COAST OF THE HAWAIIAN ISLANDS, HARBORS FOR LIGHT-DRAFT VESSELS

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED APRIL 11, 1968, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON COASTS OF THE HAWAIIAN ISLANDS, HARBORS FOR LIGHT-DRAFT VESSELS, IN FINAL RESPONSE TO AUTHORIZATIONS CONTAINED IN THE RIVER AND HARBOR ACT APPROVED MAY 17, 1950. IT IS ALSO RESPONSIVE TO AN ITEM IN THE RIVER AND HARBOR ACT APPROVED MARCH 2, 1945

JULY 8, 1968.—Referred to the Committee on Public Works and ordered to be printed with illustrations

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U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1968

96-455 O

CONTENTS

APPENDIXES ACCOMPANYING THE REPORT OF THE DISTRICT ENGINEER
(Only Appendix C printed)

ILLUSTRATIONS ACCOMPANYING THE REPORT OF THE DISTRICT ENGINEER

(Only Plates 2 and 3 printed)

LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

July 1, 1968

Honorable John W. McCormack
Speaker of the House of Representatives
Washington, D. C. 20515

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 11 April 1968, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels, in final response to authorizations contained in the River and Harbor Act approved 17 May 1950. It is also responsive to an item in the River and Harbor Act approved 2 March 1945.

The views of the State of Hawaii and the Departments of the Interior, Transportation, and Health, Education, and Welfare are set forth in the inclosed communications.

The Bureau of the Budget advises that there is no objection to the submission of the proposed report to the Congress; however, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Bureau of the Budget is inclosed.

Sincerely yours,

Stanley R. Resor

STANLEY R. RESOR
Secretary of the Army

1 Incl
Report

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
WASHINGTON, D.C. 20503

June 25, 1968

Honorable Stanley R. Resor
Secretary of the Army
Washington, D. C. 20310

Dear Mr. Secretary:

Mr. Robert E. Jordan's letter of June 12, 1968, submitted the favorable report of the Chief of Engineers on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels, in final response to authorizations contained in the River and Harbor Acts approved May 17, 1950, and March 2, 1945, respectively.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the proposed report to the Congress. No commitment, however, can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation.

Sincerely yours,

Carl H. Schwartz, Jr.
Director, Natural Resources
Programs Division

JOHN A. BURNS
GOVERNOR

FUJIO MATSUDA
DIRECTOR
E. ALVEY WRIGHT
DEPUTY DIRECTOR
JOHN H. McAULIFFE, JR.
DEPUTY DIRECTOR
LAWRENCE F. O. CHUN
DEPUTY DIRECTOR

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

IN REPLY REFER TO:
HAR-EP
1385

March 28, 1968

Major General F. J. Clarke
Department of the Army
Office of the Chief of Engineers
Washington, D. C. 20315

Dear General Clarke:

Subject: Proposed Report on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

Thank you for the opportunity contained in your November 15th letter to review and comment concerning the proposed report of the Chief of Engineers on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels, prior to transmitting it to Congress.

The ocean is one of Hawaii's primary resources and has tremendous potentials for persons utilizing small craft in recreational activities, commerce, or landing of fish. As a result of Hawaii's climate, which is conducive to year-round use of small craft, an expanding economy, growing population, and other factors, the need for additional and improved harbor facilities in the State is becoming increasingly urgent. However, since Hawaii is not well endowed with natural harbors and protected waterways, I was pleased to note that the proposed report provides possible plans for urgently needed and economically justified navigational improvements.

I concur with the proposed report of the Chief of Engineers on Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels and recommend that it be transmitted to Congress.

The Department of Land and Natural Resources is responsible for State of Hawaii fish and wildlife management activities. Comments received from that Department concerning the proposed report are enclosed.

Very truly yours,

Fujio Matsuda

FUJIO MATSUDA
Director

Enclosure

JOHN A. BURNS
GOVERNOR OF HAWAII

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FISH AND GAME
400 S. BERETANIA STREET
HONOLULU, HAWAII 96813

March 27, 1968

Mr. Melvin E. Lepine
Chief, Harbors Division
Department of Transportation
Honolulu, Hawaii

Dear Mr. Lepine:

Subject: Comments on Proposed "Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

The proposed expansion or improvement of the existing light-draft vessel facilities at Kikialoa Harbor, Kauai; Ala Wai Harbor on Oahu; and Maalaea Harbor, Maui would cause some ecological changes with consequent effect on the marine fauna occupying these areas. However, the degree of adverse or beneficial ecological changes that may result cannot be predicted with any degree of precision but can only be estimated on the basis of our best knowledge and experience with similar improvements. It is my feeling that detrimental effects to the marine fauna would be minimal and that the modifications to the harbors would tend to improve the game fish and baitfish populations therein and thereby enhance the recreational and commercial (especially the aku) fisheries.

It is our considered opinion that the advantages of the proposed projects would far outweigh any disadvantages.

Yours very truly,

Michio Takata

MICHIO TAKATA, Director
Division of Fish and Game

MT:lt

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

26 March 1968

Dear General Cassidy:

This is in reply to your letter of November 15, 1967, requesting our comments on your proposed report on Coasts of the Hawaiian Islands Harbors for Light-Draft Vessels.

The Fish and Wildlife Service reports that the navigation improvements you are recommending for Kikiaola, Ala Wai, and Maalea Harbors would benefit the commercial and sport fishery by reducing the incidence of vessel damage and by promoting greater utilization of the resource through boating.

The Bureau of Outdoor Recreation finds that the proposed small boat harbor improvements are in general agreement with the outdoor recreation plan of the State of Hawaii. The State plan emphasizes the need to increase access to the ocean to permit greater public participation in water-oriented recreation activities.

The National Park Service requests that the Regional Director, Western Region, National Park Service, 450 Golden Gate Avenue, P. O. Box 36063, San Francisco, California 94102, be advised of construction scheduled so that investigations for potential archeological and historical resources can be completed in advance of construction.

The Federal Water Pollution Control Administration does not have any comments in addition to those contained in its letter of March 24, 1967, to the District Engineer included in Appendix C to the District Engineer's report, page 71.

We appreciate the opportunity of presenting our views.

Sincerely yours,

Robert W. Nelson

Deputy Assistant Secretary of the Interior

Lt. General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D. C. 20315

96-455 O-68-2

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY

January 31, 1968

Lieutenant General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D. C. 20315

Dear General Cassidy:

This is in response to General Clarke's letter of November 15, 1967 to Secretary Boyd in regard to your proposed report concerning harbors for light-draft vessels in the Hawaiian Islands.

The District Engineer's report recommends the improvement of three existing small craft harbors in the Hawaiian Islands by enlarging them and providing additional protection from wind and wave action. The harbors which were determined to be most suitable for improvement are Kikiaola, Kauai; Ala Wai, Oahu; and Maalaea, Maui. Forty-five percent of the estimated $2,267,000 cost of construction would be contributed by local interests. The annual benefit/cost ratios are 1.8 to 1 at Kikiaola Harbor, 5.4 to 1 at Ala Wai Harbor, and 2.3 to 1 at Maalaea Harbor. The report also indicates that the establishment of a larger system of harbors to be used solely for refuge is not economically justified at the present time.

In the Coast Guard review of the proposal, it was noted that the primary purpose of the proposal is to provide additional protected mooring space for recreational boats. The three harbor projects, together with those additional small craft harbors now in operation, are expected to satisfy the needs of the boating public through 1980. In addition, the Coast Guard noted that the Commander of the 14th Coast Guard District in Honolulu, Hawaii has furnished recommendations concerning the requirement for additional aids to navigation in the proposed harbors. These recommendations indicate that breakwater lights would be required at the Maalaea and Kikialoa sites, as well as a day beacon and buoy for the Maalaea harbor. (No new aids appear necessary at Ala Wai.) The total installation costs of these aids were estimated to be $18,500.

In the event any of these projects are undertaken, the Coast Guard would also be concerned with the administration of applicable safe boating regulations as well as the provisions of appropriate merchant vessel inspection and navigation regulations. Further, any increased need for search and rescue activity would fall within the Coast Guard area of responsibility.

x

The Department of Transportation has no objection to the recommendations contained in your proposed report and appreciates your courtesy in providing it with an opportunity to review this project.

Sincerely yours,

Richard J. Barber
Deputy Assistant Secretary
for Policy Development

COMMENTS OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

NATIONAL CENTER FOR
URBAN AND INDUSTRIAL HEALTH
222 EAST CENTRAL PARKWAY
CINCINNATI, OHIO 45202

REFER TO:

February 19, 1968

General William F. Cassidy
Office of the Chief of Engineers
Department of the Army
Washington, D. C. 20315

Dear General Cassidy:

As requested in your letter of 15 November 1967 the following comments regarding the "Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels" are presented.

Previous comments by the Public Health Service, 19 June 1963 and 17 May 1965, and the Hawaii State Department of Health, 19 May 1965, have indicated that no adverse health effects are anticipated with authorization of the proposed harbor projects. Current review indicates no change in this position.

The report in paragraphs 20 and 24 requires satisfactory assurances that responsible local interests will establish regulations prohibiting discharge of pollutants in the harbor waters and also requires appropriate onshore sanitary facilities. The State Department of Health has verified the intention of the State Department of Transportation to provide additional sanitary facilities to complement those existing with the construction of the proposed improvements.

With proper care in the removal of borrow materials and in the placement of dredged and borrow materials to avoid blocking of existing drainage or ponding, no vector control problems should arise due to the projects' completion. Significant intangible benefits to the boating public including reduced loss of life and bodily injury will result from the storm refuge and emergency value of the recommended projects.

The Public Health Service, therefore, concurs in the positive recommendation for authorization presented in this report.

Sincerely yours,

Jerome H. Svore

Jerome H. Svore
Director

COASTS OF THE HAWAIIAN ISLANDS, HARBORS FOR LIGHT-DRAFT VESSELS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20315

IN REPLY REFER TO

ENGCW-PD

11 April 1968

SUBJECT: Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

TO: THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on a survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels in final response to authorizations contained in the River and Harbor Act approved 17 May 1950 calling for preliminary examinations and surveys of the Coasts of the Hawaiian Islands with a view to the establishment of harbors for light-draft vessels for refuge and other purposes, and harbor at Keauhou Bay, Hawaii. It is also responsive to an item in the River and Harbor Act approved 2 March 1945, calling for a preliminary examination and survey of Kalaupapa Landing, Island of Molokai, Hawaii. My report includes the reports of the District and Division Engineers and the Board of Engineers for Rivers and Harbors.

2. The District and Division Engineers report that improvements at Keauhou Bay, Hawaii, would not be feasible at this time because of physical and economic limitations at this site. Detailed investigation of this site was included in an interim report on Honokahau Harbor, Hawaii, printed as House Document No. 68, Eighty-ninth Congress, first session. They also report that improvements for light-draft vessels at Kalaupapa Landing, Molokai, are being accomplished under the general authority contained in Section 107 of the River and Harbor Act of 1960.

3. The reporting officers recommend navigation improvements at three existing State operated small-boat harbors at Kikiaola Harbor, Kauai; Ala Wai Harbor, Oahu; and Maalaea Harbor, Maui; generally as follows:

Kikiaola Harbor - Modify and raise existing breakwater, provide wave absorber, and dredge entrance and interior access channels.

Ala Wai Harbor - Provide revetted mole seaward from existing mole to expand harbor area, provide wave absorbers, and dredge turning area and access channels.

Maalaea Harbor - Modify existing breakwaters, close existing entrance channel, dredge new entrance channel, turning basin, and access channel.

They estimate the first cost of construction at $2,267,000 of which 44.6 percent would be contributed in cash by local interests, prior to construction, an amount presently estimated at $1,011,000. The net cost to the United States, exclusive of aids to navigation, would be $1,256,000 for construction and $13,700 annually for maintenance. The benefit-cost ratios based on a 50-year period of analysis and an interest rate of 3-1/4 percent are: 1.8 at Kikiaola Harbor, 5.4 at Ala Wai Harbor, and 2.3 at Maalaea Harbor. Construction of the improvements would be contingent upon certain requirements of local cooperation in addition to the cash contribution noted above.

4. The Board of Engineers for Rivers and Harbors concurs generally in the findings of the reporting officers and recommends construction of the improvements, subject to certain conditions of local cooperation.

5. I concur in the views and recommendations of the Board.

WILLIAM F. CASSIDY
Lieutenant General, USA
Chief of Engineers

ENGBR(30 Jun 67) 2d Ind
SUBJECT: Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

Board of Engineers for Rivers and Harbors, Washington, D. C. 20315
10 October 1967

TO: Chief of Engineers, Department of the Army

1. The Hawaiian Islands are part of a volcanic mountain range, most of which is submerged. The general ocean depth prevailing adjacent to the island chain is about 15,000 feet. The coastlines of the islands vary greatly in physical character, from steep high cliffs rising from the sea to low-lying coastal plains with broad sweeping beaches. The main islands are separated by broad windswept channels, the widest of which is about 73 miles between Kauai and Oahu; the others range in width between 7 and 30 miles. Fair weather predominates throughout much of the year in Hawaii. However, along coasts exposed to the prevailing northeast trade winds and in unsheltered interisland channels, strong gusty winds and local rain squalls frequently cause conditions ranging from difficult to dangerous for the small-boat operator. Major storms consist of low pressure troughs known locally as "kona" storms because they ordinarily produce winds from a southerly direction, cold fronts accompanied by strong northerly winds, and infrequent hurricanes. The mean tidal range in the islands averages around 1.5 feet.

2. Federal navigation improvements have been constructed specifically for light-draft vessels at Manele Harbor on Lanai and Haleiwa Harbor on Oahu. These harbors, when fully developed by the State, will accommodate approximately 125 and 220 craft, respectively. There are seven Federally improved commercial harbors of which Port Allen and Nawiliwili Harbors on Kauai, Honolulu Harbor on Oahu, Kahului Harbor on Maui, and Hilo and Kawaihae Harbors on Hawaii are 35 feet deep, and Kaunakakai on Molokai is 23 feet deep. In addition to Manele and Haleiwa Harbors, there are 21 light-draft vessel harbors along the coasts of Hawaii operated by the State and private interests. The existing Federal and non-Federal harbors, including berths used by small vessels in the deep-draft harbors, provide about 2,900 berthing spaces for light-draft vessels.

3. Traditionally, the basic industry of the islands has been agriculture, primarily sugar and pineapple production. In recent years, the activities of the Federal Government have represented the major source of income for the State, with Federal spending being $652 million in 1965. Tourism and construction are the major growth forces influencing the economy of the State. Boating and fishing are year-round activities in Hawaii and, with the expanding economy and growing population, the need for additional and improved harbor facilities is becoming increasingly urgent.

4. Local interests desire improvements for light-draft vessel navigation to accommodate the growing recreational fleet, provision of improved facilities for the commercial fishing fleet, and a system of harbors to meet the boating needs for interisland cruising and refuge in time of emergency or sudden storm.

5. The District Engineer finds that improvements to the three existing State operated harbors of Kikiaola, Kauai; Ala Wai, Oahu; and Maalaea, Maui; together with the light-draft vessel harbors previously authorized, and other existing private and State facilities, would satisfy about 90 percent of the State boat space requirements for the year 1980, about 80 percent of the need for the year 2020, and afford an integrated system of harbors for light-draft vessels plying the Hawaiian waters. He finds that there are insufficient tangible benefits at this time to justify construction of any harbor for refuge only. The District Engineer considers that his report constitutes full compliance with Section 110 of the River and Harbor Act of 17 May 1950 with respect to the Coasts of the Hawaiian Islands, harbors for light-draft vessels for refuge and other purposes, and harbor at Keauhou Bay, Hawaii; and complete compliance with Section 6 of Public Law 14, Seventy-ninth Congress, first session, approved 2 March 1945, with respect to Kalaupapa Landing, Island of Molokai, Hawaii.

6. The District Engineer finds that the most feasible plans of improvement for the three harbors are as follows:

Location	Recommended Improvement
Kikiaola, Kauai	Remove 130 feet of the east breakwater; raise 770 feet of the east breakwater 3 feet; provide a wave absorber 270 feet long; make an entrance channel 1,050 feet long, 12 feet deep, 120 feet wide; provide an access channel 630 feet long, 120 feet to 80 feet wide, 10 feet to 6 feet deep; and provide beautification by tree planting.
Ala Wai, Oahu	Provide a revetted mole 1,400 feet long; a 60-foot stub breakwater; 2 wave absorbers having a combined length of 580 feet; a turning area and access channels with total area of 6.8 acres dredged to a depth of 10 feet; and provide beautification by tree planting.
Maalaea, Maui	Provide an entrance channel 780 feet long, 150 feet wide, 15 feet deep, including a 150-foot-long transition area providing change in depth from 15 feet to 12 feet and flaring of width from 150 feet to about 300 feet at the entrance of a 6.9-acre turning basin; provide an access channel 80 feet wide, 700 feet long, 8 feet deep; provide a 650-foot extension to the south breakwater; remove the east breakwater from station 2+00 to its seaward terminus, reinforce the new head with a layer of armor stone; and provide beautification by tree planting.

7. The estimated first costs, annual charges, benefits and benefit-cost ratios for the proposed improvements, as prepared by the District Engineer, are shown below. The first costs are based on November 1966 prices, and the benefit-cost ratios are based on a 50-year period of analysis and a 3-1/8 percent interest rate. The District Engineer recommends the improvements in accordance with his plans subject to certain local cooperation. The Division Engineer concurs, noting that application of the presently prescribed interest rate of 3-1/4 percent would have no appreciable effect on the benefit-cost ratios and would result in no change in either cost sharing or apportionment.

96-455 O-68-3

PROJECT	First Costs (In Thousands of Dollars)								Total	Annual charges (2)	Annual benefits	Benefit-cost ratio
	FEDERAL				NON-FEDERAL							
	Construction (1)	Beautification	Navigation aids	Total (1)	Lands	Relocations	Cash contribution	Total			($1,000)	
Kikiaola, Kauai	$ 228	$ 8	$ 9	$ 245	0	$ 30	$ 227	$ 257	$ 502	$ 24.8	$ 45.3	1.8
Ala Wai, Oahu	535	20	0	555	0	0	535	535	1,090	48.0	267.6	5.6
Maalaea, Maui	451	14	10	475	0	0	249	249	724	34.4	80.7	2.3
Total	$1,214	$ 42	$ 19	$1,275	0	$ 30	$1,011	$1,041	$2,316	$107.2	$393.6	3.7

(1) Total first cost of construction less non-Federal cash contribution.

(2) Includes annual maintenance: Kikiaola $4,800; Ala Wai $4,700; and Maalaea $5,700.

8. The Division Engineer issued a public notice stating the recommendations of the reporting officers and affording interested parties an opportunity to present additional information to the Board. No communications have been received.

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

9. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. The Board notes that the need for small-boat navigation improvements has been considered on a statewide basis with a view to developing an adequate harbor system for the major islands. The improvements recommended by the reporting officers, in addition to those harbor improvements previously authorized, together with State and private harbor facilities, will satisfy about 90 percent of the State's boat space requirements for the year 1980, and about 80 percent of the need for the year 2020. The Board notes further that improvements would be economically justified at Waimanalo and Punaluu (or Kahana Bay as an alternate site for Punaluu) on the island of Oahu; however, in view of opposition by local residents the State has not offered to cooperate in these improvements at this time. It further notes that provision of harbors for refuge only is not economically justified at the present time. The Board considers that the improvements recommended by the reporting officers are economically justified and the requirements of local cooperation are appropriate.

10. Recommendations.--Accordingly, the Board recommends improvement of harbors for light-draft vessels at Kikiaola Harbor, Kauai; Ala Wai Harbor, Oahu; and Maalaea Harbor, Maui; generally in accordance with the plans of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at a first cost estimated at $2,267,000 for Federal construction and $13,700 annually for maintenance: Provided that prior to construction of each project local interests agree to:

a. Contribute in cash a part of the first cost of construction of the general navigation facilities to be paid in a lump sum prior to initiation of construction, subject to final adjustment after actual costs have been determined, as follows:

Location	Construction cost	Local cash contribution	
		Percent	Present estimate
Kikiaola, Kauai	$ 463,000	49.9	$ 227,000
Ala Wai, Oahu	1,090,000	50.0	535,000
Maalaea, Maui	714,000	35.5	249,000
Total	$2,267,000	44.6	$1,011,000

b. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the projects and for 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 therefor or the costs of such retaining works;

c. 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;

d. Maintain without cost to the United States adequate depths in Ala Wai Harbor entrance channel;

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 rest rooms, and boat-launching ramps 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; and

h. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbors 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:

Provided further that construction of any of the individual projects recommended for authorization may be undertaken independently of the others whenever the necessary funds therefor become available and local interests have agreed to furnish the required local cooperation, but that construction of any of the individual projects will not be construed as a commitment on the part of the Federal Government or the responsible non-Federal interests for construction of the remaining projects.

The net first costs and annual maintenance costs to the United States, exclusive of aids to navigation and after payment by local interests of the amounts indicated above, are now estimated as follows:

Location	First cost	Annual maintenance
Kikiaola, Kauai	$ 236,000	$ 4,400
Ala Wai, Oahu	555,000	4,700
Maalaea, Maui	465,000	4,600
Total	$1,256,000	$13,700

FOR THE BOARD:

R. G. MacDONNELL
Major General, USA
Chairman

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

There exists in the State of Hawaii a need for light-draft vessel facilities which is not met by existing State and private boat harbors or by authorized Federal projects. Three existing State harbors require modification to permit full utilization of the harbors, to reduce boat damages, and to provide urgently needed berthing spaces. Also, at this time there is a need for havens of refuge for vessels overtaken by sudden stress of weather or disabled.

The District Engineer finds that the modification of three existing State light-draft vessel harbors, together with the authorized Federal projects and private and State harbor facilities, would satisfy 91 percent of the State's light-draft vessel space requirements for the year 1980, and 78 percent of the need for the year 2020. He further finds that the small unsatisfied need which would exist in 1980 is attributable to a few areas where the wide dispersion of population would not justify harbor construction, and to the Punaluu and Waimanalo areas of Oahu where harbor construction would be justified, but the State is not willing at this time to support these two harbor projects in view of opposition expressed by residents living within the immediate environs of the harbor sites. He also finds that there are insufficient tangible benefits at this time to justify construction of any harbor for refuge only. The District Engineer concludes that Federal participation with the State Government in expanding or improving the existing light-draft vessel facilities at Kikiaola Harbor, Kauai; Ala Wai Harbor, Oahu; and Maalaea Harbor, Maui, is warranted and desirable in the public interest. In addition, he concludes that this report, together with prior authorized reports on light-draft vessel harbors in Hawaii, would constitute full compliance with Section 110 of the River and Harbor Act of 17 May 1950 with respect to the coasts of the Hawaiian Islands with a view to the establishment of harbors for light-draft vessels for refuge and other purposes, and a harbor at Keauhou Bay, Hawaii, and would complete compliance with Section 6 of Public Law 14, 79th Congress, 1st Session, 2 March 1945.

The District Engineer recommends Federal adoption at this time of three light-draft vessel navigation projects, subject to the conditions of local cooperation specified in the report, to include construction and maintenance of general navigation channels, maneuvering areas, protective structures and wave absorbers identified in the report and on the accompanying plans. The estimated costs and economic justification of these light-draft vessel harbor projects are as follows:

Project	Federal Construction Cost[1/]	Federal Maintenance Cost	Non-Federal Cost[2/]	Benefit-Cost Ratio
Kikiaola Harbor	$236,000	$4,800	$257,000	1.8
Ala Wai Harbor	555,000	4,700	535,000	5.6
Maalaea Harbor	465,000	5,700	249,000	2.3

1/ Exclusive of aids to navigation.

2/ Exclusive of self-liquidating facilities.

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, CORPS OF ENGINEERS
FORT ARMSTRONG
HONOLULU, HAWAII 96813

POHGP 30 June 1967

SUBJECT: Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

TO: Division Engineer, Pacific Ocean

INTRODUCTION

1. AUTHORITY

This report is submitted to complete compliance with the pertinent portions of the authorities contained in Section 110 of the River and Harbor Act of 17 May 1950, as quoted below:

> "The Secretary of the Army is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following named localities, the cost thereof to be paid from appropriations heretofore or hereafter made for such purposes: * * *
>
> * * * Harbor at Keauhou Bay, Hawaii * * * Coasts of the Hawaiian Islands with a view to the establishment of harbors for light-draft vessels for refuge and other purposes."

This report is also submitted in compliance with Section 6 of Public Law 14, 79th Congress, 1st Session, 2 March 1945, as quoted below:

> "The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following localities * * * Kalaupapa Landing, Island of Molokai, Hawaii."

Two interim reports have been completed in partial compliance with these authorities. These are "Interim Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels," House

Document No. 353/88/2 dated 19 August 1964; and "Report on Survey of Honokahau Harbor for Navigation, Island of Hawaii, Hawaii," House Document No. 68/99/1, dated 1 February 1965.

In addition, reports have been completed on Honolulu Harbor and Barbers Point Harbor, House Document No. 93/89/1; Kawaihae Harbor, House Document No. 75/89/1; and Kaunakakai Harbor, House Document No. 484/87/2, for deep-draft and light-draft vessels. Four detailed project reports for Manele, Haleiwa, Kalaupapa, and Nawiliwili harbors for light-draft vessels have been prepared under the authority contained in Section 107 of Public Law No. 86-645.

2. PURPOSE

The objectives of this final report under the cited survey authorities are to: (1) 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 (2) study the need for harbors intended exclusively for refuge purposes. Boat population projections for all existing and planned light-draft facilities (including State, Federal, and private harbors) were considered in deriving future berthing space requirements and developing new plans for additional projects. This was done to satisfy short and long term needs for protected harbor space and launching facilities.

3. EXTENT OF STUDY

Basic information necessary for this study was afforded by the Economic Base Study as presented in appendix C of the "Interim Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels" completed by the District Engineer in 1963. The findings of all previous reports listed in table 1 on light-draft vessel harbors were fully considered in reaching the conclusions and developing the recommendations of this report.

Work undertaken during the course of this study included updating and reanalysis of some of the basic data on boat population projections, site inspection, hydrographic and topographic surveys, subsurface explorations, model studies, field inventories of existing craft and harbor facilities, interviews with many knowledgeable persons in the boating and fishing fields, and consultations with the State and Federal agencies concerned with Hawaiian water resources development, fish and wildlife, land use, transportation, and planning. Map, chart, and photographic sources were fully utilized and new photographs were taken for use in site analysis and wave studies. For each harbor site, potential benefits and costs were based on detailed studies of land uses and values, real property ownership, accessibility, local economic activity, and data from the Economic Base Study for the State of Hawaii. The detailed analyses of design, costs, and benefits are contained in the appendixes.

96-455 O-68-4

The Harbors Division of the Department of Transportation, State of Hawaii, has cooperated to the fullest degree in providing supporting material and advice. This department has been assigned by the Governor of Hawaii as the official cooperating agency with the Corps of Engineers in connection with Federal and State harbor projects and studies. The State has also formulated a separate program of light-draft vessel harbor construction to augment and complement the Federal harbor system which has resulted from prior authorizations and may result from this or future surveys. Other interested parties, local government agencies, navigation companies, business and civic organizations, and boating associations and clubs were consulted for information, data, and views. Because there had been a lapse of 6 years since the formal public hearings of 1959, five informal public meetings were held to enable local interests to present their views on the proposed harbor developments recommended or considered herein.

Kewalo Harbor was included in the study of harbor requirements. At the State's request a separate report is being prepared under Section 107 of the River and Harbor Act of 1960, which provides for construction of small navigation projects under the discretionary authority of the Chief of Engineers.

Harbor improvements for Keauhou Bay are not considered in this report since investigations relatable to this harbor were presented in the special interim report, "Report on Survey of Honokahau Harbor for Navigation, Island of Hawaii, Hawaii."

4. PRIOR REPORTS

Prior reports prepared by the Honolulu District of the Corps of Engineers recommending light-draft vessel harbors are listed in the following tabulation (table 1) with the project location and name, House Document number, or date of submission of unpublished report to Congress or other authority, brief description of Corps of Engineers work under consideration, and the boat capacity of the harbor.

In addition to the prior survey reports listed in table 1, four detailed project reports have been approved under the small project authority for light-draft vessel harbors: Manele Bay, Lanai; Haleiwa, Oahu; Nawiliwili, Kauai; and Kalaupapa, Molokai. These internal Corps of Engineers reports are dated, respectively, 14 September 1962, 7 January 1963, 20 March 1963, and 30 July 1965. Construction of the Manele Bay Boat Harbor was completed in December 1965, and Haleiwa Boat Harbor was completed in November 1966. Action on the Nawiliwili project is pending the availability of State funds for the local cash contribution, and improvement to Kalaupapa Harbor is scheduled for completion in the fall of 1967.

Table 1

Prior Survey Reports on Light-Draft Vessel Harbors in Hawaii

Island Location and Project	House Document Number Congress and Session	Recommended Federal Improvement	Design Berthing Capacity Approximate Number of Boats	Status June 1967
Kauai				
Hanalei	353/88/2	Access channel 1,800 feet long, 100-120 feet wide, 12-15 feet deep, jetty 380 feet long. 1,600 feet of channel and bank revetment.	180	Authorized by River & Harbor Act of 1965, unfunded.
Oahu				
Waianae	"	Entrance channel 830 feet long, 150 feet wide, 15-17 feet deep; access channel 870 feet long, 100-150 feet wide, 12-15 feet deep; breakwater 1,350 feet long; groin 175 feet long.	380	"
Heeia-Kea	"	Three revetted moles 1,450 feet, 1,780 feet, and 1,720 feet long; 150 feet wide, 12 feet deep; north access channel 570 feet long, 150 feet wide, 12 feet deep; central access channel 1,100 feet long, 200 feet wide, 12 feet deep; south access channel 150 feet long, 150-200 feet wide, 8 feet deep, plus removal of coral head.	1,600	"
Kailua	"	Turning basin 2.8 acres, 6 feet deep, main access channel 1,800 feet long, 6 feet deep, 100-150 feet wide.	680	"
Maunalua	"	East mole 2,900 feet long, west mole 1,950 feet long; entrance channel 870 feet long, 200 feet wide, 15-20 feet deep; a widened channel section 370,000 sq. ft., 15 feet deep.	950	R&H Act of 1965. In advance design stage.
Barbers Point Light-Draft	93/89/1[1/]	Main access channel 1,200 feet long, 80 feet wide, 12 feet deep.	1,200	"

1/ Deep-draft harbor work also recommended.

Table 1 (Contd.)

Prior Survey Reports on Light-Draft Vessel Harbors in Hawaii

Island Location and Project	House Document Number Congress and Session	Recommended Federal Improvement	Design Berthing Capacity Approximate Number of Boats	Status June 1967
Maui				
Lahaina	353/88/2	Mole 620 feet long; breakwater 950 feet long; basin and main access channel of 3 acres; entrance channel 515 feet long, 150 feet wide, 15-20 feet deep; wave absorber 180 feet long.	160	Authorized by River & Harbor Act of 1965, unfunded.
Hana	"	Breakwater 1,230 feet long.	70	"
Hawaii				
Reeds Bay	"	Breakwater 870 feet long, entrance channel 880 feet long, 120 feet wide, 12 feet deep.	270	"
Kawaihae Light-Draft	75/89/1[1/]	Channel 900 feet long, 80-100 feet wide, 8-10 feet deep; wave absorber 1,075 feet long, mole 190 feet long.	300	R&H Act of 1965. In advance design stage.
Honokahau	68/89/1	Entrance and main access channel 840 feet long, 120 feet wide, 20-12 feet deep; interior service channel 200 feet long, 75 feet wide, 15 feet deep, wave absorbers and wave trap.	420	"
Molokai				
Kaunakakai	484/87/2[1/]	Separate boat basin, in conjunction with deep-draft improvements, about 10 acres in area and 15 feet deep; modified by the General Design Memorandum, approved 19 August 1965, to provide separate construction of a combination breakwater and mole 1,370 feet long; and a main access channel 1,430 feet long.	250	R&H Act of 1962. Design complete. Construction deferred.

1/ Deep-draft harbor work also recommended.

5. EXISTING CORPS OF ENGINEERS LIGHT-DRAFT VESSEL HARBOR PROJECTS

Table 2 provides a summary of the Federal work, estimated cost, and berthing capacity of the completed boat harbors at Manele Bay, Lanai, and Haleiwa, Oahu. Both projects were approved and funded under the authority of Section 107 of the River and Harbor Act of 1960. There are, in addition, six deep-draft harbors and one medium-draft harbor existing in the State which were built as Federal projects and are maintained by the Corps of Engineers. These harbors, identified on plate 1, afford refuge to light-draft vessels in their present condition as navigation facilities for ocean-going ships; three of them (Nawiliwili, Kaunakakai, and Kawaihae) will have associated light-draft facilities in the relatively near future when funding permits the construction of authorized projects.

DESCRIPTION

6. TRIBUTARY AREA

a. General. The islands of Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii comprise the tributary area of the proposed harbor system for the State. Hawaii is the 50th state in admission to the Union, 47th in size, and 42nd in population. At the beginning of 1966, Hawaii's total population was about 760,000. The total land area is 6,415 square miles. Honolulu, the capital, is 2,406 miles from San Francisco, 2,564 miles from Los Angeles, and 2,772 miles from Seattle. The Hawaiian Archipelago, under the jurisdiction of the State except for Midway Island, extends some 1,700 miles over the north Pacific Ocean, and consists of a series of mountaintop islands, islets, pinnacles, and reefs, all rising thousands of feet from the ocean floor.

The State's eight principal islands - Niihau, Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii - form a 400-mile arc at the southeastern end of the archipelago, and comprise over 99 percent of the State's land area. Kahoolawe is 45 square miles in area and is barren, uninhabited and under military control. Niihau is privately owned and is 72 square miles in area. The other six islands constitute the area of principal activity of the State.

b. Geography and geomorphology. The Hawaiian Islands are part of a great volcanic mountain range, most of which is submerged. At the highest part of the range, its southeastern portion, a number of large peaks protrude above sea level constituting the major populated islands of the State. The general ocean depth adjacent to the island chain is about 15,000 feet. Only the island of Hawaii, the largest of the group, remains actively volcanic.

The eight islands have been formed by successive flows of basaltic lavas which erupted first from vents in the ocean floor and later from craters and fissures as the lava domes rose above sea level. The island of Hawaii is basically composed of five domes; Maui, Molokai, and Oahu

Table 2

Federal Light-Draft Vessel Harbors Existing in Hawaii as of February 1967

Project	Federal Work	Estimated Total Cost of Project	Estimated Federal Cost	Estimated Non-Fed. Cost	Estimated Annual Maint.Cost	Design Berthing Capacity	Status of Project
Lanai							
Manele	590-foot breakwater; channel 150 feet wide; 8-12 feet deep; basin 4.6 acres; accommodate about 130 boats.	$743,000	$200,000	$543,000	$2,800	130 boats	Completed Dec. 1965
Oahu							
Haleiwa	Entrance channel 610 feet long, 120 feet wide, 12 feet deep; revetted mole 1,200 feet long; diversion channel 520 feet long, 80 feet wide; a dike 180 feet long; accommodate about 220 boats.	429,000	260,000	169,000	3,700	220 boats	Completed Nov. 1966

are formed of two each, and the islands of Lanai and Kauai developed from single domes. Peak elevations of lava accumulation are on Hawaii, where Mauna Kea reaches a height of 13,784 feet, and Mauna Loa 13,680 feet. Maui has the third highest mountain in the islands, Haleakala, which has a summit elevation of 10,025 feet. Peak elevations range to 5,000 feet on the other four islands.

Only the three highest and largest mountains, being geologically the youngest, retain their dome-like form. Following the period of volcanic activity, stream erosion and wave action greatly modified the surface topography of the other domes. Today they appear as rugged, irregular mountain masses or ranges. In the wetter, windward areas, steep slopes or precipitous cliffs, sharp ridges, and deeply-incised narrow valleys are characteristic of the mountainside terrain. The drier leeward slopes of the mountains are comparatively less steep and rugged.

About 20 percent of the total area of the islands is level to gently sloping. Restricted coastal-plain areas are interspaced along the shorelines of the islands. Plateau districts are situated between the mountain masses on the islands of Oahu, Molokai, Maui and Hawaii. The population and economic activity of the State are concentrated on the coastal lowlands and plateau areas of each island.

c. Coastline. The Hawaiian coastline varies greatly in physical characteristics from island to island, and from one district to another on the same island. The volcanic origin and mountainous nature of the islands, however, result in a predominantly bold and rugged coastline with few naturally protected bays or inlets. Towering cliffs rise steeply from the sea to heights of 1,000 feet or more along the northwest coast of Kauai and much of the north coast of Molokai. Lower but similarly precipitous cliffs prevail along the Hamakua coast of Hawaii, northwest of Hilo, and in other areas on Hawaii, Maui, and Lanai. Low-lying coasts with sweeping beaches are extensively developed in some areas, particularly on Maui, Oahu, and Kauai.

Another type of coastline is created by the inshore and barrier coral reefs. This type occurs extensively along the east and north sides of Oahu, the south coast of Molokai, and the north coast of Lanai. Further variety in the nature of the shoreline is seen in the low, rocky coast with occasional small pocket beaches or low shore interrupted by bold headlands.

d. Interisland channels. The main islands of the Hawaiian chain are separated by broad, windswept channels. Some channels are more sheltered from the prevailing trade winds than others. The widest channel, between Kauai and Oahu, is about 73 miles across at its narrowest point. The channels between the other islands are considerably narrower, ranging between 7 and 30 miles in width. These channels provide

the shipping lanes and boating areas between the islands. Some of them are locally important fishing grounds. Their characteristics are summarized as follows:

Table 3

Interisland Channels

Channel ame	Location--Between Islands of	Approximate Width at Narrowest Point (miles)	Average Mid-channel Depth (feet)	Exposure to Prevailing Trade Winds
Kaulakahi	Niihau/Kauai	17	2,500	Partly protected
Kauai	Kauai/Oahu	73	10,000	Exposed
Kaiwi	Oahu/Molokai	26	2,000	Exposed
Kalohi	Molokai/Lanai	9	260	Partly protected
Pailolo	Molokai/Maui	9	800	Exposed
Auau	Lanai/Maui	9	108	Partly protected
Alalakeiki	Maui/Kahoolawe	7	470	Partly protected
Alenuihaha	Maui/Hawaii	29	6,120	Exposed

e. Climate and storm frequency. Fair weather predominates throughout much of the year in Hawaii, and general storms affecting wide areas are infrequent. The northeast trade winds predominate about 9 months of the year and exert a controlling influence on the annual weather pattern. Along coasts exposed to the prevailing trade winds and in the unsheltered interisland channels, strong gusty winds and local rain squalls cause conditions ranging from difficult to dangerous much of the time.

The warm and equitable Hawaiian climate is characterized by a "two season" year; the weather from November through April being wetter and slightly cooler than the period of May through October. There is a small seasonal variation in temperature, and the daily range is also small except at high elevations. At Honolulu, for example, the warmest month is usually August with an average temperature of 78.5° F. and a record high of 92° F., and the coolest month is January with a 72° F. average and a record low of 54° F.

In contrast to the fairly uniform annual temperature pattern, Hawaiian rainfall shows considerable seasonal fluctuation from place to place and striking local variations due to elevation, slope exposure, and related locational factors. The marked differences in rainfall distribution result from the orographic influences of the various mountain masses on the prevailing winds. Annual rainfall averages 20 inches or less on some leeward areas and exceeds 250 inches on some windward slopes and

mountain summits. Rainfall intensities are also occasionally very high. The maximum recorded rate for 1 hour is about 12 inches at Kilauea Sugar Company, Kauai.

Three classes of widespread weather disturbances produce major storms: low pressure troughs, cold fronts, and hurricanes. The low pressure passages are known locally as "kona" storms because they ordinarily bring winds predominantly from southern quadrants. Cold fronts, on the other hand, bring strong northerly winds. Both types of storms cause heavy to torrential rain and high winds, but the rainfall in a well developed "kona" storm is more widespread and of longer duration than precipitation from the usual cold front storm. The winds of a "kona" storm are also generally steadier and more prolonged and usually not as intense as the more extreme winds of the cold front. Severe cold front storms occur on the average of once every three or four years.

Major storms may cause very high winds from any direction; however, in most localities the strongest winds are from the northwest and north. Extreme windspeeds resulting from these storms occasionally exceed 60 m.p.h. and may reach 100 m.p.h. in gusts momentarily. It is not unusual to have maximum speeds of only 35 m.p.h. in one locality and speeds of 70 m.p.h. or higher in a restricted area only a few miles away.

Hurricanes also affect the Hawaiian area, but only four have been recorded in the islands since Weather Bureau observations first began in 1904. These hurricanes all occurred during the past 15 years; in August 1950, September 1957, December 1957, and August 1959.

f. Tides. Normal tidal fluctuations along the coasts of the main Hawaiian Islands generally do not exceed 2 feet in the range between lower low water and higher high water. There is relatively little difference in tidal range between the several islands and from place to place along the shore of the same island. The mean tidal range averages 1.5 feet. Extreme high tides do not exceed approximately 4 feet above mean lower low water.

g. Tsunamis. Hawaii is subject to tsunami waves generated almost anywhere in the earthquake areas of the Pacific basin. Forty-five damaging tsunamis have been recorded since 1819. Nine of these have been classified as "severe" or "very severe" on the basis of damages inflicted. The two most recent "very severe" tsunamis dealt heavy blows to Hilo in 1946 and 1960 and caused lesser damage in other areas. A 1959 tsunami, classified as "severe," caused considerable damages to property along the north coast of Kauai. Tsunamis pose a potential threat to harbor facilities and small craft throughout the State. Unprotected small boat harbors and anchorages, where waves can sweep into confined areas such as stream estuaries, are particularly vulnerable.

96-455 O-68-5

7. PERTINENT STATISTICAL DATA

a. General. The relative size, population, and economic status of the islands are compared in table 4.

Table 4

Comparative Statistics for Hawaii's Counties
(Dollar values are totals for calendar year 1965)

County	Kauai[1/]	Oahu	Maui[1/]	Hawaii
Area (sq. miles)	625	604	1,128	4,030
Percent of total	9.8	9.5	17.7	63.0
Population[2/]	26,645	576,170	49,409	62,403
Percent of total	3.8	80.6	6.9	8.7
Retail trade (in millions)	$34.5	$1,031.1	$53.6	$81.5
Percent of total	2.9	85.9	4.4	6.8
Construction completed (in millions)	$5.7	$310.9	$10.6	$15.8
Percent of total	1.7	90.6	3.1	4.6
Services (in millions)	$5.8	$266.8	$9.4	$20.2
Percent of total	1.9	88.3	3.1	6.7
Tourist expenditures (in millions)	$14.8	$216.4	$16.3	$17.5
Percent of total	5.6	81.7	6.1	6.6

1/ Kauai County includes the islands of Kauai and Niihau. Maui County includes the islands of Maui, Molokai, and Lanai.

2/ As of January 1, 1966 excludes military personnel, nearly all of whom are on Oahu.

Sources: Bank of Hawaii; State Department of Health; and State Department of Planning and Economic Development.

b. Population and economic growth.

(1) Past and present situation. Personal income increased at an annual rate of 7.1 percent during the period between 1950 and 1955; 8.5 percent between 1955 and 1960, and 6.4 percent between 1960 and 1965. This is an overall growth of 191.5 percent between 1950 and 1965. Per capita personal income rose by 109.7 percent during this same period. The population increased over 53 percent during this 15-year period.

In 1965, Hawaii's economy created a gross State product of $2.3 billion, and a total personal income of $2.0 billion. Traditionally, Hawaii's basic commercial enterprises are sugar and pineapple. However, the Federal Government ranks first in Hawaii both as a source of income and as an employer. Federal spending in the State was $652 million in 1965. The gross value of construction grew from about $70 million in 1950 to $343 million in 1965. The tourist expenditures are also steadily climbing in importance to the State. These grew from $24 million in 1950 to $265 million in 1965. Table 5 contrasts the relative value of the major categories of industry in Hawaii for 1950, 1955, 1960, and 1965, and shows the average annual growth rate of each.

Table 5

Growth Rate of Major Hawaiian Industries, 1956-65[1/]

	Earnings or Value ($ millions)				Average Annual Growth (%)		
Category	1950	1955	1960	1965	1950-55	1955-60	1960-65
Federal expend:							
Defense	147.0	272.5	373.0	459.6	13.1	6.4	4.3
Non-military	55.5	65.9	112.7	192.0	3.5	11.3	11.1
Construction	69.7	97.0	275.4	343.0	6.8	23.2	4.5
Manufacturing	71.6	103.2	148.7	281.0	7.6	7.6	13.5
Tourism	24.2	55.0	131.0	265.0	17.8	19.0	15.1
Sugar	124.0	145.7	127.4	176.2	3.3	-2.7	6.7
Pineapple	101.0	115.0	118.0	127.0	2.6	0.5	1.5
Other agriculture	28.4	36.5	43.1	46.9	5.1	3.4	1.7
Trade:							
Export	230.0	270.0	264.0	336.0	3.3	-0.4	4.9
Import	363.0	419.0	566.0	713.0	2.9	6.2	4.7
Retail	480.6	636.7	948.2	1200.0	5.8	8.3	4.8
Wholesale	222.8	265.9	359.0	473.0	3.6	6.2	5.7

1/ Source: Bank of Hawaii 1966 Annual Economic Report

(2) Projected growth trends. The base study projections of economic development completed in 1963 by the Honolulu District for the State of Hawaii covering the next 50 years envisage an average annual rate of expansion of about 3.2 percent. The most current information on population and income growth indicates that the base study projections are

valid. The major growth force is the tourist industry which is expected to operate most effectively in the continued expansion of the State's basic economy. With a reasonable exploitation of the State's natural resources, continued development of the tourist plant, and active promotion, this industry should continue to expand. In making an estimate of growth, it is assumed that Federal expenditures would remain at their present level. In the agricultural sector of the economy embracing the production and processing of export crops - sugar, pineapple, and coffee - there would be an expected slight growth in the future. These products are now operating in a highly competitive market and prospects for expansion are restricted by high labor and transportation costs, and by limitations on the availability of suitable additional acreage. As the population of the State grows, however, an increased demand is expected for local agricultural produce that can favorably compete with mainland imports. Thus, the expanded local market would result in the continued moderate growth of diversified farming and livestock production. This segment of the agricultural economy, therefore, would be of particular importance to the neighbor islands where the encroachment of urbanization upon agricultural land is not such a problem as on the island of Oahu. Projections of personal income and population for the State and its four counties are summarized in table 6.

Table 6

State of Hawaii
Projection of Civilian Population and Personal Income[1/]

Civilian Population

	1966	1980	2010
STATE OF HAWAII	714,627	876,800	1,261,300
City & County of Honolulu	576,170	714,700	1,016,000
Kauai County	26,645	36,600	57,600
Maui County[2/]	49,409	53,700	80,000
Hawaii County	62,403	71,800	107,700

Total Personal Income
(Millions of constant 1958 dollars)

	1965	1980	2010
STATE OF HAWAII	$1,847	$3,000	$6,400
City & County of Honolulu	1,548	2,600	5,400
Kauai County	66	85	210
Maui County	97	135	310
Hawaii County	136	175	410

1/ Excludes military personnel but includes military dependents. Source: State of Hawaii Department of Health and Department of Planning & Economic Development for 1966 population; and First National Bank for 1965 income estimates.

2/ Includes Kalawao County (Hansen's Disease Settlement) on Molokai.

8. IMPROVEMENTS DESIRED

Following initial Congressional authorization of a preliminary examination and survey of the coasts of the Hawaiian Islands for harbors for light-draft vessels in 1950, six public hearings were held to obtain testimony of local views relative to the needs for small boat harbors throughout the Territory. These hearings were held in April 1951 in Hilo and Kailua-Kona on Hawaii, Wailuku on Maui, Kaunakakai on Molokai, Honolulu on Oahu, and at Lihue on Kauai. Work on the survey was deferred from the summer of 1951 to the fall of 1958 because of lack of funds. Upon reactivation of the Coasts of the Hawaiian Islands survey, hearings were held again at the same six places in January 1959 to gather information and public opinion.

These public hearings were attended by representatives of Federal, State, county, and municipal agencies, civic and boating organizations, and by interested private individuals. The local interests testified that there was, and had been for many years, an acute shortage of small boat harbors and related boating facilities in Hawaii. They stated that the lack of adequate protected harbor space and other shoreside improvements had impeded the growth of recreational boating and of the boating industry in general, as well as having worked a hardship on many people who depend on boating in one form or another for their livelihood. A stepped-up program for the improvement and development of harbors for light-draft vessels was strongly advocated. The testifiers pointed out the urgency of the situation in view of the heavy damages sustained by light-draft vessels in the past, the continuing threat to life and property, and the predominant and increasing inadequacy of existing facilities to protect and accommodate the rapidly-growing numbers of boats at the majority of boating centers throughout the islands. It was stressed that many people in Hawaii earn their living by commercial fishing and charter boat operations and that many more supplement their income or food supply by part-time fishing. It was also emphasized that sport fishing and boating are major recreational pursuits of the people of the islands and that boats and associated gear represent a very large capital investment on the part of the public.

During the course of the hearings held in 1951 and 1959, various local interests recommended or suggested approximately 40 sites for study for potential light-draft harbor projects. This list of sites included most of the existing improved and partially improved harbors, which were requested to be studied for further expansion, as well as all of the commonly-used natural harbors and anchorages which were unimproved or had very minor improvements. Suggested also were a number of natural sites in comparatively remote, little-used areas which could serve as possible refuge havens. Subsequently, as a result of discussions with State authorities, the final number of sites requested for consideration was raised to 45. These sites, as well as a number of others, were investigated in this survey.

The Committee on Public Works, House of Representatives, 85th Congress, 1st session, held hearings on public works projects for Hawaii in November 1957. At these hearings local interests requested that in addition to the harbors for light-draft vessel use and refuge, the studies in connection with this survey include harbors at points of each of the main islands in closest proximity to each other for possible use in a future roll-on roll-off ferry system.

In view of the time lapse between the public hearings held in 1959 and preparation of this report, five informal public hearings were held in June 1965 to obtain public opinion on the six proposed harbor projects. These meetings were held at Waimanalo, Oahu; Hauula (near Punaluu), Oahu; Honolulu, Oahu; Maalaea, Maui; and Kikiaola, Kauai.

The majority of those present at the Waimanalo and Hauula meetings were property owners or residents within the immediate vicinity of the proposed harbor sites of Waimanalo and Punaluu, respectively. The testimony and views expressed at these two meetings were predominately in opposition to harbor projects at the proposed Waimanalo and Punaluu sites. Opposition was based on the following: destruction of a beautiful, natural reef area, injurious effect on reef fish, scenic detraction, disenhancement of nearby land values, hazardous boating conditions outside of the reef, and lack of boating demand for a harbor facility. The local residents at Waimanalo stated that construction of a boat ramp would adequately meet the boating demands in their area.

The hearing on Kewalo and Ala Wai harbors was held in Honolulu. Subsequent to this hearing the State requested that the Kewalo Harbor project be constructed under the authority of the small navigation projects program.

The hearing on Maalaea Harbor was held at Maalaea, Maui; and on Kikiaola Harbor at Kikiaola, Kauai. The proposed harbor plans presented at all these meetings were enthusiastically supported by the parties attending.

9. COMPREHENSIVE PLAN FOR LIGHT-DRAFT VESSEL HARBORS

a. General. Hawaii's fragmented, insular character, its subtropical climate, and its remote, mid-ocean location make it geographically unique among the states. As a result of these characteristics, there are natural factors hindering range of boating and the types of boats used in Hawaii. These hindrances are, among others, the jagged and rough coasts which vary from island to island, onshore and barrier reefs, the widths of channels separating the islands, and the unpredictable climate changes. These factors, at present, restrict light-draft vessel navigation to the naturally sheltered areas scattered throughout the islands. As a result, some areas are overcrowded with a growing boat population, and other areas, if equipped with base harbors, could supply the necessary facilities for safer boating and interisland and also perimeter island cruising. The framework of a comprehensive plan was formulated in the interim report. Harbor projects recommended in that report would meet a large part of the State's boating need. Light-draft vessel harbor projects recommended in prior

reports together with those considered in this report and the ensuing Kewalo Harbor report constitute a coordinated harbor system which would best satisfy the boating needs of the entire State.

b. Light-draft vessel fleet. Hawaii's socal environment, geographic location, and nearly ideal climate are such that many people are strongly attracted to boating, fishing, and water sports for recreation and/or livelihood. The actual demand for berthing space exceeds the existing light-draft vessel facilities in the State. This lack of facilities has curtailed the growth rate of boat ownership. The heavy annual damages to boats sustained in recent years because of insufficient protection from storm waves and the lack of convenient or obtainable safe berthing space discourage many prospective boat buyers from purchasing new boats. With 80 percent of Hawaii's population, Oahu is the home base of the majority of the light-draft vessels in the State, accounting for 70 percent of the total number of light-draft vessels of all types. The remaining 30 percent are distributed among the neighbor islands roughly in proportion to each island's population. It is noteworthy, however, that the ratio of the number of craft to population is larger for the least populated islands. This indicates a significantly higher proportionate level of boating activity in the smaller communities and in the predominantly rural areas as compared with the metropolitan center of Honolulu and its environs on Oahu. The lower proportion of boat ownership among the urban residents of Oahu reflects, in part, the shortage of adequate berthing space at points convenient to them. The distribution of all light-draft vessels by island in 1961 is shown on table 7. Current fleet distributions and fleet growth rates as indicated by Coast Guard registration, boat trailer licenses and information from the State Department of Transportation substantiate the projections based on this count.

Table 7

Light-Draft Vessel Fleet
Boat Distribution by Island

Island	Total Boat Count (all types)
Kauai	473
Oahu	4,133
Molokai	146
Lanai	61
Maui	369
Hawaii	753
State Total	5,935

The types of light-draft vessels operating in Hawaii vary widely from expensive sailing yachts, cruisers, fishing, scientific, and work vessels to relatively inexpensive commercially-manufactured outboards and sailboats, homemade skiffs, and outrigger canoes. In the 1961 cooperative study "Recreational Boating in Hawaii," (prepared by the Harbors Division, State of Hawaii Department of Transportation) the approximate number of craft were tabulated by general categories, including all sizes, for the State as a whole. These were: outboards, 4,636; sailboats, 392; cruisers,

330; sampans, 269; inboards, 175; and sailboats or sailing yachts with auxiliary power, 133. All of the approximately 6,000 boats in Hawaii can be grouped for convenience into the four functional categories - recreational, commercial fishing, charter, and work boats.

c. Recreational boating. Recreational pleasure boating accounts for 89 percent of all boats in the State. This type of boating includes interisland and long distance cruising as well as inshore sailing, motor boating, and fishing. The majority of the recreational boats are under 20 feet in length, and their safe navigational capabilities restrict them to inshore sailing, motor boating, and fishing. The rough waters in the interisland channels which prevail much of the time, the potential danger from storms and squalls, and the long distances between islands (with the exception of the Molokai-Lanai-Maui triangle) generally restrict interisland cruising to larger craft. These craft, most of which are 20 feet or more in length, include the inboards, the auxiliary sailboats, and the cruisers and sampans. Figures 1 and 2 show representative sports cruisers and sailboats based at the Ala Wai Harbor in Honolulu. The distribution in 1961 of recreational craft by island and type is shown in table 8.

Table 8

Distribution of all Recreational Craft in the State of Hawaii
by Island and by Type of Craft
1961 Inventory

Island	Moored Out-boards	Trailer Out-boards	Sail w/o Power	Auxiliary Sail	In-boards	Cruisers	Sampans	Total
Kauai	146	270	-	3	-	2	4	425
Oahu	1,362	1,533	383	125	115	241	31	3,790
Molokai	68	20	1	-	1	3	-	93
Lanai	39	16	-	-	1	-	4	60
Maui	82	224	2	2	1	16	21	348
Hawaii	235	311	3	1	2	21	9	582
Total	1,932	2,374	389	131	120	283	69	5,298

d. Charter boating. Deep-sea fishing for marlin and other game fish in Hawaiian waters is becoming world renowned among sportsmen. The sport has also become an increasingly popular aspect of the general resort and tourist industry in recent years. Most of the charter boats for sport fishing or pleasure cruises are concentrated at Honolulu, Oahu, and at Kailua-Kona, Hawaii. The majority of the commercial sightseeing craft in the islands are based at Kewalo Basin, Honolulu. In 1961 there were 83 charter and sightseeing boats; 12 on Kauai, 54 on Oahu, 2 on Maui, and 15 on Hawaii. In addition, there were 25 miscellaneous work boats, bringing the total of commercial craft other than fishing vessels to 108. Although charter boat operations are highly competitive, the expanding tourist industry is providing impetus for growth in this facet of light-draft vessel activity.

The bulk of the recreational craft in the State are operated in the relatively sheltered waters of the leeward (generally southern) shores with the exception of three bays. Kaneohe Bay and Kailua Bay are on the windward (generally northern and eastern) coast of Oahu and protected from high surf by barrier reefs. Hilo Bay, on the windward coast of Hawaii, is protected by the Hilo Harbor breakwater. Aside from boats based at these three bays, others, singly or in small numbers, are based at points scattered along the rugged windward coasts of the islands. Most of these craft are in anchorages and pocket beach areas.

e. Trailer-mounted boats. In 1961, trailer-mounted boats comprised 45 percent of the 5,298 recreational craft in the State. The majority were in the 14- to 18-foot category. The growing popularity of trailer-mounted boats in recent years stems from a number of factors including the increased availability in the islands of newer models manufactured on the mainland, and their relative economy and overland mobility. Sample interviews conducted in 1961 with trailer-mounted boat owners reveal, however, that many would prefer to moor their boats at a harbor near their place of residence, if convenient and safe berthing space were available.

f. Commercial fishing. The commercial fishing industry has been affected by the lack of berthing space and damages sustained by the fleet while in port. Except for Maalaea Harbor on Maui, berthing space requirements for commercial fishing craft to the year 2020 would be met by recommendations in prior reports. Except for Kewalo Harbor, reduction of damages to commercial fishing boats would also be met by recommendations in prior reports. Analysis of berthing space requirements for Maalaea Harbor is contained in this report.

g. Unimproved sites. There are unimproved harbor sites and anchorages along the coastlines of the islands which are utilized by local boats and occasional transient craft. These sites include natural stream estuaries, the lower canalized reaches of streams in some urban areas, small bays or coves, inlets or natural openings in reef areas, and relatively sheltered beach areas where boats are beached or moored in shallow water. They are used to varying degrees; some seldom, others frequently. Nearly all of these sites, however, become untenable or dangerous for boats when storm waves strike from their exposed sides, although they may provide good to fair shelter during storms from other directions. An exception is the stream estuaries which generally afford a good haven from storm waves but are vulnerable to flooding and, like all harbors, to tsunamis.

h. Interisland ferry system. The State of Hawaii is considering plans for establishment of a commercial surface ferry system. The status of the State's planning is not sufficiently advanced to permit consideration of ferry operation at any of the Federal small boat harbors recommended in this or prior reports. The State officials have indicated that if, at a later date, they request a study be made on a commercial

96-455 O-68-6

ferry system after their plans have been formulated, they would provide the vessel characteristics, route, and planned schedule of operation.

10. LIGHT-DRAFT VESSEL TRAFFIC PATTERN

The major portion of the boating in the Hawaiian waters is done on the leeward side of each island (see plate 1). However, because of the high density of population, and with the major economic activity centered on the island of Oahu, there is a growing emphasis on all types of recreational boating on the windward side of this island. Oahu is unique among the islands in that the offshore reefs along the northeast coast provide sheltered areas for sailing, cruising, fishing, and many other water sports. Thus, the windward side of Oahu is the exception for boating activities as compared to the other islands.

The June 1961 boat inventory and subsequent studies disclosed a definite travel pattern for light-draft vessels plying the Hawaiian waters. Traffic patterns and sealanes are shown on plate 1. Sealane "A" is from Oahu to Kauai, a distance of about 115 miles to the northeast. Approximately 800 transits are made annually between Oahu and Kauai. Some of the craft visit the Kauai area to fish, to cruise the northern reaches of the Hawaiian Archipelago; to visit Port Allen, Hanalei, or Nawiliwili. The actual number of craft calling at specific ports has not been recorded; however, this sealane "B" is known to be well traveled primarily for fishing and cruising.

Sealane "C" lies south of Oahu between that island and the waters around Molokai, Maui, Kahoolawe, and Lanai. An estimated 22,000 transits annually cross the Penguin Bank, which is off the southwestern coast of Molokai. At the Penguin Bank, sealane "C" divides into three separate sealanes. Along the first, sealane "D", about 600 transits are made to the windward side of Molokai; along the second, sealane "E", about 2,000 transits go to the Kaunakakai and Lahaina area; and the third, sealane "F", has approximately 2,000 transits going south of Lanai and traversing the Manele Bay and Lahaina area. Annually about 30 transits go to the windward side of Maui with a small portion stopping overnight at Hana on the eastern tip of Maui. In addition, 500 transits annually pass the Maalaea and La Perouse area, sealane "G", either as a destination objective for recreational purposes, fishing, or enroute to the Big Island.

About 500 transits annually cross Alenuihaha Channel, sealane "H", with about 20 traversing the windward or Hilo side of Hawaii. Approximately 500 transits annually travel the leeward side of Hawaii, sealane "I", cruising the west coast of Hawaii for deep sea fishing. The larger sampan-type deep sea fishing boats sometimes take this course enroute to the Central Pacific. From the foregoing, it is apparent that a light-draft vessel traffic pattern has developed in Hawaiian waters. The major portion of boating is on the leeward side of the islands where the land masses - providing calmer waters in the lee of each island - afford some protection against the prevailing northeast trade winds. In conjunction with this traffic pattern, plate 1 shows the light-draft harbors, refuge harbors, and deepwater harbors.

11. REFUGE HARBORS

Another facet to the requirements of a comprehensive plan is refuge harbors. Such harbors offer refuge for vessels overtaken by sudden stress of weather, or otherwise hard pressed or disabled. The best location for the construction of harbors needed to afford shelter from storms is obviously at readily accessible places.

The existing and proposed light-draft vessel harbors will, in addition to meeting berthing needs, afford havens of refuge for light-draft vessels. The proposed system of harbors will make sailing around and between the islands less hazardous and arduous with a resulting increase in transits between harbors. However, there will still remain a few coastal reaches without refuge protection.

The island of Niihau is without a protected harbor; however, this island is privately owned and permission to visit must be obtained from the owner.

The west coast of Kauai from Hanalei to Kikiaola is without a haven for light-draft vessels; however, under favorable weather conditions light-draft vessels are anchored or beached at Milolii Landing on the Napili Coast of Kauai. This is the site of a State park and the State has constructed a boat ramp. The coastline between Hanalei and Nawiliwili is also without a harbor or anchorage. Kukuiula Bay on the south coast of Kauai about 5½ miles west of Port Allen affords light-draft vessels adequate protection in trade wind weather and during northerly storms, but the bay is untenable under southerly storm conditions.

On the island of Oahu, the proposed base harbors would also afford adequate light-draft vessel refuge, except for the north and northeast coast from Haleiwa to Kaneohe Bay.

The entire north shore of Molokai at present has no refuge harbor. The only anchorage is at Kalaupapa, which is shielded by the island mass from "kona" storm waves and the easterly trade wind generated waves but exposed to waves approaching from the north and northwesterly directions. On the south shore of Molokai, in addition to Kaunakakai, there are two existing harbors which, if provided with aids to navigation, can be used for refuge. One, at Hale o Lono, a barge harbor on the south coast of west Molokai, is leased to private interests by the State but can be used by light-draft vessels in emergencies. The other, at Kamalo, is on the south coast of east Molokai. These harbors are on heavily traveled traffic lanes and, if adequately marked, would be used for refuge.

Kaumalapau Harbor on the west coast of Lanai has a commercial barge landing protected by a 250-foot breakwater. This small harbor affords adequate refuge for small craft except during westerly or "kona" weather.

The rugged coastline between Kahului and Hana on Maui affords no haven of refuge for light-draft vessels. La Perouse Bay on the southern

tip of Maui is on the sealane between Lahaina or Maalaea and the Kona coast of Hawaii and is a well-situated stopping point or resting place for the channel crossing to the island of Hawaii's rapidly developing Kona resort areas. The bay affords a safe anchorage for light-draft vessels except during the infrequent occurrence of storm wave approach from due west to west 15° south. The bay is about 3/4 of a mile wide and indents the coast about 1/2 mile. A rock shoal, at a 10-foot depth, located in the middle of the entrance to the bay, is a hazard to navigation. However, if adequately marked, light-draft vessels could safely enter the bay north of the shoal area. Nuu, a small bay about 15 miles east of La Perouse, is sometimes used by light-draft vessels. However, the bay affords no protection from storm waves.

The northeast coast of the island of Hawaii is without refuge sites. Boats have been beached on the cobble beach at Waipio in extreme emergency. Waipio Bay is exposed to northerly and easterly storms and subject to severe wave action during such storm periods. Between Hilo and South Point on the southeast coast of Hawaii, light-draft vessel operators familiar with the waters occasionally call at Punaluu and Honuapo under calm sea conditions. The area between South Point and Honokahau on Hawaii is a good area for deep sea sport fishing. Boaters familiar with the water and under favorable sea conditions occasionally anchor in Okoe Bay or Milolii Bay. Keauhou and Kailua Bays on the Kona coast of Hawaii afford safe refuge during northerly or easterly storms.

12. BERTHING SPACE

a. Existing. There are less than 3,000 in-service harbor spaces available for light-draft vessels throughout the State. These are near centers of population and generally the facilities at these sites are overcrowded, and some have hazardous navigation conditions. The deep-water harbors and also the barge harbors are inadequate to accommodate the present light-draft vessel fleet because they were built to handle only ocean type vessels with appurtenant facilities, or only barge traffic. Some of these deep-draft harbors have light-draft vessels anchored within them; however, any increase of berthed or moored light-draft vessels in these harbors may present a navigational hazard.

b. Present and future requirements. Recreational craft and mooring requirements for 1965, 1980, 2010, and 2020 are tabulated in table 9. Future requirements for the base harbor projects of this survey were determined from the 2010 base study projections. The berthing and mooring requirements for each harbor were then projected to the year 2020 based on an initial project year of 1970 and a 50-year economic life.

Table 9

Projections of Recreational Craft and Berthing Space Requirements

Year	Total Boats Projected[1/] (1)	Boats Needing Berthing Space[2/] (2)	Boats at Moorings Along Coast[3/] (3)	Boats in Berthing Spaces Provided by Harbors not in this Report (4)	Boats in Berthing Spaces Provided by Harbors in this Report (5)	Remaining Boats for Which Berthing Spaces are not Provided[5/] (6)
1965	9,470	5,450	690	4,520	-	240
1980	16,280	8,970	920	6,690	490	870
2010	25,300	13,100	1,230	8,970	700	2,200
2020	29,000	15,000	1,350	8,970[4/]	730	3,950

1/ Projections based on base study data to 2010 were extrapolated to 2020.

2/ Excluding trailer-mounted boats.

3/ Some boat owners will moor boats in the lower canalized reaches of streams, coves, inlets, in reef areas, and relatively sheltered shallow water bays.

4/ The maximum capacity of the majority of Federal participation harbors not in this report will be filled by 2010, so the number of boats in berthing spaces shown in this column is held to the 2010 total for year 2020.

5/ Some of the boats for which berthing spaces are not provided by harbors recommended in this report will be provided for by expansion of non State harbors. It is assumed, however, that these private facilities will not expand in areas where there are available State harbor facilities.

Analyses of these projections and extrapolations, and the facilities available and planned indicate that by the year 2020 there will be about 4,680 boats (column 2 minus (column 3 plus column 4) in table 9) which will require berthing facilities. The spaces provided by harbor improvements proposed in this report will accommodate 730 of these, leaving about 3,950 craft without berthing facilities. This unsatisfied future demand exists partly in areas such as South Kona, Hawaii, and partly along windward shores of Oahu. In areas such as South Kona, Hawaii, the population will be dispersed to such an extent that it is impractical to locate a single base harbor to service all the area, and no specific location has enough boat demand to justify Federal participation in a harbor project. An unsatisfied demand for additional facilities exists in the Waimanalo and Punaluu areas of windward Oahu where, although the present need for additional facilities is small, it will increase rapidly after 1980. The present and proposed berthing spaces after the Statewide harbor system is implemented (including spaces for commercial boats) are shown on table 10.

Table 10
Berthing Spaces[1]

Island	Site	Existing	Provided by Authorized Projects	Provided by this Report	Total Existing and Recommended
Kauai	Kikiaola	13		117	130
	Kukuiula	25			25
	Port Allen	60			60
	Nawiliwili	30	195[2]		195
	Wailua River	34			34
	Hanalei	30	180[2]		180
Oahu	Waianae	100	380[2]		380
	Haleiwa[3]	220			220
	Heeia-Kea	100	1,600[4]		1,600
	Kaneohe Anchorage	90			90
	Kaneohe Yacht Club	200			200
	Kailua		680		680
	Maunalua	20	950		970
	Ala Wai Yacht Basin	515		425	940
	Kewalo Basin	122			122
	Honolulu Harbor	23			23
	Keehi Lagoon	415			415
	Barbers Point (including 2nd phase)		1,200		1,200
	Kaiser Marina	400			400
	Wailupe	10			10
Molokai	Kaunakakai	70	250[2]		250
Lanai	Manele Bay[3]	125			125
Maui	Lahaina	36	160[2]		160
	Maalaea	60		200	260
	Kahului	82			82
	Hana		70		70
Hawaii	Honokahau		420		420
	Kawaihae	35	300[2]		300
	Reeds Bay		270		270
	Wailoa River	55			55
	Hilo Harbor	25			25
	Keauhou Bay	12			12
	Totals	2,917	6,655	742	9,903

1/ Includes spaces for commercial boats.
2/ Existing berthing spaces to be abandoned after construction of authorized project.
3/ Includes spaces under development.
4/ Existing berthing spaces are included in the authorized project.

13. PROJECT FORMULATION

The recommended plans of improvement discussed in the following paragraphs and in other sections of the report would maximize the net tangible benefits based on evaluation of the needs for light-draft vessel facilities for the next 50 years. Plans of improvement were developed for Waimanalo Harbor and Punaluu Harbor on Oahu. Although these were found to be justified projects, residents in the respective areas oppose harbor construction. In view of this opposition, the State is unwilling at this time to support harbor projects at Waimanalo or Punaluu. Discussion of project formulation is limited to plans of improvement acceptable to the State officials and boating interests for three recommended harbors, namely, Kikiaola Harbor, Kauai; Ala Wai Harbor, Oahu; and Maalaea Harbor, Maui. (Maximization of net benefits is discussed in appendix A.)

a. Kikiaola Harbor, Kauai. The recommended plan for modification of the existing State-constructed light-draft vessel harbor at Kikiaola is shown on plate 2. The shallow entrance channel and storm waves overtopping the east breakwater severely limit the utilization of the existing harbor. There is a definite need for adequate light-draft vessel facilities to serve the tributary area, and local interests strongly support modification of Kikiaola Harbor to satisfy this need. This harbor, if improved, would meet the base craft space requirement and also serve as a haven for refuge. The recommended plan of improvement provides for deepening the entrance channel, raising the crest elevation of the east breakwater, and planting trees for beautification. Consideration was given to enlargement of the State's light-draft vessel harbor at Port Allen in lieu of improving Kikiaola Harbor. However, enlargement of Port Allen light-draft vessel harbor would result in higher costs with no increase in benefits.

b. Ala Wai Harbor, Oahu. The existing State-constructed Ala Wai Harbor with a 515-boat capacity is the largest and best light-draft vessel harbor in the Hawaiian Islands and has a long waiting list for berthing spaces. The recommended plan, shown on plate 3, would provide an increase in water area of about 20 acres protected by a revetted mole. This enlargement would accommodate about 425 boats, which is the berthing requirement for the year 1995. The revetted mole would be constructed at the seaward edge of the existing coral reef. Water depths increase rapidly seaward of the proposed mole structure and additional seaward extension of the harbor would subject protective structures to severe wave action, resulting in greatly increased costs for any additional berthing area. The unsatisfied need which will generate after 1995 could be met more economically by expansion of the existing State harbor in Keehi Lagoon or expansion of the authorized Federal project in Maunalua Bay. The recommended plan for Ala Wai Harbor is opposed by some surfing interests because it will occupy waters which are considered prime surfing areas. State officials support the recommended plan at this time, but considered it possible that future developments in the surfing sport may warrant a reduction in the proposed harbor size to preserve some of the surfing area. Based on model studies conducted at the U. S. Army Engineer Waterways Experiment Station, two wave absorbers are incorporated in the proposed plan. Tree planting for beautification of the fill areas is also included.

c. Maalaea Harbor, Maui. The proposed plan for modification of the existing State-constructed Maalaea Harbor is shown on plate 2. With the present entrance channel alignment, waves roll directly into the harbor basin creating objectionable surge and damaging wave action during storm periods. The existing 12-foot entrance channel depth is not adequate for safe operation of the larger commercial fishing vessels when wave heights in the channel are 6 feet or greater. The proposed improvement consists of enlargement and deepening of the entrance channel and extension of the existing south breakwater. These improvements would effectively reduce surge and wave action within the basin, increase the usable harbor area, and provide safer navigation conditions for the larger craft using this facility. The proposed plan is the least costly plan which would effectively eliminate the objectionable and hazardous navigational conditions. Construction of a new facility in lieu of the proposed modification would result in far greater cost to the Federal and State governments with no increase in benefits. Tree planting on the mole structure has been included for beautification of the harbor.

14. BASIS OF DESIGN

a. General. The general plans of the 3 base harbor projects are described individually in subsequent paragraphs and shown on plates 2 and 3. The objectives of each harbor plan are to provide the following basic features, or to allow for the development thereof: (1) a safe entrance of suitable dimensions of depth and width to satisfactorily accommodate the present and future vessel traffic; (2) adequate interior access channels leading to landings and service facilities; (3) protected berthing or mooring areas; (4) an adequate public landing and service frontage with appropriate space for all necessary service facilities; and (5) a convenient and safe launching ramp or ramps as required, providing sufficient parking space, suitable access roadways, and satisfactory public comfort facilities.

b. Depths and widths. The selected depths and widths of the entrance and other general navigation channels of the harbors were evaluated and determined on an individual basis with consideration of the following factors as applicable to each harbor: (1) the beam, draft, and clearance requirements of the larger types of craft expected to use the facility, including allowance for transient traffic, and the total number of boats expected to be based at the harbor or operate in the channels; (2) wind, wave, and current conditions and their effect on the movement and control of craft; (3) local hydrography and the nature of the bottom materials; (4) tidal ranges and estimated shoaling rates; (5) exposure of the site to deepwater waves; and (6) the views of experienced local boat operators and responsible State officials of the Harbors Division, Department of Transportation. Allowance was made for a "water cushion" to allow a margin of safety under the keels of the deeper-draft craft expected to use the channels. The effect of deepwater swells and wave action, particularly in the outer reaches of the entrance channels, was given careful study as related to the control of craft navigating these critical areas.

The relative cost of providing an extra margin of width or depth for safety was weighed carefully in relation to the total investment anticipated for the proposed improvements. The depth and width allowances made are in keeping with the practical requirements of the site and expected usage of the project. The proposed project depth indicated in the plans of improvement for dredged navigation channels and turning basins allows for 2-foot overdepth.

c. Recreational fishing at harbors. Design of the moles and breakwaters of the harbors proposed in this report is not considered adaptable for providing recreational fishing for the general public for the following reasons:

(1) Breakwaters such as proposed for Kikiaola, Maalaea, and Ala Wai to be used by the public safely would require capping, which is incompatible with their structural stability.

(2) Wave absorbers as proposed at Ala Wai are not adaptable to fishing platforms because of flat slope. Also, they are along the entrance channel where boats would snarl lines.

(3) The interior areas at Ala Wai Harbor would be occupied by berthing facilities, which should be kept free except for access and service to boats.

d. Berthing requirements. The projected demand, berthing space, and design capacities of the 3 harbors recommended in this report are tabulated in table 11. The demand figures and harbor areas include future requirements for all categories of recreational and commercial fishing craft expected to use the facility to the year 2020. An allowance for transient craft is included, but the demand estimates exclude launched or trailer-mounted boats expected to use the harbor ramps. Variance among harbors in the amount of berthing space allowed per boats reflects differences in the size and type of craft expected to use the facility. The individual design capacities are selected to meet current requirements, and, where feasible, allow for the expansion of the local boat population to the year 2020.

Except for Ala Wai Harbor, Oahu, local interests have not proposed any specific plans for the non-Federal portions of these projects. However, local interests have indicated there are adequate berthing areas in the general plans presented herein to meet projected capacity requirements.

e. Shoreline changes. No significant shoreline changes in the form of erosion or accretion are anticipated from construction of any of the harbor projects as proposed in this report. In all instances, the project structures and channels would be so situated as to have little, if any, physical effect on prevailing littoral drift.

Table 11

Projected Demand, Berthing Spaces, and Design Capacities
at Proposed Harbor Projects

Location	Projected Space Requirements 1970	1980	2020	Protected Planned Berthing Area (acres) Water area	Boats per Acre	Design Capacity
Kauai						
Kikiaola	68	96	132	5.8	22	130
Oahu						
Ala Wai	770	830	940 1/	43.0	22	940
Maui						
Maalaea	73	163	260	16.6	16	260

1/ This figure represents the maximum spaces that would be developed and occupied at this site by 1995.

15. PLANS OF IMPROVEMENT

The plans of improvement described in this report are devoted to the five harbors that were studied in detail. Discussion on Waimanalo and Punaluu Harbors has been abbreviated and the plans are shown in appendix B only.

a. Kikiaola Harbor, island of Kauai.

(1) Description. The island of Kauai is dominated by a high central mountain mass which has confined habitation to the north, east, and south coastal areas. To the northwest, the Napali Cliffs drop precipitously to the sea and the few smaller coastal areas are inaccessible except by boat or arduous mountain trails. On the southwest, an exposed coastline borders a coastal plain principally occupied by a military reservation, grazing lands, and the Kekaha Sugar Plantation. Limited harbor facilities and the absence of a protective reef along much of the shoreline have made Kauai an island of trailer-mounted boat owners. Over 50 percent of all craft are trailer-mounted boats. The best fishing grounds near Kauai are off the Barking Sands area on the west coast. The nearest harbor is Kikiaola, which would attract many boat owners if it had a deeper and safer entrance channel and adequate berthing facilities. Kikiaola with its launching ramp is one of the desirable launching points along the coast. Kikiaola is in the Waimea-Koloa judicial districts, which have a combined population of nearly 9,000.

Surveys made in 1958 and 1964 show that the hydrographic conditions have remained relatively unchanged in the vicinity of this harbor. Depressions in the bottom as shown on the 1958 survey

were still present at approximately the same depths in 1964. Serious shoaling in the entrance channel from littoral processes is not anticipated.

(2) Existing facilities. The existing facilities consist of a rubblemound west breakwater 600 feet long; a rubblemound east breakwater 1,170 feet long; a concrete launching ramp and a groin 200 feet long within the basin. The basin area is about 5.8 acres, with depths ranging from 1 to 5 feet.

(3) Difficulties attending navigation. The 6-foot depths at the entrance to this harbor are the natural depths of the bottom since the channel was not dredged when this harbor was constructed. The shallow depths produce steep wave fronts and frequent occurrence of breaking waves. Negotiating this channel is hazardous and breaking waves often prevent craft from entering or leaving the harbor. The east breakwater crest is of insufficient height and major overtopping occurs during storm periods.

(4) Plan of improvement. The harbor when fully developed would have a basin area of 5.8 acres with a capacity of about 130 base craft, of which 3 would be commercial fishing vessels. Since the harbor improvement is based on modification of the existing facility, the maximum berthing capacity is limited by the present harbor dimensions. Because full utilization of the modified harbor is not expected to be reached until 2010, further costly expansion at this time would not be appropriate. The proposed modification is shown on plate 2. That portion of the east breakwater from station 10+40 to 11+70 (130 feet) which extends into the proposed channel would be removed. The crest elevation of the east breakwater from station 2+50 to 10+20 (770 feet) would be raised from elevation 8 feet to elevation 11 feet. A wave absorber 270 feet long with a 1 on 3 side slope would be constructed between the west breakwater and groin in front of the diversion channel. The entrance channel would be 1,050 feet long, 120 feet wide, and 12 feet deep. The main access channel would be 630 feet long. The first 50 feet would be a transition from a 12-foot depth to a 10-foot depth. The second transition would be about 200 feet eastward. The width would be reduced from 120 to 80 feet and the depths from 10 to 6 feet. The 80-foot width and 10-foot depth section would extend 330 feet in an easterly direction.

The U.S. Coast Guard recommended a breakwater light.

The existing canefield drainage ditch at the west end of the harbor would be diverted by local interests. Discharge in the ditch is controlled by a multiple pipe culvert. The required channel capacity is 500 c.f.s.

To provide shade and add to the natural beauty of the site, about 30 trees indigent to the island and tolerant of saline soils would be planted on the fill area shoreward of the wave absorber and near the south end of the harbor basin.

(5) Other sites considered. Expansion of the existing State light-draft vessel harbor at Port Allen was considered as an alternate for improving Kikiaola. Preliminary cost comparisons showed that expansion of Kikiaola would maximize the net benefit.

b. Ala Wai Harbor, Oahu.

(1) Description. The Ala Wai Harbor is on the southern coast of Oahu. It is in the metropolitan area of the city of Honolulu and marks the western boundary of the world-famed Waikiki Beach area. In 1935 the Territory of Hawaii began construction of this harbor by dredging an entrance channel and small basin in the wide, shallow, fringing reef. Many improvements since that time have been made by the territory and now the State of Hawaii. The Ala Wai Harbor is now the largest and finest light-draft vessel harbor in the Hawaiian Islands and has a long waiting list for berthing spaces.

(2) Existing facilities. Ala Wai Harbor has a berthing area of about 31 acres and slips for about 515 craft. The basin is protected by a revetted seaward mole 1,500 feet long. An inner mole about 1,500 feet long and a pier 1,060 feet long partition the berthing area. Berthing areas are dredged to depths of 9 to 18 feet. The entrance channel is 200 feet wide, 20 feet deep, and approximately 2,600 feet long. Shoreside facilities are comprised of parking areas, fueling dock, boat yard, restrooms, and electric power and water sources.

(3) Difficulties attending navigation. The existing facility is the finest shallow draft vessel harbor in the Hawaiian Islands and presents no serious navigation problem. Model studies of the proposed improvement were made at the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi. Model test data reveal that the proposed additions to Ala Wai Harbor will result in the reduction of wave heights in the existing berthing areas and good wave conditions will prevail inside of the proposed additional berthing areas. Wave data show that undesired wave conditions at the entrance to the new basins can be alleviated by the addition of rubblemound wave absorbers at critical locations in the entrance channel.

(4) Plan of improvement. The proposed plan for expansion of this harbor, shown on plate 3, is designed to accommodate about 425 boats. The plan provides for an increase in water area of about 20 acres protected by a revetted mole 1,400 feet long, two wave absorbers--one on the Magic Island side of the entrance channel 110 feet long about 600 feet shoreward from the seaward end of the Magic Island fill, the other 470 feet long at the channel end of the proposed interior mole--and a 60-foot-long stub breakwater at station 10+50 of the proposed seaward mole. The Federal dredging in the seaward basin would consist of a turning area and channels with a total area of 6.8 acres to a depth of 10 feet and an area of about 3/4 acre at the channel end of the proposed interior mole to a depth of 16 feet. The berthing layout shown on the plan was prepared by

the Harbors Division, Department of Transportation, State of Hawaii. The U.S. Coast Guard recommends no additional aids to navigation. To provide shade and relieve the harsh appearance of the mole structures and fill area, about 100 trees indigent to the island and tolerant to saline soils would be planted. Planting will be designed to be compatible with State planned usage of created land.

(5) Other plans considered. Surfers have expressed opposition to the proposed harbor plan since it will occupy waters which are considered prime surfing areas. State officials are cognizant of the conflict between recreational navigation and surfing interests. At this time, they support the proposed plan as the most desirable from navigation aspects, but consider it possible that future developments in the surfing sport may dictate that a reduction in harbor size to save these surfing areas would be in the best public interest. A plan of improvement which would not infringe on the surfing areas would accommodate 260 boats instead of 425.

c. Maalaea Bay Harbor, Island of Maui.

(1) Description. Maalaea Harbor is on the northwest shore of Maalaea Bay. It is approximately 83 nautical miles southeast of Honolulu, 102 nautical miles northeast of Hilo, and 14 nautical miles southeast of Lahaina, the nearest light-draft vessel harbor. Kahului and Wailuku, 9 and 6 miles distant, respectively, across the central plain of Maui, comprise the hub of Maui's commerce and business activity. The Wailuku and Makawao Judicial districts comprise the area tributary to Maalaea Harbor. The other major towns in the area are Paia, Makawao, Puunene, and Kihei. The tributary area is predominantly agricultural, but tourism is a fast growing and important facet of business activity. The population in 1960 was about 29,800, with about 11,200 residing in Wailuku and Kahului. Projected population figures of the tributary area are 31,500 for 1965; 37,400 for 1980, and 55,800 for the year 2010.

(2) Existing facilities. The harbor was originally developed in 1952 by dredging an entrance channel and basin and constructing the south breakwater (locally known as the west breakwater) with an access roadway and parking area on the inboard side. The east breakwater was completed in 1955. In 1959, the State deepened the entrance channel, dredged a new commercial basin, and constructed a paved wharf to accommodate the fishing industry in this area. The existing facility consists of a 100-foot-wide entrance channel 12 feet deep, a harbor basin 7.5 acres in area having depths of 8 and 12 feet, a 1,000-foot-long combination breakwater and mole structure on the south side, an 840-foot-long east breakwater, a 308-foot-long by 50-foot-wide paved wharf, berthing facilities for 60 boats, and a launching ramp. The State of Hawaii has spent about $400,000 on construction and maintenance of the existing facility. Local interests have also constructed a 100,000-pound capacity cold storage plant for use by commercial fishermen.

(3) Difficulties attending navigation. Navigation by light-draft vessels entering Maalaea Harbor is adversely affected by the deep-water swell and wave action generated by southerly storms sweeping across the vast expanses of the Pacific Ocean. Larger size commercial fishing boats, which draw 9 feet and have beam widths of 15 feet, "feel" the bottom during these critical periods, and operators have taken their boats to Kahului Harbor to avoid damage. Commercial fishing boats moored along the wharf are subjected to undesirable surge and have suffered damages and high maintenance costs. These boats cannot be left long unattended and have to be moved to safer waters inside the protective structures. Diffraction studies show that wave heights at the wharf area would be 0.5 to 0.7 of the wave heights at the heads of the breakwaters. The vertical bulkheads at the wharf reflect the incoming wave energy to the recreational area, causing damages to berthed boats.

(4) Plan of improvement. The proposed modification is shown on plate 2. The harbor when fully developed will have a basin area of 16.6 acres with a berthing capacity of about 260 craft. Eight berths would be for commercial fishing vessels. The plan of improvement provides for an entrance channel 780 feet long, 150 feet wide and 15 feet deep; a transition area from station 6+30 to 7+80 (150 feet), with a change in depth from 15 to 12 feet, and a flaring of the width from 150 feet to about 250 feet at the entrance of the turning basin; a 6.9-acre turning basin; a main access channel 80 feet wide, 720 feet long, 8 feet deep; and a 650-foot extension to the south breakwater. The 780-foot-long entrance and 150-foot-long transition area with side slopes of 1 on 2 would extend shoreward from the existing 15-foot depth to the turning basin. The existing east breakwater would be removed from station 2+00 to its seaward terminus and the head of the remaining structure would be reinforced with a layer of 1-ton stone. The existing south breakwater would be extended 650 feet in an easterly direction from its present terminus. This extension would have a crest elevation of 12.5 feet and would be armored on 1 on 1.5 slope with 2 layers of 2-ton stone from station 13+00 to station 18+00 and 2.3-ton stone from station 18+00 to station 19+50. The inboard side slope of the extension to station 18+00 would be designed to permit local interests, if they desire, to extend the existing 70-foot-wide fill area. The seaward revetment of 200 feet of the existing south breakwater structure from station 11+00 to station 13+00 would be modified from the existing 1 on 1 slope to 1 on 2 slope with 1-ton stone. Dredged coral material would be used to fill the existing entrance channel to a depth of 5 feet from the proposed breakwater extension to 100 feet seaward, and then at 1 on 15 minimum slope to the existing bottom.

The aids to navigation recommended by the U.S. Coast Guard are shown on plate 2. They include a light at the head of the east and south breakwaters and a lighted buoy marking the entrance channel approach.

Beautification would consist of planting about 55 trees on the mole and any extension thereto. Trees would be indigenous to the island and tolerant of saline soils.

16. ESTIMATE AND APPORTIONMENT OF FIRST COSTS

The estimated first costs of the projects, excluding self liquidating items, are tabulated in table 12. The estimates of the direct construction costs include 20 percent allowance for contingencies and are based on November 1966 prices in Hawaii. The apportionment of first costs between Federal and non-Federal interests is also shown in this table. Those costs connected with the provision of berthing areas, related facilities, and the local access channels thereto, together with those costs involved in the development of all other onshore structures and facilities necessary to ensure a complete and adequate project, are considered self liquidating costs. These costs are borne by local interests and are not included in the project first costs. The apportionment of project costs between interests as tabulated in table 12 is based on the policy that the first costs of the Federal project shall be divided between the Federal Government and local interests in direct and identical proportion to the general and local benefits as developed in subsequent paragraphs.

Table 12

Estimate of First Costs and Apportionment of Costs Between Interests
(In Thousands of Dollars)

Project	Total First Cost	Federal									Non-Federal			
		Corps of Engineers							Coast Guard Aids to Navigation	Total Federal Cost (net)	Lands, Easements, Rights-of-way	Relocations[3]	Cash Contributions	Total non-Federal
		Protective Structures	Dredging[1]	Engineering & Design	Supervision, Administration	Beautification	Total First Cost of Construction	Net[2] Cost to Corps						
Island of Kauai														
Kikiaola	$502	$161	$222	$30	$42	$8	$463	$236	$9	$245	0	$30	$227	$257
Island of Oahu														
Ala Wai	1,090	574	388	41	67	20	1,090	555	0	555	0	0	535	535
Island of Maui														
Maalaea	724	266	355	27	52	14	714	465	10	475	0	0	249	249

1/ Dredging costs contain a minimum allowance for overdepth dredging.

2/ Total first cost of construction less the non-Federal cash contribution.

3/ Includes estimated indirect costs.

17. ESTIMATE OF AVERAGE ANNUAL CHARGES

Table 13 shows the average annual charges computed from the estimated costs of the three base harbor projects. The amortization period is 50 years, the assumed useful life of each project. The interest rate used for the Federal and non-Federal investments is 3-1/8 percent. Average annual maintenance charges are included for the estimated Federal cost of maintaining all general navigation channels and the protective structures at each project.

18. ESTIMATE OF BENEFITS

a. General. The tangible benefits that are expected to accrue to the three harbor projects over their assumed useful economic life of 50 years would consist predominately of those derived from recreational boating. Increased commercial fish catch, prevention of boat damage, and land enhancement benefits would also accrue to the harbor projects. Land enhancement benefits would accrue from new land created by spoil disposal of dredged material at the proposed harbors. Significant intangible benefits, not subject to monetary evaluation, would also result from these projects, particularly as related to the prevention or reduction of injury and loss of life, and to the promotion of the public welfare and enjoyment. The total dollar value of the estimated average annual benefits derived for each project as described below are summarized and presented in table 16.

b. Benefits from recreational boating. Average annual recreational boating benefits for the three base harbor projects were computed for the projected numbers of craft anticipated to use the facilities in the initial project year, which is assumed to be 1970, and for the years 1980, 2010, and 2020. Projections were made for these years using the expected growth rate in the boat population of each project tributary area with and without the proposed improvements. The projections for the years 1970, 1980, 2010, and 2020 are indicative of the intermediate usage and eventual full utilization of each proposed light-draft facility. From the projected boat population and their breakdowns by general categories of recreational craft for each selected level of development, average annual benefits were derived for private recreational craft, both based and launched at the harbor, for based charter boats used for sports fishing or recreational cruising, and for transient recreational craft which could be expected to regularly use a portion of each harbor's berthing facilities.

c. Benefits from commercial fishing. Indications are that the commercial fishing industry in Hawaii has at present limited growth prospects. Thus, the fishing benefits likely to accrue to the proposed light-draft vessel projects are not great in comparison with the overall recreational benefits expected. Foreseeable commercial fishing benefits at Maalaea would result from the increased fish catch attributable to the navigation improvements and from reduction of future damages. Commercial fishing benefits would result from elimination of future damages at Kikiaola, Kauai. Increases in the number of fishing trips at Maalaea would result from the greater protection and more efficient and suitable facilities

Table 13

Estimates of Average Annual Charges
(In Thousands of Dollars)

Project	Total Annual Charges	Federal					Non-Federal			
		First Cost	Interest @ 3.125 Percent	Amortization @ 0.854 Percent	Maintenance[1/]	Total	First Cost	Interest @ 3.125 Percent	Amortization @ 0.854 Percent	Total
Island of Kauai Kikiaola	$24.8	$245.0	$7.7	$2.1	$4.8	$14.6	$257.0	$8.0	$2.2	$10.2
Island of Oahu Ala Wai	48.0	555.0	17.3	4.7	4.7	26.7	535.0	16.7	4.6	21.3
Island of Maui Maalaea	34.4	475.0	14.8	4.0	5.7	24.5	249.0	7.8	2.1	9.9

1/ Includes maintenance of aids to navigation.

afforded by the improvements. To compute the anticipated monetary benefits from increased fish catch, an estimate was made of the number of increased trips per year which could be credited to the proposed harbor improvements. Benefits per additional trip were then derived by subtracting the average operating cost per trip from the average value of the catch. These benefits are tabulated in table 16.

d. Benefits from prevention of vessel damages. Information gathered from owners interviewed during preparation of the interim report showed that representative monetary damages were sustained by approximately 8 percent of the State's recreational craft. This sampling indicated that 126 boats suffered over $75,000 in damages during a typical year entirely from inadequate harbor facilities. The damages resulted from overcrowding, lack of protection, dangerous navigation channels, and launching accidents due to the lack of satisfactory ramps in many areas. Application of the sample to the total recreational fleet shows that some 1,660 boats suffer annual damages totaling approximately $274,000. Available data on fishing boat damages is less complete and insufficient for a thorough annual damage analysis. Therefore, the same figure for average annual damages per boat used for recreational craft was applied to obtain the damage prevention estimate for commercial fishing craft. This approach is considered appropriate since the average fishing craft is generally operated much more frequently than the average recreational boat. This greater use raises the chance of operational accidents stemming from unsafe harbor conditions. The damage prevention benefits estimated for each of the proposed projects are tabulated in table 14.

Table 14

Damage Prevention Benefits to Recreation and Commercial Fishing Craft

Location	1970	1980	2010	2020	Average Annual
Kauai					
Kikiaola-recreation	$400	$400	$400	$400	$400
Kikiaola-commercial	100	100	100	100	100
Oahu					
Ala Wai 1/	None	None	None	None	None
Maui					
Maalaea-recreation	2,800	5,000	5,000	5,000	4,600
Maalaea-commercial	2,500	2,800	3,400	3,700	3,000

1/ Adequately protected craft at an existing harbor.

e. Recreation benefits. Recreation benefits were computed for the boaters who would stop at refuge harbor sites for recreation offered by the area at or near the refuge harbor site. These benefits are included in table 16.

f. Land enhancement benefits. Land enhancement benefits, which would result from disposal of the dredged material from the Federal participation areas, are summarized in table 15. These benefits were based on the cost of equivalent fill, or the net increased market value, whichever was less. The net increased market value was determined by subtracting costs of protection, improvements, and added spoil costs from the gross market value. The gross market value was determined by analysis of recent land sales and current real estate assessments of comparable properties. The cost of equivalent fill was determined by estimating the delivered cost of the least expensive source of adequate fill material for creating the same acreage of land. These lands, thus created, would become the property of the State and would be for public use. Local interests would be required to make a cash contribution toward construction costs based on a ratio of enhancement benefits to total project benefits.

Table 15

Land Enhancement Benefits

Island and Location	Market Value			Equivalent Fill			
	Gross Value/ sq.ft.	Net Market Value	Benefit at 5%	Volume cu.yd.2/	Cost per cu.yd.	Total Cost	Benefit at 5%
Kauai							
Kikiaola	$0.50	$ 0 1/	$ 0	29,000	$2.00	$58,000	$ 2,900
Oahu							
Ala Wai	25.00	7,948,000	397,400	90,000	2.40	216,000	10,800
Maui							
Maalaea	1.00	0	0	76,600	2.50	186,000	9,300

1/ Market value of land less cost of appurtenant works.
2/ Volume to be dredged from Federal participation areas which would be used for non-Federal fill.

g. Intangible benefits. The proposed harbor system would prevent or reduce loss of life and bodily injuries. Construction of these harbors would also provide the boating public with assurance and knowledge that a harbor is within a reasonable distance in the event of sudden storms or other emergencies.

h. Apportionment of benefits. The distribution of the total estimated average annual monetary benefits, summarized in table 16, are separated between general and local categories in table 17. By established policy, recreational benefits are treated as half general and

Table 16

Summary of Average Annual Benefits
for 50-year Project Life

Considered Project Location	Design Capacity (approx. no. of boats)	Full Utilization Attained (year)	Recreational Benefits[1/] ($)	Land Enhancement Benefits ($)	Commercial Fishing Benefits[1/] ($)	Commercial Transportation Benefits ($)	Total ($)
Island of Kauai Kikiaola	130	2010	45,200	0	100	0	45,300
Island of Oahu Ala Wai	920	1995	256,800	10,800	0	0	267,600
Island of Maui Maalaea	260	2020	57,300	0	23,400	0	80,700

1/ Related damage prevention benefits included.

half local in nature, whereas commercial fishing benefits are regarded as all general. Local benefits accrue within the immediate vicinity or to the State of Hawaii; general benefits to the public welfare, hence to the Federal Government.

Table 17

Summary of Average Annual Benefit Apportionment[1/]

Project	General Benefits Value	General Benefits Percent of Total	Local Benefits Value	Local Benefits Percent of Total	Total
Kauai					
Kikiaola	$22,700	50.1	$22,600	49.9	$45,300
Oahu					
Ala Wai	128,400	50.0	128,400	50.0	256,800
Maui					
Maalaea	52,050	64.5	28,650	35.5	80,700

1/ Excludes land enhancement which is allocated 50 percent general, 50 percent local.

19. COMPARISON OF BENEFITS AND COSTS

The economic justification of the three proposed harbor projects is tabulated in table 18, which compares the anticipated average annual benefits and charges, and tabulates the resulting benefit-cost ratios for each plan of improvement.

Table 18

Comparison of Benefits and Costs

Project	Total Average Annual Benefits	Total Average Annual Charges	Benefit-Cost Ratio
Kikiaola, Kauai	$ 45,300	$24,800	1.8
Ala Wai, Oahu	267,600	48,000	5.6
Maalaea, Maui	80,700	34,400	2.3

20. REQUIRED LOCAL COOPERATION

Federal participation in the construction and maintenance of the three base harbor projects for light-draft vessels recommended in this report will be subject to the conditions that local interests will, as applicable to each project, satisfy 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 projects and for 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 subsequent disposal of spoil, and also provide necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works;

b. 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;

c. Maintain without cost to the United States adequate depth in the Ala Wai Harbor entrance channel;

d. 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;

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

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

g. Establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbors 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

h. Contribute in cash prior to construction of each project a lump sum payment of the estimated amount shown in table 19 expressed as a percentage of the estimated first cost of construction by the Corps of Engineers, the final contribution to be adjusted after actual costs have been determined.

The Harbors Division, Department of Transportation, State of Hawaii, the local cooperating agency, has reviewed the general plans of the three

harbor projects and has formally indicated full support of the proposed projects. Additionally, the Harbors Division has informally assured the District Engineer that, as the representative of the State, it is willing and able to fulfill the necessary requirements of local cooperation as enumerated above and desires to undertake the projects upon Federal approval. In previous navigation projects with the Federal Government, the State has met its obligations in all respects.

21. COORDINATION WITH OTHER AGENCIES

Both the Federal Government and State Government, private organizations, and individuals were contacted for advice and assistance in compiling this report. During the course of the studies, frequent conferences were held with representatives of the Harbors Division, Department of Transportation, State of Hawaii, the local cooperating agency. The related plans and desires of the cooperating agency and other local interests were carefully considered in connection with site selection and developing project capacity and improvements. In producing the recommended plans, their views were complied with to the greatest extent possible in keeping with sound engineering principles and economic limits dictated by justification procedures.

The general plans for three proposed harbor projects were submitted to the State Harbors Division, Department of Transportation, and the Departments of Planning and Research and the General Services Department; the U.S. Fish and Wildlife Service; the Federal Water Pollution Control Administration; the U.S. Department of Health, Education and Welfare; and by the U.S. Coast Guard.

The general plans for the proposed harbor projects were also presented and discussed at five informal public hearings held in the communities adjoining the project sites. All comments were given full consideration in finalizing this report. Comments were generally favorable and constituted full support of these projects. Officials of the State of Hawaii indicated strong backing of these three harbor projects.

The U.S. Fish and Wildlife Service stated the opinion that the proposed harbor improvements would be in no way detrimental to existing fish fauna. The Department of Health, State of Hawaii, advised that the projects will not jeopardize the public swimming areas within the neighborhoods of the respective projects.

22. DISCUSSION

The three harbor projects recommended for Federal construction in this report would be major modifications to State constructed facilities.

Deepening of the entrance channel and modifications of the protective structures at Kikiaola Harbor would permit full utilization of the facility. The existing 5-foot entrance channel depth and low crest heights of the protective structures severely restrict the use of this harbor. From the viewpoints of need, safety, and utilization, the recommended improvements are urgently needed.

The recommended improvement to Ala Wai Harbor is a harbor enlargement which would increase the capacity of the harbor from 515 boats to 940 boats. The demand for increased berthing space exists now and will become increasingly acute within the next few years.

The existing entrance channel at Maalaea Harbor is directly opposite the commercial wharf. Waves coming straight in the channel frequently restrict loading and unloading operations at the wharf. The recommended realignment of the entrance channel and breakwater modification will greatly reduce the wave energy entering the harbor basin and also enlarge the protected harbor area. The need for this improvement is urgent for both the commercial and recreational boating interests.

Plans for economically justified projects at Waimanalo and Punaluu were developed during the course of this study. However, in view of the opposition expressed by local residents, officials of the State of Hawaii are not willing to support these two projects at this time. Therefore, Waimanalo and Punaluu harbors are not considered for construction in this report. State officials, considering long range aspects, requested that the plans for Waimanalo and Punaluu harbors be included somewhere in the report. In response to this request, plans for the two harbors are presented in appendix B. A plan for Kahana Bay, an alternate site for Punaluu, was also developed and is shown in appendix B. In view of the opposition to Punaluu, only three miles north of Kahana Bay, and the tentative State plan to develop Kahana Valley as a park area, State officials were not willing to support a harbor project for Kahana Bay at this time.

The information called for by Senate Resolution 148, 85th Congress, adopted 28 January 1958, is contained in Attachment I to this report.

23. CONCLUSIONS

The District Engineer finds that the three projects proposed in this report and the light-draft vessel harbor projects recommended in prior reports, together with the private and State harbor facilities, will satisfy 91 percent of the State's boat space requirements for the year 1980, and 78 percent of the need for the year 2020. The small unsatisfied need which would exist in the year 1980 is attributable to a few areas where the wide dispersion of population would not justify harbor construction and to the Punaluu and Waimanalo areas of Oahu.

The three harbor projects recommended in this report are economically justified and urgently needed. In addition to the tangible benefits which would accrue to both the commercial and recreational light-draft vessel interests, improved safety to navigation which would result from the recommended projects would provide many intangible benefits.

Although there are insufficient tangible benefits at this time to justify construction of any harbor for refuge only, and none are recommended for construction, there exists along some coastal reaches a need

for havens of refuge. In a few locations, existing channels through reef areas afford access to protected anchorages. These channels are difficult to locate and hazardous to negotiate, particularly at night or during storm periods. Aids to navigation would greatly enhance the refuge value of these locations. When the base harbors recommended in prior reports are constructed, many of them will also serve as harbors of refuge and make interisland and round the island cruising less arduous and hazardous for the light-draft vessel fleet. As discussed in the report, there are a few coves and anchorages which afford protection during certain storm conditions, but are exposed to severe wave action when storms approach from other directions. For the knowledgeable boat operator, these coves and anchorages have refuge value.

The District Engineer concludes that this report, together with prior authorized reports on light-draft vessel harbors in Hawaii, would constitute full compliance with Section 110 of the River and Harbor Act of 17 May 1950 with respect to the coasts of the Hawaiian Islands with a view to the establishment of harbors for light-draft vessels for refuge and other purposes and a harbor at Keauhou Bay, Hawaii, and would complete compliance with Section 6 of Public Law 14, 79th Congress, 1st Session, 2 March 1945.

24. RECOMMENDATIONS

The District Engineer recommends the adoption of Federal projects for light-draft navigation entailing the construction of light-draft vessel harbor projects in the State of Hawaii at Kikiaola, Kauai; Ala Wai, Oahu; and Maalaea, Maui, all substantially in accordance with the general plans accompanying this report, or as modified as may be advisable in the discretion of the Chief of Engineers, the features and estimated costs of which are summarized in table 19. The estimated total first cost for the three proposed harbor projects is $2,316,000 of which $1,275,000 is a Federal cost.

He further recommends that construction of the navigation improvements cited at any of the localities named may be undertaken independently of the others whenever the necessary funds for a complete project become available and when local interests have given assurances satisfactory to the Secretary of the Army that they will (a) provide without cost to the United States all lands, easements, and rights-of-way required for the construction and subsequent maintenance of the projects and for 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 subsequent disposal of spoil, and also provide necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works; (b) 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; (c) maintain without cost to the United States adequate depth in the Ala Wai Harbor entrance channel; (d) provide and maintain without cost to the United States depths in the berthing and mooring

Table 19

Recommended Improvements and Estimated Costs

Location	Recommended Improvements	Corps of Engineers First Cost of Const[1/]	Corps of Engineers Annual Maint.	Local Cash Contribution Percent	Local Cash Contribution Estimated Amount
Kikiaola, Kauai	East breakwater 130 feet removed; 770 feet of east breakwater raised 3 feet; wave absorber 270 feet long; entrance channel 1,050 feet long, 12 feet deep, 120 feet wide; access channel 630 feet long, width varies from 120 feet to 80 feet; depth varies from 10 feet to 6 feet. Tree planting for beautification.	$ 463,000	$4,800	49.9	$227,000[2/]
Ala Wai, Oahu	Revetted mole 1,400 feet long; a 60-foot stub breakwater; 2 wave absorbers having a combined length of 580 feet; turning area and access channels with total area of 6.8 acres dredged to depth of 10 feet. Tree planting for beautification.	1,090,000	4,700	50.0	535,000
Maalaea, Maui	Entrance channel 780 feet long, 150 feet wide, 15 feet deep; 150-foot-long transition area providing change in depth from 15 feet to 12 feet and flaring of width from 150 feet to about 300 feet at entrance of 6.9 acre turning basin; access channel 80 feet wide, 700 feet long, 8 feet deep; a 650-foot extension to south breakwater; removal of east breakwater from station 2+00 to its seaward terminus; reinforcing new head with a layer of armor stone. Tree planting for beautification.	714,000	5,700	35.5	249,000

1/ Excludes aids to navigation.
2/ Excludes $30,000 for relocations.

areas, and in the local access channels commensurate with the depths provided in the related project areas; (e) provide and maintain without cost to the United States all appropriate onshore structures, access roads, parking areas, public restrooms, and boat launching ramps as necessary to insure a complete and adequate project; (f) accomplish without cost to the United States such utility, drainage, or other relocations or alterations as necessary for project purposes; (g) establish regulations prohibiting discharge of untreated sewage, garbage, and other pollutants in the waters of the harbors 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 (h) contribute in cash prior to construction of each project a lump sum payment of the estimated amount shown in table 19 expressed as a percentage of the estimated first cost of construction by the Corps of Engineers, the final contribution to be adjusted after actual costs have been determined.

The net first costs of these three harbor projects for light-draft vessels to the United States, excluding the cost of navigational aids and after reimbursement by local interests of the contributed amounts indicated in table 19, are now estimated at $236,000 for Kikiaola, Kauai; $555,000 for Ala Wai Harbor, Oahu, and $465,000 for Maalaea Harbor, Maui, as shown in table 20.

Table 20

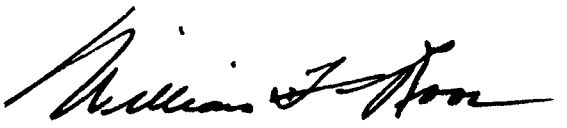
Estimated Costs and Benefit-Cost Ratios

Location	Federal Cost[1/]	Federal Maintenance Cost-Annual	Non-Federal Cost[2/]	Benefit Cost Ratio
		(In thousands of dollars)		
Kauai				
Kikiaola	$236.0	$4.8	$257.0	1.8
Oahu				
Ala Wai	555.0	4.7	535.0	5.6
Maui				
Maalaea	465.0	5.7	249.0	2.3

1/ Exclusive of aids to navigation.
2/ Exclusive of self-liquidating facilities.

The District Engineer also recommends no further consideration at this time toward adoption of a Federal project for light-draft vessel navigation at Keauhou Bay under the authority contained in Section 110 of the River and Harbor Act, 17 May 1950 since the boating needs for the area tributary to Keauhou will be satisfied by construction of the Honokahau Harbor project authorized by the 1965 River and Harbor Act.

The District Engineer finally recommends that no action be taken toward adoption of a Federal project at Kalaupapa, Molokai, under the authority contained in Section 6 of Public Law 14, 79th Congress, 1st Session, 2 March 1945, since the Kalaupapa Harbor project was authorized for construction under Section 107, Public Law 86-645.



WILLIAM F. ROOS
Colonel, Corps of Engineers
District Engineer

[First endorsement]

PODGM (30 Jun 67)
SUBJECT: Report on Survey of the Coasts of the Hawaiian Islands, Harbors for Light-Draft Vessels

DA, Pacific Ocean Div, Corps of Engineers, Honolulu, HI 96813, 25 Aug 67

TO: Chief of Engineers, Department of the Army, Washington, DC 20315

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

2. The District Engineer's report was submitted on 30 June 1967 when the approved interest rate for plan formulation and evaluation was 3-1/8 per cent. A rate of 3-1/4 per cent has now been established for current usage. Increasing the rate to 3-1/4 per cent results in annual benefits, annual costs, and benefit-cost ratios as follows:

	Annual Benefit	Annual Cost	B/C Ratio
Kikiaola Harbor	$ 45,100	$ 25,200	1.8
Ala Wai Harbor	267,200	49,100	5.4
Maalaea Harbor	80,200	35,200	2.3

3. The new interest rate results in no change in either cost sharing or apportionment.

Edward T. Podufaly

EDWARD T. PODUFALY
Brigadier General, USA
Division Engineer

HONOLULU DISTRICT, CORPS OF ENGINEERS
FORT ARMSTRONG
HONOLULU, HAWAII

APPENDIX C

COORDINATION WITH OTHER AGENCIES

TO ACCOMPANY
REPORT ON SURVEY
OF THE
COASTS OF THE HAWAIIAN ISLANDS
HARBORS FOR LIGHT-DRAFT VESSELS

REPORT ON SURVEY
OF THE
COASTS OF THE HAWAIIAN ISLANDS
HARBORS FOR LIGHT-DRAFT VESSELS

APPENDIX C

COORDINATION WITH OTHER AGENCIES

TABLE OF CONTENTS

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

ADDRESS REPLY TO:
COMMANDER
14TH COAST GUARD DISTRICT
1347 KAPIOLANI BLVD.
HONOLULU 14, HAWAII

o
H2
Serial: 32094
20 May 1963

From: Commander, FOURTEENTH Coast Guard District
To: District Engineer, U.S. Army Engineer District, Honolulu

Subj: Maalaea Harbor, Maui; recommended aids to navigation for

Ref: (a) CofE, Honolulu, ltr POHGP of 30 April 1963

1. In reply to reference (a), the following recommendations and approximate costs are furnished for aids to navigation in the proposed modification of Maalaea Harbor, Maui:

Type of Aid	Location	Initial Cost	Annual Maintenance
McGREGOR PT Daybeacon (convert to a light using shore power)	McGREGOR PT.	$600.	$50.
Breakwater Lights, shore powered, two	East end of the west mole extension and south end of the modified east breakwater.	$5,400.	$550.
6x20L Buoy	Lat. 20°47'29"N., Long. 156°30'25"W.	$3,500.	$500.
	TOTAL	$9,500.	$1,100.

C. W. SCHARFF
By direction

Encl: (1) CofE Drawing

Copy to:
COMDT(OAN) USCG/less encl

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

Address reply to:
COMMANDER (o-2)
14TH COAST GUARD DISTRICT
1347 KAPIOLANI BLVD.
HONOLULU, HAWAII 96814

3260
13 May 1965
Serial: 32308

From: Commander, Fourteenth Coast Guard District
To: District Engineer, U. S. Army Engineer District, Honolulu, Hawaii

Subj: Proposed small craft harbors at Ala Wai, Kewalo, Kikiaola

Ref: (a) Your ltr POHGP of 30 April 1965

1. Reference (a) requested recommendations for aids to navigation to mark the proposed improvements to subject harbors. No additional aids are recommended; the only change being the removal of present unlighted buoys 4 and 6 (LL Page 268) at Kewalo Basin.

2. Copies of the preliminary plans for the modifications to subject harbors are returned unmarked.

E. C. Crosby

E. C. CROSBY
By direction

Encl: (1) Preliminary Plan, Ala Wai Small Boat Harbor
(2) Preliminary Plan, Kewalo Basin
(3) Preliminary Plan, Kikiaola Small Boat Harbor

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

Address Reply To:
COMMANDER (o-2)
14th Coast Guard District
1347 Kapiolani Boulevard
Honolulu, Hawaii 96814

3260
5 August 1965
Serial: 34465

From: Commander, Fourteenth Coast Guard District
To: District Engineer, U. S. Army Engineer District, Honolulu

Subj: Kikiaola Harbor, Kauai; Aids to Navigation

Ref: (a) CofE ltr POHGP dtd 14 July 1965

1. As requested by reference (a) a review of the necessity for aids to navigation in connection with your project at subject harbor has been conducted. The following aid to navigation is recommended at this time:

Aid	Location	Installation Cost	Annual maintenance Cost
Kikiaola Breakwater Light	Seaward end of breakwater	$9,000	$400

2. It should be noted that this aid is recommended based upon information available at this time, and that changing conditions or requirements may require that additional aids be established or preclude the establishment of the recommended aid at the time the project is commenced.

B. V. WESTON
By direction

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE

PUBLIC HEALTH SERVICE
447 Federal Office Building
San Francisco 2, California

June 19, 1963

D. G. Williams
Colonel, Corps of Engineers
Building 96, Fort Armstrong
Honolulu 13, Hawaii

Ref: POHGP

Dear Colonel Williams:

The preliminary plan of improvement of the Maalaea Small Boat Harbor project has been reviewed.

It does not appear to this office that this project will have any adverse effects on public health or sanitation on the island of Maui, Hawaii.

We appreciate the opportunity afforded us to review the proposed project plans.

Sincerely yours,

WILLIAM B. SCHREEDER
Deputy Regional Program Director
Water Supply & Pollution Control

cc:
Mr. McMorrow, Hawaii Dept Health
Mr. Krause, DWS&PC, PHS, Washington DC

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE

PUBLIC HEALTH SERVICE

Water Resources Section - DWS&PC
Federal Office Building
50 Fulton Street - Room 260
San Francisco, California 94102

17 May 1965

Lt. Colonel Glenn P. Ingwersen
District Engineer
U. S. Army Corps of Engineers
Bldg. 96, Ft. Armstrong
Honolulu, Hawaii 96813

Dear Colonel Ingwersen:

This is in reply to your letter of 30 April 1965 requesting our reviews and comments on the following Corps of Engineers projects: Ala Wai Harbor, Kewalo Basin, Punaluu Harbor, and Waimanalo Harbor all on Oahu; Kikiaola Harbor, Kauai; and Maalaea Harbor, Maui.

This office commented that we foresaw no adverse effects on the Maalaea Harbor project in a 19 June 1963 letter and since changes in the proposed plan are minor this comment is still applicable.

From the limited amount of data contained in the preliminary plans there appear to be no adverse public health effects associated with these projects. The two types of problems more likely to occur in these types of development are: (1) water pollution resulting from discharge of municipal sewage into semi-closed harbors or from discharge of raw sewage from boats moored in the harbors; and (2) contamination resulting from relocation of existing water or sewage mains. The State Department of Health is in the best position to assess these types of problems and their advice should be followed during the design and construction phase of these projects. Our interest in these projects is satisfied, provided they are acceptable to Mr. McMorrow of the State Department of Health.

Thank you for giving us the opportunity to comment to these projects.

Sincerely yours,

Paul W. Eastman
Regional Program Director
Water Supply & Pollution Control

cc: B. J. McMorrow

CE 4

JOHN A. BURNS
GOVERNOR

LEO BERNSTEIN, M.D., M.P.H.
DIRECTOR OF HEALTH

DEPARTMENT OF HEALTH
STATE OF HAWAII
HONOLULU

May 19, 1965

Lieutenant Colonel Glenn P. Ingwersen
District Engineer
Corps of Engineers
Building 96, Fort Armstrong
Honolulu, Hawaii 96813

Dear Colonel Ingwersen:

Reference is made to your letter of April 30, 1965, requesting our views and comments on the harbor projects on Oahu, Kauai and Maui.

Our comments are as follows:

(1) Sufficient number of sanitary facilities is now available for the existing harbors.

(2) We were informed by Mr. Mori of the Division of Harbors, Department of Transportation, that additional sanitary facilities will be provided with the construction of the various improvements.

(3) The operation of these small boat harbors will not jeopardize the public swimming areas within these neighborhoods.

Thank you for keeping us posted on your various projects which are of mutual interest to us.

Sincerely yours,

B. J. McMORROW, Executive Officer
Environmental Health Division

CABLE ADDRESS
FISHWILD

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
P. O. Box 3830, Honolulu 12, Hawaii

HAWAII AREA

ADDRESS ONLY
THE AREA DIRECTOR

May 27, 1963

District Engineer
U. S. Army Engineer District, Honolulu
Corps of Engineers
Building 96, Fort Armstrong
Honolulu 13, Hawaii

Dear Sir:

We have examined the preliminary plans for the Maalaea Small Boat Harbor project, Maalaea Bay, island of Maui, Hawaii, particularly with respect to its possible effect on the fish and wildlife fauna in the area. This review was made in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) in consultation with the State of Hawaii Division of Fish and Game. The project involves modification to the present small boat harbor in order to correct the surge and entrance problem now existing, and to provide the projected boating needs for a 50-year life of the project. There will be a displacement of the entrance channel and this will involve construction of additional breakwater and the dredging of the new channel.

The Maalaea Harbor area is relatively unimportant as a habitat for any important species of fish. There is some bait fish, the nehu (Stolephorus purpureus), taken here and used for fishing skipjack tuna. It is very likely that the dredging of the new entrance channel will serve to improve the habitat for the nehu as well as for certain game fishes not now available in any great numbers. At any rate, it seems to us that the advantages of the proposed project would far outweigh any disadvantages.

Sincerely yours,

John C. Marr
Area Director

cc: Regional Director, Bureau of Sport Fisheries
and Wildlife, Portland, Oregon
Bureau of Commercial Fisheries, Washington, D. C.
State Division of Fish & Game, Honolulu, Hawaii

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
P. O. Box 3830, Honolulu, Hawaii 96812

CABLE ADDRESS
FISHWILD

HAWAII AREA

ADDRESS ONLY
THE AREA DIRECTOR

May 10, 1965

Reference: POHGP

Lt. Col. Glenn P. Ingwersen
District Engineer
Corps of Engineers
U.S. Army Engineer District, Honolulu
Building 96, Fort Armstrong
Honolulu, Hawaii 96813

Dear Colonel Ingwersen:

As requested by you in your letter of 30 April 1965, we submit the following comments pertaining to the preliminary plans for the improvement of six small-boat harbors in the State of Hawaii:

Ala Wai Yacht Harbor, Oahu

Commercially important fish are not found in significant quantities in the Ala Wai Yacht Harbor. There is considerable recreational fishing (of the bamboo pole variety) and crabbing within the harbor area. Various inshore species such as halfbeaks and needlefishes, papio (carangids), u'u (holocentrids), aweoweo (Priacanthus sp.), mullet, and the weke (goatfishes) are caught, but the catches are quite small and seasonal. Small catch, however, cannot be equated to the recreational value obtained from the area, which is considerable. Nearby, in the Ala Wai Canal, the skipjack fishermen often seine for nehu (Stolephorus purpureus), a silvery baitfish which occurs chiefly in brackish, turbid inshore waters such as are found there. The catch of nehu from the Ala Wai Canal in the last 5 years has averaged 593 buckets (approximately 7 pounds of fish per bucket) which is roughly 2 percent of the statewide catch of baitfish. Nehu, of course, is the major bait species on which the commercial skipjack fishery in Hawaii depends.

The proposed construction of additional small-boat harbor facilities in the Ala Wai Yacht Harbor will not in our opinion affect the habitat for the nehu in the Ala Wai Canal. Insofar as the recreational aspect of the harbor area is concerned, such facilities will serve to increase the area suitable for this purpose. Dredging will probably increase or improve the habitat for estuarine species of fish. We do not see any possibility that the proposed harbor improvement plans will be detrimental to the existing fish fauna in the area.

Kewalo Basin, Oahu

Kewalo Basin, like the Ala Wai Harbor, is a scene of considerable recreational fishing and crabbing activity. The skipjack fishermen occasionally obtain baitfish from within the harbor. Here, the iao (Pranesus insularum) is the dominant species although its supply is quite unreliable. The average catch of tuna baitfish in the harbor is about 100 buckets, or less than 1 percent of the statewide total baitfish catch.

To the best of our knowledge the proposed plans to install wave traps at the channel entrance will not affect the fish fauna presently existing within Kewalo Basin.

Maalaea Bay, Maui

It is our considered opinion that the proposed dredging of a new channel entrance as well as the construction of a breakwater will not have any detrimental effect on the existing fish fauna in Maalaea Bay. According to statistics kept by the State Division of Fish and Game, about 2 percent of the catch of tuna baitfish in the State is made in this area. Other commercially important fish species are not present in any quantity. The harbor improvement projects will not harm the existing baitfish fishery, and instead, may serve to increase the habitat suitable for various estuarine species which will be a source of pleasure for recreational fishermen. We do not foresee any detrimental effect that can accrue from the proposed harbor improvement projects.

Kikiaola Harbor, Kauai; Waimanalo Bay, Oahu; and Punaluu, Oahu

We are reasonably certain that the proposed harbor development project in these areas will be beneficial as far as fish fauna is concerned. The anticipated improvements will not curtail recreational fishing but may, in fact, provide additional habitat for the valuable baitfishes to augment the presently inadequate supply.

In general, we feel that all of the proposed projects will in no way be detrimental to existing fish fauna. They should serve to be beneficial in increasing the supply of commercially valuable baitfishes, and in increasing the habitat suitable for fish species which are the source of recreation for the State's populace.

Sincerely yours,

John C. Marr

John C. Marr
Area Director

cc: Regional Director, BSFW, Portland
Director, BSFW, Washington
Director, BCF, Washington

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION

100 McAllister Street
Room 1802
San Francisco, California 94102

March 24, 1967

Colonel W. F. Roos
District Engineer
U. S. Army Corps of Engineers
Honolulu District
Fort Armstrong
Honolulu, Hawaii 96813

Dear Colonel Roos:

Reference is made to your letter POHGP of March 7, 1967 regarding your projects on the Ala Wai Harbor, Kewalo Basin, both on Oahu, Kikiaola Harbor on Kauai and Maalaea Harbor on Maui.

According to the project description, dredged materials would be spoiled at sea only from the Maalaea Harbor project and would be used for fill at the others. Although your letter stressed that dredged materials would be inorganic, field observations should be made to confirm that organic materials are not involved since they could cause deterioration of water quality at both the dredging and disposal sites. Such organic deposits are commonly found in the proximity of sewer outfalls.

It is assumed the sea disposal site for the Maalaea Harbor project has been selected and would be designated in your survey report. We would want to review your selected disposal site.

When available, we would appreciate receiving three (3) copies of your preliminary survey report for review and comment in accordance with the provisions of Section 6 of Executive Order 11288 (July 2, 1966). This review will take into consideration the water quality standards now in preparation by the State of Hawaii.

We appreciate your early notification of the preparation of this report and the opportunity to forward these preliminary comments. As our Agency will have a continuing interest in this and future projects, we would appreciate receiving periodic progress reports on pre- and post-authorization phases of all your water resource projects.

Sincerely yours,

William B. Schreeder
Regional Director

CE 12a

JOHN A. BURNS
GOVERNOR

FUJIO MATSUDA
DIRECTOR
JOHN B. K. SUR
DEPUTY DIRECTOR

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

IN REPLY REFER TO:
HAR-ED
1564

May 31, 1967

Colonel William F. Roos
Honolulu District Engineer
Corps of Engineers
Fort Armstrong
Honolulu, Hawaii 96813

Dear Sir:

Subject: Coasts of the Hawaiian Islands Harbors

Thank you for your submittals of February 3, 1967, consisting of the preliminary draft of the survey report on the Coasts of the Hawaiian Islands Harbors for Light-Draft Vessels, POHGP, and the descriptive plates relative thereto on the following three projects - Maalaea Harbor, Maui; Kikiaola Harbor, Kauai; and Ala Wai Harbor, Oahu.

The State concurs in the general plans of development for the three harbor projects. We are pleased to note your recognition of the possible conflict between the surfing areas and the harbor size and provisions for an alternate plan of improvement to accommodate 260 additional boats instead of 425 as cited on page 31 of the preliminary draft of the survey report, and we wholeheartedly agree with this approach.

Subject to the availability of funds and to the extent permitted by law, the State agrees to comply with the following stipulated conditions of local cooperation, insofar as they are applicable to each project:

1. Provide without cost to the United States all necessary lands, easements and rights-of-entry required for construction and subsequent maintenance of the projects.

2. Provide and maintain without cost to the United States the necessary berthing and mooring facilities and utilities.

3. Maintain without cost to the United States a 20 ft. depth in Ala Wai Harbor entrance channel.

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

5. Provide and maintain without cost to the United States all appropriate onshore structures, roadways, parking areas, comfort stations and other necessary facilities.

6. Provide without cost to the United States such utilities, drainage and other alterations as necessary for project purposes.

7. Make a cash contribution for each project, a sum shown in Table 19 expressed as a percentage of the estimated first cost of construction by the Corps of Engineers.

8. Comply with the non-discriminatory provisions of Title VI of the Civil Rights Act of 1964.

Please keep us informed of future developments. We are very appreciative of your continued cooperation.

Very truly yours,

FUJIO MATSUDA
Director

ATTACHMENT I
TO
REPORT ON SURVEY
OF THE
COASTS OF THE HAWAIIAN ISLANDS
HARBORS FOR LIGHT-DRAFT VESSELS

Information Called for by
Senate Resolution 148, 85th Congress
Adopted 28 January 1958

1. PROJECT DESCRIPTION AND ECONOMIC LIFE

The Federal portions of the three recommended harbor projects would be limited to construction and maintenance of the protective structures, wave absorbers, and the general navigation channels which would include entrance and/or main access channels, and in some cases maneuvering areas or turning basins. The recommended features vary with each project and are identified in the following tabulation. Construction and maintenance of the berthing areas or mooring areas and facilities, including local access channels, and the provision of all necessary onshore installations and facilities would be accomplished by local interests as self-liquidating items not included in the Federal projects. The economic life used in the evaluation of each project is 50 years.

Location	Recommended improvements
Kikiaola, Kauai	130 feet of each breakwater removed; 770 feet of east breakwater raised 3 feet; wave absorber 270 feet long; entrance channel 1,050 feet long, 12 feet deep, 120 feet wide; access channel 630 feet long; width varies from 120 feet to 80 feet; depth varies from 10 feet to 6 feet.
Ala Wai, Oahu	Revetted mole 1,400 feet long; a 60-foot stub breakwater; two wave absorbers with a combined length of 580 feet; turning area and access channels with total area of 6.8 acres dredged to a depth of 10 feet.
Maalaea, Maui	Entrance channel 780 feet long, 150 feet wide, 15 feet deep including a 150-foot transition area providing change in depth from 15 feet to 12 feet and flaring of width from 150 feet to about 300 feet at entrance of 6.9 acre turning basin; main access channel 80 feet wide, 700 feet long, 8 feet deep; a 650-foot extension to the south breakwater; removal of east breakwater from station 2+00 to its terminus; reinforcing new head with a layer of 1-ton stone.

2. PROJECT COSTS

The estimated net first cost of construction by the Corps of Engineers (which excludes the costs of aids to navigation to be provided by the

Coast Guard) and the annual maintenance costs are shown in the following breakdown as the Federal cost for each project. The non-Federal costs shown include the cost of making any required relocations, and the local cash contribution based on a percentage of the anticipated local benefits. No costs for lands, easements, and rights-of-way, operation or replacement costs are involved. The cost estimates include allowances of 20 percent for contingencies and reflect the price levels prevailing in Hawaii in November 1966.

	Federal			
Project	First cost	Annual maintenance	Non-Federal first cost	Total first cost of project
Kikiaola, Kauai	$236,000	$4,800	$257,000	$ 502,000
Ala Wai, Oahu	555,000	4,700	535,000	1,090,000
Maalaea, Maui	465,000	5,700	249,000	724,000

3. BENEFIT-COST RATIOS

The average annual costs for the assumed 50-year economic life of each project were computed using an interest rate of 3-1/8 percent for the Federal and non-Federal capital investment. The total average annual tangible benefits expected to accrue to each light-draft navigation project, compared with the estimated annual capital costs, are shown below with the resulting benefit-cost ratios. Amortization of project costs over a greater period than a 50-year project life is not considered appropriate in determining project feasibility nor would it result in a change in the scope of the projects or the basis for cost-sharing arrangements. Projection of the boat population of the State, upon which the scale of individual projects is based, over a longer period with any reasonable degree of accuracy is not considered feasible.

Project	Total average annual benefits	Total average annual costs	Benefit-cost ratio
Kikiaola, Kauai	$ 45,300	$24,800	1.8
Ala Wai, Oahu	267,600	48,000	5.6
Maalaea, Maui	80,700	34,400	2.3

4. INTANGIBLE PROJECT EFFECTS

Storm damages to the existing light-draft vessel fleet in Hawaii which can be attributed to inadequate harbor protection or harbor entrance conditions have been substantial in past years. These losses involved loss of life and threat to life and limb. As a factor in preventing or reducing loss of life and bodily injury, the storm refuge and emergency value of the recommended projects would result in significant intangible benefits to the boating public. This protective or safety aspect of the proposed facilities is clearly a major element in the assessment of project need.

5. FEASIBILITY OF PROVIDING FOR FUTURE NEEDS

The design of each of the proposed harbor projects is based on consideration of the projected needs for safe harbor space of the boat population and prevention of damages within the local tributary areas concerned through the year 2020.

6. ALLOCATION OF COSTS

Allocation of costs between project purposes is not applicable since only one water use, navigation, is involved.

7. EXTENT OF INTEREST IN PROJECTS

The recommended projects have the full support of the State of Hawaii and are generally considered to be urgently needed by the boating public. The local cooperating agency of the State, designated by the Governor of Hawaii, is the Harbors Division of the Department of Transportation. The conditions of required local cooperation are contained in paragraph 20 in the main report, and are repeated in the recommendations. Coordination would be effected directly between the offices of the District Engineer and the Harbors Division. The Federal cost of such participation is included in the cost items shown in table 12 of the main report under the heading of Supervision and Administration.

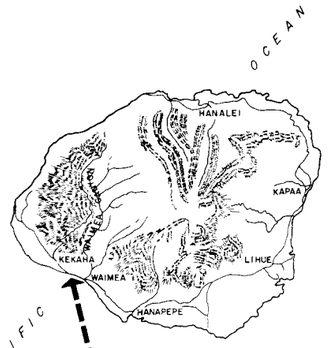
8. REPAYMENT SCHEDULES

The construction cost of the general navigation facilities, comprising the recommended features of each project, would be apportioned between the United States and the State of Hawaii in direct and identical proportion to the expected general and local benefits. No periodic repayment schedules are applicable since, in accordance with item f of the required conditions of local cooperation, local interests would be required to contribute in cash, prior to construction of each project, a lump sum payment expressed as a percentage of the Federal first cost (exclusive of aids to navigation) the final contribution to be adjusted after actual costs have been determined. The presently estimated amounts of the local cash contribution and the percentage of the project construction costs they represent are:

Project	Estimated local cash contribution	Percent of Federal construction cost
Kikiaola, Kauai	$227,000	49.9
Ala Wai, Oahu	535,000	50.0
Maalaea, Maui	249,000	35.5

9. PROJECT EFFECTS ON STATE AND LOCAL GOVERNMENTS

The increased cost of State government services in operating and maintaining the self-liquidating portions of the three harbor projects would be offset in part by the berthing fees charged to harbor users. Definite taxation advantages are expected to accrue to the State and County governments. All the projects are expected to have a positive beneficial effect on business activities in the communities concerned. The improved harbors are expected to cause a considerable increase in the rate of growth of the State's boat population which has so far been retarded because of inadequate harbor facilities. This growth should not only result in increased sales and servicing of boats, motors, and other marine equipment, but also cause expanded sales of related recreational equipment and sporting goods. In addition, increased sales of gasoline, diesel fuel, and lubricants would result in greater tax revenues for the State.



LOCATION MAP
ISLAND OF KAUAI
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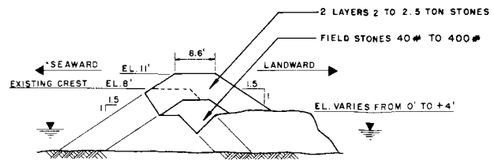

MODIFIED BREAKWATER SECTION
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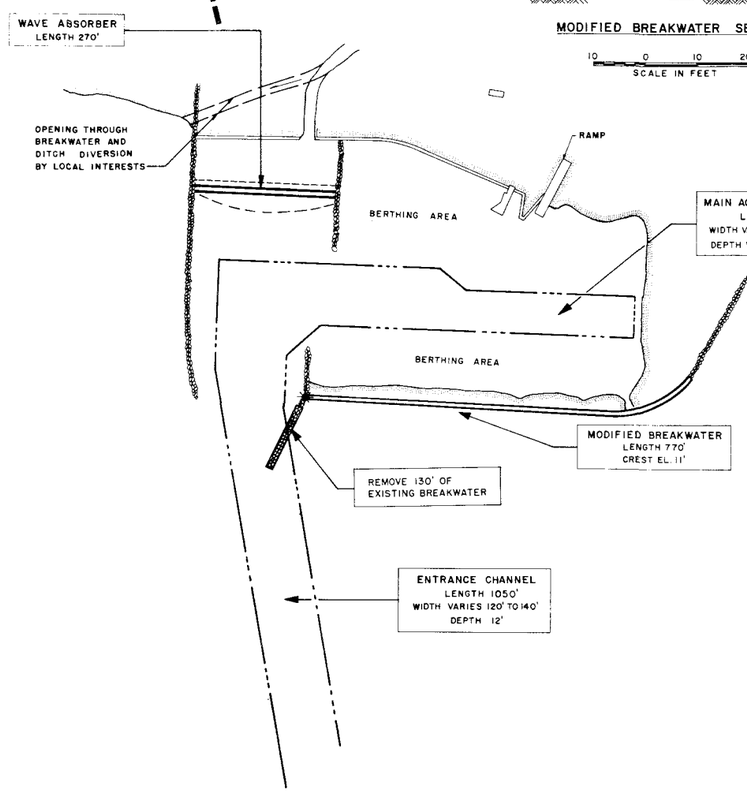

KIKIAOLA HARBOR

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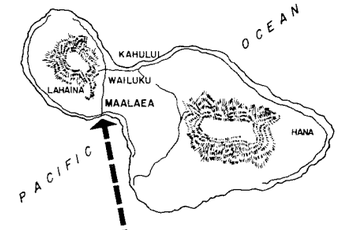

LOCATION MAP
ISLAND OF MAUI
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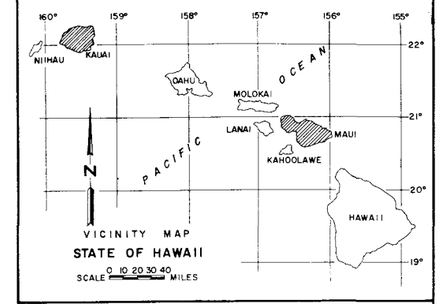
SCALE IN MILES



VICINITY MAP
STATE OF HAWAII
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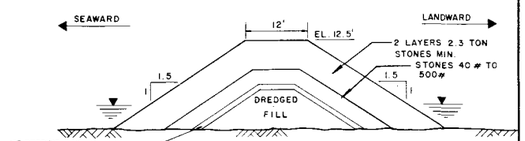

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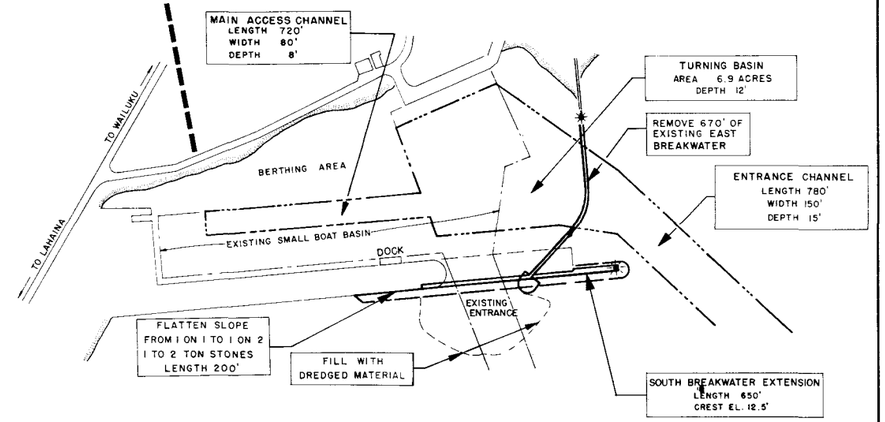


MAALAEA HARBOR

200 0 200 400
SCALE IN FEET

LEGEND

- COASTLINE
- EXISTING STRUCTURES AND ROADS
- NEW OR MODIFIED HARBOR STRUCTURES
- TOE OF STRUCTURES
- CHANNEL PROJECT LIMITS
- RECOMMENDED FEDERAL PROJECT FEATURES IDENTIFIED IN BOXES
- RECOMMENDED NAVIGATIONAL AIDS

COASTS OF HAWAIIAN ISLANDS HAWAII

REPORT ON SURVEY OF HARBORS FOR LIGHT-DRAFT VESSELS

GENERAL PLANS (ISLANDS OF KAUAI AND MAUI)

U. S. ARMY ENGINEER DISTRICT, HONOLULU

SUBMITTED	APPROVAL RECOMMENDED	APPROVED
CHIEF, CIVIL WORKS BRANCH	CHIEF, ENGINEERING DIVISION	COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN: G.Y.
TRACED:
CHECKED: JCVK

TO ACCOMPANY REPORT DATED: 30 JUNE 1967

FILE NO. RH-42/100.1

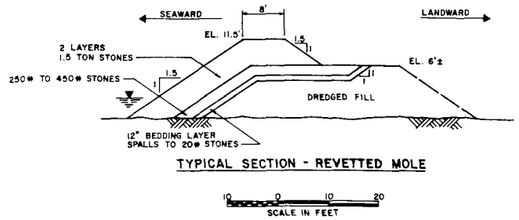
PLATE 2

96-455 O-68 (Face blank p. 80) No. 1

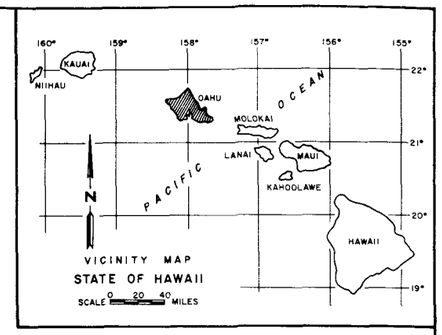
CORPS OF ENGINEERS

U. S. ARMY

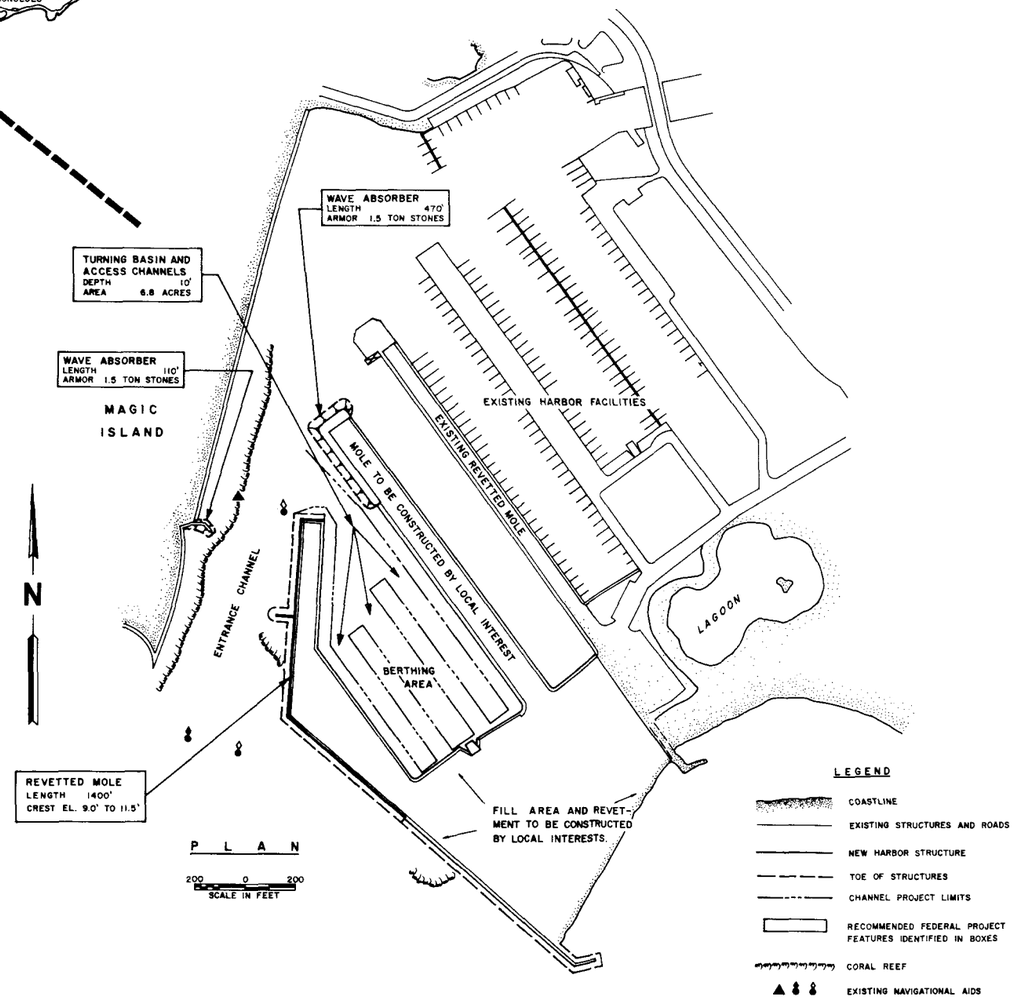
LOCATION MAP
ISLAND OF OAHU
0 2 4 6 8
SCALE IN MILES



TYPICAL SECTION - REVETTED MOLE



VICINITY MAP
STATE OF HAWAII



P L A N

200 0 200
SCALE IN FEET

LEGEND

- COASTLINE
- EXISTING STRUCTURES AND ROADS
- NEW HARBOR STRUCTURE
- TOE OF STRUCTURES
- CHANNEL PROJECT LIMITS
- RECOMMENDED FEDERAL PROJECT FEATURES IDENTIFIED IN BOXES
- CORAL REEF
- EXISTING NAVIGATIONAL AIDS

COASTS OF THE HAWAIIAN ISLANDS — OAHU, HAWAII

REPORT ON SURVEY OF
HARBORS FOR LIGHT-DRAFT VESSELS

ALA WAI HARBOR, OAHU
GENERAL PLAN

U. S. ARMY ENGINEER DISTRICT, HONOLULU

SUBMITTED:	RECOMMENDED:	APPROVED:
CHIEF, CIVIL WORKS BRANCH	CHIEF, ENGINEERING DIVISION	COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

DRAWN:
TRACED:
CHECKED HHK

TO ACCOMPANY REPORT
DATED: 30 JUNE 1967

FILE NO.
RH-42/100.2

PLATE 3

96-455 O-68 (Face blank p. 80) No. 2