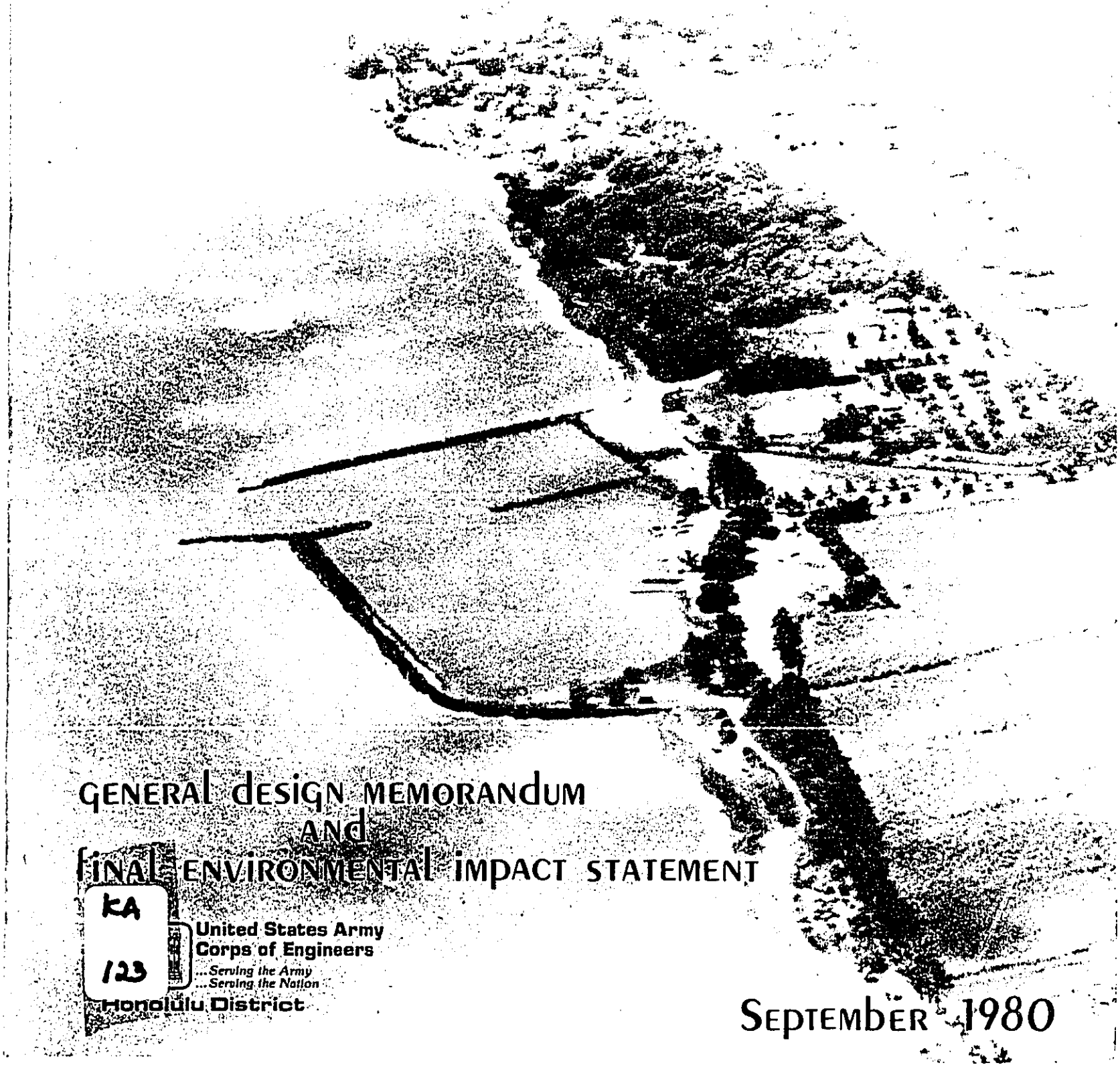
KIKIAOLA HARBOR

FOR

LIGHT - DRAFT VESSELS

KAUAI, HAWAII



GENERAL DESIGN MEMORANDUM
AND
FINAL ENVIRONMENTAL IMPACT STATEMENT

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation
Honolulu District

SEPTEMBER 1980

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

PODED-PH

26 September 1980

SUBJECT: Kikiaola Harbor for Light-Draft Vessels, Kauai, Hawaii - General Design Memorandum (GDM)

Division Engineer
US Army Engineer Division,
Pacific Ocean
Building 230
Ft Shafter, HI 96858

1. Twenty copies of subject GDM including the final Environmental Impact Statement (EIS) are forwarded for submission to the Office, Chief of Engineers, in accordance with ER 1110-2-1150 and ER 1105-2-507.

2. The draft EIS was forwarded to the Environmental Protection Agency on 30 May 1980 and was published in the Federal Register on 13 June 1980. Two copies of the Record of Public Meeting are forwarded for your information.

FOR THE DISTRICT ENGINEER:

2 Incl
as

KENNETH E. SPRAGUE
LTC, Corps of Engineers
Deputy District Engineer

PODDE (26 September 1980) 1st Ind

DA, Pacific Ocean Division, Corps of Engineers, Building 230, Ft Shafter, HI 96858, 26 September 1980

TO: HQDA (DAEN-CWE-BB), WASH DC 20314

I concur in the views and recommendations of the Deputy District Engineer.

2 Incl
nc

HENRY J. HATCH
Brigadier General, US Army
Division Engineer

GENERAL DESIGN MEMORANDUM

AND

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR

NAVIGATION IMPROVEMENTS FOR

KIKIAOLA LIGHT-DRAFT HARBOR

WAIMEA, KAUAI, HAWAII

U.S. ARMY ENGINEER DISTRICT

HONOLULU

SEPTEMBER 1980

SUMMARY

The purpose of this document is to describe the current feasibility and environmental impacts of navigation improvements for Kikiaola Harbor, Kauai, Hawaii. The project concept and site were previously authorized by Congress in 1968. This document is to reaffirm the basic planning decisions made during the preauthorization studies. The proposed improvements are designed to alleviate adverse navigation conditions and to provide a protective berthing area.

The scope of the report includes problem identification, examination of various alternative plans of improvement, and evaluation of plans in terms of technical, economic, environmental, and social acceptability. The scope of the environmental impact statement (EIS) includes the purpose and need for undertaking the proposed action, evaluation of the environmental impacts of reasonable alternatives, the existing environment of the area and the direct and indirect effects of the alternatives on the ecological, cultural, economic and social resources of the study area. The evaluation and plan selection process is guided by the co-equal national objectives of national economic development and environmental quality. The report presents five alternative plans and selects one of the plans as the recommended plan of improvement. A detailed description of the recommended plan of improvement is provided. The final Environmental Impact Statement is included as an *appendix*.

The recommended plan of improvement consists of: (a) dredging a 725-foot-long entrance channel and 320-foot-long access channel; (b) removing 150 feet of the existing outer east stub breakwater; (c) modifying 735 feet of the existing east breakwater; (d) modifying 220 feet of the existing west breakwater; and (e) removing and constructing an 85-foot-long inner east stub breakwater. Installation of necessary aids to navigation would also be included.

This report with final EIS is submitted to the Office of the Chief of Engineers for approval. The project would be implemented after approval by the Chief of Engineers, completion of local responsibility requirements, and receipt of project construction funds.

GENERAL DESIGN MEMORANDUM
KIKIAOLA HARBOR FOR LIGHT-DRAFT VESSELS
WAIMEA, KAUAI, HAWAII

PERTINENT DATA

PROJECT FEATURES

1.	BERTHING CAPACITY	105 boats
2.	ENTRANCE CHANNEL	
	a. Length	725 feet
	b. Width	105 to 205 feet
	c. Depth	12 feet
3.	ACCESS CHANNEL	
	a. Length	320 feet
	b. Width	70 to 105 feet
	c. Depth	8 feet
4.	EAST BREAKWATER HEAD MODIFICATION	
	a. Length	165 feet
	b. Crest Elevation	+12 feet MLLW
	c. Crest Width	13 feet
	d. Side Slope	1V on 2H
	e. Armor	3.5- to 5-ton stone
5.	EAST BREAKWATER TRUNK MODIFICATION	
	a. Length	570 feet
	b. Crest Elevation	+11 feet MLLW
	c. Crest Width	9 feet
	d. Side Slope	1V on 1.5H
	e. Armor	1- to 2-ton stone
6.	WEST BREAKWATER HEAD MODIFICATION	
	a. Length	220 feet
	b. Crest Elevation	+8 feet MLLW
	c. Crest Width	15 feet
	d. Side Slope	1V on 2H
	e. Armor	3.5- to 5-ton stone

7. INNER EAST STUB BREAKWATER	
a. Length	85 feet
b. Crest Elevation	+12 feet MLLW
c. Crest Width	13 feet
d. Side Slope	1V on 2H
e. Armor	3.5- to 5-ton stone
8. OUTER EAST STUB BREAKWATER	
a. Length Removed	150 feet
PROJECT FIRST COST	
Total Federal and Non-Federal Estimated Project First Cost	$2,430,000
APPORTIONMENT OF PROJECT FIRST COST	
Federal	$1,230,000
Non-Federal	1,200,000
Estimated Project First Cost	$2,430,000
AVERAGE ANNUAL CHARGES	
Total Average Annual Charges Based on a 7-1/8 Percent Interest Rate and a 50-Year Project Life	$228,400
AVERAGE ANNUAL BENEFITS	
Total Average Annual Benefits Based on a 7-1/8 Percent Interest Rate and a 50-Year Project Life	$274,000
AVERAGE ANNUAL NET BENEFITS	$45,600
BENEFIT-COST RATIO	1.2

GENERAL DESIGN MEMORANDUM
AND ENVIRONMENTAL IMPACT STATEMENT
NAVIGATION IMPROVEMENTS FOR
KIKIAOLA LIGHT-DRAFT HARBOR
WAIMEA, KAUAI, HAWAII

MAIN REPORT

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

APPENDICES

Note: Separate Table of Contents is provided for each Appendix.

LIST OF TABLES

LIST OF FIGURES

SECTION A

INTRODUCTION

PROJECT AUTHORIZATION

1. The general design memorandum (GDM) presents results from post-authorization studies for the modification of Kikiaola Light-Draft Harbor, Waimea, Kauai, Hawaii. Construction of harbor modifications was authorized by Section 101 of the River and Harbor Act of 13 August 1968 (Public Law 90-483) in accordance with House Document No. 353, 90th Congress, 2nd Session. House Document No. 353 contained the Chief of Engineers' report dated 8 July 1968 on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels. Applicable portions of this section are as follows:

> "SEC. 101. That the following works of improvement of rivers and harbors and other waterways for navigation, flood control, and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers, in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated. The provisions of section 1 of the River and Harbor Act approved March 2, 1945 (Public Law Numbered 14, Seventy-Ninth Congress, first session), shall govern with respect to projects authorized in this title; and the procedures therein set forth with respect to plans, proposals, or reports for works of improvement for navigation or flood control and for irrigation and purposes incidental thereto, shall apply as if herein set forth in full.
>
> NAVIGATION
> Coasts of Hawaiian Islands, Harbors for Light Draft Vessels".

SCOPE OF POST-AUTHORIZATION STUDIES

2. Post-authorization studies were initiated to reaffirm basic planning decisions made during the preauthorization studies or reformulate the project to reflect changes in physical, social, economic and environmental conditions and also to incorporate changes in water resources planning policies which occurred since the project was authorized.

3. Since the interval between project authorization in 1968 and post-authorization studies in 1978 was lengthy, post-authorization studies included the reevaluation of problems and needs, public attitude towards the plan of improvement, possible alternative plans, oceanographic analysis, navigation requirements, social and economic conditions, and desires of the local sponsor. In addition, an assessment and evaluation of environmental impacts was required by various laws and regulations enacted since the project was initially authorized.

DESCRIPTION OF THE AUTHORIZED PLAN

4. The authorized plan to construct harbor modifications at Kikiaola Harbor, Waimea, Kauai, is described in the Chief of Engineers' report dated 11 April 1968. The report is found in House Document No. 353, 90th

Congress, 2nd Session and will be referred to as the "project document." The pertinent features of the authorized project are shown on Figure 1 and described below:

(a) Remove 130 feet of the existing east stub breakwater;

(b) Raise the crest elevation by 3 feet along a 770-foot portion of the east breakwater.

(c) Construct a 270-foot-long wave absorber;

(d) Dredge a 1,050-foot-long, 120-foot-wide, 12-foot-deep entrance channel; and

(e) Dredge a 630-foot-long, 80 to 120-foot wide, 6 to 10-foot-deep main access channel.

The authorized harbor plan was designed to accommodate approximately 130 boats.

LOCAL COOPERATION REQUIREMENTS

5. Federal participation in the construction and maintenance of the harbor, as recommended in this report, will be contingent upon local interests satisfying the following requirements:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for the construction and subsequent maintenance of the project and aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for the initial and subsequent disposal of spoil, and also provide necessary retaining dikes, bulkheads, and embankments thereof or the costs of such retaining works;

b. Hold and save the United States free from damages due to the construction work or subsequent maintenance of the project when not due to the fault or negligence of the United States or its contractors;

c. Assure continued public ownership and use of the facilities upon which the amount of federal participation is based during the economic life of the project;

d. Provide and maintain without cost to the United States necessary berthing or mooring facilities and attendant utilities, including a public landing with suitable supply facilities open to all on equal terms;

e. Provide and maintain without cost to the United States depths in the berthing and mooring areas, and in the local access channels commensurate with the depths provided in the related project areas;

f. Provide and maintain without cost to the United States all appropriate onshore structures, access roads, parking areas, public restrooms, and boat launching and retrieving facilities as necessary to insure a complete and adequate project;

g. Accomplish without cost to the United States such utility, drainage, or other relocations or alterations as necessary for project purposes;

h. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control; and

i. Contribute in cash prior to construction of the project a lump sum payment in the estimated amount of $1,200,000 which is 49.9 percent of the estimated first cost of construction by the Corps of Engineers, the final contribution to be adjusted after actual costs have been determined.

6. The Harbors Division, Department of Transportation, State of Hawaii, the local cooperating agency, has reviewed plans of the harbor modification and has formally indicated full support of the proposed project. Additionally, the Harbors Division, as the representative of the State of Hawaii, has assured the District Engineer that it is willing and able to fulfill the necessary requirements of local cooperation as enumerated in this report and desires to undertake the project upon federal approval. The most recent letter of assurance is included in Appendix H, Public Involvement. The *principal officer responsible for complying with the aforementioned* local cooperation requirements is:

R. Higashionna, Ph.D., Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813

STUDY PARTICIPANTS AND COORDINATION

7. The U.S. Army Corps of Engineers, Honolulu Engineer District, is responsible for conducting and coordinating the study. The studies and investigations were performed in cooperation with the Harbors Division, Department of Transportation, State of Hawaii.

8. Information and comments received from the following agencies and organizations, as well as numerous individuals, were considered in identifying problems and needs and developing alternative plans:

State Department of Transportation, Harbors Division
State Department of Planning and Economic Development, Land-Use Commission
U.S. Fish and Wildlife Service
National Marine Fisheries Service
Kekaha Sugar Company (Island of Kauai)
U.S. Coast Guard
Kikiaola Land Company
E. A. Knudsen Trust

PUBLIC INVOLVEMENT PROGRAM

9. Public involvement has been an integral part of post-authorization studies throughout the study period. The program has included public meetings where testimony was received regarding Corps plans, a series of public workshops where interested individuals and organizations participated fully in the development of alternative plans, and informal conversations and correspondence with local interests. Summary of the public workshops and meetings and pertinent correspondence are contained in Appendix H, Public Involvement.

STUDIES OF OTHERS

10. In accordance with the Fish and Wildlife Coordination Act, a Planning Aid Report and a 2B Detailed Report were prepared by the U.S. Fish and Wildlife Service and was utilized in the development of alternative plans and in the selection of the Plan of Improvement. The final FWS 2b Report is included in this report as Appendix G.

THE REPORT AND STUDY PROCESS

11. This General Design Memorandum (GDM) has been prepared sequentially in the order of the study process stages. The sections of the report describe the authorized project, identify problems and needs, discuss the plan formulation process, assess and evaluate alternative plans of harbor improvement, compare detailed plans, present and discuss the recommended plan, environmental impact statement summary, and present study conclusions and recommendations.

REPORT PREPARATION

12. This document consists of a main report and a series of appendices. The main report is a self-contained document which describes the planning process and includes the final environmental impact statement. The appendices contain technical and detailed information and background data to support the information contained in the main report.

Appendix A, Benefit Analysis, contains the economic background, data, and analyses for determining the benefits and costs associated with each alternative plan.

Appendix B, Design Analysis, contains the engineering analyses and data relevant to the design of the proposed navigation improvements.

Appendix C, Geology, Foundations and Materials, provides information concerning geology, foundations and materials investigations.

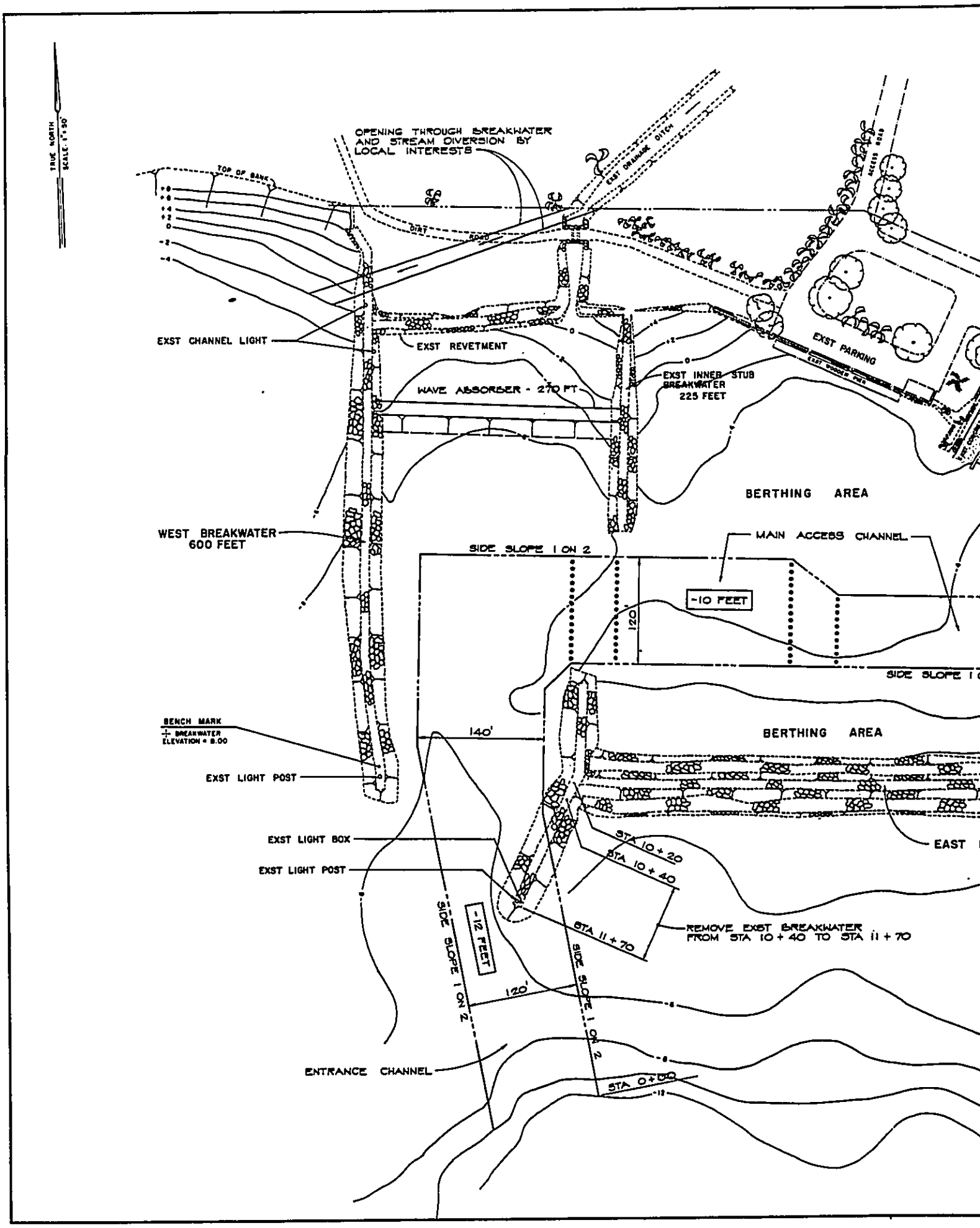
Appendix D, Recreation and Natural Resources, contains information on the recreational and natural resources within the affected study area.

Appendix E, Social and Cultural Resources, contains information on the social and cultural-archaeological resources within the affected study area.

Appendix F, Regulatory Evaluations, contains the evaluation reports required by Section 404 of the Clean Water Act, Executive Order 11988, and the Coastal Zone Management Act. The Federal Consistency Determination was filed with the State of Hawaii on 14 August 1980.

Appendix G, U.S. Fish and Wildlife Service Report, contains the report prepared in accordance with the Fish and Wildlife Coordination Act of 1958 (Public law 85-624).

Appendix H, Public Involvement, describes the public involvement program and contains list of reviewers and pertinent correspondence received during the study and evaluation period.


TRUE NORTH
SCALE - 1" = 50'
OPENING THROUGH BREAKWATER AND STREAM DIVERSION BY LOCAL INTERESTS
TOP OF BANK
DIRT ROAD
EXST DRAINAGE DITCH
ACCESS ROAD
EXST CHANNEL LIGHT
EXST REVETMENT
EXST PARKING
EXST INNER STUB BREAKWATER 225 FEET
WAVE ABSORBER - 270 FT
BERTHING AREA
WEST BREAKWATER 600 FEET
MAIN ACCESS CHANNEL
SIDE SLOPE 1 ON 2
-10 FEET
120'
BENCH MARK
+ BREAKWATER
ELEVATION = 8.00
140'
BERTHING AREA
EXST LIGHT POST
EXST LIGHT BOX
EXST LIGHT POST
STA 10 + 20
STA 10 + 40
STA 11 + 70
REMOVE EXST BREAKWATER FROM STA 10 + 40 TO STA 11 + 70
-12 FEET
SIDE SLOPE 1 ON 2
120'
SIDE SLOPE 1 ON 2
ENTRANCE CHANNEL
STA 0+00
-12

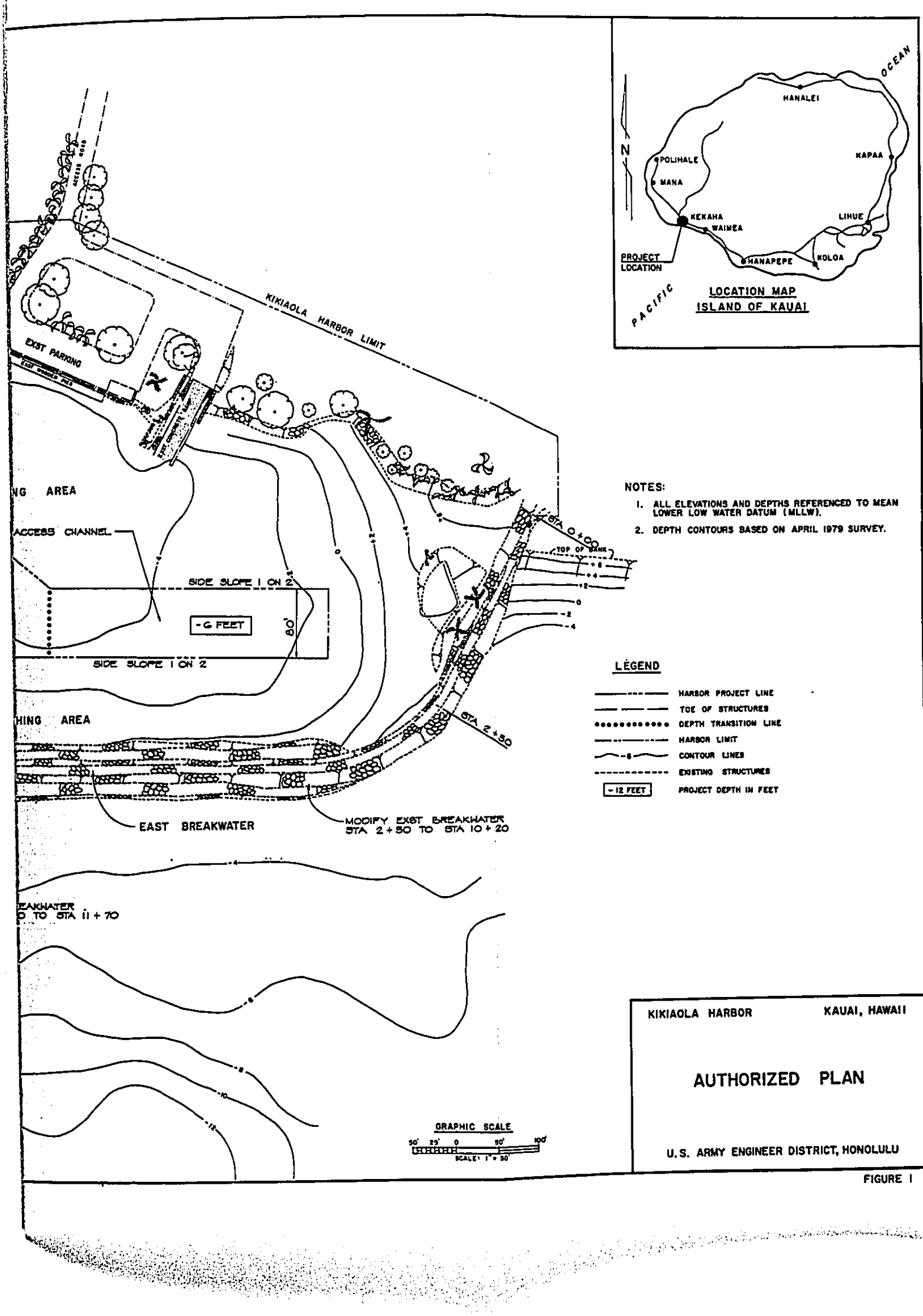

KIKIAOLA HARBOR LIMIT
EXIST PARKING
ACCESS ROAD
EXIST CONCRETE WALL
NG AREA
ACCESS CHANNEL
SIDE SLOPE 1 ON 2
-6 FEET
80'
SIDE SLOPE 1 ON 2
HING AREA
STA 0+00
TOP OF BANK
+8
+4
+2
0
-2
-4
STA 2+50
EAST BREAKWATER
MODIFY EXST BREAKWATER
STA 2+50 TO STA 10+20
EAKWATER
O TO STA 11+70
-8
-10
-12
GRAPHIC SCALE
50' 25' 0 50' 100'
SCALE: 1" = 50'
LOCATION MAP
ISLAND OF KAUAI
OCEAN
PACIFIC
N
HANALEI
POLIHALE
MANA
KAPAA
KEKAHA
WAIMEA
LIHUE
PROJECT LOCATION
HANAPEPE
KOLOA
NOTES:
1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.
LEGEND
HARBOR PROJECT LINE
TOE OF STRUCTURES
DEPTH TRANSITION LINE
HARBOR LIMIT
-8 CONTOUR LINES
EXISTING STRUCTURES
-12 FEET PROJECT DEPTH IN FEET
KIKIAOLA HARBOR KAUAI, HAWAII
AUTHORIZED PLAN
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 1

SECTION B

PROBLEM IDENTIFICATION

13. Although the primary purpose of this study is to reaffirm the planning decisions made during preauthorization studies, the initial study task was to update the problems and needs related to the authorized project. The results of the update served as the basis for translating the identified problems, needs, concerns and constraints into the planning objectives which provide a guide and focus for the post-authorization planning activities which follow.

NATIONAL OBJECTIVES

14. The planning objectives which emerge from the problem identification process are specifically directed to the need for navigation improvements. In accordance with the U.S. Water Resources Council's Principles and Standards (P&S) for Planning Water and Related Land Resources, these objectives are directed to achieve the national objectives of National Economic Development (NED) and Environmental Quality (EQ).

15. The NED objective is to enhance national economic development by increasing the value of the nation's output of goods and services and by improving national economic efficiency. The EQ objective is to enhance the quality of the environment by managing, conserving, preserving, creating, restoring, or improving the quality of certain natural and cultural resources and ecological systems.

16. During the formulation of alternative plans the NED and EQ contributions were evaluated on an equal basis. P&S also requires that the impacts of a proposed action be measured in terms of Regional Development (RD) and Social Well Being (SWB). Contributions to the RD account are determined by establishing an alternative's effects on a region's income, employment, population, economic base, and social development. Contributions to the SWB account are determined by establishing an alternative's effects on real income, security of life, health and safety, education, cultural and recreational opportunities, and emergency preparedness.

PROFILE OF EXISTING CONDITIONS

17. General Description. Kauai, the northernmost of the eight major Hawaiian Islands, is located 103 statute miles west and slightly north of Honolulu. The roughly circular island ranks fourth in land area with 549 square miles. In 1978, Kauai's total resident population was approximately 34,700.

18. Kikiaola harbor was originally developed by the State of Hawaii in 1959 by constructing the east and west breakwaters. In 1961, the State constructed the launching ramp. In 1964, the two stub breakwaters and a short inner breakwater were constructed to reduce surge within the harbor basin. No dredging work was performed during the initial construction. However, in 1969, the inner harbor areas was dredged to -5.0 feet. Also, a

small quantity of material was dredged near the marginal wharf in 1971. The existing facility consists of a 1,280-foot-long east breakwater with two short stub breakwaters; a 600-foot-long west breakwater; a 225-foot-long inner breakwater; a 150-foot-long by 10-foot-wide wooden marginal wharf; a 50-foot-long loading dock adjacent to the ramp, and a launching ramp. There are no existing berthing facilities.

19. Kikiaola Harbor is located on the southwest coast of Kauai (Figure 2). The harbor is approximately one mile southeast of Kekaha, 1.5 miles west of Waimea, and 8 miles northwest of Port Allen, the nearest light-draft vessel harbor. Lihue, the county seat and the center of commerce and business activity, is located approximately 23 miles east of Kikiaola Harbor.

20. Kikiaola Harbor is located on a uniformly straight, low, and wide beach that extends 2.7 miles from Waimea River, to the west, to Oomano Point at Kekaha. Figure 3 shows the harbor and highlights some of the existing conditions described in this section.

21. Land Use. The proposed land-use plan, as described in the Waimea-Kekaha Development Plan, provides for moderate growth and development in the Waimea-Kekaha region. The Waimea-Kekaha area is primarily regarded as an agricultural region. Sugarcane fields dominate the region's productive coastal plain and lower elevation lands. Currently, adjacent land area to the east (Waimea) is cultivated for sugarcane production. Adjacent land area to the west (Kekaha) is presently undeveloped and open pasture (Figure 4).

22. Development and Economy. The State of Hawaii is characterized as a prosperous state with a growing population and economy. Between 1950 and 1978, the total resident population increased over 780 percent from 498,000 to 896,600. During the same period, the gross State product increased from $900 million to $9 billion. The three largest contributors to the State economy are tourism, defense expenditures, and agriculture, the bulk of the last activity being in the production of sugar and pineapple. The most rapid growth during the last several years has been in the tourist industry. Tourist arrivals totaled 687,000 in 1965 and 3,670,000 in 1978. Tourist expenditures were $225 million in 1965 and $2,188 million in 1978, an increase of 872 percent.1/

23. Based on a sample telephone survey undertaken in 1970-1971, there were approximately 7,000 recreational fishermen on the Island of Kauai in 1970. Based on comparative island population increase to 1978, there could be more than 8,200 recreational fishermen today. However, using 1970-71 percentages of fishing categories, only about 406 of the 7,000 recreational fishermen in 1970 or perhaps about 475 in 1978 would have been boat-dependent. This compares with 1,072 registered vessels on Kauai. According to State sources, commercial fishing activity on Kauai is relatively small compared with the other islands of the State. In 1977, there were 192 licensed

1/ Statistical information extrated or computed from the data published in Bank of Hawaii's Annual Economic Review Reports.

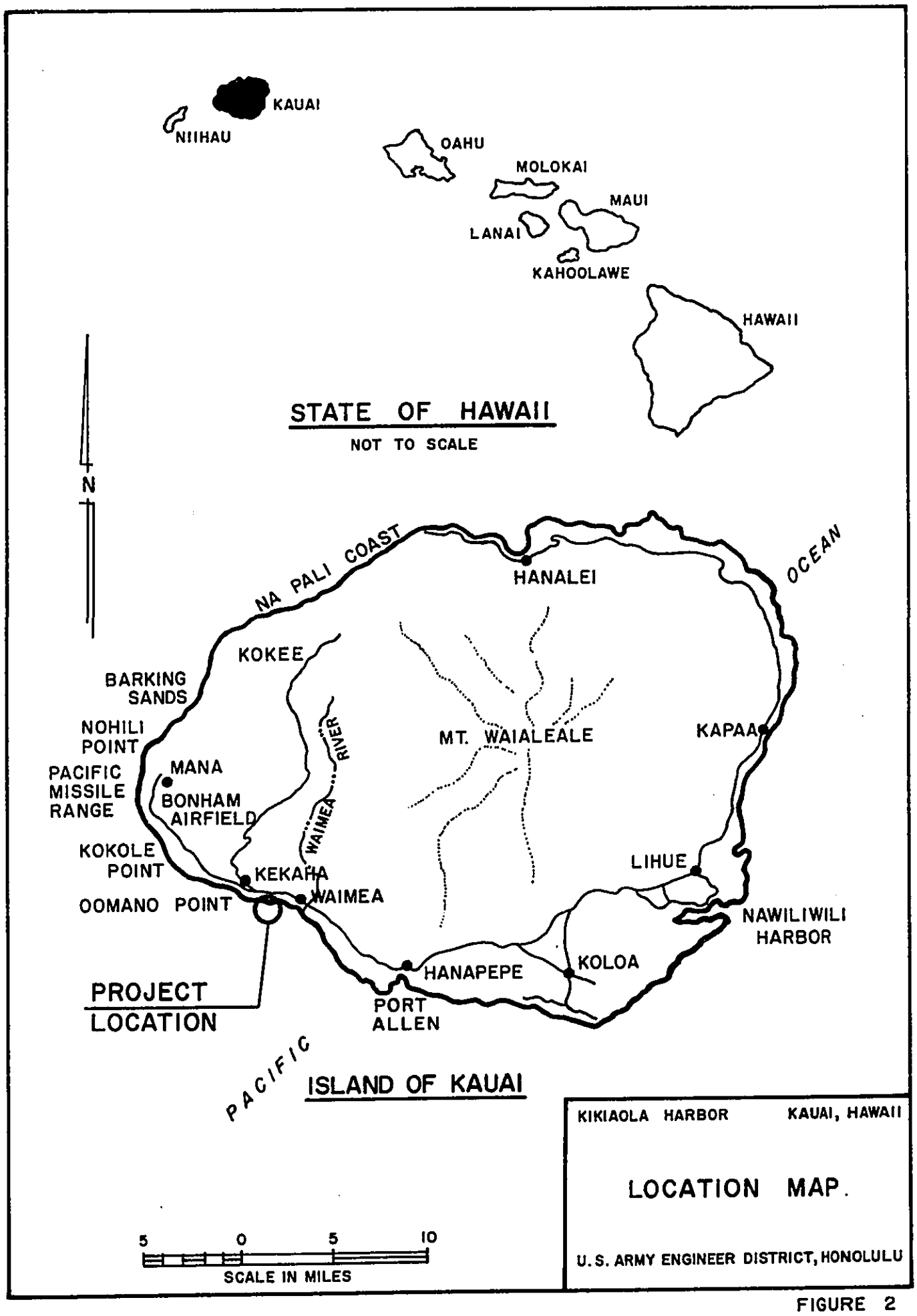

KAUAI
NIIHAU
OAHU
MOLOKAI
MAUI
LANAI
KAHOOLAWE
HAWAII
STATE OF HAWAII
NOT TO SCALE
N
NA PALI COAST
HANALEI
OCEAN
KOKEE
BARKING SANDS
NOHILI POINT
PACIFIC MISSILE RANGE
MANA
BONHAM AIRFIELD
WAIMEA RIVER
MT. WAIALEALE
KAPAA
KOKOLE POINT
KEKAHA
WAIMEA
OOMANO POINT
LIHUE
NAWILIWILI HARBOR
HANAPEPE
KOLOA
PROJECT LOCATION
PORT ALLEN
PACIFIC
ISLAND OF KAUAI
5 0 5 10
SCALE IN MILES
KIKIAOLA HARBOR KAUAI, HAWAII
LOCATION MAP.
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 2

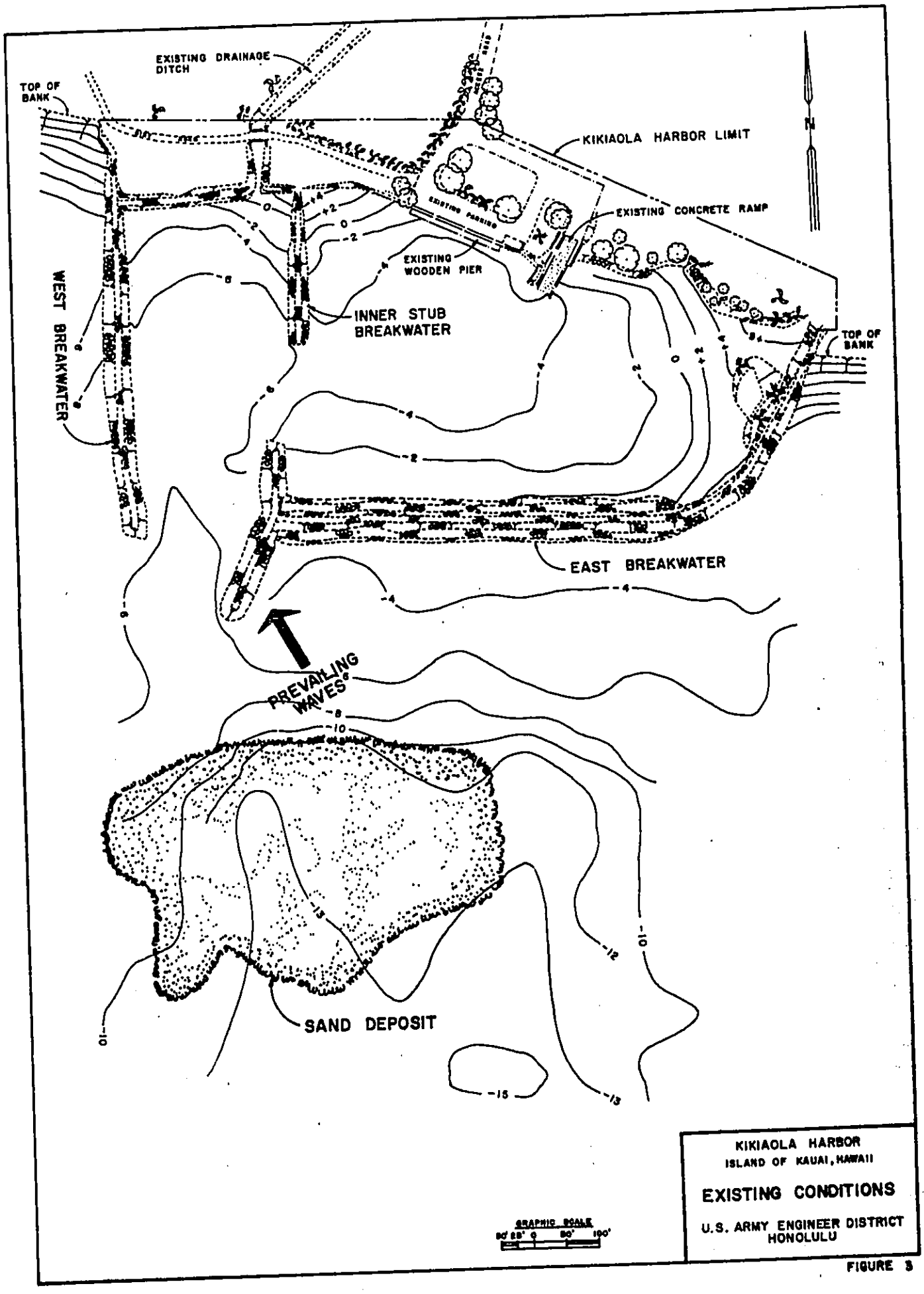

EXISTING DRAINAGE DITCH
TOP OF BANK
KIKIAOLA HARBOR LIMIT
N
EXISTING CONCRETE RAMP
EXISTING PARKING
EXISTING WOODEN PIER
WEST BREAKWATER
INNER STUB BREAKWATER
TOP OF BANK
EAST BREAKWATER
PREVAILING WAVES
SAND DEPOSIT
GRAPHIC SCALE
KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII
EXISTING CONDITIONS
U.S. ARMY ENGINEER DISTRICT
HONOLULU

FIGURE 3

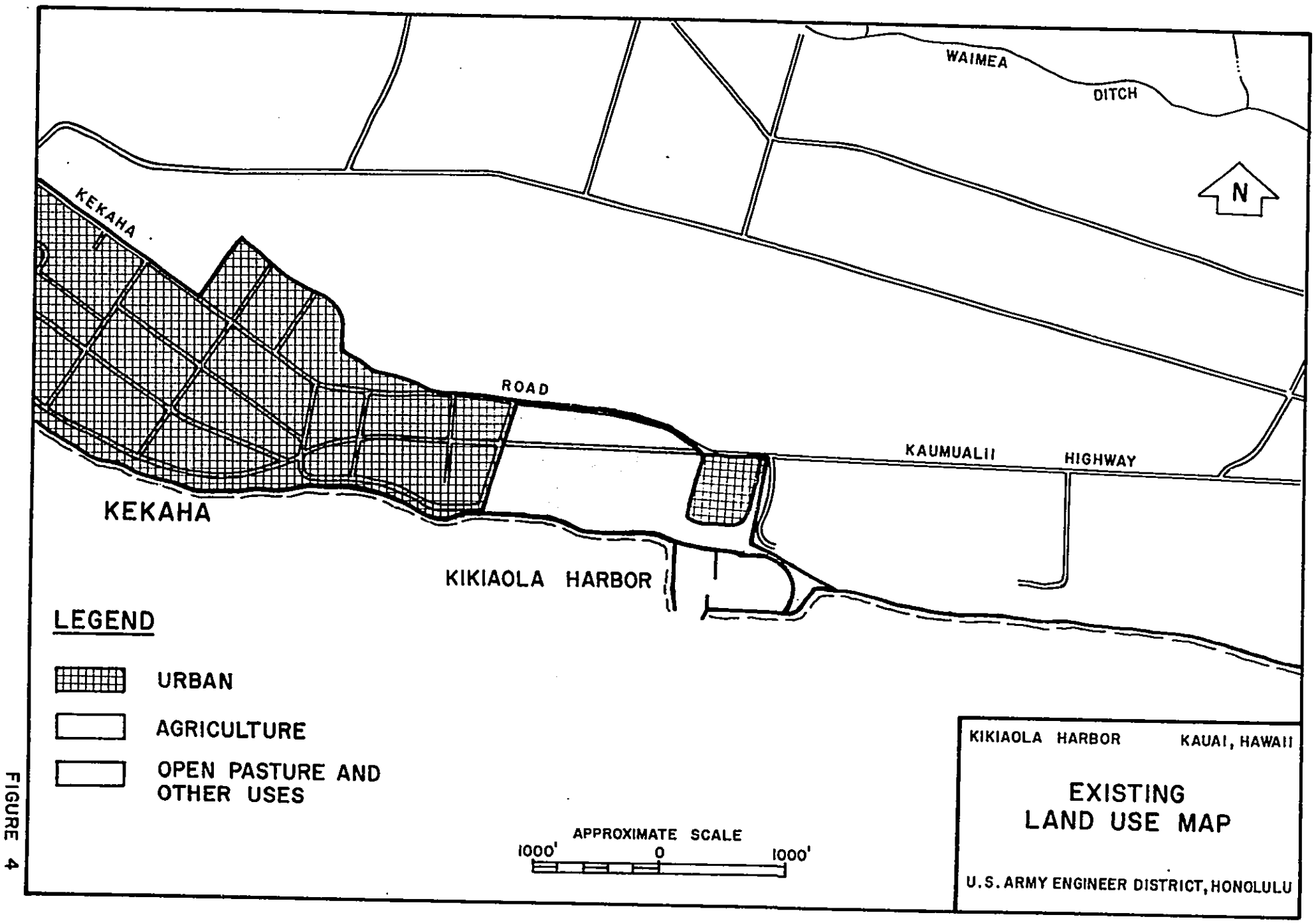


FIGURE 4

FIGURE 4

commercial fishermen on Kauai operating primarily out of Nawiliwili and Port Allen harbors. Based on comments received at a public workshop on Kikiaola Small Boat Harbor on 14 December 1978, there were at least 50 licensed commercial fishermen and about 50 non-licensed sport fishermen who may sell commercially, both of whom use Kikiaola harbor. The island-wide survey in 1970-71 estimated that recreational fishermen alone spend approximately $333,000 per annum on transportation (sea and land), $447,000 on additional living costs, and $322,000 on equipment, averaging about $157 per fisherman. No figures are available for commercial fishermen, but the annual average costs per fisherman would certainly have been far above the figure for recreational fishermen. Numbers of licensed fishermen and their annual catch in tons are unreliable statistics because of the high number of unlicensed commercial and particularly semi-commercial fishermen and under-reporting of catch by both. The State recognizes this problem, is recommending changes be made to more accurately reflect true levels fishing activity.

24. In the Waimea-Kekaha area, an economy dominated by the sugar industry is giving way to one dominated by federally-supported defense and scientific activities. Nearly all the land on Mana Plain west of Kekaha is the property of the State of Hawaii and the federal government. Almost all of the State-owned land is under long-term lease to the Kekaha Sugar Company.

25. Kekaha Sugar Company, owned by AmFac Inc., produces sugarcane on 7,947 acres and in 1976 employed approximately 440 workers. Employment at the sugar company has been declining for several decades but is now expected to remain stable or decline only gradually with continuing technological improvements. The chief economic mainstay of the Waimea-Kekaha region is the defense/scientific complex at Barking Sands and Kokee. The major operations at Pacific Missile Range (PMR) involve the US Navy's missile testing and development and Anti-Submarine Warfare training, the National Bureau of Standards, the National Weather Service, and the Energy Research and Development Agency (ERDA). At the beginning of 1976, a total of 560 persons were employed at PMR, including 105 Navy personnel and about 250 dependents who lived on base. At Kokee in the mountains, 253 full-time workers were employed by the NASA Tracking Station, the Hawaii Air National Guard, and the National Weather Service.

26. Unlike most of Kauai, tourism has not played a significant role in the economy of Waimea-Kekaha region, principally because there are no hotels or large restaurants in the area. An estimated 500,000 tourists passed through Waimea-Kekaha in 1975 to visit the Waimea Canyon area. According to County planning officials, tourists usually follow the Belt Highway along the coast to view Niihau Island then turn inland toward the mountains. Polihale State Park, beyond Barking Sands, is another favorite tourist destination.

27. The Belt Highway is the major transportation route serving the defense/scientific complex at Barking Sands and the tourist destination areas of Waimea Canyon and Polihale State Park. Although Barking Sands installation has its own airfield, most of its food and logistical needs are supplied by land transportation. According to State Department of Transportation sources, in September 1975, a one-day count of 1,519 vehicles passed in both directions on the Belt Highway west of Waimea.

28. Winds. Prevailing northeast tradewinds occur on more than 70 percent of the days each year. The tradewinds are most constant during the spring and summer with typical speeds of 10 to 20 miles per hour. Local low pressure systems frequently replace the tradewinds during the winter months. These low pressure systems, called "Kona" storms or "Kona" weather, typically produce conditions ranging from gale-force southerly winds with heavy rain to calm, humid, or rainy weather.

29. Tradewinds reach the Waimea-Kekaha coastal plain around Mount Waialeale through Hanapepe, around the Na Pali Coast or down from the mountains. The annual wind rose, taken at Bonham Air Base, Barking Sands (Figure 5), is representative of project site wind conditions. Statistical surface wind data in the offshore area, obtained from the United States Naval Oceanographic Office Publication No. 1401, 1960, entitled "Pilot Charts of the Northern Pacific Ocean," is shown on Figure 6. Winds off the study area are predominantly northeast trades with winds from the east and northeast about 75% of the time. Winds from the south, southwest, west, and northwest occur about 8% of the time.

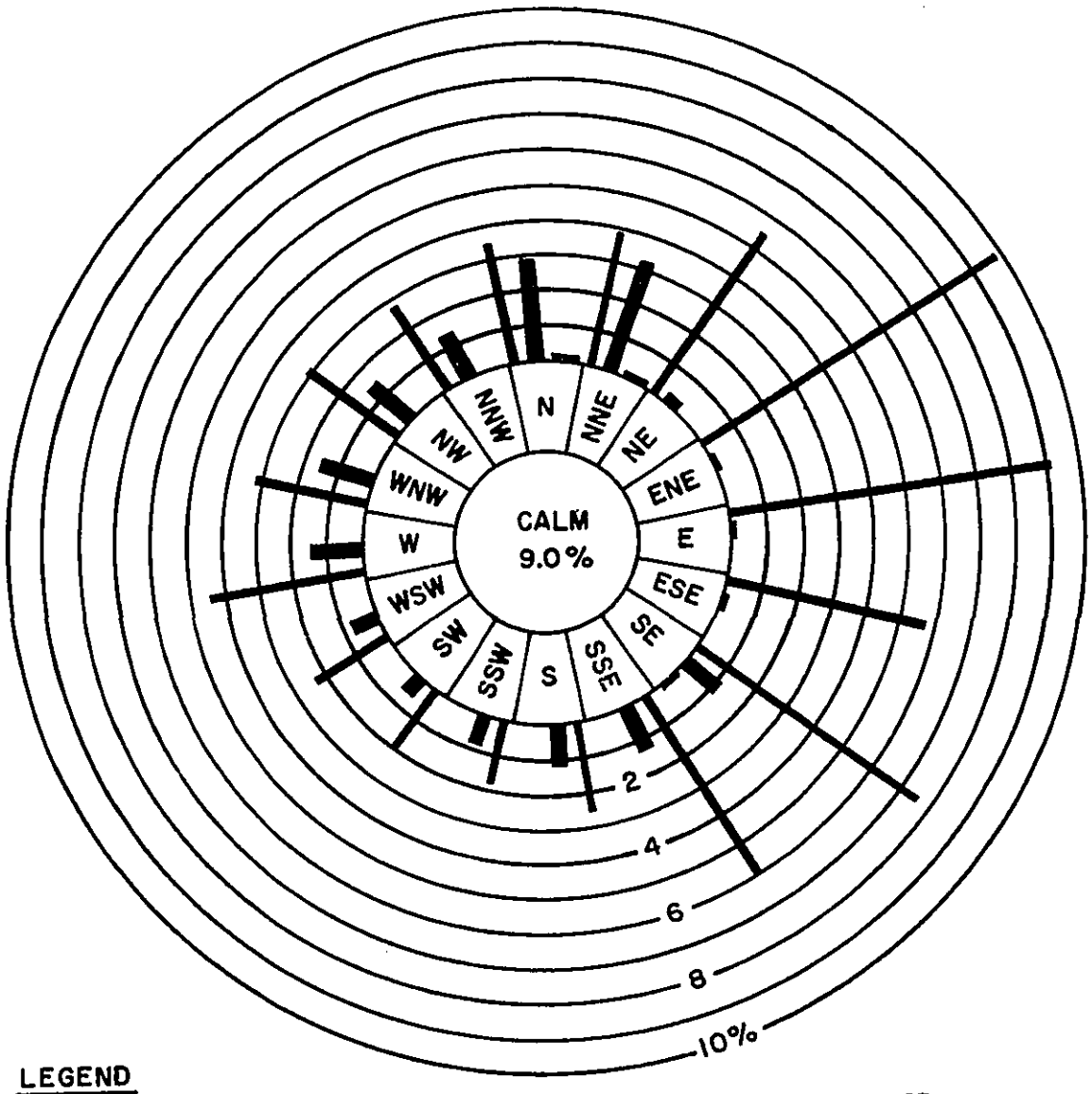
30. Waves. Critical wave types that affect Kikiaola Harbor are the "Kona" storm waves and southern swells.

31. "Kona" storm waves generally approach Kikiaola Harbor from the south through the west. These waves are produced by intense local storms. The storms are neither frequent nor consistent but occur primarily during the winter months. They may generate waves which can directly affect the harbor. Usually periods range from 8 to 10 seconds with heights varying from 10 to 15 feet.

32. Southern swells are generated during the Antarctic winter months by strong winds blowing over long fetches of the southern Pacific and Indian Oceans. After traveling over thousands of miles of open ocean, these waves arrive at the southern shores of the Hawaiian Islands as long period swells. Periods typically range between 14 and 22 seconds with heights generally 1 to 4 feet. In any year, southern swells may occur about 50 percent of the time.

33. An infrequent source of large destructive waves is hurricanes. Damaging hurricanes passed through the Hawaiian chain in December 1957, August 1959, and most recently in July 1978. Theoretical calculations by Dr. C.L. Bretschneider indicate that a significant deepwater wave height of 27 feet can be expected for a typical 50-year hurricane having the following parameters: (a) central pressure reduction of 1 inch of mercury, (b) radius of maximum winds of 20 nautical miles, and (c) forward speed of 12 knots. This results in a maximum sustained wind speed of 62 knots and a corresponding maximum deepwater wave height of 46 feet.

34. Wave refraction analysis, described in the Design Analysis, Appendix B, was performed to aid in locating zones of high energy concentration in the vicinity of the harbor, and to determine the probable approach alignment of waves.



LEGEND

1-7 MPH
8-18 MPH
OVER 18 MPH

PERIOD OF RECORD

APR 64 - FEB 65
APR 65 - MAR 66

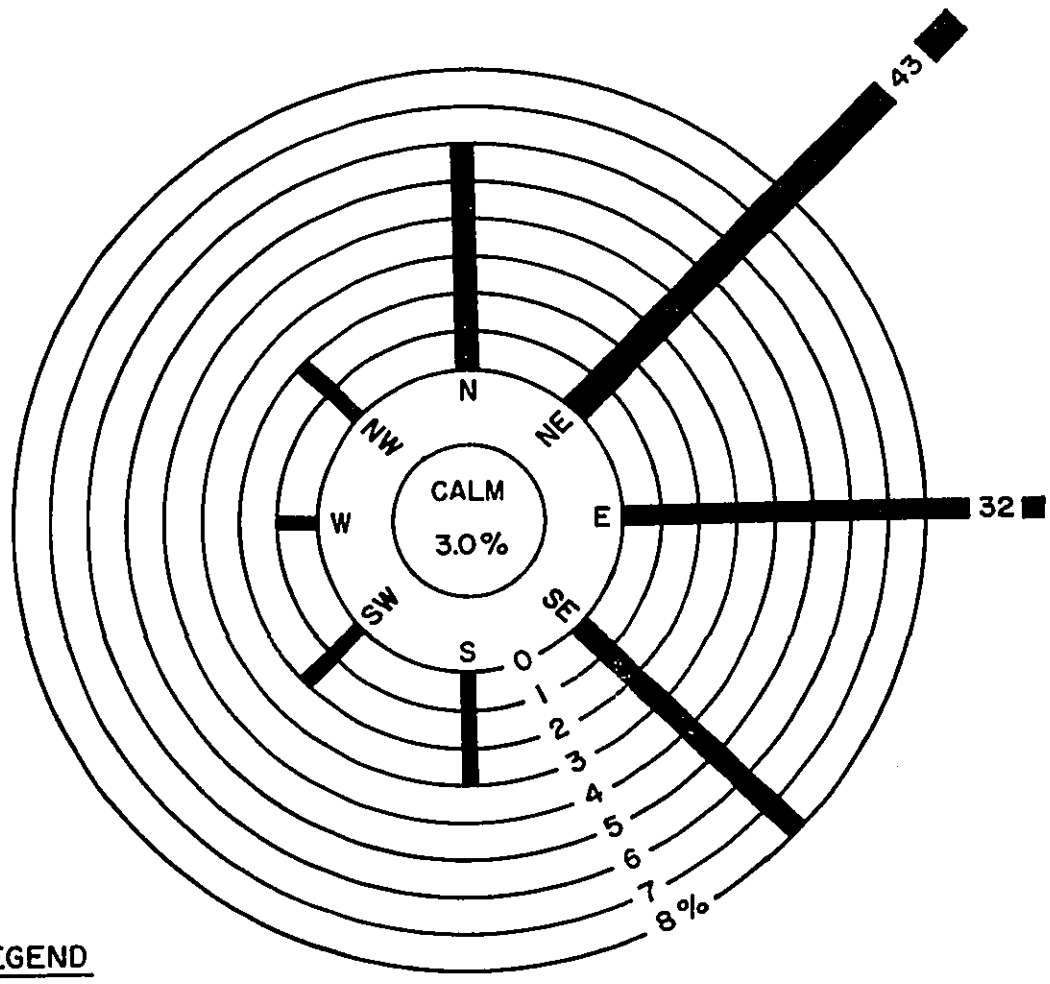
SOURCE

U.S.W.B.

ANNUAL WIND ROSE

BONHAM AIR BASE

FIGURE 5



LEGEND

- 4.0 - 7.0 MPH
- 7.0 - 12.0 MPH
- 12.0 - 18.0 MPH
- —4%— TOTAL % OF YEAR

PERIOD OF RECORD

1932 - 1942

SOURCE

U. S. NAVAL OCEANOGRAPHIC OFFICE

OFF-SHORE WIND DIAGRAM

(YEARLY AVERAGE)

BARKING SANDS

FIGURE 6

35. Tides: The tides in the Hawaiian Islands are semi-diurnal with pronounced diurnal inequalities. Tidal data, shown below, was obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and National Ocean Survey. The nearest tide gage is located at Waimea Bay, located approximately 1.8 miles east of Kikiaola Harbor. Tidal data for Kikiaola is as follows:

	Feet
Highest tide (estimated)	3.0
Mean higher high water	1.60
Mean high water	1.20
Half tide level	0.70
Mean low water	0.20
Mean lower low water	0.00
Lowest tide (estimated)	-1.0

36. Tsunami. Kikiaola Harbor area is subject to potential tsunami or seismic sea wave inundation as are all low-lying coastal areas in the Hawaiian Islands. The nature of tsunami is not fully understood: an occurrence may be totally unnoticed or may cause catastrophic destruction of coastal areas. Typically in the Kikiaola Harbor area a severe tsunami may cause abnormal rising and falling of the sea level, resulting in flooding of low-lying areas, and grounding of boats in the harbor. Kikiaola Harbor should be evacuated in the event of a tsunami warning. According to the Flood Insurance Rate Map, prepared by the Federal Emergency Management Agency, Federal Insurance Administration, Kikiaola Harbor is situated in a tsunami inundation area of zone V19 designation, where the 100-year tsunami elevation is approximately 10 feet above mean sea level.

37. Compliance with Executive Order 11988. Kikiaola Harbor lies within the 100-year tsunami inundation zone. Adverse impacts resulting from locating in the tsunami flood zone include the risks of property damage and loss of life. The proposed action will require development in the inundation zone such as harbor backup facilities. There is no alternative location for these facilities. However, utilizing construction practices which meet the requirements of the National Flood Insurance Program will minimize tsunami damages.

38. Adverse impacts resulting from increased use of the tsunami flood zone can be minimized by adequate tsunami warning. A State-wide tsunami warning system is presently in existence. Kikiaola Harbor would be evacuated in the event of a tsunami warning. Boats should not re-enter the harbor until the tsunami warning has been cancelled. Additional Executive Order 11988 compliance requirements are discussed in Appendix G of this report.

NATURAL RESOURCES

39. Climate. Temperatures on the coastal plain are generally mild throughout the year, varying from a mean monthly temperature of 70°F in winter to 78°F in summer. At 1,000 foot and higher elevations, temperatures are slightly cooler with averages from 67°F in winter to 75°F in summer.

40. The Waimea-Kekaha coastal plain is located on the leeward side of Kauai and receives the least amount of rainfall for the island. The average annual rainfall is 22 inches at Mana and 21 inches at Waimea. At high elevations, rainfall averages 100 inches annually.

41. Historic Sites. Waimea, 1.5 miles to the east of the harbor, was the site of Captain Cook's first discovery of the Hawaiian Islands in 1778, a Russian fort in 1817, and the area's first sugar industry in the 1880's. The modern village of Kekaha, 1 miles to the west was founded only in 1897. In 1787, Captain George Dixon walked west from "Wy'maia" through "very dry" country of grass-covered light red soil and came upon "A Tappa" (or Kekaha) village just inland of O'omano Point. He found "amongst these cocoa-nut trees [at Kekaha village]...a good deal of wet swampy ground which is well laid out in plantations of taro and sugarcane." There are no known prehistoric or historic sites in the immediate vicinity of Kikiaola including ones listed on or eligible for either the State or National Register of Historic Places. A cultural resource reconnaissance conducted in April 1980 found no evidence of any archaeological deposits in the project area.

THE "WITHOUT" CONDITION PROFILE

42. Without federal implementation of authorized improvements, Kikiaola Harbor will remain undeveloped with little or no change from existing conditions. Boaters and fishermen will continue to experience breaking wave condition and shallow depths at the entrance channel. Lack of a safe entrance channel and adequate protective structures will limit the State of Hawaii from developing Kikiaola into a fully operable boat harbor. Any increase in recreational and commercial fishing opportunities, and resulting local expenditures, will largely be restricted to local boaters from the Waimea-Kekaha region.

PROBLEMS AND NEEDS

43. Navigation problems experienced at Kikiaola Harbor can be primarily attributed to shallow depths in the entrance channel and harbor basin and occurrence of breaking wave conditions at the harbor entrance. Other navigation problems include the lack of protective berthing and adequate shoreside facilities, overtopping of the east breakwater, and shoaling in the channels and harbor basin.

44. Dredging work was not performed when the harbor was constructed in 1959. As a result, the shallow depth in the entrance channel produces steep wave fronts and causes breaking wave conditions. Negotiating the entrance channel becomes hazardous when wave heights exceed 4 feet causing boats to broach and ground on the breakwater structures as they enter the harbor.

45. On numerous occasions, boats have reported hitting bottom. Frequent users of the harbor facility have experienced this problem at least once. It is also not unusual to see a boat stuck in the harbor basin and being pushed to deeper water area by boaters.

46. Recent projections indicate that demand for berthing requirements at Kikiaola Harbor would be 140 spaces by the year 2000 (Appendix A, Benefit Analysis, Table A-2). However, due to existing physical limitations, demand

for berths at Kikiaola would be fulfilled by 1991. By 2000, the total wet-stored demand for the island of Kauai is projected to be 362 with only 214 available berthing spaces. The State of Hawaii currently has no plans to increase the berthing capacity of small boat harbors along the southwest coast of Kauai.

47. The best fishing grounds are off Kauai's west coast near Barking Sands. The nearest harbor is Kikiaola, which would attract many boat owners if it had a deeper and safer entrance channel and adequate berthing facilities. Currently, the west coast of Kauai from Hanalei to Kikiaola lacks a haven for light-draft vessels. In addition to serving existing light-draft vessel needs, improved Kikiaola Harbor would attract many fishing vessels.

48. In 1970, Kauai's overall boat density was 15 dry-stored boats per 1,000 population, the highest density of recreational boats among Hawaii's four counties. Kikiaola is one of the most desirable launching points along the west and southwest coasts. Of the nine launching ramp facilities on the island, Kikiaola is the third most preferred by fishermen. More boats are launched from Kikiaola than from any harbor facility along the southwest coast of Kauai.

49. Since the harbor was never fully developed, shoreside facilities at the existing harbor are not adequate. Harbor users indicate a critical shortage of automobile and trailer parking spaces. Other boat owners indicate inadequate boat launching and retrieving capacities, parking lights, and restroom facilities.

50. *During the course of this study, possible future maintenance problems in* the channels and harbor basin were investigated. An engineering investigation indicated that existing harbor basin is filled with silt, ranging in depth from one to one and a half feet, which is constantly disturbed by surge action and boats. The major source of existing silt in the harbor basin is believed to have come from the drainage ditch that empties into the harbor. Since 1972, flow from the drainage ditch has been controlled with a flap gate. The flap gate, located 980 feet from the point of discharge controls the flow through the ditch. The flap gate functions like a settling basin and allows silt to settle to the bottom of the ditch. Kekaha Sugar Company has also provided soil erosion control measures to reduce silt discharge into the drainage ditch. There is also an offshore sand deposit located about 200 feet from the tip of the outer east stub breakwater which may contribute to maintenance dredging problem in the entrance channel. The deposit is approximately 400 feet by 500 feet (Figure 4). The result of the sediment study is discussed in Appendix B, Design Analysis.

PLANNING CONSTRAINTS

51. The most significant planning constraint is that the project site is fixed. Because of prior State commitments at the existing site, alternative sites are not considered in this report. Furthermore, the existing harbor was developed on land donated by the Kikiaola Land Company. Shoreside facilities should be developed within the harbor limits.

PLANNING OBJECTIVES

52. The objectives of the pre-authorization studies, as described in the project document, were: (a) to analyze the remaining requirements for additional base harbors to satisfy most of the State's projected light-draft vessel needs to the year 2020, and (b) to study the need for harbors intended exclusively for refuge purposes.

53. The updated planning objective is to contribute to navigation improvement for commercial and recreational purposes at Kikiaola Harbor for the 1985 to 2035 period of analysis. Detailed assessment of problems and needs have resulted in specific goals which, if achieved, would satisfy the planning objective. These specific goals are:

a. To reduce navigation hazard in the entrance channel;

b. To provide adequate and protected berthing area; and

c. To minimize shoaling in the entrance channel and in the harbor basin.

SECTION C

FORMULATION OF PRELIMINARY PLANS

PLAN FORMULATION CONCEPTS AND CRITERIA

54. The formulation and analysis of alternative solutions to achieve the planning objectives are based on the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources. The evaluation and assessment of economic, social, and environmental effects also follow the guidelines of Section 122 of the River and Harbor Act of 1970 (Public Law 91-611) and the National Environmental Policy Act of 1969 (Public Law 91-190).

55. The formulation of alternate plans of improvement is guided by the following technical, economic, and environmental criteria:

56. TECHNICAL CRITERIA:

a. The protective harbor basin should provide a safe maneuvering area for design vessels, with provisions for berthing and shoreside facilities.

b. The entrance channel should be of adequate depth and width to safely permit two-way traffic by design vessels.

c. Protective structures should be designed to withstand the most severe combination of meteorological and sea conditions that are reasonably characteristic of the study area.

d. Navigation improvements should be designed to accommodate a design vessel of 45-foot length, 14-foot beam, and 5-foot draft. Design vessel is discussed in Appendix B, Design Analysis, under paragraph 9.

57. ECONOMIC CRITERIA:

a. The recommended plan of improvement should, as far as practicable, maximize net NED benefits.

b. The benefits and costs should be expressed in comparable quantitative economic terms to the fullest extent possible. Annual costs should be based on a 50-year amortization period and should be evaluated at the authorized discount rate of 3-1/4 percent as well as at the prevailing discount rate of 7-1/8 percent. Annual costs should also include estimated annual maintenance costs.

58. ENVIRONMENTAL CRITERIA:

a. Long-term disturbances to the physical environment should be minimized.

b. Short-term disturbances to the physical environment should be controlled to prevent long-term effects.

c. Environmental protection guidelines should be followed to the maximum extent practicable.

59. The following general concepts were also used to guide the formulation, assessment, and evaluation of alternative harbor plans:

a. Both adverse and beneficial impacts of the alternative plans should be identified and evaluated for each plan;

b. Alternative plans which maximize net economic benefits (the National Economic Development Plan), and those which make positive contributions to preserving, maintaining, restoring, or enhancing cultural or natural resources (the Environmental Quality Plan) would be identified and designated;

c. The plans should be developed to minimize conflicts and maximize compatibility with existing conditions as described in section "Problem Identification" of this main report, and to insure a complete and adequate project;

d. The desires of local interests including the general public, should be given full consideration; and

e. The alternate plans should be evaluated with respect to their effectiveness in meeting the established planning objectives.

PLAN FORMULATION RATIONALE

60. Formulating a plan requires the analysis of problems and logically developing solutions to resolve the problems and needs of the study area. Information received during the problem identification stage of post-authorization planning confirmed the need for investigating navigation hazards in the existing entrance channel. Furthermore, local interests expressed a desire to maximize the berthing capacity of the existing harbor. As a result, alternative plans were developed to meet planning objectives and public needs and desires.

61. Investigation of alternate sites was not performed because of the substantial investment already committed at the authorized site, and because of the expressed public desire to upgrade the existing harbor as authorized.

THE NONSTRUCTURAL ALTERNATIVE

62. Nonstructural alternatives or measures are those actions that can meet the planning objectives without constructing new facilities or performing extensive modifications of the existing facilities. A typical nonstructural alternative might include improving the efficiency of existing facilities. Without performing extensive modification of the existing facilities, the planning objectives adopted for the Kikiaola Harbor cannot be met. The breaking wave condition and shallow depths at the entrance channel and over-topping of the protective structures will continue to exist.

DESCRIPTION OF PRELIMINARY PLANNING

63. Preliminary planning focused on reevaluating plans formulated during the survey study. The authorized plan was discussed at a workshop, and results reaffirmed that the authorized project would basically meet the established planning objectives.

64. Preliminary alternative plans, presented at a second workshop, were developed by modifying the authorized plan. The current array of alternative plans is the result of detailed engineering analysis and prior public input.

RESULTS OF PRELIMINARY PLANNING

65. Four alternative plans were developed from preliminary planning. Each of the alternative plans can be implemented to improve Kikiaola Harbor. The four plans are fully evaluated in Section D of this main report. The results of all the public input and planning studies were considered with the desires of the local sponsor in the tentative selection of the recommended plan of improvement which was presented at the final public meeting on 26 June 1980.

SECTION D

ASSESSMENT AND EVALUATION OF DETAILED PLANS

66. Having identified problems and needs, planning objectives, and the formulation and evaluation concepts discussed in Section C, alternative harbor improvement plans for Kikiaola Harbor were developed and evaluated in order to determine the optimum improvement plan. The alternative harbor plans are discussed in the following paragraphs.

ALTERNATIVE PLAN 1

67. Description. When fully developed, Plan 1, shown on Figure 7, would provide berthing for about 105 boats. Plan 1 was developed to provide maximum berthing capacity with minimal amount of dredging work. Because the harbor's capacity is relatively small, consisting of 105 boats, a turning basin was not provided. However, maneuvering area at the entrance to the berthing was provided. Plan 1 consists of:

a. Removing 150 feet from the existing outer east stub breakwater which extends into the proposed channel.

b. Raising the east breakwater's crest elevation by four feet from station 8+70 to 9+85 and three feet from station 2+50 to 8+20.

c. Flattening the seaward slope of the east breakwater to one vertical on two horizontal from station 8+70 to 9+85.

d. Removing and constructing 85-foot-long inner east stub breakwater.

e. Modifying 220 feet of the existing west breakwater by placing armor, underlayer and bedding stones from station 3+80 to 6+00.

f. Dredging a 725-foot-long entrance channel to a depth of 12 feet and varying in width from 105 to 205 feet with maneuvering area to facilitate a 90^{0} right turn into the access channel.

g. Dredging a 320-foot-long access channel to a depth of 8 feet and varrying in width from 70 to 105 feet.

Plan 1 would also include about 2.7 acres of water area for berthing and access. Approximately thirty trees will be planted along the shoreline. The U.S. Coast Guard will provide necessary modifications to navigation aids.

68. Impact Assessment. The new entrance channel would provide safe navigation for design and other vessels expected to use the harbor. The modified east breakwater would prevent waves from overtopping and provide protected berthing areas. Wave heights in the berthing areas are expected to be less than two feet during reasonably expected sea conditions.

69. Approximately 4.4 acres of hard limestone reef, sand and silt bottoms, and associated benthic organisms would be destroyed by modifying the breakwaters and dredging the navigation features. Approximately 0.2 acre of

existing breakwater structure will be removed. About 0.6 acre would be covered by breakwater structure and 3.8 acres dredged. Approximately 33,800 cubic yards of consolidated coralline material, sand and silt would be dredged from the entrance and access channels. An additional 2.7 acres would be dredged from the existing harbor basin, resulting in removal of about 13,200 cubic yards of sand and silt.

70. The modified breakwater will provide habitat for marine organisms adapted to hard substrate or requiring shelter provided by the interstices of the breakwater. Some increase in populations of organisms favoring habitats provided by breakwater structure is expected, upon project completion.

71. Dredging would displace or destroy benthic organisms inhabiting the limestone, sand and silt substrates. Furthermore, dredging will cause resuspension and redistribution of bottom sediments and underlying coral material. Coarse material will settle quickly, but finer material may be transported to other areas by water currents and surge actions.

72. Along with the increased turbidity of harbor waters during dredging caused by the resuspension of silt, there will be an increase of organic detritus and nutrients in the water column. These effects are expected to be temporary and may create artificial feeding opportunities for fish which may be attracted to benthic organisms and organic detritus stirred up as a result of dredging. After project completion, water quality in the harbor is expected to improve as a result of removal of terrigenous silt deposits and improved water circulation.

73. The dredged material would be disposed at a county landfill site, approximately 7 miles from the project site.

74. Turbidity Control. Turbidity problems can be minimized by implementing construction controls such as the use of movable silt barriers around the dredging plant. The barriers would contain the sediments stirred up by dredging and prevent them from traveling to other parts of the harbor.

75. Damages to reef areas and associated ecosystems can be limited by establishing a construction easement beyond which access and construction activity would be prohibited.

ALTERNATIVE PLAN 2

76. Description. Plan 2, shown on Figure 8, would provide berthing for approximately 92 boats when fully developed. Plan 2 was developed to provide maximum safety conditions while sacrificing for a smaller berthing area. Protective structures for Plan 2 are the same as Plan 1 except for the removal of 40 feet from the inner stub breakwater. The navigation features of Plan 2 consist of a 860-foot-long entrance channel, varying in width from 105 to 205 feet and in depth from 10 to 12 feet; a 115-foot-wide, 115-foot-long, and 10-foot-deep turning basin; and a 115-foot-long access channel, varying in width from 70 to 105 feet and in depth from 8 to 10 feet.

77. Impact Assessment. Impacts of Plan 2 would be the same as for Plan 1 with the following exceptions:

a. Approximately 0.7 more acre of hard limestone reef, sand and silt bottoms would be destroyed as a result of dredging. Approximately 1,000 more square feet of existing riprap breakwater habitat would be removed.

b. Approximately 6,900 cubic yards of material would be disposed of at a landfill site in addition to the disposal requirement of Plan 1.

78. Turbidity Control. Adverse impacts for Plan 2 would be the same as for Plan 1.

ALTERNATIVE PLAN 3

79. Description. Plan 3, shown on Figure 9, would provide berthing for approximately 110 boats when fully developed. Plan 3 was developed to provide maximum berthing capacity within the existing harbor basin. Protective structures for Plan 3 are the same as Plan 1 except for the removal of 130 feet from the inner stub breakwater and construction of a new 195-foot-long inner east stub breakwater. The navigation features of Plan 3 consist of dredging a 845-foot-long entrance channel to a depth varying from 10 to 12 feet and varying in width from 105 to 205 feet with maneuvering area to facilitate a 90° right turn into the access channel; and a 310-foot-long, 70- to 105-foot-wide, and 8-foot-deep access channel.

80. Impact Assessment. Impacts of Plan 3 would be the same as for Plan 1 with the following exceptions:

a. Approximately 0.3 more acre of hard limestone reef, sand and silt bottoms would be destroyed as a result of dredging.

b. Approximately 0.2 more acre of hard limestone reef, sand and silt bottoms would be covered by structures. Approximately 0.1 more acre of existing riprap breakwater habitat would be removed.

c. Approximately 2,100 cubic yards of material would be disposed of at a landfill site in addition to the disposal requirement of Plan 1. .

81. Turbidity Control. Adverse impacts for Plan 3 would be the same as for Plans 1 and 2.

ALTERNATIVE PLAN 4

82. Description. Plan 4, shown on Figure 10, would provide berthing for approximately 105 boats when fully developed. Plan 4 was developed to reduce possible shoaling problem in the entrance channel by constructing an outer east stub breakwater. Protective structures for Plan 4 are the same as Plan 1 except for the construction of a 140-foot-long outer east stub breakwater. The navigation features of Plan 4 are the same as Plan 1.

83. Impact Assessment. Impacts of Plan 4 would be the same as for Plan 1 with the following exceptions:

a. Approximately 0.3 more acre of hard limestone reef, sand and silt bottoms would be covered by a structure.

b. Approximately 2,200 cubic yards of material would be disposed of at a landfill site in addition to the disposal requirement of Plan 1.

84. Turbidity Control. Adverse impacts for Plan 4 would be the same as for Plans 1, 2, and 3.

ALTERNATIVE PLAN 5

85. Description. Plan 5, shown on Figure 11, would provide berthing for approximately 130 boats when fully developed. Plan 5 was developed following an informal discussion held with an OCE representative. To develop an optimum plan for the project, it was suggested that a plan be developed to utilize the open space between the west and inner stub breakwaters for additional mooring spaces. Plan 5 consists of:

a. Removing 150 feet from the existing outer east stub breakwater which extends into the proposed channel.

b. Raising the east breakwater's crest elevation by four feet from station 8+70 to 9+85 and three feet from station 2+50 to 8+20.

c. Flattening the seaward slope of the east breakwater to one vertical on two horizontal from station 8+70 to 9+85.

d. Removing and constructing 85-foot-long inner east stub breakwater.

e. Constructing new 600-foot-long west breakwater extension.

f. Dredging a 1,075-foot-long entrance channel to a depth varying from 10 to 12 feet and varying in width from 105 to 105 feet with maneuvering area to facilitate a 90° right turn into the access channel.

g. Dredging a 325-foot-long access channel to a depth of 8 feet and varying in width from 70 to 105 feet.

86. Impact Assessment. Impacts of Plan 5 would be the same as for Plan 1 with the following exceptions:

a. Approximately 1.3 more acres of hard limestone reef, sand and silt bottoms would be destroyed as a result of dredging.

b. Approximately 1.5 more acres of hard limestone reef, sand and silt bottoms would be covered by structures.

c. Approximately 13,000 cubic yards of material would be disposed of at a landfill site in addition to the disposal requirement of Plan 1.

87. Evaluation. A cost-effective analysis was performed to determine the feasibility of Plan 5. A diffraction diagram analysis was performed to determine the length of breakwater required to provide wave heights of less than 2 feet in the proposed berthing area. The analysis indicated that the west breakwater be extended by 600 feet. The 600-foot extension would cost about $1,500,000.

88. Incremental benefit analysis conducted for the proposed plan indicated that providing 25 additional mooring spaces would result in additional average annual benefits of $22,000. Based on a 7-1/8% interest rate, $22,000 in benefits can only justify $300,000 in construction costs.

89. The overall benefit to cost ratio for the proposed plan was calculated. Costs and benefits calculated for Plan 1 were used as the base. The benefit to cost ratio was calculated to be 0.96.

a. Average Annual Benefits:

Plan 1	$274,000
Additional	22,000
	$296,000

b. Average Annual Costs:

Plan 1	$228,400
600 ft. extension	80,900
	$309,300

c. Benefit to Cost Ratio, 7-1/8%:

$$\frac{\$296,000}{\$309,300} = 0.96$$

90. Result of the cost-effective analysis indicated that the proposed plan is not economically feasible. Therefore, Plan 5 is not discussed further in this report.

ECONOMICS OF THE ALTERNATIVE PLANS

91. Project First Costs. Estimated first costs for alternative plans of improvement are shown on Table 1. The cost estimates are based on August 1980 price levels in the project area. Estimates for dredging include cost for land disposal of dredged material and a 1-foot allowance for overdepth. Total costs include a 15% contingency and a factor to account for price inflation during construction. First costs also include costs of post-authorization planning, engineering and design, supervision and administration, engineering during construction, project beautification, and U.S. Coast Guard navigation aids.

92. Apportionment of First Costs. Federal legislative and administrative authority governing construction of navigation improvement projects requires that the first costs of the federal (Corps of Engineers) portion of the project be shared between federal and non-federal interests in direct proportion to the general and local benefits as established in the authorizing document. The Corps of Engineers will be responsible for 50.1 percent of federal first costs, excluding costs for aids to navigation. Local interests will be responsible for 49.9 percent of federal first costs. The apportionment of project first costs is shown in Table 2.

TABLE 1. ESTIMATED PROJECT FIRST COSTS

	PLAN 1	PLAN 2	PLAN 3	PLAN 4
A. FEDERAL WORK				
Mobilization and Demobilization	$161,000	$161,000	$161,000	$161,000
Dredging	623,000	757,000	676,000	667,000
Protective structures	1,005,000	1,032,000	1,243,000	1,269,000
Beautification	22,000	22,000	22,000	22,000
Contingency (±15%)	268,000	297,000	318,000	320,000
TOTAL DIRECT COST	$2,079,000	$2,269,000	$2,420,000	$2,439,000
Engineering & Design	213,000	213,000	213,000	213,000
Supervision & Administration	118,000	128,000	137,000	138,000
TOTAL CORPS OF ENGINEERS FIRST COST	$2,410,000	$2,610,000	$2,770,000	$2,790,000
USCG Navigation Aids	20,000	20,000	20,000	20,000
TOTAL FEDERAL	$2,430,000	$2,630,000	$2,790,000	$2,810,000
B. NON-FEDERAL	0	0	0	0
C. TOTAL FEDERAL AND NON-FEDERAL FIRST COST	$2,430,000	$2,630,000	$2,790,000	$2,810,000

TABLE 2. APPORTIONMENT OF PROJECT COSTS

	PLAN 1	PLAN 2	PLAN 3	PLAN 4
A. FEDERAL WORK				
50.1% of Corps of Engineers Cost	$1,210,000	$1,310,000	$1,390,000	$1,400,000
U.S. Coast Guard Costs	20,000	20,000	20,000	20,000
TOTAL (APPORTIONED) FEDERAL COST	$1,230,000	$1,330,000	$1,410,000	$1,420,000
B. NON-FEDERAL				
49.9% of Corps of Engineers Cost	$1,200,000	$1,300,000	$1,380,000	$1,390,000
TOTAL (APPORTIONED) NON-FEDERAL FIRST COST	$1,200,000	$1,300,000	$1,380,000	$1,390,000

93. Average Annual Costs. Average annual cost estimates include amortization of project first costs over a 50-year economic life at an interest rate of 7-1/8 percent and estimated average annual maintenance costs. Annual maintenance costs include maintenance dredging and breakwater repair. Estimated federal dredging requirement is 13,000 cubic yards, based on maintenance dredging at 5-year intervals. Derivation of maintenance dredging requirement is discussed in Appendix B, Design Analysis, under Sediment Study. Breakwater repair is based on 1 percent of the armor layer cost. Average annual costs are shown in Table 3.

TABLE 3. ESTIMATED AVERAGE ANNUAL COSTS

	PLAN 1	PLAN 2	PLAN 3	PLAN 4
Interest and Amortization	$178,900	$193,600	$205,400	$206,800
Maintenance	49,500	50,500	51,000	52,000
TOTAL AVERAGE ANNUAL COST	$228,400	$244,100	$256,400	$258,800

94. Average Annual Benefits. A detailed discussion of average annual benefits is presented in Appendix A, Benefit Analysis. A summary of the results of the benefit analysis is shown in Table 4.

TABLE 4. ESTIMATED AVERAGE ANNUAL BENEFITS

Benefit Category	PLAN 1	PLAN 2	PLAN 3	PLAN 4
Recreation Navigation	$232,000	$215,000	$237,000	$232,000
Charter Operations	8,000	8,000	8,000	8,000
Commercial Fishing	24,000	24,000	24,000	24,000
EDA Benefits	10,000	11,000	11,000	12,000
TOTAL AVERAGE ANNUAL BENEFITS	$274,000	$258,000	$280,000	$276,000

95. Benefit to Cost Ratios and Net Benefits. Based on the estimated average annual costs and benefits, the benefit to cost ratios for the alternative plans are as follows:

	Benefit to Cost Ratios	Net Benefits
Plan 1	1.2	$45,600
Plan 2	1.06	13,900
Plan 3	1.09	23,600
Plan 4	1.07	17,200

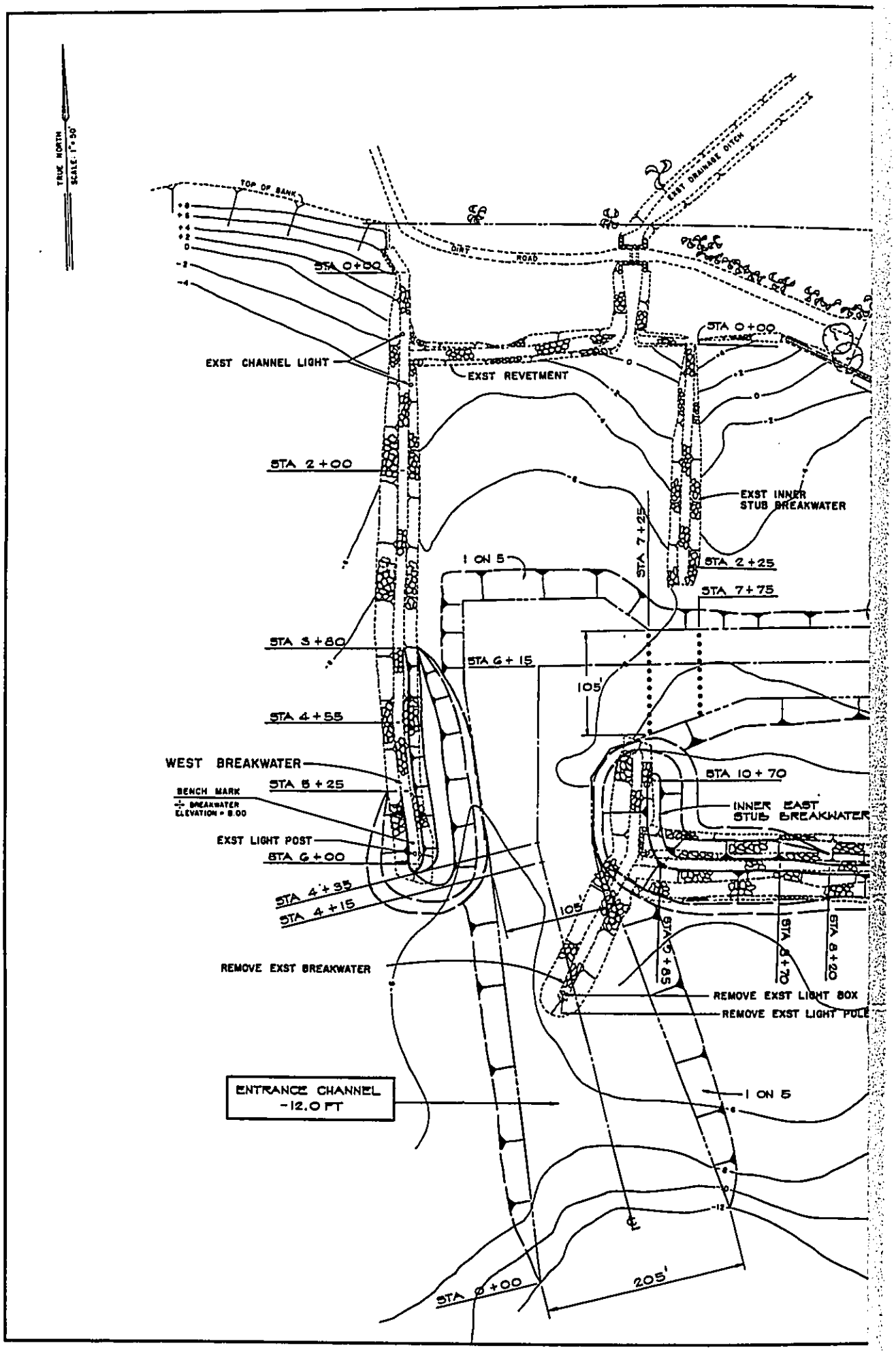
PUBLIC VIEWS

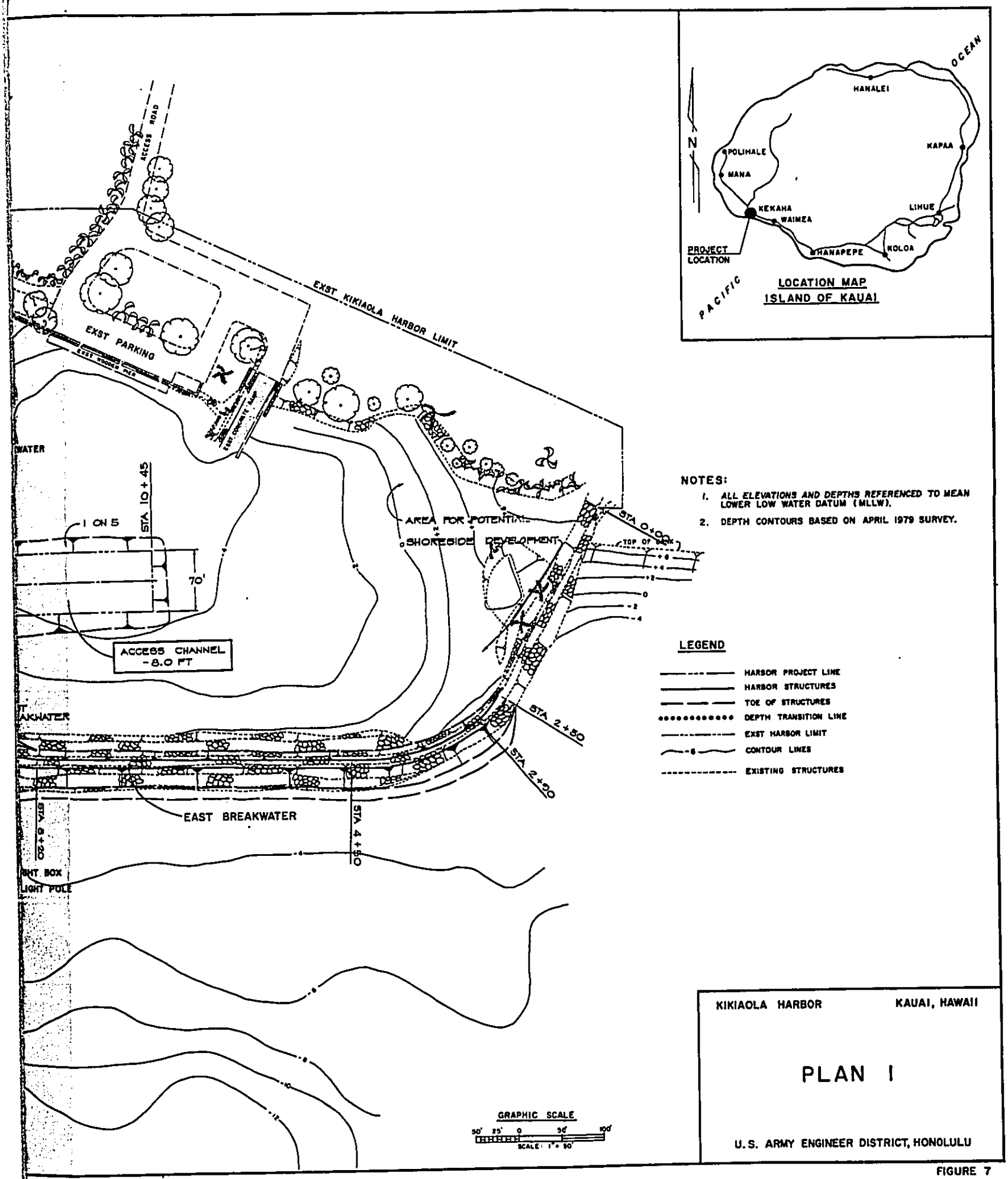
96. Public meetings, informal discussions with government agencies, and workshops were conducted during the study to maintain coordination and obtain views and input from federal and non-federal interests. Prior to the 26 June 1980 public meeting, the draft report was circulated to the federal, State and County agencies for formal review and comments. Public views expressed at the workshops and public meetings, correspondence received during report coordination, and pertinent Corps of Engineers responses are presented in Appendix H, Public Involvement.

97. Views of Federal Agencies. Comments on the proposed navigation improvements were received from the Environmental Protection Agency; the U.S. Coast Guard, Fourteenth District; the Advisory Council on Historic Preservation; and the Department of Commerce, National Marine Fisheries Service. Significant comments were not received regarding the proposed improvements. The Environmental Protection Agency has stated a lack of objections to the project and has rated the Environmental Impact Statement as adequate. Letters of comment are included in Appendix H, Public Involvement, Pertinent Correspondence.

98. Views of Non-Federal Agencies. Comments were also received from State of Hawaii Departments of Planning and Economic Development, Land and Natural Resources, Office of Environmental Quality Control and the University of Hawaii Environmental Center. Many of the comments concerned the general impacts of the project on the existing physical and social environment. Comments and responses are included in Appendix H, Public Involvement, Pertinent Correspondence.

99. Views of the General Public and Private Organizations. Public interest in the study and proposed harbor improvements has been favorable throughout the study period. This was evident from the public response at the workshops and meetings which are discussed in Appendix H, Public Involvement. The overall public response has been favorable toward the project.


TRUE NORTH
SCALE: 1" = 50'
TOP OF BANK
DIRT ROAD
EXST DRAINAGE DITCH
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 0+00
STA 2+00
EXST INNER STUB BREAKWATER
1 ON 5
STA 7+25
STA 2+25
STA 7+75
STA 3+80
STA 6+15
105'
STA 4+55
WEST BREAKWATER
STA 5+25
BENCH MARK
BREAKWATER ELEVATION = 8.00
EXST LIGHT POST
STA 6+00
STA 4+35
STA 4+15
STA 10+70
INNER EAST STUB BREAKWATER
105'
REMOVE EXST BREAKWATER
STA 9+85
STA 9+70
STA 8+20
REMOVE EXST LIGHT BOX
REMOVE EXST LIGHT POLE
ENTRANCE CHANNEL
-12.0 FT
1 ON 5
STA 0+00
205'

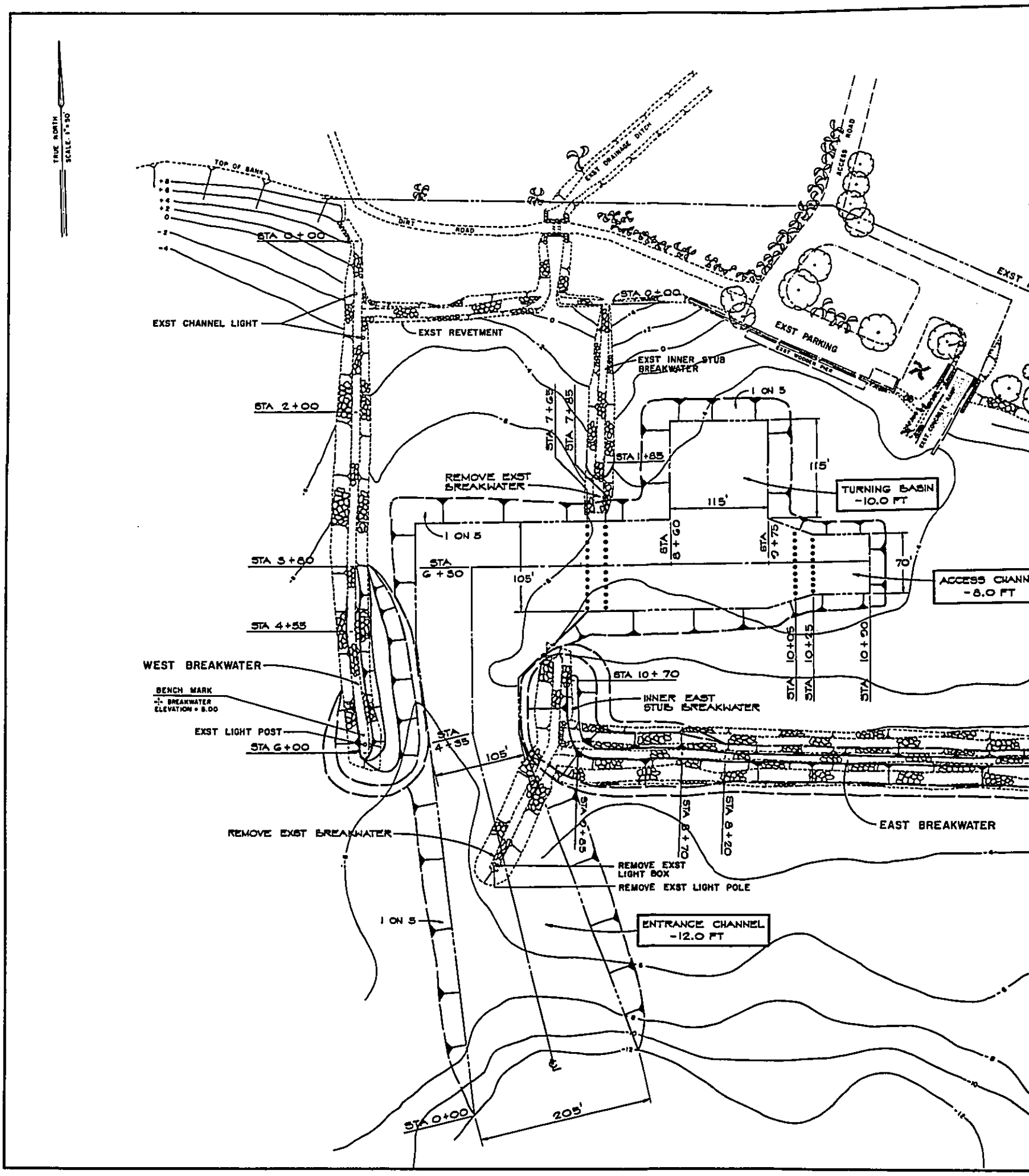


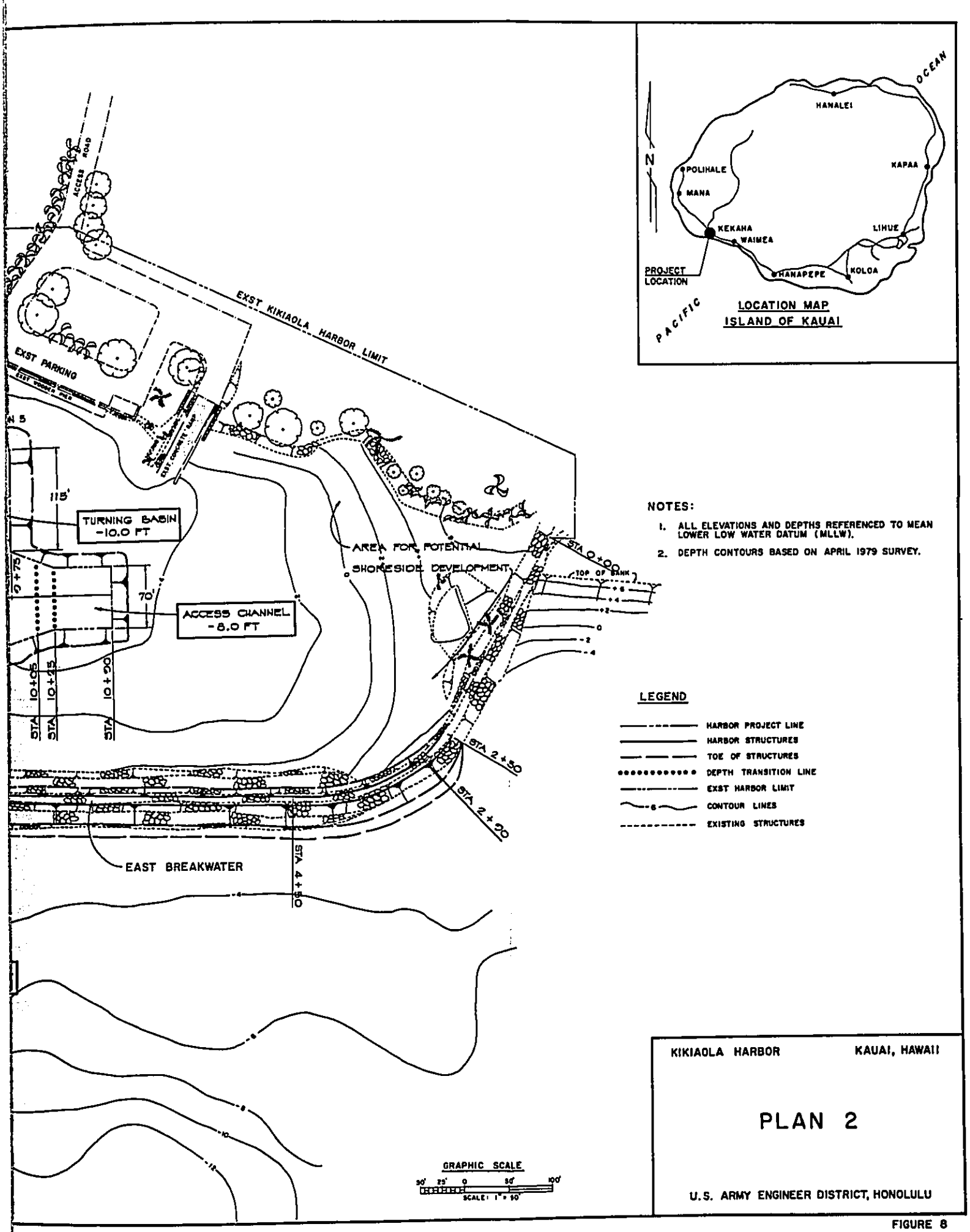
KIKIAOLA HARBOR KAUAI, HAWAII

PLAN I

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 7


TRUE NORTH
SCALE: 1"=50'
TOP OF BANK
EXST DRAINAGE DITCH
ACCESS ROAD
DIRT ROAD
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 2+00
STA 0+00
EXST PARKING
EXST CONCRETE PAD
EXST INNER STUB BREAKWATER
1 ON 5
STA 7+65
STA 7+85
STA 1+85
REMOVE EXST BREAKWATER
115'
TURNING BASIN -10.0 FT
115'
1 ON 5
STA 3+60
STA 6+50
105'
STA 8+60
STA 9+75
70'
ACCESS CHANN -8.0 FT
STA 4+55
WEST BREAKWATER
BENCH MARK
BREAKWATER ELEVATION = 8.00
EXST LIGHT POST
STA 6+00
STA 10+05
STA 10+45
STA 10+90
STA 10+70
INNER EAST STUB BREAKWATER
STA 4+55
105'
STA 8+65
STA 8+70
STA 8+20
EAST BREAKWATER
REMOVE EXST BREAKWATER
REMOVE EXST LIGHT BOX
REMOVE EXST LIGHT POLE
1 ON 5
ENTRANCE CHANNEL -12.0 FT
STA 0+00
205'

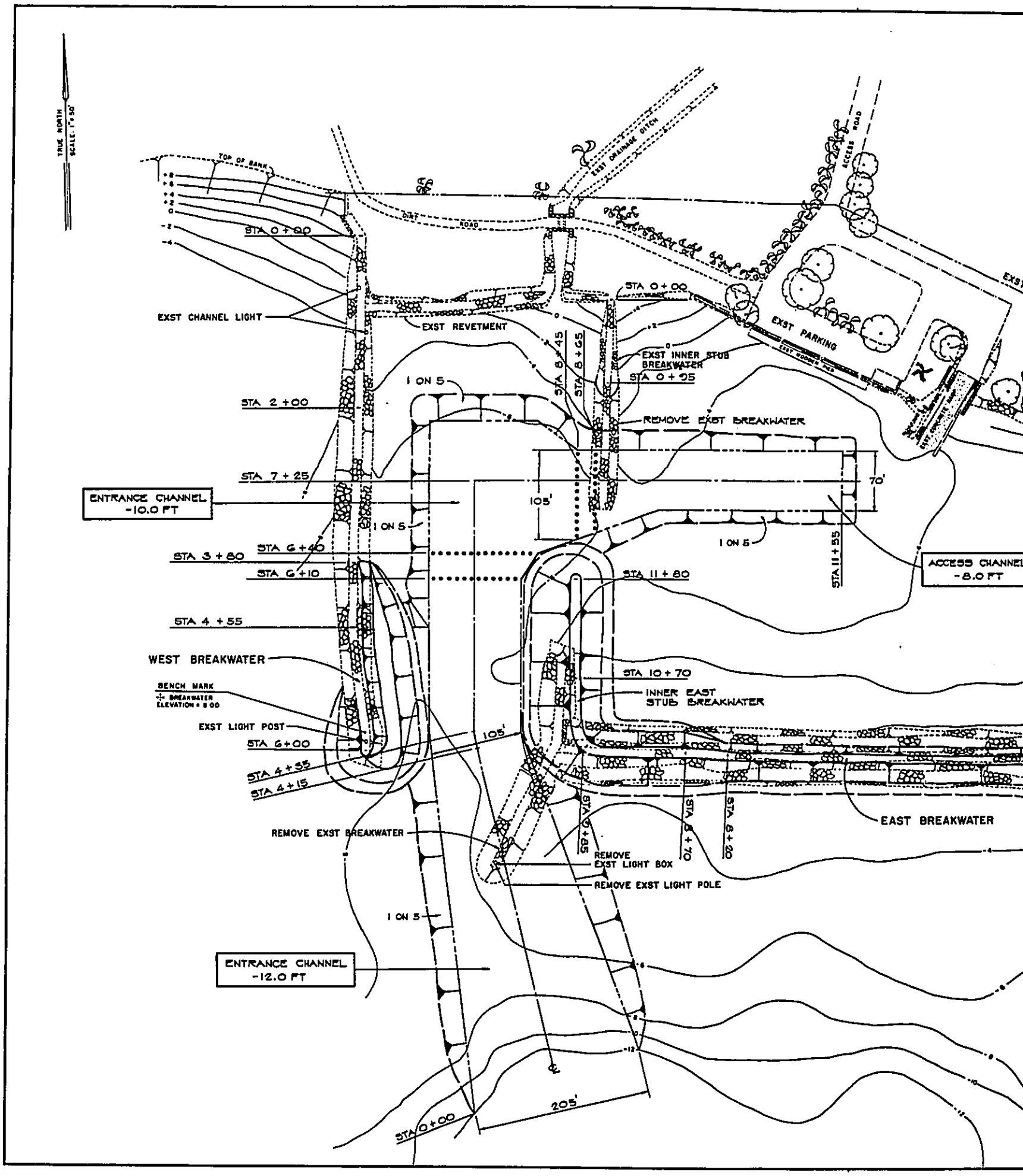


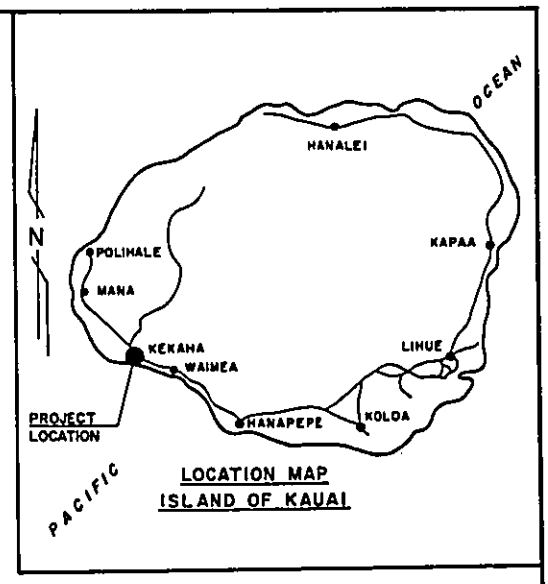
KIKIAOLA HARBOR KAUAI, HAWAII

PLAN 2

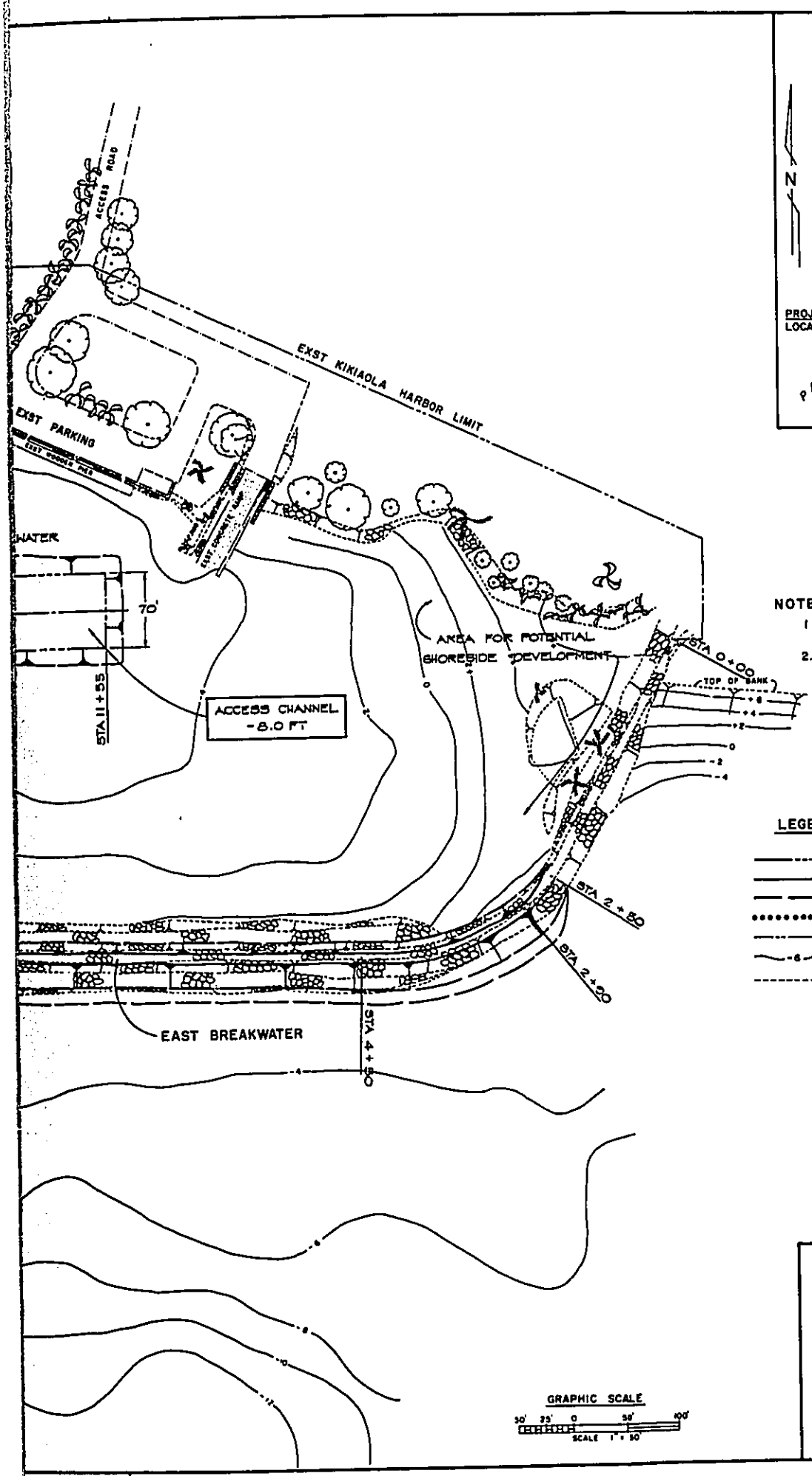
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 8


TRUE NORTH
SCALE: 1"=50'
TOP OF BANK
DIRT ROAD
EXST DRAINAGE DITCH
ACCESS ROAD
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 0+00
EXST PARKING
EXST INNER STUB BREAKWATER
STA 0+25
STA 8+45
STA 8+65
1 ON 5
STA 2+00
REMOVE EXST BREAKWATER
STA 7+25
70'
105'
ENTRANCE CHANNEL -10.0 FT
1 ON 5
STA 6+40
STA 3+80
STA 6+10
STA 11+80
1 ON 5
STA 11+55
ACCESS CHANNEL -8.0 FT
STA 4+55
WEST BREAKWATER
BENCH MARK
BREAKWATER ELEVATION = 8.00
EXST LIGHT POST
STA 6+00
STA 4+35
STA 4+15
105'
STA 10+70
INNER EAST STUB BREAKWATER
EAST BREAKWATER
REMOVE EXST BREAKWATER
STA 9+85
STA 8+70
STA 8+20
REMOVE EXST LIGHT BOX
REMOVE EXST LIGHT POLE
1 ON 5
ENTRANCE CHANNEL -12.0 FT
205'
STA 0+00



LOCATION MAP
ISLAND OF KAUAI



NOTES:

1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.

LEGEND

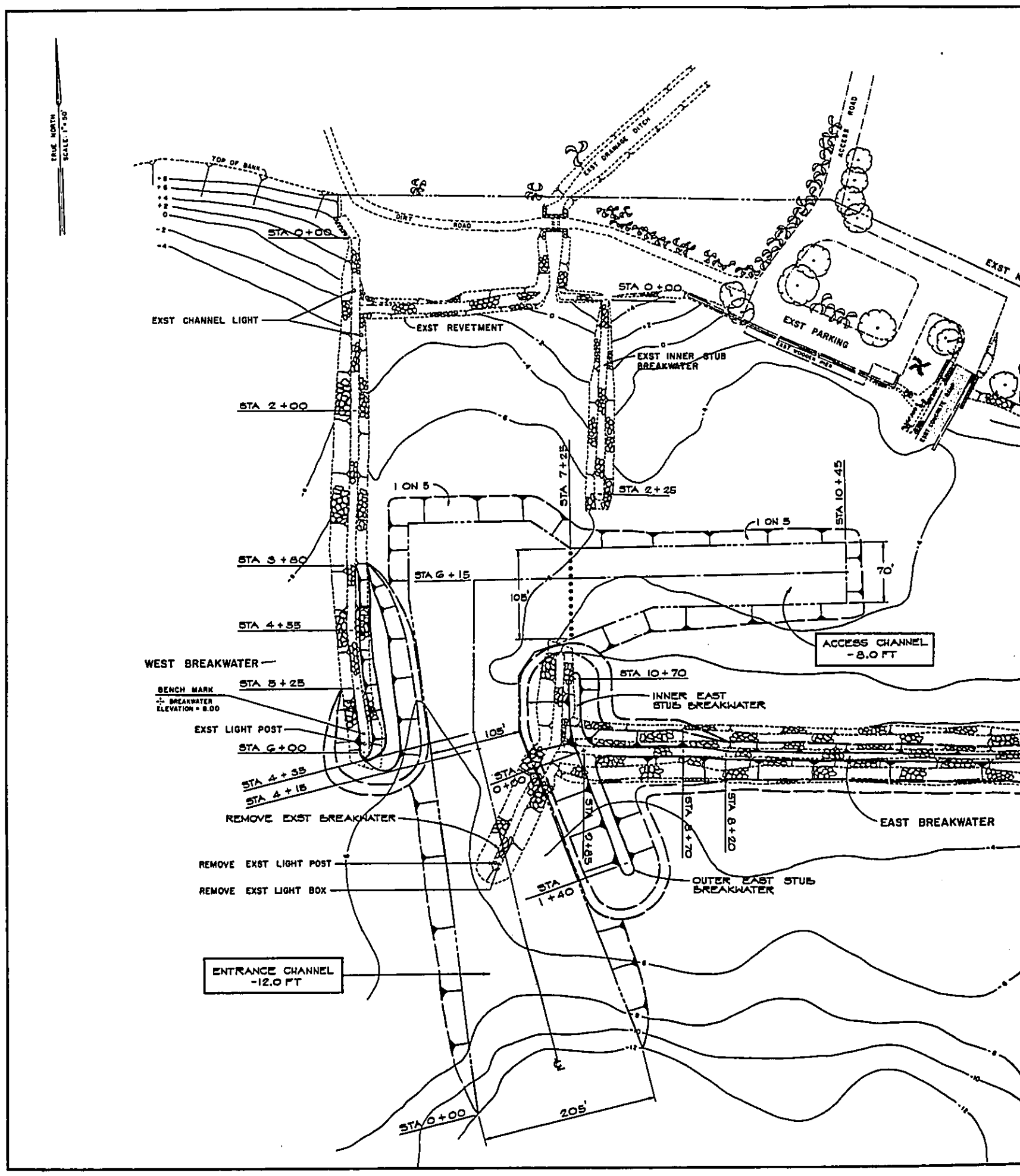
- HARBOR PROJECT LINE
- HARBOR STRUCTURES
- TOE OF STRUCTURES
- DEPTH TRANSITION LINE
- EXST HARBOR LIMIT
- -6 CONTOUR LINES
- EXISTING STRUCTURES

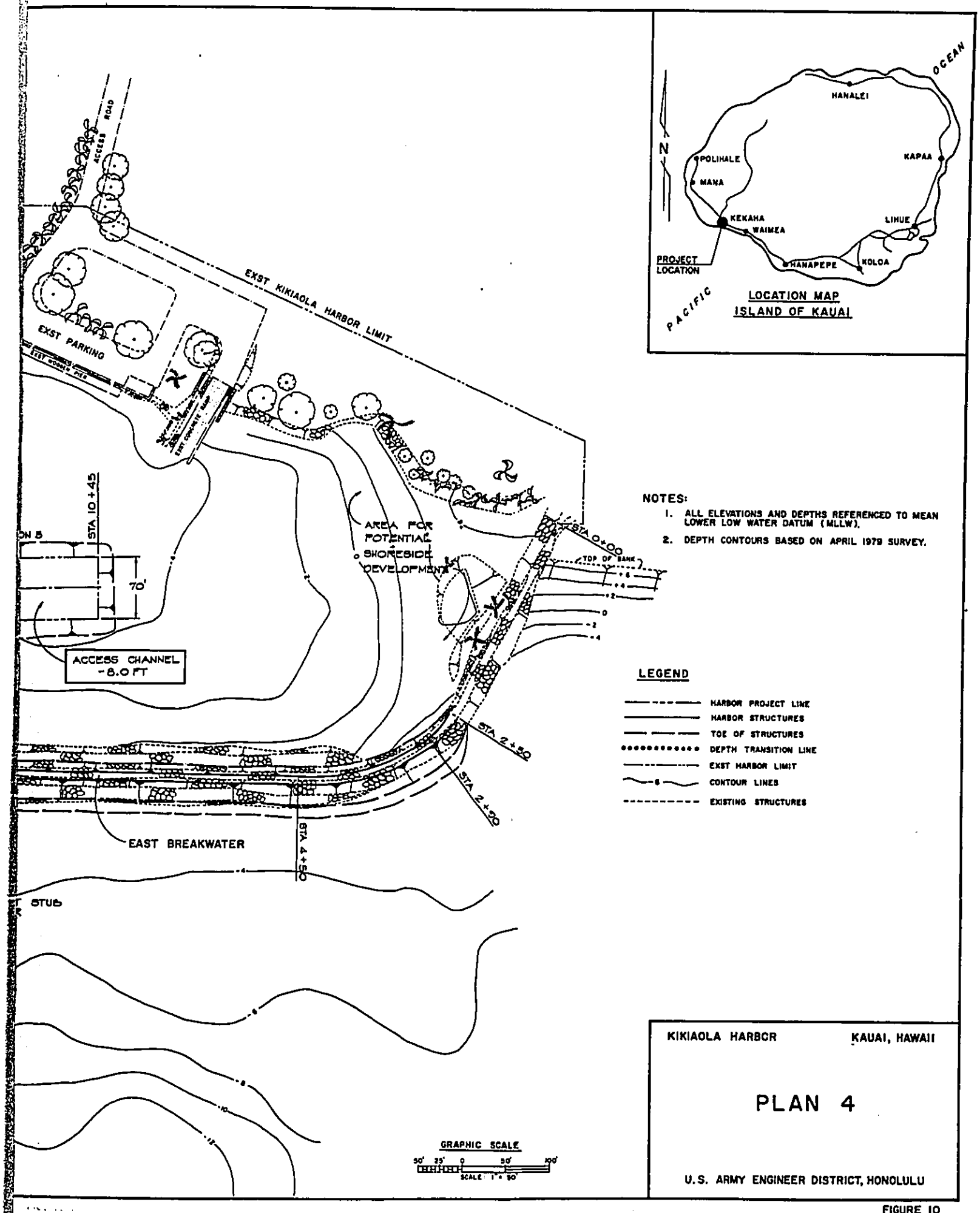
KIKIAOLA HARBOR KAUAI, HAWAII

PLAN 3

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 9


TRUE NORTH
SCALE: 1"=50'
TOP OF BANK
DIRT ROAD
EXST DRAINAGE DITCH
ACCESS ROAD
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 0+00
EXST PARKING
EXST INNER STUB BREAKWATER
STA 2+00
1 ON 5
STA 7+25
STA 2+25
1 ON 5
STA 10+45
STA 3+80
STA 6+15
105'
70'
STA 4+55
WEST BREAKWATER
ACCESS CHANNEL -8.0 FT
STA 10+70
BENCH MARK
BREAKWATER ELEVATION = 8.00
STA 5+25
INNER EAST STUB BREAKWATER
EXST LIGHT POST
105'
STA 6+00
STA 4+35
STA 4+15
STA 0+60
STA 2+85
STA 8+70
STA 8+20
EAST BREAKWATER
REMOVE EXST BREAKWATER
REMOVE EXST LIGHT POST
REMOVE EXST LIGHT BOX
STA 1+40
OUTER EAST STUB BREAKWATER
ENTRANCE CHANNEL -12.0 FT
STA 0+00
205'



NOTES:

1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.

KIKIAOLA HARBOR KAUAI, HAWAII

PLAN 4

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 10

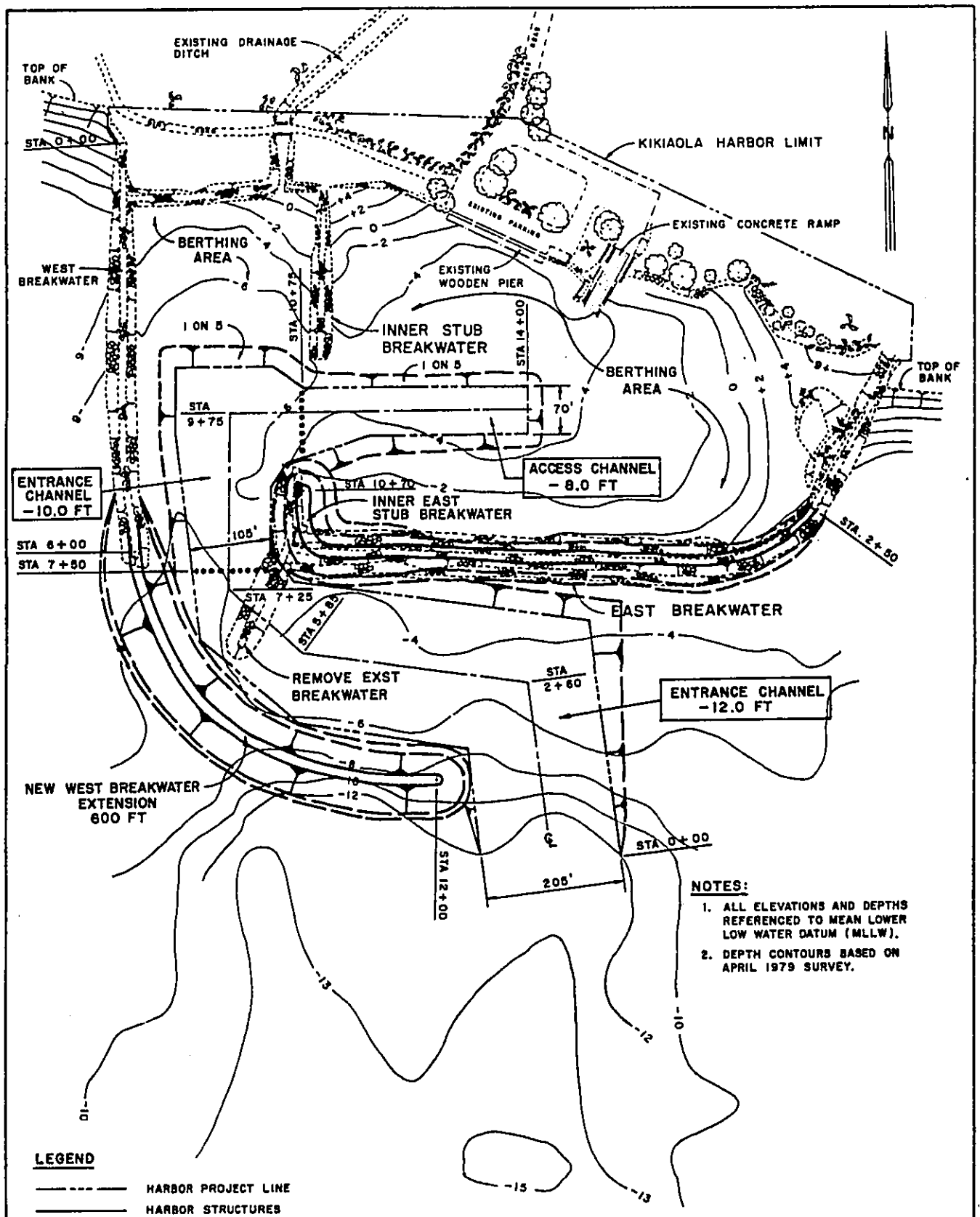

EXISTING DRAINAGE DITCH
TOP OF BANK
STA 0+00
KIKIAOLA HARBOR LIMIT
N
EXISTING CONCRETE RAMP
SHIPING PARKING
BERTHING AREA
WEST BREAKWATER
EXISTING WOODEN PIER
STA 10+75
STA 14+00
INNER STUB BREAKWATER
1 ON 5
BERTHING AREA
TOP OF BANK
STA 9+75
70'
ENTRANCE CHANNEL -10.0 FT
ACCESS CHANNEL -8.0 FT
STA 10+70
INNER EAST STUB BREAKWATER
105'
STA 6+00
STA 7+50
STA 2+50
STA 7+25
STA 5+85
EAST BREAKWATER
REMOVE EXST BREAKWATER
STA 2+60
ENTRANCE CHANNEL -12.0 FT
NEW WEST BREAKWATER EXTENSION 600 FT
STA 12+00
STA 0+00
205'
NOTES:
1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.
LEGEND
HARBOR PROJECT LINE
HARBOR STRUCTURES
TOE OF STRUCTURES
DEPTH TRANSITION LINE
EXST HARBOR LIMIT
CONTOUR LINES
EXISTING STRUCTURES
GRAPHIC SCALE
50' 25' 0 50' 100'
KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII
PLAN 5
(130 BOATS)
U.S. ARMY ENGINEER DISTRICT
HONOLULU

FIGURE 11

SECTION E

COMPARISON OF DETAILED PLANS

100. Trade-Off Analysis. Economic, social, and environmental effects of the four alternative plans have been assessed and evaluated. A summary is presented in Table 5, Summary Comparison of Alternative Plans and System of Accounts. This table displays significant contributions, beneficial and adverse, of each plan to aid the trade-off analysis, which was used to provide a basis for selecting a plan. The major monetary beneficial effect that will result from the alternative plans is the number of berthing spaces provided within the existing harbor basin. With respect to the adverse economic effects, the greatest difference among the plans is reflected in the required cost of protective structures to accommodate the number of berthing spaces for each plan.

101. Contribution to Planning Objectives. All of the alternative plans meet the planning objectives for improving navigation conditions and providing for a safe entrance channel and a protective berthing area. Major differences among the alternative plans include the number of available berthing spaces and dredging work required for complete harbor facilities. Other impacts of the alternative plans are similar.

102. Designation of NED Plan. The economic benefits derived from the four plans of improvement exceed plan costs. However, Plan 1 maximizes net economic benefits. Plan 1 is therefore designated as the NED plan.

103. Designation of LED Plan. The EQ plan is the plan which best contributes to the enhancement or conservation of the environmental values and conditions. None of the plans enhance the physical or cultural environment. However, Plan 1 affects the environment least because it requires minimal modification to the present environment.

104. All of the plans result in dredged material being disposed of at a landfill site and produce temporary and long-term environmental disturbances. Therefore in lieu of designating an EQ Plan, Plan 1 is designated the least environmentally damaging or LED Plan.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT" CONDITION	PLAN 1	PLAN 2	PLAN 3	PLAN 4
A. PLAN DESCRIPTION	Existing 1,280-ft long east breakwater; 600-ft long west breakwater; and 225-ft long inner breakwater. No defined existing channels.	Navigation features: a 725-ft long, 105-ft to 205-ft wide, 12-ft deep entrance channel; and a 320-ft long, 70-ft to 105-ft wide, 8-ft deep access channel. Protective Structures: Removing 150 ft of the outer east stub breakwater; removing and constructing 85-ft long inner east stub breakwater; modifying 735 ft of east breakwater; and modifying 220 ft of west breakwater.	Navigation features: a 860-ft long, 105-ft to 205-ft wide, 12-ft to 10-ft deep entrance channel; a 115-ft wide, 115-ft long, 10-ft deep turning basin; and a 115-ft long, 70-ft to 105-ft wide, 8-ft to 10-ft deep access channel. Protective Structures: Same as Plan 1, except for removing 40 feet of inner stub breakwater.	Navigation features: an 845-ft long, 105-ft to 205-ft wide, 10-ft to 12-ft deep entrance channel; and a 310-ft long, 70-ft to 105-ft wide, 8-ft deep access channel. Protective Structures: Same as Plan 1 except for removing 130 ft of inner stub breakwater and removing and constructing 195-ft long inner east stub breakwater.	Navigation features: Same as Plan 1. Protective Structures: Same as Plan 1, except for constructing 140-ft long outer east stub breakwater.
B. SIGNIFICANT IMPACTS					
1. Economic					
Local Govt Finance	No impact on property values or tax revenues.	Would increase property values and tax revenues around harbor.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Land Use	No change.	No change.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Public Facilities and Services	Continued safe berthing and channel navigation.	Significantly improved berthing and channel navigation safety. Enlarged berthing capacity.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Regional Growth	Poor harbor facilities hamper regional growth.	Would contribute toward increased regional growth.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Employment*	No change.	Would contribute to increased employment.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Business & Industry	No change.	Would be enhanced by improved harbor.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.

*Items specifically required by Section 221, Public Law 91-611.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT CONDITION"	PLAN 1	PLAN 2	PLAN 3	PLAN 4
2. Environmental					
a. General:					
Marine Environment	No change.	Would modify about 4.4 acres of reef, sand, and silt bottoms: 3.8 acres dredged and 0.6 acre covered by harbor structures.	Same as Plan 1, except 0.7 more acre dredged.	Same as Plan 1, except 0.3 more acre dredged and 0.2 more acre covered by structure.	Same as Plan 1, except 0.3 more acre covered by a structure.
Terrestrial	No change.	About 33,800 CY of dredged material would be disposed at a land-fill site.	About 40,700 CY of dredged material would be disposed at a land-fill site.	About 35,900 CY of dredged material would be disposed at a land-fill site.	About 36,000 CY of dredged material would be disposed at a land-fill site.
Fish & Wildlife	No change.	Loss of sessile benthic organisms. Recolonization expected after project completion. Temporary displacement of motile organisms during construction.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Water Quality*	No change.	Temporary increase in turbidity during construction.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Circulation & Flushing	No change.	Increase in harbor circulation and flushing due to deeper depths in channels and harbor basin.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Air Quality*	No change.	Temporary increase in dust and emissions during construction. Permanent increase in harbor related emissions after project completion.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Natural Resources*	No change.	Stone and materials used in harbor construction will be irreversibly committed.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Man-Made Resources*	No change.	Improved harbor facilities.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.

*Items specifically required by Section 221, Public Law 91-611.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT CONDITION"	PLAN 1	PLAN 2	PLAN 3	PLAN 4
b. Environmental Quality Enhanced:					
Water Quality and Circulation Improved	No change.	Water quality improved due to removal of silt and soft-bottom material. Water circulation improved due to deepening of channels and harbor basin.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
c. Environmental Quality Destroyed:					
Amount of Reef, Sand, and Silt Bottom Habitat Destroyed.	No change.	About 4.4 acres of reef, sand, and silt bottoms will be destroyed.	About 5.1 acres of reef, sand, and silt bottoms will be destroyed.	About 4.9 acres of reef, sand, and silt bottoms will be destroyed.	About 4.7 acres of reef, sand, and silt bottoms will be destroyed.
Amount of Riprap Breakwater Destroyed.	No change.	About 0.2 acre of existing rock revetment will be removed.	Same as Plan 1.	About 0.3 acre of existing rock revetment will be removed.	Same as Plan 1.
3. Social					
Noise*	No change.	Temporary increase due to construction and long-term increase due to additional harbor activity.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Population*	No impact.	Would enhance population growth in the harbor vicinity. No displacement of people.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Aesthetic Values*	No change.	Would add to the visual impact of the existing harbor.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Historic, Cultural, and Archaeologic Resources	No change.	No change.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Transportation	Continued unreliable and unsafe sea transportation.	Would provide more reliable and safer sea transportation.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Recreation Opportunities	No change.	Would enhance recreational boating opportunities.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Community Growth and Well-Being	Continued danger and emotional stress during high wave conditions.	Would enhance community growth and development. Would enhance community well-being due to increased opportunities and safety.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.

*Items specifically required by Section 221, Public Law 91-611.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT CONDITION"	PLAN 1	PLAN 2	PLAN 3	PLAN 4
C. PLAN EVALUATION					
1. Contributions to Planning Objectives					
Reduce Navigation Hazard	No change.	Sigificantly reduces navigation hazard in the entrance channel.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Provide Adequate and Protective Berthing Area	No change.	Provides protective berthing area. Allows development of existing harbor basin.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Minimize Shoaling in the Channels and Harbor Basin	No change.	Modified breakwater would reduce wave energy entering through the entrance channel and reduce transport of sediments.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
2. Contributions to National Objectives					
Engineering Effectiveness	Poor	Good	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Economically Justified	Not Applicable	Yes	Yes	Yes	Yes
Socially Acceptable	No	TO BE COMPLETED AFTER PUBLIC COORDINATION OF DRAFT REPORT			
3. Response to Formulation Criteria					
Technical:					
Safe Navigation Conditions	Unsafe when waves exceed about 4 ft and shallow depths in harbor basin.	Would be safe during all but severe storm, hurricane, or tsunami conditions.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Structural	Structures are stable under existing conditions.	Structures designed for maximum breaking wave conditions. Structures are not designed to withstand tsunami.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.
Design Vessel	Existing depths too shallow to accomodate design vessel.	Design vessel is safely accomodated under all but severe storm, hurricane, or tsunami conditions.	Same as Plan 1.	Same as Plan 1.	Same as Plan 1.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT CONDITION"	PLAN 1	PLAN 2	PLAN 3	PLAN 4
Economics:					
Economically Feasible	Not Applicable.	Yes	Yes	Yes	Yes
Benefits Greater Than Costs	Not Applicable.	Yes	Yes	Yes	Yes
Maximize Net Benefits	Not Applicable.	Yes	No	No	No
Environmental:					
Minimize Reef, Sand, and Silt Bottoms Modifications	No Change.	Yes	No	No	No
Minimize Long-Term and Short-Term Effects	No Change.	Yes	Yes	Yes	Yes
4. Relationship to National Accounts					
National Economic Development:					
Avg Annual Benefits	Not Applicable.	$274,000	$258,000	$280,000	$276,000
Avg Annual Costs	Not Applicable.	228,400	244,100	256,400	258,800
Net Annual Benefits	Not Applicable.	45,600	13,900	23,600	17,200
Benefit to Cost Ratio	Not Applicable.	1.2	1.06	1.09	1.07
Environmental Quality	SEE ITEM B.2 IN THIS TABLE				
Social Well-Being	SEE ITEM B.3 IN THIS TABLE				
Regional Development	SEE ITEM B.1 IN THIS TABLE				
5. Response to Evaluation Criteria					
Acceptability	Not Applicable.	Acceptable	Acceptable	Acceptable	Acceptable
Completeness	Not Applicable.	Complete	Complete	Complete	Complete
Effectiveness	Not Applicable.	Effective	Effective	Effective	Effective
Reversibility	Not Applicable.	Irreversible	Irreversible	Irreversible	Irreversible

* Items specifically required by Section 221, Public Law 91-611.

TABLE 5: SUMMARY COMPARISON OF ALTERNATIVE PLANS AND SYSTEM OF ACCOUNTS

	NO IMPROVEMENTS "WITHOUT CONDITION"	PLAN 1	PLAN 2	PLAN 3	PLAN 4
Efficiency	Not Applicable	High	Moderate	Moderate	Moderate
Certainty	Not Applicable	High	Moderate	Moderately High	Moderate
NED B/C Ratio	Not Applicable	1.2	1.06	1.09	1.07
Stability	Not Applicable	Moderately High	Moderate	Moderate	Moderate

SECTION F

THE RECOMMENDED PLAN OF IMPROVEMENT

105. The selection of a recommended plan of improvement results from evaluation of information gathered during planning studies. After planning, engineering, environmental, and economic criteria have been satisfied, consideration is given to local sponsor preferences as well as the desires and expressed opinions of the general public.

106. The Recommended Plan. All of the alternative plans presented in this report satisfy the technical, environmental, and economic requirements for project approval and construction (except Plan 5, benefit-cost ratio is 0.95). Plan 1 has the highest net benefits and is favored by the local sponsor because it requires the smallest cash contribution. As a result, Plan 1 has been selected as the recommended plan.

107. Description. The recommended plan, shown on Figure 12, would provide berthing for about 105 boats when fully developed. The recommended plan of improvement consists of:

a. Removing 150 feet from the existing outer east stub breakwater which extends into the proposed channel.

b. Raising the east breakwater's crest elevation by four feet from station 8+70 to 9+85 and three feet from station 2+50 to 8+20.

c. Flattening the seaward slope of the east breakwater to one vertical on two horizontal from station 8+70 to 9+85.

d. Removing and constructing 85-foot-long inner east stub breakwater.

e. Modifying 220 feet of the existing west breakwater by placing armor, underlayer and bedding stones from station 3+80 to 6+00.

f. Dredging a 725-foot-long entrance channel to a depth of 12 feet and varying in width from 105 to 205 feet with maneuvering area to facilitate a 90° right turn into the access channel.

g. Dredging a 320-foot-long access channel to a depth of 8 feet and varying in width from 70 to 105 feet.

Approximately thirty trees would be planted along the shoreline. Installation of necessary aids to navigation would also be included.

ECONOMICS OF THE RECOMMENDED PLAN

108. Project First Costs. Estimated first costs for the recommended plan are shown on Table 6. The cost estimate is based on August 1980 price levels in the project area. Estimates for dredging include cost for land disposal of dredged material and a 1-foot allowance for overdepth. Total costs include a 15% contingency and a factor to account for price inflation during construction. First costs also include costs of post-authorization planning, engineering and design, supervision and administration, engineering during construction, project beautification, and U.S. Coast Guard navigation aids.

109. Apportionment of First Costs. Federal legislative and administrative authority governing construction of navigation improvement projects requires that the first costs of the federal (Corps of Engineers) portion of the project be shared between federal and non-federal interests in direct proportion to the general and local benefits as established in the authorizing document. The Corps of Engineers will be responsible for 50.1 percent of federal first costs, excluding costs for aids to navigation. Local interests will be responsible for 49.9 percent of federal first costs. The apportionment of project first costs is shown in Table 7.

110. Average Annual Costs. Average annual cost estimates include amortization of project first costs over a 50-year economic life at an interest rate of 7-1/8 percent and estimated average annual maintenance costs. Annual maintenance costs include maintenance dredging and breakwater repair. Estimated federal dredging requirement is 13,000 cubic yards, based on maintenance dredging at 5-year intervals. Breakwater repair is based on 1 percent of the armor layer cost. Average annual costs are shown in Table 8.

TABLE 6. ESTIMATED PROJECT FIRST COSTS
(Recommended Plan)

A. FEDERAL WORK	
Mobilization and Demobilization	$ 161,000
Dredging	623,000
Protective structures	1,005,000
Beautification	22,000
Contingency (±15%)	268,000
TOTAL DIRECT COST	$2,079,000
Engineering & Design	213,000
Supervision & Administration	118,000
TOTAL CORPS OF ENGINEERS FIRST COST	$2,410,000
USCG Navigation Aids	20,000
TOTAL FEDERAL	$2,430,000
B. NON-FEDERAL	0
C. TOTAL FEDERAL AND NON-FEDERAL FIRST COST	$2,430,000

TABLE 7. APPORTIONMENT OF PROJECT COSTS
(Recommended Plan)

A. FEDERAL WORK	
50.1% of Corps of Engineers Cost	$1,210,000
U.S. Coast Guard Costs	20,000
TOTAL (APPORTIONED) FEDERAL COST	$1,230,000
B. NON-FEDERAL	
49.9% of Corps of Engineers Cost	$1,200,000
TOTAL (APPORTIONED) NON-FEDERAL FIRST COST	$1,200,000

TABLE 8. ESTIMATED AVERAGE ANNUAL COSTS
(Recommended Plan)

Interest and Amortization	$178,900
Maintenance	49,500
TOTAL AVERAGE ANNUAL COST	$228,400

111. Average Annual Benefits. A detailed discussion of average annual benefits is presented in Appendix A, Benefit Analysis. A summary of the results of the benefit analysis is shown in Table 9.

TABLE 9. ESTIMATED AVERAGE ANNUAL BENEFITS
(Recommended Plan)

Benefit Category	
Recreation Navigation	$232,000
Charter Operations	8,000
Commercial Fishing	24,000
EDA Benefits	10,000
TOTAL AVERAGE ANNUAL BENEFITS	$274,000

112. Benefit to Cost-Ratio and Net Benefits. Based on the estimated average annual costs and benefits, the benefit to cost ratio for the recommended plan is as follows:

Benefit to Cost Ratio	Net Benefits
1.2	$45,600

113. Construction Activities. Construction of the proposed navigation improvements will impact temporarily on harbor activities. Work and storage area requirements will temporarily reduce available harbor backup area. Designation of work and storage areas will be coordinated with the State Harbors Division. Dredging of the entrance and access channels and modification of the brakwaters should not cause serious disruption of channel navigation. Construction spectifications will restrict channel closures to reasonable periods of time. The construction period will be approximately 12 months. A construction work schedule is shown in Figure 15.

114. Mitigation Requirements. Mitigation of temporary turbidity impacts during dredging can be minimized by implementing construction controls such as the use of movable silt barriers around the dredging plant. The barriers would contain the sediments stirred up by dredging and prevent them from traveling to other parts of the harbor. Damages to reef areas and associated ecosystems can be limited by establishing a construction easement beyond which access and construction activity would be prohibited.

DEPARTURES FROM THE AUTHORIZED PLAN

115. Several changes to the authorized plan have resulted from post-authorization studies. The departures involve engineering, economic, and environmental aspects of the project. None of the changes are defined as significant by Engineer Regulations.

116. Engineering Departures. Certain engineering features of the recommended plan are different from the plan presented in the authorizing document. Dredging the entrance channel will alter existing conditions and require that the existing breakwaters be modified to withstand bigger waves. Soft bottom conditions will require that the stable side slope for dredging be 1 vertical on 5 horizontal. Table 10 highlights the engineering departures. There is no significant change in scale or scope of the project.

TABLE 10. ENGINEERING DEPARTURES OF PROJECT FEATURES FROM THE AUTHORIZED PLAN

Project Features	Authorized Plan	Recommended Plan
Berthing Capacity	130 boats	105 boats
Entrance Channel		
Length	1,050'	725'
Width	120'	205'-105'
Depth	12'	12'
Access Channel		
Length	630'	320'
Width	120'-80'	105'-70'
Depth	10'-6'	8'
Outer East Stub Breakwater		
Length Removed	130'	150'
East Breakwater Head		
Raise Crest Elevation	None	to +12'
Length Raised	None	165'
Flatten Seaward Slope	None	1V on 2H
East Breakwater Trunk		
Raise Crest Elevation	to +11'	to +11'
Length Raised	770'	570'
Inner East Stub Breakwater Length		
Removed and Reconstructed	None	85'
West Breakwater		
Length Modified	None	220'
Wave Absorber		
Length	270'	None

117. Economic Departures. Many changes in project economics have occurred since authorization. Changes have occurred to both estimated costs and benefits as explained in the following paragraphs, including a change in the interest rate used for calculations. An interest rate of 3-1/4 percent was used in the authorizing document, whereas the current interest rate used in this report is 7-1/8 percent.

118. Changes in estimated project costs have occurred since project authorization. Table 11 shows a comparison between costs presented in the project document, updated costs for the authorized plan, and estimated costs for the recommended plan. Cost increases revealed in the update of the authorized plan reflect price inflation. Comparison of the recommended plan costs with the updated authorized plan costs reflects increases due to plan changes of $410,000, which is a 21 percent increase.

119. The average annual benefits have grown substantially above estimates presented in the authorizing document. The average annual benefits, as presented in the authorizing document and shown in this report, are displayed in Table 12. Major changes are described in the following paragraphs.

120. The market value of boats has increased greatly due to a shift to more expensive craft, particularly in the outboard and trailer-mounted categories. The average value per craft for these two categories has doubled.

121. The total demand for berthing space at Kikiaola has grown beyond expectation. Because the base year is now 1985, as compared to 1970 in the authorizing document, initial year benefits are larger due to larger demand. Current projections indicate that the improved harbor will be filled to capacity within 6 years of the base year, whereas the project document estimated maximum capacity to be reached 50 years after project completion.

122. Employment benefits, not applicable at the time of authorizing document, have been included in this report.

123. Benefit-cost ratios, resulting from preceding costs and benefit comparisons at the authorized and current interest rates, are as follows:

	at 3-1/4%	at 7-1/8%
1968 Project Document	1.8	Not Applicable
Recommended Plan	1.9	1.2

TABLE 11. PROJECT FIRST COST COMPARISON

	1968 Project Document[1/]	August 1980 Update of Authorized Plan[2/]	Recommended Plan[3/]
A. FEDERAL WORK			
Mobilization & Demobilization			$ 161,000
Dredging	$187,000	$990,000	623,000
Protective Structures	132,000	371,000	1,005,000
Beautification	8,000	33,000	22,000
Contingency[4/]	64,000	209,000	268,000
Total Direct Cost	$391,000	$1,603,000	$2,079,000
Engineering & Design	30,000	213,000	213,000
Supervision & Administration	42,000	97,000	118,000
Total Corps of Engineers First Costs	$463,000	$1,913,000	$2,410,000
USCG Navigation Aids	9,000	20,000	20,000
Total Federal First Cost	$472,000	$1,933,000	$2,430,000
B. NON-FEDERAL WORK			
Stream Diversion	$20,000	$67,000	0
Contingency[4/]	4,000	10,000	0
Indirect Costs	6,000	10,000	0
Total Non-Federal First Costs	$30,000	$87,000	0
C. TOTAL FEDERAL AND NON-FEDERAL FIRST COST	$502,000	$2,020,000	$2,430,000

1/ The Project Document is the Chief of Engineers' Report on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels, contained in House Document No. 353, 90th Congress, 2nd Session.

2/ This update reflects price level increases since project authorization. Prices are at August 1980 level.

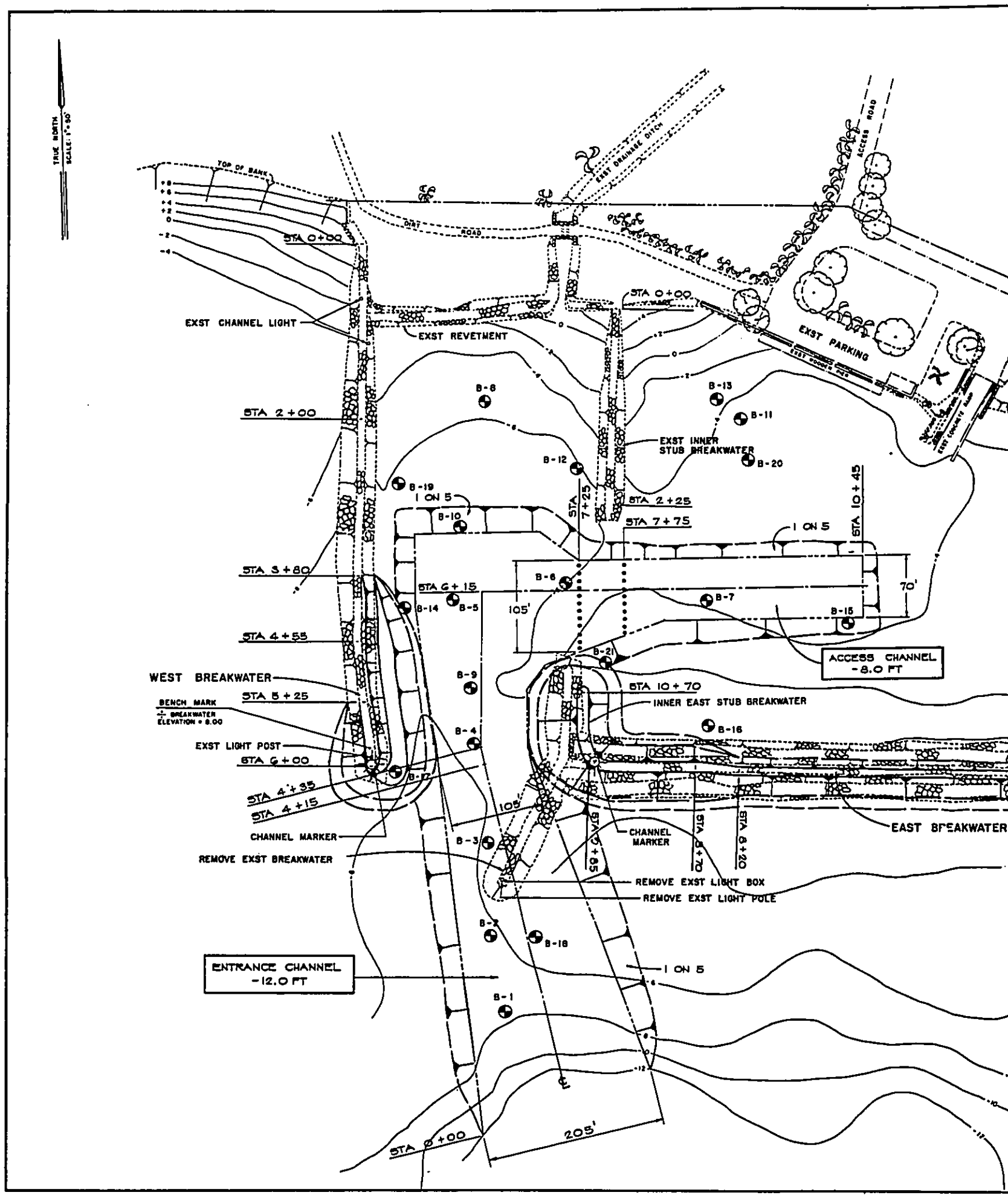
3/ From Table 1 in this report. Prices are at August 1980 level.

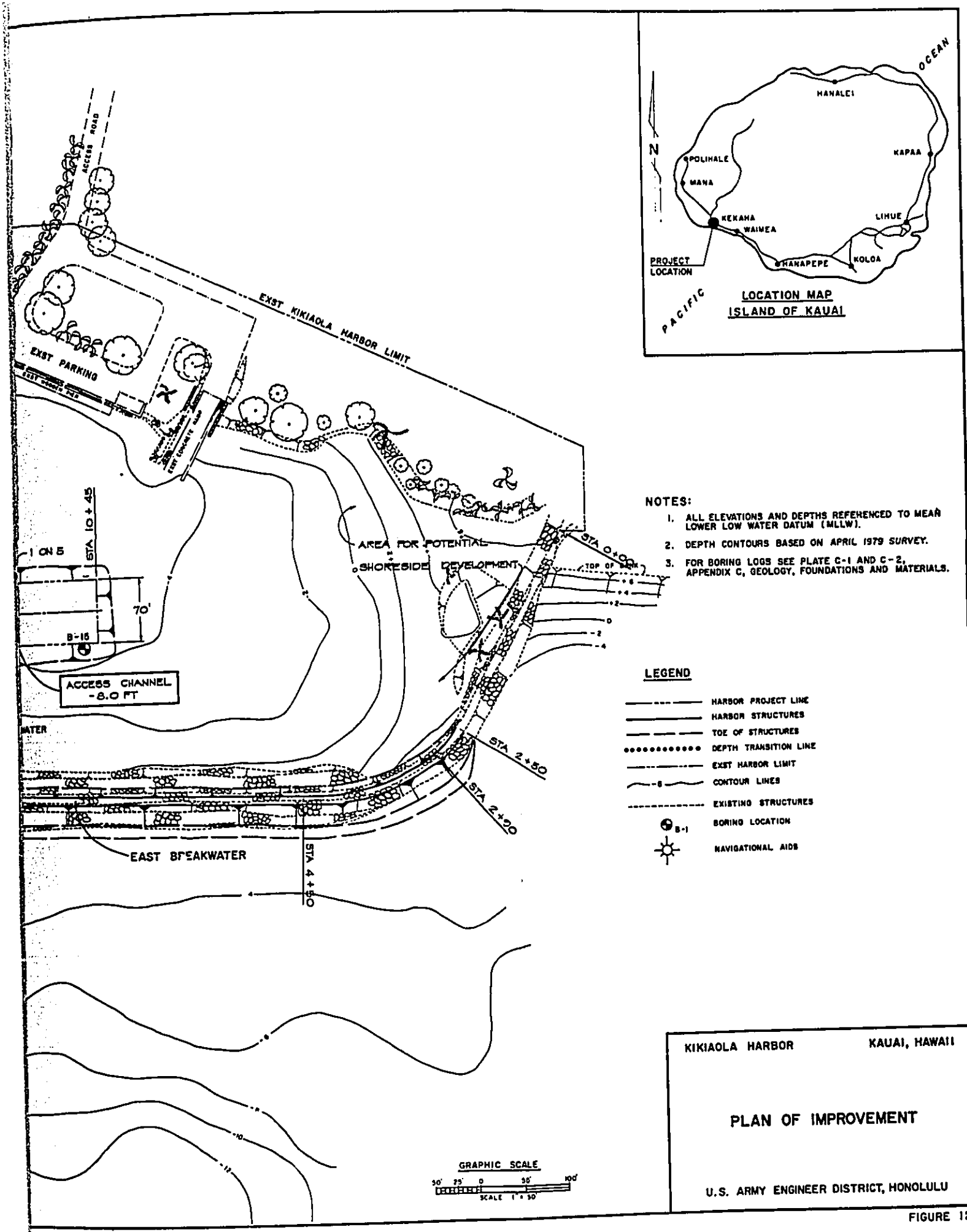
4/ Contingency for Project Document is ±20 percent. Contingency for Authorized Plan Update and for Recommended Plan is ±15 percent in accordance with Engineer Regulations.

TABLE 12. AVERAGE ANNUAL BENEFITS COMPARISON

Benefit Category	1968 Project Document[1/]	Recommended Plan Benefits
Recreation Navigation	$44,800	$232,000
Charter Operations	0	8,000
Commercial Fishing	0	24,000
Damage Reduction to Existing Craft:		
Recreation	400	0
Fishing	100	0
Employment Benefits	0	10,000
TOTAL	$45,300	$274,000

1/ The Project Document is the Chief of Engineers Report on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels, contained in House Document No. 353, 90th Congress, 2nd Session. Authorized interest rate is 3-1/4 percent.


TRUE NORTH
SCALE: 1"=50'
TOP OF BANK
DIRT ROAD
EXST DRAINAGE DITCH
ACCESS ROAD
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 0+00
EXST PARKING
EXST CONCRETE PAD
B-6
B-13
B-11
STA 2+00
EXST INNER STUB BREAKWATER
B-20
B-12
B-19
1 ON 5
STA 7+25
STA 2+25
B-10
STA 7+75
1 ON 5
STA 10+45
STA 3+80
B-6
STA 6+15
B-14
B-5
105'
B-7
70'
B-15
STA 4+55
ACCESS CHANNEL
-8.0 FT
B-21
WEST BREAKWATER
B-9
STA 10+70
STA 5+25
INNER EAST STUB BREAKWATER
BENCH MARK
BREAKWATER ELEVATION = 8.00
B-16
B-4
EXST LIGHT POST
STA 6+00
B-8
STA 4+35
STA 4+15
105'
EAST BREAKWATER
CHANNEL MARKER
B-3
CHANNEL MARKER
STA 8+65
STA 8+70
STA 8+20
REMOVE EXST BREAKWATER
REMOVE EXST LIGHT BOX
REMOVE EXST LIGHT POLE
B-2
B-18
ENTRANCE CHANNEL
-12.0 FT
1 ON 5
B-1
STA 0+00
205'



NOTES:

1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.
3. FOR BORING LOGS SEE PLATE C-1 AND C-2, APPENDIX C, GEOLOGY, FOUNDATIONS AND MATERIALS.

LEGEND

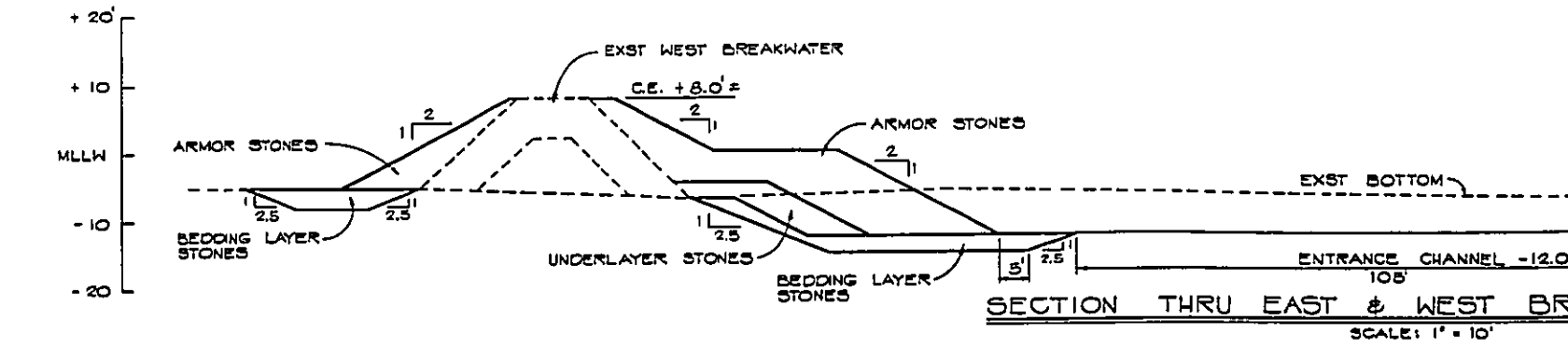
- HARBOR PROJECT LINE
- HARBOR STRUCTURES
- TOE OF STRUCTURES
- DEPTH TRANSITION LINE
- EXST HARBOR LIMIT
- -8 CONTOUR LINES
- EXISTING STRUCTURES
- B-1 BORING LOCATION
- NAVIGATIONAL AIDS

KIKIAOLA HARBOR KAUAI, HAWAII

PLAN OF IMPROVEMENT

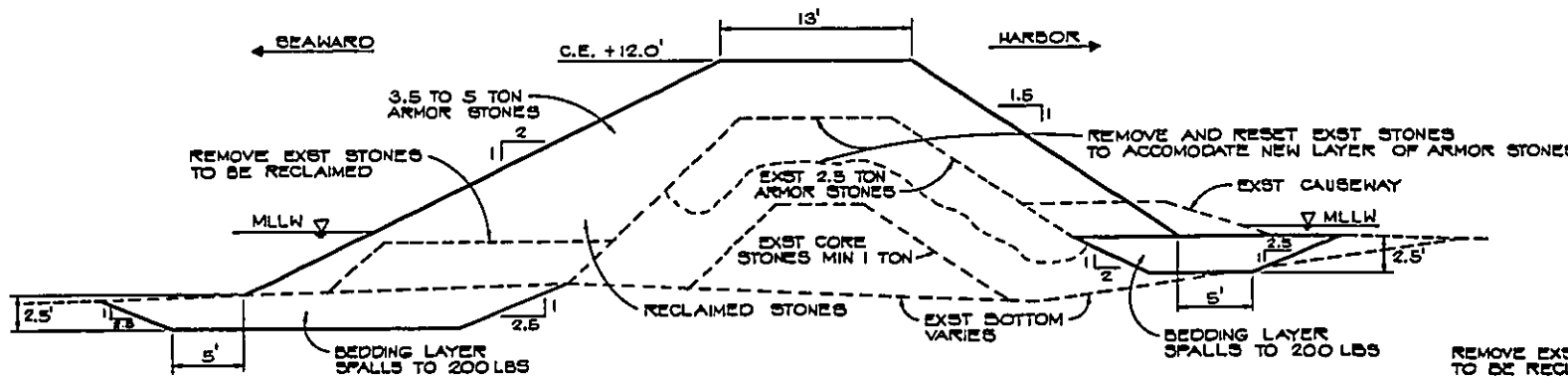
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 12



SECTION THRU EAST & WEST BR

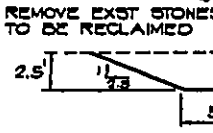
SCALE: 1" = 10'

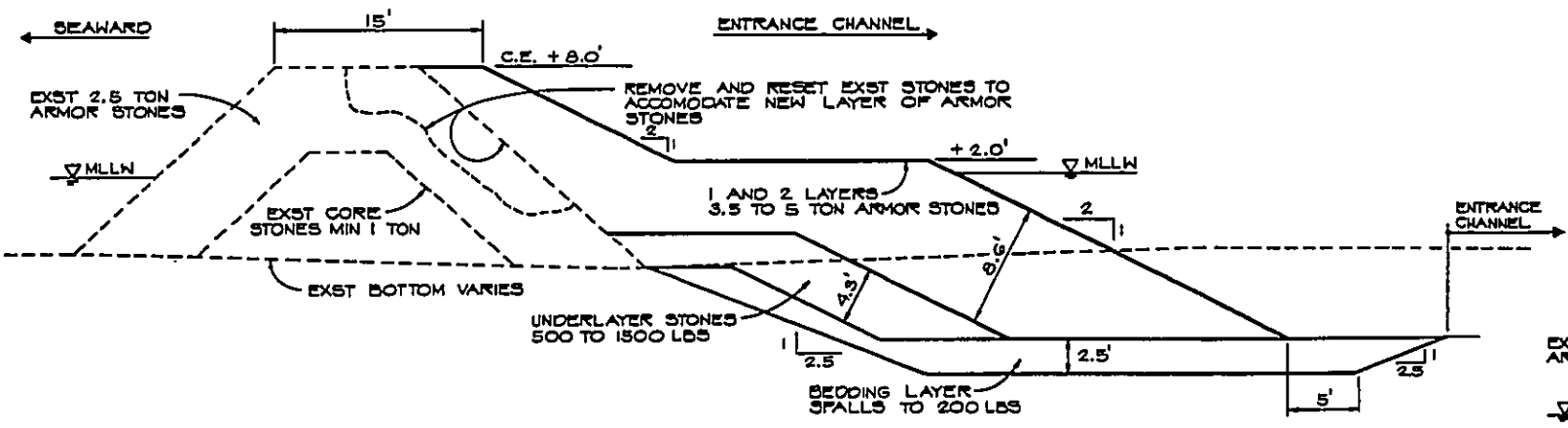


TYPICAL EAST BREAKWATER HEAD SECTION

SCALE: 1" = 5'

STA 8+70 TO STA 9+85
(TRANS SEC STA 8+20 TO STA 8+70)





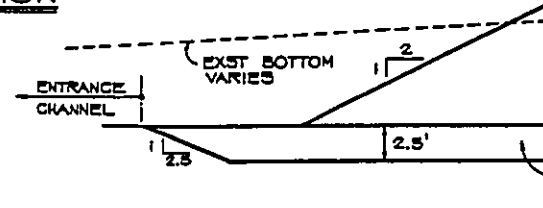
TYPICAL WEST BREAKWATER HEAD SECTION

SCALE: 1" = 5'

STA 4+55 TO STA 6+00
(TRANS SEC STA 3+80 TO STA 4+55)

NOTE:

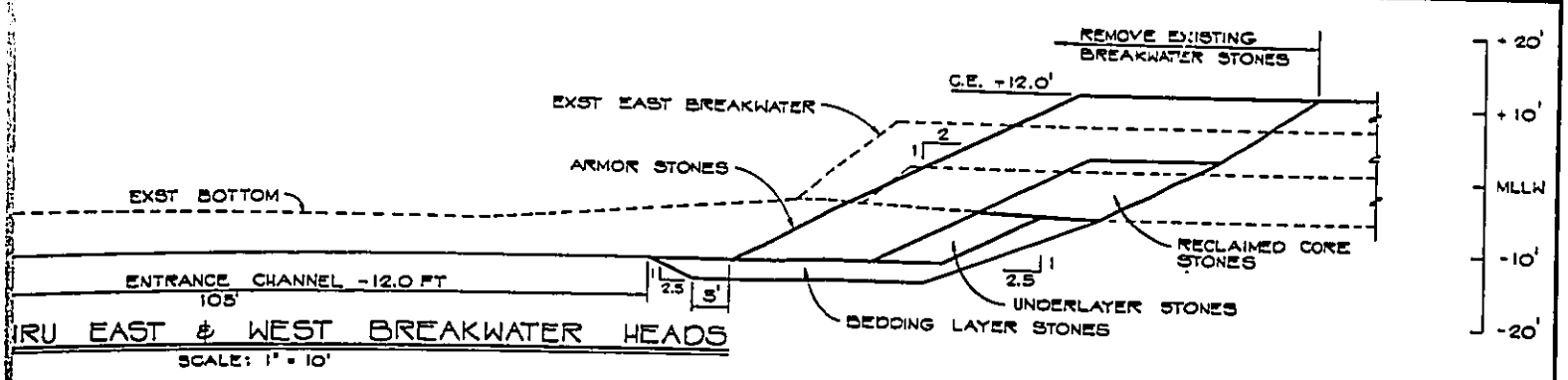
1. RECLAIMED STONES SHALL BE USED TO THE MAXIMUM EXTENT IN THE MODIFICATION WORK.



TYPICAL INNER EA

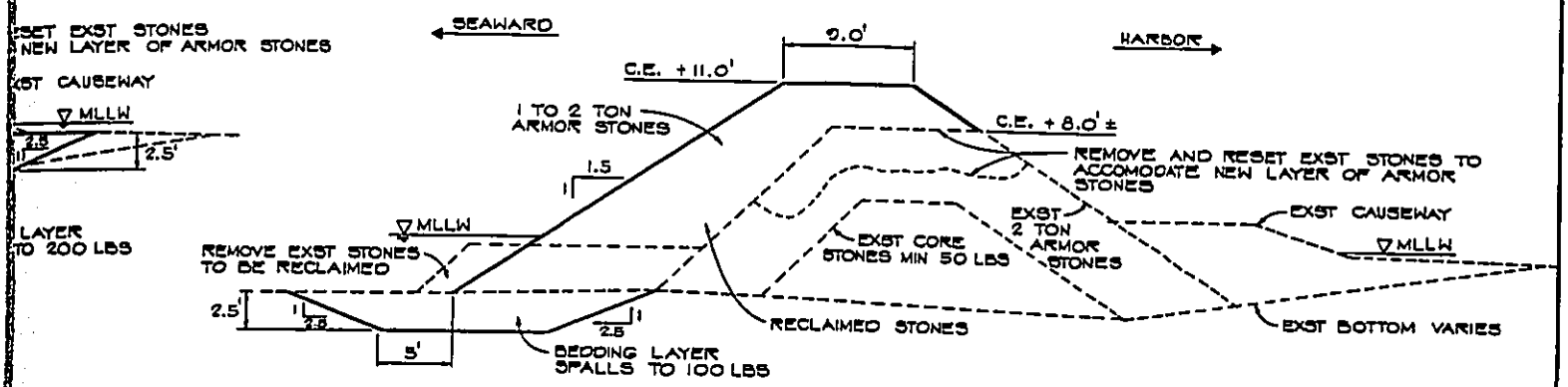
SCALE: 1" = 5'

STA 9+85



IRU EAST & WEST BREAKWATER HEADS

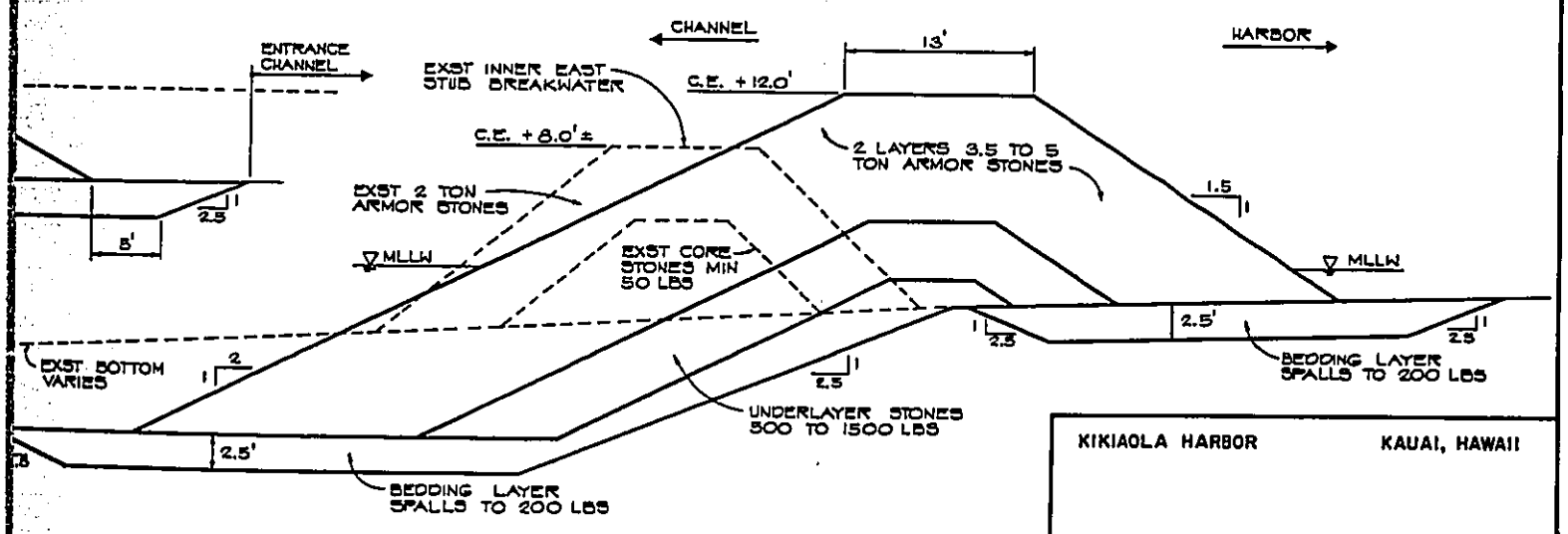
SCALE: 1" = 10'



TYPICAL EAST BREAKWATER TRUNK SECTION

SCALE: 1" = 5'

STA 2 + 00 TO STA 8 + 20
(TRANS SEC STA 2 + 50 TO 2 + 00)



TYPICAL INNER EAST STUB BREAKWATER SECTION

SCALE: 1" = 5'

STA 9+85 TO STA 10+70

GRAPHIC SCALES

1" = 5' 5' 0 5' 10'

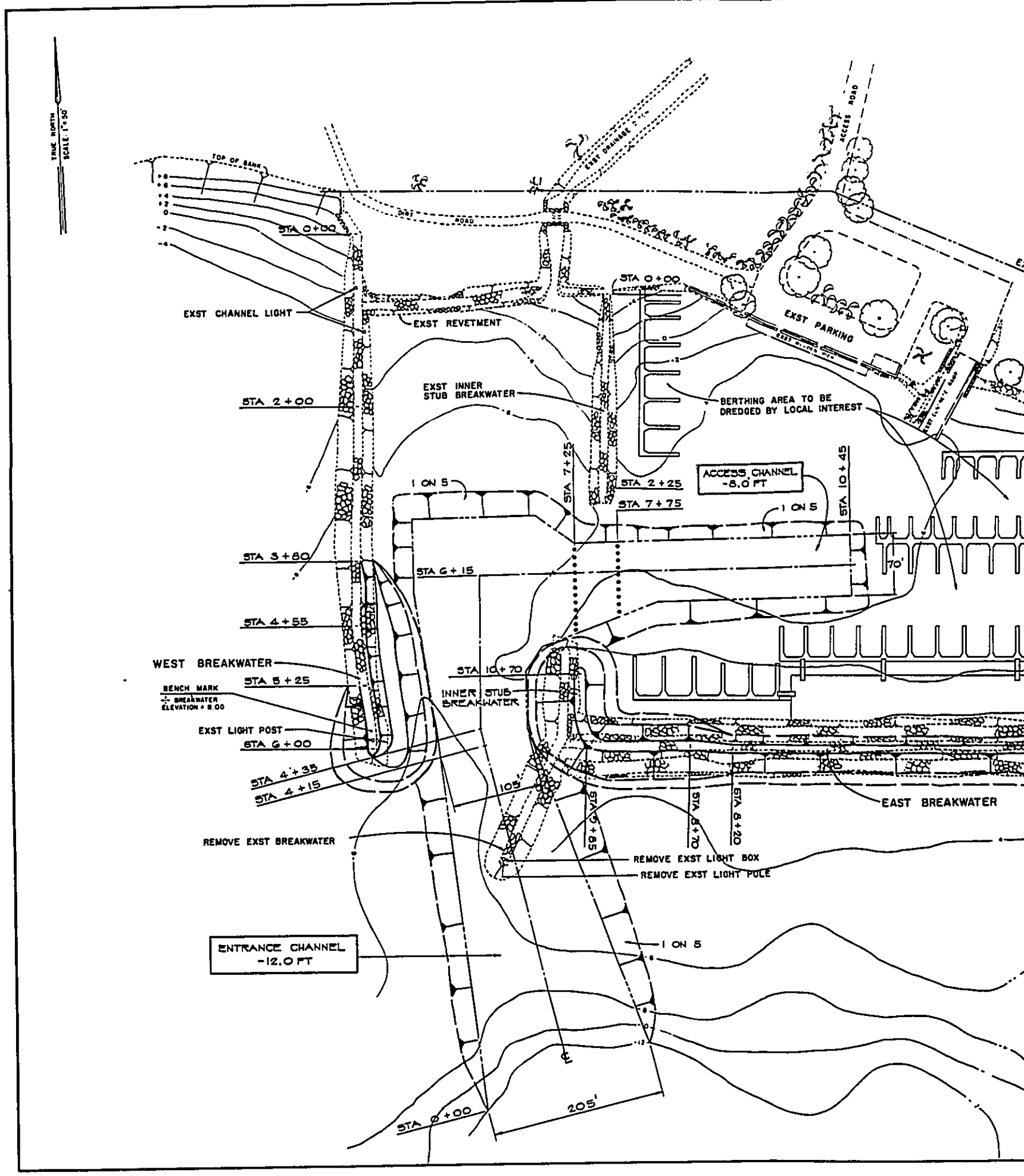
1" = 10' 10' 0 10' 20'

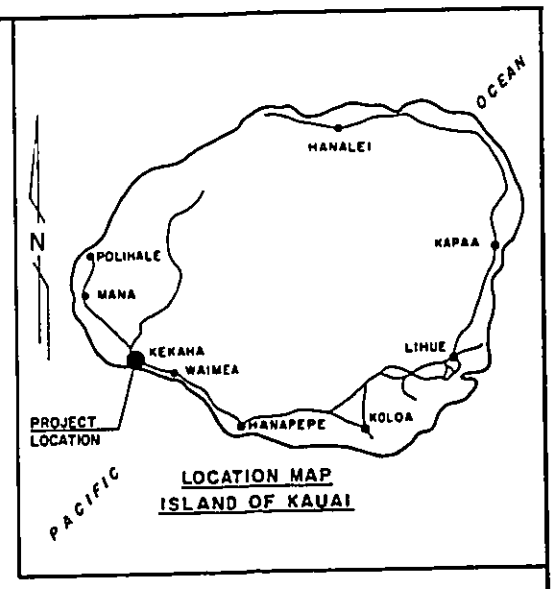
KIKIAOLA HARBOR KAUAI, HAWAII

TYPICAL SECTIONS

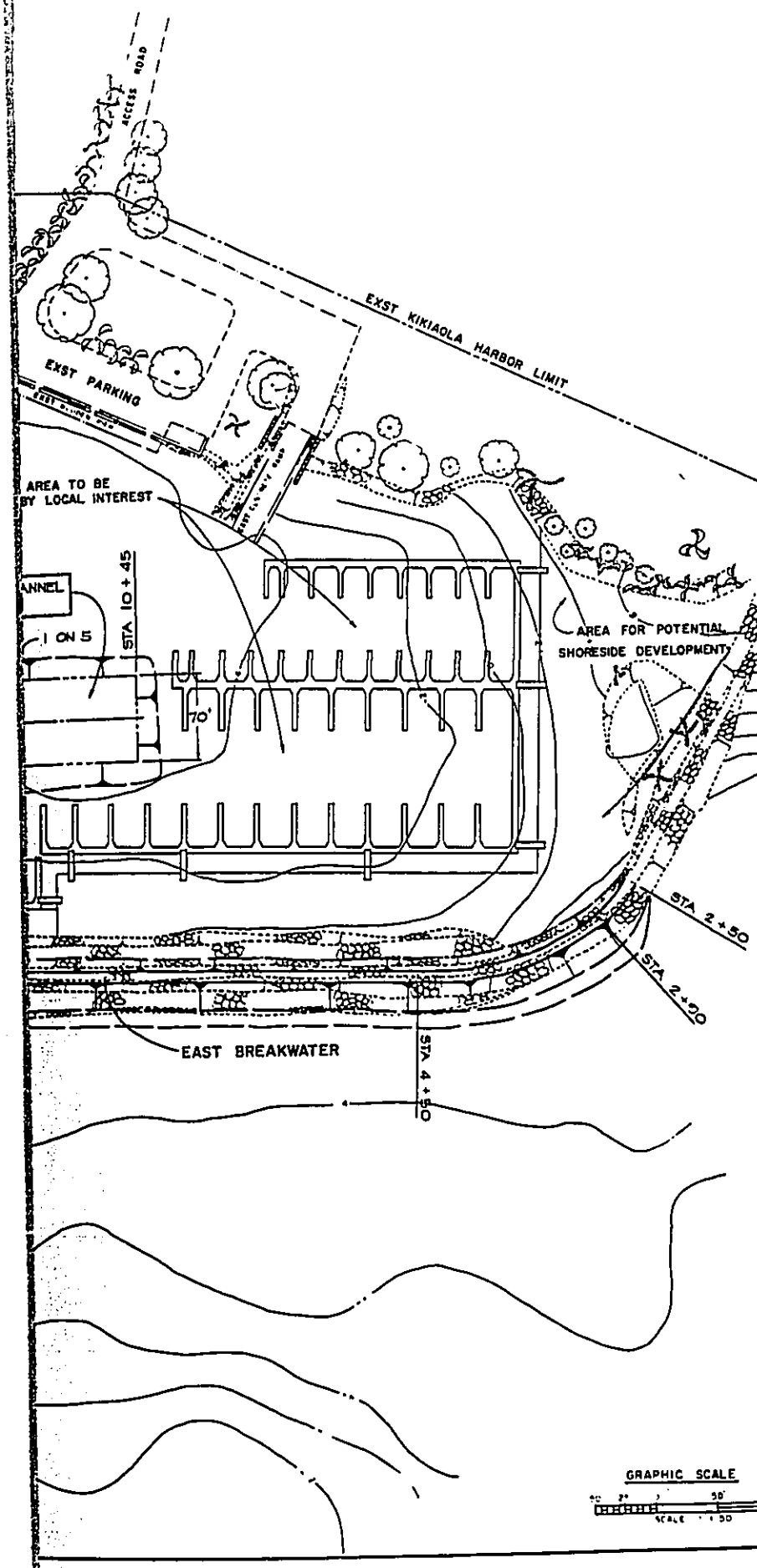
U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 13


TRUE NORTH
SCALE 1"=50'
TOP OF BANK
DIRT ROAD
EXST DRAINAGE
ACCESS ROAD
STA 0+00
EXST CHANNEL LIGHT
EXST REVETMENT
STA 0+00
EXST PARKING
EXST CURB & GUTTER
EXST INNER STUB BREAKWATER
STA 2+00
BERTHING AREA TO BE DREDGED BY LOCAL INTEREST
ACCESS CHANNEL -8.0 FT
1 ON 5
STA 7+25
STA 2+25
STA 7+75
1 ON 5
STA 10+45
STA 3+80
STA 6+15
70'
STA 4+55
WEST BREAKWATER
STA 5+25
BENCH MARK
BREAKWATER ELEVATION = 8.00
STA 10+70
INNER STUB BREAKWATER
EXST LIGHT POST
STA 6+00
STA 4+35
STA 4+15
105'
STA 9+85
STA 8+70
STA 8+20
EAST BREAKWATER
REMOVE EXST BREAKWATER
REMOVE EXST LIGHT BOX
REMOVE EXST LIGHT POLE
ENTRANCE CHANNEL -12.0 FT
1 ON 5
STA 0+00
205'



LOCATION MAP
ISLAND OF KAUAI



NOTES:

1. ALL ELEVATIONS AND DEPTHS REFERENCED TO MEAN LOWER LOW WATER DATUM (MLLW).
2. DEPTH CONTOURS BASED ON APRIL 1979 SURVEY.

LEGEND

- HARBOR PROJECT LINE
- HARBOR STRUCTURES
- TOE OF STRUCTURES
- DEPTH TRANSITION LINE
- EXST HARBOR LIMIT
- -6 CONTOUR LINES
- EXISTING STRUCTURES

GRAPHIC SCALE

0 25 50 100
SCALE 1" = 50'

KIKIAOLA HARBOR KAUAI, HAWAII

POSSIBLE BERTHING PLAN

U.S. ARMY ENGINEER DISTRICT, HONOLULU

FIGURE 14

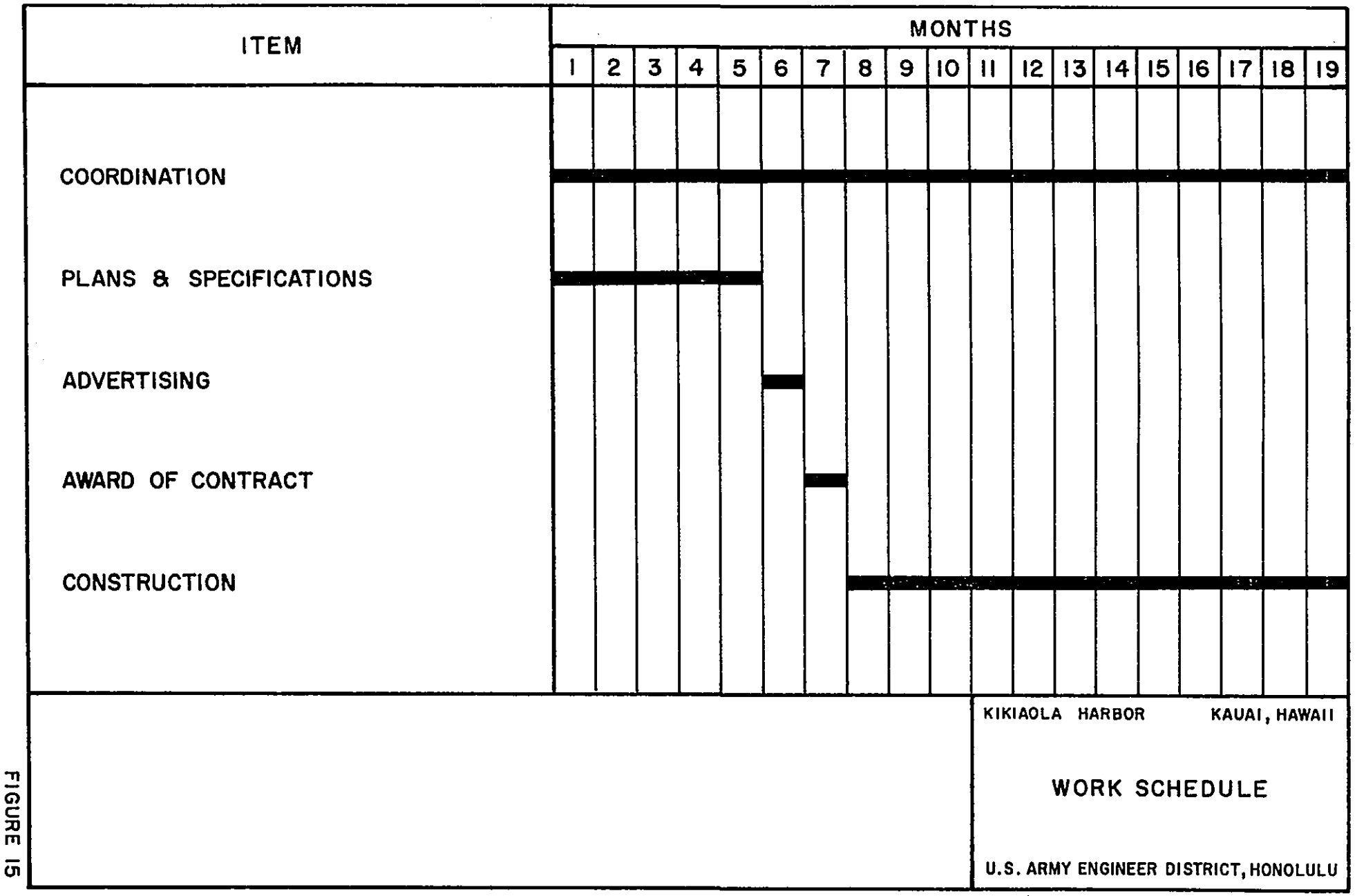


FIGURE 15

FIGURE 15

SECTION G

ENVIRONMENTAL IMPACT STATEMENT SUMMARY

124. Major Conclusions and Findings. The alternative plans are discussed in detail in Section D of the main report. All four plans meet the primary objective of reducing navigational hazards in the harbor and provide economic benefits that exceed the project costs. Plan 1 maximizes economic benefits. It is therefore designated the National Economic Development (NED) Plan. None of the plans enhance the physical or cultural environment. However, Plan 1 is the least environmentally damaging plan because it entails the least amount of modification to the existing environment. The Final Environmental Impact Statement is contained in Section I of the main report.

125. All plans require the discharge of fill material for breakwater and revetment structures. A section 404 evaluation (Appendix F) finds that materials to be used in breakwater construction are suitable discharge of navigable waters. None of the alternatives involve wetland areas or wildlife refuges or Federal sanctuaries, nor will they affect groundwater resources. The U.S. Fish and Wildlife Service coordination report, (Appendix G) determined that the recommended plan of improvement should not have any significant, long-term impacts on fish and wildlife resources. The proposed project does not involve a riverine floodplain; however, the coastal area is subject to tsunami inundation hazards.

126. Areas of Controversy. None.

127. Unresolved Issues. None.

128. Relationship to Environmental Requirements. An outline of the relationship of the alternative plans to environmental laws and regulations affecting the study are presented in Table I-1 of Section I of the main report, Environmental Impact Statement (Final).

SECTION H

CONCLUSIONS AND RECOMMENDATIONS

129. CONCLUSIONS. The proposed navigation improvements at Kikiaola Harbor, Kauai, as described in this report, are the most efficient means of improving navigation conditions at the harbor. The plan of improvement will provide safe navigation and berthing conditions for vessels using the harbor. The plan of improvement satisfies the planning objectives established in the authorizing document and in this report. The proposed improvements were developed in accordance with accepted engineering, economic, environmental and social criteria and involved detailed assessment and evaluation of alternative solutions to navigation problems in accordance with the Water Resources Council's Principles and Standards. Four alternative plans were coordinated with interested federal and local government agencies as well as with the general public. The recommended plan of improvement is favored by the local sponsor and is consistent with existing land use plans developed by the State of Hawaii. The local sponsor has indicated by letter and by public testimony that it is willing and able to provide local cooperation requirements as established in the authorizing document and amended by statutory requirements. Any adverse effects which may result from implementation of the recommended plan are substantially outweighed by other considerations of national interest. On the balance, the total public interest would best be served by implementation of the recommendation.

130. RECOMMENDATIONS. The District Engineer recommends that the plan of improvement presented in this General Design Memorandum be approved and implemented subject to the condition that the local sponsor provides the required local cooperation. The recommended plan of improvement consists of:

a. Removing 150 feet from the existing outer east stub breakwater which extends into the proposed channel.

b. Raising the east breakwater's crest elevation by four feet from station 8+70 to 9+85 and three feet from station 2+50 to 8+20.

c. Flattening the seaward slope of the east breakwater to one vertical on two horizontal from station 8+70 to 9+85.

d. Removing and constructing 85-foot-long inner east stub breakwater.

e. Modifying 220 feet of the existing west breakwater by placing armor, underlayer and bedding stones from station 3+80 to 6+00.

f. Dredging a 725-foot-long entrance channel to a depth of 12 feet and varying in width from 105 to 205 feet with maneuvering area to facilitate a 90^{o} right turn into the access channel.

g. Dredging a 320-foot-long access channel to a depth of 8 feet and varying in width from 70 to 105 feet.

Approximately thirty trees would be planted along the shoreline. Installation of necessary aids to navigation would also be included.

SECTION I

FINAL ENVIRONMENTAL IMPACT STATEMENT

SECTION I

ENVIRONMENTAL IMPACT STATEMENT
KIKIAOLA HARBOR NAVIGATION IMPROVEMENTS
KAUAI, HAWAII

The responsible lead agency is the U.S. Army Corps of Engineers, Honolulu Engineer District.

The responsible cooperating agency is the U.S. Fish and Wildlife Service, Hawaii Region.

Abstract. Post-authorization studies for navigation improvements to Kikiaola Harbor were conducted by the U. S. Army Corps of Engineers in cooperation with the Harbors Division, Department of Transportation, State of Hawaii. Based on an assessment of public needs and concerns, four alternative plans of improvement were developed for detailed investigation. The four plans are similar in that they all involve construction of a 12-foot-deep entrance channel, turning basin maneuvering area and modifications to the existing breakwater structures. The new entrance channel would provide safe navigation for design vessels and others expected to use the harbor. Modifications to breakwater structures would prevent wave overtopping and provide protected berthing areas. The plans differ in extent of breakwater modifications, size and location of turning basin maneuvering area and berthing capacity. No significant resources were identified within or adjacent to the project area. Therefore, none of the alternatives would have an adverse impact on significant resources.

Further technical information concerning this statement may be obtained from:

Dr. James E. Maragos
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858
Telephone: (808) 438-2263/2264

NOTE: Information, displays, maps, etc. discussed in the main report are incorporated by reference in the EIS.

SECTION I

Environmental Impact Statement

Table of Contents

Table of Contents

LIST OF TABLES

LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

NAME	EXPERTISE	EXPERIENCE	PROFESSIONAL DISCIPLINE
Mr. Robert Moncrief	B.A., Zoology	7 Years, Biologist, National Marine Fisheries Service 4 Years, Biologist, U.S. Navy 2 Years, EIS Studies, U.S. Army Engineer District, Honolulu	Ecologist
Mr. James Hatashima (Study Manager)	B.S. Civil Engineering	7 Years, Hydraulic Engineer, U.S. Army Engineer District, Honolulu	Hydraulic Engineer
Mr. David G. Sox	M.A., Historical and Cultural Geography	2 Years Geography 4 Years EIS Studies, U.S. Army Engineer District, Honolulu	Social Environmental Specialist
Dr. James E.Maragos (EIS Coordinator)	Ph.D., Marine Ecology	2 Years, Post Doctoral Research 8 Years, Environmental Consultant 4 Years, EIS Studies, U.S. Army Engineer District, Honolulu	Supervisory Environmental Biologist

SUMMARY

1. Major Conclusions and Findings. The alternative plans are discussed in detail in Section D of the main report. All four plans meet the primary objective of reducing surge and navigational hazards in the harbor and provide economic benefits that exceed the project costs. Plan 1 maximizes economic benefits. It is therefore designated the National Economic Development (NED) Plan. None of the plans enhance the physical or cultural environment. However, Plan 1 is the least environmentally damaging plan because it entails the least amount of modification to the existing environment.

2. All plans require the discharge of fill material for breakwater and revetment structures. A section 404 evaluation (Appendix F) finds that materials to be used in breakwater construction are suitable for discharge into navigable waters. None of the alternatives involve wetland areas or wildlife refuges or Federal sanctuaries, nor will they affect ground water resources. The proposed project does not involve a riverine flood plain; however, the coastal area is subject to tsunami inundation hazards.

3. Areas of Controversy. None.

4. Unresolved Issues. None.

5. Relationship to Environmental Requirements. An outline of the relationship of the alternative plans to environmental laws and regulations affecting the study are presented in Table I-1.

NEED FOR AND OBJECTIVES OF THE ACTION

6. Study Authority. Post-authorization studies for navigation improvements to Kikiaola Harbor are authorized under Section 101 of the River and Harbor Act of 1968. The purpose of the studies is to recommend a harbor improvement plan which will signifiantly reduce surge and wave action within the basin and entrance channel, increase the usable harbor area, and provide safe navigation conditions for the larger craft using this facility.

7. Public Concerns. The major concern of boaters using Kikiaola Harbor is the hazardous conditions at the harbor entrance during periods of south swell. When the south swell is running, usually during the summer, surf up to 15 feet breaks approximaely 1,000 yards off the harbor entrance where the bottom rises from 70-80 feet to about 15 feet. The swell then reforms and breaks again right at the channel entrance. Boats trying to leave the harbor under these conditions must make a "running start." If timing isn't right and the outer break begins breaking, boats are forced to turn around and return to the protection of the harbor. Only faster boats with speeds greater than 18-20 knots can attempt exiting the harbor when the south swell is up. For larger, slower boats the harbor is inaccessible during periods of moderate to high south swell which occur with greatest frequency from approximately June to August. This situation is aggravated by the summer Ahi run which usually occurs during this period. Fishing boat owners do not want to risk being inadvertently harbor-bound due to surf any time during the Ahi run. Concern was also expressed with respect to diversion of the existing drainage ditch

TABLE I-1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

FEDERAL STATUTES:	
National Environmental Policy Act (NEPA)	In full compliance.
Prime Agricultural Lands	Not Applicable.
National Historic Preservation Act	In full compliance.
National Landmarks	Not Applicable.
Clean Water Act	
Section 404 - Dredged or Fill Materials	In full compliance.
Section 402 - NPDES Permit	Not Applicable.
Fish and Wildlife Coordination Act of 1958	In full compliance.
Endangered Species Act of 1978	In full compliance.
Migratory Bird Treaty Act of 1918	Not Applicable.
Marine Mammal Protection Act of 1972	In full compliance.
Marine Protection, Research and Sanctuaries Act	Not Applicable.
Section 102 - EPA Permit	Not Applicable.
Section 103 - Dredged Material	Not Applicable.
Title III - Marine Sanctuaries	Not Applicable.
Federal Water Project Recreation Act of 1965	In full compliance.
Coastal Zone Management Act	In full compliance.
Scenic and Wild River Act	Not Applicable.
Water Resources Planning Act	In full compliance.

TABLE I-1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS (Contd)

EXECUTIVE ORDERS:	
E.O. 11987 - Exotic Organisms	Not Applicable.
E.O. 11988 - Flood Plain Management	In full compliance.
E.O. 11593 - Protection and Enhancement of Cultural Environment	In full compliance.
E.O. 11990 - Protection of Wetlands	Not Applicable.
STATE AND LOCAL LAWS:	
Hawaii Coastal Zone Management Program	In full compliance. Federal Consistency Statement is contained in Appendix G and was filed with State DPED on 14 August 1980.
Chapter 343, HRS: State EIS Law	In full compliance.

from the harbor to a new location just west of the harbor. It was felt that any degradation of receiving waters by this source should be confined to the harbor rather than be diverted to adjacent nearshore waters.

8. Planning Objectives. Detailed assessment of problems and needs have resulted in specific goals which, if achieved, would satisfy the planning objective. These specific goals are:

a. To reduce navigation hazard in the entrance channel;

b. To provide adequate and protected berthing area; and

c. To minimize shoaling in the entrance channel and in the harbor basin.

ALTERNATIVES CONSIDERED

9. Plans Eliminated From Further Study. The authorized plan as shown in the project document was used as a basis for development of the four alternative plans presented in the report. Changes in the authorized plan as a result of post-authorization studies include engineering, environmental and economic aspects of the project, and are discussed in Section F of the main report.

10. Without Conditions. Without Federal implementation of authorized improvements at Kikiaola Harbor will remain undeveloped with little or no change from existing conditions. Boaters and fishermen will continue to experience breaking wave condition and shallow depths at the entrance channel. Lack of a safe entrance channel and adequate protective structures will limit the State of Hawaii from developing Kikiaola into a fully operable boat harbor. Any increase in recreational and commercial fishing opportunities, and resulting local expenditures, will largely be restricted to local boaters from the Waimea-Kekaha region.

11. Plans Considered in Detail. Detailed treatment of alternative plans is provided in Section D of the report and Appendix B, Design Analysis.

12. Comparative Impacts of Alternatives. Comparative effects of the alternative harbor plans on the environment are provided in Table I-2. Additional comparison of alternative plans are contained in the Summary Comparison of Alternative Plans and System of Accounts (Table 5 of the main report).

AFFECTED ENVIRONMENT

13. Environmental Conditions. Kikiaola Harbor is located on the southwest coast of Kauai approximately half way between the towns of Kekaha and Waimea. Kauai, the northernmost of the eight major Hawaiian Islands, is 103 statute miles west and slightly north of Honolulu. The roughly circular island is fourth largest in land area with 549 square miles. The broad coastal plain on which Kikiaola is situated was formed by wave action along a prehistoric shoreline which was higher and farther inland than it is today. This emergent marine terrace was subsequently overlain with alluvial deposits from upland erosion (ref 8). The climate of the Waimea-Kekaha region is characterized by a two-season year (summer and winter) with mild and uniform temperature ranging from a monthly mean of 70°F in the winter to 78°F in the summer. The average annual rainfall of 22 inches per year at Kekaha is the lowest on the island. Trade winds (NE) prevail 80 to 90 percent of the time during the summer decreasing to about 60 to 70 percent during the

TABLE I-2. COMPARATIVE IMPACTS OF ALTERNATIVES

BASE CONDITION AND ALTERNATIVES	REEF RESOURCES	COASTAL WATER QUALITY	PLAN ECONOMICS
Base Condition	Available: Several hundred acres between Waimea and Kekaha. Reef resources within and adjacent to the project area comprise a flat relatively barren limestone reef with shallow sand-filled channels and pockets overlying a hard corralline pavement. Benthic algae comprise the dominant biotic component. Few corals or benthic invertebrates.	Class A embayment. (State Water Quality Standards). Protected uses include small boat facilities, bait fishing, and compatible recreational activities.	Not Applicable
Without Condition	No Change	No Change	Not Applicable
Plan 1	Approximately 3.8 acres of relatively barren consolidated limestone reef would be modified by dredging the entrance and access channels to a depth of -12 and -8 feet, respectively. Sessile organisms inhabiting the bottom would be destroyed. Fishes and other mobile organisms would be temporarily displaced. Limited recovery would be expected. Approximately 2.7 acres of silt-covered limestone within existing harbor basin would be dredged to a depth of -8 feet. Dredging would remove the silt-sand substrate and with it the soft bottom benthic community. Sedimentation within the harbor basin will gradually restore this soft bottom community.	Temporarily localized turbidity during dredging and construction of breakwaters. Water quality should improve within the harbor basin as a result of removal of existing silty sediment.	Average Annual Benefits: $274,000 Average Annual Costs: $228,400 Net Benefits: $45,600 B/C Ratio: 1.2
	Removal of 150 feet from the existing outer stub breakwater would result in the loss of about 0.2 acre of rocky intertidal and submerged habitat and associated biological community. Construction of an 85-foot inner east stub breakwater and modifications to the east and west breakwaters will cover approximately 0.6 acre of existing rock breakwater habitat and hard, biologically unproductive limestone bottom. The increased area of rocky habitat will provide additional substrate and cover for fishes and benthic organisms.		
Plan 2	Approximately 0.7 acre more than Plan 1 of bottom dredged. Dredging impacts would be the same as Plan 1. Protective structures same as for Plan 1 except for the removal of 40 feet from the inner stub breakwater.	Same as Plan 1.	Average Annual Benefits: $258,000 Average Annual Costs: $244,100 Net Benefits: $13,900 B/C Ratio: 1.06
Plan 3	Approximately 0.3 acre more than Plan 1 of bottom dredged. Impacts would be the same as Plan 1. Protective structures are the same as Plan 1 except for removal of 130 feet from the inner stub breakwater (a loss of about 0.1 acre of rocky substrate) and construction of a new 195-foot-long inner east stub breakwater. Approximately 0.3 acre of soft bottom habitat would be covered and converted to a rock-rubble habitat.	Same as Plan 1.	Average Annual Benefits: $280,000 Average Annual Costs: $256,400 Net Benefits: $23,6000 B/C Ratio: 1.09
Plan 4	Dredging impacts and area dredged would be the same as Plan 1. Approximately 0.3 acre more than Plan 1 of limestone reef substrate would be covered by protective structures. The existing biological community would be destroyed. A more rich and diverse community would establish on the rock-rubble substrate and within the interstices of the breakwater.	Same as Plan 1.	Average Annual Benefits: $276,000 Average Annual Costs: $258,800 Net Benefits: $17,200 B/C Ratio: 1.07

winter. Land uses in the vicinity of Kikiaola Harbor are primarily agricultural and urban. Sugarcane cultivation and some cattle grazing are the major agricultural uses.

14. Significant Resources. Environmental investigations conducted at Kikiaola Harbor by the U.S. Army Corps of Engineers and its contractors determined that no significant resources exist within or adjacent to the project area and that no significant resources will be affected by the project. No endangered species, including the Hawaiian hoary bat (Lasiurus cinereus semotus) are known to reside in or use the Kikiaola project area (ref 10). The project area is not located within any designated wildlife refuge, marine sanctuary or natural reserve area. No significant recreational resources including surfing sites, National Shoreline, Parks or Beaches are located in or adjacent to the project area. There are no sites of national or state historical significance within the limits of the harbor. Recreational, natural, social and cultural resources are described in Appendices D and E of the main report.

15. Resources and Values Identified in Section 122 of Public Law 91-611. The following resources and environmental values have been fully considered with respect to possible adverse economic,social and environmental effects resulting from implementation of the proposed project (Table D-5. Summary Comparison of Alternative Plans and System of Accounts):

(a) Air, Noise and Water Pollution. Adverse impacts related to air,noise and water would be temporary impacts during construction of harbor improvements. Minimization of these impacts would be affected by employment of construction methods that do not cause excessive or unnecessary turbidity, dust, hydrocarbon emissions or noise.

(b) Man-made or natural resources, esthetic values, community cohesion and availability of public facilities and services:

Destruction or disruption of the above resources as a result of project implementation would be minimal and are not considered significant.

(c) Employment effects and tax and property value:

Adverse employment effects and/or tax and property value losses would not result from project implementation.

(d) Displacement of people, businesses and farms:

No injurious displacement of people businesses and farms would result from project implementation.

ENVIRONMENTAL EFFECTS

16. Effects of the proposed harbor improvement project on the environment are discussed in Section D of the main report and Table I-2 of the Environmental Impact Statement. No significant resources exist within or immediately adjacent to the project area. The project will not affect any significant resources.

17. No significant adverse economic, social or environmental effects on resources and values identified in Section 122 of PL 91-611 would result from project implementation.

PUBLIC INVOLVEMENT

18. Public Involvement Program. Early planning coordination involved informal discussions with members of participating government agencies and an initial public meeting at which testimony was received on the Corps proposed harbor improvement plan. A series of workshops were held to determine problems and needs related to potential harbor improvements and obtain input on alternative designs as they evolved during the course of the study. The final public meeting was held on 26 June 1980 at which time the results of the Corps investigations were presented for public review and comment. A Notice of Intent to prepare a Draft EIS was published in the Federal Register on 5 October 1979.

19. Required Coordination. Coordination was initiated with the U.S. Fish and Wildlife Service (FWS), Office of Ecological Services at the inception of the study to fulfill the requirements of the Fish and Wildlife Coordination Act. A final 2(b) report has been submitted by FWS which describes fish and wildlife resources in the project area, discusses potential project impacts and recommends appropriate mitigation measures which are listed below and in Appendix G. Endangered species coordination with the U.S. Fish and Wildlife Service, Office of Endangered Species, has been completed.

20. Coordination with the State Historic Preservation Officer (SHPO) has been initiated. A cultural reconnaissance survey has been conducted, and a Determination of Effect based on survey findings was forwarded to SHPO for his review and concurrence. A letter of concurrence was received on 21 July 1980.

21. Measures Recommended by the USFWS to Minimize Project Impacts:

a. The use of existing upland spoil disposal and quarry sites is encouraged. If new sites are selected, the Fish and Wildlife will be given the opportunity to evaluate the environmental effects of these activities.

b. Field stone, if used, will be acquired from agricultural or cleared lands and not from forested lands.

c. Dredging will be performed during periods of low tide and low surf.

d. Silt curtains will be deployed as necessary to control turbidity.

e. No dredged material will be stockpiled in the marine environment.

f. On land, spoil disposal will be conducted behind maintained berms above the influence of the tide. No spoil will be placed in any watercourse or wetland. Only clean runoff water from the spoil disposal area will be allowed to reenter any waterway.

g. All permanent spoil disposal areas will be stabilized with vegetative cover or other suitable means to prevent erosion.

h. Terrestrial vegetation at the project site will be restored and erodible embankments will be stabilized immediately following construction.

i. The Fish and Wildlife Service will be notified of any change in project design or construction methodology so that potential impacts can be evaluated.

22. Statement of Recipients. A list of agencies receiving copies of the draft report and environmental statement is provided in Appendix H, Public Involvement, List of Reviewers and Recipients.

PUBLIC VIEWS AND RESPONSES

23. Public meetings, informal discussions with government agencies, and workshops were conducted during the study to maintain coordination and obtain views and input from federal and non-federal interests. Prior to the 26 June 1980 public meeting, the draft report was circulated to the federal, State and County agencies for formal review and comments. Public views expressed at the workshops and public meetings, correspondence received during report coordination, and pertinent Corps of Engineers responses are presented in Appendix H, Public Involvement.

24. Views of Federal and Non-Federal Agencies. Comments on the proposed navigation improvements were received from the Environmental Protection Agency; the U.S. Coast Guard, Fourteenth District; the Advisory Council on Historic Preservation; and the Department of Commerce, National Marine Fisheries Service. Significant comments were not received regarding the proposed improvements. The Environmental Protection Agency has stated a lack of objections to the project and has rated the Environmental Impact Statement as adequate. Comments were also received from State of Hawaii Departments of Planning and Economic Development, Land and Natural Resources, Office of Environmental Quality Control and the University of Hawaii Environmental Center. Many of the comments concerned the general impacts of the project on the existing physical and social environment. Letters of comments and responses are included in Appendix H, Public Involvement, Pertinent Correspondence.

25. Views of the General Public and Private Organizations. Public interest in the study and proposed harbor improvements has been favorable throughout the study period. This was evident from the public response at the workshops and meetings which are discussed in Appendix H, Public Involvement. The overall public response has been favorable toward the project.

TABLE I-3, INDEX, REFERENCES AND APPENDICES

Subject	Environmental Statement	Main Report & Appendices
Affected environment	pp I-8	None
Alternatives	pp I-8	para 67-90, pp 17-21
Areas of Controversy	para 3, pp I-5	para 126, pp 35
Comparative Impacts of Alternatives	para 12, pp I-8	Table 5, pp 26A-26F
Cover Sheet	pp I-1	Not Applicable
Environmental Conditions	para 13, pp I-8	Table 5, pp 26B
Environmental Effects	para 15, pp I-10	Table 5, pp 26C
List of Preparers	pp I-4	Not Applicable
Major Conclusions and Findings	para 1, pp I-5	Sec H, pp 36
Need for and Objectives of the Action	pp I-5	None
Planning Objectives	para 8, pp I-8	para 52-53, pp 13
Plans Considered in Detail	para 11, pp I-8	para 66-90, pp 17-21
Plans Eliminated from Further Study	para 9, pp I-8	None
Public Concerns	para 7, pp I-5	para 42-49, pp 11-12
Public Involvement	pp I-11	Appendix H
Public Involvement Program	para 16, pp I-11	Appendix H
Public Views and Responses	pp I-11	Appendix H
Relationship to Environmental Requirements	para 5, pp I-5	Table 5, pp 26B-26C
Required Coordination	para 17, pp I-11	para 7-8, pp 3
Significant Resources	para 14, pp I-10	None
Statement Recipients	para 19, pp I-11	Appendix H

Subject	Environmental Statement	Main Report & Appendices
Study Authority	para 6, pp I-5	para 1, pp 1
Table of Contents	pp I-2	pp iiii
Unresolved Issues	para 4, pp I-5	None
Without Conditions (No action)	para 10, pp I-8	pp 42, pp 11

APPENDIX A

BENEFIT ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

APPENDIX A

BENEFIT ANALYSIS

APPENDIX A

BENEFIT ANALYSIS

GENERAL

1. Project benefits consist of navigation benefits to recreational boating, charter fishing, and commercial fishing. There are also benefits due to the employment of unemployed labor in project construction (EDA benefits). Calculations use a discount rate of 7-1/8%, and a 50-year period of analysis, assuming project construction is complete by 1985. Benefits are based on August 1980 price levels.

METHOD OF ANALYSIS

2. Benefits for the four alternative harbor and navigation improvements are based on the assumption that without the proposed harbor project, the moored fleet at Kikiaola will remain at a zero level. The number and types of moored craft in the harbor with improvements are based on the estimated demand for mooring facilities, and the capacity afforded by the size of each alternative harbor plan. There are also estimated benefits resulting from increased use of harbor facilities by trailer-mounted craft. EDA benefit calculations follow the U.S. Water Resources Council procedures.

BERTHING SPACE DEMAND

3. Requirements for berthing space are based on an assessment of population, growth in vessel registration, and other factors. Table A-1 shows historical and projected demand determinants for Kikiaola.

4. Population. The Hawaii State Department of Planning and Economic Development (DPED) is the source for historical and projected population for Kauai (1979 figure is interpolated). The OBERS-E projections for the non-SMSA portion of OBERS Economic Region 173 (Hawaii) would ordinarily be applicable to the growth of Hawaii's islands other than Oahu. The OBERS projection, made in 1972, forecasts a declining population for this part of the State. In view of the rapid growth that these islands have experienced since 1972, and which seem to have every reason for continuing growth, the OBERS-E projections are not used in this analysis. The island projections for Kauai, based on DPED County growth rate forecasts, follow from historical trends and econometric projections for the State and its island components.

5. Registered Craft. The State Department of Transportation, Harbors Division, maintains records of small craft registrations by island. The number of registered vessels per 1,000 population for Kauai has been increasing rather steadily in recent years, growing from 18.2 in 1970 to 29.3 in 1978, representing an average growth of 6.1% per year. Plotting this ratio indicates a general trend of growth at a declining rate. A reasonable extension of this trend indicates that the growth should reach a plateau of about 50 registered vessels per 1,000 population by the year 2000. The projection of the total number of registered vessels on Kauai is based on the projections of population growth and vessel registration per 1,000 population (see Table A-1).

TABLE A-1. KIKIAOLA SMALL BOAT HARBOR DEMAND DETERMINANTS

YEAR	(1) KAUAI POPULATION (1,000's) 1/	(2) KAUAI REGISTERED VESSELS 3/	(3) VESSELS PER 1000 POP. NO. 2/	(4) VESSELS PER 1000 POP. AVG. ANNUAL GROWTH (%)	(5) NUMBER OF 4/ APPLICATIONS ON STATE-WIDE BOAT HARBOR WAITING LISTS	(6) STATE-REGISTERED VESSELS	(7) NUMBER ON WAITING 5/ LIST AS A % OF STATE-REGISTERED VESSELS	(8) PROJECTED 6/ EXCESS KAUAI DEMAND FOR HARBOR SPACE
1970	30.1	549	18.2		747	8,042	9.3	-
1971	31.1	598	19.2	5.5	-	8,803	-	-
1972	31.7	731	23.1	20.3	982	10,171	9.7	-
1973	32.1	868	27.0	17.3	1,565	12,002	13.0	-
1974	32.1	864	26.9	-.4	1,345	11,796	11.4	-
1975	32.7	929	28.4	5.6	1,819	12,911	14.1	-
1976	34.0	973	28.6	.7	2,419	13,092	18.5	-
1977	34.4	956	27.8	2.8	3,011	13,313	22.6	-
1978	34.9	1,022	29.3	5.4	3,042	13,644	22.3	-
1979	35.7	1,106	31	5.8	1,660	13,900	12.0	-
1980	36.5	1,168	32	3.2	-	-	12	140
1985	40.6	1,583	39	4.0	-	-	12	190
1990	46.5	2,046	44	2.4	-	-	12	245
1995	53.1	2,548	48	1.8	-	-	12	306
2000	60.4	3,020	50	.8	-	-	12	362

1/ State Department of Planning and Economic Development (DPED), Hawaii

2/ Historically computed. Projections are based on historical trend, assuming continued growth at a declining rate.

3/ Historical data from Hawaii State Department of Transportation, Harbors Division. Projections = Column 3 x Column 1. 1979 figure estimated.

4/ Drop in 1979 due to imposition of waiting list fee which discouraged multiple applications.

5/ Projected to remain at current (1979) estimated level of 12%.

6/ 12 percent (column 7) of Kauai-registered vessels (column 2).

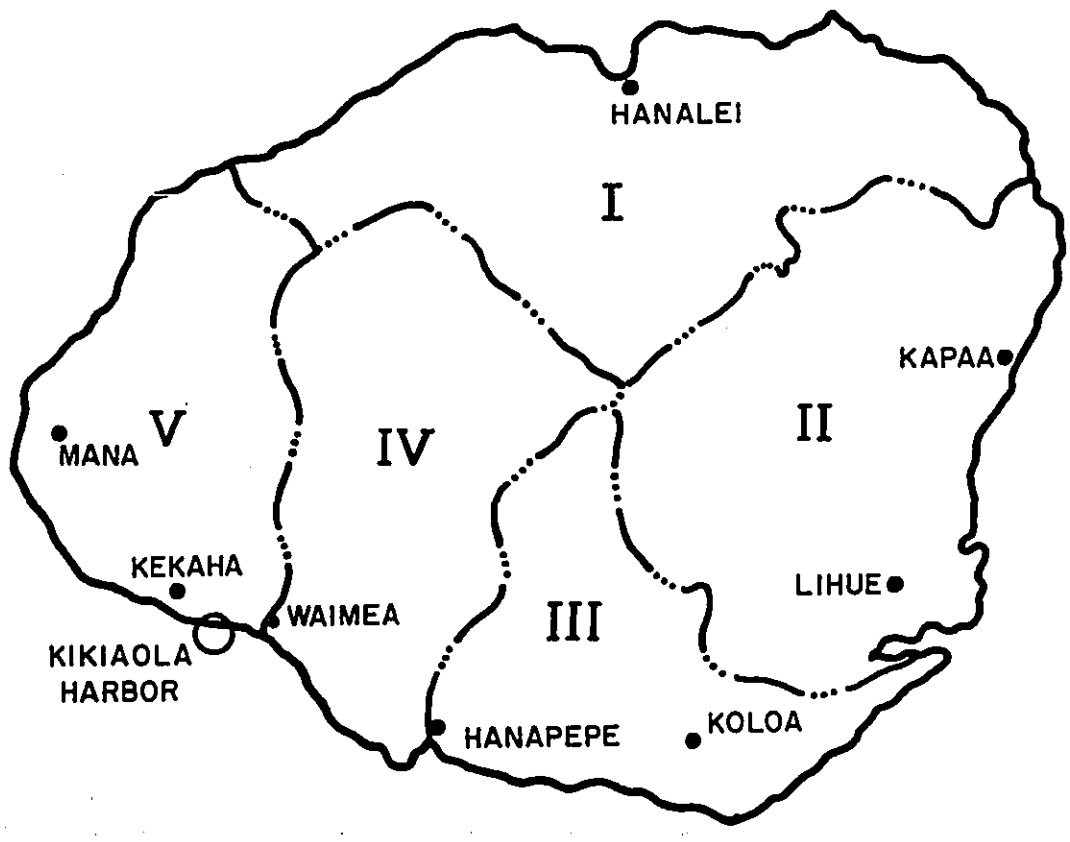
6. The State of Hawaii Department of Transportation also maintains records of the number of craft moored at State harbors, as well as a registry of persons applying for space to moor vessels, for each harbor. These records are only for State harbors, which for Kauai means all harbors since there are no private harbors on the island. The number of berthing space applications for Kauai's harbors is a poor indication of demand. In recent years only a handful of applications have been on file. Of the four harbors on the island, only one is fully developed with slips (Port Allen), and it is filled to capacity. A second harbor, Nawiliwili, presently has 27 on the waiting list, due primarily to the fact that the first development phase for berth construction is now in progress. Harbor construction and development on Kauai has been of such a small scale, and harbor berths are so few, that the overwhelming majority of Kauai's boaters have been oriented to trailer-mounted vessels over the years. The demand for harbor space for wet storage is evident, however, in that the low level of available storage is filled to capacity, and waiting lists exist where there are prospects for new capacity. Waiting lists at other harbors are unusually small. There is little turnover, and Kauai's boaters are accustomed to trailering, despite the problems associated with trailering the larger vessels required for boating in the island's rough waters.

7. Most of the applicants on State harbor waiting lists are waiting for a space before they buy a boat, due to the general statewide shortage of harbor space. Besides the fact that State harbors are full, private facilities throughout the islands are also at capacity.

8. Although Kauai represents an exception, current waiting lists throughout the State represent a measure of effective demand for harbor mooring space. While waiting lists for Kauai's harbors are small, estimates of Kauai's demand for berthing space are based on the trend in waiting list applications throughout the State, as they relate to the total number of registered vessels (see Table A-1).

9. The information in Table A-1 shows that the ratio of harbor space applications to registered vessels steadily increased through 1978, with a significant drop in 1979. This was due to the imposition of a waiting list fee, which discourages multiple applications. Freezing the ratio at its current level of 12 percent yields a conservative projection of the demand for harbor space. That is, the projection of effective demand for bertning space on Kauai = (.12) x (projected vessel registration). This is shown as the last column in Table A-1.

10. The portion of Kauai harbor space demand allotted to Kikiaola is derived in Table A-2. Allocation of demand to Kikiaola is based on population distribution, weighted by distance from the harbor. For example, in 1985, projected berthing space demand (in excess of existing facilities) is 190. 41.8% of this demand, or 79, could be met by an improved Kikiaola facility. This figure is based on the assumption that Kauai berthing space demand is regionally distributed in direct proportion to population distribution. Also, of this demand, none in Region I, 10% in Region II, 50% in Region III, and all in Regions IV and V will be met by an improved Kikiaola facility. This weighted average (41.8% in 1985) is calculated in Table A-2 for each of the projection years shown to get the projected berthing space demand at Kikiaola. The regions referred to in the table are shown on Plate A-1.



ISLAND OF KAUAI

5 0 5 10

SCALE IN MILES

KIKIAOLA HARBOR KAUAI, HAWAII

KAUAI

POPULATION DISTRIBUTIONS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE A-1

TABLE A-2. BERTHING SPACE DEMAND IN KAUAI

Kauai Region[1/]		1985	1990	1995	2000
I	% of Population	4.5	5	5.5	6
	% Share of Demand[2/]	0	0	0	0
II	% of Population	48.0	48.0	48.0	48.0
	% Share of Demand	10	10	10	10
III	% of Population	23.0	23.0	23.5	24.0
	% Share of Demand	50	50	50	50
IV	% of Population	11.5	10	9	8
	% Share of Demand	100	100	100	100
V	% of Population	14	14	14	14
	% Share of Demand	100	100	100	100
	% Share of Kauai Demand[3/]	41.8	40.3	39.6	38.8
	Kauai Demand[4/]	190	245	306	362
	Kikiaola Demand	79	99	121	140

1/ Regions and population shares are from Hawaii Water Resources Regional Study, 1975 (see Plate A-1).
2/ Regions IV and V are in southern Kauai, where the project site is. Region III is in southeast Kauai, Region II is in eastern Kauai, and Region I is northern Kauai, the other side of the island (see Plate A-1).
3/ Sum of (population share) x (demand share) for each region.
4/ From Table A-1.

RECREATIONAL AND COMMERCIAL NAVIGATION BENEFITS

11. Distribution of Moored Vessel Types. Since there are presently no vessels moored in the harbor, this distribution is expected to be similar to that for Port Allen Boat Harbor, also on southern Kauai. Information on average value of vessels and net returns to charter and full-time commercial fishing operations was taken from a survey of boat owners on Maui and Hawaii. The future distribution in the harbor will most likely be similar to the current distribution of effective demand, at least for the early years of project life. The distribution of types and values of vessels is probably a conservative estimate for the rest of the project life since there is a continuing statewide trend for an upgrading of the fleet to more expensive craft.

12. Trailer-Mounted Vessels. Information on present use of the site indicates that there are currently about 100 trailer-mounted vessels using the ramp at the project location. Survey information from Maui has revealed that the average number of trips per year for moored recreation craft is about the same as for trailer-mounted craft. Because of this similarity in number of uses per craft per year, the 100 trailer craft are considered in this analysis as full time equivalent vessels.

13. Transient Vessels. Kauai is a popular destination for interisland recreational boat cruising. Kikiaola would serve as an ideal rest stop for people taking their boats for a cruise along the island's West, or Napali Coast. This area, with its steep cliffs, lush vegetation, and beautiful beaches, is inaccessible by car and is essentially an uninhabited wilderness. Aside from hiking, boating is the only way to visit this part of Hawaii. A nominal estimate of two equivalent transient craft is used in the benefit analysis to approximate this part of the fleet using Kikiaola. The value of transient craft expected to use the transient slips is a weighted average of the values of vessels large enough to negotiate the seas between the islands. The values used in the averaging are from the distribution of other vessels expected to moor at Kikiaola.

14. Tables A-3 through A-5 show the calculation of navigation benefits for recreational and commercial boating for the four plans. Since benefits are related to harbor capacity, Plans 1 and 4 have the same level of benefits since they have the same harbor capacities. Net returns to commercial fishing and charter fishing operations are based on survey information. The net annual returns to moored recreational vessels is shown in the table as a percentage of investment, expressed as average depreciated value per vessel. Trailer-mounted vessel owners have complained that conditions in the entrance channel significantly detract from full utilization of this launching location a large percentage of the time. During the summer when southerly swell conditions tend to prevail, it is difficult to enter or leave the launch area under existing conditions. With the harbor improvements, this situation is expected to be resolved. This difference between with- and without-project conditions is reflected in the percentage of ideal net return (70%) shown in Table A-3 for trailer-mounted vessels, without harbor improvements. While most of the trailer-mounted vessels are used for fishing on a part-time basis, data collected on catch, value of catch, expenses, and number of trips per year indicate an economic net loss for these operators when viewed as commercial fisnermen. Because they are probably deriving rewards from the lifestyle to continue these operations, trailer vessels are treated as recreation craft for purposes of benefit analysis.

15. Damage Prevention Benefits. Without the project, only trailer-mounted vessels will use the harbor site. Most of the boaters know when conditions are dangerous and avoid damages by not going out during dangerous conditions. There are no official records of damages, accidents, or personal injuries for this location. But it is very likely that over the 50-year period of analysis without a project, there will be at least some incidents which will result in damage or injury which would be prevented by any of the proposed harbor improvement plans. While this indicates that damage prevention benefits will probably result from a harbor improvement project at the Kikiaola site, they are not included on this report, due to the lack of any firm information at this time.

LAND ENHANCEMENT AND EDA BENEFITS

16. Land Enhancement. No fast lands will be created with the dredged material. Therefore, no land enhancement benefits are computed.

17. EDA Benefits. EDA benefits are calculated in accordance with Part IX, U.S. Water Resources Council final rule, 14 December 1979. Kauai has been an area of prolonged and substantial unemployment. The proposed construction

TABLE A-3. NAVIGATION AND FISHING BENEFITS - PLANS 1, 4

YEAR	TOTAL HARBOR MOORING 1/	COMMERCIAL		RECREATION				
		FISHING	CHARTER	CRUISERS AND OTHER INBOARDS	OUTBOARDS	SAIL W/POWER	TRANSIENT	TRAILER
Prospective Fleet With Improvements 2/								
1985	81	3	1	53	14	8	2	135
1990	101	3	1	67	18	10	2	175
1991	105	3	1	69	19	11	2	184
1995	105	3	1	69	19	11	2	218
2000	105	3	1	69	19	11	2	258
2010	105	3	1	69	19	11	2	258
2035	105	3	1	69	19	11	2	258
Prospective Fleet w/o Improvements								
1985	0	0	0	0	0	0	0	135
1990	0	0	0	0	0	0	0	175
1995	0	0	0	0	0	0	0	218
2000	0	0	0	0	0	0	0	258
2010	0	0	0	0	0	0	0	258
2020	0	0	0	0	0	0	0	258
2035	0	0	0	0	0	0	0	258
Average Depreciated Value/Vessel 5/		$26,400	$82,300	$20,300	$ 6,040	$22,300	$21,300 3/	$ 9,150
Returns Per Craft								
With Improvements (Ideal Conditions)		4/	4/	9%	15%	9%	9%	15%
% Annual Return		$ 7,880	$ 7,940	$ 1,830	$ 901	$ 2,010	$ 1,920	$ 1,070
Net Annual Return								
W/O Improvements		0%	0%	0%	0%	0%	0%	10.5%
% Annual Return		$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 751
Net Annual Return								
Annual Benefit 6/								
1985		$23,600	$ 7,940	$ 97,000	$12,600	$16,100	$ 3,840	$43,100
1990		23,600	7,940	123,000	16,200	20,000	3,840	55,800
1991		23,600	7,940	126,000	17,100	22,100	3,840	58,700
1995		23,600	7,940	126,000	17,100	22,100	3,840	69,500
2000		23,600	7,940	126,000	17,100	22,100	3,840	82,800
2010		23,600	7,940	126,000	17,100	22,100	3,840	82,800
2035		23,600	7,940	126,000	17,100	22,100	3,840	82,800
Equivalent Avg. Annual Benefit 7/		$23,600	$ 7,940	$122,000	$16,400	$21,000	$ 3,830	$68,400

1/ From Table A-2 (includes two transient vessels; excludes trailer-mounted vessels). Growth in trailer mounted boats proportional to growth in number of registered vessels.

2/ Moored fleet distribution - commercial and transient vessel share of moored fleet is a constant. Recreation vessels based on distribution similar to that for Port Allen Boat Harbor, also on southern Kauai: inboards - 70%; outboards - 19%; and sailboats - 11%.

3/ This is a weighted average of the average depreciated values of vessel types expected to stop as transients and require temporary mooring (50% sailboats and 50% cruisers/inboards).

4/ Estimated returns for charter vessels and full-time fishing boats derived from information provided by operators of these types of craft on Maui.

5/ Derived from a survey of boat owners using harbors on Maui.

6/ Annual Benefit for Each Year = (No. of Vessels) x (Net Annual Return w/Improvements - Net Annual Return w/o Improvements).

7/ Annualized discounted stream of benefits at 7-1/8%, 50-year period of analysis.

TABLE A-4. NAVIGATION AND FISHING BENEFITS - PLAN 2

YEAR	TOTAL 1/ HARBOR MOORING	COMMERCIAL FISHING	COMMERCIAL CHARTER	CRUISERS AND OTHER INBOARDS	OUTBOARDS	SAIL WITH POWER	TRANSIENT	TRAILER
Prospective Fleet w/Improvements 2/								
1985	81	3	1	53	14	8	2	135
1988	92	3	1	60	16	10	2	159
1990	92	3	1	60	16	10	2	175
1995	92	3	1	60	16	10	2	218
2000	92	3	1	60	16	10	2	258
2010	92	3	1	60	16	10	2	258
2035	92	3	1	60	16	10	2	258
Prospective Fleet w/o Improvements								
1985	0	0	0	0	0	0	0	135
1990	0	0	0	0	0	0	0	175
1995	0	0	0	0	0	0	0	218
2000	0	0	0	0	0	0	0	258
2010	0	0	0	0	0	0	0	258
2020	0	0	0	0	0	0	0	258
2035	0	0	0	0	0	0	0	258
Average Depreciated Value/Vessel 5/		$26,400	$82,100	$ 20,300	$ 6,010	$22,300	$21,300 3/	$ 7,150
Returns Per Craft								
With Improvements (Ideal Conditions)								
% Annual Return		4/	4/	9%	15%	9%	9%	15%
Net Annual Return		$ 7,880	$ 7,940	$ 1,830	$ 901	$ 2,010	$ 1,920	$ 1,070
W/O Improvements		0%	0%	0%	0%	0%	0%	10.5%
% Annual Return		$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 751
Net Annual Return								
Annual Benefit 6/								
1985		$23,600	$ 7,940	$ 97,000	$12,600	$16,100	$ 3,840	$43,100
1988		23,600	7,940	110,000	14,400	20,100	3,840	50,700
1990		23,600	7,940	110,000	14,400	20,100	3,840	55,800
1995		23,600	7,940	110,000	14,400	20,100	3,840	69,500
2000		23,600	7,940	110,000	14,400	20,100	3,840	82,300
2010		23,600	7,940	110,000	14,400	20,100	3,840	82,300
2035		23,600	7,940	110,000	14,400	20,100	3,840	82,300
Equivalent Average Annual Benefit 7/		$23,600	$ 7,940	$109,000	$14,300	$19,800	$ 3,840	$68,400

1/ From Table A-2 (includes two transient vessels; excludes trailer-mounted vessels). Growth in trailer-mounted boats proportional to growth in number of registered vessels.

2/ Moored fleet distribution - commercial and transient vessel share of moored fleet is a constant. Recreation vessels based on distribution similar to that for Port Allen Boat Harbor, also on southern Kauai: inboards - 70%; outboards - 19%; and sailboats - 11%.

3/ This is a weighted average of the average depreciated values of vessel types expected to stop as transients and require temporary mooring (50% sailboats and 50% cruisers/inboards).

4/ Estimated returns for charter vessels and full-time fishing boats derived from information proveded by operators of these types of craft on Maui.

5/ Derived from a survey of boat owners using harbors on Maui.

6/ Annual Benefit for Each Year = (No. of Vessels) x (Net Annual Return w/Improvements - Net Annual Return w/o Improvements).

7/ Annualized discounted stream of benefits at 7-1/8%, 50-year period of analysis.

TABLE A-5. NAVIGATION AND FISHING BENEFITS - PLAN 3

YEAR	TOTAL 1/ HARBOR MOORING	COMMERCIAL		RECREATION				
		FISHING	CHARTER	CRUISERS AND OTHER INBOARDS	OUTBOARDS	SAIL WITH POWER	TRANSIENT	TRAILER
Prospective Fleet With Improvements 2/								
1985	81	3	1	53	14	8	2	135
1990	101	3	1	67	18	10	2	175
1992	110	3	1	73	20	11	2	192
1995	110	3	1	73	20	11	2	218
2000	110	3	1	73	20	11	2	258
2010	110	3	1	73	20	11	2	258
2035	110	3	1	73	20	11	2	258
Prospective Fleet w/o Improvements								
1985	0	0	0	0	0	0	0	135
1990	0	0	0	0	0	0	0	175
1995	0	0	0	0	0	0	0	218
2000	0	0	0	0	0	0	0	258
2010	0	0	0	0	0	0	0	258
2035	0	0	0	0	0	0	0	258
Average Depreciated Value/Vessel 5/		$26,400	$82,300	$ 20,300	$ 6,010	$22,300	$21,300 3/	$ 7,150
Returns Per Craft								
With Improvements (Ideal Conditions)		4/	4/	9%	15%	9%	9%	15%
% Annual Return		$ 7,880	$ 7,940	$ 1,830	$ 901	$ 2,010	$ 1,920	$ 1,070
Net Annual Return								
W/O Improvements		0%	0%	0%	0%	0%	0%	10.5%
% Annual Return		$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 751
Net Annual Return								
Annual Benefits 6/								
1985		$23,600	$ 7,940	$ 97,000	$12,600	$16,100	$ 3,840	$43,100
1990		23,600	7,940	123,600	16,200	20,100	3,840	55,800
1992		23,600	7,940	134,000	18,000	22,100	3,840	61,200
1995		23,600	7,940	134,000	18,000	22,100	3,840	69,500
2000		23,600	7,940	134,000	18,000	22,100	3,840	92,300
2010		23,600	7,940	134,000	18,000	22,100	3,840	92,300
2035		23,600	7,940	134,000	18,000	22,100	3,840	92,300
Equivalent Average Annual Benefit 7/		$23,600	$ 7,940	$127,000	$17,000	$20,900	$ 3,840	$68,400

1/ From Table A-2 (includes two transient vessels; excludes trailer-mounted vessels). Growth in trailer-mounted boats proportional to growth in number of registered vessels.

2/ Moored fleet distribution - commercial and transient vessel share of moored fleet is a constant. Recreation vessels based on distribution similar to that for Port Allen Boat Harbor, also on southern Kauai: inboards - 70%; outboards - 19%; and sailboats - 11%.

3/ This is a weighted average of the average depreciated values of vessel types expected to stop as transients and require temporary mooring (50% sailboats and 50% cruisers/inboards).

4/ Estimated returns for charter vessels and full-time fishing boats derived from information provided by operators of these types of craft on Maui.

5/ Derived from a survey of boat owners using harbors on Maui.

6/ Annual Benefit for Each Year = (No. of Vessels) x (Net Annual Return w/Improvements - Net Annual Return w/o Improvements).

7/ Annualized discounted stream of benefits at 7-1/8%, 50-year period of analysis.

would have labor costs of 17.6% of total construction cost. The construction work force has been calculated to be about 50% skilled and 50% unskilled workers. Their wages were multiplied by .30 and .47, respectively, to compute the NED portion of the wages (Case 1). The number of insured unemployed construction industry workers averaged 120 per month on Kauai for 1979. The plan employing the largest amount of workers, Plan 4, will employ 9 skilled and 9 unskilled workers previously unemployed. Their respective wages would total $231,000 and $201,000. EDA benefits for the 4 plans are calculated in Table A-6.

TABLE A-6. EDA BENEFIT (1000'S)

Plan	Construction Cost	Wages Paid to Local Labor[1/]			EDA[2/] Benefit
		Skilled	Unskilled	Other	
1	$2,078	$195	$170	--	$10.2
2	2,196	206	180	--	10.8
3	2,290	215	188	--	11.3
4	2,453	231	201	--	12.1

1/ Skilled = 9.4% of construction cost; unskilled = 8.2% of construction cost; data on other wages not available.

2/ Benefit = annual equivalent of (.3) x (skilled wages) + (.47) x (unskilled wages) + (.35) x (other wages), at 7-1/8%, 50-year period of Analysis, per Case 1, NED Employment Benefits, U.S. Water Resources Council.

SUMMARY AND ALLOCATION OF BENEFITS

18. The average annual benefits anticipated for the four proposed plans are summarized in Table A-7. The benefits are allocated to the categories of general and local, for cost sharing purposes.

TABLE A-7. SUMMARY AND ALLOCATION OF PROJECT BENEFITS
(1,000's)

BENEFIT CATEGORY	PLAN 1 (105 BOATS)			PLAN 2 (92 BOATS)			PLAN 3 (110 BOATS)			PLAN 4 (105 BOATS)		
	TOTAL	GENERAL	LOCAL	TOTAL	GENERAL	LOCAL	TOTAL	GENERAL	LOCAL	TOTAL	GENERAL	LOCAL
Recreational	$232	$116	$116	$215	$107.5	$107.5	$237	$118.5	$118.5	$232	$116	$116
Commercial	32	32	0	32	32	32	32	32	0	32	32	0
Total w/o EDA Benefit	$264	$148	$116	$247	$139.5	$107.5	$269	$150.5	$118.5	$264	$148	$116
(% of Total)	(100)	(56.1)	(43.9)	(100)	(56.5)	(43.5)	(100)	(55.9)	(44.1)	(100)	(56.1)	(43.9)
EDA Benefit	$ 10	-	-	$ 11	-	-	$ 11	-	-	$ 12	-	-
TOTAL	$274	-	-	$258	-	-	$280	-	-	$276	-	-

APPENDIX B

DESIGN ANALYSIS

APPENDIX B

DESIGN ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS

LIST OF PLATES

APPENDIX B

DESIGN ANALYSIS

WAVE EXPOSURE AND REFRACTION ANALYSIS

1. Kikiaola Harbor is exposed to deep water waves approaching from S 46° E clockwise to N 82° W (Plate B-1). The harbor is directly exposed to wave attack from the south and indirectly exposed from the north. The indirect exposure from the north can produce large waves as a result of north Pacific storm waves. However, these waves refract around the western tip of Kauai before reaching the project area. The wave attack from the south is more likely to produce maximum wave conditions. A detailed computer-aided refraction analysis was performed for wave attacks from the southern exposure regime. Results of the refraction analysis were used to locate wave energy convergence zones near the harbor and determine critical wave crest alignment at the proposed entrance channel. Critical wave crest alignment is used in wave diffraction analaysis discussed later.

2. Examination of the southern exposure regime indicated a range of possible deep water wave attacks from S 23° E to due south. Wave refraction analyses were performed for waves approaching from S 23° E, S 11.5° E, and due south with periods ranging from 8 to 16 seconds. A computer program from the U.S. Army Engineer Waterways Experiment Station was employed in a two-step analysis to perform these refraction diagrams. Step one of the analysis carried wave rays from deep water to a depth of 70 feet. Step two carried wave rays from a depth of 70 feet to the harbor area.

3. Results of step one indicated that deepwater waves approaching from S 23° E, S 11.5°E, and due south could affect Kikiaola Harbor. Waves from due south, however, appear to be most likely to cause critical wave attacks because of higher refraction coefficients. Table B-1 shows average refraction coefficients and approach directions for the various wave periods.

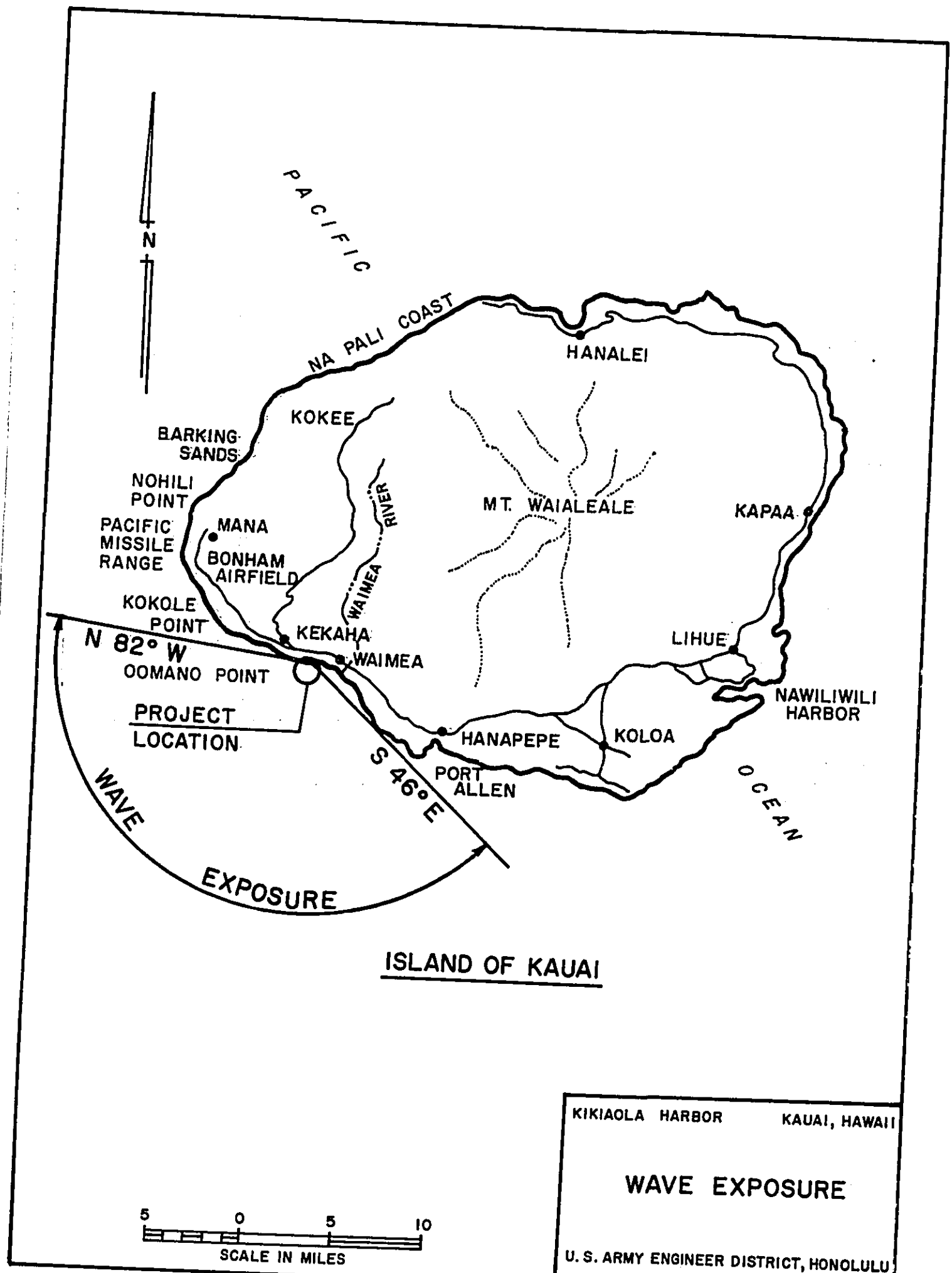

N
PACIFIC
NA PALI COAST
HANALEI
KOKEE
BARKING SANDS
NOHILI POINT
PACIFIC MISSILE RANGE
MANA
BONHAM AIRFIELD
WAIMEA RIVER
MT. WAIALEALE
KAPAA
KOKOLE POINT
KEKAHA
WAIMEA
LIHUE
N 82° W
OOMANO POINT
PROJECT LOCATION
NAWILIWILI HARBOR
HANAPEPE
KOLOA
PORT ALLEN
S 46° E
WAVE EXPOSURE
OCEAN
ISLAND OF KAUAI
5 0 5 10
SCALE IN MILES
KIKIAOLA HARBOR KAUAI, HAWAII
WAVE EXPOSURE
U. S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE B-1

TABLE B-1. WAVE REFRACTION DATA

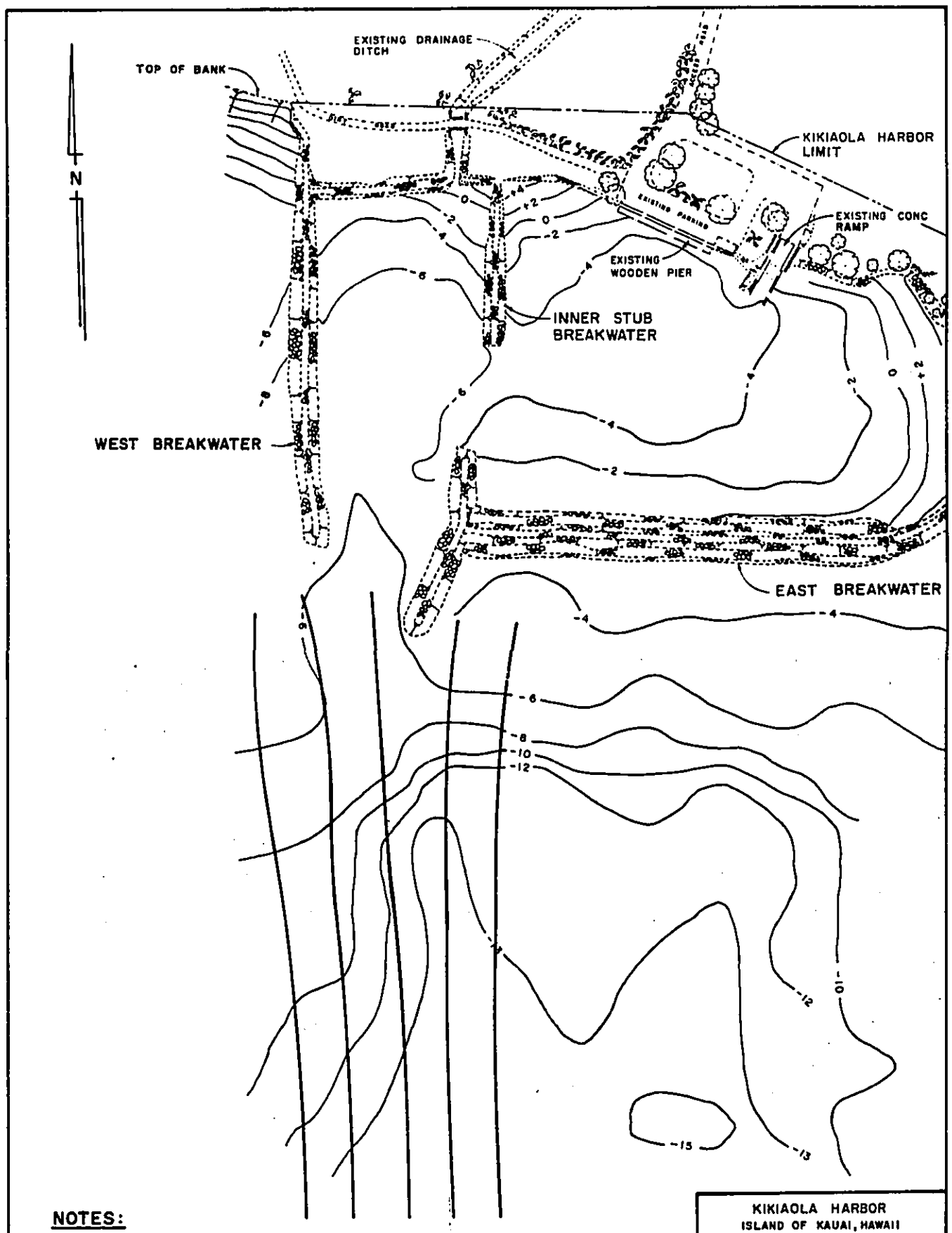
DEEPWATER WAVE APPROACH	WAVE PERIOD (SECONDS)	AVERAGE REFRACTION COEFFICIENT	WAVE APPROACH AT -6' CONTOUR
S 23° E	8	0.98	160°
	10	0.99	159°
	12	0.97	160°
	14	0.98	159°
	16	0.93	160°
S 11.5° E	8	0.99	170°
	10	0.97	169°
	12	0.97	170°
	14	0.95	169°
	16	0.90	166°
Due South	8	0.99	177°
	10	0.97	176°
	12	1.00	177°
	14	0.98	174°
	16	0.99	177°

4. Wave rays with the highest refraction coefficients and directions likely to affect the harbor were transferred to a larger grid scale for step two analysis. To insure adequate coverage and account for possible discrepancies, each transferred ray was replaced by 3 sets of 7 to 10 rays each. Approach directions for the 3 sets were based on the direction of the ray from step one. Directions of the 3 sets were 2 degrees apart with the center direction being that of the transferred ray.

5. Results of the refraction analysis indicate that large southern swell waves, especially those approaching from due south with 12-second periods, are the critical waves affecting the harbor. The refraction diagram, Plate B-2, shows that the proposed entrance channel is located in an area of wave divergence and for this reason it is situated in the most desirable location.

WAVE DIFFRACTION ANALYSIS

6. A theoretical wave diffraction analyses, Plates B-3 to B-6, were conducted for the four plans. Incident wave direction was determined from the refraction analysis described previously. Angle of approach at the entrance channel mouth was determined to be from S 3° E. Diffraction analyses were performed in accordance with procedures, techniques, and diagrams described in the CERC Shore Protection Manual (SPM).



NOTES:

1. DEEPWATER WAVES ARE APPROACHING FROM DUE SOUTH.
2. PERIOD IS 12 SECONDS.

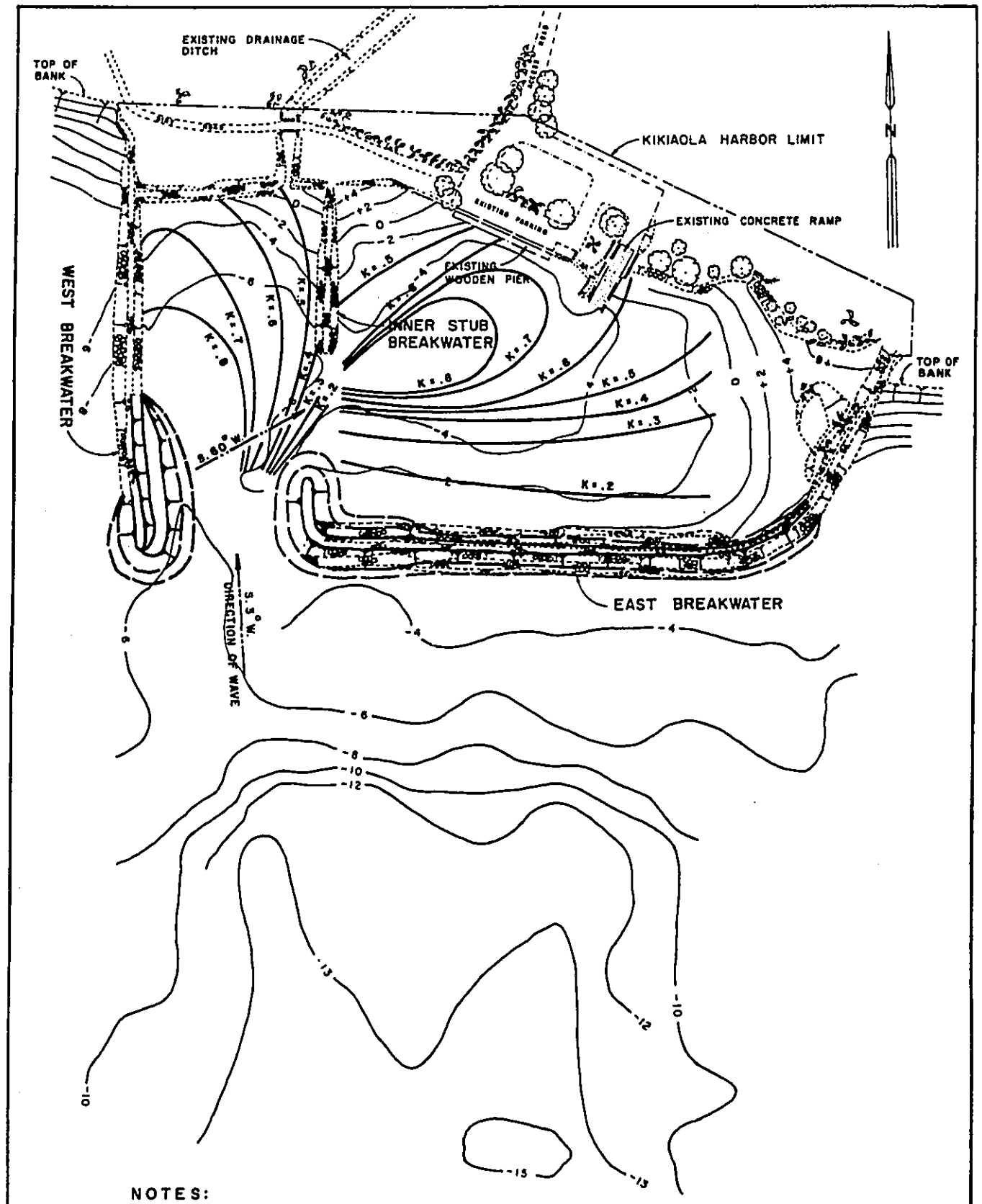
GRAPHIC SCALE
60' 30' 0 60' 100'

KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII

REFRACTION DIAGRAM

U.S. ARMY ENGINEER DISTRICT
HONOLULU

PLATE B-2



NOTES:

1. WAVE HEIGHT AT THE CHANNEL MOUTH IS 9.8 FEET.
2. PERIOD IS 12 SECONDS.

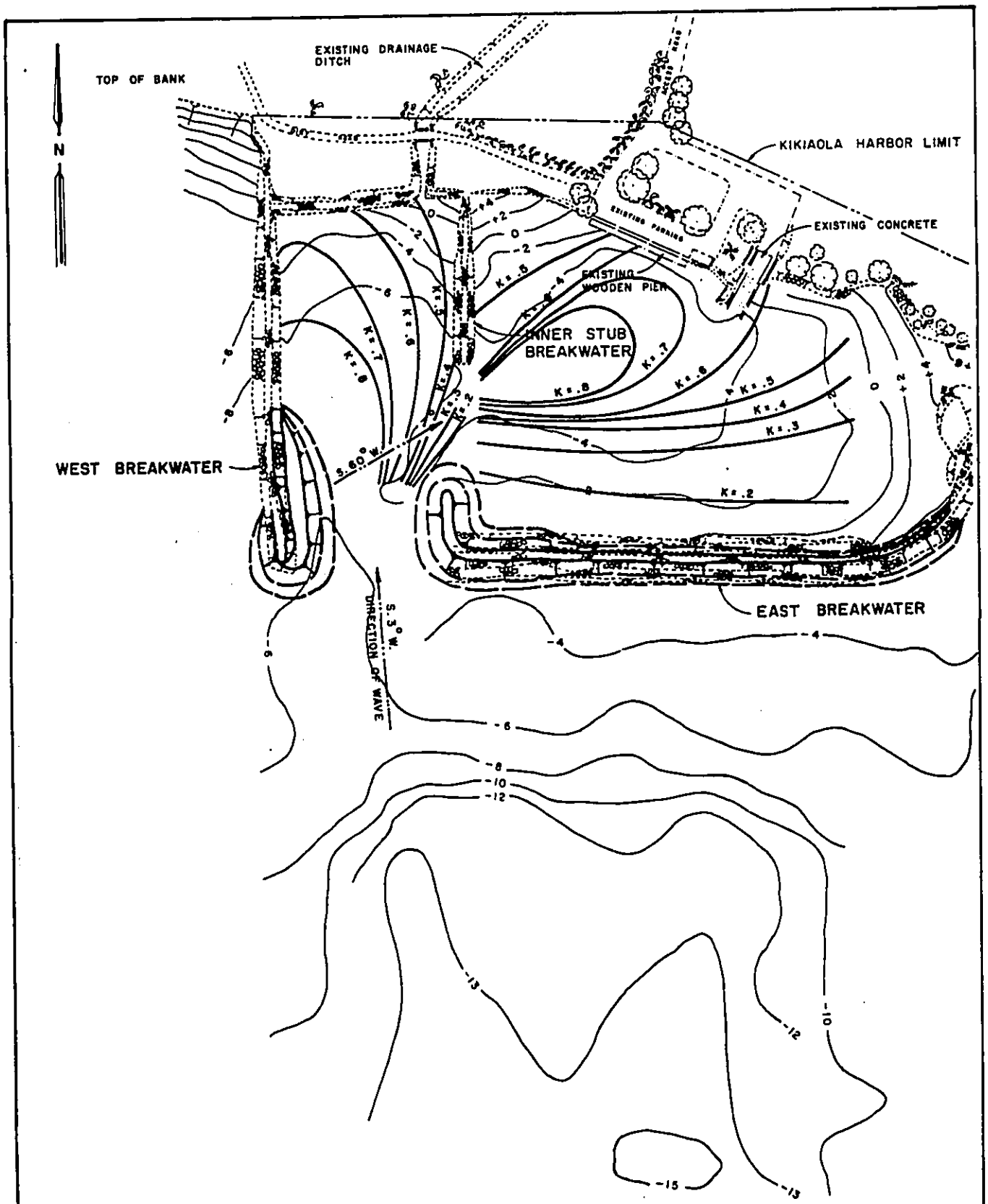
GRAPHIC SCALE
50' 25' 0 50' 100'

KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII

PLAN I
DIFFRACTION DIAGRAM

U.S. ARMY ENGINEER DISTRICT
HONOLULU

PLATE B-3



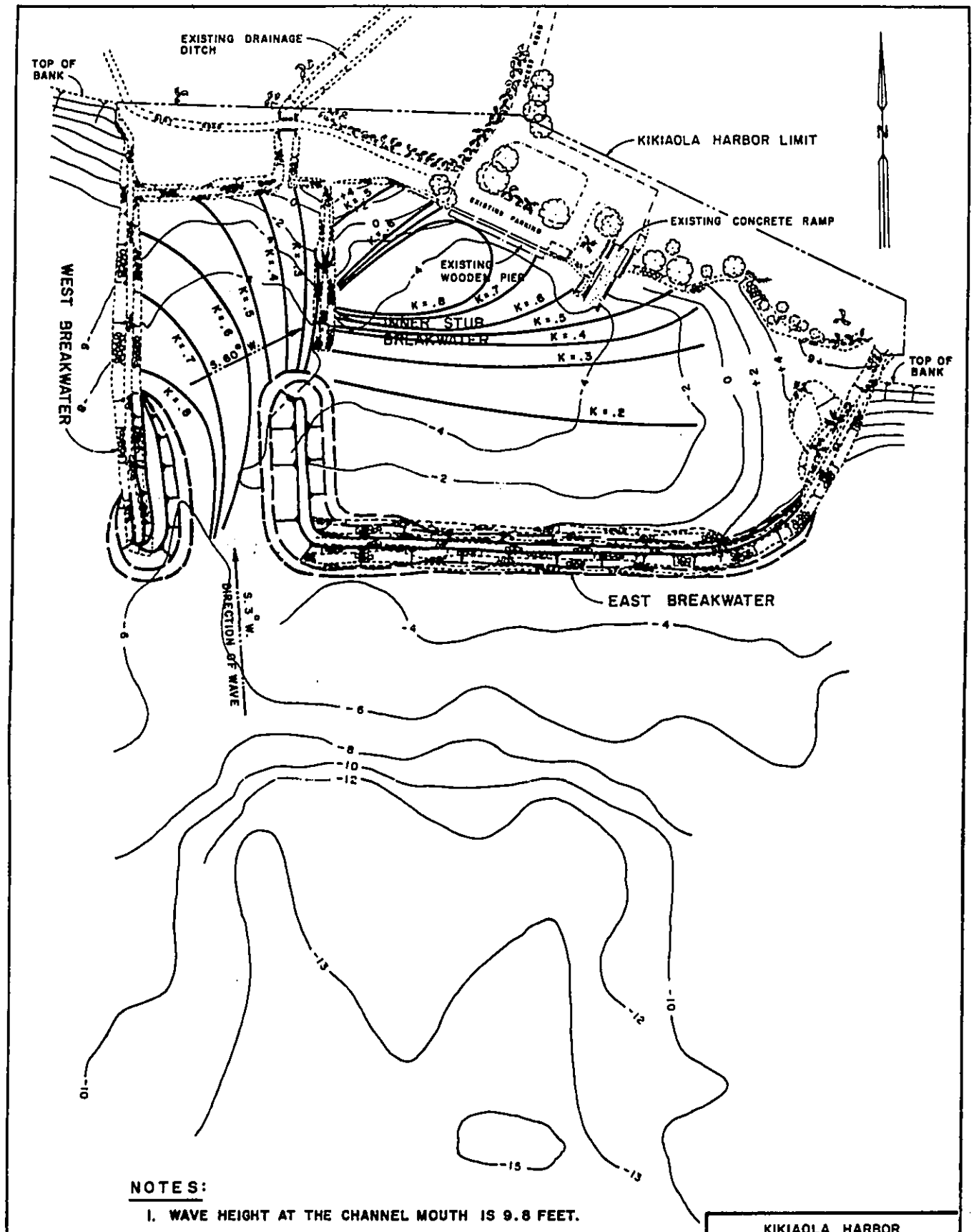
NOTES:

1. WAVE HEIGHT AT THE CHANNEL MOUTH IS 9.8 FEET.
2. PERIOD IS 12 SECONDS.

GRAPHIC SCALE
80' 40' 0 80' 100'

KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII
PLAN 2
DIFFRACTION DIAGRAM
U.S. ARMY ENGINEER DISTRICT
HONOLULU

PLATE B-4



NOTES:

1. WAVE HEIGHT AT THE CHANNEL MOUTH IS 9.8 FEET.
2. PERIOD IS 12 SECONDS.

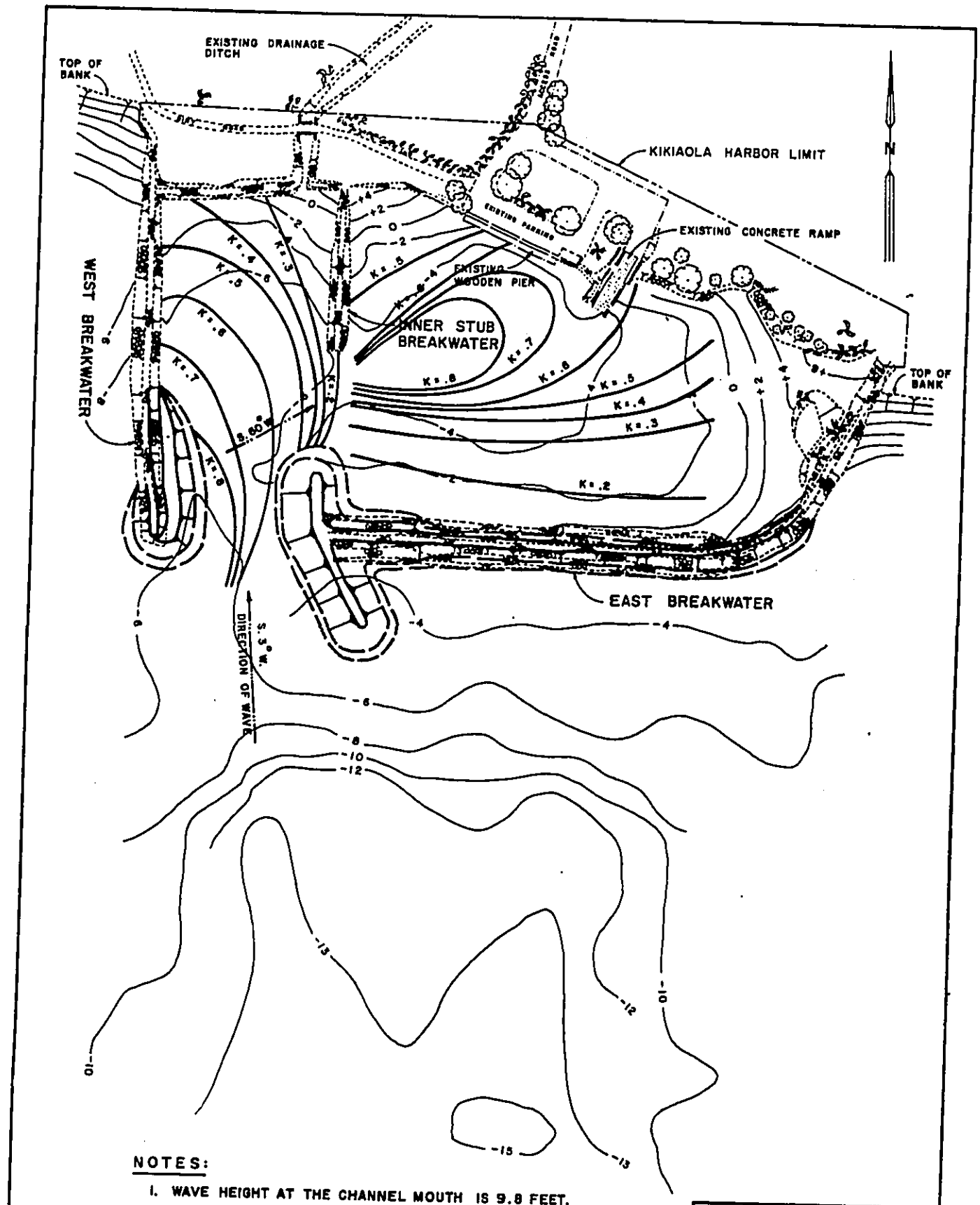
GRAPHIC SCALE
50' 25' 0 50' 100'

KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII

PLAN 3
DIFFRACTION DIAGRAM

U.S. ARMY ENGINEER DISTRICT
HONOLULU

PLATE B-5



NOTES:

1. WAVE HEIGHT AT THE CHANNEL MOUTH IS 9.8 FEET.
2. PERIOD IS 12 SECONDS.

GRAPHIC SCALE
50' 25' 0 50' 100'

KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII

PLAN 4
DIFFRACTION DIAGRAM

U.S. ARMY ENGINEER DISTRICT
HONOLULU

PLATE B-6

7. The theoretical wave incident to the breakwater opening at the channel mouth is assumed to be a broken wave of 9.8 feet, based on an average depth of 12.5 feet and slope of m = 0.0. A breakwater opening, leading into the harbor basin, produces a secondary diffraction effect. Derivation of wave height at the channel mouth is further discussed under "Design Wave Height," paragraph 13. Lines of equal diffraction coefficient are plotted and labeled on diffraction diagrams. Wave height at any point within the entrance channel is determined by multiplying the diffraction coefficient by the incident wave height. Wave height in the harbor basin area is computed by multiplying the incident wave height, H_b, by the diffraction coefficient, K, in the entrance channel and the diffraction coefficient, K, in the harbor basin (H_b x K = Channel X K = Basin).

STILLWATER LEVEL

8. The stillwater level (SWL) is defined as the level of water above the elevation datum plane when no waves are present. Components of the SWL are astronomical tide level (S_a), wave setup (S_w), atmospheric pressure induced level (S_p), and storm surge (S_s). Stillwater level components are calculated as follows:

a. Astronomical tide level, S_a: Maximum astronomical tide expected is estimated to be about 0.4 foot above the mean higher high water level of 1.6 feet, discussed in Section B of the main report. Total astronomical tide level is 1.6' + 0.4' = 2.0 feet.

b. Wave setup, S_w: Wave setup is estimated from calculated theoretical values being that the location of the primary protective structure is not in the area of maximum wave setup. For engineering calculations, a value of 0.5 foot is used for S_w.

c. Atmospheric pressure induced level, S_p: The following storm parameters were used in calculating S_p: A 1-inch central pressure drop of mercury (Hg), a 20-mile radius of maximum wind, and a distance of 35 miles to the storm center. The resulting water level rise is calculated to be 0.5 foot.

d. Storm surge, S_s: Storm surge is estimated rather than calculated because of difficulty in assessing values for complex hydrographic conditions. The estimated storm surge of 0.5 foot is used.

Therefore,

$$SWL = S_a + S_w + S_p + S_s$$
$$= 2.0' + 0.5' + 0.5' + 0.5'$$
$$= 3.5 \text{ feet}$$

CHANNELS AND TURNING BASIN DESIGN

9. Design Vessel. The entrance channel, turning basin, and access channel are designed to provide safe navigation for vessels up to lengths of 45 feet, 14-foot beam, and 5-foot draft. These dimensions are characteristic of fishing boats which are the largest vessel anticipated to use the harbor.

10. Entrance Channel Design. The minimum width and depth of the entrance channel were computed as follows:

Minimum Width = 5 x Design vessel Beam x 1.5 to allow for navigation through waves
= 5 x 14' x 1.5
= 105 feet

Depth:

Draft	5 feet
Bottom Clearance and Squat	2 feet
Wave Allowance	4 feet
Minimum Tide Below MLLW	1 foot
Total Channel Depth	12 feet

Although the minimum entrance channel width is 105 feet, a flared entrance channel width of 205 feet at the seaward end is provided. A flared entrance channel will dissipate wave energy and cause less wave disturbance at the channel mouth.

11. Turning Basin Design. The length, width, and depth of the turning basin were computed as follows:

Minimum Length and Width = 2.5 x Design Vessel Length
= 2.5 x 45 feet
= 112.5 feet
Use: 115 feet

Depth:

Plan 2

Draft	5 feet
Bottom Clearance and Squat	2 feet
Wave Allowance	2 feet
Minimum Tide Below MLLW	1 foot
Total Basin Depth	10 feet

12. Access Channel Design. The width and depth of the access channel were computed as follows:

Minimum Width = 5 x Design Vessel Beam
= 5 x 14 feet
= 70 feet

Depth:

Draft	5 feet
Bottom Clearance and Squat	1 foot
Wave Allowance	1 foot
Minimum Tide Below MLLW	1 foot
Total Access Channel Depth	8 feet

DESIGN WAVE HEIGHT

13. Breakwater design is based on depth-controlled breaking wave criteria which determines the maximum wave height to which the structure might be subjected. The design wave height is based on depth at the structure toe, wave period, and slope (m) seaward of structure toe.

14. Design wave heights computed for the east and west breakwater heads, inner and outer east stub breakwaters, and used for the diffraction analyses were based on average depth across the channel mouth.

Channel: 12 feet (depth) + 3.5 feet (SWL) = 15.5 feet
Adjacent Area: 6 feet (depth) + 3.5 feet (SWL) = 9.5 feet
Average Depth: $\frac{15.5 \text{ feet} + 9.5 \text{ feet}}{2}$ = 12.5 feet (d_s)

Therefore, for constant channel depth, m (slope) = 0.0
and from SPM, Figure 7-4,

$$\frac{H_b \text{ (design wave height)}}{d_s \text{ (depth)}} = 0.78,$$

Design Wave Height = 12.5 *feet* x 0.78
= 9.8 feet

15. The design wave height for the east breakwater trunk was computed on depth at the structure toe, d_s, of 7 feet, 12-second wave period, and slope of m = 0.006. From SPM, Figure 7-4,

$$\frac{H_b \text{ (design wave height)}}{d_s \text{ (depth)}} = 0.83,$$

Design Wave Height = 7.0 feet x 0.83
= 5.8 feet

16. Table B-2 shows the design wave heights obtained for the applicable structures.

TABLE B-2. DESIGN WAVE HEIGHTS

Structure	Design Wave Heights (Feet)
East and West Breakwater Heads	9.8
East Breakwater, Trunk	5.8
Inner and Outer East Stub Breakwaters	9.8

DESIGN FACTORS

17. The Coastal Engineering Research Center's Shore Protection Manual (SPM) design formulas were used to determine the weight of the stones and the thickness of the stone layers. Table B-3 shows the design factors used in computing the armor layer design.

TABLE B-3. DESIGN FACTORS

STRUCTURE	UNIT WEIGHT OF ARMOR STONE W_r	SPECIFIC GRAVITY OF ARMOR STONE S_r	STABILITY COEFFICIENT K_D	SIDE SLOPE Cot θ	LAYER THICKNESS n	LAYER COEFFICIENT $K\Delta$	DESIGN WAVE HEIGHT H_b
East Breakwater Head	156 lbs/ft^3	2.44	2.5	1:2	1 and 2	1.15	9.8 feet
East Breakwater Trunk	156 lbs/ft^3	2.44	3.5	1:5	1	1.15	5.8 feet
West Breakwater Head	156 lbs/ft^3	2.44	2.5	1:2	1 and 2	1.15	9.8 feet
Inner & Outer East Stub Breakwaters	156 lbs/ft^3	2.44	2.5	1:2	2	1.15	9.8 feet

18. East Breakwater Design. Armor stone size and armor layer thickness for the east breakwater head section were computed as follows:

$$\text{Armor stone size,} \quad W = \frac{W_r H_b^3}{K_D (S_r-1)^3 \cot \theta}$$

$$= \frac{(156)(9.8)^3}{(2.5)(2.44-1)^3(2.0)}$$

$$= 9{,}800 \text{ lbs}$$

Range of armor stone size: .75W to 1.25W = 3.5 - 5.0 tons

$$\text{Armor layer thickness, two layers} = nK_\Delta \left(\frac{W}{W_r}\right)^{1/3}$$

$$= (2)(1.15)\left(\frac{8500}{156}\right)^{1/3}$$

$$= 8.6 \text{ feet}$$

$$\text{One layer} = 4.3 \text{ feet}$$

Armor stone size and armor layer thickness for the east breakwater trunk section were computed in a similar way. Table B-4 shows the results of the computations.

TABLE B-4. STONE WEIGHT AND LAYER THICKNESS FOR EAST BREAKWATER

	ARMOR LAYER		BEDDING LAYER	
STATION	DESIGN STONE WEIGHT (tons)	LAYER THICKNESS (feet)	STONE WEIGHT (pounds)	DESIGN LAYER THICKNESS (feet)
2+50 to 8+20 (Trunk)	1.0-2.0	3.1 (1 layer)	Spalls to 100	2.5
8+70 to 9+85 (Head)	3.5-5.0	4.3 (1 layer)	Spalls to 200	2.5

19. Wave runup and resulting crest elevation for the trunk and head sections of the east breakwater were based on CERC report number CETA 79-1, "Wave Runup on Rough Slopes." The runup computations were based on a 12-second wave period, 3.5-foot stillwater level, and 1 vertical on 2 horizontal side slope for the head section and 1 vertical on 1.5 horizontal side slope for the trunk section. The computed runup for the head section was 9.8 feet and resulted in a crest elevation of 13.3 feet (9.8' + 3.5' SWL = 13.3'). The computed runup for the trunk section was 7.3 feet and resulted in a crest elevation of 10.8 feet (7.3' + 3.5' SWL = 10.8').

20. As discussed in paragraph 10, the flared entrance channel and flat dredged side slope, 1V on 5H, will dissipate wave energy and reduce wave height at the channel mouth. Therefore, allowing for minor overtopping during the most severe wave conditions, crest elevation for the head section was set at +12 feet MLLW. The crest elevation for the trunk section was set at +11.0 feet MLLW.

21. West Breakwater Head Design. Dredging the entrance channel will alter existing conditions and require that the existing breakwater be modified to withstand bigger waves. Computations for armor stone size and armor layer thickness are the same as the east breakwater head section. Table B-5 shows the results of the computations.

TABLE B-5. STONE WEIGHT AND LAYER THICKNESS FOR WEST BREAKWATER HEAD

	ARMOR LAYER		UNDERLAYER		BEDDING LAYER	
STATION	DESIGN STONE WEIGHT (ton)	LAYER THICKNESS (feet)	DESIGN STONE WEIGHT (pounds)	DESIGN LAYER THICKNESS (feet)	STONE WEIGHT (pounds)	LAYER THICKNESS (feet)
3+80 to 6+00	3.5-5.0	8.6 (2 layers) 4.3 (1 layer)	500-1,500	4.3	Spalls to 200	2.5

22. Crest elevation was set at the existing elevation of +8 feet MLLW. Overtopping of the structure will occur during storm wave conditions.

23. Inner and Outer East Stub Breakwaters Design. Computations for armor stone size and armor layer thickness are similar to the east breakwater head section. Table B-6 shows the results of the computation.

TABLE B-6. STONE WEIGHT AND LAYER THICKNESS FOR INNER AND OUTER EAST STUB BREAKWATERS

	ARMOR LAYER		UNDERLAYER		BEDDING LAYER	
STATION	DESIGN STONE WEIGHT (ton)	LAYER THICKNESS (feet)	DESIGN STONE WEIGHT (pounds)	DESIGN LAYER THICKNESS (feet)	STONE WEIGHT (pounds)	LAYER THICKNESS (feet)
Inner:						
Plans 1, 2 and 4 9+85 to 10+70	3.5-5.0	8.6	500-1,500	4.3	Spalls to 200	2.5
Plan 3 9+85 to 11+80	3.5-5.0	8.6	500-1,500	4.3	Spalls to 200	2.5
Outer:						
0+00 to 1+40	3.5-5.0	8.6	500-1,500	4.3	Spalls to 200	2.5

24. Computed wave runup results for the two stub breakwaters is similar to the east breakwater head. The incident wave approaches the two stub breakwaters at an angle of 90 degrees, angle between wave crest and breakwater. The striking wave runs along the structure, increasing the effective surface area available for wave energy dissipation and decreasing the wave runup. Although the wave runup was computed to be 9.8 feet, with a crest elevation of 13.3 feet, crest elevations for the two stub breakwaters were set at +12 feet MLLW, allowing for minor overtopping.

SEDIMENT STUDY

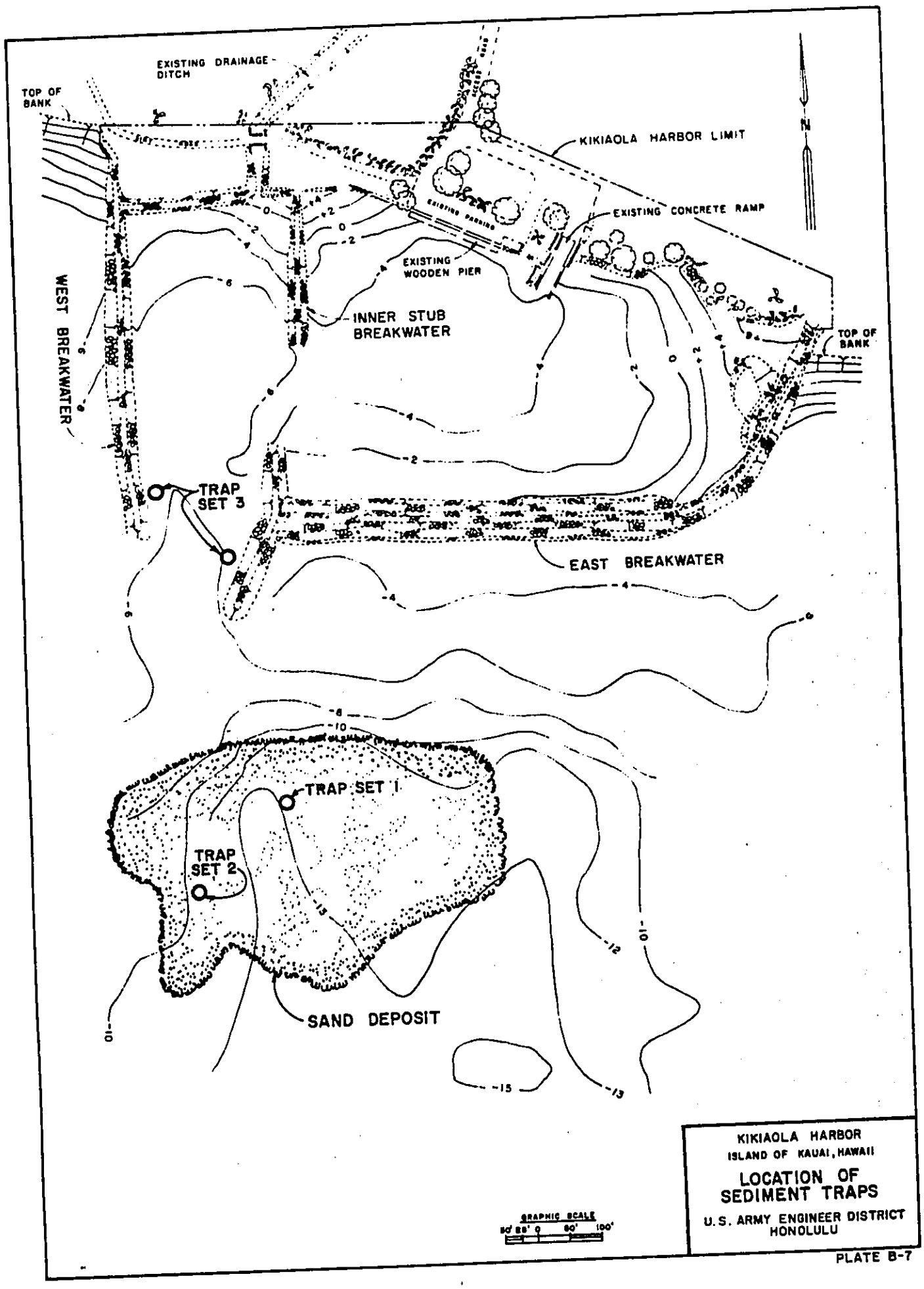
25. The ocean bottom off Kikiaola Harbor consists of sand channels and deposits, interspersed with coral reef segments. The offshore sand deposit is located approximately 200 feet from the tip of the outer east stub breakwater. An engineering investigation was conducted to measure alongshore sediment transport. Sediment traps were emplaced offshore from the harbor area (Plate B-7). One set of traps, trap set 1, was emplaced in the sand deposit just seaward of the proposed entrance channel alignment.

26. Each trap set consisted of two traps running parallel to the coast, one facing east and the other facing west. The trap set would therefore catch littoral drift moving in either direction and the absolute sum of measurements would total gross alongshore transport. It should be noted that gross alongshore transport is different from net alongshore transport. Net alongshore transport is the difference between east and west littoral drifts.

27. Study results showed that sand filled sediment traps to normal capacity each time they were emplaced. Study results also showed great movement of sediments in the sand deposit area. This was determined by measurement of gross alongshore transport taken during the two-hour trap emplacement. A gross transport rate of 0.357 cubic yard per day per foot of width was measured. Assuming that gross alongshore transport is approximately the same throughout the surf zone, but limited primarily to the 400 feet wide sand deposit area in the channel vicinity, the yearly gross transport (in both directions) would be 52,000 cubic yards. This estimate is based on a very brief (2-hour) measurement.

28. During the course of the investigation, sediment traps were not set shoreward of the sand deposit, as breaking waves prevented boat and divers from operating in the area. However, two sediment traps, trap set 3 were placed at the seaward end of the harbor entrance to estimate the rate of sediment transport into the harbor. The measured transport rate was 0.0026 cubic yard per foot width per day. For the 200-foot wide opening, the yearly transport would be approximately 190 cubic yards per year.

29. Based on the sediment study results, which indicated that there is a highly active littoral movement zone offshore of the harbor, it is estimated that approximately 13,000 cubic yards of material would be dredged every 5 years. High maintenance dredging requirements were based on removing 4 feet of shoaled material in the entrance channel (seaward end to channel mouth), 2 feet in the inner channel and 1 foot in the access channel.


EXISTING DRAINAGE DITCH
TOP OF BANK
KIKIAOLA HARBOR LIMIT
N
EXISTING CONCRETE RAMP
EXISTING WOODEN PIER
WEST BREAKWATER
INNER STUB BREAKWATER
TOP OF BANK
TRAP SET 3
EAST BREAKWATER
TRAP SET 1
TRAP SET 2
SAND DEPOSIT
GRAPHIC SCALE
50' 25' 0 50' 100'
KIKIAOLA HARBOR
ISLAND OF KAUAI, HAWAII
LOCATION OF SEDIMENT TRAPS
U.S. ARMY ENGINEER DISTRICT HONOLULU
PLATE B-7

CURRENTS

30. Measurements taken during the sediment study indicate that the surface currents in the vicinity of Kikiaola Harbor are predominantly wind driven. Surface drogues released near the harbor entrance moved in response to the prevailing wind. Turbid water from the harbor or from dredging operations can be expected to move approximately downwind. Due to the reflection of the tradewinds around the island, the downwind direction during tradewind conditions would be predominantly alongshore. During Kona winds, the downwind direction would be predominantly onshore.

APPENDIX C

GEOLOGY, FOUNDATIONS AND MATERIALS

APPENDIX C

GEOLOGY, FOUNDATIONS AND MATERIALS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

APPENDIX C

GEOLOGY, FOUNDATIONS AND MATERIALS

REGIONAL GEOLOGY

1. Kauai consists of a single, large, shield volcano built from the sea floor by many thousands of thin flows of lava basalt (Reference 5). Toward the end of growth of the shield about five million years ago (Reference 9) the volcano summit collapsed to form a broad, well-defined central depression (caldera). The town of Lihue is located on the southeast edge of this huge depression. The high mountains Kawaikini and Waialeale on the west side are erosional remnants of the crater rim of the original shield volcano. The huge depression was bordered by less depressed fault blocks, some of which merged imperceptibly with the outer slopes of the volcano. Volcanic activity about one million years ago gradually filled the depression burying piles and ridges of talus along the foot of the boundary cliffs.

SITE GEOLOGY

2. The light-draft vessel harbor at Kikiaola is located on a uniformly straight, low and wide beach that extends for 2.7 miles from Waimea River, to the west, to Oomano Point at Kekaha. The land away from the harbor is a flat, alluvial terrace (or platform), 10 to 15 feet in elevation above sea level, one mile in width and underlain by both alluvial and marine sediments. On the outer or seaward edge of the terrace there is a low beach with calcareous sand dune ridges. At the inner edge, the spurs of lava flows (Waimea Canyon Volcanic Series) are truncated by an ancient sea cliff. The sea covered the terrace in ancient times and deposited a series of calcareous sandstone and sandy limestone benches and reefs. The rock benches and reefs have been removed by erosion (at least down to -12 feet MLLW) over most of the harbor. Remnants of the ancient reefs were found in previous borings and seen in a drainage ditch that empties into the harbor just west of the center groin structure. The composition and gradation of the calcareous sandstone in the ditch is similar to the material found in the black beach sand today, showing that erosional and depositional processes have been the same along this part of the coast for several hundred thousands of years. The sandstone is tightly cemented and requires a jackhammer and considerable effort to excavate. The beach along this section of the Kauai coast is sand, consisting of 60 to 75 percent fine grained pieces of basalt and olivine, and 25 to 40 percent of calcareous skeletal material from shallow water marine plants and animals. Black colored basalt pieces predominate and when wet the sand has a uniform, black appearance. When dry it is black with white specks much like salt and pepper. The material ranges in average size from medium grained sand (1 millimeter) to silt (0.03 millimeter). The detrital basalt sand comes from the Waimea River and mixes with small pieces of limestone rock from coral reef deposits found southeast of the Waimea River and 2,000 feet northwest of Oomano Point, opposite the cemetery at Kekaha. All grains coarser than silt are subrounded to rounded reflecting the ease with which basalt and coral limestone abrade in the surf zone. There is a strong

westward current flowing nearshore that moves the sand along the beach (and in shallow water) so that there is a gradual decrease westward in the percentage of basalt components and an increase in calcareous grains. No appreciable change or variation in size of sand grains was noticed in the 14,000 feet of beach.

SEISMICITY

3. The record of earthquake activity in the Hawaiian Islands indicates much variation in frequency and intensity from location to location. The greatest seismic activity has been observed on the Island of Hawaii which is subjected to frequent and occasionally severe earthquakes. The other major islands experience earthquakes less frequently and generally of lower intensity than the Island of Hawaii.

4. The earthquakes that are frequent on the Island of Hawaii are for the most part related to the volcanic activity. Several severe earthquakes have been recorded and indeed have caused extensive damage and loss of life both from collapse of structures and from tsunamis.

5. In recent years, attention has been given to the seismic events generated by tectonic activity along the Molokai Fracture Zone. The zone of faults lies roughly east-west and transects the chain of principal islands about midway (in the area of Molokai). Actually, a fracture zone consisting of a multitude of faults extends from north of Kauai to south of the Island of Hawaii. These faults run in various directions but generally trend east-west.

6. The possibility of destructive earthquakes originating in this fracture zone lends credibility to the upgrading of Kauai from a Zone 0 to a higher classification. An examination of the seismic history of Kauai indicates that the possibility of earthquake damage should be considered. The April 2, 1868 earthquake, centered south of the Island of Hawaii, was probably the most severe recorded in the islands and has been estimated at 7 to 8 on the Modified Mercalli Scale. This event was felt in Kauai, however, no structural damage was reported.

7. The earthquake occurring on February 19, 1871 was a strong event and was associated with tectonic movements in the fault zones between Oahu and the Island of Hawaii. This event caused severe damage to Maui and Molokai, which were located near the epicenter. This earthquake was felt in Kauai and the movement lasted thirty to forty seconds. Serious damage was not reported.

8. A report published by the Hawaii Institute of Geophysics (Reference 3) contains recommendations for upgrading Kauai from Zone 0 to at least Zone 1. This recommendation is based on historical data for numerous earthquakes in the islands and an evaluation of the possibility of severe earthquake occurrence in the Molokai Fracture Zone.

9. Government design manual TM S-809-10 dated April 1973 shows Kauai located in seismic probability Zone 0. In view of the low probability of loss of life, seismic considerations are not applicable for stability analyses of channel excavation and breakwater structures.

SUBSURFACE INVESTIGATIONS

10. Eleven borings (B-1 to B-11) were made by the Government in March 1965 in connection with an earlier study on Kikiaola Harbor. Supplemental subsurface investigations (B-12 to B-21) were performed during May-June 1980 to confirm preliminary design assumptions in terms of stable cut and fill slopes, potential for settlement and the level of effort required in excavating the entrance channel, turning basin and access channel. Location of explorations are shown on Figure 12 of the main report. Logs of explorations are shown on Plates C-1 and C-2.

LABORATORY TESTING

11. Routine laboratory tests were performed on samples obtained from the subsurface investigtions to determine characteristics of the in-situ materials and develop soil parameters for design. Results of laboratory tests are shown in Table C-1.

SUBSURFACE CONDITIONS

12. A black colored basalt-coral beach sand averaging between 2 and 8 feet in thickness is found in the existing harbor. Red terrestrial silt and clay, washed in by the drainage ditches, overlies the sand in about half the harbor area nearest the beach. The silt and clay measures 1 to 3 feet in thickness. At elevations between 9 and 13 feet below mean lower low water level there is a layer of reef rock 0.3 to 8.5 feet thick, which may be the ancient fringing reef surface formed before deposition of the basalt-coral sands. The subgrade for the breakwater modifications consists mainly of sand-silt mixtures and some terrestrial silt.

DESIGN CONSIDERATIONS

13. Dredgeability. The material to be excavated consists mainly of basalt-coral beach sand and terrestrial silt and clay. Reef rock will be encountered within the lower limits of the excavations. Removal of approximately 28,400 to 34,800 cubic yards of material is required for the construction of the harbor. With the exception of reef rock and the loose and saturated terrestrial silt and clay, the existing materials can be readily removed with an ordinary clamshell dredge. A special "water tight" clamshell bucket will be required for removal of the terrestrial silt and clay. Some drilling and blasting may be required for removal of reef rock.

14. Breakwater Toe Protection. The toe of the modified breakwater structures will be imbedded below the anticipated depth of scour. A 3-foot thick bedding layer will be provided beneath and 5 feet beyond the toe to serve as a filter blanket to prevent foundation materials from migrating through the armor layers and causing the breakwater to settle.

15. Excavation Slopes. Based on slope stability analyses assuming a very loose silty sand foundation, excavation slopes of 1V on 5H are stable for the entrance channel, turning basin and access channel. To preclude slope failures as a result of surcharge loads from adjacent breakwater structures, a minimum berm width of 25 feet will be maintained between the top of excavation and the toe of all breakwater structures.

TABLE C-1: SUMMARY OF SUBSURFACE INVESTIGATION TEST DATA

BORING NO./ SAMPLE NO.	SOIL CLASS	MLLW ELEVATION (FT)	CUMULATIVE % PASSING												SPECIFIC GRAVITY	WATER CONTENT %	NATURAL DRY DENSITY PCF
			1-1/2	1	3/4	1/2	3/8	4	8	16	30	50	100	200			
12-1A	SP-SM	4.0-7.0		100	87	85	84	79	75	70	58	47	27	12	2.80	31.1	94
14-4	SM	19.8-22.8	100	98	93	85	78	68	60	52	42	30	24	17		24.8	
14-5	SP-SM	0.0- 3.0					100	98	94	87	63	31	17	7		26.6	
15-1	SP-SM	2.8-5.8	100	95	88	81	77	72	68	65	60	50	22	11		25.8	
15-4	SM	11.6-14.6	100	98	98	96	94	88	80	72	61	48.3	36	30	2.76	23.4	105
16-1	SP-SM	4.0-7.0	100	96	83	68	63	56	50	44	37	30	16	10	2.70	15.7	119
16-2	SP-SM	7.0-10.0	91	91	81	70	67	61	56	49	42	35	20	11		17.6	
17-1	SP-SM	0.0-1.0	100	94	86	82	76	64	51	42	32	26	20	12		22.4	
17-2	SW-SM	1.5-4.5	100	95	90	82	73	57	43	33	27	23	17	12	2.66	15.6	118
18-1	SP-SM	0.0-3.0	100	92	87	81	75	61	49	40	35	28	19	12		18.7	
18-2	GM	3.0-6.0	100	78	67	62	56	44	36	29	24	20	17	13		20.9	
19-1A	SP-SM	1.0-2.5					100	98	96	93	86	69	36	8		26.0	
19-1B	SM	2.5-4.0			100	96	95	85	73	59	46	37	29	18	3.01	17.0	106
20-1	GP-GM	2.0-4.0	100	93	82	68	64	51	41	35	32	29	21	12	2.47	28.3	91
21-1A	SP-SM	3.5-5.0					100	99	99	98	96	33	16	7		20.3	
21-1B	GM	5.0-6.5	100	75	73	69	65	57	51	44	41	37	26	16		20.8	

16. Breakweater Slopes: Slope stability analyses assuming a very loose silty sand foundation were also performed for the head and trunk sections of the east breakwater. Side slopes of 1V on 2H and 1V on 1.5H were found to be stable for the head and trunk sections, respectively. Results of the above stability analyses were used as a basis in selection of side slopes for the remaining breakwater modifications.

CONSTRUCTION CONSIDERATIONS

17. Silt curtains or other barriers will be used to contain turbidity during dredging of the entrance channel, turning basin and access channel. Disposal of hydraulically-dredged excavated materials on land will require construction of a series of sediment basins to settle out suspended fines prior to discharge of return water to the harbor.

18. An ordinary clamshell will not be efficient in removing the loose, saturated clay-silt material within the harbor since the material will drain out with the water as the clamshell is raised out of the water. A "water tight" clamshell or suction dredge would be more efficient for removing this material.

SOURCES OF CONSTRUCTION MATERIALS

19. Stones reclaimed from the existing breakwaters will be used in the breakwater modifications to the greatest extent possible.

20. The balance of the stone required for the breakwater modifications could be obtained from field stones located on the lower slopes of the Waimea Mountains, 2 to 3 miles northwest of the harbor near Kokee Road and the Waiawa Reservoir. An abandoned quarry site is located just off Alae Road above field No. 4. Drilling and blasting would be required to obtain armor stone from the quarry. Field stones in practically unlimited quantity are available in the cane fields in the Koloa area.

REFERENCES

1. Chamberlain, Nearshore Oceanographic Investigations, Cable Route Surveys, Nohili Point, Kauai, Hawaii Institute of Geophysics, University of Hawaii, Applied Oceanography Series No. 1.

2. Emery, et al, Beachrock in the Hawaiian Islands, Pacific Science, Vol. X, 1956.

3. Furumoto, et al, A Study of Past Earthquakes, Isoseismic Zones of Intensity, and Recommended Zones for Structural Design for Hawaii, Hawaii Institute of Geophysics, Publ. HIG-73-4, March 1973.

4. Inman, et al, Littoral Sedimentary Processes on Kauai, Pacific Science, Vol. XVII, No. 1, January 1963.

5. MacDonald, et al, Geology and Groundwater Resources of the Island of Kauai, Hawaii, Hawaii Division of Hydrography, Bulletin 13, 1960.

6. Moberly, Loss of Hawaiian Littoral Sand, Hawaii Institute of Geophysics, Journal of Sedimentary Petrology, Vol. 38, No. 1.

7. Moberly, et al, Hawaiian Beach Systems, Hawaii Institute of Geophysics, Report 64-2, Final Report Two Volumes, 1964.

8. Moberly, Final Report of the Inshore Current and Littoral Transport Surveys, Proposed Barking Sands Harbor, Kauai, Hawaii Institute of Geophysics, 1968.

9. McDougall, Potassium-Argon Ages from Lavas of the Hawaiian Islands, Geological Society of America, Bulletin No. 2, Vol. 75, February 1964.

10. Prugh, et al, Dewatering Carbonte Soils of the Pacific, Proceedings of the American Society of Civil Engineers, September 1962, pp. 41-55.

11. U.S. Army Engineer District, Honolulu, Feasibility Study, Barking Sands Harbor, Phase II, Kauai, Hawaii, June 1969.

12. U.S. Army Engineer Division, Pacific Ocean, Detailed Project Report, Beach Erosion Control, Kapaa Beach, Kauai, Hawaii, March 1975.

HOLE NUMBER B-1
PROJECT KIKIAOLA HARBOR
LOCATION N 44 170 E 434 345
DATE STARTED 15 MAR 1965 | DATE COMPLETED 15 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–10.0	WATER
-10.0	10–10.5	CORAL LIMESTONE
-10.5	10.5–13.0	BLACK, LOOSE, SILTY SAND, SM
-13.0	13.0–21.0	LIGHT COLORED CORAL FRAGMENTS, SILT-SAND-GRAVEL MIXTURE, GM/SP
-21.0		

HOLE NUMBER B-2
PROJECT KIKIAOLA HARBOR
LOCATION N 46 255 E 434 380
DATE STARTED 12 MAR 1965 | DATE COMPLETED 12 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–7.5	WATER
-7.5	7.5–14.0	BLACK, LOOSE, SILTY SAND, SM
-14.0	14.0–22.0	LIGHT COLORED CORAL FRAGMENTS, SILTY-SAND-GRAVEL MIXTURE, GM/SP
-22.0		

HOLE NUMBER B-3
PROJECT KIKIAOLA HARBOR
LOCATION N 46 365 E 434 380
DATE STARTED 15 MAR 1965 | DATE COMPLETED 15 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–6.5	WATER
-6.5	6.5–11.0	BLACK, LOOSE, SILTY SAND, SM
-11.0	11.0–11.5	C 100% CORAL LIMESTONE
-11.5	11.5–21.0	LIGHT COLORED CORAL FRAGMENTS, SILTY-SAND-GRAVEL MIXTURE, GM/SP
-21.0		

HOLE NUMBER B-4
PROJECT KIKIAOLA HARBOR
LOCATION N 46 480 E 434 395
DATE STARTED 16 MAR 1965 | DATE COMPLETED 16 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–6.8	WATER
-6.8	6.8–12.8	BLACK, LOOSE, SILTY SAND, SM
-12.8	12.8–13.1	CORAL LIMESTONE
-13.1	13.1–21.0	LIGHT COLORED CORAL FRAGMENTS, SILTY-SAND-GRAVEL MIXTURE, GM/SP
-21.0		

HOLE NUMBER
PROJECT KIKIAOLA HARBO
LOCATION N 46 655
DATE STARTED 11 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–8.0	WATER
-8.0	8.0–10.0	BLACK, LOOSE, SILTY SAND, SM
-10.0	10.0–19.0	LIGHT COLORED CORAL FRAGMENTS, SILTY-SAND-GRAVEL MIXTURE, GM/SP
-19.0		

HOLE NUMBER B-11
PROJECT KIKIAOLA HARBOR
LOCATION N 46 840 E 434 080
DATE STARTED 16 MAR 1965 | DATE COMPLETED 16 MAR 1965

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	0–4.8	WATER
-4.8	4.8–8.0	LOOSE, RED, CLAY-SILT, CL
-8.0	8.0–12.0	LOOSE, BLACK, SILTY SAND, SP
-12.0		

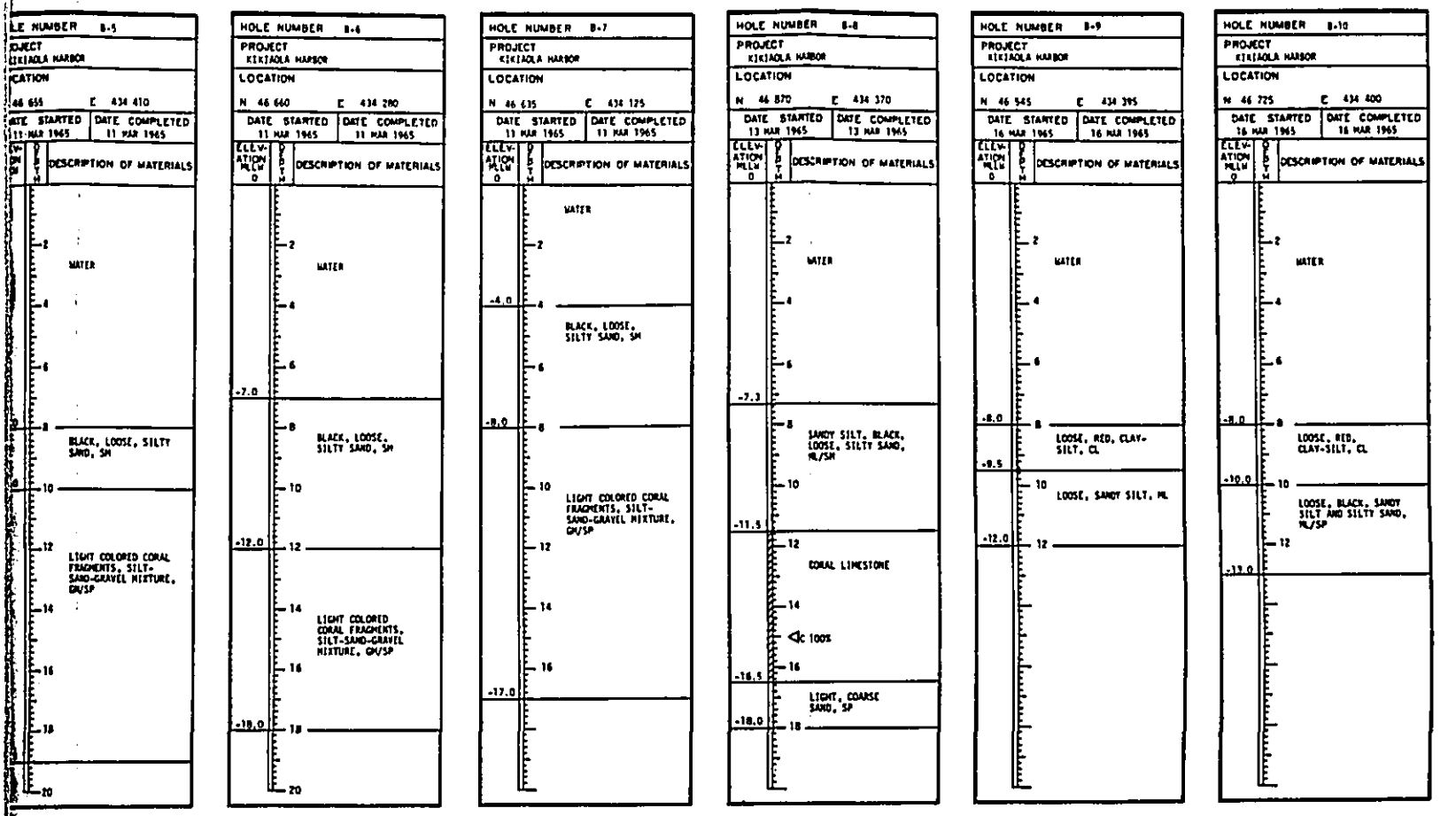
LEGEND

CORE DRILLING (4" x 5-1/2")

C 50% PERCENT 4" DIAMETER CORE RECOVERED

STANDARD PENETRATION TEST

R 20 PENETRATION RESISTANCE IN BLOWS PER FOOT, ASTM D 1586-67. WHERE RESISTANCE IS HIGH, BLOWS FOR LESSER PENETRATION IS INDICATED.



DESCRIPTION OF REEF ROCK

CORAL LIMESTONE: WHITE TO TAN, SINGLE CALCAREOUS MARINE FOSSIL GROWTH, UNIFORM CELLULAR TEXTURE AND LACY FABRIC. CELLS RANGE IN SIZE FROM MICRO TO MACRO AND MAY BE OPEN OR FILLED WITH SECONDARY CALCIUM CARBONATE AND BRECCIA (ANGULAR FRAGMENTS).

L-2 MODERATELY HARD TO HARD, PARTLY WEATHERED, LESS THAN 20% VUGS AND CAVITIES. SCRATCHES EASILY, DULL RINGS WHEN STRUCK WITH HAMMER. WILL REQUIRE SMALL AMOUNTS OF BLASTING, SPUDDING OR EQUIVALENT EXCAVATING EFFORT TO REMOVE.

L-3 CREAM TO TAN, SOFT, WEATHERED SKELETAL CORAL; CRUMBLES UNDER HAND PRESSURES; CAN BE EXCAVATED WITHOUT MUCH EFFORT.

CORAL LIMESTONE BRECCIA: CREAM TO TAN, DARKER COLORS INDICATE WEATHERING AND SOFTER ROCK. FRAGMENTS OF MANY CALCAREOUS MARINE FOSSILS AND SHELLS (REEF SCREE) IN A FINE GRAINED CEMENTING MATRIX OF CALCIUM CARBONATE. ANGULAR FRAGMENTS RANGE FROM SAND TO COBBLE IN SIZE, DEGREE OF CEMENTATION VARIES.

LB-3 SOFT, WEATHERED, MATRIX CEMENTING MATERIAL DECOMPOSED. MATERIAL CRUMBLES UNDER PRESSURE. CAN BE EXCAVATED WITHOUT MUCH EFFORT.

NOTES TO BORING LOGS

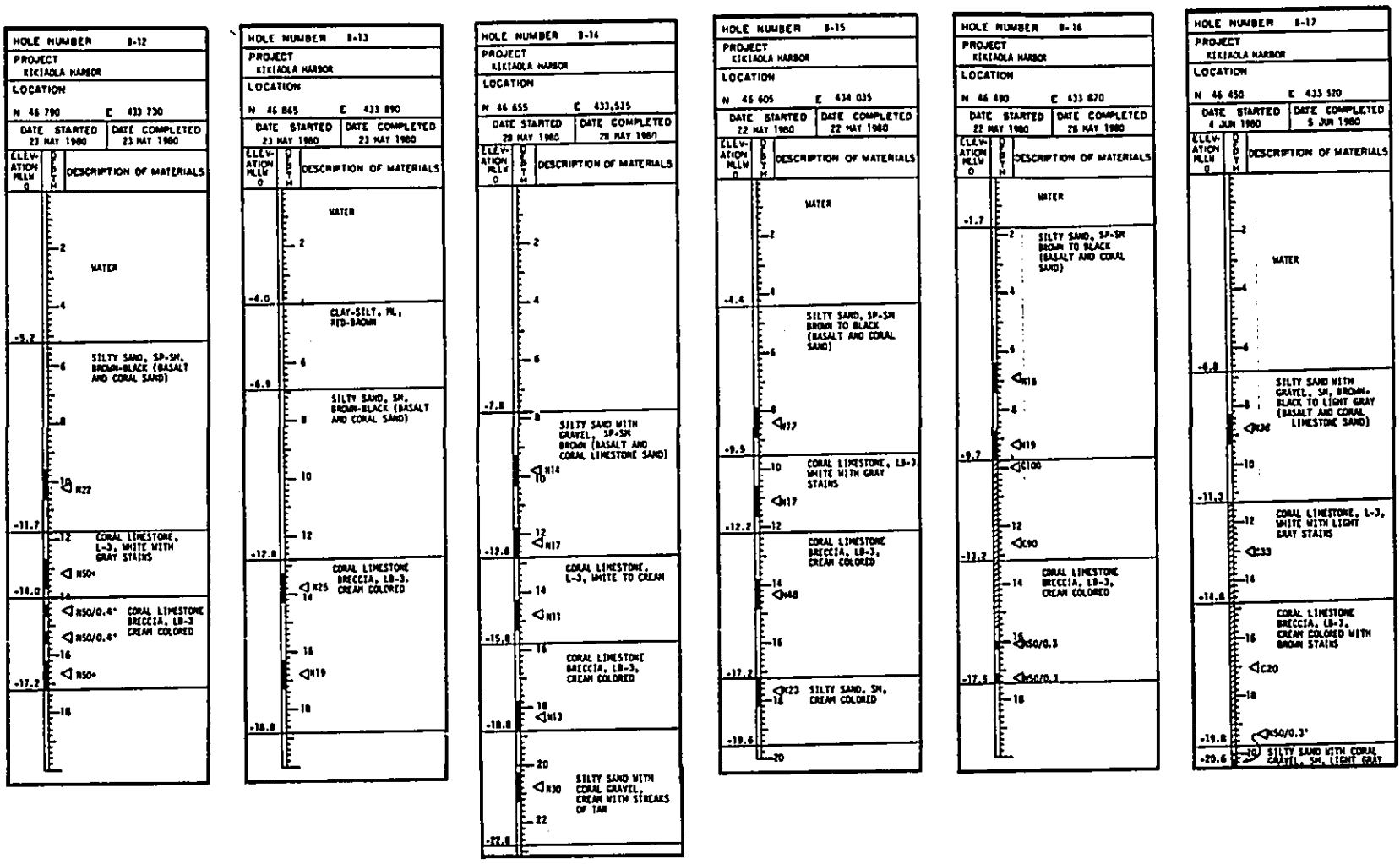
1. FOR BORING LOCATIONS SEE FIGURE 12
2. COORDINATES ON BORING LOGS ARE REFERRED TO HAWAII STATE PLANE SYSTEM, ZONE 4.
3. DEPTHS AND ELEVATIONS ARE MEASURED FROM ZERO MLLW DATUM.
4. DESCRIPTION OF MATERIALS SHOWN ON THE LOGS ARE BASED ON VISUAL CLASSIFICATION OF SAMPLES IN THE FIELD. ALL SOIL CLASSIFICATIONS ARE BASED ON ASTM D 2487-69.
5. BORINGS B-1 TO B-11 WERE MADE IN MARCH 1965. HOLES 1, 2, 4, 5, 6 AND 7 WERE WASH JET DRILLED USING 1-INCH INDUCTOR PIPE INSIDE 2-INCH CASING. HOLES 3 AND 8 WERE DRILLED USING A 4-INCH INSIDE DIAMETER CORE BARREL.
6. BORINGS B-12 TO B-21 WERE MADE IN MAY-JUNE 1980 USING 4" x 5-1/2" CORE BARREL AND STANDARD SPLIT SPOON SAMPLER.
7. DISCREPANCIES IN MATERIAL CLASSIFICATIONS BETWEEN THE 1965 AND 1980 BORINGS ARE ATTRIBUTED TO DIFFERENCES IN DRILLING METHODS EMPLOYED. WHERE DISCREPANCIES OCCUR, MATERIAL CLASSIFICATIONS SHOWN FOR THE 1980 BORINGS WILL GOVERN.

KIKIAOLA HARBOR KAUAI, HAWAII

BORING LOGS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE C-1


HOLE NUMBER B-12
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 790 E 433 730
DATE STARTED 23 MAY 1980
DATE COMPLETED 23 MAY 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
WATER
-5.2
SILTY SAND, SP-SM, BROWN-BLACK (BASALT AND CORAL SAND)
N22
-11.7
CORAL LIMESTONE, L-3, WHITE WITH GRAY STAINS
N50+
-16.0
N50/0.4"
N50/0.4"
CORAL LIMESTONE BRECCIA, LB-3 CREAM COLORED
N50+
-17.2
HOLE NUMBER B-13
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 865 E 433 890
DATE STARTED 23 MAY 1980
DATE COMPLETED 23 MAY 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
WATER
-4.0
CLAY-SILT, ML, RED-BROWN
-6.9
SILTY SAND, SM, BROWN-BLACK (BASALT AND CORAL SAND)
-12.8
N25
CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
N19
-18.8
HOLE NUMBER B-14
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 655 E 433,535
DATE STARTED 28 MAY 1980
DATE COMPLETED 28 MAY 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
-7.8
SILTY SAND WITH GRAVEL, SP-SM BROWN (BASALT AND CORAL LIMESTONE SAND)
N14
-12.8
N17
CORAL LIMESTONE, L-3, WHITE TO CREAM
N11
-15.8
CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
N13
-18.8
N30
SILTY SAND WITH CORAL GRAVEL, CREAM WITH STREAKS OF TAN
-22.8
HOLE NUMBER B-15
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 605 E 434 035
DATE STARTED 22 MAY 1980
DATE COMPLETED 22 MAY 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
WATER
-4.4
SILTY SAND, SP-SM BROWN TO BLACK (BASALT AND CORAL SAND)
N17
-9.5
CORAL LIMESTONE, LB-3 WHITE WITH GRAY STAINS
N17
-12.2
CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
N48
-17.2
N23
SILTY SAND, SM, CREAM COLORED
-19.6
HOLE NUMBER B-16
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 490 E 433 870
DATE STARTED 22 MAY 1980
DATE COMPLETED 28 MAY 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
WATER
-1.7
SILTY SAND, SP-SM BROWN TO BLACK (BASALT AND CORAL SAND)
N16
N19
-9.7
C100
CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
C90
-12.2
N50/0.3
N50/0.3
-17.5
HOLE NUMBER B-17
PROJECT KIKIAOLA HARBOR
LOCATION
N 46 450 E 433 520
DATE STARTED 4 JUN 1980
DATE COMPLETED 5 JUN 1980
ELEVATION MLLW 0
DEPTH
DESCRIPTION OF MATERIALS
WATER
-6.8
SILTY SAND WITH GRAVEL, SM, BROWN-BLACK TO LIGHT GRAY (BASALT AND CORAL LIMESTONE SAND)
N36
-11.3
CORAL LIMESTONE, L-3, WHITE WITH LIGHT GRAY STAINS
C33
CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED WITH BROWN STAINS
C20
N50/0.3"
-19.8
SILTY SAND WITH CORAL GRAVEL, SM, LIGHT GRAY
-20.6

B-16

E 433 870

DATE COMPLETED 28 MAY 1980

PTION OF MATERIALS

TER

LTY SAND, SP-SM
OWN TO BLACK
ASALT AND CORAL
ND)

UAL LIMESTONE
ECCIA, LB-3,
EAM COLORED

HOLE NUMBER B-17

PROJECT KIKIAOLA HARBOR

LOCATION N 46 450 E 433 520

DATE STARTED 4 JUN 1980 | DATE COMPLETED 5 JUN 1980

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	2	WATER
-6.8	6	
	8	SILTY SAND WITH GRAVEL, SM, BROWN-BLACK TO LIGHT GRAY (BASALT AND CORAL LIMESTONE SAND)
-11.2	10	
	12	CORAL LIMESTONE, L-3, WHITE WITH LIGHT GRAY STAINS
-14.8	14	
	16	CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED WITH BROWN STAINS
-19.8	18	
-20.6	20	SILTY SAND WITH CORAL GRAVEL, SM, LIGHT GRAY

N50/0.3'

HOLE NUMBER B-18

PROJECT KIKIAOLA HARBOR

LOCATION N 46 255 E 433 670

DATE STARTED 2 JUN 1980 | DATE COMPLETED 3 JUN 1980

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	2	WATER
-7.0	6	
	8	SILTY SAND WITH CORAL GRAVEL, SM, BROWN-BLACK (BASALT AND CORAL LIMESTONE SAND)
-12.0	10	
	12	CORAL LIMESTONE, L-3, WHITE TO LIGHT GRAY
-15.5	14	
	16	CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
-20.0	18	
	20	SILTY SAND, SM, LIGHT GRAY
	22	

N37 N22 N18 N40 C0

HOLE NUMBER B-19

PROJECT KIKIAOLA HARBOR

LOCATION N 46 780 E 433 530

DATE STARTED 10 JUN 1980 | DATE COMPLETED 10 JUN 1980

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	2	WATER
-6.1	6	
	8	SILTY SAND, SP-SM BROWN-BLACK (BASALT AND CORAL LIMESTONE SAND)
-12.6	12	
	14	CORAL LIMESTONE, L-3, WHITE WITH LIGHT GRAY STAINS
-16.6	16	
	18	CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
-21.1	20	
	22	

N6 N18 C50 N14

HOLE NUMBER B-20

PROJECT KILIAOLA HARBOR

LOCATION N 46 795 E 433 925

DATE STARTED 29 MAY 1980 | DATE COMPLETED 29 MAY 1980

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	2	WATER
-4.6	4	
	6	CLAY-SILT, CL, RED-BROWN
-7.1	8	N41 SILTY GRAVEL, GP-GM BROWN-BLACK (BASALT AND CORAL GRAVEL)
-9.1	10	CORAL LIMESTONE BRECCIA, L-2, WHITE TO LIGHT GRAY
-12.6	12	C100
	14	CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
-16.1	16	C20
	18	SILTY SAND WITH CORAL GRAVEL, SM, LIGHT GRAY
-19.6	20	N10

HOLE NUMBER B-21

PROJECT KIKIAOLA HARBOR

LOCATION N 46 565 E 433 760

DATE STARTED 9 JUN 1980 | DATE COMPLETED 9 JUN 1980

ELEVATION MLLW 0	DEPTH	DESCRIPTION OF MATERIALS
	2	WATER
-2.3	4	
	6	SILTY SAND, SP-SM BROWN-BLACK TO LIGHT GRAY (BASALT AND CORAL SAND)
	8	N47
-9.8	10	N43 CORAL LIMESTONE, L-3, WHITE WITH LIGHT GRAY STAINS
-13.3	12	C30
	14	CORAL LIMESTONE BRECCIA, LB-3, CREAM COLORED
-16.8	16	N50

KIKIAOLA HARBOR KAUAI, HAWAII

BORING LOGS

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE C-2

APPENDIX D

RECREATIONAL AND NATURAL RESOURCES

APPENDIX D

RECREATIONAL AND NATURAL RESOURCES

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX D

RECREATIONAL AND NATURAL RESOURCES

RECREATIONAL RESOURCE

1. Recreation. The Lucy Wright County Park, located at the mouth of the Waimea River, a 2.25-acre beach park with about 650 feet of beach-frontage parking, picnicking, and restroom facilities within a pleasant tree-covered setting. Within the park is a boulder upon which is affixed a plaque commemorating the landing of Captain Cook in 1778. The park is also a favorite place from which tourists view the Russian Fort Elizabeth across the river. Several parks are located in the Waimea-Kekaha region.

2. Across the Kaumualii Highway from Kekaha Beach is H.P. Faye Park and swimming pool comprising a total of 18.22 acres. The park complex was formerly named Kekaha Beach Park. The public recreational facilities there are in heavy demand among the residents of Kekaha and serve as one of the principal foci of community social cohesion. In 1977 draft Kauai County Recreational Master Plan calls for upgrading the neighborhood park with new tennis courts and fencing. Both the Kauai General Plan and the 1976 draft Waimea-Kekaha Regional Development Plan recommend development of a new Kekaha Beach Park seaward of Kekaha Gardens and west of Akialoa Road. According to officials of the Kauai County Planning Department, the new beach park, planned for construction in the early 1980's, would have a pavilion, restrooms, showers, cooking grills, paved parking, and a surrounding fence. At present, there is adequate power and road access, but inadequate sewerage and water supply. These planners recognize that no park improvements should be made until after the shoreline erosion problem has been permanently solved.

3. Kekaha Beach Park, a shoreline strip park on the seaward side of Kaumualii Highway, has been subjected in recent years to severe shoreline erosion. It once consisted of 30.7 acres, nearly half of which has been lost to erosion. Picnicking, body surfing and shoreline fishing are popular recreational pursuits here. The most popular recreational facility west of Kekaha is Polihale State Park, which is an improved beach park used heavily by campers and sightseeing tourists. Polihale is the last accessible area along the shore before the Napali Coast, where cliffs drop directly into the sea.

4. Numerous surfing sites exist along the southwest coast of Kauai. A total of nine sites were identified between Kekaha and Kikiaola Harbor in the 1971 Statewide Surfing Site Survey. Wave and water characteristics are good both in the summer and winter at most of the sites identified.

5. Biking is quite popular among the Kekaha residents, a great many of whom commute to the sugar mill by bicycle. The State of Hawaii Bikeway Master Plan shows a route along the Kaumualii Highway in front of Kekaha. The Mayor of Kauai's Bikeway Committee is presently setting priorities for bikeway development.

6. Fishing is another very popular recreational activity in the Waimea-Kekaha region. Shoreline fishing (surf casting, throw-netting, and beach seining) is widely practiced. Many residents of the area have trailored boats that are launched primaily at Kikiaola Harbor. Trolling, diving and surround-netting are the principal fishing methods employed by the boaters.

7. Scenic and Wild Rivers. None are present in the Waimea-Kekaha area.

8. National Trails. None are present in the Waimea-Kekaha area.

9. National Shoreline, Parks or Beaches. None are present in the Waimea-Kekaha area.

NATURAL RESOURCES

10. General Setting. The island of Kauai is the summit of one of the principal volcanic mountains of the partially submerged Hawaiian range. This range extends for a distance of 1,500 miles across the Pacific Ocean floor. Kauai has a complex geologic structure as a result of volcanic activities, separated by intervals of erosion and decomposition combined with faulting. The soils in the basin are mainly residual. The soils in the lower flood plains are alluvial and marine deposits of silts, sand and gravely sands, and plastic clay and silt. A thin layer of red-brown soil covers the area along the confluence of the Waimea and Makaweli Rivers and lower slopes of the ridges.

11. The upper and central regions of the Waimea River basin are characterized by deep canyons and steep hills. The upper western portion of the basin contains Waimea Canyon, one of the popular tourist attractions of Kauai. The Alakai Swamp, located in the higher regions of the drainage area, measures 1/2 to 2 miles wide and 10 miles long. The ridges that bound the drainage basin on the west and east rise from sea level to elevations of 4,000 and 5,000 feet, respectively.

12. The climate of the Waimea-Kekaha region ranges from subtropical in the lower regions to temperate in the upper and central regions. Mean monthly temperatures in the coastal area range from 67°F to 75°F. Trade winds predominate the air flow patterns in Waimea, blowing from 80 to 90 percent of the time during the summer months and 50 to 80 percent during the winter months.

13. Located on the leeward side of Kauai, the Waimea-Kekaha area receives the least amount of rainfall on the island. The average annual rainall rate is about 22 inches per year in the coastal plain. In the upper regions, rainfall averages 100 inches per year. Rainfall on Kauai is produced chiefly by orographic lifting of the trade winds which originate from the east or northeast. The rainfall is seldom intense and is usually not responsible for the large floods in the Waimea Valley. The "kona" (southerly) storms, associated with fronts of extratropical cyclonic disturbances, are responsible for most of the floods in the area. During a kona storm, the dry leeward and coastal areas may receive enough rain within a single day to nearly equal their average annual total.

14. The light-draft vessel harbor at Kikiaola is located on a uniformly straight, low and wide beach that extends for 2.7 miles from the Waimea River to the west, to Oomano Point at Kekaha. The land away from the harbor is a flat, alluvial terrace (or platform), 10 to 15 feet in elevation above sea level, 1 mile in width and underlain by both alluvial and marine sediments. On the outer or seaward edge of the terrace there is a low beach with calcareous sand dune ridges. At the inner edge, the spurs of lava flows (Waimea Canyon Volcanic Series) are truncated by an ancient sea cliff. The sea covered the terrace in ancient times and deposited a series of calcareous sandstone and sandy limestone benches and reefs. The rock benches and reefs have been removed by erosion (at least down to -12 feet MLLW) over most of the harbor.

15. The project area is not located within any designated wildlife refuge, marine sanctuary, or natural area reserve, nor are there any threatened or endangered species or their habitats within the study area.

16. Terrestrial Resources. The project vicinity is devoted primarily to urban, military, and agricultural uses. Terrestrial flora primarily consists of introduced and/or cultivated species, including coconut palms (Cocos nucifers), kiawe (Prosopis pallida) ironwood (Casuarina equisetifolia) hau (Hibiscus tiliaceous), koa haole (Leucaena leucocephala), klu (Acacia farnesiana), banyan (Ficus sp.), Plumeria sp., beach morning glory (Ipomoea pes-caprae) and other herbaceous weeds and grasses, as well as commercially-cultivated sugarcane (Saccharum officinarum).

17. Terrestrial fauna are primarily limited to domestic animals and livestock and exotics, many of which are circumtropical in distribution. Included are the domestic dog (Canis familiaris), cat (Felis domesticus), house mouse (Mus musculus), roof rat (Rattus rattus), Norway rat (Rattus norvegicus), Hawaiian rat (Rattus exulans hawaiiensis), and mongoose (Herpestes auropunctatus). Hawaii's only exclusively terrestrial mammal, the endangered Hawaiian hoary bat (Lasiurus cinereus semotus), probably does not exist in the project area.

18. Two species of passerine birds, the common mynah (Acridotheres tristis) and the house sparrow (Passer domesticus) were observed in the project area. Table 1 lists bird species commonly found within the Kekaha-Mana area. No forest or wetland areas which could provide suitable habitat for endangered forest birds or waterbirds exist in the immediate project area. However, endangered waterbirds are found in low-lying coastal wetlands located 3 to 8 miles northwest of Kekaha on State Highway 50. Shorebirds such as wandering tatter and ruddy turnstone can be expected to utilize the shoreline within and adjoined to the project area. Suitable feeding habitat for these birds does exist along the shoreline near the project area.

19. Reptiles observed in the project area included the blue-tailed skink (Emoia caruleocauda), snake-eyed skink (Ablepharous boutoni), and several species of the family Gekkonidae (gekkos). The marine toad, Bufo marinas, is common throughout the Pacific and probably occurs in the project area, as well.

20. Marine Resources. Biological Reconnaissance surveys at Kikiaola Harbor were conducted by U.S. Army Corps of Engineers biologists in February and May of 1979 and by U.S. Fish and Wildlife Biologists in April 1979. Species lists of organisms observed during those surveys are provided in Tabaes D-1 and D-2. Due to the high turbidity (and consequent poor water visibility) organisms that occur in the harbor project area, especially fisn species, may nave escaped observation. The inner harbor bottom is composed of terrigenous silt and sand. Calcareous sand of marine origin occurs at the eastern end and in the northwest corner of the harbor. Benthic organisms adapted to soft silt-sand substrate (a variety of crustaceans and polychaete worms) most likely occur within the harbor. The swimming crab (Portunus Sanguinolentus), and an unidentified paleomonid shrimp were collected in the FWS sampling effort using a small beach seine. Turbidity precluded direct visual sampling within the harbor. The predominant fish species collected with the seine net were the iao (Pranesus insularum) nenu (Stolephorus purpereus), aholehole (Kuhlia sandvicenses), and mullet (Chelon engeli). The predaceous goby (Eleotris sandavicenses), juvenile mullet and aholehole were abundant in the drainage canal where it enters the harbor. The substratum outside the mouth of the harbor appeared to be scoured rock bench. Small flattened colonies less than 2" in diameter of the stony coral Porites were observed sparely scattered over this bench. Encrustations of corraline algae were the dominant benthic organisms observed in this exposed habitat. The seaward sides of the existing jetties and breakwater, and those portions of rock submerged immediately inside the mouth of the harbor possess a relatively rich intertidal fauna. Submerged armor rock is covered with the coraline algae Porolithon onkodes. Other species of foliose algae observed here include Acanthophora, Caulerpa, Sargassum and Padina. Common intertidal invertebrates include: Nerita picea (pipipi), Littorina pintado (periwinkle), the snail Morula, the rock crab Metapograpsus messor, hermit crab Clibanarius zebra and urchin Colobocentrotus sp. No fishes were observed near the breakwaters. However, it is likely that the structures provide habitat and shelter for a number of shallow water, reef species.

21. The marine substrate consists of a flat limestone reef with shallow channels and pockets overlying a hard coralline pavement. Macro-invertebrates oberved in the sand areas were two species of sea cucumber. They were not abundant. Detritus and kukui nut shells were commonly seen on the surface of the sand within 1,000 feet of the shore. Coralline algae (mainly Porolithon and related species) dominate the hard limestone pavement. Sargassum found on the hard limestone was encrusted with coralline algae. The sargasum was sparse. Scattered small colonies of live coral (Montipora spp., Pocillopora meandrina, and Porites compressa occurred on the hard substrate throughout the study area. Coral colonies are predominantly of a flat encrusting form. No dense concentrations of live coral were observed. Fish were rarely seen during the surveys due to both extreme turbid water conditions and lack of vertical relief on the reef flat providing shelter and habitat for common reef fishes. Surgeon fish (Manini), wrasse, (Hinalea) and rudder fish (Nenui) were observed in the vicinity of the harbor. Area residents interviewed during these surveys stated that throw net fishermen frequently catch mullet and oio within the harbor. The moi (Polydactylus sexfilis), which is of recreational, subsistence and commercial value, may be caught by hook and line or net on the sandy beaches adjacent to the harbor, and often within the harbor itself. Pole fishing from tne ends of the breakwaters for ulua and papio is said to be generally successful.

22. Coastal Water Quality. The State Department of Health Water Quality Standards have classified Kikiaola Small Boat Harbor as Class B waters. This classification applies only to harbors, boat docking facilities, and some embayments. Protected uses in this category included small boat facilities, commercial and industrial shipping, bait fishing and compatible recreational activities. Generally, water quality criteria for this category were the least stringent. Under the newly adopted water quality standards, Kikiaola Harbor is classified as a Class A Embayment. Use of these waters do not include commercial shipping, and quality criteria are slightly more stringent. No point source discharges would be permitted. However, maintenance dredging is provided for. The Department of Health does not maintain a water quality sampling station within the harbor. Factors influencing water quality in the harbor include cumulative deposition of terrigeneous silt via the small drainage channel, a discharge of silt from the nearby Waimea River with subsequent accretion in the harbor and reduced internal circulation and flushing.

23. The drainage ditch discharging surface runoff into Kikiaola Harbor is no longer a major source of silt (ref 6). Since 1972 the ditch has been opened only during periods of flooding in cane lands behind Kikiaola Harbor. The Civil Defense Department must authorize opening of the flap gate north of Kaumaualii Highway. This occurs on the average of 2 to 3 times a year, often less frequently. During flooding, water ponds in the cane land above the flap gate where most of the silt settles out. The water velocity and silt load of the discharge at the flap gate is very low. Hence, silt contributed to the harbor by this source has been minimal since 1972.

24. Endangered Species. No endangered species were observed in or adjacent to the project site during the biological reconnaissance surveys conducted in 1979. There are no records or reports of nesting green sea turtles or hawksbill turtles between Kekaha and the Waimea River. There are no reported sightings of the Hawaiian hoary bat (Lasiurus cinerescens) in the Kikiaola Project Area.

TABLE D-1

LIST OF BIRDS COMMONLY FOUND IN THE KEKAHA-MANA AREA
(Adapted from Pyle, 1977, and Telfer)

FAMILY Genus/Species/Subspecies	Common Name
ARDEIDAE	
Bubulicus ibis	cattle egret
Nycticorax n. hoactli	black-crowned night heron
ANATIDAE	
Spatula clypeata	shoveler duck
Anas acuta	pintail duck
Anas wyvilliana (E)	Koloa duck
PHASIANIDAE	
Phasianus colchicus	ring-necked pheasant
RALLIDAE	
Gallinula chloropus sandvicensis (E)	Hawaiian gallinue
Fulica americana alai (E)	Hawaiian coot
CHARADRIIDAE	
Pluvialis dominica	American golden plover
SCOLOPACIDAE	
Heteroscelus incanus	wandering tattler
Arenaria interpres	ruddy turnstone
Calidris alba	sanderling
RECURVIROSTRIDAE	
Himantopus mexicanus knndseni (E)	Hawaiian stilt
COLUMBIDAE	
Streptopelia chinensis	lace-necked dove
Geopelia striata	barred dove
TYTONIDAE	
Tyto alba	barn owl
STRIGIDAE	
Asio flammeus sandwichensis	Hawaiian owl
TIMALIIDAE	
Garrulax canorus	Chinese thrush
MIMIDAE	
Mimus polyglottus	mocking bird
ZOSTEROPIDAE	
Zosterops japonica	Japanese white-eye

TABLE D-2

MARINE FAUNA COLLECTED AND/OR OBSERVED
IN THE PROJECT AREA

PHYLUM CLASS FAMILY Genus/species/subspecies	Common Name
ARTHROPODA CRUSTACEA	
GRAPSIDAE *Metapograpsus* messor	rock crab, ama
OCYPODIDAE unidentified spp.	ghost crab
PORTUNIDAE *Portunus sanguinolentus*	swimming crab
PALAEMONIDAE unidentified spp.	snrimp
MOLLUSCA GASTROPODA	
PATELLIDAE *Cellana exarata* *C. argentata*	black limpet kneecap shell
NERITIDAE *Nerita picea*	common nerite
LITTORINIDAE *Littorina pintado pintado*	ditted periwinkle
SIPHONARIIDAE *Siphonaria normalis*	false limpet
PELECYPODA ISOGNOMIDAE *Isognomon californicum*	purse shell
OSTREIDAE unidentified spp.	oyster
ECHINODERMATA HOLOTHUROIDEA *Holothuria atra*	sea cucumber

TABLE D-2 (Cont)

MARINE FAUNA COLLECTED AND/OR OBSERVED
IN THE PROJECT AREA

STURNIDAE	
Acridotheres tristis	common mynah
ICTERIDAE	
Sturnella neglecta	western meadow-lark
PLOCEIDAE	
Lonchura punculata	spotted munia, ricebird
Passer domesticus	house sparrow
FRINGILLIDAE	
Cardinalis cardinalis	northern cardinal

(E) indicates endangered species

LIST OF REFERENCES

1. Aotani and Associates. Kauai County Recreation Master Plan (Draft), for County of Kauai, 1977.

2. Belt, Collins and Associates, Ltd., and Daly and Associates. Waimea-Kekaha Regional Development Plan, for County of Kauai, (draft), 1976.

3. Eckbo, Dean, Austin & Williams, and Muroda, Tanaka & Itagaki, Inc. A General Plan for the Island of Kauai, 1970.

4. Hydropnysics Corporation. Littoral Transport Study, Kekaha, Kauai, prepared for US Army Corps of Engineers, Pacific Division, (1977).

5. Hawaii Water Resources Regional Study. Social Base Study Element Report, 1975.

6. Moe R., Kekaha Sugar Company, Personal Communication, 2 Nov 1979.

7. Sunn, Low, Tom & Hara, Inc. Water Quality Management Plan as Related to Waste Treatment for the County of Kauai, for Department of Public Works, County of Kauai, 1973.

8. U.S. Army Corps of Engineers (1979), "Detailed Project Report and Final Environmental Statement, Kekaha Beach Shore Protection, Kekaha, Hawaii."

9. U.S. Fish and Wildlife Service (1979), "Planning Aid Letter for Kikiaola Small Boat Harbor, Kauai."

10. Telfer, T., Personal Communication, Sep. 1979.

11. Surfing Education Association (1971), "Statewide Surfing Site Survey."

APPENDIX E.

SOCIAL AND CULTURAL RESOURCES

APPENDIX E

SOCIAL AND CULTURAL RESOURCES

LIST OF TABLES

LIST OF PLATES

APPENDIX E

SOCIAL AND CULTURAL RESOURCES

INTRODUCTION

1. Part I of the social and cultural resources appendix summarizes pertinent socioeconomic profile data on the study area and assesses the social well-being components of the four alternative plans. The social-well being component analysis derives from the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources" (P&S), 38 Federal Register 24778-24869, 10 September 1973. The social well-being components required by P&S consist of (1) Real Income Distribution: (2) Life, Health, and Safety; (3) Educational, Cultural, and Recreational Opportunities and other Community Services; and (4) Emergency Preparedness. The U.S. Army Corps of Engineers have added two additional components-Community Cohesion and Other Population Characteristics.

2. Part II of Appendix E summarizes the findings of the Corps efforts in identifying prehistoric sites, historic structures, or other cultural resources in the study area and assessing the effects of the alternatives on the sites or resources. Identification of historic sites is required by the Reservoir Salvage Act of 1960 as amended and Executive order 11593 (1971). The Federal agency must evaluate the significance of the sites in order to determine possible eligibility for the National Register of Historic Places. If any sites in the project area were determined eligible for or already listed on the National Register, they would be protected by Federal law and regulation to the extent that the Federal agency must consult with the State Historic Preservation Officer and the U.S. Advisory Council on Historic Preservation to determine the effect of the Federal project and to idenify measures to either avoid or nitigate for any adverse effects.

PART I. SOCIAL WELL-BEING

3. Introduction. The social well-being appendix identifies the social and economic characteristics of Kauai Island and the Waimea-Kekaha region, and evaluates the alternatives in relation to the social well-being components pertinent to the problem and region.

4. Regional Social Characteristics. The "WAIMEA-KEKAHA Regional Development Plan Supplement" prepared for the County of Kauai in September 1977 (Ref. 14), provides a wealth of socioeconomic and land-use information on the Waimea-Kekaha region. Its findings are summarized here and should be referred to for more detail. The Plan's data base year is 1975, but island-wide data has been updated to 1978. The social profile of recreational fishermen is based on 1970-1971 social characteristics (Ref. 13).

5. Like the rest of the islands other than Oahu, the population of the island of Kauai declined between 1930 and 1960. However, Kauai's population increased 12.2 percent from 27,922 in 1960 to 39,700 in 1978 (Ref. 8). This is an average of 75 persons per square mile compared with an average of 1,300

persons per square mile on Oahu. Since 1960, Kauai's population has steadily increased, as shown in Table E-1. The increase in population was a reversal of the previous decade's decline, and is primarily attributed to the expansion of the visitor industry on the island. The anticipated economic growth associated with the growth of the visitor industry is expected to result in continued increases in the population of the island.

6. The Waimea-Kekaha region had an estimated population of 4,220 in 1974, up 1.5 percent from 1970 (Ref. 11). This region's population is projected to rise to 5,200 by 1980, to 8,400 by the year 2000, and to 12,100 by 2020 (Ref. 12). Population growth has been, and is expected to continue to be dependent upon increased employment opportunities within federally-supported industries, relocation of federal employees to new housing in the nearby area, and immigration of new sugar plantation workers, mainly Filipinos, to replace retiring workers (Ref. 14). The dominant ethnic groups in the region are Japanese (35 percent) and Filipino (30 percent), both slightly more than the average percentage for the island as a whole. With considerable out-migration of young people, the median age (30 years) is quite high, and about 10 percent of the people are over age 64 compared with only 6 percent for the State as a whole. In 1974, the median income for Waimea-Kekaha was $10,110, slightly below the county average.

TABLE E-1

POPULATION OF KAUAI

YEAR	TOTAL POPULATION
1831	10,947
1878	5,634
1884	8,764 1/
1890	11,691 1/
1896	15,228
1900	20,562
1910	23,744
1920	29,247
1930	35,806
1940	35,636
1950	29,683
1960	27,922
1970	29,524
1975	31,800 1/
1978	34,700 1/

1/ Figures are estimates.

Source: Demographic Statistics of Hawaii, 1778-1965, by Robert C. Schmitt, 1968; State of Hawaii Data Book, a Statistical Abstract, by the Department of Planning and Economic Development; Statistical Report 95, by the Department of Planning and Economic Development; Statistical Report 113, Department of Planning and Economic Development; Statistical Report 131, Department of Planning and Economic Development.

7. There is great stability in the population of the Waimea-Kekaha region, more so than virtually any other area on the island of Kauai. The 1970 Census indicated that two-thirds of the people had lived in the same house for at least 5 years (Ref. 14). Among the older age groups there is very little movement. Moreover, there is little in-migration of outsiders except for Filipino immigrant workers and professionals associated with the military and scientific facilities at the U.S. Navy's PMR and NASA's Kokee Tracking Station.

8. Community Characteristics and Facilities. Kekaha is a resident plantation community of more than 2,400 residents and is dominated by the centrally-placed Kekaha Sugar Mill. The expanding population has generated continuous need for replacement of houses, facilities, and services. Since 1970, most of Kekaha's new houses, 148 dwelling units, have been constructed in Kekaha Gardens, located just west of the main village. Over 50 percent of the buyers have been local Kekaha Sugar Company employees with many of the remainder being civilian employees working at the U.S. Navy's Pacific Missile Range Facility (PMR) and other federal facilities. In general, most residential expansion in the near future is expected to occur on this western side of Kekaha, which has open space for another 200 to 300 single-family homes. A small subdivision of about 26 improved lots at the eastern edge of town was developed in 1977.

9. Waimea Town is the region's second largest community with about 1,600 residents, but is the center of the area's social, economic, and institutional activities. Students from Barking Sands to Hanapepe-Eleele attend Waimea High School. Also serving the entire West Kauai area are a police substation, the Waimea Public Library, and the Kauai Veterans Memorial Hospital. Waimea has a fire station, post office and health dispensary. In back of the commercial-residential district of Waimea in the lower Waimea River Valley lies a small but rich agricultural area in taro, seed corn and other diversified truck crops. Most of the houses in Waimea are old like Kekaha, but a new subdivision is under construction immediately northeast of the commercial area within the floodplain area. Most residential expansion is likely to be westward and on the bluff overlooking the small town. The new Waimea-Kekaha Development Plan has a large "Project District" zone designated for the area seaward of Kaumualii Highway between Waimea Town and the access road to Kikiaola Harbor. Most of this 100-acre parcel is under sugarcane, but proposed uses could include resort, commercial, possible light industrial, open, recreational and public facilities, any of which should be planned as an integrated community (Ref. 14). All of the land immediately landward of the small boat harbor is owned by Kikiaola Land Company. Kikiaola Land is interconnected with Kekaha Sugar Company. Knudsen Trust owns land immediately west of the harbor toward Kekaha. The Kikiaola Land Company at one time formulated a master plan for the development of its lands in Waimea area which included a resort complex on the coast. No development has occurred under the master plan (Ref. 14). It is unlikely that any change from the present sugarcane cultivation adjacent to the small boat harbor will occur until after the State constructs berthing and other backup facilities for the harbor. According to the State, no such development is anticipated in the near future (Ref. 1).

10. The Kaumualii Highway, immediately paralleling the Kekaha Beach shoreline, is the major land transportation route serving the defense-scientific complex at Barking Sands (PMR) and the tourist destination area of Waimea Canyon and Polihale State Park. PMR is also served by its own airfield, but most of its daily energy, food and other logistical needs are supplied by land. According to Hawaii State Highway Department figures, a one-day count at the intersection of Kekaha Road and the highway to the east of Kekaha indicated about 1,500 vehicles passing in each direction.

11. Potable water is readily available from County wells and storage tanks located west of Kekaha and Waimea in the lower mountains (Ref. 14). New inland wells were constructed in the late 1920's for Waimea and Kekaha. Kekaha Sugar Company also supplies water for industrial mill uses and for domestic uses by its employee housing. Together, these sources supply 70 percent of the U.S. Navy's water through 4-inch mains to PMR running along the northern side of Kaumualii Highway. Fresh water is piped to Kikiaola Small Boat Harbor.

12. A secondary-level sewage treatment plant was constructed in 1978 to initally serve Waimea. The wastewater is discharged into a reservoir above Waimea for subsequent use in the canefield irrigation system. A sewage collection system has been constructed in lower Waimea town and westward along Kaumualii Highway. A connection to Kekaha will not take place until sometime in the 1980's. Kekaha is currently served by cesspools and by sewers which discharge into the canefields (Ref. 14). Kikiaola Harbor is served by an eight-foot-diameter cesspool located about 160 feet from the waters edge (Ref. 10). According to State Department of Transportation estimates, it would probably not be adequate if the State fully developed the small boat harbor (Ref. 1).

13. The nearest U.S. Coast Guard facility is located at Nawiliwili Harbor, about 45 miles by sea from Kikiaola.

14. Economic Opportunities. In other areas of Kauai, agriculture has declined in recent years and tourism has replaced it as a major employment generator. Waimea-Kekaha, however, differs from the rest of the island in that the major employers in the area, first, the defense/scientific complex at Barking Sands and Kokee, and second, the sugar industry. Sugar employment in this region has declined somewhat over the past decade but is now relatively stable and has reasonably good prospects for stability in the future. Moreover, Waimea-Kekaha differs from other areas on Kauai in that it has not yet experienced any major direct economic benefits from the increase in tourism (Ref. 14).

15. The chief economic mainstay of the Waimea-Kekaha region is the defense/scientific complex at Barking Sands and Kokee. The major operations at the U.S. Navy's Pacific Missile Range Facility at Barking Sands involve missile testing and development, Anti-Submarine Warfare training, the National Bureau of Standards, the National Weather Service, and the Energy Research and Development Agency (ERDA). At the beginning of 1976 the total employment at PMR was 560 persons, of whom 105 were Navy personnel, 54 were Civil Service

employees, and the remainder were civilians employed by the prime contractor, Dynalectron Corporation. Operations at Kokee include the NASA Tracking Station, the Hawaii Air National Guard, and the National Weather Service. Total employment at the beginning of 1976 in the Kokee facility was 253 people on a full-time basis and 83 part-time workers (Ref. 14).

16. The primary agricultural activity in the Waimea-Kekaha region is sugar production. Kekaha Sugar Company, owned by Amfac, produces sugarcane on 7947 acres (virtually all of which is state-owned land) and employed approximately 440 works in 1976. The cane lands are presently under long-term leases and the future stability of the company appears reasonably assured for the next 15 years. Over the past 10 years employment at Kekaha has declined at an annual rate of 0.7 percent. It is anticipated that future employment will be stable or will decline only slightly; major decreases would occur only if acreage were cut back severely or significant technological advances were realized. Gay and Robinson (G & R) has 2644 acres in cane and employed 169 workers in sugar and 13 in ranching activities in 1976. Total employment at G & R has declined at an annual rate of 5 percent over the last 10 years. Future employment at G & R is expected to decrease at a much lower rate because the existing force is close to the minimum required to operate a plantation of that size. Olokele Sugar Company, though located just outside the Waimea-kekaha area, is a major economic activity that does have an impact on Waimea. A number of the Olokele employees live and shop in the Waimea-Kekaha area. Olokele, a subsidiary of C. Brewer, employed about 316 workers in 1976. Total employment has declined at an annual rate of 0.6 percent over the past decade. Olokele's projections are also for stability because it is difficult to reduce employment below present levels unless major technological advances are made in the sugar industry.

17. The remainder of the Waimea-Kekaha's farm workers are engaged in various small agricultural ventures. Virtually all of the arable land in the area is now under cultivation; much of the land near the Waimea River, for example, is in taro, which is processed at a poi factory inland from Waimea town. In the same area there are several experimental plots in seed culture--alfalfa, sunflower, seed corn, and sorghum--and a few small ranching activities. A dairy farm on the Kikiaola lands east of the harbor, run by Meadow Gold, is the main dairy activity for the island of Kaui.

18. The Waimea-Kekaha area has a full range of retail, commercial, and service establishments, most of which are located in the center of Waimea town in older structures, and many are run as family operations. .Table E-2 summarizes the retail, commercial, and service activities in Waimea and Kekaha. Employment figures are shown on both full-time and part-fime workers. Federal, County, and State governments are also major employers in the region. Public facilities maintained by the government include among others the Kauai Veterans Memorial Hospital, the public schools, the post office, the library, the police substation, and the fire station. Table E-3 summarizes total employment as of 1972 in the Waimea-Kekaha region.

19. According to the 1970 census, the unemployment rate in Waimea-Kekaha was 3 percent. Information available from the State department of labor, based on the third quarter in 1975, showed an unemployment rate of 7.2 percent,

TABLE E-2: RETAIL, COMMERCIAL, AND SERVICE ESTABLISHMENTS IN WAIMEA AND KEKAHA, 1976

Type of Establishment	Waimea No. of Employees			Kekaha No. of Employees		
	No.	Full-time	Part-time	No.	Full-time	Part-time
Food and Beverage	9	13	9	2	2	9
General/Department Stores	4	28	29	1	17	7
Groceries	3	6	-	2	7	3
Special (Garden, Jewelry, Gift, Automobile)	15	22	4	-	-	-
Service (Cleaning, Service Stations, Beauty Shops)	18	28	4	2[1]	3	11
Financial Institutions/ Insurance	4	16	-	-	-	-
Professional Services (Dentists, Lawyers, Optometrists)	3	6	2	-	-	-
Movie Theater	-	-	-	1	-	3
TOTAL	56	119	47	8	29	33

1/ Service stations.
Source: Ref. 14

TABLE E-3: SUMMARY OF EMPLOYMENT IN WAIMEA-KEKAHA[1/]

Industry	No. of Workers	% Distribution
Agriculture	186	11.9
Construction	64	4.1
Manufacturing (mostly sugar mill)	262	16.7
Transportation	34	2.2
Communications and Utilities	236	15.1
Wholesale Trade	12	0.8
Retail Trade	251	16.0
Finance, Insurance, Real Estate	4	0.3
Business & Repair Services	36	2.3
Personal Services	81	5.2
Health Services	78	5.0
Education	121	7.7
Other Professions	43	2.7
Public Administration	71	4.5
Other Industries	87	5.5
TOTAL	1566	100.0

1/ Derived from Hawaii State Department of Labor & Industrial Relations [1972: p.40].
Source: Ref. 14

reflecting the general rise in unemployment throughout the country during 1974 and 1975 (Ref. 14). Comparable rates for tne third quarter in 1975 were 8.8 percent for Kauai and 7.2 percent for Oahu, indicating that the employment situation in Waimea-Kekaha may have been stronger or more stable than in the rest of the Island of Kauai. By 1979 the annual average rate of non-agricultural unemployment was 5.6% compared for statewide figure of 6.3% (Ref. 4).

20. Commercial and Recreational Fishing. As a separate economic activity, recreational and commercial fishing are economic sectors which are significant but often understated in terms of their real impact on the statewide economy. On the surface, Hawaii's commercial fishing industry has remained virtually static for the last 75 years or more (Ref. 7). Fish landings in 1975 of 9 million pounds were only slightly higher than the 6.0 million pounds landed in 1900. The number of licensed commercial fisherment fell from a high of 3,532 in 1947 to a low of 716 in 1966. Since 1966, however, this number has steadily increased to a current 2,574 in 1978. As might be expected, the value added to the economy by fishermen increased from about $355 per fisherman in 1900 to $4,340 per fisherman in 1978 and in current dollars, the 1978 catch was worth $11.1 million. Fisheries scientists now estimate that potential fish yields in the Hawaii region could be as high as 100 million pounds worth $60 to $80 million. Hawaii State Plan projections indicate that commercial fishing could generate 3,800 direct jobs and an additional 2,210 indirect and induced jos in processing and at the consumer level by 1985 (Ref. 7).

21. These figures involve only commercial fishing and understate the total catch and value of fish actually getting into the market and non-market system and eventually to the consumer. Commercial statistics are based only on licensed commercial fishermen and on the volume of reported catch. According to State sources, "there are untold numbers of others who sell without purchasing the $10 license" and the data from commercial catch reports "is frequently open to question in terms of accuracy and reliability" (Ref. 5). These same sources estimate that as much as 2 or 3 times the reported $11.1 million amount in 1978 was actually sold. Over and above this figure is the unknown impact of recreational fishermen who sell commercially. Most are weekend fishermen but many also turn to near fulltime fishing in their retirement years. Their catch is sold to local markets, restaurants, "pupu" bars or to an established list of neighborhood customers. Fishery products are also distributed among extended family members and close friends either free or for an exchange of non-monetary goods and services. Statewide, it is estimated that 68 percent of all sports fishermen are shoreline fishermen.

22. The fisheries in Kauai are exploited primarily by part-time fishermen. The commercial fishing activity is relatively small today compared with the other islands. Table E-4 shows a breakdown of licensed commercial fishermen on Kauai and in the State by gear type. In 1977, there were 193 licensed commercial fishermen on Kauai (Ref. 5). The same source indicated, however, that there were 213 undocumented vessels on Kauai identified as principally commercial or charter fishing vessels. Of these 174 vessels were stored on land and 39 were moored on water. There were also 3 fishing vessels (over 5 tons) documented by the U.S. Coast Guard. In 1978 it was estimated at a public workshop on the Kikiaola Small Boat Harbor that at least 50 licensed

commercial fishermen used Kikiaola Harbor, averaging 52 launchings per boat per year (Ref. 19). The same source also estimated that there could be about 50 non-licensed sport fishermen that may sell commercially using Kikiaola Harbor. Both licensed and unlicensed fishermen were estimated to catch about 62,500 pounds per year. Based on 1970-1971 figures derived from a telephone survey of 433 responding households on Kauai, there were an estimated 7,000 recrational fisermen (12 years and older) of which only about 5.8 ercent or 406 fished from a boat (Ref. 13). This latter figure compares with from 549 to 598 registered vessels on Kauai in the 1970-1971 period. Another study conducted for the Statewide Boat Launching Facilities Master Plan in 1970 indicated that there were 428 dry-stored recreational boats in 1970 of which 89 were based in Waimea District (slightly larger than the Waimea-Kekaha region)(Ref. 9). Among 51 boat-owners surveyed for that study, 84 percent participated in pleasure fishing and 12 percent in commercial fishing. Another 4 percent went crabbing and laid salt nets.

TABLE E-4. LICENSED COMMERCIAL FISHERMEN BY GEAR TYPE1/

Type of Fishing	Kauai	State of Hawaii
Aquarium	1	107
Fishpond	0	4
Hand	6	56
Handline	139	1,374
Longline	4	106
Pole & Line	6	197
Net	50	537
Trap	3	109
Trolling	159	1,247
Other	12	174

1/ Hawaii Fish and Game Data, FY 1978-79. These numbers represent gear preferences not actual numbers of fishermen. Total number of licensed commercial fishermen is 2,447.

Source: Ref. 5.

23. On a statewide basis, using commercial license forms in the 1977 period, the median age of commercial fishermen is 40 years old and 84 percent of the fishermen had been born within the state (Ref. 5). The sample survey of recreational fishermen of all types conducted in 1970-1971 showed that 65 percent were younger than 40 years of age statewide while about 56 percent were less than 40 on Kauai (Ref. 13). Fishermen of Japanese and Caucasian ethnicity predominated (59 percent total) statewide, but Filipino and Japanese predominated (59 percent) on Kauai. Almost 20 percent of the fishermen were of Hawaiian or part-Hawaiian extraction on Kauai compared with only about 14 percent statewide. Education level among Kauai recreational fishermen was significantly lower than statewide levels, but Kauai had the highest level of trade school graduates among their fishermen. The County of Kauai had the second highest percentage of recreational fishermen among the lower income levels (those below $6,000--1971 dollars), although for the Counties of Maui and Hawaii the percentages were skewed toward the lowest income levels. Participation rates statewide tended to rise as income level increased to the

$6,000 level; thereafter the participation rate decreased. The average recreational fisherman on Kauai spent $157 per person in 1970-1971 (Ref. 13). The total 7,000 fishermen on Kauai were estimated to have directly contributed $333,000 in transportation expenditures, $447,000 in additional living expenditures (including food, beverages and onsite living expenses), and $322,000 in equipment expenditures. This same study also estimated indirect impacts on the state and local economy based on the then-current State Input-Output model. A later input-output model derived from County of Kauai data in 1975 was unable to calculate an income multiplier for the category of forestry and fishery products because the direct income change was zero, based on the spending patterns of the responses (Ref. 2). This was the only economic sector for which no income multiplier could be calculated, perhaps indicating the difficulty in collecting reliable economic statistics from local fishermen.

24. The study for the Statewide Boat Launching Master Plan indicated in 1970 that over 90 percent of the boaters on Kauai launched their craft within 8 miles of their homes (Ref. 9). Field surveys indicated however that boaters' time and place of launchig depended somewhat upon where the fish were running. Their desire to follow the fish was evidenced by the fact that 24 percent of the boaters launched at 4 different sites while another 13 percent launched at 3 different sites. Of the nine existing launching facilities in 1970 (Kikiaola, Port Allen, Kukuiula, Niumalu, Nawiliwili, Wailua, Kaumualii, Waikaea Canal and Hanalei), Waikaea Canal and Nawiliwili harbor were the most popular, account for 37 percent of preferred launching locations. Use of Kikiaola Boat Harbor was third with a preference of 13 percent. These reported preferences generally corresponded with the owners' area of residence (Ref. 9).

25. Plate E-1 shows the order of saltwater fishing area preferences for the County of Kauai (Ref. 13). Other information generated at the public workshop held on 14 December 1978 indicated that local people felt that those using Kikiaola Harbor came from all parts of Kauai (Ref.19). As early as 1959, the Kauai County Fishing Advisory Council noted in testimony to the Corps of Engineers that the best fishing areas were located off Waimea, Kekaha and Barking Sands (Ref. 16). The Council felt that "adequate facilities in this area would enable a successful commercial venture of charter boat service, similar to what you have in Kona". Another long-time fisherman representing the Kauai Fishing Association stated in 1959 that "the biggest fishing ground are still in the west (of Kauai). We have 85 percent of the fishing vessels west of Port Allen" (Ref. 20). Still another survey conducted in 1973 of commercial divers around Kauai showed that fish catches were generally greater in the inshore areas (502-503--see Plate E-1) to the northwest and north of Kauai (Ref. 15). A spear-fishing sample conducted in the same period supported the claim of commercial fishermen that fish are more abundant in shallower waters off Kauai than in deeper waters. The single sampling station in West Kauai (other than Port Allen) near the island of Niihau had the highest number of fish caught, the highest weight per hour of effort, and the highest value ($/Hr) using 1973 dollars and fish prices in Honolulu, Hawaii (Ref. 15).

26. One of the concerns expressed at the public workshop of 14 December 1978 was an opposition to installing mooring slips because improvement would bring larger boats. Fishermen with small boats would have to compete with those having the larger craft (Ref. 19). This concern is widespread throughout Hawaii and is discussed at length in the Executive Summary of the Hawaii Coastal Zone Fisheries Management Study (Ref. 4). According to a survey of University of Hawaii Sea Grant Marine Advisory agents, the commercial-recreational fishermen conflict on Kauai was exemplified by such problems as prices being cut by casual "commercial" fishermen, a drastic overfishing of all reef areas, and conflicting multiple use of bays and harbors between recreational and commrcial fishermen (Ref. 5).

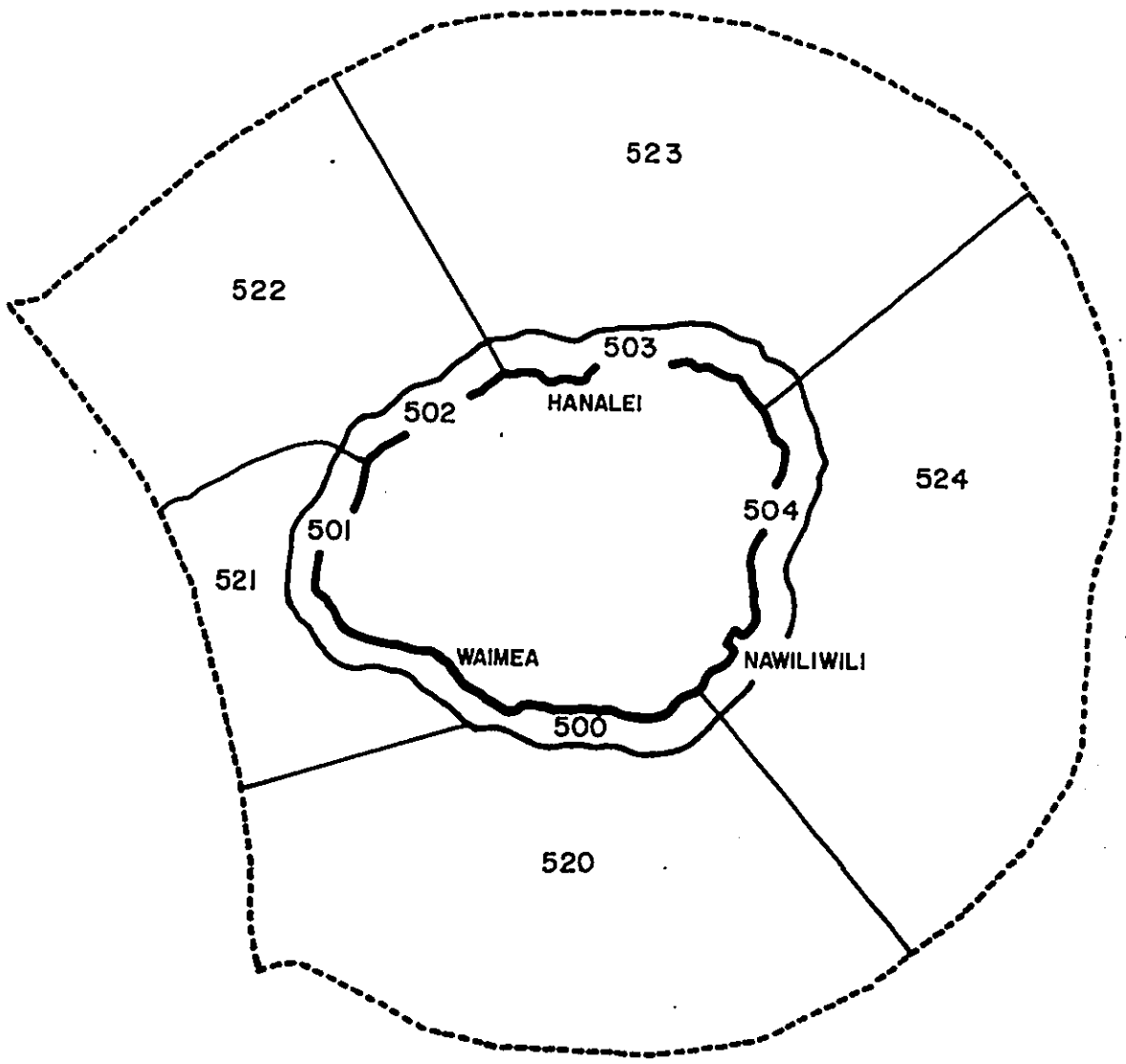
27. An additional issue of potential conflict is that there are large portions of the waters between the U.S. Navy's Pacific Missile Range at Barking Sands and the island of Niihau which are restricted during Navy operations. In addition, the local fishermen report that almost every day, the Navy launches about four 18-foot target boats from Kikiaola Harbor (Ref. 19).

28. Other Recreational Opportunities. The survey of statewide surfing sites conducted by the Surfing Education Association for the State Department of Planning and Economic Development in 1971 identified three surfing sites immeidately east of the harbor within 1,200 feet and two more surfing sites within about 1,500 feet to the west of the harbor (Ref. 17). The sites to the east (Harbor's Rights) extend seaward about 1,200 feet at the most, but the sites to the west (Faye's) hug the shoreline, extending no further seaward than the harbor itself. Another surfing site survey conducted by the Hawaii Surfing Association in 1968 identified only one surfing site called "Graveyard", named after the cemetery located just landward and north of the harbor (Ref. 11). "Graveyard" was identified as breaking about 300 feet offshore. Sharks were identified as a common danger there and elsewhere along the Kekaha-Waimea shoreline a maximum of 20 surfers were observed at one time. The site was evaluated as "not consistently good" with "usually mushy" waves (Ref. 11).

29. The water at Kikiaola is generally turbid and is not a popular swimming area. There are picnic tables and a restroom at the harbor and picnickers are occasionally seen. The nearest other small boat harbor is at Port Allen, about 1.5 hours away by boat. Until the 1940's, local fishig boats were moored around the Waimea pier, but the pier is now abandoned and collapsed.

EVALUATION OF ALTERNATIVES

30. None of the social well-being components are critical in selecting one alternative over another. Implementation of any of the plans, however would be dependent in part on the ability to improve safe navigation and storage of boats moored within the harbor and on endhancement of boating-dependent recreational and commercial fishing (real income and recreational) opportunities within the Waimea-Kekaha region and the island as a whole.



AREA CODE	INSHORE AREAS	PERCENTAGE OF TOTAL INSHORE FISHERMEN
504	MOLOAA TO KAWELIKOA PT.	39.6
501	PUOLO PT. TO MAKAHA PT.	21.5
500	KAWELIKOA PT. TO PUOLO PT.	20.4
503	KAILIU PT. TO MOLOAA	18.1
502	MAKAHA PT. TO KAILIU	0.4
		100.0

AREA CODE	OFFSHORE AREAS	PERCENTAGE OF TOTAL OFFSHORE FISHERMEN
524	MOLOAA TO KAWELIKOA PT.	43.3
521	PUOLO PT. TO MAKAHA PT.	31.3
523	KAILIU PT. TO MOLOAA	11.2
520	KAWELIKOA PT. TO PUOLO PT.	10.5
522	MAKAHA PT. TO KAILIU	3.7
		100.0

SOURCE: Ref. 13

KIKIAOLA HARBOR KAUAI, HAWAII

ORDER OF SALTWATER FISHING AREA "PREFERENCES"

COUNTY OF KAUAI

U.S. ARMY ENGINEER DISTRICT, HONOLULU

PLATE E-1

31. Health, Safety, and Community Well-Being. The most significant beneficial effect of providing improvements to Kikiaola Small Boat Habor would be to improve the health and safety of boaters and indirectly the general community. These effects can be measured monetarily in terms of prevented boat damages and in terms of increased use of the harbor by commercial and semi-commercial fishermen. The monetary benefits are calculated in Appendix A. Non-monetary benefits accrue to boat owners and the community in terms of lessened emotional stress associated with navigating the entrance channel to the small boat harbor. According to the boaters, it is estimated that most fishermen will not go out fishing 50 percent of the time because they cannot return using the entrance channel (Ref. 19). If the water is rough, they will not return, but stay out all night in the ocean. As long ago as 1959, the problem was recognized by a representative of the Kauai Boat Club in saying: "a safe harbor and channel, as a refuge point for the west end of Kauai and Niihau, can save lives. Waimea Harbor (as it was then called) with a good channel will make such a haven for small boats in time of distress" (Ref. 16).

32. At present there are two points which boaters identify as dangerous wave breaks, one about 2,000 feet off the harbor entrance. The most dangerous break is the offshore one. When the south swell is up during the summer months, the offshore surf is estimated to be as high as 15 feet. According to the local boaters, boats trying to leave the harbor under these conditions must make a "running start" (Ref. 18). If timing is not right and the outer break starts breaking, boats must turn around and return to harbor. Only faster boats with speeds greater than 18-20 knots can attempt exiting harbor when south swell is up. For larger slower boats, harbor would be unusable during periods of moderate to high south swell which occur with the greatest frequency from approximately June to August. This situation is compounded by the fact that the summer Ahi (Yellow-fin Tuna) run usually occurs during this period. Fishing boat owners would not want to risk being inadvertently harbor-bound due to surf at any time during the Ahi run.

33. None of the proposed alternative plans will change the offshore break, but under each of the plans, the break at the entrance channel should be eliminated. Under these proposed conditions, even during heavy south swell conditions, boats would be better able to negotiate outer break because elimination of inner break would leave an uninterrupted straight run and eliminate having to time those runs to periods when a lull in both breaks occurred. Nevertheless, these modified conditions may still prevent slower boats from navigating through the heavy summer surf.

34. Knowledge that a safe anchorage and fully navigable harbor (excluding the offshore summer swell) is available should impart to the general community and to the families and relatives of boaters more of a feeling of security and community well-being than at present during storm and summer swell conditions. The benefits from improved navigation will be felt immediately upon completion of the federal project, but the long-term benefits from a safe anchorage or moorage will not be reaped until the State of Hawaii provides berthing spaces and other harbor improvements.

35. Recreational and Commercial Fishing Opportunities. Implementation of any of the four alternatives should increase the use of Kikiaola Small Boat Habor, but tne full benefits of the harbor will not be reached until the State constructs berthing spaces, access to the spaces and other backup facilities such as readily available fresh water, improved restrooms and sewage disposal systems and ice facilities. Based on the current Capital Improvements program of the State and the "Hawaii Fisheries Development Plan" (Ref. 6), there are no plans for improving facilites at Kikiaola at least through 1985. According to the "Fisheries Development Plan" the only west Kauai harbor planned for expansion and improvement is the already developed small boat harbor at Port Allen. Increased recreational (included semi-commercial fishermen) and commercial fishing opportunities, and thus local expenditures, should for the next ten years be largely restricted to local boaters from the Waimea-Kekaha and also Hanapepe (Port Allen) region. The latter may use Kikiaola if they prefer the fisheries of northwestern Kauai and Niihau to those of Koloa-Port Allen. The increased usability of Kikiaola would save them considerable over-water transportation time, up to 1.5 hours each way. Only one charter firm currently operates out of Port Allen. His firm or another local one could begin to operate out of Kikiaola soon after completion of the project, but it is likely that the charter-fishing benefits may not be fully felt until after berthing and other backup facilities are provided by the State.

36. In 1959, the Kauai Boat Club was optimistically forecasting that once the entrance channel was improved and the harbor fully developed that the harbor:

> "will surely develop businesses around boating and fishing interests, such as boat repair and building, charataer boat fishing, sales of marine supplies and sporting goods, hotels, refreshment establishments, and tourists...We need this facility to attract tourists and people from Oahu to come to Kauai (Ref. 16)."

Today the 10 boaters and fishermen attending a Corps workshop in November 1979 were not too enthusiastic about creating a permanent mooring facility (Ref. 18). The local fishermen with small boats did not want to have to compete with fishermen with big boats who could only use the harbor on a regular basis if it had adequate mooring facilities (see para 6f above and Ref. 5 for further discussion of this issue). For the next ten years or so, the local community's fears may not be realized, but eventual development of the harbor by the State seems inevitable. Development of harbor-related public and commercial facilities should also eventually occur, presumably on the "Project District" set aside in the Waimea-Kekaha Regional Development Plan (Ref. 13), but this is not anticipated to occur probably until into the 1990's.

CONCLUSIONS

37. The immediate, short-term effects of harbor improvements are anticipated to be shared largely by the boating and fishing community alone with little leakage into the general community except by enhancing the community's feeling of security by having safer harbor and possibly by providing a larger and more regular supply of fish and other sea products. In the long-term, the benefits of federal harbor improvement, associated with State-sponsored construction of berthing and other backup facilities are anticipated to "leak" into the regional and island-wide community to a greater extent as boat-dependent industries develop followed by marine-oriented tourism. The economic benefits should be welcomed by the community and region, but the social impacts of shoreline tourist development may not be greeted with the same enthusiasm.

38. Waimea, 1.5 miles to the east of the harbor, was the site of Captain Cook's first discovery of the Hawaiian islands in 1778, a Russian fort in 1817, and the area's first sugar industry in the 1880's. The modern village of Kekaha, 1 mile to the west was founded only in 1947. In 1787, Captain George Dixon walked west from "Wy'maia' through "very dry" country of grass-covered light red soil and came upon "A Tappa" (or Kekaha) village just inland of O'omano Point (Ref. 3). He found "amongst these cocoa-nut trees [at Kekaha village]...a good deal of wet swampy ground which is well laid out inplantations of taro and sugar-cane." There are no known prehistoric or historic sites in the immediate vicinity of Kikiaola including ones listed on or eligible for either the State or National Register of Historic Places (Refs. 21 and 22). A cultural resource reconnaissance conducted in April 1980 found no evidence of any archaeological deposits in a proposed alignment for diverting the drainage ditch. All other harbor construction is offshore in previously disturbed areas. A copy of the report is attached.

LIST OF REFERENCES.

1. Amaki, S. (State Department of Transportation, Harbors Division) Personal Communication.

2. Anderson, Robert N. and others. "Kauai Socioeconomic Profile," Departmental Paper 35. Center for Nonmetropolitan Planning and Development, Cooperative Extension Service and Hawaii Agricultural Experiment Station, Honolulu, Hawaii: University of Hawaii, May 1975.

3. Handy, E.S. Craighill and Elizabetn Green Handy. With the Collaboration of Mary Kawene Pukui. "Native Planters in Old Hawaii: Their Life, Lore, and Environment." Bernice P. Bishop Museum Bulletin 233. Honolulu, Hawaii: Bishop Museum Press, 1972.

4. Hawaii, State of. Department of labor and Industrial Relations, Research and Statistics Office. "Labor Area News", April 1980.

5. Hawaii, State of. Department of Land and Natural Resources (DLNR), Division of Fish and Game. "Executive Summary of the Hawaii Coastal Zone Fisheries Management Study," Honolulu, Hawaii: DLNR, December 1979.

6. Hawaii, State of. Department of Land and Natural Resources (DLNR). "Hawaii Fisheries Development Plan." Honolulu, Hawaii: DLNR, 1979.

7. Hawaii, State of. Department of Planning and Economic Development (DPED), Economic Development Division. "Annual Overall Economic Development Program--1979." Prepared for the Hawaii Economic Development District Committee. Honolulu, Hawaii: DPED, 1979.

8. Hawaii, State of. Department of Planning and Economic Development, Research and Economic Analysis Division. "The Population of Hawaii, 1978," Statistical Report 131, Honolulu, Hawaii: DPED, April 2, 1979.

9. Hawaii, State of. Department of Transportation, Harbors Division. "State-wide Boat Launching Facilities Master Plan." Prepred by Koebig & Koebig, Hawaii. Honolulu, Hawaii: Koebig & Koebig, 1972.

10. Hawaii, State of. Department of Transportation, Harbor's Division, "Statewide Sewer System Improvements to Boating Facilities." Prepared by R. M. Towill. Honolulu, Hawaii: November 1976.

11. Hawaii Surfing Association (HSA). "Surfing Site Survey." Prepared for State Department of Planning and Economic Development, Honolulu, Hawaii, HSA 1968.

12. Hawaii Water Resources Regional Study (HWRRS). "Social Base Study Element Report." Honolulu, Hawaii: HWRRS, April 1975.

13. Hoffman, Robert G. and Hiroshi Yamauchi. "Impact of Recreational Fishing Expenditures on the State and Local Economies of Hawaii." Sea Grant Advisory Report UNIHI-SEAGRANT-AR-72-02. Honolulu, Hawaii: University of hawaii, June 1973.

14. Kauai, County of. "Waimea-Kekaha Regional Development Plan and Supplement." 2 Vols. Prepared by Belt, Collins & Associates, Ltd. Honolulu, Hawaii: September 9, 1977.

15. Kauai, County of. Department of Public Works. "Water Quality Management Plan as Related to Waste Treatment for the County of Kauai." Prepared by Sunn, Low, Tom & Hara, Inc. Honolulu, Hawaii: SLT&H, July 1973.

16. Lent, Ralph C., Commodore, Kauai Boat Club. Letter of January 15, 1959 to US Army Engineer District, Honolulu. In US Army Engineer District, Honolulu "Survey of Coasts of Hawaiian Islands, Hawaii. Harbors for Light-Draft Vessels, Lihue, Kauai." Record of Public Hearing. Honolulu, HI: USAED, Honolulu 16 January 1959.

17. Surfing Education Association. "1971 Statewide Surfing Site Survey." Narrative Report and Site Maps and Lists for Kauai. Honolulu, Hawaii 1971.

18. US Army Engineer District, Honolulu (USAED), Memorandum for Record, subject: "Public Workshop and General Coordination for Kikiaola Boat Harbor Study," Honolulu, Hawaii: USAED, 14 November 1979.

19. US Army Engineer District, Honolulu. Memorandum for Record, subject: "Public Workshop and General Coordination for Kikiaola Boat Harbor Study," Honolulu, Hawaii: USAED, 21 December 1978.

20. US Army Engineer District, Honolulu. "Survey of Coasts of Hawaiian Islands, Hawaii. Harbors for Light-Draft Vessels," Record of Public Hearing. Lihue, Hawaii, Honolulu, Hawaii: USAED, 16 January 1959.

21. US Department of the Interior, Heritage Conservation and Recreation Service, National Register of Historic Places. "Annual Listing of Historic Properties." 44 Federal Register 7615, February 6, 1979.

22. US Department of the Interior, Heritage Conservation and Recreation Service, National Register of Historic Place. "Annual Listing of Historic Properties." 45 Federal Register 17,453, March 18, 1980.

hawaii marine research • 677 ala moana blvd., suite 200 • honolulu, hawaii 96813

Ser 100

May 2, 1980

Contracting Officer
Corps of Engineers
Pacific Ocean Division
Building 230
Fort Shafter, Hawaii 96858

Attention: Mr. David Sox

Dear Sir:

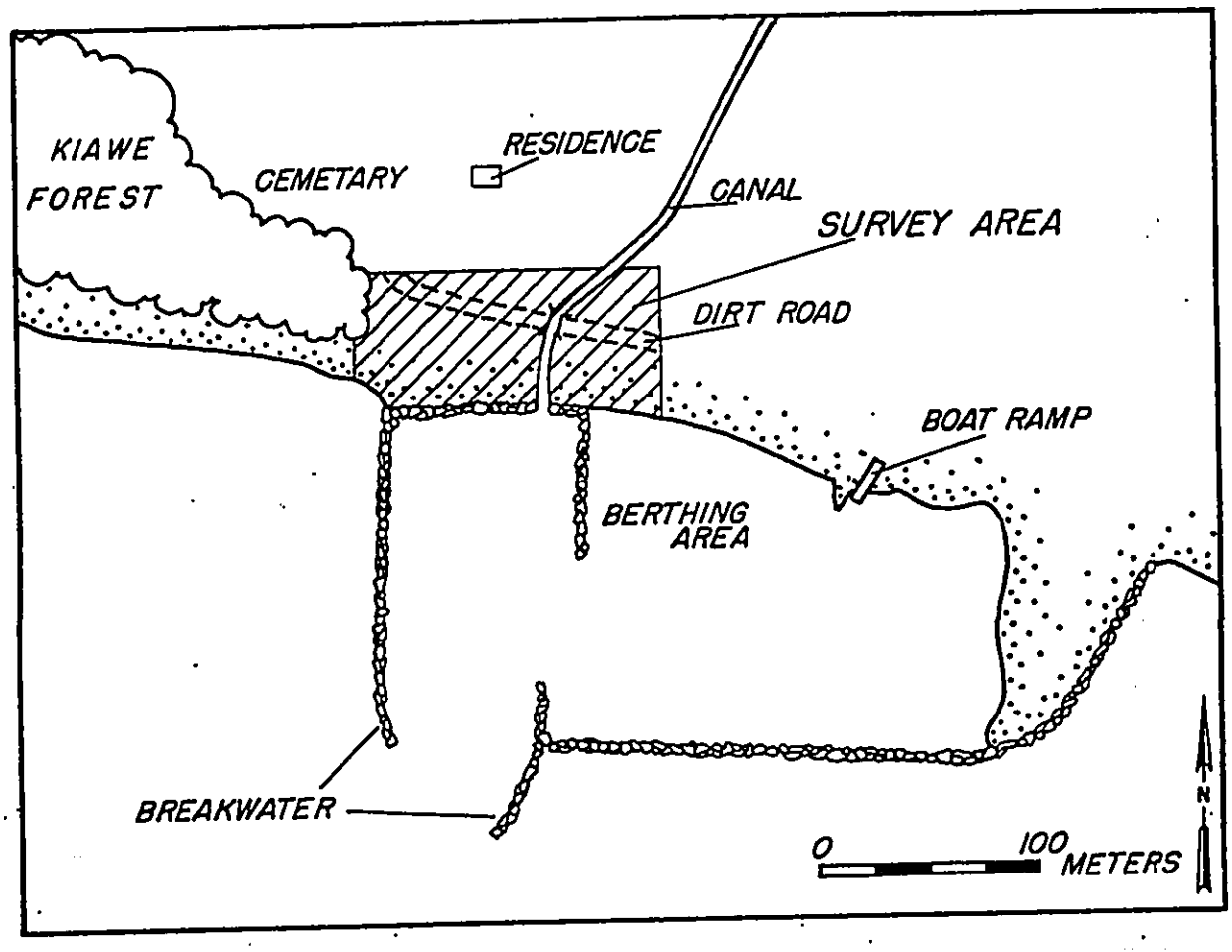
We have completed the Cultural Resources Reconnaissance Survey of the Kikiaola Small Boat Harbor Study Area, Kauai, Hawaii as provided by modification P0005 to Contract Number DACW84-79-C-0012.

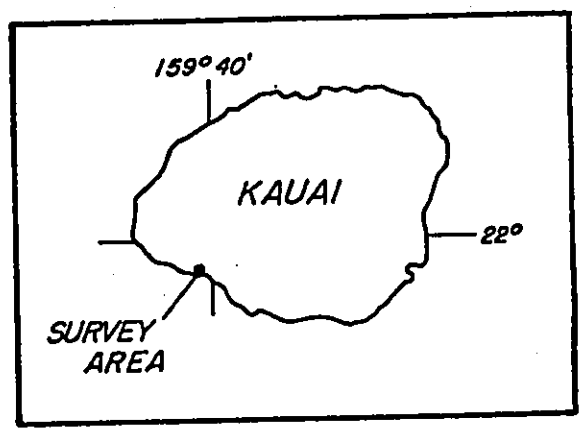
The entire area indicated on the attached map was intensively examined to determine whether any cultural resources were present.

Major literature sources and the site files at the Historic Sites Section of the Division of State Parks, Department of Land and Natural Resources were reviewed to determine if any sites were previously recorded in the area. As far as we could determine, none were.

The area of the survey is currently part of a landscaped area associated with the Kikiaola Small Boat Harbor. Bermuda grass covers most of the area while kiawe (Prosopis pallida), koa haole (Leucaena glauca), coconut (Cocos nucifera), and various other weedy species are present on the fringes of the survey area.

A historic cemetary with headstones dating from the early 1900's is located about 35 meters NNW of the project area. Immediately to the east of the cemetary and to the north of the project area is what appears to be a private residence surrounded by a large lawn. The area to the west of the project area is a sandy beach approximately 10 meters wide and bordered on its inland margin by a kiawe forest. The eastern boundary of the project area is bounded by a canal with a boulder revetment on both banks. This canal drains into the harbor. To the south is a boulder seawall.





LOCATION MAP

KIKIAOLA SMALL BOAT HARBOR KAUAI, HAWAII

The archaeological survey consisted of detailed inspection of the ground surface within the project area and examination of all exposed faces along the intersection of the breakwater and the beach to the west, the seawall to the south, and the banks of the canal to the east. No cultural resources of any kind were found. It appears that the project area is primarily fill material placed after construction of the seawall to the south. Hypothetical extension of the beach from the west to east suggests that the original shoreline was for the most part inland of the project area. As such, it is highly unlikely that any cultural resources are contained within this fill.

The cemetary to the north is clearly delineated along its southern border by a fence which is at a minimum 35 meters from the project area. It is very unlikely that any graves exist south of this fence.

Because the area is probably fill material, monitoring of the construction activity is not warranted. Further archaeological work would not be likely to yield any additional information. If any archaeological material is uncovered during construction, we recommend that a qualified archaeologist be consulted.

This letter serves as our draft for this project.

If you have any questions or need any additional information, please contact me.

Sincerely yours,

Hamilton M. Ahlo, Jr.
Vice President

HMA/s

Enclosure

APPENDIX F

REGULATORY EVAULATIONS

APPENDIX F

EVALUATION OF THE EFFECTS OF THE DISCHARGE OF FILL MATERIAL INTO WATERS OF THE U.S. USING "SECTION 404(B)" GUIDELINES

APPENDIX F

EVALUATION OF THE EFFECTS OF THE DISCHARGE OF FILL MATERIAL INTO WATERS OF THE U.S. USING "SECTION 404(B)" GUIDELINES

TABLE OF CONTENTS

APPENDIX F

EVALUATION OF THE EFFECTS
OF THE DISCHARGE OF FILL MATERIAL INTO
WATERS OF THE U.S. USING "SECTION 404(B)" GUIDELINES

1. Project Description.

a. Description of the proposed discharge of fill materials.

(1) General characteristics of material. Basalt stone: 1 lb - 5 tons.

(2) Quality of material proposed for discharge.

	Basalt Stone
Plan 1	18,500 cu yds
Plan 2	18,500 cu yds
Plan 3	23,000 cu yds
Plan 4	24,700 cu yds.

(3) Source of material to be discharged. Quarry and fieldstone.

b. Description of the proposed discharge site(s) for dredged or fill material.

(1) Location of the discharge site. Kikiaola Small Boat Harbor, Southwest Kauai, Hawaii.

(2) Type of discharge site involved. The site is an existing light-draft harbor on the island of Kauai.

(3) Method of discharge: Stone will be placed by crane, truck, loader and bulldozer.

(4) Date and length of time when discharge will occur: Project scheduled to commence in FY86. Duration of discharge would be one year.

(5) Life of discharge site. Project life is 50 years.

(6) Bathymetry (if open water discharge site(s) is used). Bathymetry varies from -2' to -8' MLLW.

2. Physical Effects (40 CFR 230.4-1(a)).

a. Potential Destruction of Wetlands (40 CFR 230.4-1(a)(1)). Not applicable; no wetlands are present at the discharge site.

b. Other Physical Effects (40 CFR 230.4-1(a)(1)).

(1) Area of bottom covered by the discharge. Plan 1: 0.6 acres; Plan 2: 0.6 acres; Plan 3: 0.8 acres, Plan 4: 0.9 acres.

(2) Changes in bottom geometry and substrate composition. Breakwater structures will create a rubble mound of basalt rock with side slope of 1:15 and 1:2.

(3) Water circulation and flushing characteristics. No significant changes.

(4) Salinity distribution and gradients. No effect.

(5) Natural drainage characteristics and flood and storm water storage areas. Not applicable, discharge site is not a drainage basin with flood or storm water storage characteristics.

(6) Groundwater levels and recharge. Not applicable. Project is not located in a recharge area. No effect to groundwater levels anticipated.

3. Chemical Biological Interactive Effects (40 CFR 230.4-1(b)).

a. The material proposed for discharge meets the exclusion criteria promulgated by the Environmental Protection Agency under Section 404(b)(1) of the Clean Water Act. Thus, no further testing under 40 CFR 230-4-2(b)(2) (Elutriates) and (3) Bioassay is required. Breakwater and revetment material is larger than silt size and obtained from sources which are not expected to be contaminated by pollutants.

b. Impacts on the Water Column (40 CFR 230.4-1(b)(2)).

(1) Reduction in light transmission: Procurement of field stone and quarried rock may cause a temporary increase in turbidity.

(2) Degradation in water aesthetic values: Turbidity resulting from the discharge would temporarily discolor the water.

(3) Direct destructive effects on nektonic and planktonic populations: The discharge does not contain toxic pollutants that could have a direct destructive effect on nekton and plankton populations.

(4) Area contaminants found in the material? Fill material is expected to be free of contaminants. The rock is naturally occurring field stone or quarried rock from local sources.

(5) Elutriate testing results: Material excluded from testing.

(6) Compare constituent concentrations with applicable water quality standards: Material excluded from testing.

(7) Mixing zone: Not required.

c. Impacts on the Benthos (40 CFR 230-4-1(b)(3)).

(1) Area actually covering the benthic communities. Plan 1: 0.6 acres; Plan 2: 0.6 acres; Plan 3: 0.8 acres; Plan 4: 0.9 acres.

(2) Changes in community structure or function. Breakwater and revetment structures will increase available habitat for fish, shellfish and benthic algae. Increase in reef fish population, especially cryptic and nocturnal species, and in crabs and lobsters would be expected.

(3) Benthic bioassay results: Material excluded from bentnic bioassay or bioaccumulation testing.

d. Site comparision (40 CFR 230.4-1(c)): The material proposed for discharge is excluded from chemical-biological interaction testing and meets criteria promulgated by the Environmental Protection Agency. The material is not expected to contain critical amounts of contaminated or prohibited materials necessitating selection of another discharge site.

4. Impacts of the Discharge at the Discharge Site (40 CFR 230.5).

a. Need for the proposed activity: Harbor improvements are needed to reduce surge and navigational hazards at Kikiaola Harbor.

b. Availability of alternate discharge sites and methods of discharge: The site is an existing light-draft harbor, hence alternative sites are not feasible. Practical alternative methods of discharge not available.

c. Description of Impacts:

(1) Chemical, physical and biological integrity of tne aquatic ecosystem: Chemical and physical integrity not affected. Biology of ecosystem will be modified. Long-term effect would increase biological productivity at the discharge site.

(2) Food chain and trophic level: Revetment and breakwater habitat may alter trophic levels, increasing proportion of carnivores and planktivores.

(3) Diversity of plant and animal species: Long-term increase in diversity of plant and animal species resulting from breakwater and revetment structures.

(4) Movement into and out of feeding, spawning, breeding and nursery areas: No effect anticipated. Breakwater will become feeding, spawning, breeding and nursery area.

(5) Wetlands: No wetlands occur at discharge site.

(6) Areas that serve to retain natural high waters or flood waters: Not applicable. Discharge site is a small boat harbor.

(7) Degradation of water quality: Discharge is not expected to degrade water quality. Discharge material does not contain contaminants or prohibited material and consists of material larger than silt size.

d. Methods to minimize turbidity (40 CFR 230.5(a)(7)):

(1) Discharge will consist of material larger than silt size.

(2) Protective measures will be utilized to prevent erosion of material from the dredged causeway.

(3) The material will be confined to the discharge site.

e. Methods to minimize degradation of water aesthetic, recreation and economic values: Same as those in item d.

f. Other metnods investigated to minimize possible harmful effects.

(1) Scientific literature developed by EPA, National Water Quality Criteria: None.

(2) Alternatives to open water discharge: Not applicable.

(3) Disposal sites where physical environmental characteristics are most amenable to the type of dispersion desired: Not applicable. Discharge site is not a disposal site.

(4) Discharge beyond the baseline of the territorial seas: The discharge does not affect the baseline from which the territorial seas are measured.

(5) Covering contaminated dredged material with cleaner material: Alternative not applicable to the project purpose or design.

(6) Any EPA monitoring requirement specified during the coordination process: None.

g. Impact on water use (40 CFR 230.5(b)):

(1) Municipal water supply intakes: None. No intakes exist at the discharge site.

(2) Shellfish: None. Commerical, narvestable shellfish beds are absent at the discharge site.

(3) Fisheries: The discharge forms structures which should increase localized fish and crustacean abundance.

(4) Wildlife: None. Wildlife is absent at the discharge site.

(5) Recreation: Recreational fishing from breakwater would be enhanced by project. Increased boating activity expected.

(6) Benthic life: Placement of breakwater and revetment structures will destroy all benthic life in the discharge site. Recolonization of the new breakwater and revetments should result in increased species diversity and biomass.

(7) Wetlands: None. Wetlands are absent at the discharge site.

(8) Threatened and endangered species: None. Discharge will not affect endangered humpback whale.

(9) Submerged vegetation: Benthic algae should increase in biomass and diversity resulting from increased substrate and vertical zonation.

(10) Size of disposal site: The discharge site is a one time construction activity. Future maintenance activities will not increase the size of the discharge site.

(11) Coastal zone management programs: Projects is consistent with coastal zone management plans.

5. Determination.

a. An ecological evaluation has been made following the guidance in 40 CFR 230.4 in conjunction with the evaluation considerations in 40 CFR 230.5 (40 CFR 230.3(d)).

b. Appropriate measures have been identified and incorporated in the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge (40 CFR 230(d)(1)).

c. Consideration has been given to the need for the proposed activity, the availability of alternative sites and methods of discharge that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law (40 CFR 230.5).

d. No wetlands are affected by the proposed action.

APPENDIX F

PRESIDENTIAL
EXECUTIVE ORDER 11988
ON FLOODPLAIN MANAGEMENT
EVALUATION REPORT

APPENDIX F

PRESIDENTIAL EXECUTIVE ORDER 11988
ON FLOODPLAIN MANAGEMENT EVALUATION REPORT

1. The objective of the Executive Order on Floodplain Management is to avoid adverse impacts associated with the occupancy and modification of the base floodplain and to avoid direct and indirect support of development in the base floodplain if there is a practicable alternative. Under the order, the Corps of Engineers is required to provide leadership and take action to:

a. Avoid development in the base floodplain unless it is the only practicable alternative;

b. Reduce the hazard and risk associated with floods;

c. Minimize the impact of floods on human safety, health and welfare; and

d. Restore and preserve the natural and beneficial values of the base floodplain.

2. The following paragraphs describe the responses to the general compliance procedures as outlined in Engineering Regulation 1165-2-26, dated 15 May 1979.

3. The proposed harbor improvement project will probably require construction of typical harbor backup facilities including fuel station, harbor master office, restrooms, parking area, and boat haulout and repair facilities.

4. There is no practicable alternative to locating harbors within the tsunami inundation zone in the State of Hawaii. All of Hawaii's low-lying shorelines are subject to potential tsunami inundation. As discussed in Section C, Formulation of Preliminary Plans, of the main report, nonstructural plan was determined to be impractical. Therefore, no detailed analysis was performed during the study stage.

5. The primary natural and beneficial value of the tsunami inundation zone is its action as a buffer zone between the ocean and inland areas not subject to potential tsunami inundation. The harbor improvement project will not impact on the natural and beneficial value of the tsunami inundation zone.

6. Although the harbor improvement project will require development within the tsunami inundation zone, implementation of harbor improvements is in the National interest because the developed harbor will provide for safer navigation and berthing conditions, and will enhance commercial and recreational boating opportunities.

7. The most viable method of minimizing adverse impacts on development within the tsunami inundation zone is utilization of an adequate tsunami warning system. The existing system now being utilized in Hawaii is an effective system and should give adequate warning for most tsunami occurrences. Proper structural design now required by the National Flood Insurance Program should adequately reduce the damages to structures in the tsunami inundation zone.

8. Development of this proposed action in the floodplains would help meet the needs identified by this study. This project would outweigh the anticipated environmental losses and added potential flood damage resulting from this action. The general public is being advised of tsunami danger on a continuing basis in Hawaii. In addition, public meetings held in conjunction with the harbor improvement project have informed the public that proposed improvements will require development within the tsunami inundation zone.

APPENDIX F

COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

APPENDIX F

FEDERAL CONSISTENCY DETERMINATION
STATE OF HAWAII, COASTAL ZONE MANAGEMENT PROGRAM
KIKIAOLA HARBOR IMPROVEMENT PROJECT
WAIMEA, KAUAI, HAWAII

1. The Kikiaola Harbor navigation improvement project, located on the southwest coast of Kauai (Figure 1), is proposed for construction in the coastal zone management area. The project (Figure 2) involves construction of:

a. Removing 150 feet from the existing outer east stub breakwater.

b. Raising 115 feet and 570 feet of the east breakwater's crest elevation by four feet and three feet, respectively.

c. Removing and constructing 85-foot-long inner east stub breakwater.

d. Modifying 220 feet of the existing west breakwater head.

e. Dredging a 725-foot-long entrance channel to a depth of 12 feet and width varying from 105 to 205 feet.

f. Dredging a 320-foot-long access channel to a depth of 8 feet and width varying from 70 to 105 feet.

This construction will modify the existing state-owned, boat harbor. The improvements were requested by the State of Hawaii, and were authorized by Congress in 1968. The following consistency determination summarizes the project's conformance with policies of the Hawaii State Coastal Zone Management Program.

2. The project meets the objectives and policies of the CZM program as follows.

SECTION 205A-(b)(1). Recreational Resources.

OBJECTIVE: "Provide coastal recreational opportunities accessible to the public."

POLICIES:

a. "Improve coordination and funding of coastal recreation planning and management."

The project document and subsequent Congressional authorization have resulted in the coordination and funding of harbor planning.

b. "Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area."

Developement of berthing areas and safe entrance channel will provide

for adequate and accessible recreational boating opportunity.

SECTION 205A-2(b)(2). Historic Resources.

OBJECTIVE: "Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American History and culture."

POLICIES:

a. "Identify and analyze significant archaeological resources."

No archaeological resources have been identified during project planning, however, construction specifications will detail procedures for dealing with archaeological resources should they be discovered during project construction.

b. "Maximize information retention through preservation of remains and artifacts or salvage operations."

Construction specifications will detail methods of maximizing preservation of any remains or artifacts which may be discovered during construction activities.

c. "Support State goals for protection, restoration, interpretation and display of historic resources."

State goals regarding historic resources will be supported via active coordination throughout the planning and construction phases of the project with the State Historic Preservation Officer.

SECTION 205A-2(b)(3). Scenic and Open Space Resources.

OBJECTIVE: "Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources."

POLICIES:

a. "Identify valued scenic resources in the coastal zone management area."

No scenic resources will be affected by harbor modifications.

b. "Insure that new developments are compatible with their visual environment by designing and locating such development to minimize the alteration of natural land forms and existing public views to and along the shorline."

The project modifies an existing harbor facilily and therefore is compatible with the existing visual environment. No natural land forms will be altered along the shoreline.

c. "Preserve, maintain and, where desirable, improve and restore shoreline open space and scenic resources."

The project does not affect shoreline open space or scenic resources.

d. "Encourage those developments which are not coastal dependent to locate in the inland areas."

The harbor project is coastal dependent.

SECTION 205A-2(b)(4). Coastal Ecosystems.

OBJECTIVE: "Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosysyems."

POLICIES:

a. "Improve the technical basis for natural resources management."

Subsurface borings performed as part of project planning will improve technical knowledge of the offshore area in the vicinity of the harbor and will aid in the management of that resource.

b. "Preserve valuable coastal ecosystems of significant biological or economic importance."

Although project construction may temporarily disturb the nearby coastal ecosystems, those ecosystems will be enhanced after project completion due to the diverse marine habitat which will be provided by the project.

c. "Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs."

Coastal waters will be temporarily degraded during dredging activities, but this degradation will be minimized by the enforcement of specified standards during the construction activities.

d. "Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate State water quality standards."

Construction specifications and State and local laws will promote planning and management practices which reflect the tolerances of marine ecosystems and prohibit uses which violate State water quality standards. A water quality certification will be obtained from the State Department of Health prior to the start of construction.

SECTION 205A-2(b)(5). Economic Uses.

OBJECTIVE: "Provide public or private facilities and improvements important to the State's economy in suitable locations."

POLICIES:

a. "Concentrate in appropiate areas the location of coastal dependent development necessary to the State's economy."

The project modifies an existing State-owned harbor. The project will enhance commercial fishing opportunities which aids the State's economy.

b. "Insure that coastal dependent development such as harbors and ports, visitor industry facilities and energy generating facilities are located, designed, and constructed to minimize adverse social, visual and environmental impacts in the coastal zone management area."

The project will add to an existing facility and thus will minimize the social, visual, and environmental impacts in the coastal zone. Now new shoreline areas will be affected by the harbor improvement.

c. "Direct the location and expansion of coastal dependent developments to areas presently designated and used for such development and permit reasonable long term growth at such areas and permit coastal dependent development outside of presently designated areas when a) utilization of presently designated locations is not feasible; b) adverse environmental effects are minimized; and c) important to the State's economy."

The project is confined to an area already committed to harbor activities.

SECTION 205A-2(b)(6). Coastal Hazards.

OBJECTIVE: "Reduce hazard to life and property from tsunami, storm waves, stream flooding erosion and subsidence."

POLICIES:

a. "Develop and communicate adequate information on storm wave, tsunami, flood, erosion, and subsidence hazard."

The planning studies and project report develop and communicate detailed information on storm waves and on the risk of coastal flooding due to tsunami.

b. "Control development in areas subject to storm wave, tsunami, flood, erosion and subsidence hazards."

The harbor project may encourage harbor-related development however, such development is subject to coastal zone building requirements. The improved harbor will offer improved storm wave protection for areas within the harbor basin.

c. "Insure that developments comply with requirements of the Federal Flood Insurance Program."

Not applicable to the project.

d. "Prevent coastal flooding from inland projects."

Not applicable to the project.

SECTION 205A-2(b)(7). Managing Development.

OBJECTIVE: "Improve the development review process, communication, and public participation in the management of coastal resources and hazards."

POLICIES:

a. "Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development."

The project planning process utilizes and implements existing federal, state and county laws and ordinances as well as existing federal and US Army Corps of Engineers regualtions.

b. "Facilitate timely processing of application for development permits and resolve overlapping or conflicting permit requirements."

The implementation of project planning facilitates timely processing of permit applications to the maximum extent practicable.

c. "Communicate the potential short- and long-term impacts of proposed signigicant coastal developments early in their life cycle and in terms understandable to the general public to facilitate public participation in the planning and review process."

The project report thoroughly discusses all aspects of short- and long-term impacts relative to the project. Significant impacts were discussed at the final public meeting held before commencement of project construction.

APPENDIX G

US FISH AND WILDLIFE SERVICE REPORT

United States Department of the Interior

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

IN REPLY REFER TO:
ES
Room 6307

August 8, 1980

Colonel Alfred J. Thiede
U.S. Army Engineer District Honolulu
Building 230
Fort Shafter, Hawaii 96858

Re: Detailed Report
Kikiaola Harbor for
Light-Draft Vessels
Kekaha, Kauai, Hawaii

Dear Sir:

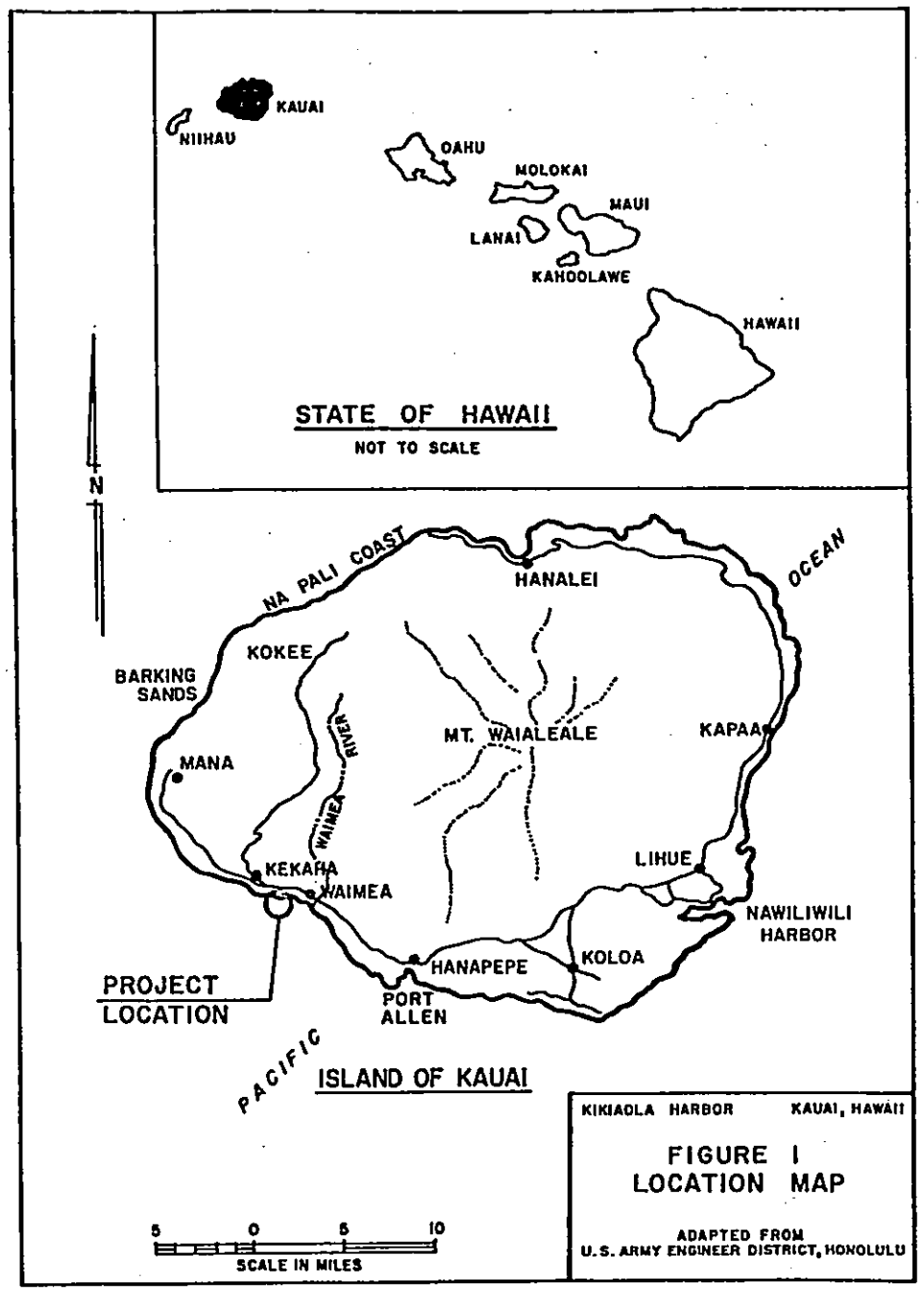
This is the detailed report of the U.S. Fish and Wildlife Service on plans developed by the Honolulu District of the U.S. Army Corps of Engineers to improve navigation at Kikiaola Boat Harbor, Kekaha, Kauai, Hawaii, under the authority of Section 107 of the River and Harbor Act of 1960, as amended.

This report has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and other authorities mandating Department of Interior concern for environmental values, and fulfills the responsibility of the Fish and Wildlife Service under Section 2(b) of the Act. It is also consistent with the intent of the National Environmental Policy Act.

The analysis and recommendations herein are based on information contained in the Corps of Engineers' Report on Survey of the Coast of the Hawaiian Islands, Harbors for Light-Draft Vessels (1967), Stage II Planning Documentation for Kikiaola Harbor (1979), and the Draft General Design Memorandum for Kikiaola Harbor (1980). Biological information was obtained from field investigations conducted by Fish and Wildlife Service biologists and from a survey of pertinent scientific literature.

Introduction

Kikiaola Small Boat Harbor is located on the southwestern coast of the island of Kauai, Hawaii, near the town of Kekaha (Fig. 1). Kauai is



approximately 100 statute miles west-northwest of Honolulu. Formed originally as a solitary volcanic shield, Kauai is geologically the oldest of the six major islands in the Hawaiian archipelago. Its deeply incised river valleys, sharp ridges, and sheer cliffs, or "pali", provide visual evidence of its long exposure to subaerial erosion and wave action. Kikiaola is situated on the seaward margin of broad coastal plain which was formed by wave action along a prehistoric shoreline as defined by the steep bluffs which form its inland boundary. This emergent marine terrace was subsequently overlain with alluvial deposits from upland erosion (1).

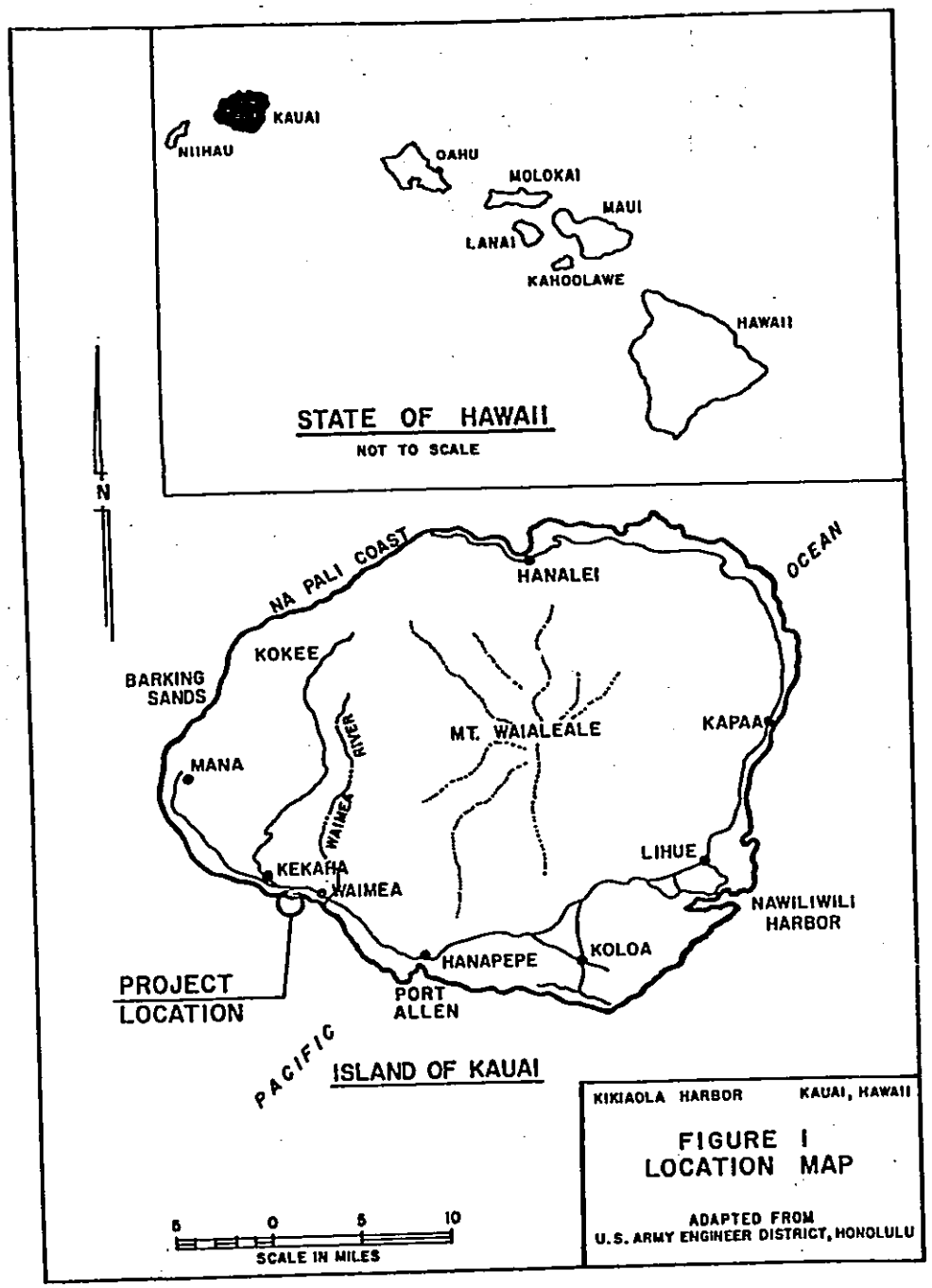
This region has a mild and relatively dry climate, averaging 75°F and 20 inches of rainfall annually. Land uses are primarily urban, military, and agricultural. With irrigation, soils are suitable for cattle grazing and sugarcane cultivation. Under a long-term lease to the Kehaka Sugar Company, State-owned agricultural lands are devoted primarily to sugarcane production (2).

Kauai is the fourth largest island in the State of Hawaii, 555 square miles in area. Its shoreline is 113 miles in length. However, 11 miles of shoreline are rendered inaccessible by sheer sea cliffs, and an additional 39 miles are only marginally accessible or totally inaccessible as a result of private ownership or military security. Of the remaining 63 miles of shoreline, only 11 miles are available for public recreation (3).

With a resident population of 29,542 (1970 census), Kauai is the fourth most populous island in the State and has the highest number of dry-stored boats per capita. This latter statistic is due, in part, to the limited number of berthing spaces available on the island. Most of these boats are trailer-mounted and are launched at any of nine existing public launching ramps. Kikiaola Harbor is the third most popular launching site on Kauai and is the only such facility in the Waimea District. Its proximity to the towns of Waimea and Kekaha and its convenient location with respect to excellent fishing grounds off Barking Sands may account for its popularity (4).

The existing structures at Kikiaola Harbor (Fig. 2) include a 600-foot-long west breakwater and a 1,170-foot-long east breakwater with two stub breakwaters which enclose an area of 5.8 acres ranging in depth from 1 to 5 feet below mean lower low water (MLLW). A 235-foot-long inner stub breakwater protects a concrete launching ramp and 150-foot-long marginal wharf from ocean swells which enter the harbor (5, 6). However, the shallow entrance channel often produces steep wave fronts and breaking waves, which prevent boats from safely entering or leaving the harbor. Shallow harbor depths and surge prevent the use of the harbor for berthing of boats. Furthermore, the low crest elevation of the east breakwater (+8 feet MLLW) permits overtopping by storm waves, which precludes the use of Kikiaola as a harbor of refuge (5).

The Water Transportation Facilities Division of the Hawaii Department of Transportation was authorized under a Department of the Army permit (Ref. PODCO-O 1502-SD) to remove approximately 6,600 cubic yards of sand and silt from the harbor facility by dredging an 80-foot-wide channel to a depth of -8 feet MLLW and a 50-foot-wide area seaward of and parallel to the marginal wharf to a depth of -6 feet MLLW (Fig. 2).



approximately 100 statute miles west-northwest of Honolulu. Formed originally as a solitary volcanic shield, Kauai is geologically the oldest of the six major islands in the Hawaiian archipelago. Its deeply incised river valleys, sharp ridges, and sheer cliffs, or "pali", provide visual evidence of its long exposure to subaerial erosion and wave action. Kikiaola is situated on the seaward margin of broad coastal plain which was formed by wave action along a prehistoric shoreline as defined by the steep bluffs which form its inland boundary. This emergent marine terrace was subsequently overlain with alluvial deposits from upland erosion (1).

This region has a mild and relatively dry climate, averaging 75°F and 20 inches of rainfall annually. Land uses are primarily urban, military, and agricultural. With irrigation, soils are suitable for cattle grazing and sugarcane cultivation. Under a long-term lease to the Kehaka Sugar Company, State-owned agricultural lands are devoted primarily to sugarcane production (2).

Kauai is the fourth largest island in the State of Hawaii, 555 square miles in area. Its shoreline is 113 miles in length. However, 11 miles of shoreline are rendered inaccessible by sheer sea cliffs, and an additional 39 miles are only marginally accessible or totally inaccessible as a result of private ownership or military security. Of the remaining 63 miles of shoreline, only 11 miles are available for public recreation (3).

With a resident population of 29,542 (1970 census), Kauai is the fourth most populous island in the State and has the highest number of dry-stored boats per capita. This latter statistic is due, in part, to the limited number of berthing spaces available on the island. Most of these boats are trailer-mounted and are launched at any of nine existing public launching ramps. Kikiaola Harbor is the third most popular launching site on Kauai and is the only such facility in the Waimea District. Its proximity to the towns of Waimea and Kekaha and its convenient location with respect to excellent fishing grounds off Barking Sands may account for its popularity (4).

The existing structures at Kikiaola Harbor (Fig. 2) include a 600-foot-long west breakwater and a 1,170-foot-long east breakwater with two stub breakwaters which enclose an area of 5.8 acres ranging in depth from 1 to 5 feet below mean lower low water (MLLW). A 235-foot-long inner stub breakwater protects a concrete launching ramp and 150-foot-long marginal wharf from ocean swells which enter the harbor (5, 6). However, the shallow entrance channel often produces steep wave fronts and breaking waves, which prevent boats from safely entering or leaving the harbor. Shallow harbor depths and surge prevent the use of the harbor for berthing of boats. Furthermore, the low crest elevation of the east breakwater (+8 feet MLLW) permits overtopping by storm waves, which precludes the use of Kikiaola as a harbor of refuge (5).

The Water Transportation Facilities Division of the Hawaii Department of Transportation was authorized under a Department of the Army permit (Ref. PODCO-O 1502-SD) to remove approximately 6,600 cubic yards of sand and silt from the harbor facility by dredging an 80-foot-wide channel to a depth of -8 feet MLLW and a 50-foot-wide area seaward of and parallel to the marginal wharf to a depth of -6 feet MLLW (Fig. 2).

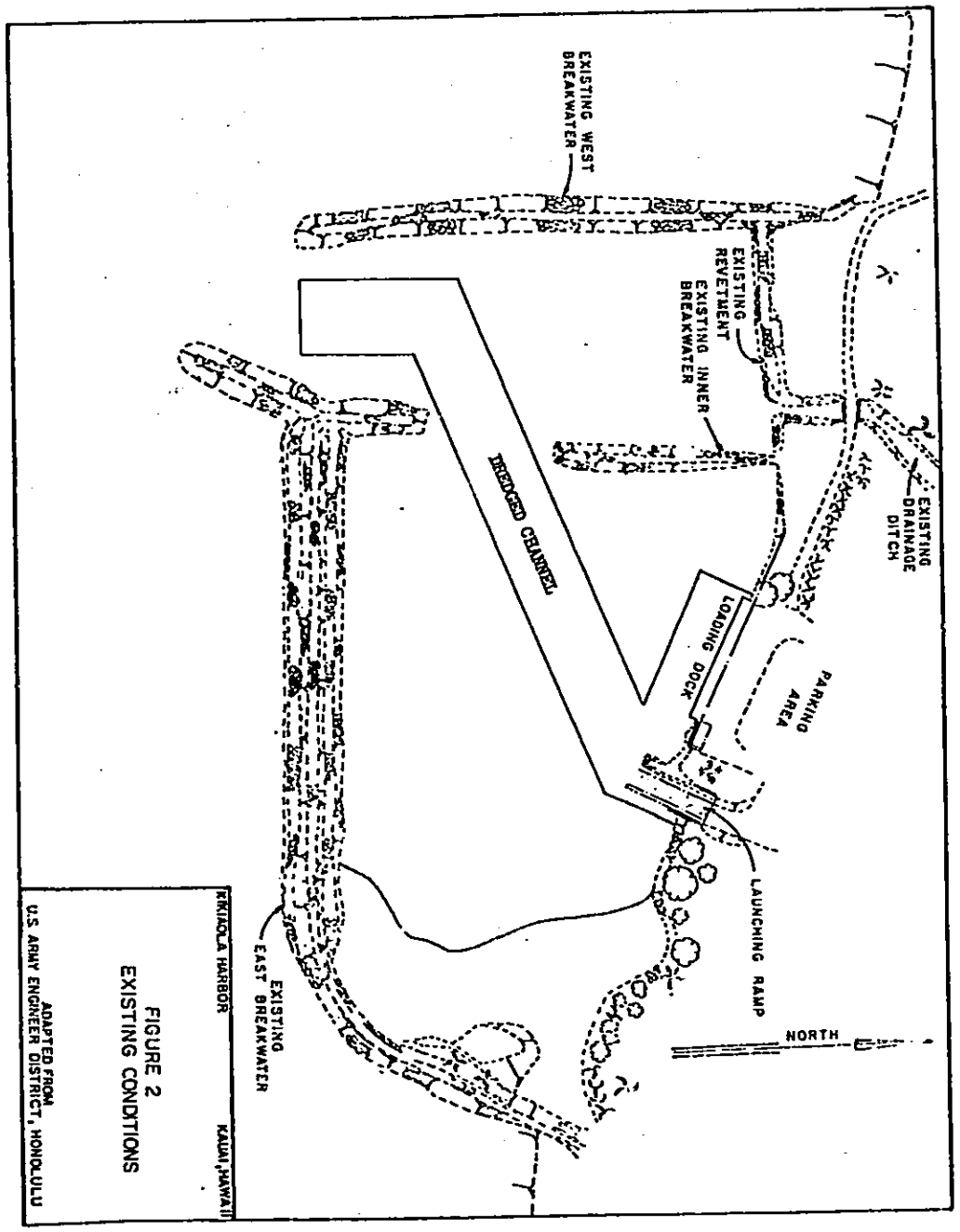


FIGURE 2
EXISTING CONDITIONS

Following this State-funded action, the Corps of Engineers proposes to modify the existing Kikiaola Harbor facility in order to reduce hazardous wave conditions in the entrance channel, provide for adequate berthing spaces, reduce surge within the harbor basin, and minimize siltation in the entrance channel and harbor basin.

Project Description

Table 1 provides a summary of the features of the selected plan based on preliminary project designs provided by the Corps on July 22, 1980, and as described in the General Design Memorandum (7). Figure 3 is a plan view of the proposed project design.

These proposed modifications intended to meet existing requirements and accommodate expansion of the local boat population to the year 2020.

Environmental Setting Without the Project

Methodology

Biologists from the U.S. Fish and Wildlife Service conducted a field reconnaissance of the project area on April 11-12, 1979, to identify and evaluate fish and wildlife resources. Visual observations and collections of terrestrial and intertidal flora and fauna were made at the project site. Highly turbid conditions in the marine environment precluded direct visual observations. However, by using a 25-foot seine, it was possible to sample the marine fauna of Kikiaola Harbor. A representative sample of specimens collected was preserved for later identification. Physical parameters, such as temperature, salinity, and turbidity were measured also.

Terrestrial Resources

The project vicinity is devoted primarily to urban, military, and agricultural uses. Terrestrial flora largely consists of introduced and/or cultivated species, including coconut palms (Cocos nucifera), "kiawe" (Prosopis pallida), ironwood (Casuarina equisetifolia), "hau" (Hibiscus tiliaceus), "koa haole" (Leucaena leucocephala), "klu" (Acacia farnesiana), banyan (Ficus sp.), Plumeria sp., beach "naupaka" (Scaevola taccada), beach morning glory (Ipomoea pes-caprae) and other herbaceous weeds and grasses, as well as commercially-cultivated sugarcane (Saccharum officinarum).

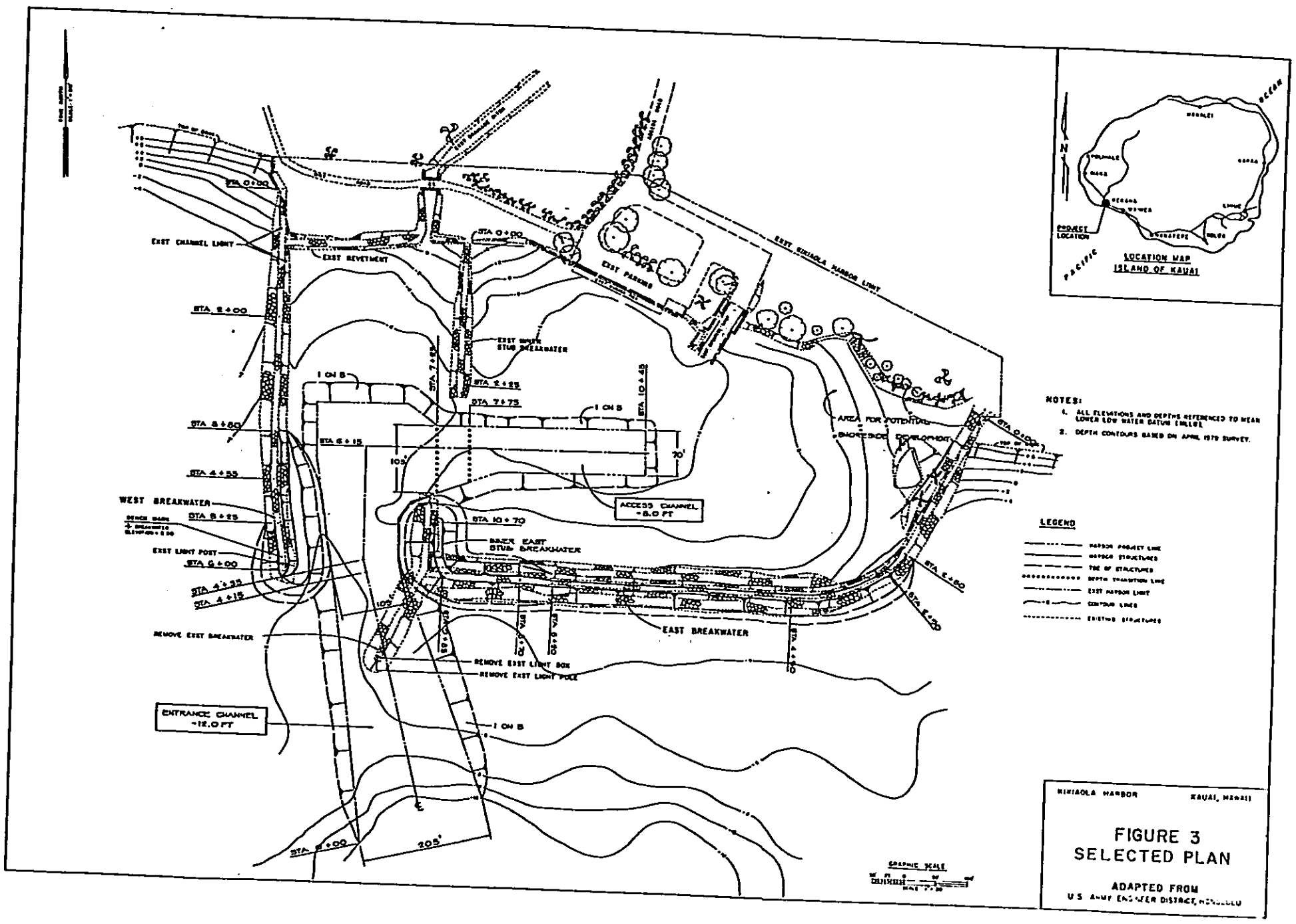
Terrestrial fauna are predominantly domestic animals and livestock and exotics, many of which are circumtropical in distribution. These include the domestic dog (Canis familiaris), domestic cat (Felis catus), house mouse (Mus musculus), roof rat (Rattus rattus), Norway rat (Rattus norvegicus), Hawaiian rat (Rattus exulans hawaiiensis), and mongoose (Herpestes auropunctatus). Hawaii's only exclusively terrestrial endemic mammal, the endangered Hawaiian hoary bat (Lasiurus cinereus semotus), probably does not exist in the project area.

Two species of passerine birds, the common mynah (Acridotheres tristis) and the house sparrow (Passer domesticus) were observed in the project area. Table 2 lists bird species commonly found within the Kekaha-Mana area (8, 9).

TABLE 1

PROJECT FEATURES

1. BERTHING CAPACITY	105 boats
2. ENTRANCE CHANNEL	
a. Length	725 feet
b. Width	105 to 205 feet
c. Depth	12 feet
3. ACCESS CHANNEL	
a. Length	320 feet
b. Width	70 to 105 feet
c. Depth	8 feet
4. EAST BREAKWATER HEAD MODIFICATION	
a. Length	115 feet
b. Crest Elevation	+12 feet MLLW
c. Crest Width	13 feet
d. Side Slope	1V on 2H
e. Armor	3.5- to 5-ton stone
5. EAST BREAKWATER TRUNK MODIFICATION	
a. Length	570 feet
b. Crest Elevation	+11 feet MLLW
c. Crest Width	9 feet
d. Side Slope	1V on 1.5H
e. Armor	1- to 2-ton stone
6. WEST BREAKWATER HEAD MODIFICATION	
a. Length	220 feet
b. Crest Elevation	+8 feet MLLW
c. Crest Width	15 feet
d. Side Slope	1V on 2H
e. Armor	3.5- to 5-ton stone
7. INNER EAST STUB BREAKWATER	
a. Length	85 feet
b. Crest Elevation	+12 feet MLLW
c. Crest Width	13 feet
d. Side Slope	1V on 2H
e. Armor	3.5- to 5-ton stone
8. OUTER EAST STUB BREAKWATER	
a. Length Removed	150 feet



NIIHAU HARBOR KAUAI, HAWAII

FIGURE 3
SELECTED PLAN

ADAPTED FROM
U.S. ARMY ENGINEER DISTRICT, HONOLULU

TABLE 2
List of Birds Commonly Found in the Kekaha-Mana Area
(Adapted from Pyle, 1977, and Telfer)

FAMILY Genus/Species/Subspecies	Common Name
ARDEIDAE	
Bubulous ibis	cattle egret
Nycticorax n. hoactli	black-crowned night heron
ANATIDAE	
Spatula clypeata	shoveler duck
Anas acuta	pintail duck
Anas wyvilliana (E)	Koloa duck
PHASIANIDAE	
Phasianus colchicus	ring-necked pheasant
RALLIDAE	
Gallinula chloropus sandvicensis (E)	Hawaiian gallinue
Fulica americana alai (E)	Hawaiian coot
CHARADRIIDAE	
Pluvialis dominica	American golden plover
SCOLOPACIDAE	
Heteroscelus incanus	wandering tattler
Arenaria interpres	ruddy turnstone
Calidris alba	sanderling
RECURVIROSTRIDAE	
Himantopus mexicanus knudseni (E)	Hawaiian stilt
COLUMBIDAE	
Streptopelia chinensis	lace-necked dove
Geopelia striata	barred dove

TABLE 2 (cont'd)

FAMILY Genus/Species/Subspecies	Common Name
TYTONIDAE	
Tyto alba	barn owl
STRIGIDAE	
Asio flammeus sandwichensis	Hawaiian owl
TIMALIIDAE	
Garrulax canorus	Chinese thrush
MIMIDAE	
Mimus polyglottus	mocking bird
ZOSTEROPIDAE	
Zosterops japonica	Japanese white-eye
STURNIDAE	
Acridotheres tristis	common mynah
ICTERIDAE	
Sturnella neglecta	western meadowlark
PLOCEIDAE	
Lonchura punculata	spotted munia, ricebird
Passer domesticus	house sparrow
FRINGILLIDAE	
Cardinalis cardinalis	northern cardinal

(E) indicates endangered species

No significant forest or wetland areas which could provide suitable habitat for endangered forest birds or waterbirds exist in the immediate project area. However, endangered waterbirds are found in low-lying coastal wetlands located 3 to 8 miles northwest of Kekaha on State Highway 50 (8).

Although no shorebirds were sighted during the field survey, suitable feeding habitat for these birds does exist along the shoreline in the project area.

Reptiles observed in the project area include the metallic skink (Leiolopisma metallicum), snake-eyed skink (Cryptoblepharus boutoni), and several species of gekkos (Gekkonidae). The marine toad, Bufo marinus, is common throughout the tropical Pacific and probably occurs in the project area, as well.

Marine Resources

Agricultural land use in the project area has had a profound effect on the nearshore marine environment. In the past, silt-laden runoff from sugarcane fields has been collected and discharged into Kikiaola Harbor via a drainage ditch. Terrigenous sediments, predominantly red clay and silt, have accumulated in the harbor basin, which acts as a sediment trap. Nearshore waters are rendered a reddish-brown color, reducing Secchi disc measurements to as little as one foot in the inner harbor. Core samples indicate that these sediments have been deposited on the harbor bottom, overlying and mixing with calcareous and basaltic sands (5).

The discharge of agricultural runoff is now regulated by a flap gate located 980 feet inland. The gate is only opened during periods of local flooding, about 2-3 times per year (7).

Salinity was measured using a refractometer. Values of 28-29 parts per thousand were measured at wharfside. These values are approximately four-fifths that of normal seawater, indicative of recent freshwater runoff or infiltration of groundwater through the permeable sandy substratum of the coastal plain. This condition may be exacerbated by relatively poor circulation between the harbor and open ocean waters.

Intertidal habitat includes both soft, silty-sand and hard, basaltic rock substrates, which are inhabited by distinctly different flora and fauna.

Man-made breakwaters provide a hard substrate on which attached and encrusting algae are abundant. These include the green algae (Cladophora fascicularis and Ulva fasciata), red algae (Acanthophora spicifera) and crustose Porolithon onkodes. The latter was found predominantly on the wave-washed seaward face of the east breakwater. Grapsid crabs (Metapograpsus sp.) are particularly abundant along this high energy intertidal zone, as well. Gastropod mollusks were more abundant in the calmer intertidal habitat of the harbor. These species include the dotted periwinkle (Littorina pintado pintado), common nerite (Nerita picea), kneecap shell (Cellana argentata), black limpet (C. exarata), and false limpet (Siphonaria normalis) in descending order of abundance. Pelecypod (bivalve) mollusks were found in the less rigorous environment of the inner harbor. These included the purse shell (Isognomon californicum) and the encrusted bottom shells of one or more unidentified species of oyster (Ostreidae).

Soft, sandy substrates are located at the eastern end and in the northwest corner of Kikiaola Harbor. This habitat is occupied by one or two different species of ghost crab (Ocypodidae). Their burrows ranged in density from less than one per square meter to approximately 5 per square meter.

Five separate hauls were made at two different sites within the harbor using a 25-foot seine. Invertebrates collected by this means included the white crab (Portunus sanguinolentus) and an unidentified palaemonid shrimp. The predominant fish collected include the island silverside (Pranesus insularum), "nehu" (Stolephorus purpureus), "aholehole" (Kuhlia sandvicensis), and Samoan mullet (Chelon engeli). Table 3 is a list of marine fauna collected or observed in the project area.

One fisherman was observed fishing for mullet using a cast net near the shoreline at the east end of the harbor. Interviews with other local fishermen indicated that a fishery for "mol" (Polydactylus sexfilis) also exists in the harbor, although no specimens were collected.

Environmental Impact With the Project

Terrestrial Resources

Construction staging, temporary storage of materials, and movement of heavy equipment in the project area would have limited, short-term adverse impacts on terrestrial flora and fauna. Noise, subsonic vibration, dust and airborne pollutants could disturb or temporarily displace wildlife from the project area. These impacts could be minimized by revegetation and restoration of the site immediately following construction.

Impacts related to the collection of field stone or quarry rock could not be evaluated, since these impacts depend on site selection and excavation methods.

Marine Resources

Intertidal organisms will be displaced or destroyed by removal and reconstruction of portions of the east breakwater. However, that portion of the the modified breakwater subject to tidal fluctuation and wave wash will provide intertidal habitat for fauna requiring a hard substrate.

Reductions in surge and the incidence of breaking waves in the entrance channel should improve water clarity within the harbor. Deepening the entrance and access channels should contribute to improved circulation and water clarity. These conditions could attract reef-dwelling fish species into the inner harbor, thereby enhancing species diversity.

Discussion/Recommendations

The proposed modification of Kikiaola Small Boat Harbor should not have any significant, long-term, adverse impacts on fish and wildlife resources. The project site has been developed as a boat harbor, and adjacent land uses are urban and agricultural. The latter use is largely responsible for sedimentation which has occurred within the harbor basin with subsequent degradation of

TABLE 3

Marine Fauna Collected and/or Observed in the Project Area

PHYLUM / CLASS / FAMILY / Genus/species/subspecies	Common Name
ARTHROPODA	
CRUSTACEA	
GRAPSIDAE	
Metapograpsus sp.	rock crab
OCYPODIDAE	
unidentified spp.	ghost crab
PORTUNIDAE	
Portunus sanguinolentus	white crab
PALAEMONIDAE	
unidentified spp.	shrimp
MOLLUSCA	
GASTROPODA	
PATELLIDAE	
Cellana exarata	black limpet
C. argentata	kneecap shell
NERITIDAE	
Nerita picea	common nerite
LITTORINIDAE	
Littorina pintado pintado	dotted periwinkle
SIPHONARIIDAE	
Siphonaria normalis	false limpet
PELECYPODA	
ISOGNOMIDAE	
Isognomon californicum	purse shell
OSTREIDAE	
unidentified spp.	oyster

Table 3 (Cont'd.)

PHYLUM / CLASS / FAMILY / Genus/species/subspecies	Common Name
ECHINODERMATA	
HOLOTHUROIDEA	
Holothuria atra	sea cucumber
VERTEBRATA	
OSTEICHTHYES	
ENGRAULIDAE	
Stolephorus purpureus	Hawaiian anchovy, nehu
MUGILIDAE	
Chelon engeli	Samoan mullet
ATHERINIDAE	
Pranesus insularum	island silverside
POLYNEMIDAE	
Polydactylus sexfilis	threadfin, moi
KUHLIIDAE	
Kuhlia sandvicensis	Hawaiian flag-tail, aholehole
BLENNIDAE	
Istiblennius zebra	rock skipper
GOBIIDAE	
Unidentified spp.	goby
BOTHIDAE	
Engyprosopon hawaiiensis	Hawaiian flounder
DIODONTIDAE	
Unidentified spp.	spiny puffer

nearshore water quality. Although these turbid harbor waters do not support reef-building organisms, a relatively diverse and abundant benthic and intertidal marine fauna exists. In addition, offshore coral reefs in the vicinity could be adversely affected by temporary increases in siltation and turbidity due to project construction. Dredging will temporarily resuspend bottom sediments and worsen turbid conditions which already exist in the harbor; however, these impacts can be confined to the harbor area through the application of appropriate construction techniques and control measures.

In view of the preceding, the U.S. Fish and Wildlife Service recommends that the following measures be incorporated into the final project plans in order to minimize adverse environmental impacts.

1. The use of existing upland spoil disposal and quarry sites is encouraged. If new sites are selected, the Fish and Wildlife will be given the opportunity to evaluate the environmental effects of these activities.

2. Field stone, if used, will be acquired from agricultural or cleared lands and not from forested lands.

3. Dredging will be performed during periods of low tide and low surf.

4. Silt curtains will be deployed as necessary to control turbidity.

5. No dredged material will be stockpiled in the marine environment.

6. On land, spoil disposal will be conducted behind maintained berms above the influence of the tide. No spoil will be placed in any watercourse or wetland. Only clean runoff water from the spoil disposal area will be allowed to reenter any waterway.

7. All permanent spoil disposal areas will be stabilized with vegetative cover or other suitable means to prevent erosion.

8. Terrestrial vegetation at the project site will be restored and erodible embankments will be stabilized immediately following construction.

9. The Fish and Wildlife Service will be notified of any change in project design or construction methodology so that potential impacts can be evaluated.

Sincerely yours,

Nevin D. Holmberg
Deputy Project Leader
for Ecological Services

cc: OEC, Washington, D.C. (2)
ARD-E, Portland, OR (2)
Public Affairs Office, Portland
Region 1 Field Offices
Boise
Laguna-Niguel
Olympia
Sacramento
EPA, San Francisco
National Marine Fisheries Service, HI
Hawaii Division of Fish and Game

Literature Cited

1. Armstrong, R. Warwick (Ed.). 1973. Atlas of Hawaii. Department of Geography, University of Hawaii. University Press of Hawaii.

2. Belt, Collins and Associates. 1977. Waimea-Kekaha Regional Development Plan.

3. U.S. Army Engineer Division, Honolulu. 1971. Hawaii Regional Inventory of the National Shoreline Study.

4. Koebig & Koebig - Hawaii. 1972. Statewide Boat Launching Facilities Master Plan.

5. U.S. Army Engineer District, Honolulu. 1967. Report on Survey of the Coast of the Hawaiian Islands, Harbors for Light-Draft Vessels.

6. _____. 1979. Stage II Documentation Kikiaola Harbor, Island of Kauai, Hawaii.

7. _____. 1980. Draft General Design Memorandum - Kikiaola Harbor for Light-Draft Vessels, Kauai, Hawaii.

8. Telfer, Thomas C. Area Evaluation Report -- Kekeha-Mana Lowland Waterbird Habitat Area Survey.

9. Pyle, Robert L. 1977. Preliminary List of Birds of Hawaii.

APPENDIX H

PUBLIC INVOLVEMENT

APPENDIX H

PUBLIC INVOLVEMENT

TABLE OF CONTENTS

APPENDIX H

PUBLIC INVOLVEMENT

PUBLIC INVOLVMENT PROGRAM

1. The U.S. Army Corps of Engineers, Honolulu Engineer District, is responsible for conducting and coordinating the overall study. Public participation was conceived and carried out as a key element throughout the study process. To insure that the desires and needs of the public were identified and considered, a public involvement program was developed. During the early study period, planning efforts were concentrated on problem identification. The study team members then, through meetings and personal contacts with federal, state, and local agencies, and private citizens, attempted to identify the concerns of the public relating to navigation problems. Feedback from the coordination was used to develop the study scope, planning objectives, the extent of the study area, applicable constraints and controls, and how subsequent planning action would be scheduled.

2. A close coordination was maintained with the State Harbors Division. Representatives of the State Harbors Division have been involved in discussions of plans of others and alternative solutions. The State Harbors Division participated in the public workshops on 14 December 1978 and 1 November 1979 and public meetings on 20 February 1979 and 26 June 1980.

SUMMARY OF PUBLIC WORKSHOPS AND MEETINGS

3. An informal workshop was held on 14 December 1978 at the Waimea Neighborhood Center. The purpose of the workshop was to inform the public of the study initiation and at the same time, to provide the public an opportunity to express their views. About 20 persons, representing residents, boaters, and fishermen, attended the workshop. Significant points and/or concerns voiced during the workshop are summarized below:

a. Boaters and fishermen indicated that an immediate action be taken to solve the problem of shallow depths in the channels.

b. To improve existing harbor instead of relocating to another site.

c. To improve existing navigational aids to mark the location of the entrance channel.

d. To expand launching ramp and parking facilities.

4. On 20 February 1979, a plan formulation public meeting was held at the Waimea Neighborhood Center to further discuss and identify the navigation problems and needs and discuss the authorized plan. The meeting was attended by about 30 persons. During the discussion period, the following views were expressed:

a. The alignment of the entrance channel as shown on the authorized plan is acceptable.

b. The drainage ditch should remain in its present location.

5. A second informal workshop was held on 1 November 1979 at the Waimea Neighborhood Center. Preliminary alternative plans were presented for public review and comment. The workshop was attended by 10 boaters and fishermen. Following views and comments were expressed at the workshop:

a. Dredging entrance channel to -12 feet would be adequate to accommodate the largest fishing vessel expected.

b. State Harbors Division expressed a desire to develop a plan which maximizes the berthing capacity within the existing harbor basin.

c. Turning basin/maneuvering area should be large enough to accommodate several boats at a time.

d. Presently, there is no serious surge problem. If the existing inner breakwater is shortened substantially, it might create a surge problem.

6. A final public meeting was held on 26 June 1980 at the Waimea Neighborhood Center. The purpose of the meeting was to provide the public an opportunity to participate in the plan selection process. Total attendance was 15 persons. The presentation included detailed discussions on plan features of the alternatives; economic, social and environmental factors; engineering considerations; and designation of the tentatively selected plan.

7. On behalf of the State Department of Transportation, a representative of the Harbors Division testified in support of the tentatively selected plan. He expressed their appreciation to the Corps for conducting the study and assessing the need for navigation improvements at Kikiaola Harbor. No objection was voiced on the study recommendations.

APPENDIX H

LIST OF REVIEWERS AND RECIPIENTS

APPENDIX H
LIST OF REVIEWERS AND RECIPIENTS

FEDERAL GOVERNMENT

HQDA (DAEN-CWP-W)
WASH DC 20001

HQDA (DAEN-PAO)
WASH DC 20314

Library Branch
Waterways Experiment Station
P. O. Box 631
Vicksburg, MI 39180

Deputy Assistant Secretary
for Environmental Affairs
U.S. Department of Commerce
Washington, DC 20230

Pacific Region Manager
Office of Coastal Zone Management
3300 Whitehaven Street, N.W.
Washington, DC 20235

Secretarial Representative, Region IX
U.S. Department of Commerce
Federal Bldg, Box 36135
450 Golden Gate Avenue

Director, Environmental Protection
Agency
Office of Field Activities
EIS Filing Section
401 M. Street, S.W.
Washington, DC 20460

EIS Coordinator, Region IX
U.S. Environmental Protection Agency
215 Fremont Street
San Francisco, CA 94105

Executive Director
Advisory Council on Historic
Preservation
P. O. Box 25085
Denver, CO 80225

Chief, Interagency Archeological Svcs
Heritage Conservation & Rec Svc
450 Golden Gate Ave., Box 36065
San Francisco, CA 94102

Assistant Secretary, Program Policy
Office of Environmental Project Review
U.S. Department of the Interior
Washington, DC 20240

Administrator, Southwest Region
National Marine Fisheries Service
U.S. Department of Commerce
P. O. Box 3830
Honolulu, HI 96812

Regional Director, SW Region
National Marine Fisheries Service, NOAA
300 South Ferry Street
Terminal Island, CA 97031

Regional Director, Fish & Wildlife Svc
U.S. Department of the Interior
Lloyd 500 Bldg, Suite 1692
500 N.E. Multnomah Street
Portland, OR 97232

Administrator
Fish & Wildlife Service
US Department of the Interior
300 Ala Moana Blvd, Room 5302
Honolulu, HI 96850

Field Supervisor, Ecological Services
Fish and Wildlife Service
U.S. Department of the Interior
300 Ala Moana Blvd, Room 5302
Honolulu, HI 96850

District Chief
Water Resources Division
U.S. Geological Survey
300 Ala Moana Blvd, Room 6110
Honolulu, HI 96850

Office of Environmental Analysis
Federal Maritime Commission
1100 "L" Street N.W., Room 9102
Washington, D.C. 20573

Commander
Pacific Missile Range Facility
Barking Sands
Kekaha, Hawaii 96752

Asterisk (*) denotes an agency or organization which commented on the draft report.

FEDERAL GOVERNMENT (Cont)

Commander
Fourteenth Coast Guard District
ATTN: Aids to Navigation Branch
300 Ala Moana, 9th Floor
Honolulu, HI 96850

*State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
300 Ala Moana, Room 4316
Honolulu, Hawaii 96850

STATE OF HAWAII

*Director
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813

District Manager
Kauai District Office
DOT, Harbors Division
Lihue, Kauai, HI 96766

*Chairman
Board of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Administrator, Div of Fish & Game
Department of Land & Natural
Resources, State of Hawaii
1151 Punchbowl Street
Honolulu, HI 96813

Administrator, State Parks
Outdoor Recreation & Historic
Sites Division
Dept of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

CZM Programs Manager
DPED
P. O. Box 2359
Honolulu, HI 96804

*Deputy for Environmental Health
State Department of Health
1250 Punchbowl Street
Honolulu, HI 96813

*Commander
Fourteenth Coast Guard District
300 Ala Moana Blvd, 9th Floor
Honolulu, HI 96850

T. E. Tilghman
Lieutenant Junior Grade
Commander, USCG Group Kauai
P. O. Box 68
Koloa, Kauai, HI 96756

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

Marine Affairs Coordinator
Office of Marine Affairs
State of Hawaii
Honolulu, HI 96813

Program Planning Coordinator
Planning Office
Department of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

State Historic Preservation Officer
Department of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Director of State Clearinghouse
Department of Planning & Economic
Development
P. O. Box 2359
Honolulu, HI 96804

*Director
Dept of Planning & Economic
Development, State of Hawaii
250 South King Street
Honolulu, HI 96813

*Environmental Center
University of Hawaii
10 Maile Way
Honolulu, HI 96822

APPENDIX H
LIST OF REVIEWERS AND RECIPIENTS

FEDERAL GOVERNMENT

HQDA (DAEN-CWP-W)
WASH DC 20001

HQDA (DAEN-PAO)
WASH DC 20314

Library Branch
Waterways Experiment Station
P. O. Box 631
Vicksburg, MI 39180

Deputy Assistant Secretary
for Environmental Affairs
U.S. Department of Commerce
Washington, DC 20230

Pacific Region Manager
Office of Coastal Zone Management
3300 Whitehaven Street, N.W.
Washington, DC 20235

Secretarial Representative, Region IX
U.S. Department of Commerce
Federal Bldg, Box 36135
450 Golden Gate Avenue

Director, Environmental Protection
Agency
Office of Field Activities
EIS Filing Section
401 M. Street, S.W.
Washington, DC 20460

EIS Coordinator, Region IX
U.S. Environmental Protection Agency
215 Fremont Street
San Francisco, CA 94105

Executive Director
Advisory Council on Historic
Preservation
P. O. Box 25085
Denver, CO 80225

Chief, Interagency Archeological Svcs
Heritage Conservation & Rec Svc
450 Golden Gate Ave., Box 36065
San Francisco, CA 94102

Assistant Secretary, Program Policy
Office of Environmental Project Review
U.S. Department of the Interior
Washington, DC 20240

Administrator, Southwest Region
National Marine Fisheries Service
U.S. Department of Commerce
P. O. Box 3830
Honolulu, HI 96812

Regional Director, SW Region
National Marine Fisheries Service, NOAA
300 South Ferry Street
Terminal Island, CA 97031

Regional Director, Fish & Wildlife Svc
U.S. Department of the Interior
Lloyd 500 Bldg, Suite 1692
500 N.E. Multnomah Street
Portland, OR 97232

Administrator
Fish & Wildlife Service
US Department of the Interior
300 Ala Moana Blvd, Room 5302
Honolulu, HI 96850

Field Supervisor, Ecological Services
Fish and Wildlife Service
U.S. Department of the Interior
300 Ala Moana Blvd, Room 5302
Honolulu, HI 96850

District Chief
Water Resources Division
U.S. Geological Survey
300 Ala Moana Blvd, Room 6110
Honolulu, HI 96850

Office of Environmental Analysis
Federal Maritime Commission
1100 "L" Street N.W., Room 9102
Washington, D.C. 20573

Commander
Pacific Missile Range Facility
Barking Sands
Kekaha, Hawaii 96752

Asterisk (*) denotes an agency or organization which commented on the draft report.

FEDERAL GOVERNMENT (Cont)

Commander
Fourteenth Coast Guard District
ATTN: Aids to Navigation Branch
300 Ala Moana, 9th Floor
Honolulu, HI 96850

*Commander
Fourteenth Coast Guard District
300 Ala Moana Blvd, 9th Floor
Honolulu, HI 96850

*State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
300 Ala Moana, Room 4316
Honolulu, Hawaii 96850

T. E. Tilghman
Lieutenant Junior Grade
Commander, USCG Group Kauai
P. O. Box 68
Koloa, Kauai, HI 96756

STATE OF HAWAII

*Director
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813

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

District Manager
Kauai District Office
DOT, Harbors Division
Lihue, Kauai, HI 96766

Marine Affairs Coordinator
Office of Marine Affairs
State of Hawaii
Honolulu, HI 96813

*Chairman
Board of Land and Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Program Planning Coordinator
Planning Office
Department of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Administrator, Div of Fish & Game
Department of Land & Natural
Resources, State of Hawaii
1151 Punchbowl Street
Honolulu, HI 96813

State Historic Preservation Officer
Department of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Administrator, State Parks
Outdoor Recreation & Historic
Sites Division
Dept of Land & Natural Resources
1151 Punchbowl Street
Honolulu, HI 96813

Director of State Clearinghouse
Department of Planning & Economic
Development
P. O. Box 2359
Honolulu, HI 96804

CZM Programs Manager
DPED
P. O. Box 2359
Honolulu, HI 96804

*Director
Dept of Planning & Economic
Development, State of Hawaii
250 South King Street
Honolulu, HI 96813

*Deputy for Environmental Health
State Department of Health
1250 Punchbowl Street
Honolulu, HI 96813

*Environmental Center
University of Hawaii
10 Maile Way
Honolulu, HI 96822

APPENDIX H

PERTINENT CORRESPONDENCE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

July 14, 1980

Col. B. R. Schlapak
Corps of Engineers
District Engineer
Department of the Army
Building 230
Fort Shafter, Hawaii 96858

Dear Col. Schlapak:

We have reviewed the subject draft report and find no objections to the proposed action to improve the nagivational conditions at Kikiaola Boat Harbor.

We support Plan 1, the tentatively-selected plan, but note that this project is not high on our priority list. Consequently, funding and development scheduling must be closely coordinated between the Corps of Engineers and our Harbors Division to insure that proper timing of the project is maintained.

Very truly yours,

Ryokichi Higashionna

Ryokichi Higashionna
Director of Transportation

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

August 8, 1980

HAR-EP 694

Colonel Alfred J. Thiede
District Engineer
U.S. Army Engineer District,
Honolulu
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Thiede:

Draft Design Memorandum with Draft
Environmental Statement for the
Kikiaola Harbor, Kauai

In response to your letter dated July 14, 1980, we hereby intend to comply with the provisions of the conditions of local cooperation. These conditions were listed and enclosed with your letter and also previously documented in the draft General Design Memorandum.

To reiterate our earlier position, we support the proposed Kikiaola Boat Harbor project; however, it is not considered a high priority item on the State's Boating Program. This project must compete with other higher priority projects since there is a definite limitation on State funding. Therefore, the construction phase may have to be deferred several years.

We appreciate your fine cooperation on this matter.

Very truly yours,

Ryokichi Higashionna
Director of Transportation

UNITED STATES ENVIRONMENTAL PROTECTION AGENC
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

Project #D-COE-K32025-HI

Colonel B.R. Schlapak, District Engineer
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Schlapak:

The Environmental Protection Agency (EPA) has received and reviewed the Draft Environmental Impact Statement (DEIS) titled DRAFT GENERAL DESIGN MEMORANDUM: KIKIAOLA HARBOR FOR LIGHT-DRAFT VESSELS.

The EPA's comments on the DEIS have been classified as Category LO-1. Definitions of the categories are provided by the enclosure. The classification and the date of the EPA's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal Actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and the adequacy of the environmental statement.

The EPA appreciates the opportunity to comment on this DEIS and requests three copies of the Final Environmental Impact Statement when available.

If you have any questions regarding our comments, please contact Susan Sakaki, EIS Coordinator, at (415)556-7858.

Sincerely yours,

Jake Mackenzie, Director
Surveillance and Analysis Division

Enclosure

EIS CATEGORY CODES

Environmental Impact of the Action

LO—Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER—Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU—Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1—Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2—Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3—Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

COMMANDER(oan)
Fourteenth Coast Guard District
Prince Kalanianaole Federal Bldg.
300 Ala Moana Blvd.
Honolulu, Hawaii 96850
Tel (808) 546 7130

16500
Serial 32100
22 JUL 1980

From: Commander, Fourteenth Coast Guard District
To: District Engineer, U. S. Army Engineer District Honolulu
Building 230, Ft. Shafter, Hawaii 96858

Subj: Aids to Navigation requirements for the proposed improvements to Kikiaola Light Draft Harbor Kauai, Hawaii

Ref: (a) Your ltr of 29 May 80

1. The design memorandum for Kikiaola Harbor has been reviewed. It is felt that the State of Hawaii aids to navigation that presently mark the harbor should be replaced with Coast Guard maintained aids to navigation. This office has contacted the State of Hawaii to discuss the option of the Coast Guard assuming the aids to navigation responsibility for the harbor.

2. Based on the tentatively selected plan for the harbor design, the Coast Guard currently plans to establish a lighted aid to navigation on the end of each breakwater to mark the channel entrance. The estimated Coast Guard cost for this project is $20,000.

Engrg Coord early

3. If the harbor is constructed in accordance with the preliminary design, the Coast Guard will request that the contractor who is responsible for the harbor improvements also provide the foundations for the lights and cable run to the sites of the lights to allow for commercial power operation.

V. R. ROBILLARD
By direction

DEPARTMENT OF THE NAVY
PACIFIC MISSILE RANGE FACILITY
HAWAIIAN AREA
BARKING SANDS
KEKAHA, KAUAI, HAWAII 96752

7032/RSI:
11250
Ser: 051
24 Jun 1980

From: Commanding Officer, Pacific Missile Range Facility, Hawaiian Area
To: Commander, Pacific Ocean Division, Corp of Engineers, Building 230, Ft. Shafter, Hawaii 96858

Subj: Draft General Design Memorandum, Kikiaola Harbor for Light-Draft Vessels, Waimea, Kauai, Hawaii

Ref: (a) PODEO-PH ltr of 29 May 1980

1. The subject study forwarded by reference (a) has been reviewed. The harbor upgrade will improve PMRF small boat operations and enhance PMRF surface target reliability. Command representatives will be available at the public hearing to answer questions concerning Navy use of the harbor facilities.

Robert E. Berger

ROBERT E. BERGER
By direction

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 30 1980

OFFICE OF THE ADMINISTRATOR

Colonel B. R. Schlapak
District Engineer
US Army Engineer District,
Honolulu
Building 230
Ft. Shafter, Hawaii 96858

Dear Colonel Schlapak:

On June 5, 1980 this office received five copies of the draft Environmental Impact Statement (EIS) entitled Kikiaola Harbor Navigation Improvement Study, Hawaii.

Your agency requested comments on the EIS be received by July 15, 1980. In accordance with Section 1506.10 of the CEQ regulations (40 CFR 1500-1508), the 45 day review period will be calculated from the Federal Register Notice dated June 13, 1980 and will extend until July 28, 1980.

May I advise you to send a letter to all persons receiving the EIS informing them of the correct date. If you have any questions, please contact Mrs. Kathi Wilson of my staff on (202) 245-3006.

Sincerely,

for William N. Hedeman, Jr.
Director
Office of Environmental Review (A-104)

Advisory Council On Historic Preservation

The Council was established by the National Historic Preservation Act of 1966 ... of Executive Order 11593.

1522 K Street, NW
Washington, DC 20005

Reply to:
Lake Plaza South, Suite 616
44 Union Boulevard
Lakewood, CO 80228

June 20, 1980

Colonel B.R. Schlapak
District Engineer
Corps of Engineers, Honolulu District
Department of the Army
Building 230
Ft. Shafter, Hawaii 96858

Dear Colonel Schlapak:

This is in response to your request of May 29, 1980, for comments on the draft environmental statement (DES) for the Kikaola Harbor Navigation Improvement Study, Kauai, Hawaii.

The Council has reviewed the DES and notes that the COE has determined that the proposed undertaking will not affect properties included in or eligible for inclusion in the National Register of Historic Places. Accordingly, the Council has no comment to make at this time. It is suggested, however, that the final environmental statement contain the Hawaii State Historic Preservation Officer's concurrence in the Corps' determination of no effect.

Should you have any questions or require additional information regarding this matter, please contact Jane King of the Council staff at 303/234-4946 an FTS number.

Sincerely,

Louis S. Wall
Chief, Western Division
of Project Review

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
Western Pacific Program Office
P. O. Box 3830
Honolulu, Hawaii 96812

July 25, 1980

Colonel B. R. Schlapak
District Engineer
U.S. Army Engineer District
Honolulu, Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Schlapak:

The National Marine Fisheries Service (NMFS) has reviewed the draft environmental impact statement (DEIS) and general design memorandum for the Kikiaola Harbor for light-draft vessels, Kauai, Hawaii. An extension of the comment period was requested by this office in writing on June 11, 1980.

We are submitting this comment letter to you directly in parallel with its transmittal to the Department of Commerce for incorporation in the Departmental response. The views submitted herein represent those of the NMFS.

Resources for which NMFS bears a responsibility and alternatives to reduce adverse impacts on these resources have for the most part been addressed to our satisfaction in the DEIS. The site is an existing small boat harbor and the surrounding area has been subjected to runoff and discharge from agricultural operations for many years. The removal of silt during dredging and the creation of solid substrate and cover from breakwater construction will enhance species diversity in the immediate area.

The document states that no endangered species were observed in, or adjacent to, the project site during the biological reconnaissance surveys conducted in 1979. During four consecutive humpback whale surveys conducted in the Hawaiian Islands by NMFS from 1976 to 1979, whales were consistently sighted close to shore off the south coast of Kauai. However, the preferred habitat appears to be those coastal waters between Hanapepe and Nawiliwili Harbor. In addition, the section on construction considerations in the DEIS indicates that submarine blasting will not be required, therefore construction activities should not adversely impact the endangered humpback whale during their seasonal occurrence seaward of the site.

The DEIS indicates that a "water tight" clamshell or suction dredge will be utilized to remove the loose, saturated clay-silt material within the harbor and that silt curtains or other barriers will be used to contain turbidity during dredging of the entrance channel. This agency concurs with these measures. We also recommend that dredging be halted during periods of strong south winds and/or swells to further reduce unnecessary turbidity in adjacent waters.

We hope these comments will be of use to you in preparing the final document. Please send us a copy of the final EIS as soon as completed.

Sincerely,

Doyle E. Gates
Administrator

cc: F/SWR3
Office of Habitat Protection, F/HP

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Productivity, Technology and Innovation
Washington, D.C. 20230
(202) 377-3111

July 15, 1980

Colonel B. R. Schlapak
U. S. Army Engineer District,
Honolulu
Department of the Army
Building 230
Ft. Shafter, Hawaii 96858

Dear Colonel Schlapak:

This is in reference to your draft environmental impact statement entitled, "Kikiaola Harbor for Light-Draft Vessels, Kauai, Hawaii." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight (8) copies of the final environmental impact statement.

Sincerely,

Bruce R. Barrett

Bruce R. Barrett
Acting Director
Office of Environmental Affairs

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

OA/C52x6:JLR

JUL

RECEIVED
JUL 02 1980

TO: PP/EC - Joyce N. Wood

FROM: OA/C5 - Robert B. Rollins

SUBJECT: DEIS #8006.13 - Kikiaola Harbor for Light-Draft Vessels, Kauai, Hawaii

The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

The physical oceanographic and meteorological information contained in Section B, paragraphs 27 through 35, is thorough and adequate for the purposes of the project. The tide data in paragraph 34 are accurate.

Memo from: Robert B. Rollins
National Oceanic Survey - NOAA

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESHH

15 July 1980

SUBJECT: Review of Draft General Design Memorandum on Kikiaola Harbor

Division Engineer
U. S. Army Engineer Division, Pacific Ocean
ATTN: PODED-PH
Building 230
Ft. Shafter, HI 96858

1. The subject report draft has been reviewed by our Hydraulics and Environmental Laboratories and comments are as follows:

a. In paragraph 67, Section D, page 16, it is stated that "wave heights in berthing areas are expected to be less than two feet during reasonably expected sea conditions." However, in paragraph 30, Section B, page 8, it is stated that southern swell occurs about 50 percent of the time with typical heights of 1 to 4 ft and that "Kona" storms occur less frequently with heights of 10 to 15 ft. Wave-refraction coefficents (Table B-1, page B-2) vary from 0.93 to 1.0 indicating little or no reduction in height from deep water to the harbor entrance. The depth-limited criterion (page B-5) indicates a maximum wave of 9.8 ft. Therefore, wave heights up to 4 ft from southern swell and 9.8 ft for "Kona" storms could be expected at the harbor entrance. The diffraction diagram for Plan 1 (tentatively selected plan - Plate B-3) indicates K values inside the harbor of 0.2 to 0.8 which would result in wave heights as large as 0.3 to 3.2 ft for southern swell and 2.0 to 7.8 ft for "Kona" storms. These values appear excessively large for berthing of small boats, especially when using slips (possible berthing plan shown in Figure 13).

b. The environmental assessment is straightforward and complete relative to the expected environments change.

c. The choice to maintain the discharge of the existing drainage ditch within the harbor may result in increased maintenance dredging and exacerbate the condition of decreased circulation within the harbor.

d. The statement regarding exchange between the harbor and adjacent waters may be speculative. There is a need for guidelines relating small-boat harbor design to mixing of pollutants within and exchange with adjacent coastal waters.

FOR THE COMMANDER AND DIRECTOR:

H. B. SIMMONS
Engineer
Chief, Hydraulics Laboratory

PODED-PH 8 August 1980

SUBJECT: Review of Draft General Design Memorandum on Kikiaola Harbor

Commander and Director
US Army Engineer Waterways
Experiment Station
ATTN: WESHH
PO Box 631
Vicksburg, MS 39180

In reference to letter WESHH dated 15 Jul 80, subject as above, responses to your comments are provided below:

a. Diffraction Analysis. The openings between the west and east breakwaters and the two inner stub breakwaters result in a double diffraction effect. To calculate the wave heights within the proposed berthing areas, the theoretical incident wave of 9.3 feet is multiplied by the diffraction coefficient of 0.3 in the entrance channel and by the diffraction coefficient in the proposed berthing area. When this calculation is performed, the maximum wave height within the proposed berthing areas, as shown on Possible Berthing Plan (Fig 13), would be less than two feet.

b. Drainage Ditch. As discussed in the draft report, the major source of existing harbor basin silt originated from the drainage ditch. Since 1972, the drainage ditch flow has been controlled by a gate structure. Flow through the ditch is controlled and a settling basin effect is achieved. In addition, Kekaha Sugar Company has provided soil erosion control measures to reduce silt discharge into the drainage ditch. Silt discharge into the harbor area is expected to be minimal.

c. Mixing of Pollutants. Removing silt from the existing harbor basin will improve circulation and flushing action within the harbor area. Removal of terrigenous silt may also result in water quality improvement. We agree that there is a need for guidelines on mixing of pollutants for small boat harbor designs; however, we expect no significant pollutants to be discharged into the harbor waters. Regulation of any pollutant discharges

from boats or any other source within state harbors is the responsibility of the State Department of Transportation and the US Coast Guard.

FOR THE DIVISION ENGINEER:

KISUK CHEUNG
Chief, Engineering Division

United States Department of Agriculture

Soil Conservation Service

P. O. Box 50004
Honolulu, Hawaii
96850

July 11, 1980

Colonel B. R. Schlapak
District Engineer
U.S. Army Engineer District
Honolulu
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Schlapak:

We have reviewed the draft General Design Memorandum with Environmental Statement for the Kikiaola Harbor Navigation Improvement Study and have no comments to offer.

Thank you for the opportunity to review this document.

Sincerely,

JACK P. KANALZ
State Conservationist

L ARIYOSHI
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

550 HALEKAUWILA ST
ROOM 301
HONOLULU HAWAII 96813

RICHARD O'CONNELL
DIRECTOR

TELEPHONE NO.

July 9, 1980

Colonel B.R. Schlapak
U.S. Army Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858

Subject: Draft General Design Memorandum and E.I.S. for Kikiaola Harbor for Light Draft Vessels, Kekaha, Kauai

Dear Colonel Schlapak,

We have reviewed the subject document and offer the following comments for your consideration.

Draft Design Memorandum

Costs

The estimated project costs should include estimates for shoreside facilities, parking lot expansion, utilities and berthing to be provided by the State. These costs should be given to reflect the actual cost of the entire project.

Pages 20-21 Tables 1 & 2

The total costs given for Plan 3 appear to be incorrect. Is this an error in addition or in the costs given? What are the correct costs?

E.I.S.

The total harbor improvements proposed consist of state and federal project features, all of which should be described in a single joint state-federal EIS.

It is recognized that there are timing problems in preparing a joint federal-state EIS. If a separate federal EIS is believed to be necessary, then it should describe and analyze the entire project, including the state features and not be limited to just the federal portion. Otherwise the total impact of the overall project cannot be fully understood.

Environmental Effects

Reference to table F-1 appears to be incorrect. Table F-1 shows the relationship of existing plans to environmental requirements, and not a table of the effects of harbor development on the environment as stated.

Demand

How many persons are on the waiting list for Kikiaola Harbor? More importantly, it should be indicated how many on the waiting list are residents of Kauai, residents within the state, and residents elsewhere. By breaking down those on the waiting list, one can more readily identify the critical need of berthing space for local residents. A discussion of this is recommended.

Ciguatera

During dredging and construction of the Kaianae boat harbor, poisoning of fish by ciguatera toxin was encountered. Has the possibility of this occurring at Kikiaola Harbor been considered? Since this harbor is designed to make the Barking Sands fishing area more accessible to commercial fishermen, a discussion of this possibility appears warranted.

Whales

A discussion of whales and green sea turtles should be included in the EIS since they occasionally are observed in this area.

Secondary Impacts

A discussion of secondary impacts of harbor development should be included. How will the harbor affect urbanization in the area? Will any public facilities need to be upgraded as a result of increased development in the Kekaha area?

Erosion

The present harbor may be responsible for extensive erosion along the Waimea-Kekaha section of the Kauai Belt Road. What impact will the proposed harbor have on this section of road? Will the proposed harbor improvements have an impact on the severe erosion problem at Kekaha Beach Park? Any adverse or beneficial impacts that may occur should be described.

Surf Sites

What impact will harbor development and increased boating in the Kekaha region have on the numerous surf sites in this area? Will any sites be destroyed as a result of construction and dredging activities?

Coastal Water Quality

The discussion of water quality should be expanded. How often does flushing occur at Kikiaola Harbor? Will the proposed harbor improvements affect circulation within the harbor? Currently, Kikiaola Harbor waters are very turbid. Will water quality improve as a result of this project? Deteriorate?

Sewage

How will sewage discharged from boats be handled? Will monitoring occur to assure sewage is not disposed of overboard into the harbor or other coastal waters?

We trust that these comments will be helpful to you in preparing the final document. We would like to request 22 copies of the final document when it becomes available.

Enclosed is a list of commenting agencies and organizations on an attached sheet.

We appreciate the opportunity to review the subject EIS and look forward to the final statement.

Sincerely,

Richard L. O'Connell
Director

Attachment

PODED-PH 4 August 1980

Mr. Richard O'Connell, Director
Office of Environmental Quality
Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

We are replying to your letter of 9 July 1980 commenting on our Draft Design Memorandum and Environmental Impact Statement for Kikiaola Harbor, Kauai. Responses to your comments are provided:

a. Costs. Federal policy requires that we exclude non-federal costs for shoreside facilities, etc., from the benefit-cost calculation. Shoreside facilities are self-liquidating features which consequently do not enter into the issue of feasibility. We have added a footnote to Tables 1 and 3 on pages 20 and 21 noting that project costs shown exclude such non-federal items. We have also changed the headings in Table 2 on page 20 to read "Federal Share" and "Non-Federal Share" to avoid confusion.

b. Tables 1 and 2, page 20-21. The total costs given for Plan 3 in Tables 1 and 2 have been corrected. The corrected cost is $2,670,000.

c. EIS. We agree that a joint State-Federal EIS would have been desirable. Planning and implementation of harbor facilities are the responsibility of the State Harbor Division. We recognize that the total impact of the overall project cannot be fully understood without discussing impacts of the harbor-related facilities. The State will prepare a separate EIS to assess and evaluate possible impacts of the implementation of shoreside facilities.

d. Environmental Effects: Reference should have been made to Table E-2 rather than Table E-1. The Final EIS will incorporate the revision.

e. Demand. As of September 1979, according to the then-published "Small Craft Mooring Facilities Utilization Report," which the State Department of Transportation, Harbors Division, releases periodically, there was one valid application on file. As discussed in the report, estimating the demand for berthing space in a developed facility is a matter of reviewing statistics on boat registration and harbor utilization throughout the state and relating these statistics to population and its distribution on Kauai. While it would be interesting to know what the breakdown of demand is by local, state, out-of-state, and other categories, this type of information is not pertinent for the determination of economic feasibility and project formulation requirements. Federally constructed boat harbors are open to all users irrespective of residency.

f. Ciguatera. The relationship between boat harbor construction (dredging, new breakwater structures, etc.) and ciguatera outbreaks has not been established. The once popular "new surface theory" is rife with contradictions and inconsistencies and is no longer given much credence. Recent investigations by Hawaii Institute of Marine Biology (HIMB) researchers have implicated a microscopic dinoflagellate, Gambierdiscus toxicus, as the source of ciguatoxin. The preferred substrate of this organism seems to be two species of benthic algae, Acanthophora specifera and Sargassum polyphyllum, both common shallow nearshore species. Colonization of dredged areas are not likely to be dominated by these two benthic algae. Therefore, significant increases in the toxic dinoflagellate population as a result of project construction are not anticipated.

g. Whales. Although Humpback whales do occur off the Kauai coast during their seasonal residency in the islands few have been observed in the reach between Waimea and Barking Sands. Kikiaola Harbor is not adjacent to a whale breeding, calfing or assembly area. Therefore, impacts from construction of harbor improvements are expected to be negligible and consequently, were not addressed in the DEIS. There are no records of green sea turtle nesting sites between Waimea and Kekaha. Project construction is not expected to have any impact on green sea turtles.

h. Secondary Impacts. A discussion of secondary impacts is contained in Appendix E, "Social and Cultural Resources." No effect on significant resources is anticipated as a result of secondary impacts of harbor development; therefore, no discussion of secondary impacts was included in the DEIS.

PODED-PH

4 August 1980

Mr. Richard O'Connell

i. Erosion. We do not concur that the proposed harbor improvements will alter the existing pattern of littoral transport and cause erosion at Kekaha Beach. The Kekaha Shore Protection report prepared by the U.S. Army Corps of Engineers, dated February 1978, concluded that the existing Kikiaola Harbor does not contributed to erosion problems at Kekaha Beach.

j. Surf Sites. Surfing sites were identified for the island of Kauai in the Statewide Surfing Site Survey, 1971. Numerous sites exist to the east and west of Kikiaola Harbor. However, none of the siteswill be affected by the proposed harbor improvement. Increased boating activity in the Kekaha region is not expected to impinge upon surfing. Boaters in this area and elsewhere in the islands as well generally avoid surf zones for reasons of safety.

k. Coastal Water Quality. Flushing of Kikiaola Harbor occurs twice each day corresponding with the semidiurnal tides. Proposed harbor improvements would have a negligible effect on circulation within the harbor. Removal of terrigenous silt during dredging of the access channel may result in some degree of improvement in harbor water quality.

l. Sewage. Regulation of pollutant discharges including sewage within state harbors is the responsibility of the State Department of Transportation, Harbors Division, and the U.S. Coast Guard. Discharge of sewage is prohibited in state harbors. Presently, the State Department of Health has no water quality monitoring program for light draft harbors.

Sincerely,

KISUK CHEUNG
Chief, Engineering Division

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

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

July 21, 1980

REF. No.: CPO-1862

Mr. Kisuk Cheung, Chief
Engineering Division
U.S. Army Corps of Engineers
Building 230
Ft. Shafter, Hawaii 96858

Dear Mr. Cheung:

We have reviewed the Draft General Design Memorandum and Draft Environmental Impact Statement for Kikiaola Small Boat Harbor, Kauai. The proposed modifications will require a Conservation District permit from this agency.

The proposed undertaking will have no effect on historical, cultural, architectural and/or archaeological resources which are listed on the Hawaii Register and/or the National Register of Historic Places, or that have been determined eligible for inclusion on the National Register of Historic Places.

If a permit is secured and any unanticipated sites or remains such as artifacts, shell, bone or charcoal deposits; human burials; rock or coral alignments, pavings, or walls are encountered during construction, please contact us (548-6408) immediately.

The memorandum does not discuss the impact that the harbor's modifications will have on longshore transport and deposition of sediments and sand. This factor is important in evaluating the impact harbor modifications will have on the shoreline and on the existing and potential recreational opportunities that they offer.

Each of the four alternative design plans involves what appears to be a significant alteration of the marine benthos. Plan 1, for example, which is considered to be the least

FIND A HAND TO CLEAN OUR LAND, HAWAII
STATE OF HAWAII

environmentally damaging, consists of modifying a total area of 7.1 ac. of ocean bottom by dredge removal of some 47,000 cu. yds. of hard limestone reef, sand and silt material in the entrance channel and within the harbor. From a biological point of view, however, the project probably will not have significantly more negative impact on the constituent marine life than what is impacted during routine maintenance dredging of the harbor and entrance channel.

With respect to the statement "No siginficant resources were identified within or adjacent to the project area" (DEIS. Section F, p. F-1), we are prone to disagree in light of the species of fish, opihin and crabs that are known to be harvested by recreational fishermen within this area.

Very truly yours,

SUSUMU ONO, Chairman
Board of Land and Natural Resources and
State Historic Preservation Officer

PODED-PH

12 August 1980

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

Dear Mr. Ono:

We are replying to your letter of 21 July 1980 commenting on our Draft Design Memorandum and Environmental Impact Statement for Kikiaola Harbor, Kauai. Responses to your comments are provided below:

a. Conservation District Permit. The State Harbors Division will prepare the necessary documents to acquire the permit.

b. Longshore Transport. Proposed harbor improvements do not include construction of a new groin or jetty to alter the existing pattern of littoral transport. As discussed in the draft report, a study was performed to determine littoral processes in the project area. The study indicated that there is large movement of littoral material offshore of Kikiaola Harbor. However, the direction of net transport could not be determined. Since the original harbor was constructed in 1959, there has been no significant shoreline erosion or accretion within the immediate boat harbor area. Based upon this evaluation, it appears the new harbor improvements will not significantly affect littoral movement nor result in adverse impacts.

c. Recreational Fishing. Although reef resources such as edible fish species, opihi and crabs, do exist within the project area and are sometimes harvested by recreational fishermen, these resources are common to and, in fact, more abundant in other nearshore areas of Kauai. These resources did not in our opinion meet the criteria for

significance and therefore were not identified as such in the Draft Environmental Impact Statement. Criteria used in defining and identifying significant resources are attached. (Incl 1)

We concur with your other comments and appreciate your review of the report.

Sincerely,

1 Incl
As stated

LAWRENCE S. FUJII
Acting Chief
Engineering Division

Criteria used in defining and identifying significant resources for the US Army Corps of Engineers' environmental impact statements include the following:

(1) Resources identified with laws, regulations, guidelines, or other institutional standards of national, regional, or local public agencies (e.g., sites listed on the National or State Register of Historic Places, listed threatened or endangered species or their critical habitat, etc.).

(2) Resources meeting certain study-specific technical criteria for measuring characteristics that may be critical to resource existence such as measurement of resource scarcity, fragility, resiliency, reproductive capacity, etc.

(3) Resources specifically identified by public interests as being important.

(4) Resources which, if effected by a proposed plan, would violate an institutional standard, meet a study-specific technical criterion or become the subject of public concern.

Inclosure 1

University of Hawaii at Manoa

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

Office of the Director

July 10, 1980

RE:0310

Colonel B. R. Schlapak
Corps of Engineers
District Engineer
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Schlapak:

Review of Draft
Environmental Impact Statement
and
General Design Memorandum
Kikiaola Harbor for Light-Draft Vessels
Waimea, Kauai

The Environmental Center has reviewed the above cited document with the assistance of Elizabeth Winternitz, Colleen Brady, Barbara Vogt, and Doak C. Cox, Environmental Center.

Our review indicates that most of the environmental impacts that can be expected to result from the proposed project have been adequately addressed except in the critical area of beach erosion. Since it is well known that construction of groins, etc., alter the pattern of littoral transport of sand, some discussion of the probable erosion potential presented by the new harbor improvements on nearby shorelines, particularly Kekaha Beach, should be incorporated into the final statement. An evaluation of the possible need for future mitigative measures including beach nourishment if erosion becomes a problem should also be included.

In addition, the topics of on-site sewage disposal related to shoreside facilities and infrastructure, and the method of data collection on which the problems and needs of boaters were assessed requires further clarification.

We also suggest that further discussion regarding the State of Hawaii's role in providing the docks, ramps, and shoreside facilities be made in the final EIS. We understand from communication with the COE that such conveniences are provided through state funds, often becoming available years after completion of the harbor renovations by the COE. Since disposal of waste and sewage could present significant environmental problems later on for both residents and boaters, clarification of the COE's role in the harbor development would be beneficial.

The system used for extrapolation of data used as a base for needs and problems of boaters appears unclear. Has the data from the 1970-71 telephone survey been incorporated into the present calculations? If so, what type of survey was conducted? Indication or reference to the original questionnaire, especially on page 6, would be helpful in determining the applicability to current needs and associated public input.

Finally, the basis for the calculation of navigation benefits, as presented in Appendix A, Benefit Analysis, requires more substantiation. What is the economic rationale for assuming that the net annual benefit to a recreational boater can be equated to a dollar figure based on the annual average depreciation of a vessel?

We appreciate the opportunity to comment on this document and hope our review is useful in preparation of the final document.

Sincerely,

Doak C. Cox
Director

DCC/cu

cc: OEQC
Barbara Vogt
Elizabeth Winternitz
Colleen Brady

PODED-PH 5 August 1980

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii
2550 Campus Road
Honolulu, HI 96822

Dear Dr. Cox:

We are replying to your letter of 10 July 1980 commenting on our Draft Design Memorandum and Environmental Impact Statement for Kikiaola Harbor, Kauai. Responses to your specific comments are provided below:

a. Beach Erosion. The proposed harbor improvements do not include construction of a groin or jetty that may alter the existing pattern of littoral transport. The Kekaha Shore Protection report, prepared by the US Army Corps of Engineers, dated February 1978, concluded that the existing Kikiaola Harbor did not contribute to erosion problems at Kekaha Beach.

b. Sewage Disposal. Regulation of pollutant discharges within state harbors is the responsibility of the State Department of Transportation, Harbors Division, and the US Coast Guard. Discharge of sewage is prohibited in state harbors. Presently, the State Department of Health has no water quality monitoring program for [illegible] harbors. Also, the problems and needs as identified in the draft report are the result of public input received during public workshops and meetings.

c. COE's Role in the Harbor Development. The Corps is responsible for the design and construction of navigation features such as entrance channels and turning basins, and associated protective structures including breakwaters and revetted moles. State interests are responsible for other shoreside and berthing development.

d. Extrapolation of Data. Data from the 1970-1971 survey did not enter into the present benefit calculations. Current needs were based on statistics on boat registration and harbor utilization throughout the state, and on the relationship between these statistics and population distribution on Kauai. A more detailed discussion of demand methodology is found on pages A-1 through A-4 of the report, in Appendix A, "Benefit Analysis."

e. Basis for Calculation of Navigation Benefits for Recreation Boaters. Net annual recreation benefits are not based on average annual depreciation of a vessel. The benefit is related instead to the average depreciated value of the vessel. This is a proxy for the vessels' market values. There is a rationale for using a percentage of the average vessel values as the recreation benefit. It is based on the concept that the satisfaction people get from recreation is related to the money they spend on it. The basis generally considered most logical for computing recreational benefits resulting from navigation facilities is that such benefits are equivalent to the net return on the depreciated investment in boats as received by owners of for-hire vessels. The specified ranges of percentage returns to vessel value as recreation benefits for different vessel types are based on this principle.

Sincerely,

KISUK CHEUNG
Chief, Engineering Division

DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

HIDETO KONO

FRANK SKRIVANEK

Kamamalu Building, 250 South King St., Honolulu, Hawaii • Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

July 11, 1980

Ref. No. 1766

Colonel B.R. Schlapak
District Engineer
U.S. Army Engineer District
Department of the Army
Building 230
Fort Shafter, Hawaii 96858

Dear Colonel Schlapak:

Subject: Draft General Design Memorandum with Environmental Statement, Kikiaola Harbor for Light Draft Vessels, Waimea, Kauai

We have reviewed the subject draft report and offer the following comment for your consideration.

Although an effort has been made on page 11 of the draft report to describe and assess the existing problem of sedimentation within the harbor basin and entrance channel, we believe a more in-depth review of offshore sand movement and potential shoreline accretion and/or erosion pattern particular to the study area is warranted. Perhaps this information can be incorporated within the results of the on-going sedimentation study which is stated to be more fully discussed within the final report.

We have no further remarks to offer at this time. Thank you for the opportunity to review and comment upon this document.

Sincerely,

Frank Skrivanek
for Hideto Kono

cc: Mr. Richard L. O'Connell, Director
Office of Environmental Quality Control

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

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

GEORGE A. L. YUEN
DIRECTOR OF HEALTH

[redacted]
DEPUTY DIRECTOR OF HEALTH

HENRY N. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH

[redacted]
DEPUTY DIRECTOR OF HEALTH

[redacted]
DEPUTY DIRECTOR OF HEALTH

June 23, 1980

MEMORANDUM

To: Col. B. R. Schlapak, District Engineer
Corps of Engineers

From: Deputy Director for Environmental Health

Subject: Environmental Impact Statement (EIS) for Kikiaola Harbor for Light-Draft Vessels, Kauai, Hawaii

Thank you for allowing us to review and comment on the subject EIS. On the basis that the project will comply with all applicable Public Health Regulations, please be informed that we do not have any objections to this project.

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

for Brian H. Sun
MELVIN K. KOIZUMI

cc: Office of Environmental Quality Control
Dept. of Transportation

UNIVERSITY OF HAWAII
Water Resources Research Center

16 July 1980

B. R. Schlapak
Colonel, Corps of Engineers
District Engineer

SUBJECT: Kikiaola Harbor Navigation Improvement Study

Dear Colonel Schlapak:

We have reviewed the draft General Design Memorandum and the draft Environmental Impact Statement and have no comments to submit.

Thank you for allowing us the opportunity to review the two documents.

Sincerely,

Henry K. Gee
Acting WRRC EIS Coordinator

HKG:jm

cc: F. Peterson
Y.S. Fok
E. Murabayashi

2540 Dole Street • Honolulu, Hawaii 96822

University of Hawaii at Manoa
J.K.K. Look Laboratory of Oceanographic Engineering
Department of Ocean Engineering
811 Olomehani Street • Honolulu, Hawaii 96813 • Cable Address: UNIHAW
Telephones: (808) 533-6412 • (808) 538-3381

June 27, 1980

Col. B. R. Schlapak
District Engineer
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, HI 96858

Attention: Mr. James Hatashima

Subject: Kikiaola Small Boat Harbor Study, Kauai

Thank you for notifying us and soliciting comments concerning the subject project.

It is our understanding that the primary purpose of this project is to deepen the Kikiaola Harbor entrance channel to alleviate hazardous conditions during moderate and high wave conditions. The project also involves changing the configuration and orientation of the breakwaters at the entrance channel. Since these changes will allow more wave energy to enter the harbor as well as alter the harbor response, the engineering design portion of the study should evaluate the possible consequences, such as increased surge.

We suggest that such an evaluation be a standard part of any new harbor design or significant alteration of an existing harbor. The recent emphasis on environmental and social concerns, while important, should not overshadow engineering concerns.

If we can be of further assistance in this matter, please let us know.

Sincerely,

Hans-Jürgen Krock
Director

KEKAHA SUGAR COMPANY, LIMITED

AN amfac COMPANY

P. O. BOX AA
KEKAHA, HAWAII 96752
TELEPHONE: (808) 337-1472

July 14, 1980

B. R. Schlapak
Colonel, Corps of Engineers
District Engineer
Department of the Army
Building 230
Ft. Shafter, Hawaii 96858

Dear Sir:

We have reviewed the draft, General Design Memorandum with Environmental Statement for the Kikiaola Harbor Navigation Improvement Study.

As the draft notes in paragraph 40 on page 10, that Captain Dixon found just inland of O'Omano Point a good deal of wet swampy ground . . . which is still our concern today. In order to be able to live in Kekaha, grow and process sugar cane economically, these lands must be drained. Shown on the map of existing condition, Figure 3 is an important drainage ditch. It is used to prevent severe flooding which could be a threat to the community during the severe storms which Kauai experiences every few years. It is imperative that an outlet be provided for this drainage ditch in any planned design change for the boat harbor so that everyone is assured of a means to provide flood abatement for the local community.

Yours very truly,

T. J. O'BRIEN
President and Manager

ORM/ls

VALDEMAR KNUDSEN
P.O.Box 757,Koloa,Hi 95756

June 17,1980

U.S.Army Engineer District,Honolulu
Building 230
Fort Shafter,Hawaii 96858

Gentlemen; Attention:Colonel B.R.SCHLAPAK

Thank you for the transmittal of the revised plan for the KIKIAOLA SMALL BOAT HARBOR announcing the date of the meeting June 26th in Waimea.

Please be advised that I am in complete agreement with the Tentatively Selected Plan you sent.

Our earlier objection revolved around one proposal that located the outfall of the existing drainage ditch on the outside of the West revetment,which surely would have caused severe pollution on the beach running West from the Harbor.The present location with the outfall within the harbor eliminates our objection completely.

Yours truly

VALDEMAR KNUDSEN, Trustee
E.A.Knudsen Estate

c.c.Clyde French,Trustee
First Hawaiian Bank,Honolulu

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556.8200

ER 80/1450

January 15, 1981

Kisuk Cheung
Chief, Engineering Division
U.S. Army Corps of Engineers
Honolulu District
Building 230
Fort Shafter, Hawaii 96858

Dear Mr. Cheung:

The Department of the Interior has reviewed the draft General Design Memorandum for Kikiaola Harbor, Kauai, Hawaii and offer the following comments.

General Comments

The Heritage Conservation and Recreation Service recommends that sites to be used for disposal of soil be investigated for the presence of cultural resources, and the results of this investigation be included in subsequent documents. In addition a letter from the State Historic Preservation Officer commenting on the adequacy of the reconnaissance survey already conducted and the possibility of underwater cultural resources in the project area should be included. The Fish and Wildlife Service has noted that their April 17, 1980 draft Fish and Wildlife Coordination report was appended to the General Design Memorandum and the Service's concerns have been covered in the context of the report.

Specific Comments

Page 23b, Circulation and Flushing

Consideration of hydrologic conditions that may be affected by the project should include changes in salinity and in hurricane- and wind-generated storm surges.

Thank you for the opportunity to comment on this document.

Sincerely yours,

Patricia S. Port

Patricia Sanderson Port
Regional Environmental Officer

cc: Director, OEPR (w/copy incoming)
Director, Fish and Wildlife Service
Director, Heritage Conservation & Recreation Service
Director, National Park Service
Director, Geological Survey
Director, Bureau of Mines
Reg. Dir., FWS
Reg. Dir., HCRS
Reg. Dir., NPS
Reg. Dir., GS
Reg. Dir., BM

Rev. 13 March 1981

PODED-PH

10 February 1981

Ms. Patricia Port
Regional Environmental Officer
Pacific Southwest Region
450 Golden Gate Avenue
San Francisco, CA 94102

Dear Ms. Port:

We are replying to your letter of 15 January 1981 regarding comments on our Draft Design Memorandum and Environmental Impact Statement for Kikiaola Harbor, Kauai, Hawaii. Responses to your comments are provided below:

a. Cultural Resources Reconnaissance. The dredged material would be temporarily stockpiled on the beach adjacent to the harbor and later transferred to the County sanitary landfill site.- A cultural resources reconnaissance survey of the study area was conducted during the course of this study and was included in the Draft Design Memorandum. We do not feel that an additional cultural resources reconnaissance survey of the beach and the County sanitary landfill site is necessary because of severe existing surface disturbance at both sites. The State Historic Preservation Officer has commented on the draft report and the cultural resources reconnaissance report conducted for the study. As indicated in his letter (Incl 1), there were no objections regarding cultural and historical aspects to the project nor the cultural resources reconnaissance report.

b. Circulation and Flushing. Any changes in the harbor water salinity due to storm run-off would be minimal. During a hurricane, water level would rise above the normal tide and induce greater circulation and flushing action within the harbor area. However, the occurrence of a severe hurricane in the project area is infreqeuent to cause significant increase in circulation and flushing actions.

Sincerely,

1 Incl
As stated

KISUK CHEUNG
Chief, Engineering Division

Rev. 13 March 1981