persons) is 25 gpm. Restaurant, bar, and clubhouse activities of perhaps 20,0000 square feet will generate a design peak flow of 47 gpm on an 8-hour day basis. Six comfort stations serving the 350 marina slips will generate a peak flow of 25 gpm on a 10-hour day basis. The total peak flow is 200 gpm for the conceptual improvements.

Pending the above-mentioned upgrade of the 54-inch gravity sewer main along Nimitz Highway, sewage is proposed to be collected by service laterals connected to existing gravity mains in the South Ramp service area across Lagoon Drive. Collected sewage will flow to existing Pump Station C, which currently operates below capacity and may easily accommodate the additional flows, even with the planned buildup of the Honolulu International Airport South Ramp facilities. The pump station discharges to a force main leading to a connection with the City gravity collection system at the corner of Lagoon Drive and Aolele Street. Figure 10 shows the schematic layout for the Lagoon Drive marina collection system assuming that the 54-inch gravity sewer main along Nimitz Highway is upgraded to accommodate additional flows.

LAGOON ISLAND SITE

The various land use types and activities in the Lagoon Island site will produce sewage at varying rates. For some use types, a per capita flow figure was deduced from comparable estimated flows at other areas. The basis of flow determination for each land use or activity is identified below.

Sewage generated at comfort stations in the 19 acres of park lands on the south and east shore of the Lagoon Island is based on estimated park usage of 500 park users per day, with per-user average sewage generation of 15 gallons per person. Total peak design flow for the 19-acre park site is 85 gpm for the 8-hour flow day.

Sewage from the Lagoon Island marina is based on the number of slips. Assuming owners visiting their vessels once per week with a generation rate of 15 gallons per person per visit, peak flow at the Lagoon Island marina is calculated to be 17 gpm.

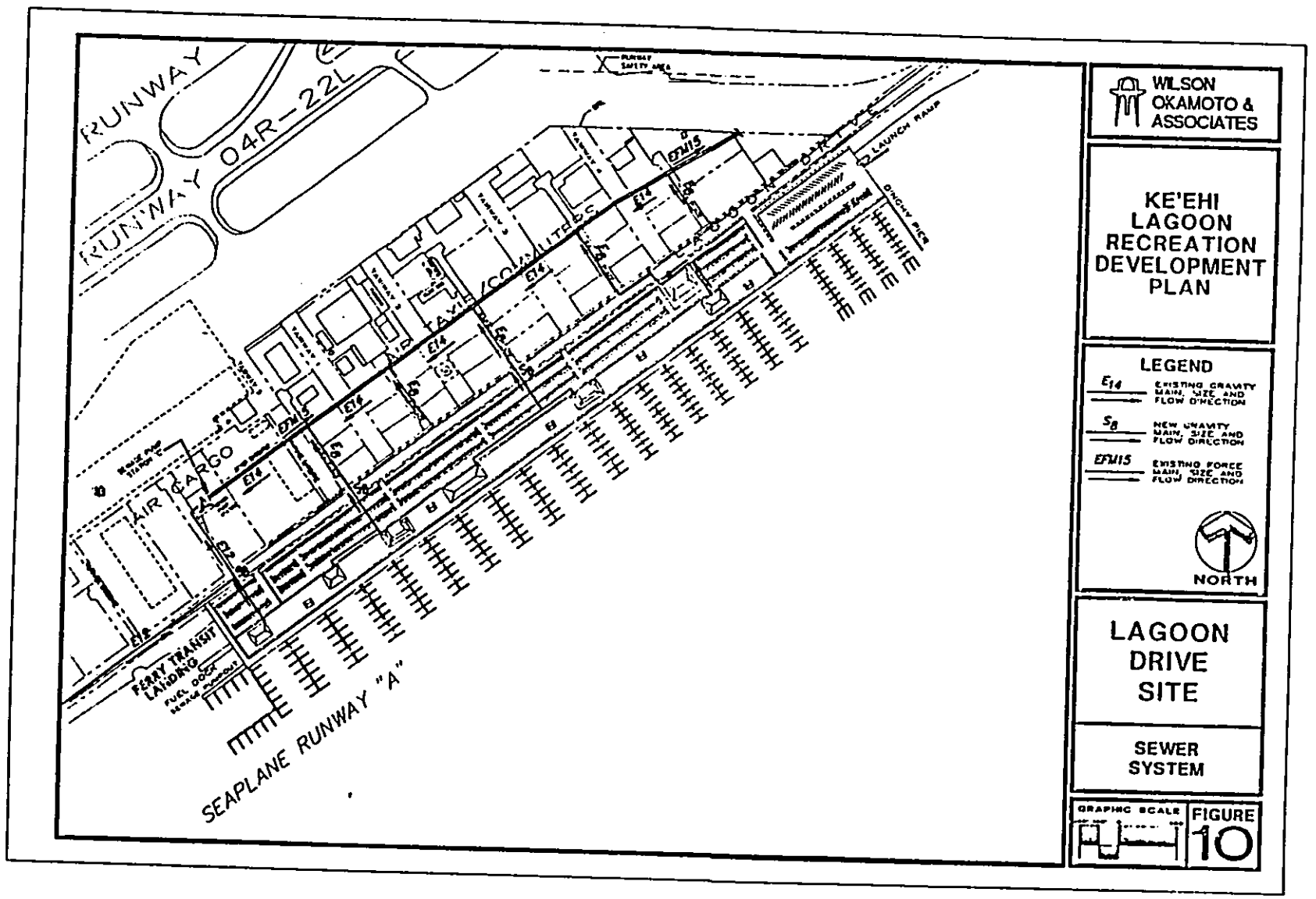
The yacht race/ocean sports center may experience highly variable occupancy depending on the utility of the site for purposes other than it's primary function. Presuming occupancy as for waterfront industrial usage, with a population density of 40 persons per acre, design peak flow for the 48-acre site is 1,550 gpm.

The maritime commercial facilities encompass 16 acres located across from the yacht race site. Using a waterfront industry population density of 40 persons per acre, and the standard allowance of 80 gallons per capita per day, calculated design peak flow for the site is 580 gpm.

Inquiry was made of the current and future operations of the University of Hawaii Marine Expeditionary Center. It was indicated that a fulltime staff of perhaps 15 persons, and an additional dozen visitors per day, would be appropriate for shoreside operations. Site operations include servicing research vessels from foreign ports and the University's own ships. These ships may carry wastewater in holding tanks, but are free to dump their tanks in international waters, thus no specific provision is made for import of sanitary wastes at the relocated Expeditionary Center. Contaminated or oily wastes are not permitted to be disposed to sanitary collection systems.

Design peak flow based on the indicated future staffing level is 62 gpm, totalling 30,000 gallons in the 8-hour flow day. Sewage flow may also be calculated based on the waterfront industry development type. The density specified in the sewer standards yields a peak flow of 545 gpm. In consideration of the recorded average daily water usage of 90,000 gallons per month, the former figure is appropriate and sufficient to allow for future relocation.

The interior portion of the Lagoon Island, totalling 119 acres, is identified for light industrial and commercial uses in the Lagoon Recreation Development Plan. Development may range up to several


RUNWAY 04R-22L
RUNWAY SAFETY AREA
LAUNCH RAMP
DINGHY RACK
AIR CARGO
FERRY TRANSIT LANDING
FUEL DOCK
SEAPLANE RUNWAY "A"
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
LEGEND
EXISTING GRAVITY MAIN, SIZE AND FLOW DIRECTION
NEW GRAVITY MAIN, SIZE AND FLOW DIRECTION
EXISTING FORCE MAIN, SIZE AND FLOW DIRECTION
NORTH
LAGOON DRIVE SITE
SEWER SYSTEM
GRAPHIC SCALE
FIGURE 10

stories of general light industrial or commercial construction. It is assumed the business of the area will be in some measure dependent on proximity to water frontage or to the airport. Calculation of sewage generation assumes that land usage intensity will be approximately eighty percent of the total available, excerpting twenty percent for streets and open space. Sewage flow calculations based on 95 acres of general light industrial usage indicate a peak hour flow of 5,400 gpd with sewers above the water table. Due to the areal extent of the commercial area, and depending on the constructed elevation of the Lagoon Island, some sewer lines may not lie above the water table. A peak flow of 6,285 gpm is computed for lines lying below the water table.

The schematic layout for the Lagoon Island collection system is shown in Figure 11. The Island system will consist of gravity lines ranging in size from 6-inch service laterals to 24-inch trunk lines. A sewage lift station located immediately at the island end of the access bridge may convey sewage through a new force main over the bridge and along Lagoon Drive to a connection at the existing manhole at Lagoon Drive and Aolele Street.

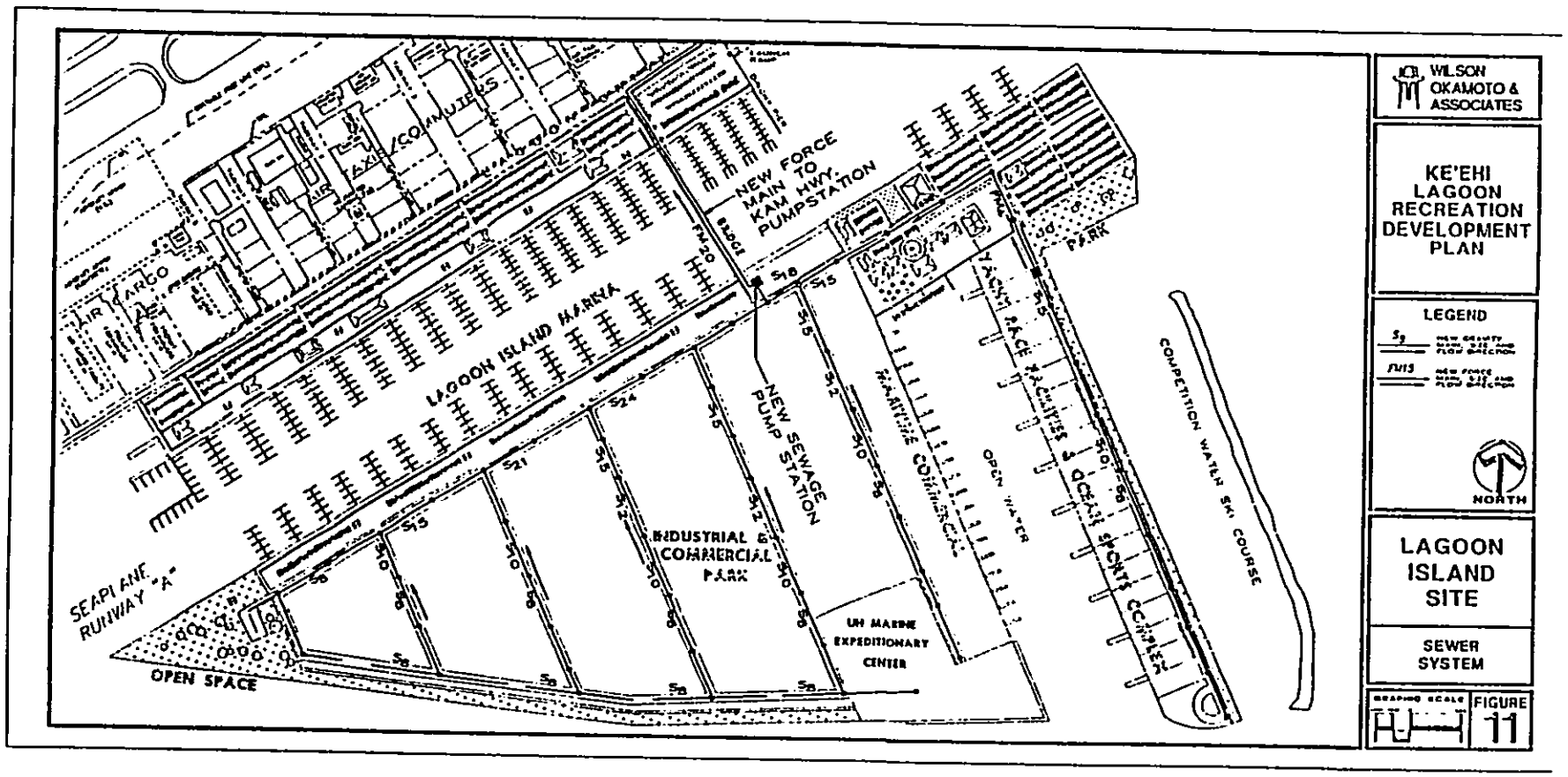
The Lagoon Island sewage pumping station must be capable of pumping the peak hour flow with one of the largest pumps out of service. A large wet well must be provided and sized in conjunction with the pumps to ensure appropriate detention times are maintained. Portions of the collection system will lie below the water table, making infiltration a potentially significant factor in the total collected sewage quantity. To preclude excessive infiltration, lines may be somewhat oversized to keep pipe slopes as slight as possible and the system at the highest elevation.

The condition shown presumes that improvements to the Nimitz Highway 54-inch interceptor will be made. Should construction of a relief line not be complete within an appropriate time frame, a new submarine force main may be laid or drilled across Ke'ehi Lagoon to the Kalihi Kai shoreline area in the vicinity of the existing Ke'ehi Marina and to Sand Island. Once past the access bridge, a gravity main may convey sewage to the Sand Island Treatment Plant headworks.

A new submarine main may enable the Lagoon Island improvements to be constructed on a timetable independent of City upgrades of the 54-inch Nimitz main and Kamehameha Highway pump station. A new main will require extensive, long-term close coordination between the City, State, and private developers involved. If the new main is to be considered a viable option, the acceptability, responsibility for operation and maintenance should be discussed further between potential developers and State and City agencies.

TABLE 5: LAGOON ISLAND DEVELOPMENT SUMMARY OF SEWAGE FLOWS

Land Use	Peak Hour Flow, gpm
Parks	85
Marina	17
Yacht Race/Ocean Sports	1,550
Maritime Commercial	580
U. of H. Marine Expeditionary Center	62
Light Industrial/Commercial	6,285
Total Peak Flow	= 8,579 gpm
	= 12.4 MGD


WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
LEGEND
NORTH
LAGOON ISLAND SITE
SEWER SYSTEM
GRAPHIC SCALE
FIGURE 11
AIR CARGO
AIR/COMMUTER
LAGOON ISLAND MARINA
NEW FORCE MAIN TO KAM HWY. PUMPSTATION
NEW SEWAGE PUMP STATION
INDUSTRIAL & COMMERCIAL PARK
UH MARINE EXPEDITIONARY CENTER
YACHT RACE
COMPETITION WATER SKI COURSE
SEAPLANE RUNWAY "A"
OPEN SPACE

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HAWAIIAN CANOE CENTER SITE

The eventual usage type for the Hawaiian Canoe Center site, between the confluence of Kalihi and Moanalua Streams, is at this time not well defined. In it's greatest capacity the site may be considered for exhibit or museum type use, and may receive 1,500 visitors per day. Alternatively, a minimum development level may provide office usage for various canoe-related organizations, with occupancy of 50 persons. The site will certainly be subject to considerable foot traffic during major canoe racing events such as the State Championship regatta if pedestrian bridges linking the Park and Kalihi Kai shorelines are installed.

In the maximum development condition, high visitor usage indicates a design peak flow of 162 gpm based on an 8-hour flow day. Low-intensity usage as office space could result in peak flows of only 12 gpm.

No existing sewer facilities are currently accessible on the site. As for the other three sites, sewage connection to the City collection system must await relief line construction. Upgrading of the 54-inch line as mentioned above may not occur until at least 1992. Figure 12 depicts the connection of the Hawaiian Canoe Center site to the transition manhole, pending construction of interceptor relief.

Under the Department of Health regulations, public buildings must connect to a public sewer if one is available. Determination of availability shall be made by the Director of the Department of Public Health. If a sewer is not available, a treatment works may be installed. Guidelines for wastewater treatment works provide that sewage shall receive treatment in accordance with Chapter 11, subchapter 23. In general, such treatment works are costly and inappropriate for this site. However, it may be possible to construct a small-scale project on the site utilizing a septic tank and leach field for effluent disposal. The scope of such a project would be controlled by the area and capacity of the leach field. In effect, the State Department of Health will control the project scope through its regulations controlling effluent disposal. A general guideline for project sizing proceeding from disposal regulations requires a land area of 625 feet per person.

The Kalihi Kai shoreline is proposed for filling and construction of parking lot, canoe launch ramp, shed and comfort station. The station may be heavily used during regattas; peak flow rate from the station could approach 207 gpm. The elevation of the vicinity of the proposed comfort station preclude onsite disposal of wastewater. Also, as noted above, no connections to the existing gravity system are being allowed pending installation of a relief line for the 54-inch sewer main.

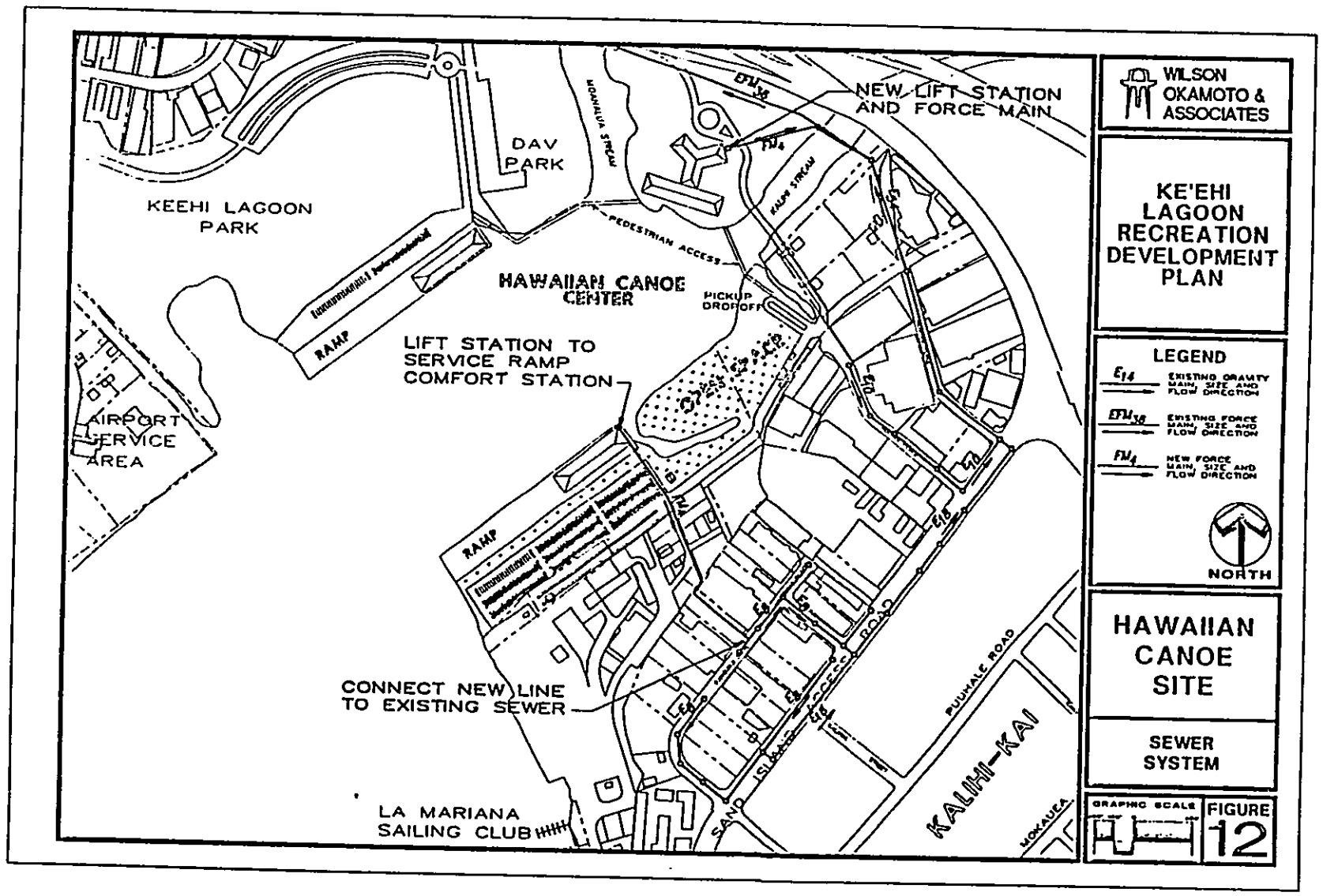
In the event that a parallel relief line is installed, connection of the Hawaiian Canoe Center and shoreline comfort station will each require a lift station and force main. Effluent may be led to connection manholes on Hoonee Place and Pahounui Drive respectively.

The shoreline comfort station force main may traverse private property to make the connection. The gravity lines in the area currently operate at approximately 86 percent of capacity; addition of more than about 32 gpm will exceed gravity line capacity and require improvements be made to downstream collection lines.

PIER 60 SITE

The variety of conceptual shoreside improvements which may occur at the Pier 60 site make determination of an appropriate sewage generation rate difficult. The maximum rate is based on waterfront industry of 2.2 acres extent. Calculation by the City standards yields a design peak flow of 80 gpm. Alternatively, minimum facilities may be provided ashore for the estimated 185 new slips, generating a peak hour flow rate of approximately 8 gpm.

As for all the proposed developments, connection to the City gravity collection system is unavailable at this time. Pending an upgrade to the Nimitz Highway interceptor, Pier 60 sewage may be pumped to the existing 8-inch line on Pahounui Drive. The added flow in the minimum development condition will achieve 100 percent commitment of the existing small diameter local sewers. Flows above the minimum improvement level exceed available sewerline capacity will require upgrading of the collection system. Figure 13 depicts the connection to the local service system pending improvement of the Nimitz interceptor.


NEW LIFT STATION AND FORCE MAIN
DAV PARK
KEEHI LAGOON PARK
MOANALUA STREAM
PEDESTRIAN ACCESS
HAWAIIAN CANOE CENTER
PICKUP DROPOFF
RAMP
LIFT STATION TO SERVICE RAMP COMFORT STATION
AIRPORT SERVICE AREA
RAMP
CONNECT NEW LINE TO EXISTING SEWER
LA MARIANA SAILING CLUB
SAND ISLAND ACCESS ROAD
PUUKALE ROAD
KALIHI-KAI
MOKAUEA
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
LEGEND
EXISTING GRAVITY MAIN, SIZE AND FLOW DIRECTION
EXISTING FORCE MAIN, SIZE AND FLOW DIRECTION
NEW FORCE MAIN, SIZE AND FLOW DIRECTION
NORTH
HAWAIIAN CANOE SITE
SEWER SYSTEM
GRAPHIC SCALE
FIGURE 12

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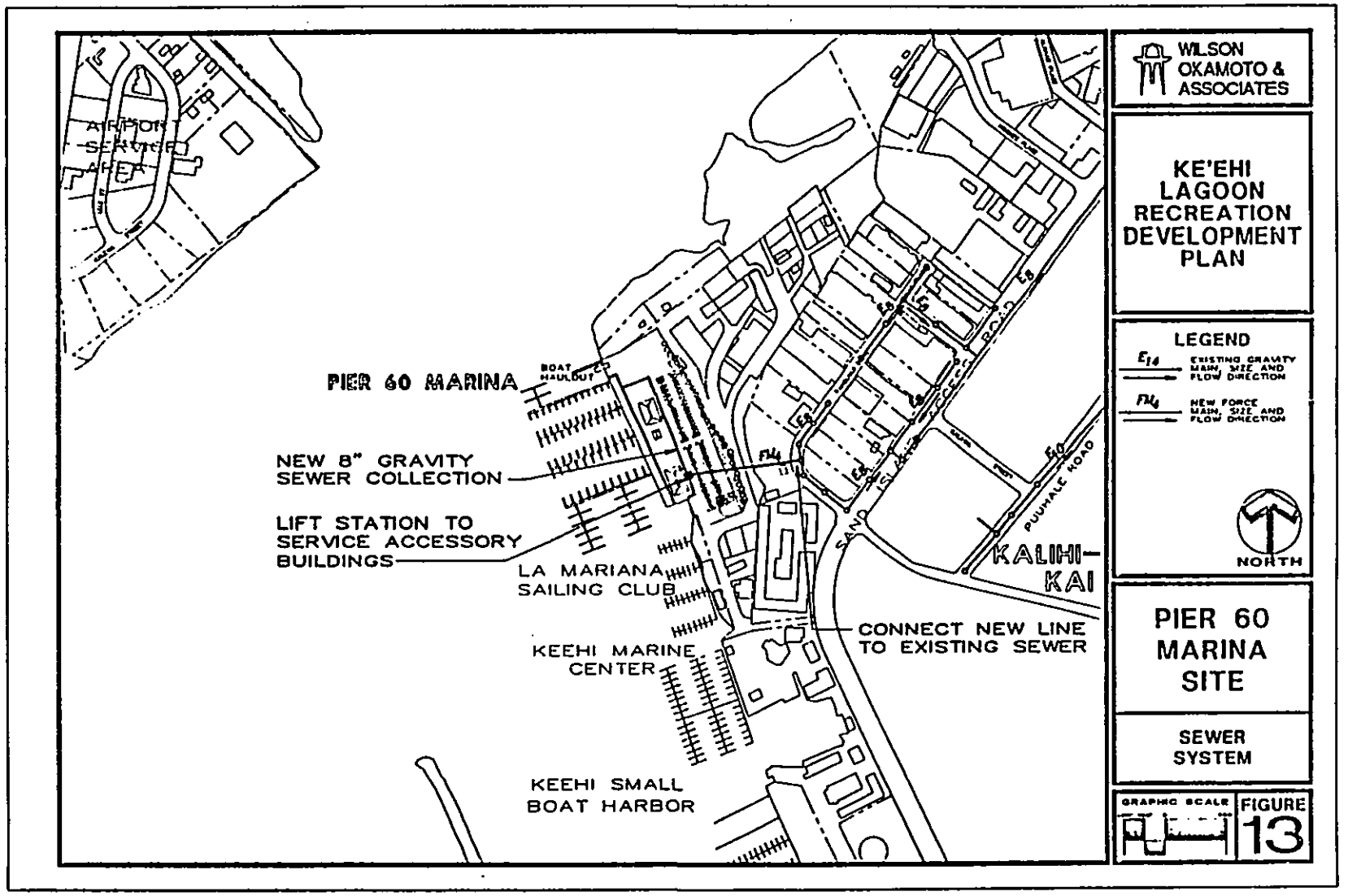
AIRPORT SERVICED AREA
PIER 60 MARINA
BOAT HAULOUT
NEW 8" GRAVITY SEWER COLLECTION
LIFT STATION TO SERVICE ACCESSORY BUILDINGS
LA MARIANA SAILING CLUB
KEEHI MARINE CENTER
KEEHI SMALL BOAT HARBOR
CONNECT NEW LINE TO EXISTING SEWER
SAND ISLAND ACCESS ROAD
PUUHALE ROAD
KALIHI-KAI
WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
LEGEND
EXISTING GRAVITY MAIN, SIZE AND FLOW DIRECTION
NEW FORCE MAIN, SIZE AND FLOW DIRECTION
NORTH
PIER 60 MARINA SITE
SEWER SYSTEM
GRAPHIC SCALE
FIGURE 13

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CHAPTER III UTILITY REQUIREMENTS - DRAINAGE

Drainage calculations were performed for all development areas generating significant runoff. All sites proposed for development are either existing waterfront properties or when created will lie close to the waterfront, with the exception of the lagoon island interior light industrial/commercial development. Storm runoff disposal is thus simplified, becoming a matter of routing flows to the ocean.

Storm runoff was calculated for different land use areas following the Rational Method outlined in the Honolulu City and County Department of Public Works publication "Storm Drainage Standards". For a selected recurrence interval storm, the Rational Method assumes that storm runoff from a drainage basin may be determined as the product of the drainage basin runoff coefficient, rainfall intensity corresponding to the time of concentration, and the drainage basin area.

A typical drainage pattern for each development area was assumed based on existing ground conditions, improvement size and configuration, and distance to the lagoon. A drainage network of inlets and conduits was laid out from which individual drainage basins could be identified.

Each drainage basin was assigned a runoff coefficient number according to the development type and ground cover character, in accordance with the Standards. A 10-year recurrence interval storm was taken as the criteria for determining rainfall runoff. The basic intensity value was determined to be approximately 2 inches per hour in the Standards. The basic intensity value was modified by a correction factor based on the time of concentration for each basin, and the peak runoff rate as the product of runoff coefficient number, corrected intensity, and site area.

LAGOON DRIVE MARINA SITE

It it's current condition the Lagoon Drive Marina site consists of a strip approximately 50 feet wide and 4,000 feet long. Ground cover is generally bare coral fill with some scattered grass and scrub brush. The site slopes slightly from the edge of pavement to the riprapped shoreline and runoff enters the Lagoon by sheet flow. Runoff from the 10-year recurrence interval storm is 3.7 cubic feet per second (cfs), evenly distributed along the length of the site. Seven existing drainlines cross the site and enter Ke'ehi Lagoon. The lines drain the South Ramp area and range in size from 36-inch to 84-inch diameter.

The developed condition of the Lagoon Marina is similar to the existing in that the sheet flow runoff pattern will be maintained and no drain system specific to the Marina improvements will be installed, except that where existing drainlines cross the site near new structures, local drainage may be led into the lines. The shoreside site will be widened by filling and paved for parking except for

structures housing support, administration, club house, restaurant/snack bar facilities. These areas are a negligible portion of the total land area and do not warrant special consideration for runoff generation. The farthest reach to the Lagoon is estimated at 300 feet. Total calculated runoff in the developed condition is approximately 67 cfs, evenly distributed along the length of the site.

LAGOON ISLAND SITE

Storm runoff from the Lagoon Island development need not be computed for the existing condition; rainfall enters the Lagoon directly. Due to the size of the site and impervious nature of much of the ground surface, the proposed Lagoon Island site developments will generate considerable runoff and require several drainage collection networks and outfalls. To determine the required sizing of drain improvements, each land use type is examined separately with respect to it's location and orientation within the site.

The south and east sides of the island are identified for park areas. The park will be gently sloping grassed or landscaped ground with low runoff characteristics. Most of the park lands, lying along the southern and eastern shores of the island, are narrow strips which will drain by sheet flow directly to Ke'ehi Lagoon. The south shoreline will be punctuated by six drain outlets from the interior light industrial and commercial development and perimeter roadway. Local drainage along the perimeter roadway may be inlet to these lines where they cross park lands, however generally the lands may drain by sheet flow to Ke'ehi Lagoon. Total runoff from the entire park land designated area is 3.5 cfs.

The Lagoon Island Marina site along the west shore may be sloped to drain towards Ke'ehi Lagoon and entirely paved. Six drain lines crossing the parking lot from the commercial and light industrial area will collect and discharge runoff. Again, as the site is relatively narrow, runoff may be allowed to sheet flow to the sea except in localized areas which may be drained by the transverse drainlines. Approximate total runoff from the marina parking is calculated to be 3 cfs, distributed along the shoreline.

No storm drainage system need be provided for the narrow yacht race and ocean sports peninsula fronting the inlet at the island's east shore. Runoff will sheet flow to the lagoon evenly along the length of the site. Total runoff from the paved site is 6.6 cfs, distributed along the bulkhead length of approximately 1900 feet.

The maritime commercial area occurs as a strip along the inlet opposite the yacht race facility (see Figure 3). No drainage system for the area nearest open water is necessary as sheet flow or paved swales to the bulkhead will handle runoff. The portion of the maritime commercial area fronting the interior road will be drained by inlets along the roadway. Total runoff from a strip 200 feet wide fronting the

interior roadway and intercepted by the road drainlines is 28 cfs; sheet flow to the Lagoon inlet will total 14 cfs along 2,000 feet of bulkhead. A schematic layout of the drain system and drainage basins for the Lagoon Island development is presented in Figure 14.

The 15 acres designated for Snug Harbor will be entirely paved for parking and materials storage and handling, or roofed for covered storage, administration, and shop facilities. The site will be bordered by drainlines on the west side and a line crosses the eastern quarter of the site. Ocean frontage of 1,050 feet will be available and open area behind it may drain by sheet flow as for other water frontage on other island areas. The remaining 10 acres will generate 40 cfs to the west drainline and 13 cfs to the east line. Both lines will discharge to Ke'ehi Lagoon at the pier face.

The commercial and light industrial area comprising the interior of the Lagoon Island may be approximately 70 percent under roof, with the remainder paved. Runoff will be collected by inlets at approximately 75 foot intervals on both sides of the roadways. Drainlines will lead from near the island drainage divide (roughly the east-west centerline of the island) to Ke'ehi Lagoon. Each inlet will collect about 2.1 cfs of runoff from an area of approximately half an acre. Inlets are sited along the developer-provided interior roadways only; additional inlets necessitated by tenant site layout will be the leasee's responsibility.

Total runoff from the Lagoon Island site will be distributed among 12 drain systems in the interior and perimeter roadways as shown in Figure 14. The drainlines will cross park lands, Snug Harbor and the marina parking lot to outlet into Ke'ehi Lagoon. A tabulation of the line sizes and footage for the conceptual drain layout is included in Chapter V.

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HAWAIIAN CANOE CENTER SITE

The Hawaiian Canoe Center site occupies approximately 15 acres. The extension of the shoreline fronting the existing Ke'ehi Lagoon Park may be drained by sheet flow as is the park currently. Improvements including the Center structure and an associated parking lot will generate approximately 12 cfs of storm runoff in the 10-year recurrence interval storm. It is recommended that this runoff be allowed to run to Kalihi and Hoanalua Streams in grassed swales on either side of the site. No underground collection and disposal system is warranted for the site in view of the small runoff flows generated and proximity to the Lagoon.

PIER 60 SITE

Drainage from the Pier 60 site may be via sheet flow since the area is relatively narrow and on the waterfront. The short flow path will afford no concentration of flow.

CHAPTER IV UTILITY REQUIREMENTS - ELECTRICAL, TELEPHONE, CATV

The conceptual developments were reviewed with the Distribution Engineering Section at Hawaiian Electric Company (HECo) to determine the requirements for electrical service. The policy of the company is to provide electrical power when and where needed; no difficulty was foreseen in providing power to any of the sites. The Lagoon Island development would likely require an additional substation, for which a site has already been purchased. In all cases the developer will be required to provide and dedicate electrical ducts. The power requirements specific to each site are reviewed in the following paragraphs.

LAGOON MARINA SITE

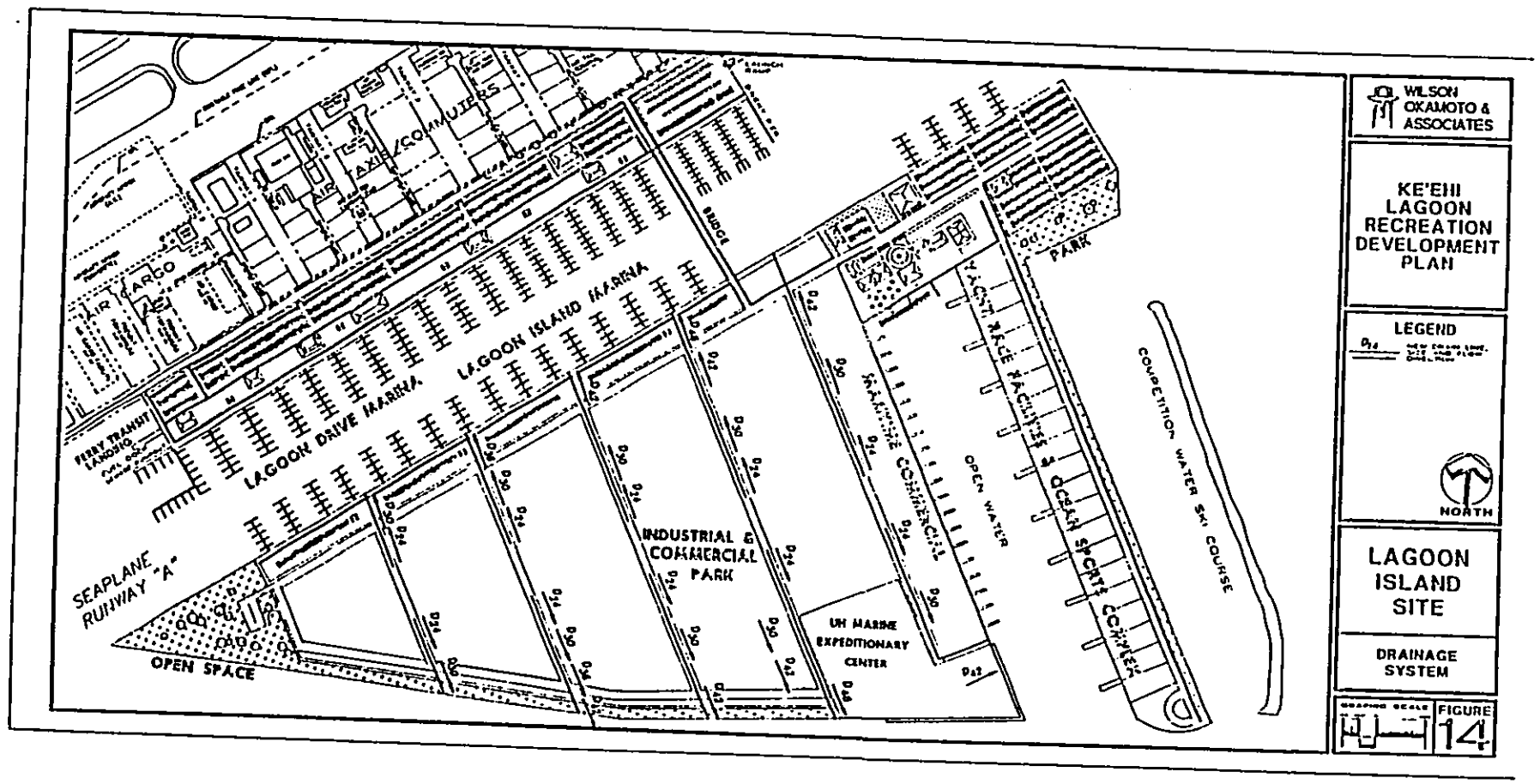
The Lagoon Marina, consisting of approximately 680 slips, attendant service facilities, and limited commercial spaces may be served from the existing power grid. No offsite upgrading of the distribution system will be required to serve the conceptual plan marina.

LAGOON ISLAND SITE

The Lagoon Island improvements will constitute a considerable load on the existing power system. In anticipation of development in the Lagoon Drive/South Ramp area, HECo has already purchased a parcel in the Kalewa Street service area for a future substation site. In that currently planned development along Lagoon Drive may be served from the existing power grid, construction of the substation will depend on demands by the Lagoon Island Site development. It is expected that the substation may be constructed and brought on-line is less time than the Lagoon Island will be created and occupied. Phasing of improvements and resulting electrical demand may allow that substation construction may be delayed until after completion of initial Lagoon Island developments.

HAWAIIAN CANOE CENTER AND PIER 60 SITES

The existing power grid in the Kalihi Kai area is capable of supplying the electrical needs of the conceptual Canoe Center and Pier 60 Sites. Powerline layout will depend on the final site plan.


WILSON OKAMOTO & ASSOCIATES
KE'EHI LAGOON RECREATION DEVELOPMENT PLAN
LEGEND
NORTH
LAGOON ISLAND SITE
DRAINAGE SYSTEM
GRAPHIC SCALE
FIGURE 14
AIR CARGO
AIR TAXI/COMMUTERS
FERRY TRANSIT (ARCHIVE)
LAGOON DRIVE MARINA
LAGOON ISLAND MARINA
PARK
COMPETITION WATER SKI COURSE
OPEN WATER
SEAPLANE RUNWAY "A"
OPEN SPACE
INDUSTRIAL & COMMERCIAL PARK
UH MARINE EXPEDITIONARY CENTER

CHAPTER V COST SUMMARY

The following tabulation lists estimated budget improvement costs for civil engineering utilities for each site. The cost figures are representative of present bid prices and do not include allowance for engineering, inflation or inspection.

Lagoon Marina Site:

Water System:	$407,768
Water System Facilities Charge:	562,800
Sewer System:	108,800
Subtotal =	$515,768

Lagoon Island Site:

Water System:	$3,163,120
Estimated Water Development, Facilities, Storage:	$1,500,000
Onsite Sewer System:	5,706,160
Drainage System:	2,084,198
Subtotal =	$12,453,478

Lagoon Island Offsite Sewer Improvements:

The submarine force main alternative is included with the Lagoon Island development costs as only this development may possess the financial strength to consider construction. Other site developers, not necessarily part of the Ke'ehi projects considered herein, may consider participation.

Option A:
Connection to Kamehameha Highway Pump Station: $2,967,380

Option B:
New submarine main to Sand Island Treatment Plant: $3,452,625

Hawaiian Canoe Center Site, Private Portion:

Water System:	$95,310
Water System Facilities Charge:	28,100
Sewer System:	71,213
Subtotal =	$194,623

Hawaiian Canoe Center Site, Public Portion:

Water System:	$40,230
Sewer System:	77,963
Subtotal =	$118,193

Pier 60 Marina Site:

Water System:	$110,025
Water System Facilities Charge:	56,300
Sewer System:	69,930
Subtotal =	$236,255

APPENDIX -- COST ESTIMATES

Itemized cost estimates for utility improvements to service the conceptual site developments is presented below. Prices for items are based on the estimated linear footage of utility lines required in the conceptual scheme for each development site. The unit prices represent typical bid amounts for the improvements in 1989 dollars and do not include allowance for engineering, inspection, contingencies, escalation or phasing of construction.

LAGOON MARINA SITE

Water System	Quantity	Unit	Unit Price	Total
12" Main	3,850	LF	$ 48.00	$184,800
Fire Hydrants	14	Ea	2,200.00	30,800
2" Stubouts to Piers	4,400	LF	14.00	61,600
Fire Cabinets on Piers	22	Ea	675.00	14,850
Connect to existing Lagoon Drive main, valves	2	Ea	5,000.00	10,000
Subtotal, Direct Field Level			=	$302,050
Contractor's Overhead and Profit (35%)			=	105,718
Water System Facilities Charge			=	562,800
ONSITE WATER SYSTEM TOTAL			=	$970,568

Sewer System				
8" main to existing	2,000	LF	$ 31.00	$62,000
Sewer Manholes	6	Ea	2,500.00	15,000
Connection to South Ramp	1	LS		3,000
Subtotal, Direct Field Level			=	$80,000
Contractor's Overhead and Profit (35%)			=	$28,000
ONSITE SEWER SYSTEM TOTAL			=	$108,000

TOTAL LAGOON MARINA ONSITE UTILITIES COST = $1,078,568

LAGOON ISLAND SITE

Water System	Quantity	Unit	Unit Price	Total
24-inch Main to Kilihau St.	6700	LF	$ 112.00	$750,400
20-inch Perimeter main	11200	LF	95.00	1,064,000
12" Onsite main	6450	LF	48.00	309,600
8-inch Onsite main	2100	LF	30.00	63,000
Fire Hydrants	71	Ea	2,200.00	156,200
Subtotal, Direct Field Level			=	$2,343,200
Contractor's Overhead and Profit (35%)			=	820,120
Offsite Water Development Participation			=	1,500,000
WATER SYSTEM TOTAL			=	$4,663,320

Sewer System (Onsite only)				
Gravity Mains:				
8-inch	11,200	LF	$ 31.00	$347,200
10-inch	3,350	LF	34.00	113,900
12-inch	1,700	LF	54.00	91,800
15-inch	4,900	LF	58.00	284,200
18-inch	250	LF	75.00	18,750
21-inch	850	LF	82.00	69,700
24-inch	1,250	LF	87.00	108,750
Sewer Manholes	70	Ea	2,750.00	192,500
Lift Station, 12.4 MGD	1	LS		3,000,000
Lift Station	1	LS		35,000
Subtotal, Direct Field Level			=	$4,261,800
Contractor's Overhead and Profit (35%)			=	$1,491,630
ONSITE SEWER SYSTEM TOTAL			=	$5,753,430

Drainage System				
Catch Basins	90	Ea	$2,750.00	$247,500
Drainlines:				
23-inch	2,050	LS	87.00	178,350
30-inch	3,150	LS	135.00	425,250
36-inch	400	LS	170.00	68,000
42-inch	2,425	LS	180.00	436,500
48-inch	450	LS	285.00	128,250
Outlet Headwalls	10	Ea	6,000.00	60,000
Subtotal, Direct Field Level			=	$1,543,850
Contractor's Overhead and Profit (35%)			=	$540,348
DRAINAGE SYSTEM TOTAL			=	$2,084,198

TOTAL LAGOON ISLAND ONSITE UTILITIES COST, (includes offsite water connection and development charges) = $12,500,948

OPTION A: Sewer Connection to Kamehameha Highway Pumping Station

Water Crossing to South Ramp	1200	LF	$ 750.00	$900,000
24-inch main to Pump Station	5800	LF	100.00	580,000
AC Pavement	2000	SY	35.00	70,000
Traffic Control	5800	LF	10.00	58,000
Major Intersection	1	LS		40,000
Pump Station Connection	1	LS		100,000
Pump Station Upgrading	1	LS		450,000
Subtotal, Direct Field Level			=	$2,198,000
Contractor's Overhead and Profit (35%)			=	$769,300
OPTION A TOTAL			=	$2,967,300

OPTION B: Submarine Force Main to Sand Island Treatment Plant

Submarine Line to Pier 60				
24-inch land line	300	LF	$ 125.00	$37,500
24-inch underwater line	1,200	LF	750.00	900,000
Force Main to Sand Island				
Water Crossing	600	LF	$ 900.00	$540,000
24-inch mainland line	3,000	LF	100.00	300,000
24-inch Sand Island line	3,000	LF	100.00	300,000
AC Pavement	4,000	LF	35.00	140,000
Traffic Control	6,000	LF	10.00	60,000
Major Intersection	1	LS		60,000
Connection to Headworks	1	LS		200,000
Subtotal, Direct Field Level			=	$2,537,500
Contractor's Overhead and Profit (35%)			=	$888,125
OPTION B TOTAL			=	$3,425,625

HAWAIIAN CANOE CENTER SITE -- PRIVATE SYSTEM

Water System	Quantity	Unit	Unit Price	Total
8-inch main	2,100	LF	$ 30.00	$63,000
Fire Hydrants	3	Ea	2200.00	6,600
Connection to exist., valves	1	LS		1,000
Subtotal, Direct Field Level			=	$70,600
Contractor's Overhead and Profit (35%)			=	$24,710
WATER SYSTEM TOTAL			=	$95,310

Sewer System	Quantity	Unit	Unit Price	Total
4-inch force main	800	LF	$ 20.00	$16,000
Sewer manhole	1	Ea	1,750.00	1,750
Lift Station	1	LS		35,000
Subtotal, Direct Field Level			=	$52,750
Contractor's Overhead and Profit (35%)			=	$18,463
SEWER SYSTEM TOTAL			=	$71,213

TOTAL HAWAIIAN CANOE CENTER SITE UTILITIES COST (Private system only) = $166,523

HAWAIIAN CANOE CENTER SITE -- PUBLIC SYSTEM

Water System

	Quantity	Unit	Unit Price	Total
6-inch main	1,000	LF	$ 25.00	$25,000
Fire Hydrants	1	Ea	2,200.00	2,200
Connection to exist., valves	1	LS		2,600
Subtotal, Direct Field Level			=	$29,800
Contractor's Overhead and Profit (35%)			=	$10,430
WATER SYSTEM TOTAL			=	$40,230

Sewer System

	Quantity	Unit	Unit Price	Total
4-inch force main	1,000	LF	$ 21.00	$21,000
Sewer manhole	1	Ea	1,750.00	1,750
Lift Station	1	LS		35,000
Subtotal, Direct Field Level			=	$57,750
Contractor's Overhead and Profit (35%)			=	$20,213
SEWER SYSTEM TOTAL			=	$77,963

TOTAL HAWAIIAN CANOE CENTER SITE UTILITIES COST (Public system only) = $118,963

TOTAL HAWAIIAN CANOE CENTER SITE UTILITIES COST, Private and public systems = $284,716

PIER 60 MARINA SITE

Water System

	Quantity	Unit	Unit Price	Total
8-inch main	1,900	LF	$ 30.00	$57,000
Fire Hydrants	3	Ea	2,200.00	6,600
2-inch stubouts to piers	800	LF	14.00	11,200
Fire Cabinets	4	Ea	675.00	2,700
Connect to main, valves	1	LS		4,000
Subtotal, Direct Field Level			=	$81,500
Contractor's Overhead and Profit (35%)			=	$28,525
TOTAL			=	$110,025

Sewer System

	Quantity	Unit	Unit Price	Total
4-inch force main	800	LF	$ 21.00	$16,800
Lift Station	1	Ea		35,000
Subtotal, Direct Field Level			=	$51,800
Contractor's Overhead and Profit (35%)			=	$18,130
TOTAL			=	$69,930

TOTAL PIER 60 SITE UTILITIES COST = $179,955

APPENDIX G

Numerical Model Study of the Circulation in Keehi Lagoon

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NUMERICAL MODEL STUDY OF THE CIRCULATION IN KE'EHI LAGOON

Prepared for:

Harbors Division
Department of Transportation
State of Hawaii

Prepared by:

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615 Piikoi Street, Suite 1000
Honolulu, Hawaii 96814

January 1989

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1.0 Introduction

Studies conducted subsequent to the completion of the Reef Runway at Honolulu International Airport indicated that water quality and circulation within Ke'ehi Lagoon had improved compared to the conditions existing prior to the construction of the Reef Runway and Circulation Channel. In order to assess the probable impacts due to implementation of the Ke'ehi Lagoon Recreation Plan, a numerical circulation model was used to simulate the existing circulation patterns within the lagoon and the resulting patterns due to the proposed development plan for the lagoon. This report describes the numerical circulation model and results.

The proposed development within Ke'ehi Lagoon as modeled herein consists of:

- Lagoon Drive Marina with associated shoreline fill and floating slips;
- Triangle development with associated fill over the shallow interior reef/mud flat, floating slips, and peninsula fill for the Yacht Race/Ocean Sports Complex;
- Pier 60 Marina with floating slips;
- Canoe Race Course improvements with associated shoreline fill;
- Breakwater and swimming beach development at the southwest tip of Sand Island.

2.0 Description of Model

The circulation study for Ke'ehi Lagoon was performed using a detailed numerical model which is a variation of the HYDRO-3 model described by Dean and Taylor (1972), Burns and Taylor (1979), and Taylor and Pagenkopf (1981). The model assumes that vertical acceleration is negligible and the vertical distribution in the water column is hydrostatic. By ignoring the vertical

variations, the model computes vertically-averaged flow values.

The governing equations are:

Momentum:

$$\frac{\partial q_x}{\partial x} + \frac{\partial M_{xx}}{\partial x} + \frac{\partial M_{xy}}{\partial y} = fq_y - gD\frac{\partial \eta}{\partial x} + \frac{\tau_{sx}}{\rho} - \frac{\tau_{bx}}{\rho}$$

$$\frac{\partial q_y}{\partial y} + \frac{\partial M_{yy}}{\partial y} + \frac{\partial M_{xy}}{\partial x} = -fq_x - gD\frac{\partial \eta}{\partial y} + \frac{\tau_{sy}}{\rho} - \frac{\tau_{by}}{\rho}$$

Conservation of Mass:

$$\frac{\partial \eta}{\partial t} + \frac{\partial q_x}{\partial y} + \frac{\partial q_y}{\partial x} = 0$$

where:

$q_{x,y}$ = components of volume transport
M_{xx}, M_{xy}, M_{yy} = convective inertia transport
f = Coriolis parameter
η = surface displacement
D = water depth
g = gravitational acceleration
ρ = density of water
τ_s = surface wind stress
τ_b = bottom friction

In this model, the nonlinear terms have been removed to create a stable scheme for large time steps, and the convective inertia and the Coriolis terms are small. The bottom stress component is applied using the usual quadratic form. In this application, the bottom friction coefficient corresponds to a Manning's n=0.02. This represents a bottom which is generally smooth and slightly rippled. The wind stress is modeled using the usual form:

$$\tau_s = k\rho V^2 \cos\theta$$

where k is the wind stress coefficient, θ is the wind direction and V is the wind speed. Following field measurements by Van Dorn (1953) k is represented as:

$$k = 1.21 \times 10^{-6} + 2.25 \times 10^{-6} (1 - V_{crit}/V)^2$$

The term in parenthesis will be deleted for V less than the critical velocity, V_{crit}, which is 18.4 ft/sec.

The governing equations are solved numerically for a finite difference grid, which represents the bathymetry and coastal features of the area. In this case, the grid cells represent water or land, and a grid spacing of 300 feet has been selected. Figure 1 shows the land grid cells superimposed on the existing coastline. The boundary condition applied along the perimeter's water grid elements is a phased tidal response with a wave height of two feet. The land boundaries simply impose a zero flow condition for that cell. The solution involves the application of a hybrid implicit/explicit computational time-stepping scheme which calculates the x and y flow components, and the water elevation at each water grid cell, for each time step.

3.0 Verification and Calibration

The model results were verified and calibrated using measured data presented in the "Reef Runway Post-Construction Environmental Impact Report" (Parsons, Hawaii, 1979). The measured data represented the tidal current velocities at five stations which were located in the Honolulu Harbor Entrance, the Kalihi Entrance Channel, the Ski Channel, the Circulation Channel at the end of the Reef Runway, and Seaplane Runway "B". The calibration of the model involved an iterative process whereby the measured data were compared with the modeled velocity data, and the model's boundary conditions subsequently modified until

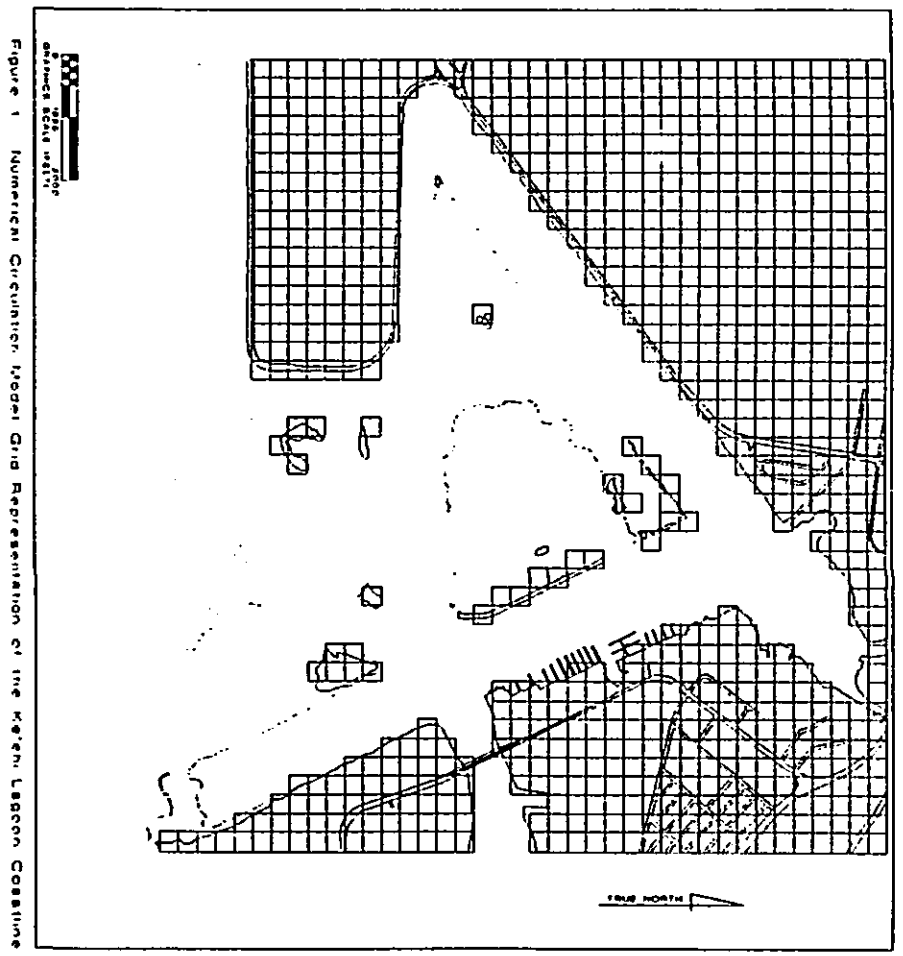

Figure 1 Numerical Circulation Model Grid Representation of the Kaneohe Lagoon Coastline

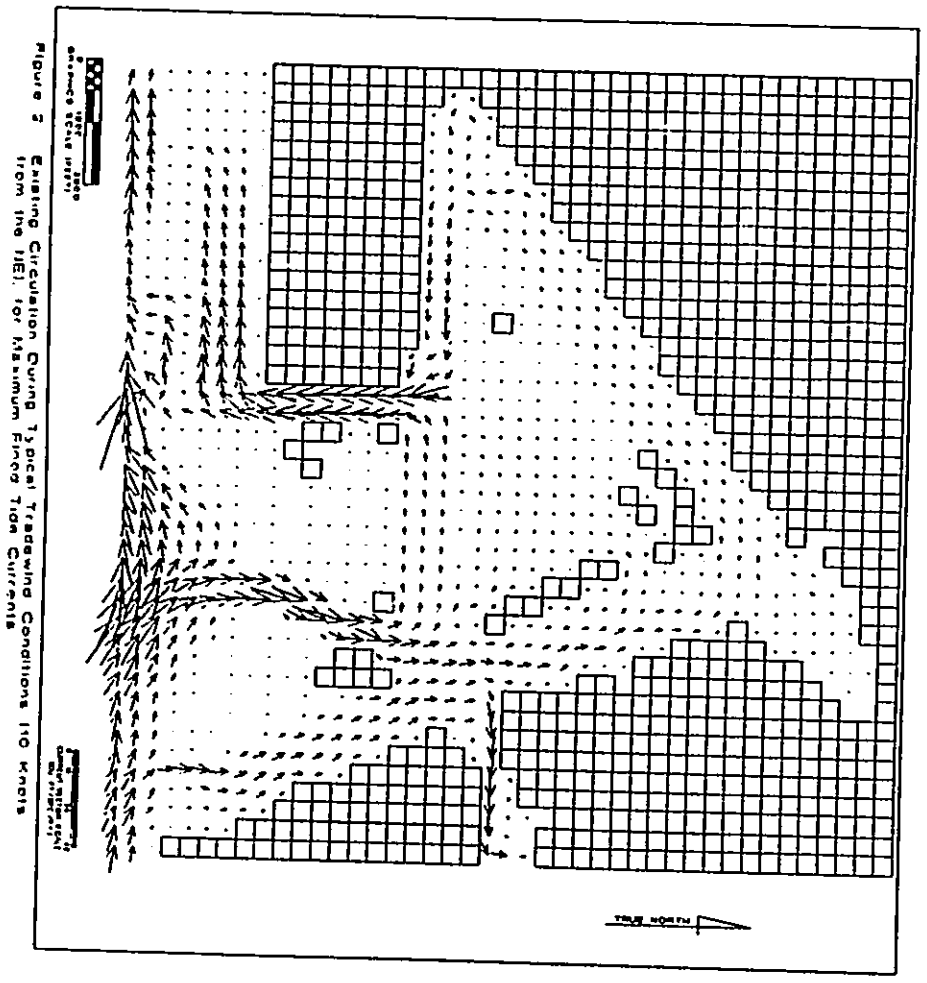

Figure 2 Existing Circulation During Typical Tradewind Conditions (10 Knots from the NE), for Maximum Flood Tide Currents

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the model results correlated satisfactorily with the measured data.

4.0 Presentation of Results

The model results are plotted as "snapshots" representing the circulation within the lagoon over one tidal cycle. The snapshots are taken at approximately three hour time intervals representing the approximate times of maximum tidal flows (flood and ebb) and minimum tidal flows (high and low tide). For each grid cell, arrows indicate the direction of the flow, and the length of the arrow indicates the magnitude of the flow in cubic feet/second/foot of water surface width.

Figures 2 through 5 represent the circulation for existing conditions with typical tradewinds of 10 knots and a wind direction from the northeast (45 degrees True). The circulation due to the proposed development in the lagoon for this typical tradewind condition is shown in Figures 6 through 9. The proposed landfills are represented by additional land grid cells. The new marinas are emulated by increased flow resistance through the affected grid cells, which are input as a bottom friction coefficient equivalent to a weedy, winding channel.

Figures 10 through 13 represent the circulation for existing conditions with typical Kona winds of 5 knots and a direction from the southwest (225 degrees True). Figures 14 through 17 represent the circulation due to proposed development for this wind condition.

Figure 18 through 20 represent the circulation for existing conditions with strong tradewinds of 40 knots from the northeast (45 degrees True). Figures 21 through 23 represent the circulation due to proposed development for this wind condition.

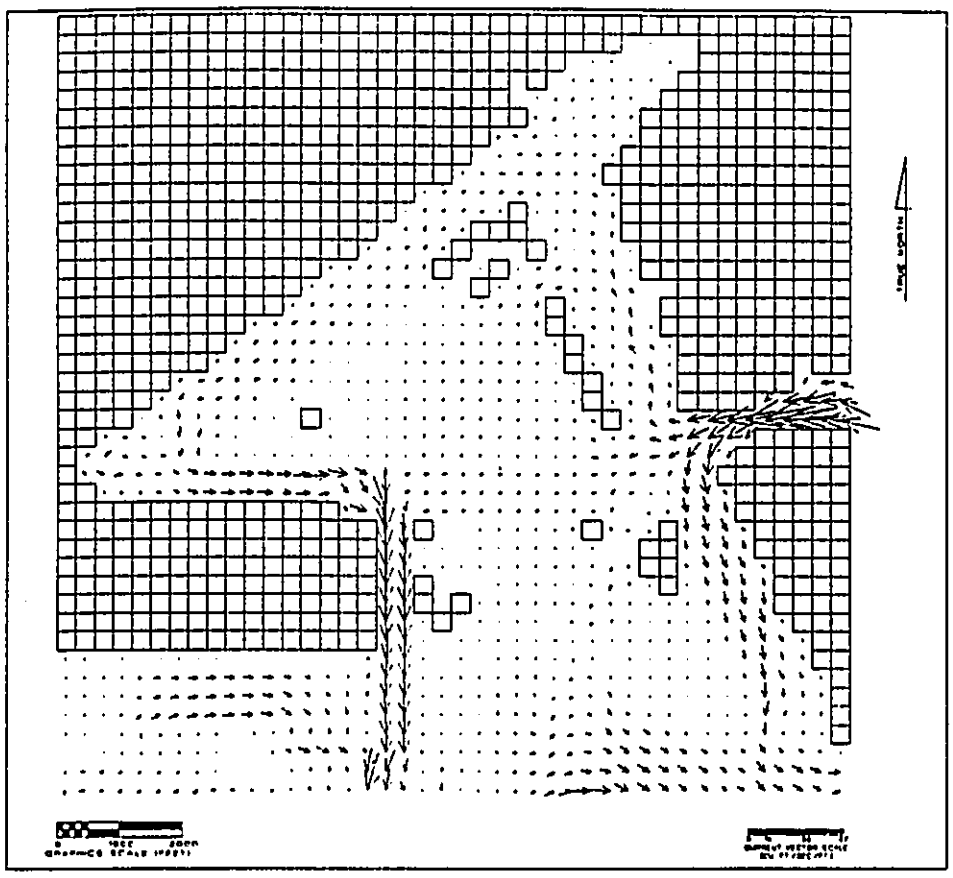

Figure 3 Existing Circulation During Typical Tradewind Conditions (10 Knots from the NE) for Transition Tide Currents

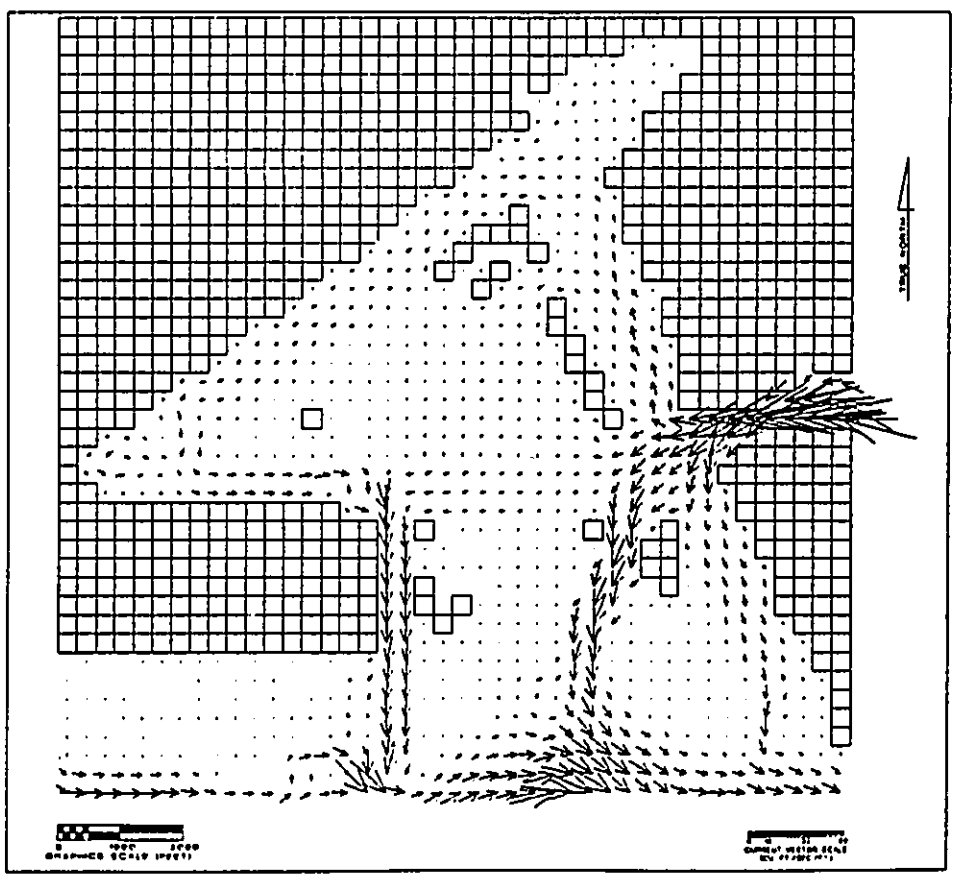

Figure 4 Existing Circulation During Typical Tradewind Conditions (10 Knots from the NE) for Maximum Ebb Tide Currents

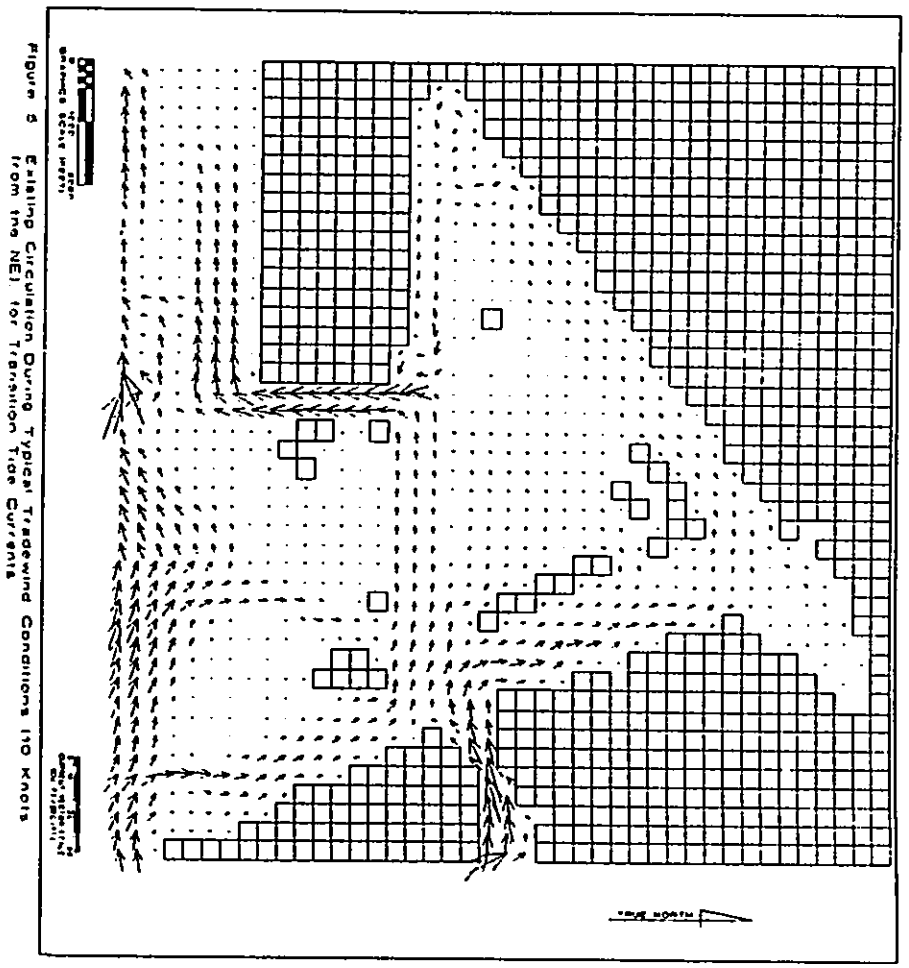

Figure 5 Existing Circulation During Typical Tradewind Conditions (10 Knots from the NE) for Transition Tide Currents

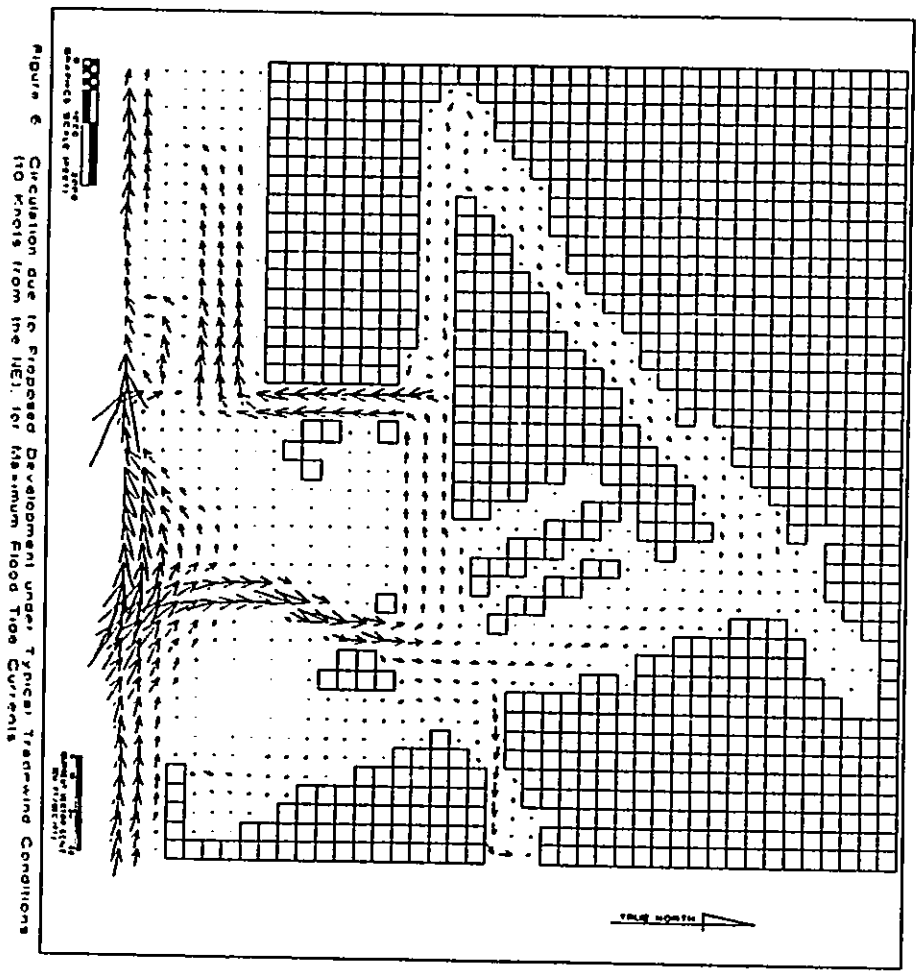

Figure 6 Circulation due to Proposed Development under Typical Tradewind Conditions (10 Knots from the NE), for Maximum Flood Tide Currents

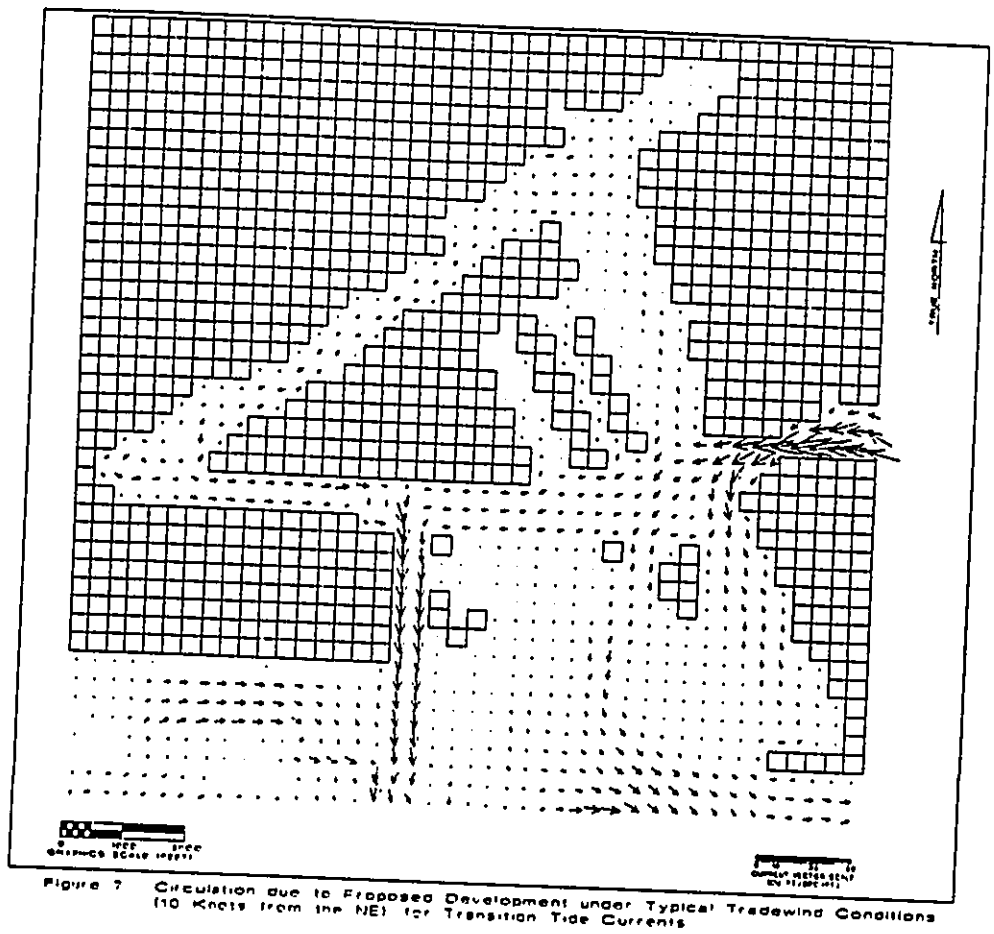

Figure 7 Circulation due to Proposed Development under Typical Tradewind Conditions (10 Knots from the NE) for Transition Tide Currents

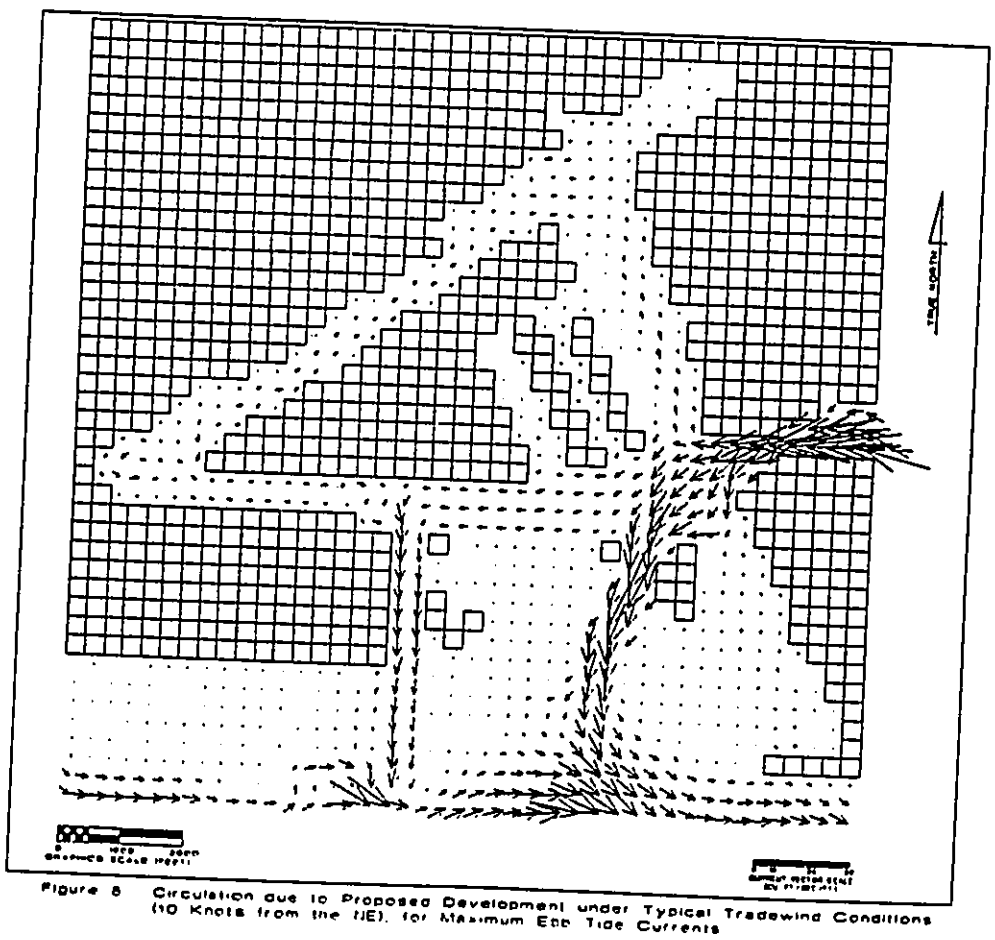

Figure 8 Circulation due to Proposed Development under Typical Tradewind Conditions (10 Knots from the NE), for Maximum Ebb Tide Currents

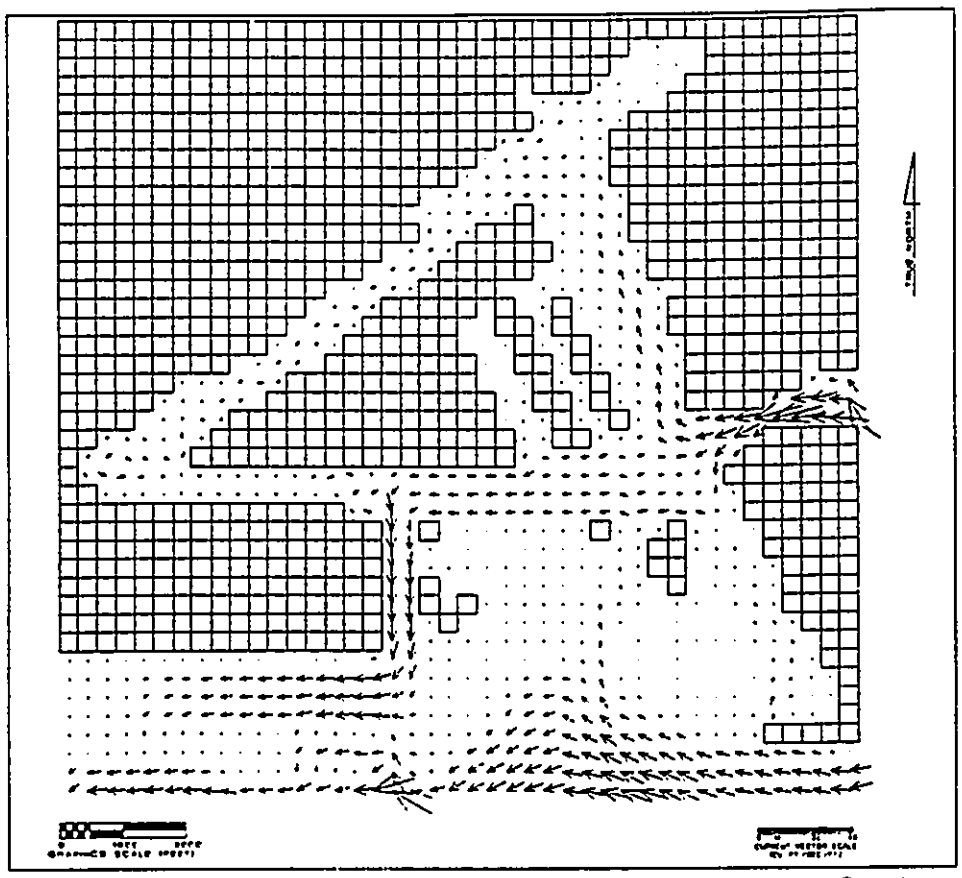

Figure 9 Circulation due to Proposed Development under Typical Tradewind Conditions (10 Knots from the NE), for Transition Tide Currents

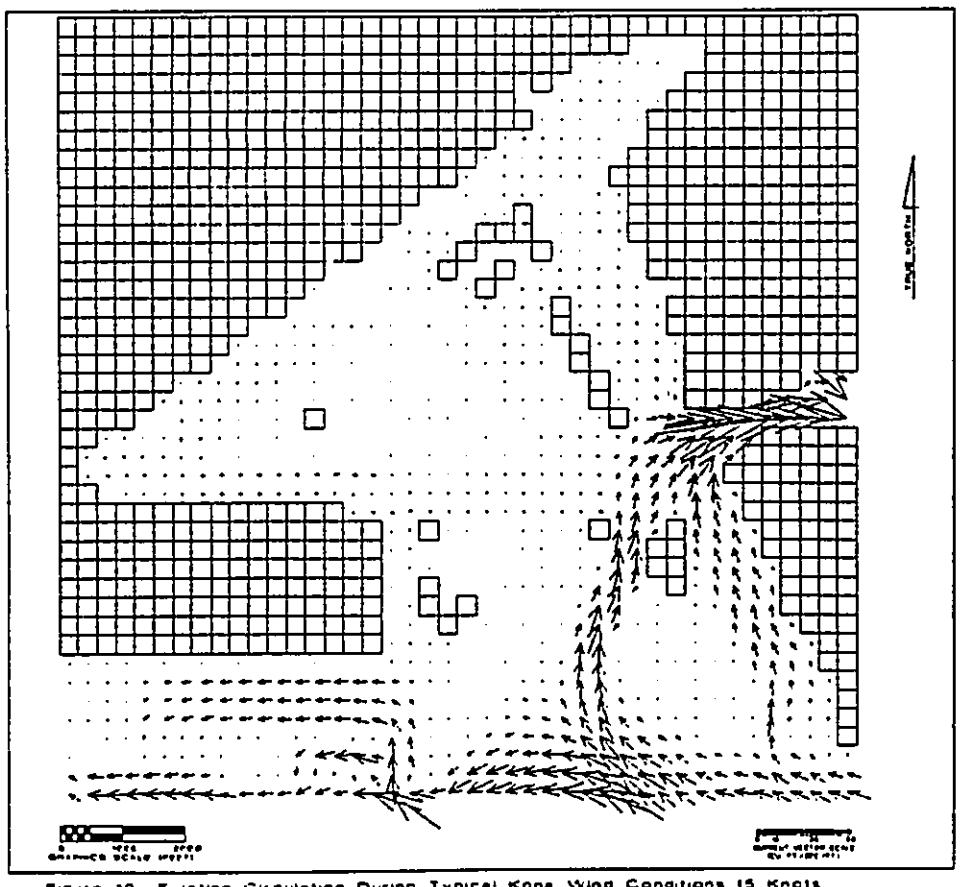

Figure 10 Existing Circulation During Typical Kona Wind Conditions 15 Knots from the SW, for Maximum Flood Tide Currents

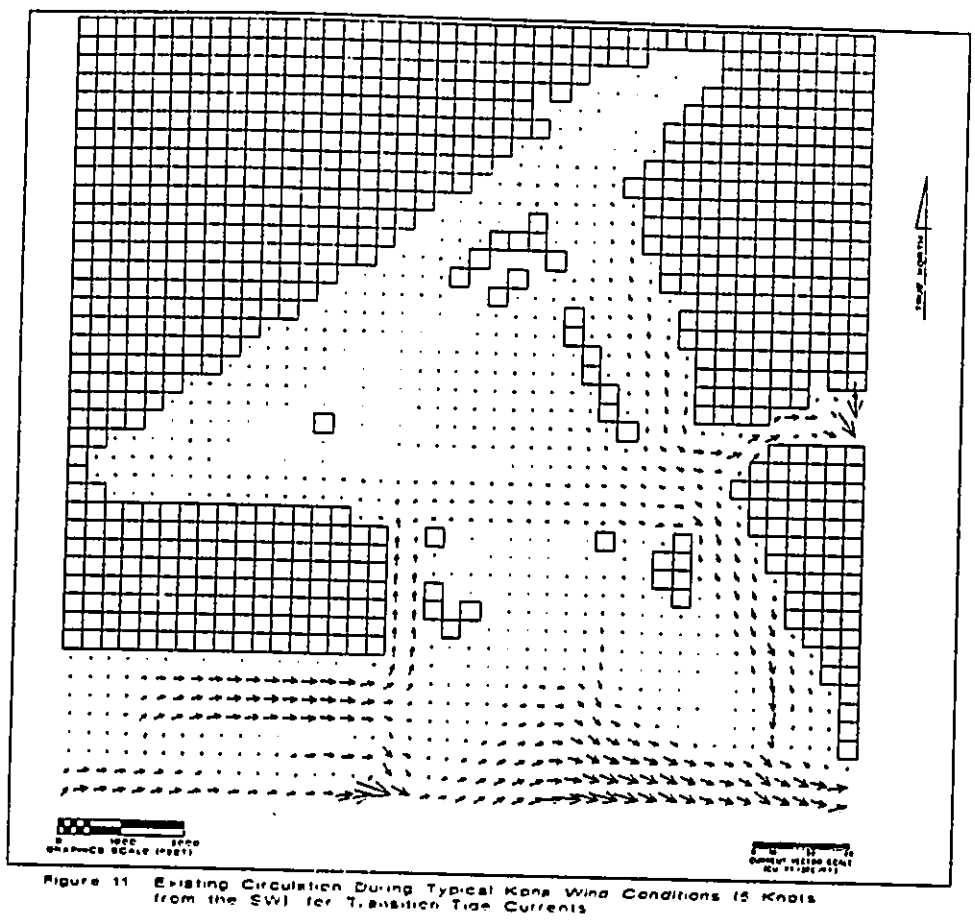

Figure 11 Existing Circulation During Typical Kona Wind Conditions (5 Knots from the SW) for Transition Tide Currents

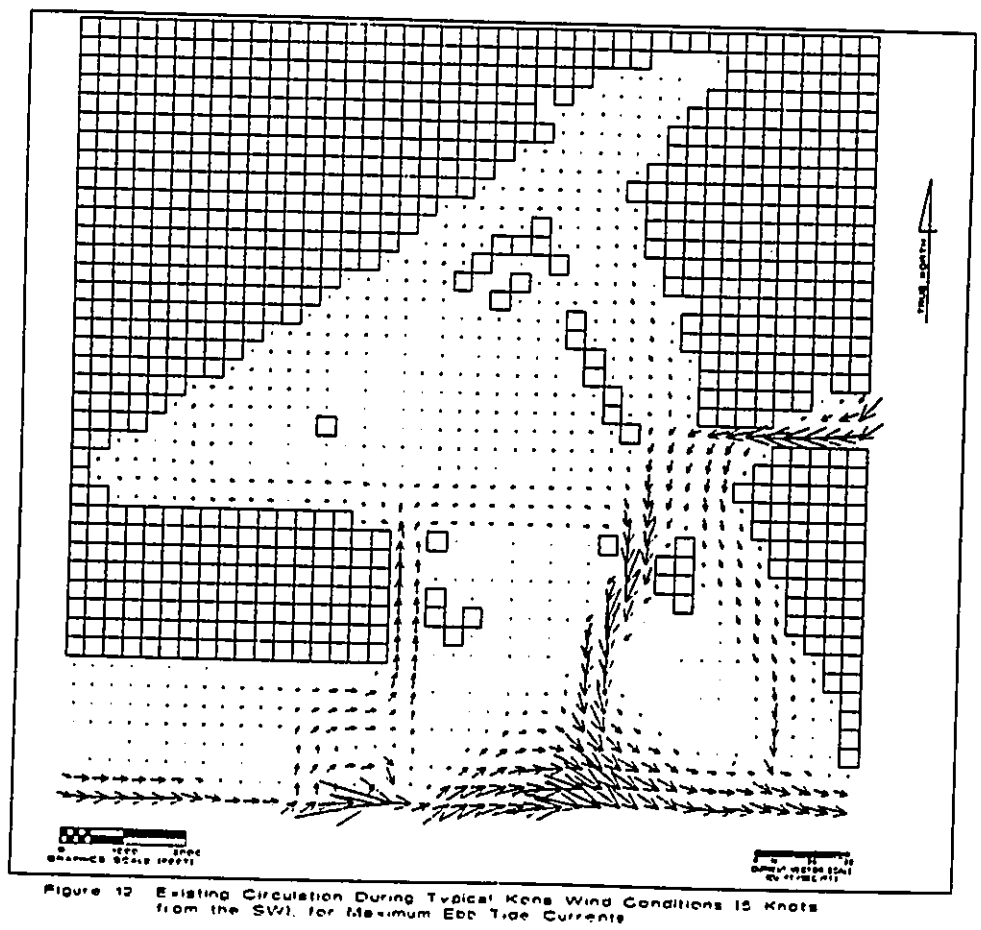

Figure 12 Existing Circulation During Typical Kona Wind Conditions (5 Knots from the SW), for Maximum Ebb Tide Currents

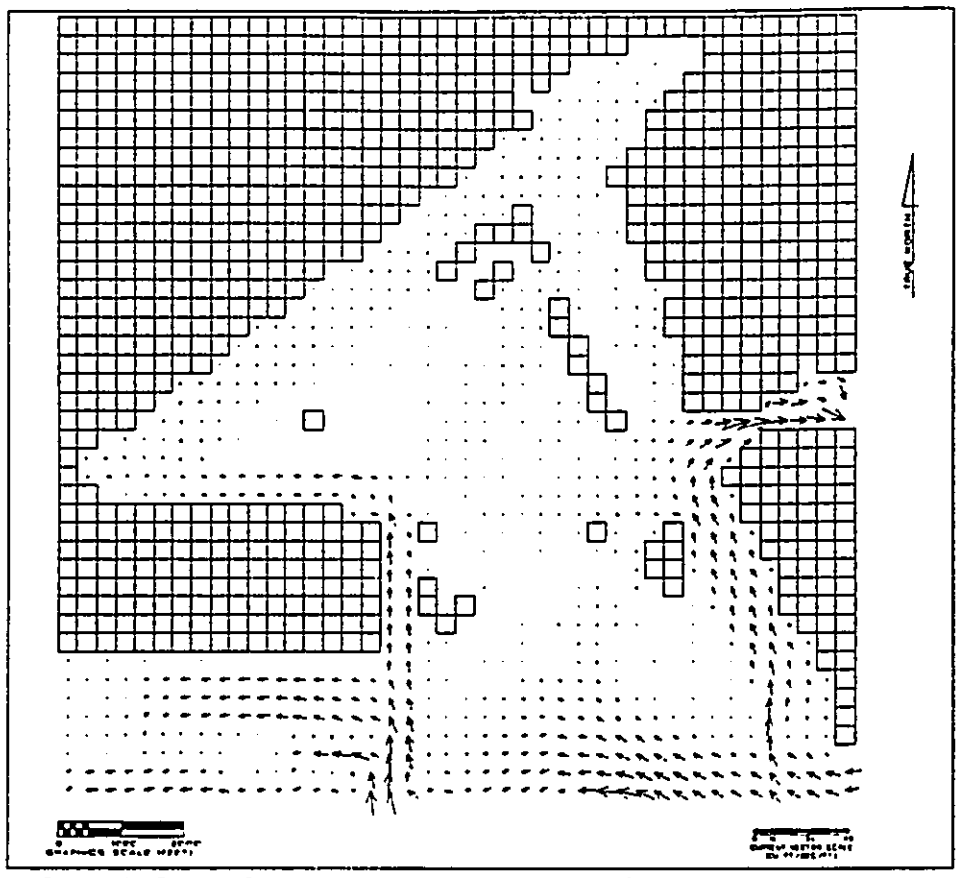

Figure 13 Existing Circulation During Typical Kona Wind Conditions 15 Knots from the SW, for Transition Tide Currents

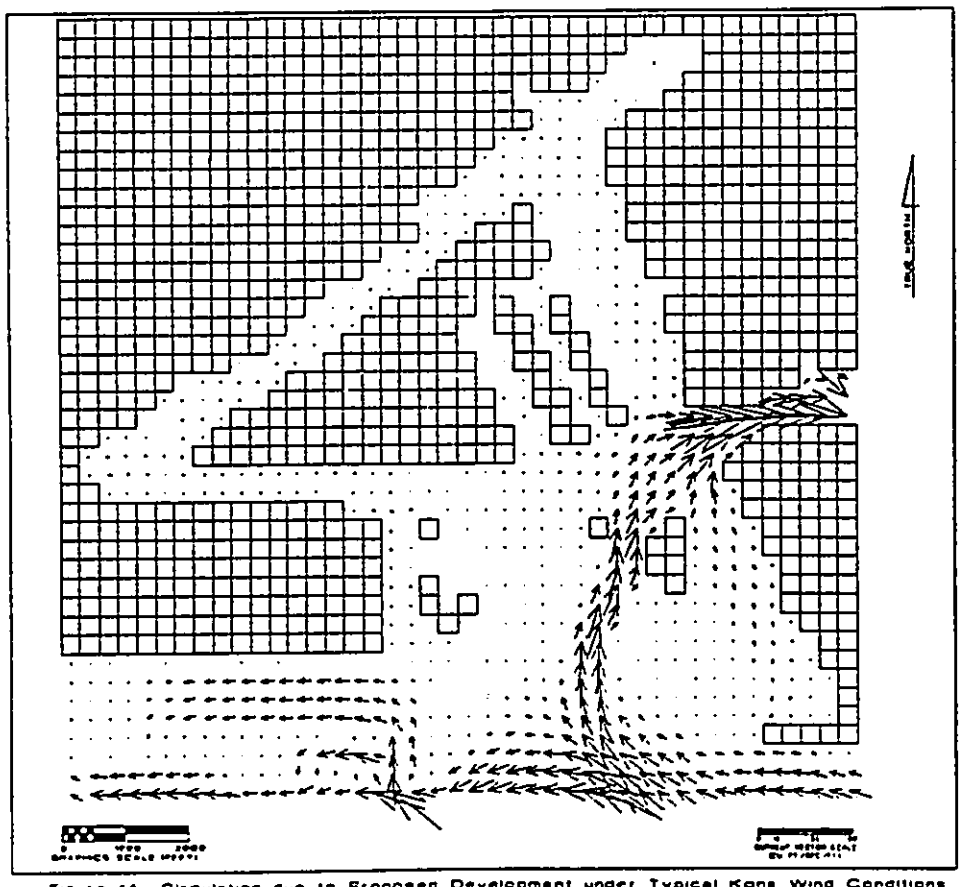

Figure 14 Circulation due to Proposed Development under Typical Kona Wind Conditions (5 Knots from the SW), for Maximum Flood Tide Currents.

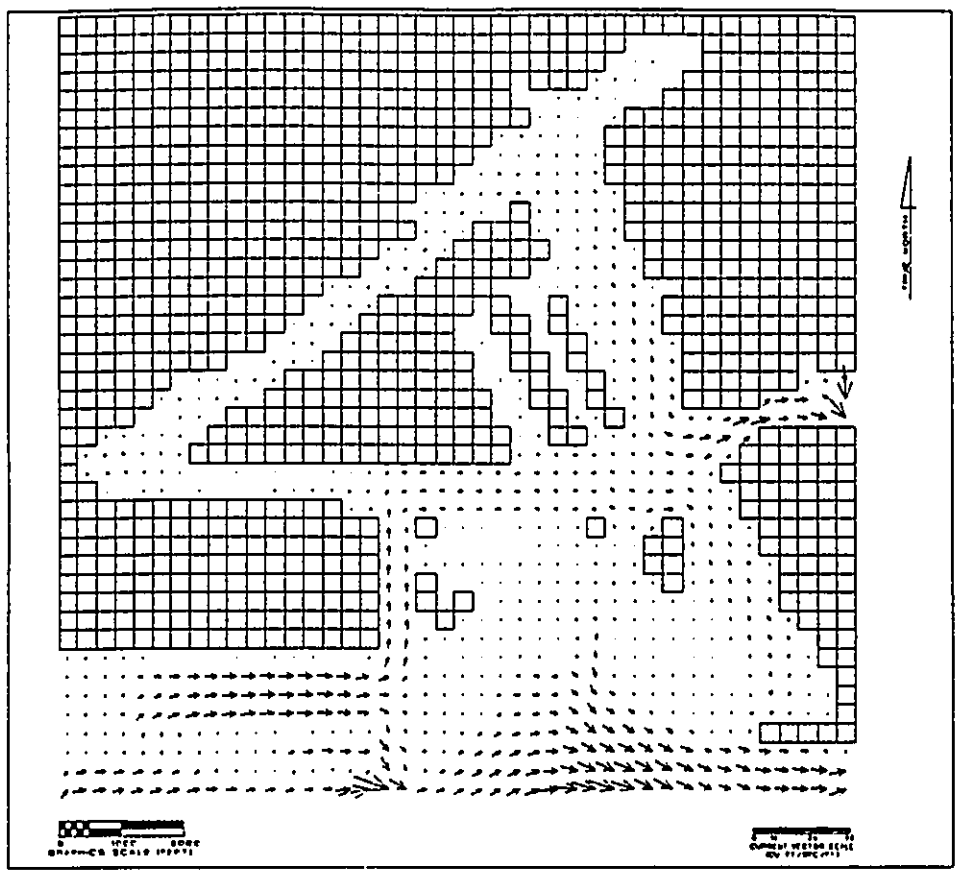

Figure 15 Circulation due to Proposed Development under Typical Kona Wind Conditions (5 Knots from the SW) for Transition Tide Currents

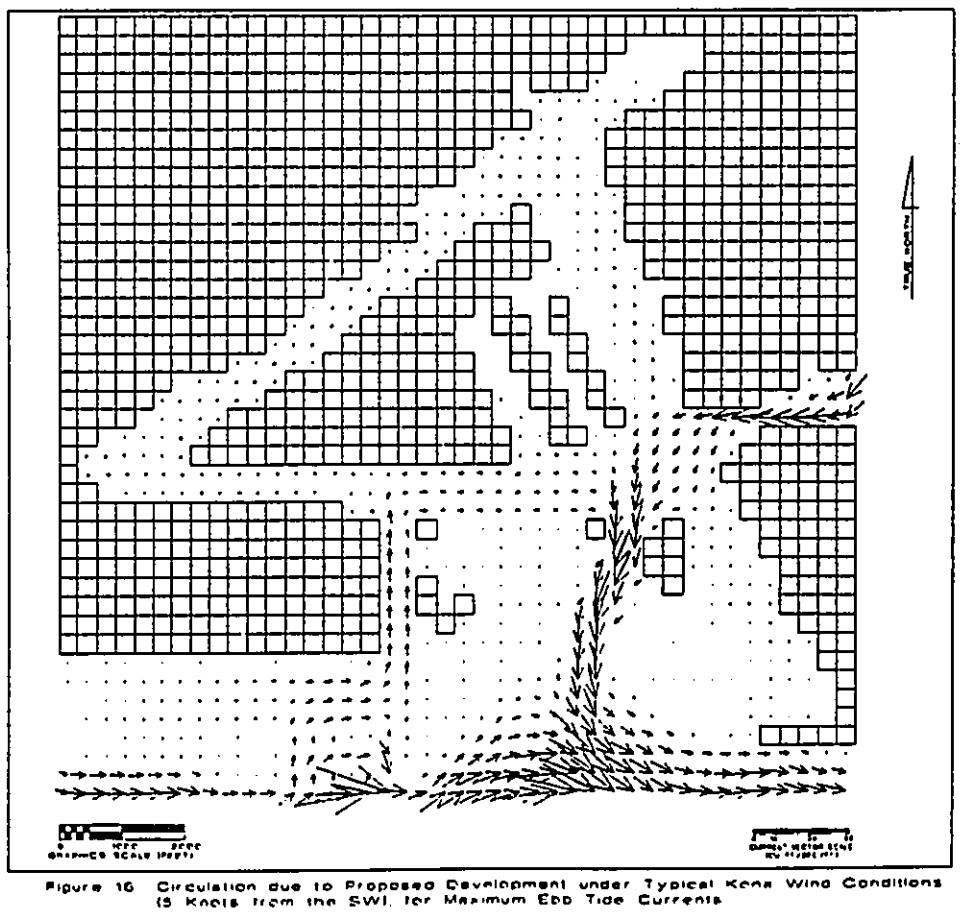

Figure 16 Circulation due to Proposed Development under Typical Kona Wind Conditions (5 Knots from the SW) for Maximum Ebb Tide Currents

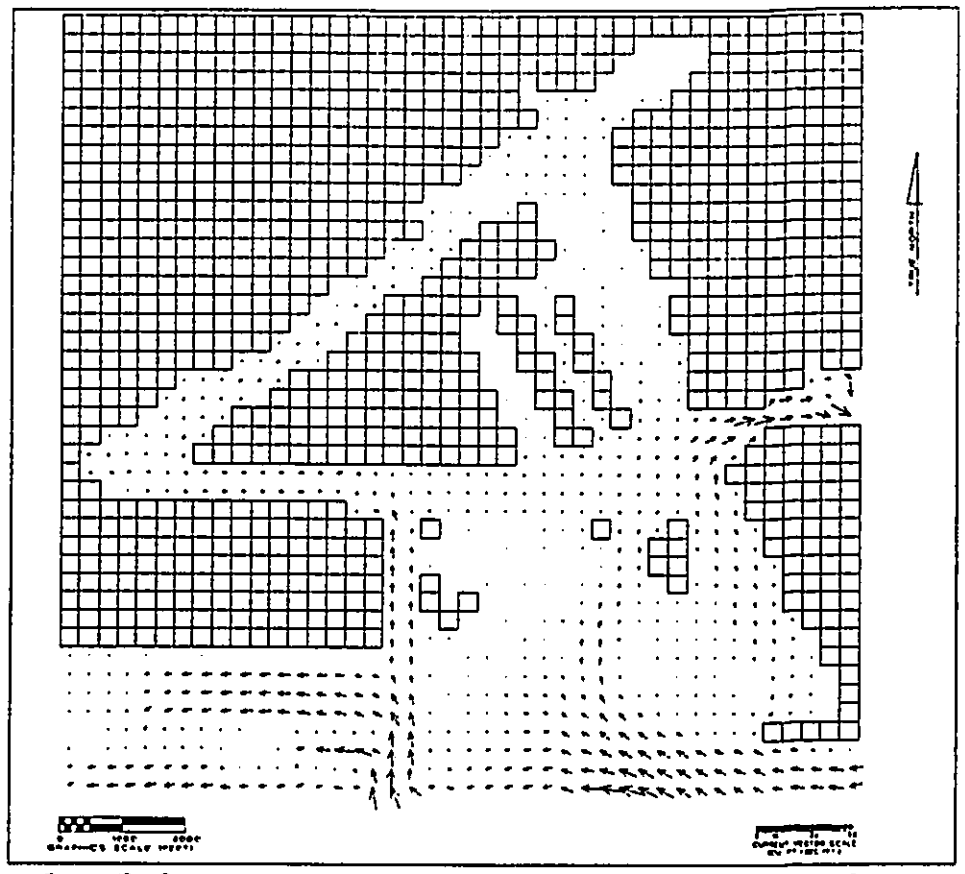

Figure 17 Circulation due to Proposed Development under Typical Kona Wind Conditions (5 Knots from the SW), for Transition Tide Currents

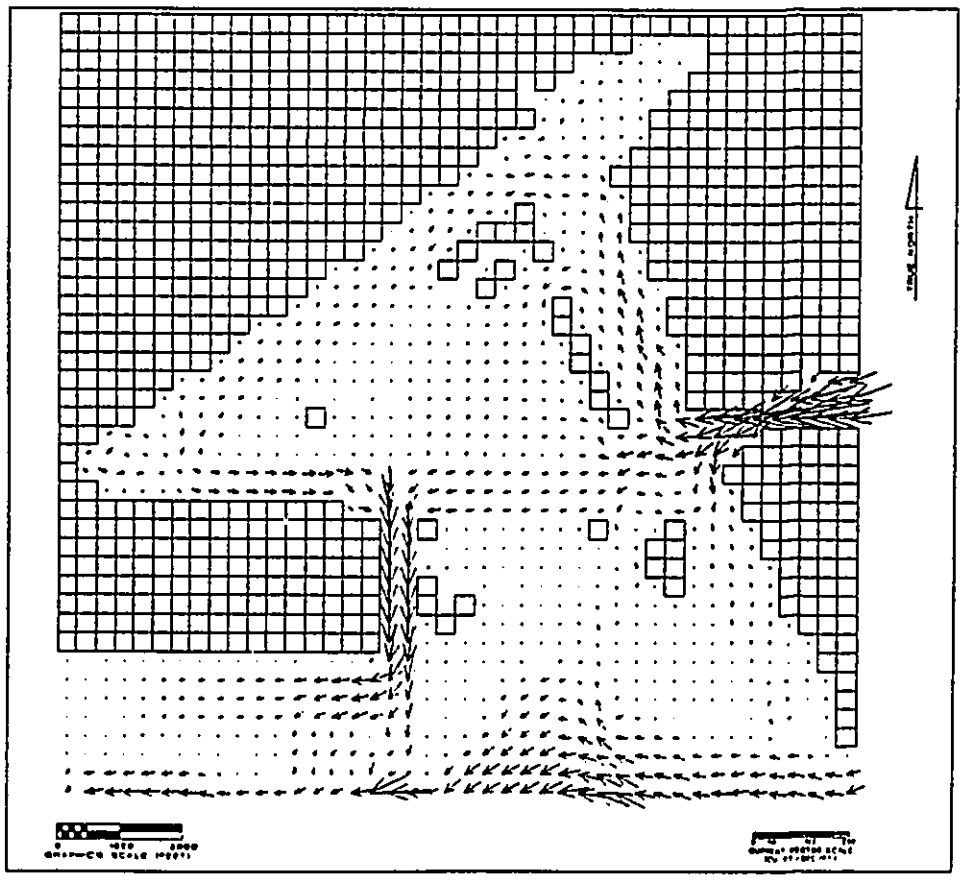

Figure 18 Existing Circulation During Strong Tradewind Conditions (15 Knots from the NE), for Maximum Flood Tide Currents

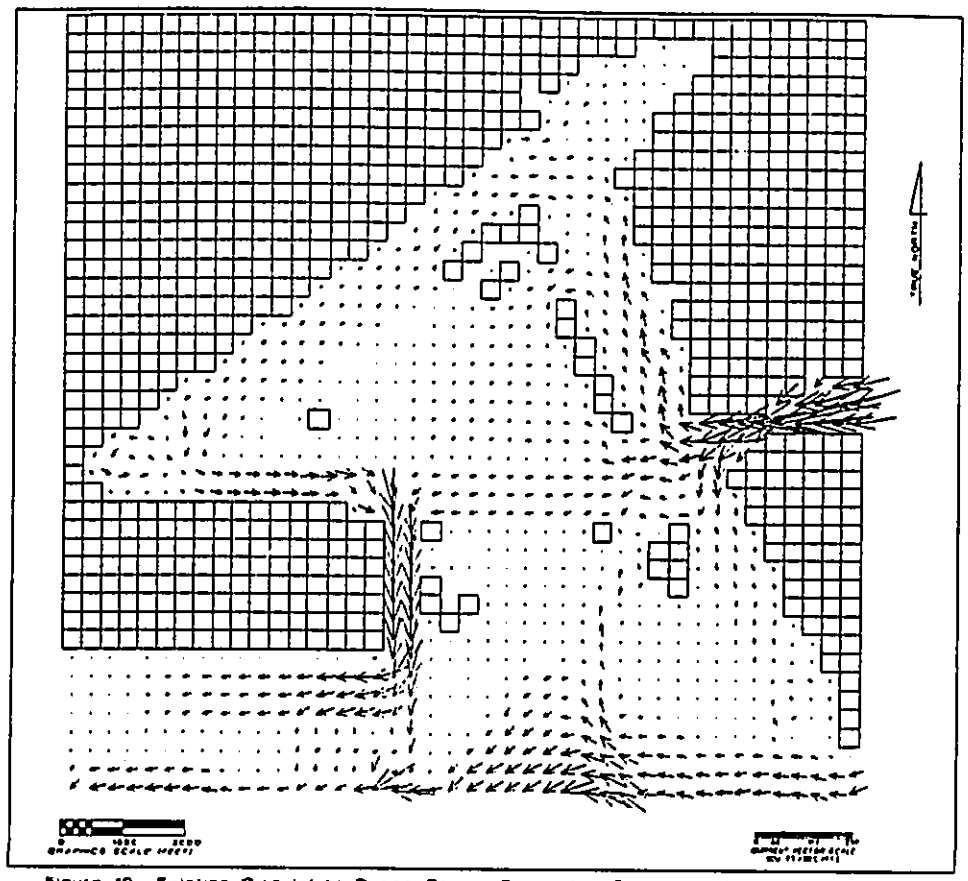

Figure 19 Existing Circulation During Strong Tradewind Conditions (45 Knots from the NE), for Transition Tide Currents

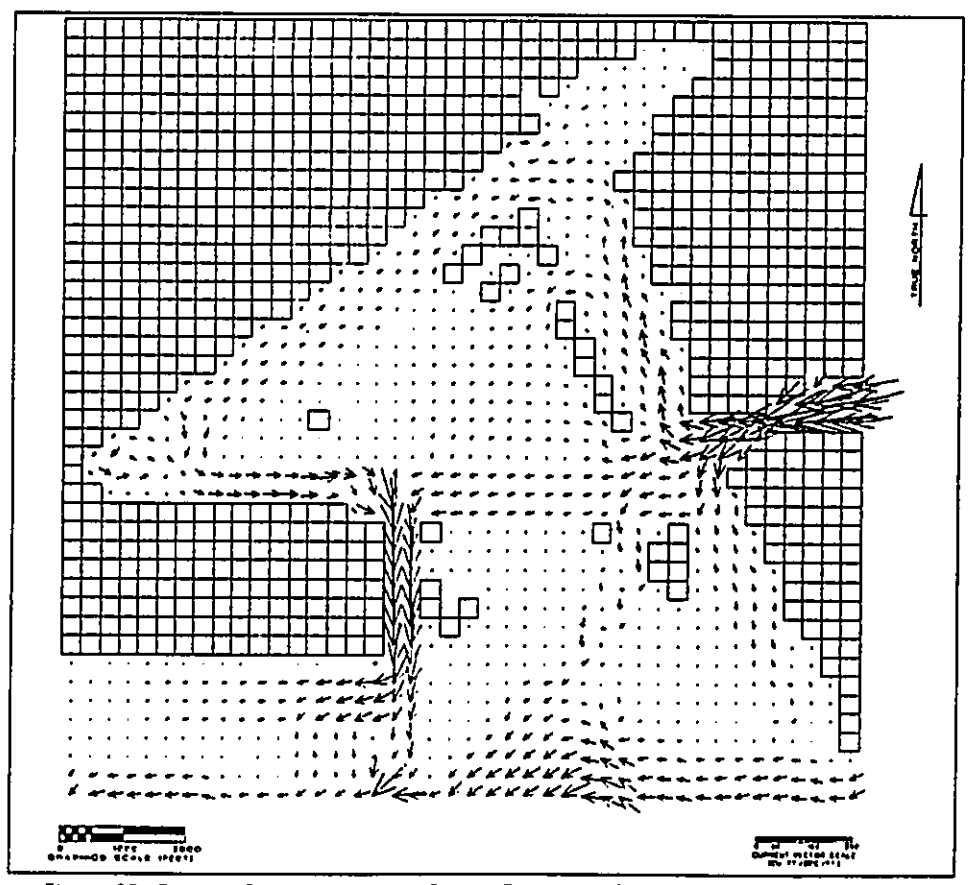

Figure 20 Existing Circulation During Strong Tradewind Conditions (45 Knots from the NE) for Maximum Ebb Tide Currents

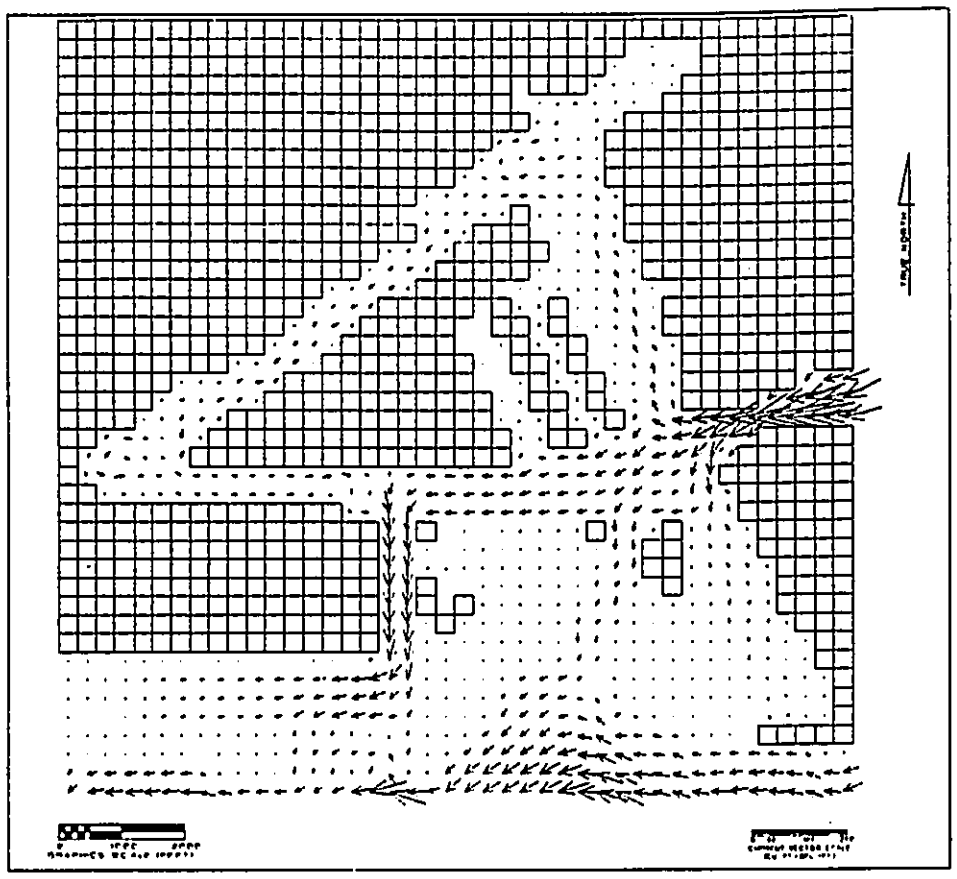

Figure 21 Circulation due to Proposed Development under Strong Tradewind Conditions (45 Knots from the NE), for Maximum Flood Tide Currents

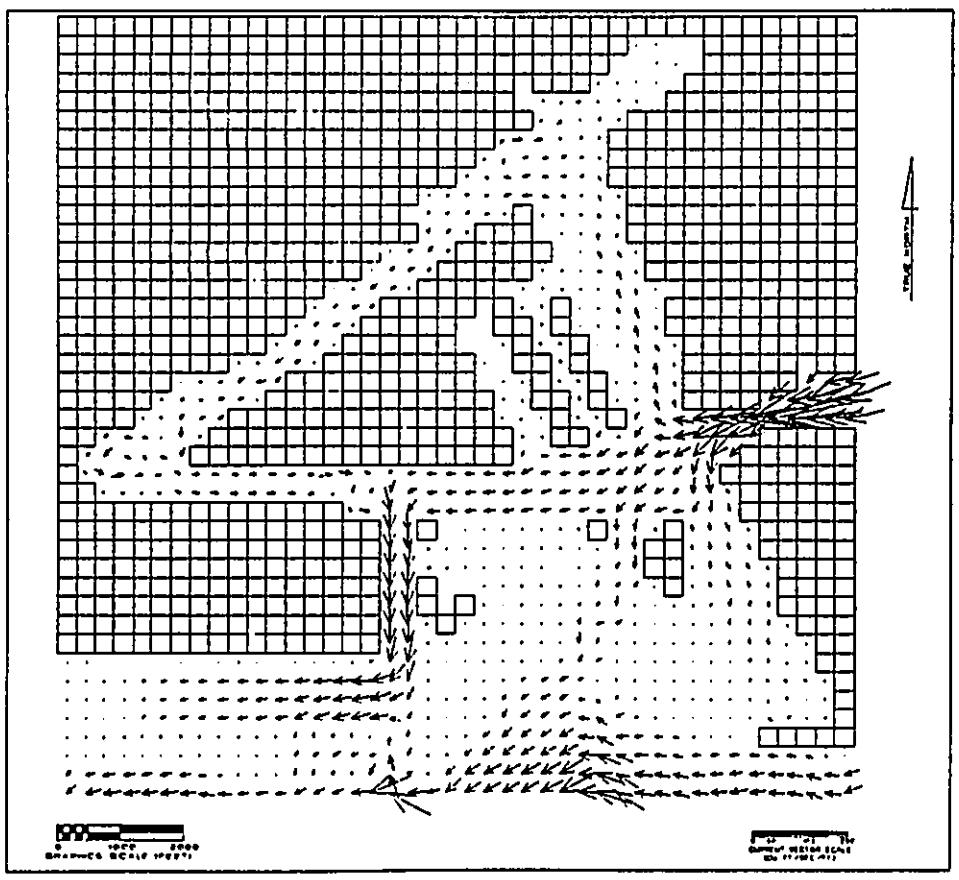

Figure 22 Circulation due to Proposed Development under Strong Tradewind Conditions (45 Knots from the NE), for Transition Tide Currents

5.0 Discussion and Impact Assessment

Typical Tradewind Conditions:

Under typical tradewind conditions, flood tide currents enter Ke'ehi Lagoon primarily through the Kalihi Entrance Channel and to a limited degree over the reef flat at the seaward end of Seaplane Runway "D" adjacent to Sand Island. Wind stress acting along the Seaplane Runway "A" (fronting Lagoon Drive) drives a counter-clockwise circulation around the triangular reef flat, with seaward flows through the circulation channel at the end of the Reef Runway. During ebb tide, waters from Honolulu Harbor enter Ke'ehi Lagoon and drain seaward predominantly through the Kalihi channel, although some flows are driven northward due to the counter-clockwise circulation sustained by the tradewinds around the central triangular area. This counter-clockwise circulation sustained by the tradewinds consistently drives seaward flows through the Reef Runway Circulation Channel regardless of the tidal phase.

With the land reclamation in the central triangle area and the other proposed developments in the lagoon, the circulation patterns during typical tradewind conditions generally remain the same except that the total flow through the Seaplane Runways is reduced due to the narrower width of Seaplane Runway "A". However, the magnitude of the mid-channel flows in Seaplane Runway "A" generally increase due to the "funnelling" effect of flow through the narrower channel width. The model results indicate that peak velocities would increase from about 0.3 ft/sec under existing conditions to 0.5 ft/sec with the proposed developments. The reduction of total flow that is driven by the tradewinds around the central triangle area results in a more direct interaction between Honolulu Harbor and Kalihi Entrance

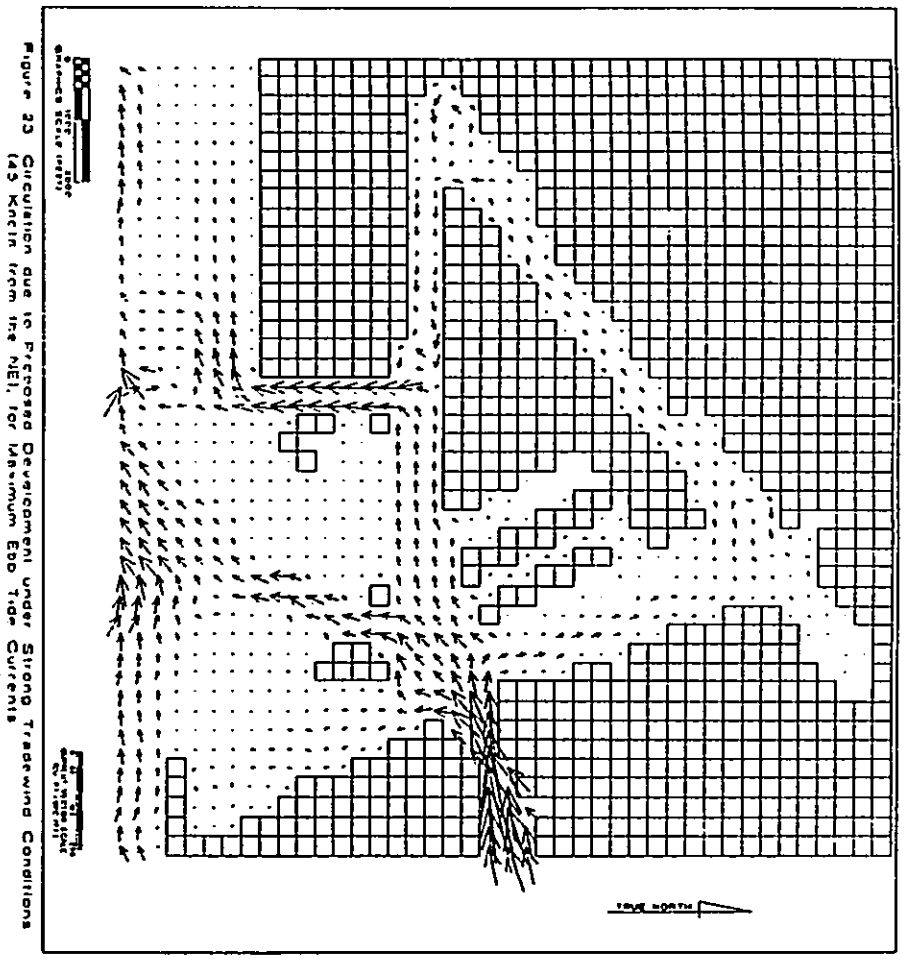

Figure 23 Circulation due to Proposed Development under Strong Tradewind Conditions (45 Knots from the NE), for Maximum Ebb Tide Currents

Channel during ebb tide flows. Thus, potential water quality impacts from Honolulu Harbor would be reduced since discharge flows from the harbor are less likely to flow northward towards the inner reaches of Ke'ehi Lagoon.

The breakwater and swimming beach development at the southwest tip of Sand Island decreases the circulation in Seaplane Runway "D" by reducing the interaction with the open ocean. This impact can be mitigated by providing a channel through the reef at the west end of the breakwater, which would permit direct interactive flows between Seaplane Runway "D" and the open ocean similar to existing conditions.

The existing circulation in the water ski area adjacent to the berm is poor, and the peninsula fill for the Yacht Race/Ocean Sports Complex may decrease circulation flows even further. The berthing basin created by this peninsula fill would sustain little circulation, and flushing would be dependent on the tidal prism exchange. Design mitigation measures to improve the circulation within these areas could consider the provision of pipes or culverts through the peninsula fill.

Typical Kona Wind Conditions:

Under typical Kona conditions when winds are light from the southwest, circulation within Ke'ehi Lagoon is poor. There is direct flow interaction between Honolulu Harbor and the Kalihi Entrance Channel, but circulation is ill-defined within Seaplane Runway "A" and the inner reaches of the lagoon. The light winds do not set-up a well-defined circulation pattern around the central triangle area, and the circulation flows are driven primarily by the tidal current hydraulics. Thus, tidal current flows are confined primarily to the deep channels, especially Kalihi Channel which connects directly to Honolulu Harbor.

The land reclamation in the central triangle area and other proposed development in the lagoon would have little impact on the circulation patterns during this Kona wind condition. The breakwater and swimming beach development at the southwest tip of Sand Island decreases the circulation in Seaplane Runway "D", similar to the decrease during typical tradewind conditions. Provision of a channel through the reef at the end of the breakwater would restore the circulation similar to existing conditions.

As with the tradewind conditions, the existing circulation in the water ski area during typical Kona wind conditions is poor, and the proposed development for the Yacht Race/Ocean Sports Complex may further decrease circulation. Provision of pipes or culverts through the peninsula fill, as mentioned previously, will improve the circulation in these areas.

Strong Tradewind Condition:

The circulation pattern during strong tradewind conditions is driven predominantly by the winds and less by the tidal current flow. The strong northeasterly winds drive a strong counter-clockwise circulation around the central triangle area with sustained seaward flows through the Reef Runway Circulation Channel, which is similar to the typical tradewind conditions but with a greater flow magnitude. This circulation sustains consistent flows from Honolulu Harbor into Ke'ehi Lagoon with little inflow or outflow through the Kalihi entrance channel, regardless of the tidal current phase.

The land reclamation in the central triangle area and other proposed development in the lagoon would have significant effects on the circulation patterns during strong tradewinds. However,

the effects would be somewhat positive in that there is greater interaction between Honolulu Harbor and the Kalihi Channel, resulting in a reduction of potential water quality impacts in Ke'ehi Lagoon due to reduced harbor discharges entering the interior reaches of the lagoon. Also, there is an increase of the mid-channel velocities within Seaplane Runway "A" due to the funnelling effect of the narrower channel width. The model results indicate that peak velocities would increase from about 2 ft/sec under existing conditions to 3.3 ft/sec with the proposed developments. This will help to scour and flush silty sediments discharged by Kalihi and Moanalua Streams.

The breakwater/swimming beach development at the southwest tip of Sand Island has little impact on the circulation patterns and volume flows under these strong tradewind conditions.

6.0 Summary

Existing circulation within Ke'ehi Lagoon during typical tradewind conditions is driven by tidal current inflow and outflow as well as the wind stress acting on the Seaplane Runway "A" water surface. It is clear to see how the dredging of the Reef Runway Circulation Channel has helped to improve the circulation and flushing characteristics within the lagoon by providing a secondary major outlet to the open ocean. This Reef Runway Circulation Channel enhances the counter-clockwise circulation around the central triangle area by providing an outlet for the wind-driven flows, especially during flood tide when flows enter the lagoon through the Kalihi Channel.

Filling of the shallow reef flat within the central triangle area has little effect on typical circulation patterns since the existing flows are predominantly confined to the deeper Seaplane

Runways. However, filling and the development of the marina along Lagoon Drive decreases the total volume of flow through Seaplane Runway "A", although mid-channel velocities are increased. The breakwater and swimming beach at the southwest tip of Sand Island decreases circulation flows through Seaplane Runway "D". This impact can be mitigated by providing a channel through the reef at the west end to the breakwater. The peninsula fill for the yacht Race/Ocean Sports Complex potentially will decrease circulation in the water ski area, where existing circulation is already poor. Provision of pipes or culverts through the peninsula fill will mitigate this impact.

In general, the proposed development within Ke'ehi Lagoon would not have a substantially detrimental impact on the circulation and flushing characteristics of the lagoon. The approximate net decrease of inflow and outflow from the lagoon over a tidal cycle is comparable to the decrease in the water volume of the lagoon tidal prism due to the proposed filling and development. Thus, the flushing efficiency due to the proposed development would be comparable to the existing flushing efficiency. Positive impacts include (a) higher flow velocities in Seaplane Runway "A" during strong tradewind conditions, resulting in better flushing of the silty sediments discharged from Kalihi and Moanalua Streams, and (b) reduced water quality impacts from Honolulu Harbor due to more direct discharge of the Harbor's waters through the Kalihi Channel during ebb tide flows as well as during strong tradewind conditions.

7.0 References

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APPENDIX H

Sea Turtle Survey
in the Vicinity of Keehi Lagoon

Assessment of Sea Turtle Populations
In the Vicinity of Keehi Lagoon, Oahu, Hawaii

Submitted to:

Edward K. Noda & Assoc.

by

Steven Dollar, Ph.D.
Marine Research Consultants

February 10, 1989

Objective

The Keehi Lagoon Development Plan involves diverse uses of the marine environment including marine recreation in a designated area separate from the main Lagoon. A potential conflict with such uses and federally protected marine biota, particularly sea turtles, is a concern to be addressed in the planning process. The objective of this report is to present the results of a survey designed to assess the populations of turtles that presently exist in the area, and to evaluate if there is potential for negative impacts to these populations from the planned usage.

Methods

The area surveyed included two regions: 1) the dredged area at the southwestern end of Keehi Lagoon bounded by the seaward edge of the reef runway and the reef flat, and 2) the outer reef area extending from the western edge of Sand Island to the eastern edge of the Pearl Harbor entrance channel (see Figure 1).

Three surveys were conducted on Dec. 3, 1987, Jan. 28 and Feb. 5, 1989. All field surveys were conducted with a 15 outboard motorboat, fitted with a recording fathometer. To inspect the reef and lagoon for turtles, a diver was towed 160 ft. behind the boat on a steerable sled with capabilities of descending to depths of 50 ft. The sled is equipped with an electronic signaling device which allows communication between the towed diver and the boat operator. With this communication system the diver was able to direct the tow to shallower or deeper water, and to signal the sightings of turtles. The pattern of each tow consisted of a zig-zag course over the reef area extending from the maximum depth of reef growth (approximately 50 ft.) to the shallowest areas that were regarded as safe for the tow boat (about 20 ft.) (see figure 1 for tow tracts). Observations were concentrated in the deeper areas because turtles usually spend daylight hours in resting modes, and forage during the night (G. Balazs, NMFS, personal communication). When the observer passed an area of caves or undercuts, a signal to stop the tow boat was given, and the area inspected.

When turtles were sighted, the tow boat was signaled to stop and the boat operator marked the location on a chart. The diver attempted to approach the turtle to determine, species (either green sea or hawksbill), approximate carapace length, sex, distinguishing marks (tumors and tags) and behavior. All information was written on an underwater slate attached to the sled.

Using a steerable tow sled for surveys requiring coverage of large areas of underwater terrain appears to be a much more efficient method of covering large areas of underwater territory than swimming, or "bounce" diving. In the present survey the length of the towed area was approximately 3 miles. With a conservative estimated field of view of 30 ft on either side of the tow sled, the area of reef covered with each tow was approximately 860 acres.

In addition to underwater observations, the boat driver noted the position of any turtles seen on the surface. Several local commercial aquarium fish collectors also supplied information on turtle sightings in the vicinity of the reef runway.

Results

Physical Structure of the Environment

Because turtle behavior is related to environmental parameters of water quality and substrata, a brief description of the regions surveyed is provided.

The dredged area connected to Keehi Lagoon south of the reef runway consists of a lagoon between 45 and 60 ft. deep. Water clarity is poor owing to fine suspended material in the water column. The lagoon bottom is composed a fine silt-mud that is marked with numerous burrow holes of benthic infauna. The shoreward edge of the lagoon is bordered by the fill material composing the reef runway, while the seaward edge is composed of a shallow reef flat.

The outer reef area from the Pearl Harbor entrance channel to the Kalihi Channel is composed of fringing reef typical of southern coastlines in Hawaii. Bottom structure is composed primarily of limestone reef accretions from the shoreline to a depth of approximately 50 ft. Bisecting the reef platform are numerous sand channels oriented perpendicular to shore. A

characteristic of the area that renders it unique, however, is the large proportion of reef surface that is presently covered with calcareous encrusting algae, rather than reef corals. Close examination of the reef indicates that the encrusting algae is growing over coral colonies that appear to have been killed relatively recently. It is probable that the lack of living corals is a result of environmental stress associated with either discharge of raw sewage from the old Sand Island sewage treatment plant (see Dollar 1979), or episodic sedimentation events caused by construction of the reef runway. In any case, it is apparent from the present condition of low coral cover and high calcareous algal cover that the reef is not in a pristine conditions.

Turtle Abundance

Figure 1 shows the track of the three observation tows and the locations of turtle sighting. Table 1 lists characteristics of the sighted turtles. Because it was not possible to approach all turtles before the animals fled it was not possible to positive identify individuals. It is probable, however, that some of the sightings were of the same individuals on separate days.

It can be seen in Figure 1 that no turtles were observed within the dredged part of Keehi Lagoon off the reef runway. Of the 7 turtle sightings, 5 were off the western half of the reef runway downcoast from dredged area. In addition, information provided by commercial divers revealed the majority of sightings off the western half of the reef runway, or near the Pearl Harbor entrance channel.

All of the turtles sighted were in water 30 to 40 ft. in depth and were either resting on the bottom or swimming near the bottom. None were observed to be feeding. Several of the resting animals were lying on living coral surfaces of the upper reef, while one was tucked inside a small cave bordering a sand channel. While the tow surveys did not cover the very shallow nearshore areas, this region was examined from the surface with no sightings during any of the tows.

Several of the large turtles that allowed approach by divers had tumors on the head or neck. None of the turtles were noted to be tagged.

Conclusions

The purpose of the present survey is to estimate the potential for alteration to turtle behavior and habitat from recreational usage of the dredged area of Keehi Lagoon adjacent to the reef runway. Results of 3 tow surveys through the area in question revealed no turtles inhabiting the area during daylight hours. This result is not surprising as water quality (extremely turbid) and bottom type (silty-mud) in the lagoon do not appear to be

preferred environmental settings for sea turtles. Thus, it does not appear that marine recreational activities within the lagoon will result in alteration of turtle behavior.

There appears to be a small population of turtles that reside on the reef areas fronting the reef runway. Observations of these areas indicates that turtles are mainly engaged in resting behavior during daylight hours. Thus, even if these turtles transit across the reef flat and lagoon during the night, it does not appear that they would be disturbed by activities during the day.

In conclusion, the results of the survey indicate that while turtles occur in the region offshore of Keehi Lagoon, there is no indication of large aggregations of animals. In addition, it does not appear that the animals frequent the dredged area during the day, and as such it does not appear that increased activity in the lagoon will result in alteration of turtle behavior or occurrence.

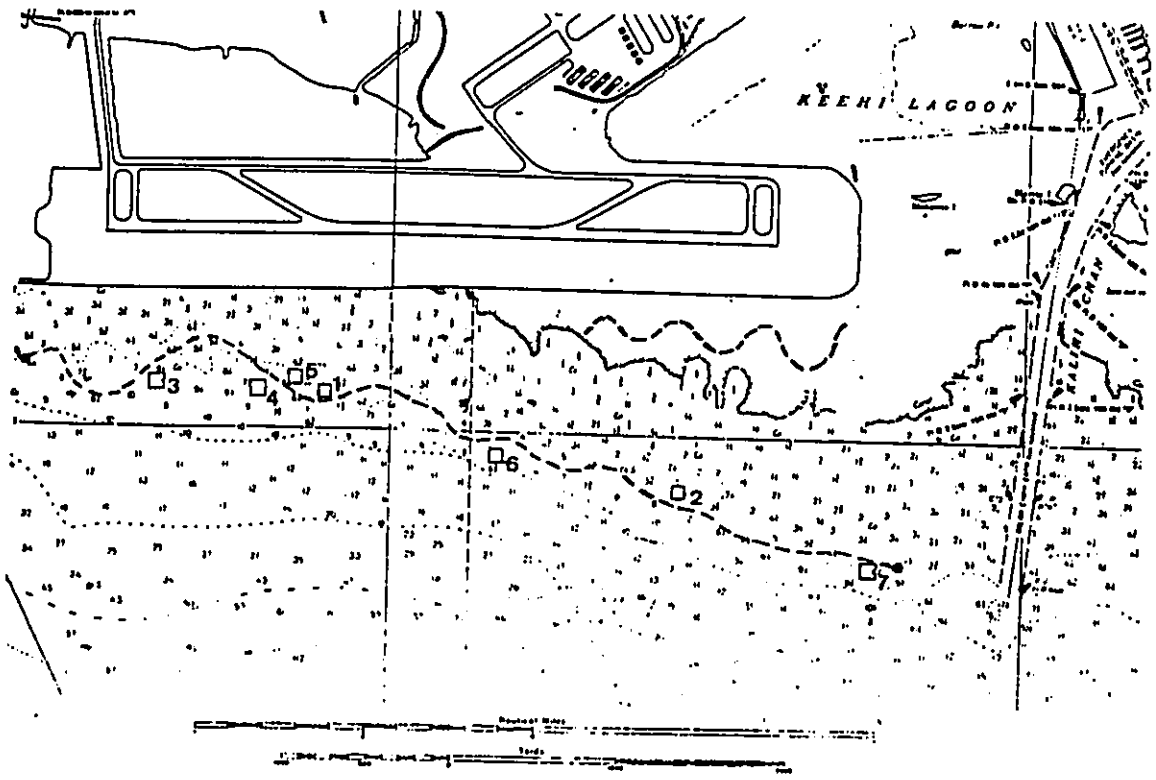

Figure 1. Map showing location of tow tracks (dashed lines), and locations of turtle sightings (squares). Numbers correspond to I.D. Nos. in Table 1.

References Cited

Dollar, S. J. 1979. Ecological response to relaxation of sewage stress off Sand Island, Oahu, Hawaii. Water Resources Research Center, Tech. Rpt. No. 124.

Table 1. Characteristics of turtles sighted during Keehi Lagoon survey
See Figure 1 for locations corresponding to I.D. No.

Date	I.D. No.	Carapace Length (cm.)	Sex	Distinguishing Marks	Behavior
12-3-88	1	90	F	Tumor on neck	Lying on reef surface
1-28-89	2	36	F	none	Swimming over reef
2-5-89	3	90	F	none	Lying on reef surface
2-5-89	4	85	F	none	Resting in cave
2-5-89	5	30	M	none	Swimming over reef
2-5-89	6	90	M	Tumors on both eyes	Lying on reef surface
2-5-89	7	40	F	none	Swimming over reef surface

APPENDIX I

Air Quality Study

AIR QUALITY STUDY
FOR THE PROPOSED
KE'EHI LAGOON RECREATION PLAN

KALIHI, HONOLULU, OAHU

Prepared for:

Edward K. Noda & Associates

Prepared by:

Barry D. Root & Barry D. Neal

September 1989

CONTENTS

FIGURES

TABLES

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

The Harbors Division of the State of Hawaii Department of Transportation is proposing to expand recreation facilities within the Ke'ehi Lagoon area in Kalihi, Honolulu, Oahu. As indicated in Figure 1, the proposed project plan involves a two square mile area within the lagoon and the shoreline areas extending from the South Ramp area of Honolulu International Airport to the Pier 60 area in the Kalihi Kai industrial area. The major elements of the proposed project include a Hawaiian canoe center and race course, a marina at Pier 60, a marina along Lagoon Drive near the Airport South Ramp, and a mixed used development located in the central triangle land reclamation portion of the lagoon. The mixed used Triangle Development would include a marina, parks, yacht racing and ocean sports complex, maritime commercial facilities, industrial/ commercial space, and the University of Hawaii Marine expeditionary Center. Development is expected to be completed by 1998.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate these impacts are suggested where possible and appropriate.

2.0 AMBIENT AIR QUALITY STANDARDS

National Ambient Air Quality Standards (AAQS) are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the

state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six pollutants. The pollutants for which AAQS have been established include particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii

1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural, industrial and/or vehicular sources, and perhaps to a lessor extent from distant agricultural activities. Table 2 presents an air pollutant emission summary for the City and County of Honolulu which was compiled in 1980. These are the latest data that are available. The mineral products industry was the most significant source category for emissions of particulate

matter. Sulfur dioxide emissions originated mainly from power plants, while motor vehicles accounted for much of the emissions of nitrogen oxides, carbon monoxide and hydrocarbons.

Natural sources of air pollution emissions which could also affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and perhaps distant volcanoes on the Island of Hawaii.

An annual summary of air quality measurements for monitoring stations nearest the project site is presented in Table 3 for the years 1985, 1986 and 1987. These data were collected by the State Department of Health. Twenty-four hour average sulfur dioxide measurements were made at Barbers Point, about 13 miles west of the project site. There were no exceedances of the state/national 24-hour AAQS for sulfur dioxide during the 3-year period. Concentrations monitored during the last 2 years reported were consistently low with daily mean values at or below 5 ug/m^3.

Both total particulate and PM-10 concentrations were monitored at Liliha, approximately 3 miles east of the Ke'ehi Lagoon area. During the 1985-87 reporting period, the highest 24-hour average total particulate concentration measured was 254 ug/m^3, while the corresponding value for PM-10 was 52 ug/m^3. Both of these concentrations were measured during 1985; measured values for the two subsequent years were significantly lower. Average daily concentrations for total particulate and for PM-10 were about 30 to 35 ug/m^3 and 17 to 18 ug/m^3, respectively, during 1986 and 1987. Averages for 1985 were about 25 to 30 percent higher. Three

exceedances of the state AAQS were recorded in 1985, but there have been no exceedances since.

The nearest carbon monoxide measurements were made at the Department of Health building in downtown Honolulu (about 3 miles to the east). The average daily maximum 1-hour concentration measured at this location was about 2 mg/m³. During the most recent year reported, 1987, the daily maximum 1-hour concentration ranged from 0.3 to 11.1 mg/m³; one exceedance of the state AAQS was recorded. During the previous year (1986), three exceedances of the state AAQS were measured. Except for traffic congested areas, carbon monoxide concentrations in the vicinity of the proposed project are likely lower than those reported for downtown Honolulu. Present concentrations are estimated later in this study based on air quality modeling of vehicular emissions in the project area.

The nearest available ozone measurements were taken at Sand Island (about 2 miles southeast of the project site). During 1987 the Sand Island daily maximum 1-hour concentration averaged 33 ug/m³ and ranged from 4 to 84 ug/m³, and there were no exceedances of the state AAQS. Concentrations during 1986 were similar to those recorded for 1987, while in 1985 maximum 1-hour concentrations were significantly higher. Three exceedances of the state AAQS were measured during the 1985 period.

The closest measurements for ambient lead concentrations are made at the Liliha monitoring station near downtown Honolulu. During the 1985-87 reporting period, lead concentrations at this location had a downward trend, most probably reflecting the increased use of unleaded gasoline. Average quarterly concentrations were near

or below the detection limit. No exceedances of the state AAQS have ever been recorded.

Nitrogen dioxide is no longer monitored by the Department of Health anywhere in the state. Concentrations of this pollutant were measured from 1971 through 1976 at Barbers Point, and annual mean values were found to vary from 11 to 29 ug/m³, safely inside the state and national AAQS.

Based on the data and discussion presented above, it appears likely that State of Hawaii AAQS for particulates, sulfur dioxide, nitrogen dioxide and lead are currently being met at the project site. The ozone AAQS has not been exceeded during the past two years at the nearby Sand Island monitoring station. Carbon monoxide readings from urban Honolulu indicate that the state AAQS for carbon monoxide may be exceeded at a rate of one to three times per year in traffic-congested areas.

4.0 SHORT-TERM DIRECT AND INDIRECT IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential sources of air pollution emissions which could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation and (2) exhaust emissions from on-site construction equipment. Indirectly, there could also be short-term impacts from slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers.

Fugitive dust emissions may arise from grading and dirt-moving activities within the project site. The emission rate for fugitive dust is nearly impossible to estimate accurately because of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions in the project area would probably be somewhere near this level. In any case, State of Hawaii Air Pollution Control Regulations [4] require that visible emissions of fugitive dust from construction activity be essentially nil.

Adequate fugitive dust control can usually be accomplished by establishment of a frequent watering program to keep bare-dirt surfaces in work areas from becoming significant dust generators. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest

of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are very low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction are relatively easy to mitigate.

5.0 LONG-TERM DIRECT AND INDIRECT IMPACTS OF PROJECT

5.1 Roadway Traffic

By serving as an attraction for increased motor vehicle traffic on nearby roadways, the proposed project must be considered to be a potential indirect air pollution source. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and those burning leaded gasoline can contribute lead to the atmosphere as well. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently

operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from vehicle exhausts. By the year 1995 carbon monoxide emissions are expected to be about one fourth less than the amounts now emitted. At present, no further reductions in vehicular emissions have been mandated and increases in traffic levels after 1995 will result in nearly proportional increases in vehicle-related pollutant emissions. However, the President recently proposed legislation which would further reduce vehicular emissions by the year 2000.

I-7

To evaluate the potential long-term indirect air quality impact of increased roadway traffic associated with a project such as this, computerized atmospheric dispersion models are utilized to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the motor vehicle generated pollutants. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides and related ozone air pollution most often are regional issues.

Four scenarios were selected for study. The first scenario examined was for the year 1989 with present conditions. The other three scenarios studied were for the year 1998. Case 1 for 1998 assumed no project traffic. Case 2 for 1998 assumed project traffic without the mitigative measures recommended by the project traffic study, while Case 3 also assumed project traffic in 1998 but with the recommended mitigative measures.

To begin the carbon monoxide modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic cycling: decelerating, stopping, queueing and accelerating. For this study, the six key intersections identified in the traffic study were also selected for air quality analysis. These include: Lagoon Drive at Nimitz Highway and at Aolele Street, Sand Island Access Road at Nimitz Highway and at Auiki Street, and Nimitz Highway at Kalihi Street and at Waiakamilo Road. The traffic impact study for the project [5] describes the present and future configuration of these intersections and roadways in detail.

The main objectives of the air quality modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentration which could be directly compared to the national and state AAQS. The traffic analysis report cited above indicates that current weekday traffic volumes approaching the key intersections in the project area peak both in the morning and in the afternoon. Morning and afternoon weekday peak-hour traffic volumes are or would be roughly equal in magnitude at several of the locations to be studied. In the

vicinity of the project, worst-case meteorological conditions can occur nearly any time of the day due to urban influences and due to effects from the nearby ocean, except that vehicular emissions on a per car basis are higher in the morning when ambient temperatures are cooler. Hence, to ensure that worst-case conditions were identified, both morning and afternoon peak traffic hours were analyzed for the weekday case. Similar to the project traffic study, weekend afternoon conditions were also examined.

Initially, the EPA computer model MOBILE3 [6] was used to calculate vehicular carbon monoxide emission estimates for each of the years studied. One of the inputs to MOBILE3 is vehicle mix. Based on recent vehicle registration figures, typical vehicle mix in the state is estimated to be 91.9% light-duty gasoline-powered vehicles, 4.2% light-duty gasoline-powered trucks and vans, 0.3% gasoline-powered trucks between 6000 and 8500 lbs, 0.5% heavy-duty gasoline-powered vehicles, 0.5% light-duty diesel-powered vehicles, 0.1% light-duty diesel-powered trucks, 1% heavy-duty diesel-powered trucks and buses, and 1% motorcycles. The percentage of heavy duty trucks and buses on many of the roads in the project area is probably higher the percentage reflected by motor vehicle registration data. Based on a report by the State Department of Transportation (DOT) [7], motor vehicle registration percentages were adjusted as shown in Table 4 for input to MOBILE3.

Other key inputs to MOBILE3 are the percentages of vehicles operating in cold and hot start modes. For vehicles on surface streets, it was assumed that about 21 percent of all vehicles would be operating in the cold-start mode and that about 27 percent would be operating in the hot-start mode. These are typical values that are used in calculating cold/hot start emissions. For freeway

traffic, values of 5 percent for cold starts and 1 percent for hot starts were used. These values are based on a study done by the California Department of Transportation [8].

National averages for "mis-fueling" were assumed for all MOBILE3 computations. Ambient temperatures of 59 and 68 degrees F, respectively, were used for morning and afternoon peak-hour emission computations. These temperatures are conservative since actual ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE3 are inversely proportional to the ambient temperature.

Subsequent to the completion of this study, EPA's new emission model, MOBILE4 [9], became available. A comparison between MOBILE3 and MOBILE4 emission factors revealed that MOBILE4 emission factors were about 8 percent lower for the 1989 scenario and from 25 to 30 percent lower for the 1998 case. The differences in the emission model estimates are a result of improvements in the speed correction factors and incorporation of new data that became available since MOBILE3 was released.

After computing vehicular carbon monoxide emissions through the use of MOBILE3/MOBILE4, these data were then input to the computer model CALINE4 [10]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data for CALINE4 were obtained from the traffic study cited previously (except for traffic volumes for the H-1 Freeway which were estimated based on State DOT data [7].) Traffic volumes given in the traffic study for the future scenarios include project traffic as well as traffic from other growth that is expected to occur in the area by the year 1998. In all modeling assessments, vehicles were assumed not to accelerate above 25 mph either due to posted speed limits or because congested traffic during peak traffic periods would preclude faster speeds.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Model receptor sites were located between 4 and 10 meters from the edge of the roadways near the intersections studied at a height of 1.5 meters above grade to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 4 was assumed for both morning and afternoon cases. This is the most conservative stability category that can be used for estimating afternoon pollutant dispersion in model calculations, and it is the most likely worst-case condition that occurs during the morning within urban areas. A surface roughness length of 200 cm was assumed with a mixing height of 300 meters. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of air pollution in the project vicinity are believed to be moderate. Background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a concentration of 1 ppm to all predicted 1-hour concentrations.

Table 5 summarizes the final results of the modeling study in the form of the predicted maximum 1-hour carbon monoxide concentrations for the four year/scenarios studied. These results can be compared directly to the state and the national AAQS. The locations of the predicted maximum concentrations all occurred at or near the intersections in question. As discussed previously, modeling was done initially using MOBILE3 emission estimates. Predicted concentrations were then revised downward based on the new MOBILE4 emission calculations.

Insofar as present conditions are concerned, the highest worst-case 1-hour carbon monoxide concentration that was predicted in the vicinity of the project was 24.1 mg/m³. This is predicted to occur near the Nimitz Highway/Kalihi Street intersection during a weekday morning commute hour. Weekday morning/afternoon peak-hour concentrations at the other locations studied ranged from 10.2 mg/m³ at the Lagoon Drive/Aolele Street intersection during the morning to 23.3 mg/m³ at the Nimitz Highway/Waiakamilo Road intersection also during the morning. For the weekend afternoon case, only the Nimitz Highway intersections at Lagoon Drive and at Sand Island Access Road were modeled. Worst-case concentrations were 12.0 mg/m³ at Lagoon Drive and 13.5 mg/m³ at Sand Island Access Road, lower than weekday maxima. All estimated present 1-hour concentrations exceed the state AAQS but are within the national standard.

In the year 1998 without the proposed project, all predicted worst-case 1-hour concentrations are reduced compared to 1989 levels except for the area near Lagoon Drive and Aolele Street. Of the six intersections modeled, the highest concentration was again predicted to occur during a weekday morning near the Nimitz Highway/Kalihi Street intersection. A maximum concentration of 17.0 mg/m' is predicted at this location by the model. This is nearly 30 percent lower than the 1989 level. Other predicted weekday peak 1-hour concentrations varied from 10.0 mg/m' at Sand Island Access Road and Auiki Street to 14.9 mg/m' at Nimitz Highway and Waiakamilo Road. Weekend afternoon concentrations at the two key intersections along Nimitz Highway were 8.8 and 9.8 mg/m'. Based on these estimates, it appears that the state 1-hour AAQS for carbon monoxide would continue to be exceeded during weekday commute hours without the project in the year 1998, while the corresponding national AAQS would be met at all locations.

For the 1998 Case 2 scenario (which assumes with project traffic but no mitigation), worst-case 1-hour weekday concentrations ranged from 10.3 mg/m' near Sand Island Access Road and Auiki Street to 17.3 mg/m' near the intersection of Lagoon Drive and Aolele Street. Predicted concentrations were highest at the Lagoon Drive/Aolele location because this intersection would be severely over capacity. Worst-case weekend afternoon concentrations were about 11 mg/m'. Estimated worst-case 1-hour concentrations at all locations analyzed for the 1998 Case 2 scenario exceeded the state AAQS but were within the national AAQS.

Predicted worst-case 1-hour concentrations for the 1998 Case 3 scenario (which assumes project traffic but with the traffic consultant's mitigation measures) were generally about 5 to 10 percent lower at most locations than the 1998 Case 2 scenario with concentrations ranging from 9.7 mg/m' at the Sand Island Road/Auiki Street intersection to 16.4 mg/m' at the Nimitz Highway/Kalihi Street intersection. Worst-case concentration at the Nimitz Highway/Sand Island Road location would increase slightly during the morning compared to the without mitigation measures scenario (Case 2) because of the intersection geometry and because more vehicles would occupy the intersection at any given time due to the increased capacity. Worst-case weekend afternoon concentrations would remain about 11 to 12 mg/m'. All predicted values were near to or exceeded the state AAQS but were within the national standard.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One recent study based on modeling [11] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [12] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health [13] suggests that this factor may range between about 0.35 and 0.55 depending on location and traffic variability. Considering the

location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 is probably most appropriate for this application.

The resulting estimated maximum 8-hour concentrations are indicated in Table 6. The highest estimated worst-case 8-hour carbon monoxide concentration for 1989 was 12.0 mg/m'. This occurred on a weekday near the intersection of Nimitz Highway and Kalihi Street. Maximum weekday 8-hour concentrations at other locations varied from 6.0 mg/m' at Lagoon Drive and Aolele Street to 11.6 mg/m' at Nimitz Highway and Waiakamilo Road. Weekend concentrations were predicted to be 6.7 mg/m' or less along Nimitz Highway. In the year 1998 without project case, the predicted maximum weekday 8-hour value was 8.5 mg/m' at the Nimitz/Kalihi intersection. Estimated weekday concentrations for other locations ranged from 5.6 mg/m' Lagoon Drive and Aolele Street to 7.4 mg/m' at the intersection of Nimitz Highway and Waiakamilo Road. Predicted weekend concentrations were about 20 percent lower than the projected values for 1989. In the with project without mitigation case, the year 1998 concentrations were highest on a weekday with concentrations of 8.6 mg/m' occurring both at Lagoon Drive and Aolele Street (due to the congestion that would occur at this location) and at Nimitz Highway and Kalihi Street. Weekday concentrations at the other locations studied varied from 6.4 to 8.0 mg/m'. Weekend concentrations would be lower than weekday values. With mitigation, the predicted 1998 with project concentrations drop by about 5 to 10 percent or more except at Sand Island Road and Nimitz Highway where there would be little change.

Thus, estimated worst-case 8-hour concentrations in the project vicinity exceed the state AAQS (5 mg/m') at all locations for all

scenarios examined. For the current situation, predicted concentrations are near or above the national AAQS (10 mg/m') at three out of the six locations studied. In 1998 with or without the project, concentrations should meet the 8-hour national standard.

It should be mentioned here that the above predicted concentrations generally are "hot spot" values. That is, concentrations are not widespread but diminish rapidly with distance from the roadway. It should also be noted that the results of this study reflect several assumptions that must be made concerning worst-case meteorological conditions. As mentioned above, a worst-case wind speed of 1 meter per second with a steady direction was assumed. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

5.2 Electrical Generation

The proposed project would also cause indirect emissions from power generating facilities as a consequence of electrical power usage. The annual electrical demand of the project when fully developed is not expected to exceed 68 million kilowatt-hours. This power demand would most probably be provided mainly by oil-fired generating facilities located on Oahu. However, with H-Power currently under construction and plans for a coal-fired power plant at Campbell Industrial Park in the near future, some of the project power could well come from sources burning other fuels. In order to meet the electrical power needs of the proposed project, power generating facilities would be required to burn more fuel and hence

more air pollution would be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at Oahu's power plants. If power is supplied instead or in part by coal or solid waste burning facilities, emissions would likely be higher than the values given in the table.

5.3 Solid Waste Disposal

Solid waste generated by the project when fully occupied is expected to amount to about 16 tons of refuse per day. Most if not all of this refuse will likely be trucked away and either landfilled or burned at another location. If all refuse is landfilled, the only air pollution emissions associated with solid waste disposal would be due to exhaust fumes from the trucks and heavy equipment used to place the refuse in the landfill. If, on the other hand, all or part of the refuse is burned at a municipal incinerator or other facility (such as H-Power), disposal of solid waste from the project would also result in the emissions of particulate, carbon monoxide and other contaminants from the incineration facility. Table 7 gives emission factors for municipal refuse incinerators (without controls) in terms of pounds of air pollution per ton of refuse material charged. Thus, uncontrolled air pollutant emission rates in terms of pounds per day, for example, can be estimated by multiplying the emission factors given in the table by the number of tons per day of refuse that is burned. Particulate emissions from the H-Power facility will be much lower because emissions will be treated by a high-efficiency particulate control system. It should also be noted that if the project electrical demand derives all or in part from

H-Power, this will help to offset emissions from burning oil or coal to produce power that might otherwise result.

5.4 Industry Emissions

Air pollution emissions from industries locating at the proposed light industrial/commercial park could potentially result in direct impacts on air quality. While the specific industrial residents of the proposed project have not yet been identified, it is intended that these enterprises be maritime or aviation related and that these facilities should be in keeping with the beauty of the site. With this intention and with these types of facilities, it is unlikely that significant amounts of air pollution would be emitted.

Without specific information concerning stack heights and stack gas temperatures, exit velocities and emission rates, any air quality impacts from the potential light industrial/commercial facilities cannot be quantitatively estimated. At the present time, such detailed information is not available. However, Hawaii air pollution control rules [4] require that any activity that causes air pollution must obtain written approval from the director of the Hawaii Department of Health. This written approval generally involves applying for both a permit to construct and a permit to operate. At the time of application, detailed information must be provided by the applicant concerning the type and nature of any air pollution emissions and the emission control technology that would be utilized. Depending on the magnitudes of the project emissions and other factors, air quality impact analyses and/or air quality monitoring may be required before the application to construct/ operate is approved. Thus, even though an assessment of potential

direct impacts from project air pollution emissions cannot be done at this time, state rules may require that such analyses be performed at a later date when specific businesses apply to locate at the proposed industrial park.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on air quality data for nearby monitoring stations, modeling of carbon monoxide emissions from vehicles traversing nearby roadways, and considering the location and character of the proposed project site, it appears likely that all state and national air quality standards are currently being met in the project vicinity except for the AAQS for carbon monoxide. Based on air quality modeling, it is concluded that several "hot spot" areas in the vicinity of the proposed project probably exceed both the state and the national AAQS for carbon monoxide during worst-case conditions. With or without the proposed project, carbon monoxide concentrations in the area will likely improve during the next several years due to the overall reduction in emissions from the vehicle fleet as older model vehicles with less effective emission control devices drop out of service. However, by the year 1998, it is projected that the state standards would continue to be exceeded in the project area either with or without the project. Even though the state standards would likely be exceeded, worst-case concentrations should comply with the national AAQS with or without the project.

Assuming the project is built, short-term direct and indirect air quality impacts would result from project construction. Fugitive dust emissions will occur due to site grading and other construction activities, and fumes from gasoline- and diesel-powered

construction equipment will also be emitted. The movement of construction equipment and the commuting of construction workers to the site will also cause more air pollution in the area, albeit temporary. Fugitive dust emissions can and should be controlled by watering of work areas and by covering open-bodied trucks. Paving of parking areas and roads and establishing landscaping early in the construction schedule will also reduce fugitive dust emissions. Exhaust emissions from construction equipment should be relatively inconsequential. If construction-related traffic to and from the site causes a problem with traffic movement in the area, work schedules could be adjusted to avoid peak traffic hours.

Emissions from vehicular traffic associated with the proposed project after it is fully developed could result in long-term, indirect impacts on the local air quality. Air quality model projections predict that even with the mitigative measures proposed in the project traffic study the state air quality standards for carbon monoxide would continue to be exceeded in hot spot areas near roadway intersections. The national standards, on the other hand, would be met. Despite the continued exceedance of the state AAQS, with the project and with the proposed roadway improvements, worst-case carbon monoxide concentrations would improve compared to present concentrations at the locations where the highest values are predicted to occur for the existing case.

Reducing traffic volumes, improving traffic flow and/or reducing emissions are the only possible means to reduce carbon monoxide concentrations. With the high level of traffic in the project area, it is very unlikely that the state standards can be achieved by any means. If more traffic could be diverted from Nimitz Highway to the proposed Makai Boulevard, it may be possible to

reduce concentrations further in the vicinity of Nimitz Highway and Kalihi Street. Also, it may be possible to further improve the Nimitz/Kalihi intersection so as to reduce traffic congestion. Insofar as emission reductions are concerned, these can only be achieved on a state- or nation-wide basis. It is possible that state and/or federal legislation could mandate reductions in motor vehicle emissions by the time the project is completed. The President recently proposed a plan to reduce such emissions substantially by the year 2000. Also, although it is not presently contemplated, it is conceivable that the state may be forced to adopt an inspection and maintenance program at some point in the future to ensure that air pollution emission control devices are maintained properly. If such a program were to be established, this would result in lower emissions from motor vehicles on an area-wide basis.

Some long-term impacts could also potentially occur due to indirect emissions from power generating facilities supplying the project with electricity and from the burning of waste materials generated by the project. Quantitative estimates of these impacts were not made, but it appears likely that any impacts would be relatively small since emissions from supplying the project with electrical power and solid waste disposal service would be less than 1 percent of current Oahu emissions.

Depending on the types of industries that locate at the proposed light industrial/commercial park, long-term impacts on air quality could potentially occur as a direct result of industry emissions. A quantitative analysis of the potential impacts cannot be done at the present time because the specific industries have not yet been identified. However, any of the prospective occupants emitting air

pollution will be required to apply for state permits to construct and to operate. Before granting a permit to construct or a permit to operate, the state may require the applicant to prepare an air quality impact assessment. Although definite industrial/commercial tenants have not been identified, it appears likely that they will not be excessive emitters of air pollution.

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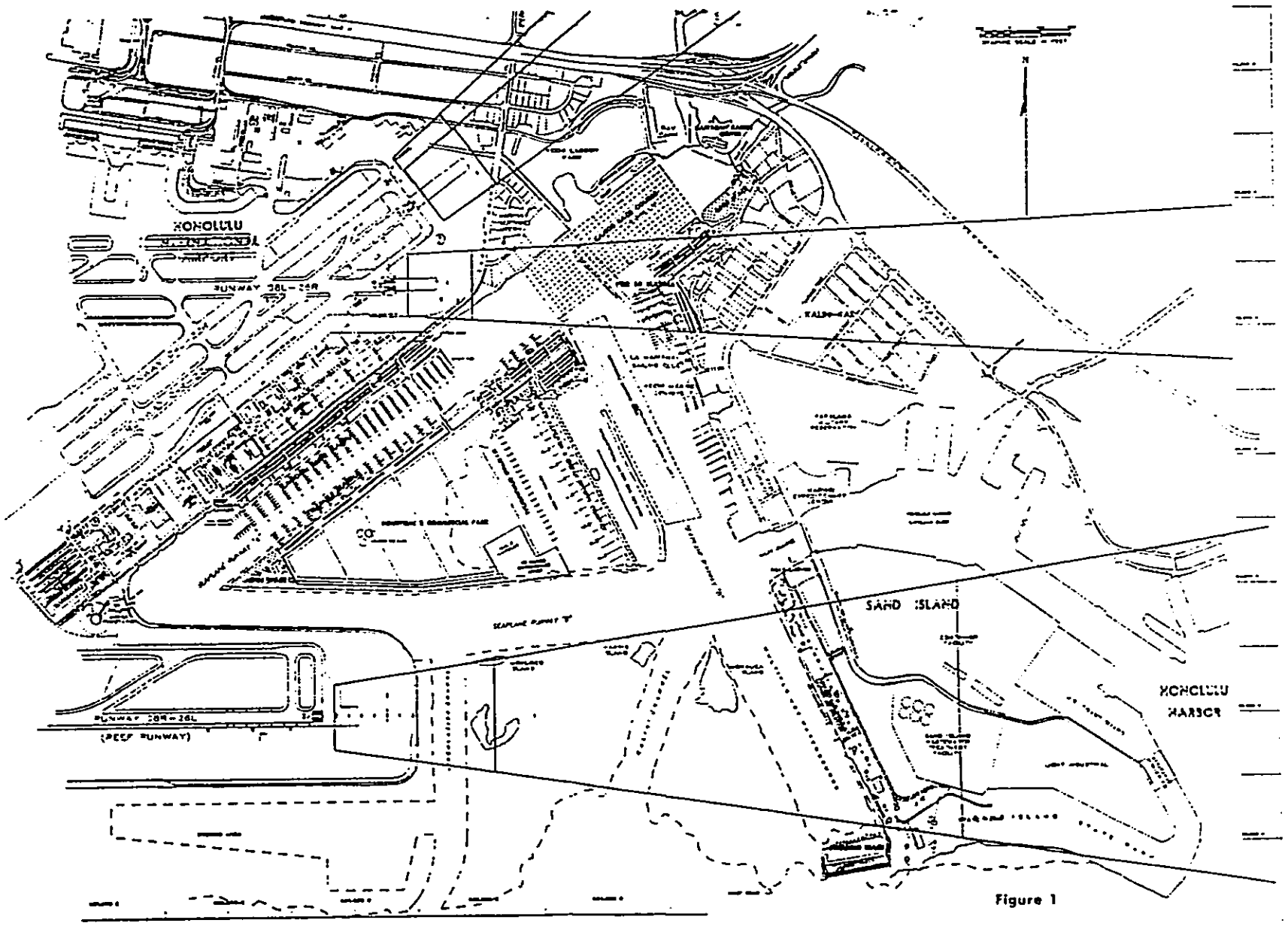

Figure 1

KEEHI LAGOON RECREATION PLAN

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS (AAQS)

Pollutant (units)	Averaging Time	Maximum Allowable Concentration: National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter (ug/m³)	Annual	-	-	60[1]
	24 Hours	-	-	150[2]
Particulate Matter[3] (ug/m³)	Annual	50	50	-
	24 Hours	150[2]	150[2]	-
Sulfur Dioxide (ug/m³)	Annual	80	-	80
	24 Hours	365[2]	-	365[2]
	3 Hours	-	1300[2]	1300[2]
Nitrogen Dioxide (ug/m³)	Annual	100	100	70
Carbon Monoxide (mg/m³)	8 Hours	10[2]	-	5[2]
	1 Hour	40[2]	-	10[2]
Ozone (ug/m³)	1 Hour	235[2]	235[2]	100[2]
Lead (ug/m³)	Calendar Quarter	1.5	1.5	1.5

[1]Geometric mean
[2]Not to be exceeded more than once per year
[3]Particles less than or equal to 10 microns aerodynamic diameter

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR CITY AND COUNTY OF HONOLULU, 1950

Source Category	Emissions (tons/year): Particulate	Sulfur Oxides	Nitrogen Oxides	Carbon Monoxide	Hydrocarbons
Steam Electric Power Plants	2,092	36,736	12,455	1,965	154
Gas Utilities	14	0	199	0	0
Fuel Combustion in Agricultural Industry	1,038	579	358	0	31
Refinery Industry	822	7,996	2,169	266	2,584
Petroleum Storage	0	0	0	0	1,261
Metallurgical Industries	28	96	40	0	0
Mineral Products Industry	6,884	1,583	597	0	31
Municipal Incineration	42	145	2,029	0	184
Motor Vehicles	1,413	1,014	17,270	239,198	22,353
Construction, Farm and Industrial Vehicles	184	193	2,507	3,729	338
Aircraft	382	145	1,751	5,594	1,476
Vessels	42	386	438	533	123
Agricultural Field Burning	1,399	0	0	15,982	1,692
Total:	14,190	48,273	39,793	266,367	30,757

Source: State of Hawaii, Department of Health

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Table 3

ANNUAL SUMMARY OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KE'EHI LAGOON

Parameter / Location	1985	1986	1987
Sulfur Dioxide / Barbers Point			
No. of 24-Hr Samples	59	57	53
Range of 24-Hr Values (ug/m3)	10-48	<5-10	<5-13
Average Daily Value (ug/m3)	24	<5	5
No. of State AAQS Exceedances	0	0	0
Particulate / Liliha			
No. of 24-Hr Samples	60	58	55
Range of 24-Hr Values (ug/m3)	11-256	17-50	20-59
Average Daily Value (ug/m3)	45	32	31
No. of State AAQS Exceedances	3	1	3
PM-10 / Liliha			
No. of 24-Hr Samples	10	51	42
Range of 24-Hr Values (ug/m3)	13-52	7-35	10-33
Average Daily Value (ug/m3)	23	18	17
No. of State AAQS Exceedances	NA	NA	NA
Carbon Monoxide / Downtown Honolulu			
No. of Daily Samples	342	348	345
Range of Daily Max. 1-Hr Values (mg/m3)	0.0-10.4	0.2-13.5	0.3-11.1
Avg. Daily Maximum 1-Hr Value (mg/m3)	1.5	2.2	1.7
No. of State AAQS Exceedances	1	3	1
Ozone / Sand Island			
No. of Daily Samples	341	336	342
Range of Daily Max. 1-Hr Values (ug/m3)	8-198	10-58	4-34
Avg. Daily Maximum 1-Hr Value (ug/m3)	43	39	18
No. of State AAQS Exceedances	3	0	0
Lead / Liliha			
No. of 24-Hr Samples	58	61	59
Range of 24-Hr Values (ug/m3)	0.0-0.5	0.0-0.3	0.0-0.1
Average Quarterly Value (ug/m3)	0.2	0.0	0.0
No. of State AAQS Exceedances	0	0	0

Source: "Hawaii Air Quality Data for the Period of January 1985 to December 1987", State of Hawaii Department of Health

Table 6

VEHICLE MIX USED FOR CALCULATION OF EMISSION FACTORS (%)

Roadway (time)	Vehicle Category							
	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC
Sand Island Road (am)	74.2	4.2	7.9	4.3	0.5	3.1	3.7	1.9
Sand Island Road (pm)	82.7	4.2	4.9	2.5	0.5	2.1	1.3	1.0
Nimitz Highway (am)	85.9	4.2	2.9	1.8	0.5	2.1	2.6	1.0
Nimitz Highway (pm)	86.7	4.2	2.6	1.6	0.5	2.1	2.3	1.0
Kalihi Street (am)	89.2	4.2	1.7	1.1	0.5	2.1	2.2	1.0
Kalihi Street (pm)	90.2	4.2	1.4	0.9	0.5	2.1	1.7	1.0
Other (am/pm)	91.9	4.2	0.8	0.5	0.5	2.1	1.3	1.0

Key to vehicle categories:

LDGV - Light duty gasoline vehicles
LDGT1 - Light duty gasoline trucks, less than 6000 lbs
LDGT2 - Light duty gasoline trucks, 6000 to 8500 lbs
HDGV - Heavy duty gasoline vehicles, greater than 8500 lbs
LDDV - Light duty diesel vehicles
LDDT - Light duty diesel trucks
HDDV - Heavy duty diesel vehicles
MC - Motorcycles

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Table 5

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR KE'ENI LAGOON PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario: 1989/ Present AM	PM	1998/ Case 1[a] AM	PM	1998/ Case 2[b] AM	PM	1998/ Case 3[c] AM	PM
Weekday:								
Lagoon Drive at:								
Kamitz Highway	18.3	18.5	12.5	12.8	15.9	15.2	15.0	14.5
Aolele Street[d]	10.2	12.1	10.4	11.3	13.6	17.3	12.3	13.2
Sand Island Road at:								
Kamitz Highway	17.8	17.8	12.4	12.5	12.9	13.5	13.1	13.4
Auiki Street	19.6	16.8	12.7	10.0	12.7	10.3	11.4	9.7
Kamitz Highway at:								
Kalihi Street	24.1	22.0	17.0	16.8	16.8	17.1	15.7	16.4
Waiakamilo Road	23.3	22.9	16.9	11.8	15.0	13.5	-	-
Weekend:								
Kamitz Highway at:								
Lagoon Drive	-	12.0	-	8.8	-	11.0	-	10.9
Sand Island Road	-	13.5	-	9.8	-	11.2	-	12.1

Hawaii State AAQS: 10
National AAQS: 40

[a]Case 1 - without project

[b]Case 2 - with project

[c]Case 3 - with project plus mitigation

[d]Assumes stop controlled in 1989. Signal assumed installed by 1998 with or without project.

Table 6

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR KE'ENI LAGOON PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario: 1989/ Present	1998/ Case 1[a]	1998/ Case 2[b]	1998/ Case 3[c]
Weekday:				
Lagoon Drive at:				
Kamitz Highway	9.2	5.4	5.0	7.5
Aolele Street[d]	6.0	5.6	5.5	6.5
Sand Island Road at:				
Kamitz Highway	8.9	5.4	6.8	6.7
Auiki Street	9.8	5.4	6.4	5.7
Kamitz Highway at:				
Kalihi Street	12.0	8.5	8.6	8.2
Waiakamilo Road	11.6	7.4	7.5	-
Weekend:				
Kamitz Highway at:				
Lagoon Drive	6.0	4.6	5.5	5.4
Sand Island Road	6.7	4.9	5.6	5.0

Hawaii State AAQS: 5
National AAQS: 10

[a]Case 1 - without project

[b]Case 2 - with project

[c]Case 3 - with project plus mitigation

[d]Assumes stop controlled in 1989. Signal assumed installed by 1998 with or without project.

RECEIVED AS FOLLOWS

Table 7

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KE'EHI LAGOON RECREATION PLAN ELECTRICAL DEMAND'

Air Pollutant	Emission Rate (tons/year)
Particulate	5
Sulfur Dioxide	168
Carbon Monoxide	12
Volatile Organics	<1
Nitrogen Oxides	47

'Based on U.S. EPA emission factors for industrial boilers [3]. Assumes electrical demand of 68 million kw-hrs per year and low sulfur oil used to generate power.

Table 8

UNCONTROLLED AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)'

Air Pollutant	Emission Factor
Particulate	14
Sulfur Oxides	2.5
Carbon Monoxide	35
Organics	1.5
Nitrogen Oxides	3

'Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.
'Assumes incinerator equipped with settling chamber and water spray.

Source: U.S. Environmental Protection Agency [3]