

KAHULUI HARBOR, HAWAII

LETTER

FROM

THE SECRETARY OF WAR

TRANSMITTING

A REPORT FROM THE CHIEF OF ENGINEERS ON PRELIMINARY
EXAMINATION AND SURVEY OF KAHULUI HARBOR, HAWAII

JANUARY 30, 1926.—Referred to the Committee on Rivers and Harbors and
ordered to be printed, with illustration

WAR DEPARTMENT,
Washington, January 29, 1926.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

MY DEAR MR. SPEAKER: I am transmitting herewith a report, dated the 26th instant, from the Chief of Engineers, United States Army, on preliminary examination and survey, respectively, of Kahului Harbor, Hawaii, authorized by the river and harbor act approved September 22, 1922, together with accompanying papers and map.

Sincerely yours,

DWIGHT F. DAVIS,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, January 26, 1926.

Subject: Preliminary examination and survey of Kahului Harbor, Hawaii.

To: The Secretary of War.

1. I submit, for transmission to Congress, my report on preliminary examination and survey of Kahului Harbor, Hawaii, authorized by the river and harbor act approved September 22, 1922, together with accompanying papers and map.

2. Kahului Harbor is the principal port of the island of Maui. It has been improved by the United States under a project providing for two converging breakwaters, and for dredging an area in the lee of the east breakwater to a depth of 35 feet at mean lower low water. The distance between the ends of the breakwaters is 1,600 feet. Range of tide between mean lower low water and mean higher high water is 2.4 feet. Request is made for extension of the breakwaters and for additional deep water in the harbor.

3. Maui is the second largest island of the Hawaiian group. Its present population is estimated at 43,500. The principal products of the island are sugar and pineapples, the production of which is considerable and is increasing. Most of the island's commerce is handled through Kahului, which is the only improved port. Its traffic for the ten years previous to 1924 averaged 230,000 tons. In 1924 it was 304,000 tons, and estimates for 1925 indicate a further increase. Of the 1924 commerce, 90 per cent was trans-Pacific, the remainder being interisland.

4. Local interests and the Territorial Government have spent to date \$1,290,000 for dredging in the harbor, for breakwater work undertaken before the commencement of Federal improvement, and for terminals. Terminal facilities include one thoroughly modern wharf with railroad connections, transit sheds and mechanical handling facilities. The territory has appropriated \$600,000 for another terminal unit, and plans have been made for further work at an additional cost of \$750,000.

5. The area of the harbor, and the distance from the entrance to the terminals are very limited. The harbor entrance faces north from which direction at certain seasons heavy seas enter the harbor, and create considerable disturbance within, making it difficult to maneuver vessels. When, in 1910, the investigation was made which resulted in the construction of the present east breakwater, the Board of Engineers for Rivers and Harbors expressed the belief that further extension of the breakwater would probably be desirable, but preferred in the interest of economy to build it only to the present point, additional work to be postponed until experience had demonstrated its necessity. The west breakwater was subsequently built with its end opposite that of the east breakwater.

6. During the winter of 1924-25 the district engineer kept a careful record of conditions in the harbor. He reports that the weather was more favorable than is usual at that season, but that nevertheless there were a number of cases where steamers were unable to enter the harbor, or could not remain moored to the territorial wharf or make use of the handling facilities, or where a dredge operating in the harbor was damaged or unable to work. These conditions were directly attributable to wave action caused by the excessive width of the opening between the ends of the breakwaters. It is estimated that the losses during the winter arising from this cause were \$40,000, exclusive of indirect losses resulting from the lack of safety and facility in handling shipping.

7. The district engineer points out that each of the four principal islands of the Hawaiian group has one harbor improved at Federal expense. The expenditure which the United States has made, or to which it is committed, by the existing project at Kahului is \$783,000. At the harbors of Hilo, Honolulu, and Nawiliwili, on the other three

major islands, the corresponding figures vary from \$2,144,000 to \$3,808,000. The expenditures at Kahului have thus been far less than those at the major harbors for the other three large islands, in spite of the fact that weather conditions at Kahului are peculiarly unfavorable, and that its commerce is practically equal to that of Hilo and much greater than that of any other Hawaiian port except Honolulu. The district engineer believes that further improvement is justified. He considers three alternative plans for further improvement. The one he prefers is an extension of the breakwaters along their present axes so as to leave an entrance channel 600 feet wide; together with an increase of the dredged area within the harbor, as shown on the attached map, to facilitate the maneuvering of vessels and provide additional anchorage which is much needed when no berthing space is available. The estimated cost of the work is \$1,270,000, with \$10,000 annually for maintenance. The division engineer concurs.

8. These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith agreeing with the district and division engineers.

9. After due consideration of the above-mentioned reports I concur in the views of the district and division engineers and the Board of Engineers for Rivers and Harbors. It is considered proper that the United States should furnish an adequate harbor, suitably protected, at each of the major islands of the Hawaiian group. This policy has been followed in the case of the islands of Hawaii, Oahu, and Kauai. In the case of Maui, it was deemed advisable to undertake initially an improvement on a rather limited scale, which it was hoped might prove adequate for the needs of commerce, though doubt was expressed at the time by the Department as to whether this would prove to be the case. Subsequent developments have clearly shown that an extension of the breakwaters is necessary to provide a safe and adequate harbor. The cost of doing this, added to expenditures already authorized, will still leave the total cost to the United States of the Kahului improvement less than that of the other ports in question; and the existing and prospective commerce, and the benefits which will result to this commerce, amply justify the work. I therefore report that modification of the project for the improvement of Kahului Harbor, Hawaii, is deemed advisable by extension of the breakwaters along their present axes so as to leave a clear opening 600 feet at the entrance, and by dredging to a depth of 35 feet at mean lower low water within the area ABCDE shown on the attached map, in general as proposed by the district engineer, at an estimated cost of \$1,270,000, with \$10,000 annually for maintenance. The initial appropriation should be \$400,000 followed by two annual appropriations of approximately equal amounts.

Very truly yours,

H. TAYLOR,
Major General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

SYLLABUS

The Board of Engineers for Rivers and Harbors concurs with the district and division engineers in recommending modification of the existing project so as to provide for extending both breakwaters along their present axes, leaving an entrance 600 feet wide, and for dredging within the area ABCDE to a depth of 35 feet at mean lower low water, substantially as proposed by the district engineer, at an estimated cost of \$1,270,000, with \$10,000 annually for maintenance. The initial appropriation should be \$400,000.

[Third indorsement]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., December 22, 1925.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. The following is in review of the reports on preliminary examination and survey of Kahului Harbor, Hawaii, authorized by the river and harbor act approved September 22, 1922.

2. Kahului Harbor is on the northern shore of the island of Maui, one of the Hawaiian Islands. It is situated at the head of a broad bay or indentation in the coast line, and in its original state was practically without protection from the northern quadrant. It is under improvement by the United States in accordance with a project providing for two breakwaters, and for dredging to a depth of 35 feet at mean lower low water a basin approximately 900 feet wide in the lee of the east breakwater. A portion of the east breakwater was constructed by local interests; it has since been extended, and the west breakwater built, by the Government. The two breakwaters converge toward the entrance at an angle of about 120°, their outer extremities being on an approximate east and west line and about 1,600 feet apart. The range of tide between mean lower low water and mean higher high water is 2.4 feet. Local interests request further protection by extension of the breakwaters, and the provision of additional deep water area within the harbor for the maneuvering of ships.

3. Maui is the second largest island of the Hawaiian group, with an area of 728 square miles, and a population of about 37,000 in 1920 and estimated to be about 43,300 in 1925. The principal products are sugar and pineapples. The sugar crop remained generally stable over a number of years, with some decrease around 1921, due to generally depressed business conditions and to the fall in the price of sugar. It has recently materially increased, largely on account of greater economy in production. In the production of pineapples Maui ranks among the Hawaiian Islands second to, though much behind, Oahu. There has been a rapid increase in this industry in recent years; the 1924 production was the largest of record, and that of 1925 will probably be materially greater. The total acreage of pineapples is about 14,000, and projects now under way will involve an increase of over 100 per cent, all in territory tributary to Kahului.

4. Kahului is the only improved port on the island. Its commerce from 1914 to 1923 averaged about 230,000 tons. In 1924 it increased to 304,000, and a conservative estimate for 1925, based on statistics for the first nine months, is 335,000. Of the 1924 commerce, 273,000

tons, or 90 per cent, were trans-Pacific, the remainder being inter-island. The principal shipments were 140,000 tons of sugar and molasses and 18,000 tons of canned pineapples. The receipts were of a varied character, the largest items being petroleum products, lumber, hay and feeds, rice, metal manufactures, and fertilizers.

5. Other ports of the island are open roadsteads. The only important one is Kaanapali on the west coast, which serves one of the large plantations and in 1924 had a commerce of 70,000 tons. Two other ports, for which records are available, handled a total of 7,000 tons.

6. The greater part of the producing area of the island is naturally tributary to Kahului. At this port, local interests and the Territory have spent \$1,290,000 for dredging, for breakwater work undertaken before the commencement of the Federal improvement, and for terminals. The Territory has appropriated \$600,000 for additional terminal improvements, and is planning further work which it is estimated will cost another \$750,000. The work thus far done includes the provision of a thoroughly modern wharf near the base of the east breakwater with rail and highway approaches and suitable transit and storage facilities. An additional unit is projected. A pier, known as the Claudine Wharf, also under territorial control, extends from the shore somewhat farther to the west; this is used for interisland traffic.

7. In House Document No. 593, Sixty-first Congress, second session, dated 1910, which recommended the extension of the east breakwater, the district engineer proposed that it be carried to a point designated as "K," about 600 feet beyond its present end at the shoal known as American Girl Rock. The board expressed the belief that this extension would probably be desirable, but in the interests of economy recommended that for the present the breakwater be not carried beyond American Girl Rock, further work to be postponed until experience had demonstrated its necessity. This recommendation was adopted by Congress. The west breakwater, when subsequently constructed, was so sited as to have its outer end approximately opposite the outer end of the east breakwater.

8. The district engineer states that experience has now shown the inadequacy of the present structures. Large waves approach the harbor from two principal directions, northeast and north. The east breakwater is a reasonably adequate protection against the former. The heavy seas from the north, however, which are particularly prevalent from November to March, enter the harbor by the wide opening between the breakwaters and cause very disturbed conditions within. Until the construction of the new territorial wharf, it was necessary for all large vessels to anchor or moor in the harbor and lighter their goods ashore, as they could not tie up at existing terminals. The new wharf provides facilities for vessels to come alongside for loading or unloading; but the severity of wave action frequently makes this unsafe, and until conditions are corrected it will still be necessary, for much of the time, for vessels to moor at a distance from the wharf and handle goods at a large additional expense. During the winter of 1924-25 the district engineer had a careful record kept of conditions in the harbor. It appears that, while the weather was more favorable than usual, there were a number of cases where steamers were unable to enter, or carried away their

lines and could not remain moored to the Territorial wharf, or were unable to use the mechanical handling facilities, or where a dredge was damaged or unable to work. The district engineer estimates the losses during this winter caused by the wave conditions in the harbor at \$40,000. Of this, \$14,000 is given as the loss to the community due to the suspension of monthly calls by the tourist steamship *City of Los Angeles*. The remainder is from delays to trans-Pacific ships, loss of tolls to the Territory, and delays and damages to wharf structures and to the dredge. In addition to these direct losses, there are indirect losses that inevitably result from lack of safety and facility in handling shipping.

9. The four major islands of the Hawaiian group each has one harbor under Federal improvement. Expenditures on these harbors by the United States, including work completed or authorized by Congress, are in round numbers as follows:

Harbor	Island	Expenditure
Hilo.....	Hawaii.....	\$3,808,000
Honolulu.....	Oahu.....	2,693,000
Nawiliwili.....	Kauai.....	2,144,000
Kahului.....	Maui.....	783,000

Of the four harbors in question, Honolulu is situated on the southern or leeward side of its island and is naturally protected. Nawiliwili and Hilo have projects which, when completed, will give adequate protection. Kahului, which is one of the two most exposed, is the only one which does not possess suitable protection. Its 1924 commerce, though much less than that of Honolulu, was only 5 per cent less than that of Hilo, and was much greater than that of Nawiliwili or any other Hawaiian port. The 1924 trans-Pacific movements were greater than those of Hilo or of any other Hawaiian port except Honolulu.

10. Under these conditions, the district engineer believes that the harbor is entitled to additional breakwater protection. The minimum width of entrance consistent with the safety of vessels is in his opinion 600 feet, and for the reduction of wave effect an entrance no wider than this should exist. It could be provided (1) by extension of both breakwaters along the line joining their present ends, (2) by extension of both along their present axes, or (3) by the extension of the east breakwater a greater distance so as to overlap the west breakwater. The third plan would probably give the maximum protection against waves, but would make it necessary for vessels to approach too near shoal water outside the harbor beyond the west breakwater, and is therefore undesirable. The first plan would cost \$772,000, against \$944,000 for the second. Nevertheless the district engineer prefers the second. He points out that the heavy seas come direct from the north, and that the stability of the breakwaters will be increased, and maintenance cost reduced, if the waves strike them at an angle instead of normal to them. Moreover, the second plan would move the entrance 400 feet farther out, which would assist in reducing the wave disturbance at the wharves, and would

moreover materially increase the limited distance within which an outgoing ship can get under way before passing into the open sea.

11. The district engineer proposes a modification of the dredging project so as to provide 35 feet to the line ABCDE on the attached map. This he considers necessary to permit the safe maneuvering of large ships to and from the Territorial Wharf, to obviate the danger of their grounding on the shoals in the western part of the harbor, to prevent the necessity of their making a sharp turn as they enter the harbor, to give room for ships to anchor within the harbor in an emergency and when no berthing space is available, and to facilitate approach to the additional terminal developments projected by the Territory in the vicinity and to the east of Claudine Wharf. The estimated cost of dredging is \$326,000, which, with \$944,000 for the breakwaters, gives a total cost for the proposed work of \$1,270,000, with \$10,000 annually for maintenance. The district engineer recommends modification of the project along these lines, with an initial appropriation of \$400,000; authority for a continuing contract to complete the breakwaters, and another to complete the dredging; and authority to use funds for the purchase of dredging equipment if favorable bids for dredging are not received. The division engineer concurs.

12. Maui is one of the most important islands of the Hawaiian group. Its only satisfactory means of communication with the outside world is by the harbor of Kahului, through which it ships large quantities of sugar, molasses, and pineapples and receives supplies not produced on the island. Numerous vessels visit the harbor annually, including some of the largest engaged in trans-Pacific trade. The Kahului Railroad Co., which originally undertook the improvement of the harbor and constructed the first part of the east breakwater, has expended to date \$357,000 on harbor improvements. The Territory has already spent over \$900,000 on its new wharf and some dredging, and contemplates further expenditure of \$1,350,000. The terminal facilities which it has provided and proposes to provide are modern in design and equipment. It is proper that the Federal Government should furnish adequate protective works and a suitable channel. This has been done in the case of the other three major islands of the Hawaiian group, but has not been satisfactorily provided for in the case of Maui. Federal expenditures on the harbors selected for improvement at these other islands are far in excess of those on Kahului, and the total which would be expended at Kahului, including the work now proposed by the district engineer, would still be less than that thus far spent or approved for expenditure at any of the other three ports. As stated above, the War Department, when reporting in 1910 on the east breakwater, believed it probable that further protection would later be required. The necessity for this has been shown to exist, not only by the testimony of local interests but by the detailed investigations of the district engineer during the winter of 1924-25, which demonstrate clearly that the present partially unprotected condition of the harbor results in large direct and indirect losses to public and private interests. The work proposed by the district engineer represents the minimum which can be counted on to provide adequate protection and suitable navigation facilities. The board therefore concurs with the district and division engineers, and rec-

ommends that the existing project for Kahului Harbor, Hawaii, be modified so as to provide for extension of the east and west breakwaters along their present axes, leaving an entrance 600 feet wide, and dredging in the harbor within the area ABCDE, to a depth of 35 feet at mean lower low water, in general as proposed by the district engineer, at an estimated cost of \$1,270,000, with \$10,000 annually for maintenance. The initial appropriation should be \$400,000.

13. In compliance with law, the board reports that there are no questions of terminal facilities, waterpower, or other subject so related to the project proposed that they may be coordinated therewith to lessen the cost and compensate the Government for expenditures made in the interests of navigation.

For the board:

HERBERT DEAKYNE,
Colonel, Corps of Engineers, Senior Member Present.

PRELIMINARY EXAMINATION OF KAHULUI HARBOR, HAWAII

SYLLABUS

The district engineer considers the harbor worthy of further improvement, and recommends that a survey be made to determine the cost of extending the east breakwater and of increasing the width of the dredged basin.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Honolulu, Hawaii, December 22, 1922.

Subject: Preliminary Examination of Kahului Harbor, Hawaii.

To: The Chief of Engineers, United States Army
(Through the Division Engineer).

1. The following report of the preliminary examination of Kahului Harbor, Hawaii, is submitted in accordance with instructions from the Chief of Engineers in letter dated October 5, 1922.¹ This examination was provided for in section 12 of the river and harbor act approved September 22, 1922, which reads, in part, as follows:

SEC. 12. That the Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following localities, and a sufficient sum to pay the cost thereof may be allotted from appropriations heretofore made, or to be hereafter made, for examinations, surveys, and contingencies for rivers and harbors:

* * * * *

Kahului Harbor, Hawaii.

2. Kahului Harbor is located on the northern coast of the island of Maui, which has an area of 728 square miles, and is the second largest island of the Hawaiian group. Its greatest length is about 47 miles from northwest to southeast. The greatest width across Maui is about 25 miles, and the least width is about $6\frac{1}{2}$ miles. The island contains seven sugar plantations, some of which are the largest and most productive on the islands. One of these plantations, Hawaiian Commercial, in 1921, harvested 48,500 tons of sugar valued at \$2,885,743.12. Large cattle ranches exist on the upper slopes of the

¹Not printed.

mountains, while sugar cane and pineapples are cultivated on the lower levels. Taro, rice, potatoes, and corn to a small extent are also grown on the island. The principal fruits are the mango, lime, guava, papaia, avocado pear, fig, grape, and orange. Good roads exist connecting all of the plantations on the island.

3. Maalaea Bay, on the south side of the island, is the largest bay and is the only natural deep harbor. It is protected by the island from the prevailing northeast trade winds, but has no protection from the infrequent southern hurricanes, locally called "konas." It has a small wharf constructed by the Territory, but is little used.

4. There are no adjacent or competitive ports, although there are landings at Lahaina and Hana which are used for interisland traffic. The distance from Honolulu to Lahaina, the nearest landing on Maui, is 72 miles. This landing is used mainly for passengers traveling on interisland boats and is on the opposite side of the island from Kahului. Passengers and freight are landed here by means of row-boats. The Territorial Board of Harbor Commissioners, in their last annual report, state that they propose to dismantle this wharf, as a new concrete wharf has been recently constructed at Mala Bay, about 2 miles distant. Mala Bay wharf is of concrete, built by the Territory at a cost of \$204,830.90, and is open to all on equal terms. Sugar from Pioneer plantation and pineapples from this side of the island are shipped from this port. The United States Government has made no improvements here, and there is no protection from storms. Another small wharf has been built by the Territory at Hana at the northeast end of the island. Interisland boats take freight and passengers from this landing. The freight consists mainly of sugar from one plantation.

5. Kahului Harbor is the only harbor on the island that has been improved by the United States Government. It is about 94 miles, by water, S. 18° E. from Honolulu and about 100 miles by water, N. 40° W. from Hilo. It is an inlet dredged in a coral reef and protected by two breakwaters, which inclose a water area nearly rectangular in shape and approximately 3,500 feet by 3,700 feet in dimension. Located on its shore is the town of Kahului, the terminus of Kahului Railroad and the principal shipping port of the island. Wailuku, situated at the mouth of Iao Valley, is the leading town and is connected by rail with Kahului, 4 miles distant.

6. Maui, like the other islands of the Hawaiian group, is girdled with living coral reefs closing the entrances to bays, except where fresh water enters and restricts the growth of coral. At Kahului the usual coral conditions existed and a small stream entered the sea, restricting coral growth at its mouth and forming a small bay. To the eastward of the harbor, a continuous coral reef extends more than one-half mile from the shore. Originally this small bay, or rather deep bight in the coral reef, was protected by the shape of the shore against winds from all directions except within an azimuth angle of about 90° from a little to the west of north to a little to the north of east. It was also partially protected by the reefs extending out on either side. Being on the north side of the island, the harbor was not affected by the hurricane winds from the south, but was exposed to the prevailing northeast trade winds. The most severe conditions exist when huge rollers enter the harbor from the north,

not necessarily accompanied by strong winds. The mean range of tide is only 2.4 feet and the extreme range, under normal conditions, is 3.4 feet.

7. The Hawaiian Commercial & Sugar Co., producing the most sugar of any plantation in the Hawaiian Islands, together with the Kahului Railroad (this railroad is owned by the Hawaiian Commercial & Sugar Co.), owns all the land surrounding Kahului Harbor, except that the Territory owns all shore land in the Territory between high and low water.

8. In order to ship the sugar of the Hawaiian Commercial & Sugar Co., the Kahului Railroad Co. started the improvement of Kahului Harbor at its own expense and expended \$164,908 in constructing a breakwater and enlarging the bay by dredging.

9. The breakwater was 1,800 feet long and was built upon a coral flat, over which there was from 3 to 6 feet of water. Part of the core of the breakwater was of coral dredged from the harbor but the slopes were rip-rapped with boulders cleared from the sugar fields. The outer portion was built of boulders. Some time after its construction, more than 100 feet of the outer end was carried away by a storm and was rebuilt with a concrete core 125 feet long, 4 feet wide, and extending downward to the coral rock. At the outer end, an arrow-shaped pierhead was constructed of monolithic concrete, estimated to weigh 300 tons. During the first severe storm, this was carried away and the United States Government was requested to take over the improvement of the harbor.

10. A preliminary examination and survey of the harbor was made in 1909 and published in House Document No. 593, Sixty-first Congress, second session.

11. The district engineer prepared four different projects for the improvement of the harbor covering breakwaters, dredging, and an inland harbor.

12. Act of June 25, 1910, adopted a project for extending the existing breakwater and widening and deepening the basin undertaken by the Kahului Railroad Co. This project has been completed. The breakwater was completed in 1913 and has a length of 2,200 feet. The dredged basin was completed in 1919. It has an average width of 900 feet, and a minimum depth of 35 feet, mean lower low water.

13. About 2,000 yards north of the harbor, on the west shore, the Iao stream enters the ocean. The banks of this stream near its mouth are composed of sand, are high and unstable. During the greater part of the year this stream is practically dry, the upper waters being conserved for irrigation. It, therefore, ordinarily carries no sediment. During freshets, however, the sandy banks are undermined, and a great deal of material is carried into the sea, causing a discoloration of the water for some distance from the mouth. A littoral current carried this material along the west coast and thence into the dredged basin, tending to restore original conditions existing before dredging operations began. To remedy this condition the river and harbor act of July 25, 1912, provided:

That the Secretary of War is authorized and directed to report to Congress as to the advisability of providing for the west breakwater referred to under project numbered two in House Document numbered five hundred and ninety-three, Sixty-first Congress, second session.

In accordance with the above act, a preliminary examination and survey was made in 1912 and is published in House Document No. 1330, Sixty-second Congress, third session.

14. Act of July 27, 1916, adopted the project as recommended in the above House document and provided for a breakwater from the west shore having a length of 2,000 feet at an estimated cost of \$250,000. This project was completed in 1919 and the breakwater has a length of 1,950 feet. It not only has had the desired effect of diverting the littoral current so as not to carry the material from Iao stream into the dredged basin, but has also diminished the currents in the harbor that so seriously interfered with the shipping. The district engineer stated in his report that, "if this amount were capitalized at 4 per cent, the interest would be \$10,000 per annum. The saving in dredging effected by the breakwater would much more than counterbalance this. For this reason, if for no other, the construction of the breakwater is recommended."

15. The existing project for the improvement of this harbor has been completed, and on June 30, 1922, \$1,558,623.25 had been expended for new work and \$74,573.74 for maintenance.

16. When Congress adopted the first project, it required the Kahului Railroad Co. to cede to the United States, free of cost all its rights in the breakwater and make no claim for reimbursement for work done by it in constructing the breakwater or in improving the harbor; the conditions also required that a public street of proper width, giving access to the wharf, be provided. These conditions have been complied with.

17. There is one wharf owned and operated by the Kahului Railroad Co. This wharf was constructed under an agreement with the Territory which contains the following clause:

The Territory may at any time, upon six months' notice to the company, given by the superintendent (territorial superintendent of public works) in writing, take over the wharf and wharf shed, and shall, within 30 days thereafter, pay to the company the value of the wharf and wharf shed, not exceeding, however, the original cost thereof, as agreed between the superintendent and the company, or as determined by a majority of three appraisers, one appointed by the superintendent, one by the company, and the third by the two so appointed.

The rates are fixed by the Territorial board of harbor commissioners and the wharf is open to all on equal terms. Boats requiring no more than 25 feet of water use this wharf, but the larger boats anchor in the dredged basin, in the lee of the east breakwater, and lighter the freight and passengers.

18. The Territory is now constructing a wharf, with latest mechanical conveyances, at the shore end of the east breakwater. The contract for this wharf, including dredging, amounts to \$528,382. It is to be of reinforced concrete construction throughout, with a structural steel and concrete shed. The wharf will be approximately 500 feet long, 166 feet wide, and will have a combined general merchandise and sugar storage shed 375 feet by 135 feet in dimension.

19. The Territory has recently dredged 106,000 cubic yards in front of this wharf and inside of the pierhead line, at a cost of \$79,500. This will enable the wharf to accommodate boats requiring 35 feet of water. The maximum draft of boats now calling at this port is 31 feet 6 inches. The Territorial harbor commissioners are

now planning an extension to this wharf. It will be open to all on equal terms.

20. The following expenditures for the improvement of the harbor have been made in addition to funds appropriated by Congress:

Kahului Railroad Co.

Previous to adoption of project:	
For breakwater construction.....	\$37, 644. 65
For harbor dredging.....	79, 222. 97
For moorings and buoys.....	48, 041. 20
	164, 908. 82
Since adoption of project:	
Wharf and improvements.....	155, 875. 96
For moorings and buoys.....	36, 039. 53
	356, 824. 31

Territory

Dredging.....	\$96, 967. 96
Other improvements.....	17, 519. 96
Contract for wharf under construction.....	448, 882. 00
	563, 369. 92

21. Kahului Harbor now has two breakwaters, almost at right angles, with an entrance between the ends of the breakwaters of approximately 1,600 feet. The area inclosed by the breakwaters is approximately 180 acres, in which a basin having an area of approximately 31 acres has been dredged by the United States Government, to a depth of 35 feet below mean lower low water. The Territory has also dredged, to the same depth, approximately 4 acres inside of the pierhead line for accommodating boats at the new wharf now under construction.

22. The dredging of the basin by the United States was completed in 1919. Since that date some shoaling has occurred in the western part of the basin, the 35-foot depth contour having receded about 300 feet as shown on the accompanying map.¹ The east breakwater is in good condition. The west breakwater has lost some of the stones near the outer end which have been carried away by storms.

23. At the present time the large boats anchor in the lee of the east breakwater about halfway between the pierhead line and end of the breakwater. Gasoline, fuel oil, and molasses are pumped between the boats and shore and the freight and passengers are lightered. The Kahului Railroad connects the wharves with the big sugar plantations and pineapple fields on this side of the island. While this railroad owns only 18.87 miles of track, it connects with 51.5 miles of the Hawaiian Commercial & Sugar Co. plantation, 30 miles of the Maui Agricultural Co. plantation, and several miles of the Wailuku plantation.

24. Before the west breakwater was constructed, boats had difficulty at their anchorages as an offshore current affected the sterns and the prevailing on-shore winds affected the bows in an opposite direction. The west breakwater has greatly improved this condition but it is still necessary to have anchoring lines extending practically across the dredged basin which interfere with the passage of

¹ Not printed.

boats to the wharf. This basin should be widened for the economical maneuvering of the large ocean-going vessels especially in connection with the use of the new wharf.

25. The territory tributary to Kahului Harbor includes the rich cane and pineapple lands of the central part of the island which extend from the north to the south shore. Approximately two-thirds of the commerce of the island is through the port of Kahului.

26. The east breakwater affords partial protection from the ordinary northeast trade winds, but the harbor has very little protection from the north as is evident from the opening between the breakwaters as shown on the accompanying map. On account of the direction of the east breakwater any increase in length will give additional protection from both the northeast and a more northerly direction.

27. In recommending the present length the Chief of Engineers stated, "with the understanding that the limited project recommended is tentative in character and that extension of the jetty to full length as proposed by the district officer and at the cost estimated by him may be necessary in the future to properly protect the harbor."

28. Referring to House Document No. 593, Sixty-first Congress, second session, page 27, the Board of Engineers for Rivers and Harbors states:

The district officer discusses in considerable detail the question of the extension of the breakwater, and concludes, for reasons given, that its extension to American Girl Rock would give comparatively little increased protection and that it should be carried at least to "K." Local and navigation interests are of the opinion that sufficient protection will be afforded if the extension were carried to American Girl Rock. While the board is inclined to concur in the views of the district officer, it is obvious that it would be in the interest of economy to postpone the construction beyond American Girl Rock, which is very expensive, until experience has demonstrated its necessity.

The breakwater has been constructed to the American Girl Rock referred to above, and it is now apparent that the extension is essential.

29. In 1908, before the improvement was undertaken by the United States Government, the total tonnage handled at Kahului amounted to 140,126 tons, valued at approximately \$10,000,000. In 1921, the value of the commerce at this port exceeded \$20,000,000. Since 1909 the pineapple industry has increased from 69,047 cases to 875,983 cases in 1921, valued at approximately \$3,500,000, of which 780,289 cases, valued at \$2,955,081.41, were shipped through Kahului. It is expected that the pineapple industry will continue to expand. Approximately two-thirds of the commerce of the island passes through Kahului. From July 1, 1921, to June 30, 1922, 68 trans-Pacific boats, having a gross tonnage of 463,782 tons, visited this port in addition to the interisland traffic.

30. Approximately one-third of the entire area of the island is owned by the Territory. The assessed valuation of the other two-thirds has increased from \$24,385,130 in 1909 to \$47,513,872 in 1920.

31. Comparative statement of traffic, Kahului Harbor, 1921:

Year	Short tons	Value	Passengers
1915.....	254,975	\$18,311,484	9,844
1916.....	247,159	21,291,046	9,007
1917.....	243,441	21,656,117	10,843
1918.....	232,835	27,829,517	12,183
1919.....	242,943	32,116,437	12,734
1920.....	228,286	37,257,112	17,860
1921.....	177,620	20,613,558	20,201
		Short tons	Value
Trans-Pacific.....		149,499	\$15,420,456
Interisland.....		28,121	5,193,102
		177,620	20,613,558

32. Résumé for the Port of Kahului, 1921:

Number and tonnage of vessels entering and clearing during the year

Class	Domestic	Foreign	Total	Net registered tonnage
TRANS-PACIFIC				
Inward:				
Steam.....	71	1	72	312,738
Sail.....	1		1	1,502
Total.....	72	1	73	314,240
Outward:				
Steam.....	71	1	72	312,738
Sail.....	1		1	1,502
Total.....	72	1	73	314,240
Total in and out.....	144	2	146	628,480
INTERISLAND				
Inward.....			168	121,849
Outward.....			170	123,641
Total inward and outward.....			338	245,490

Draft of vessels entering and clearing during the year

Trans-Pacific vessels:	No.	21 feet.....	No.	12
30 feet.....	6	20 feet.....		4
29 feet.....	2	Less than 20 feet.....		32
28 feet.....	2			
27 feet.....	16			146
26 feet.....	10	Interisland vessels: All less than		
25 feet.....	6	20 feet.....		338
24 feet.....	20			
23 feet.....	22	Total.....		484
22 feet.....	14			

33. It is believed that the present and prospective commerce would justify a survey and estimate of cost for determining a project for further improvement, to include the extension of the east break-water and increasing the width of the dredged basin, as the protection is not sufficient at the present time for the economical handling of freight in the harbor and apparently the width of the dredged basin is not sufficient for the maneuvering of boats.

34. There will be no water power development or land reclamation involved and it is not believed that any local cooperation should be required.

W. A. JOHNSON,
*Major, Corps of Engineers,
District Engineer.*

[First Indorsement]

OFFICE DIVISION ENGINEER, PACIFIC DIVISION,
San Francisco, Calif., January 16, 1923.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The improvements already made in this harbor have consisted of the construction of two breakwaters and dredging to a depth of 35 feet. The effect has been to provide an anchorage area of suitable depth, protected from the prevailing northeast trade winds.

2. The additional improvements now requested are the removal of shoals in the dredged area, the enlargement of this area, and the extension of the east breakwater. It appears that the dredged basin is subject to wave action to such an extent that mooring lines have to be used to hold vessels in place in the harbor. The presence of these lines and the comparatively narrow width of the basin make it difficult for other boats to move into or out of the harbor past those already moored.

3. The commerce of the harbor in 1908, before improvement by the United States, was 140,000 tons. By 1915 the commerce had increased to 254,000 tons, but since that date the tonnage has decreased to 177,000 tons in 1921. The reason for this decline in tonnage is not given in the report, but is doubtless due to the depression in the sugar business and the resulting decrease in general business. The pineapple industry is increasing rapidly on the island of Maui, but sugar still continues to be much the largest element in the tonnage.

4. The total expenditures on the improvement amount to \$2,718,000, those by the United States being \$1,633,000 and those by local interests \$1,085,000. The local expenditures have been borne almost equally by the territorial government and the Kahului Railroad Co. The figures given include the cost of a wharf now under construction by the territorial government, which will make a great increase in the facilities of the port.

5. The advisability of further improvement depends upon certain factors that can best be determined by a survey. The enlargement of the basin is a simple matter to be accomplished by dredging, provided the material encountered can be dredged. The increased protection of the harbor from wave action is a matter for study. The direction from which protection is most needed is the north. Study should be given to the question of whether this additional protection can be secured most satisfactorily and economically by extending the east breakwater or the west breakwater or both. The commerce of the harbor should receive further study to determine whether the decline in tonnage is likely to continue or whether an increase may now be expected.

6. I am of the opinion that Kahului Harbor is worthy of further improvement and concur with the district engineer in recommending a survey.

HERBERT DEAKYNE,
Colonel, Corps of Engineers, Division Engineer.

[Third indorsement]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., February 13, 1923.

To the CHIEF of ENGINEERS, UNITED STATES ARMY

1. For the reasons stated herein, the board concurs with the district and division engineers in recommending a survey to determine the extent and advisability of the improvement.

For the Board:

H. TAYLOR,
Senior Member of the Board.

SURVEY OF KAHLUI HARBOR, HAWAII

SYLLABUS

The district engineer recommends the extension of both existing breakwaters, along their present axes so as to reduce the width of the entrance from 1,600 feet to 600 feet; and the dredging of the area between the combined pierhead—bulkhead line on the northeast side of the harbor and the proposed southwestern dredging line—so as to provide a turning basin 1,400 feet in width. All dredging to be 35 feet below mean lower low water, with an allowance of 2 feet for overdepth.

Estimated cost of extending breakwaters.....	\$944, 000
Estimated cost of dredging.....	326, 000
Total.....	1, 270, 000

Annual maintenance is estimated at \$10,000.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Honolulu, Hawaii, October 28, 1925.

Subject: Survey of Kahului Harbor, island of Maui, Territory of Hawaii.

To: The Chief of Engineers, United States Army.
(Through the Division Engineer.)

1. In accordance with instructions contained in letters¹ from the Chief of Engineers, dated February 28, 1923, December 26, 1923, and November 15, 1924, the following report on the survey of Kahului Harbor, island of Maui, Territory of Hawaii, is submitted.

PRELIMINARY EXAMINATION

2. The report of the preliminary examination authorized by the river and harbor act of September 22, 1922, was submitted December 22, 1922. It contained the following data:

Description of the island of Maui.
Description of the harbor of Kahului.

¹ Not printed.

Description of other ports on Maui.
 Description of previous projects.
 Description of terminal facilities.
 Previous expenditure on improvements.
 Traffic statements.

CHARACTER OF SURVEY

3. The survey authorized as a result of the preliminary examination consisted of the following:

- (a) Surveying and compilation of map of Kahului Harbor and vicinity.
- (b) Sounding the dredged basin of the harbor, the areas adjoining it, and the entrance between the breakwaters.
- (c) Study of the island of Maui, particularly the portion tributary to Kahului, with respect to its present water-borne traffic and the possibilities for increased traffic in the future.
- (d) Investigation of previous harbor improvements at Kahului, both local and Federal.
- (e) Study of the harbor with reference to its adequacy to handle present and expected traffic safely and economically. Comparison with other Hawaiian ports.
- (f) Consideration of the most feasible and economical additional improvements that are essential to make the harbor safe and adequate.
- (g) Estimate of the cost of making such improvements.
- (h) Benefits that will result from such improvements.
- (i) Recommendations.

A detailed presentation of data under the above headings follows.

(A) AND (B) MAP AND SOUNDINGS

4. The attached map, file No. 431.35A, shows Kahului Harbor and vicinity on a scale of 1:2,000 with soundings in feet below mean lower low tide level. An inset map shows the principal features of the island of Maui on a scale of 1:380,160, and a small inset map shows the position of Maui in the Hawaiian Islands and the principal ports of these islands.

(C) THE ISLAND OF MAUI AND THE HARBOR OF KAHULUI

5. *General.*—The island of Maui, with an area of 728 square miles, is the second largest of the Hawaiian group. It is formed by two mountain masses—the extinct volcano of Haleakala, which rises fairly symmetrically to a height of 10,000 feet, and a smaller and very irregular mass known as West Maui, much older geologically than Haleakala and consequently much more extensively eroded by deep canyons. These two masses are joined by a neck of flat land about 5 miles wide rising to an elevation of only 110 feet in the 7 miles between Kahului and Maalaea Bay. This low-lying land, together with a short, steep slope of West Maui and a much longer and more gradual slope at the base of Haleakala, comprises the bulk of the productive portion of Maui. All of it is tributary to Kahului.

6. *Population.*—The population of Maui, according to the 1920 census, was 37,385, or 14.6 per cent of the population of the Territory. The estimated population in 1925 is 43,500. The population of the district of Wailuku, the principal town of the island, in which the town of Kahului is situated, was 14,941 in 1920 and the population

of the outlying districts also tributary to Kahului was 10,900, making a total of 25,841, or 69 per cent of the population of the island, that depend upon Kahului as a port. The primary industries are raw cane sugar (which is refined on the Pacific coast) and canned pineapples. Stock raising is quite extensive on the higher slopes of Haleakala, and much small farming of rice, taro, and other products is carried on.

7. *Wealth.*—The assessed valuation of property in the county of Maui (which includes the unimportant islands of Molokai, Lanai, and Kahoolawe) was \$24,385,130 in 1909 and \$52,688,561 in 1924, an increase of 116 per cent in 15 years. Maui represented in 1924, 14.8 per cent of the taxable value of the Territory, which was \$357,002,080.

8. *Production of sugar.*—Maui ranked third among the Hawaiian Islands in sugar production in 1924, being exceeded by Hawaii and Oahu. The 1924 production was 155,364 tons, or 22 per cent of the total of 701,433 tons produced in the islands. The Maui production of 155,364 tons, valued at \$17,908,886.32, came from six plantations, three of which, with a production of 113,536 tons, or 73 per cent of the total, are tributary to Kahului. One of these plantations, that of the Hawaiian Commercial & Sugar Co., is the largest producer of sugar in the Hawaiian Islands. The record of sugar production on Maui for the past 10 years is as follows:

	Tons of 2,000 pounds		Tons of 2,000 pounds
1915.....	160, 283	1921.....	115, 599
1916.....	150, 312	1922.....	123, 847
1917.....	147, 648	1923.....	113, 069
1918.....	137, 786	1924.....	155, 364
1919.....	132, 991	1925 (estimated).....	169, 100
1920.....	136, 170		

9. *Pineapple production.*—Maui ranks second among the islands in the production of pineapples. The following table shows the record for all the islands during the last 23 years in cases (about 33 cases to the ton of 2,000 pounds).

Year	Oahu	Maui	Kauai	Hawaii	Total cases
1903.....	1, 893	-----	-----	-----	1, 893
1904.....	8, 717	1, 587	-----	-----	10, 304
1905.....	40, 668	4, 373	-----	-----	45, 041
1906.....	63, 592	10, 653	-----	-----	74, 245
1907.....	142, 036	23, 597	2, 572	-----	168, 205
1908.....	282, 488	55, 224	6, 014	-----	343, 726
1909.....	326, 485	69, 047	6, 408	-----	401, 940
1910.....	363, 315	89, 146	12, 507	-----	464, 968
1911.....	601, 099	108, 677	15, 966	-----	725, 742
1912.....	1, 156, 988	125, 355	31, 000	-----	1, 313, 363
1913.....	1, 427, 100	186, 870	53, 152	-----	1, 667, 122
1914.....	1, 909, 062	293, 873	65, 846	-----	2, 268, 781
1915.....	2, 284, 619	290, 494	94, 503	-----	2, 669, 616
1916.....	2, 239, 246	259, 840	110, 397	-----	2, 609, 483
1917.....	2, 171, 655	300, 614	134, 762	-----	2, 607, 031
1918.....	3, 215, 279	441, 234	190, 802	-----	3, 847, 315
1919.....	4, 394, 374	481, 826	195, 776	-----	5, 071, 976
1920.....	5, 011, 609	764, 210	211, 163	-----	5, 986, 982
1921.....	4, 204, 404	875, 983	171, 227	10, 889	5, 262, 503
1922.....	3, 646, 011	904, 901	182, 552	36, 775	4, 770, 239
1923.....	4, 806, 625	814, 160	252, 859	22, 103	5, 896, 745
1924.....	5, 356, 968	962, 226	438, 889	67, 821	6, 825, 804
1925 (estimated).....	6, 490, 000	1, 160, 000	450, 000	125, 000	8, 225, 000

The 1924 pack was handled by three packers:

	Cases
Baldwin Packers.....	245, 789
Haiku Fruit & Packing Co.....	592, 073
Pauwela Pineapple Co.....	124, 364
Total.....	962, 226

The value of the 1924 pack was approximately \$4,233,794; three-fourths of it, produced by Haiku and Pauwela canneries, was shipped through Kahului.

The total pack is not all grown by the large plantations, but includes the production from a large number of small growers, which is sold to the canneries.

The total acreage now under pineapples is approximately 14,000. Projects now under way involve the planting of some 15,000 acres additional, all in territory tributary to Kahului.

The California Packing Corporation has recently begun the construction of a cannery in the vicinity of Kahului. This is expected to be ready in time to handle the 1926 crop.

10. *Ports other than Kahului.*—All ports on Maui except Kahului are open roadsteads, where freight is handled to and from the landing by ships' boats. The most important one is Kaanapali on the northwest coast. One of the large plantations ships its sugar and receives the bulk of its freight by trans-Pacific steamers at this port. The shipments from this port in 1924 were as follows:

	Tons	Value
Sugar.....	34, 289	\$3, 970, 220
Molasses.....	6, 130	56, 519
Canned pineapples.....	4, 458	802, 172
Total.....	44, 877	4, 828, 911

Or about one-fourth of the trans-Pacific shipments at Kahului. The receipts consisted of the following:

	Tons	Value
Lumber.....	3, 407	\$56, 583
Fertilizer.....	2, 299	109, 202
Fuel oil.....	12, 819	79, 357
Miscellaneous.....	6, 931	1, 396, 200
Total.....	25, 456	1, 631, 362

Or less than one-fourth of the trans-Pacific receipts at Kahului.

Owing to the distances, the broken and unfavorable character of the country to be traversed, and the relatively small amount of traffic, it is not expected that Kaanapali will be connected by railroad with Kahului.

Trans-Pacific steamers also handled 4,588 tons of sugar and some pineapples through the port of Hana, at the eastern point of the island, in 1924, and delivered a small amount of cargo from the Pacific coast.

Through Olowalu, on the west coast, interisland steamers handled 2,289 tons of sugar.

Lahaina, on the west coast, is a port of call for interisland passenger steamers, but the freight traffic there is inconsiderable.

Approximately four-fifths of the producing portion of Maui is tributary to Kahului and one-fifth to other ports, principally Kaanapali. No improvements have ever been made by the United States at ports other than Kahului, nor is it expected that any will be made.

11. *Growth of traffic, Kahului.*—Following is a comparative statement of the water-borne traffic in and out of Kahului, in tons of 2,000 pounds or ship tons of 40 cubic feet:

Year	Tons	Value	Year	Tons	Value
1909.....	158,400	\$10,000,000	1918.....	232,835	\$27,829,517
1910.....	194,451	12,276,043	1919.....	242,943	32,116,437
1911.....	197,399	12,404,300	1920.....	228,286	37,257,112
1912.....	217,686	14,960,503	1921 ¹	177,620	20,615,568
1913.....	229,826	10,369,361	1922.....	220,293	23,948,700
1914.....	213,667	13,255,317	1923.....	240,814	25,573,099
1915.....	254,975	18,311,484	1924.....	304,411	30,133,965
1916.....	247,159	21,293,846	1925 (estimated).....	335,000	-----
1917.....	228,853	22,594,205			

¹ A decided decrease in the price of sugar resulted in the falling off of traffic in 1921, both in tonnage and value. The recovery since that time has been due to increased economy in sugar production and to the normal growth of general business rather than to a restoration of high sugar prices.

NOTE.—Tonnage for the calendar year 1925 reached 275,000 on September 21, 1925; the estimate of 335,000 tons for the year allows 20,000 tons per month for the last 3 months against an average of 30,000 tons for the first 9 months.

Average sugar prices for the last 12 years are as follows:

Cents per pound		Cents per pound	
1913.....	3.506	1919.....	7.724
1914.....	3.814	1920.....	12.362
1915.....	4.642	1921.....	4.763
1916.....	5.786	1922.....	4.632
1917.....	6.228	1923.....	7.020
1918.....	6.447	1924.....	5.964

In view of the rapid growth of traffic during the last four years, the proposed extension of terminal facilities by the Territory, and the expected increase in pineapple production, it may reasonably be expected that the traffic of Kahului will reach 400,000 tons within a few years.

12. *Classification of Kahului traffic by routing, 1924.*—The traffic at Kahului during the calendar year 1924 was distributed as follows:

Kahului, 1924

Class	Receipts		Shipments		Total	
	Tons	Value	Tons	Value	Tons	Value
Trans-Pacific.....	111,853	\$7,610,788	160,772	\$17,866,756	272,625	\$24,877,544
Interisland.....	26,816	4,207,445	4,970	1,048,976	31,786	5,256,421
Total.....	138,669	11,218,233	165,742	18,915,732	04,411	30,133,965

Kahului traffic is 90 per cent trans-Pacific, and the port must therefore have safe and adequate berthage for the largest ships.

The figures for trans-Pacific traffic given above include foreign traffic, which is quite small; there were no foreign exports in 1924, and the imports were confined to three shipments of cement from Norway (total, 5,025 tons) and one shipment of fertilizer from Chile (1,980 tons).

13. *Classification of Kahului traffic by commodities.*—The following tables show the classification of Kahului traffic in 1924 by commodities:

Trans-Pacific traffic, domestic, 1924

Classes and commodities	Amount in short tons		Value—	
	By commodities	By classes	By commodities	By classes
RECEIPTS				
Animals and animal products, except wool and hair		144		\$185,076
Live animals	23		\$14,582	
Poultry	5		3,390	
Meat and products	40		19,360	
Leather and manufactures of	76		147,744	
Vegetable food products, oil seeds, expressed oils, and beverages		13,135		876,042
Flour	884		56,576	
Fruits	390		47,580	
Hay and feeds	7,537		287,160	
Rice	3,355		335,500	
Granulated sugar	969		149,226	
Other vegetable products, except fibers and wood		131		272,742
Tobacco and manufactures of	131		272,742	
Textiles		32		40,887
Clothing and wearing apparel	10		30,165	
Cotton and manufactures of	22		10,722	
Wood and paper		22,495		945,381
Lumber	15,136		293,241	
Shooks	2,417		36,932	
Shingles	1,302		21,535	
Posts and logs	121		2,497	
Railroad ties	309		7,416	
Wood and furniture	334		160,988	
Paper, books, stationery, etc.	2,876		422,772	
Nonmetallic minerals		55,533		961,535
Building materials, sand, etc.	126		28,224	
Cement	5,502		85,061	
Coal	89		476	
Asphalt	586		11,471	
Lime ¹	287		8,179	
Bricks	600		11,538	
Fuel oil	37,351		231,219	
Kerosene oil	1,605		70,888	
Lubricating oil	968		105,266	
Gasoline	8,096		396,304	
Distillate	223		12,909	
Ores, metals and manufactures of, except machinery and vehicles		6,010		1,223,902
Steel	86		4,644	
Tin plates	786		94,320	
Steel rails	30		1,178	
Iron and manufactures of	5,108		1,123,760	
Machinery and vehicles		1,231		537,708
Engine parts, boilers, etc.	249		72,210	
Other machinery	34		20,128	
Tractors	57		32,903	
Automobiles	891		412,467	
Chemicals		4,905		291,195
Drugs	186		53,940	
Fertilizers	4,672		222,920	
Explosives	47		14,335	
Unclassified		8,237		1,676,320
Groceries and canned goods	1,446		318,120	
Miscellaneous	6,791		1,358,200	
Total receipts		111,853		7,010,788

¹ Prices procured from local dealers. (All other prices were procured from Monthly Summary of Foreign Commerce of the United States.)

Trans-Pacific traffic, domestic, 1924—Continued

Classes and commodities	Amount in short tons—		Value—	
	By commodities	By classes	By commodities	By classes
SHIPMENTS				
Animals and animal products, except wool and hair		6		\$1, 026
Hides	6		\$1, 026	
Vegetable food products, oil seeds, expressed oils, and beverages		158, 688		17, 477, 580
Sugar	120, 644		13, 969, 007	
Molasses	19, 547		180, 223	
Canned pineapples	18, 497		3, 328, 350	
Ores, metals and manufactures of, except machinery and vehicles		150		2, 550
Scrap iron ¹	150		2, 550	
Unclassified		1, 928		385, 600
Miscellaneous	1, 928		385, 600	
Total shipments		160, 772		17, 866, 756
Total receipts and shipments		272, 625		24, 877, 544

Interisland traffic, domestic, 1924

Classes and commodities	Amount in short tons—		Value—	
	By commodities	By classes	By commodities	By classes
RECEIPTS				
Animals and animal products, except wool and hair		35		\$17, 615
Beef cattle ¹	1		\$351	
Mules	6		2, 367	
Horses	23		13, 800	
Hogs	5		1, 097	
Vegetable food products, oil seeds, expressed oils, and beverages		10		423
Rice and bran	10		423	
Wood and paper		561		10, 173
Lumber	385		7, 455	
Posts	176		2, 723	
Nonmetallic minerals		391		* 16, 523
Cement	24		371	
Coal	48		257	
Kerosene oil in cases ¹	250		12, 500	
Gasoline	69		3, 395	
Metals, ores and manufactures of, except machinery and vehicles		46		4, 177
Pipes	46		4, 177	
Machinery and vehicles		364		182, 054
Steam rollers	7		11, 276	
Sugar boilers, etc.	13		5, 642	
Tractors	25		14, 431	
Auto trucks	12		8, 050	
Automobiles	306		141, 655	
Motor cycles ¹	1		1, 000	
Chemicals		7, 248		344, 280
Fertilizers	7, 248		344, 280	
Unclassified		18, 161		3, 632, 200
Miscellaneous	18, 161		3, 632, 200	
Total receipts		26, 815		4, 207, 445

¹ Prices procured from local dealers. (All other prices were procured from Monthly Summary of Foreign Commerce of the United States.)

Interisland traffic, domestic, 1924—Continued

Classes and commodities	Amount in short tons—		Value—	
	By commodities	By classes	By commodities	By classes
SHIPMENTS				
Animals and animal products, except wool and hair.....		205		\$63,642
Beef cattle ¹	72		\$25,301	
Horses.....	27		16,200	
Hogs.....	100		21,115	
Hides.....	6		1,026	
Vegetable food products, oil seeds, expressed oils, and beverages.....		103		8,573
Fresh pineapples.....	50		2,372	
Honey.....	53		6,201	
Wood and paper.....		125		2,428
Lumber.....	125		2,428	
Nonmetallic minerals.....		41		614
Cement.....	39		603	
Coal.....	2		11	
Machinery and vehicles.....		250		124,519
Compressor, etc.....	33		19,536	
Tractors.....	24		13,854	
Auto trucks.....	6		4,025	
Automobiles.....	186		86,104	
Motor cycles ¹	1		1,000	
Unclassified.....		4,246		849,200
Miscellaneous.....	4,246		849,200	
Total shipments.....		4,970		1,048,976
Total receipts and shipments.....		31,786		5,256,421

¹ Prices procured from local dealers. (All other prices were procured from Monthly Summary of Foreign Commerce of the United States.)

It will be noted that the trans-Pacific shipments of 160,772 tons were made up almost entirely of three items, viz:

	Tons	Value
Sugar.....	120,644	\$13,969,007
Molasses.....	19,547	180,223
Canned pineapples.....	18,497	3,328,350
Total.....	158,688	17,477,580

Sugar shipments for 1925 are estimated at 126,000 tons. Canned pineapples are expected to reach 30,000 tons.

Of the trans-Pacific receipts of 111,853 tons, the largest single item was fuel oil, amounting to 37,351 tons. Coal is used very little in the Hawaiian Islands. Honolulu is the only port having coal-bunkering facilities for ships. Other important items received in 1924 were:

	Tons	Value
Hay and feeds.....	7,537	\$287,160
Rice.....	3,355	335,500
Lumber.....	15,136	293,241
Cement.....	5,502	85,061
Gasoline.....	8,096	396,304
Iron and manufactures of.....	5,108	1,128,760
Fertilizers.....	4,672	222,920
Total.....	49,406	2,748,946

Of the interisland receipts, the only large single item was fertilizer (7,248 tons, valued at \$344,280). This was imported or manufactured at Honolulu and distributed to the islands from there. The remainder was miscellaneous.

Interisland shipments were quite small (4,970 tons, valued at \$1,048,976).

A total tonnage (interisland and trans-Pacific) of 400,000 by 1930 is a reasonable expectation.

14. *Shipping at Kahului.*—Following is a list of trans-Pacific vessels arriving and departing from the port of Kahului during the calendar year 1924:

List of trans-Pacific vessels arriving and departing from the port of Kahului, Maui, January 1 to December 31, 1924

Name of vessel	Gross tons	Where from	Date of arrival	Cargo in	Date of departure	Destination
S. S. H. T. Harper	3, 803	Richmond	Jan. 5	Gasoline	Jan. 6	Honolulu.
S. S. Manukai	9, 547	Kaanapali	Jan. 6	General	Jan. 8	Hilo.
S. S. Makaweli	2, 512	Honolulu	Jan. 10	Lumber	Jan. 11	Honolulu.
S. S. Manoa	6, 085	do	Jan. 12	General	Jan. 13	Kaanapali.
S. S. Wilhelmina	6, 947	do	Jan. 25	do	Jan. 27	Honolulu.
S. S. Manoa	6, 085	do	Feb. 8	do	Feb. 10	Do.
S. S. Manukai	9, 547	Hilo	Feb. 14	Sugar	Feb. 18	San Francisco.
S. S. Frank G. Drum	7, 048	Honolulu	Feb. 20	Gasoline	Feb. 20	Hilo.
S. S. Makena	2, 532	Bellingham	do	Lumber	Feb. 23	Honolulu.
S. S. Wilhelmina	6, 947	Honolulu	Feb. 22	General	do	Do.
S. S. Makiki	6, 090	do	Mar. 1	do	Mar. 3	Hilo.
S. S. Manoa	6, 085	do	Mar. 7	do	Mar. 9	Honolulu.
S. S. Theodore Roosevelt	7, 116	do	Mar. 10	Cement	Mar. 11	Hilo.
S. S. Wilhelmina	6, 947	do	Mar. 21	General	Mar. 22	Honolulu.
S. S. Manukai	9, 547	do	Mar. 28	do	Apr. 1	Hilo.
S. S. Manoa	6, 085	do	Apr. 5	do	Apr. 6	Honolulu.
S. S. Col. E. L. Drake	4, 205	Mahukona	Apr. 7	Gasoline	Apr. 7	San Francisco.
S. S. Makena	2, 532	Bellingham	Apr. 10	Lumber	Apr. 12	Honolulu.
S. S. Makiki	6, 090	Honolulu	Apr. 15	do	Apr. 16	Hilo.
S. S. Wilhelmina	6, 947	do	Apr. 18	General	Apr. 21	Honolulu.
S. S. Mahukona	2, 512	Bellingham	Apr. 19	Lumber	Apr. 24	Do.
S. S. Makaweli	2, 512	Mahukona	Apr. 22	do	Apr. 22	Do.
S. S. Manulani	9, 556	Kaanapali	Apr. 27	General	Apr. 28	San Francisco.
S. S. Manoa	6, 085	Honolulu	May 2	do	May 3	Honolulu.
S. S. Manua Loa	6, 805	Hilo	May 5	do	May 9	Hilo.
S. S. Col. E. L. Drake	4, 205	Mahukona	May 7	Gasoline	May 7	Honolulu.
S. S. Wilmington	990	Hilo	May 9	Lumber	May 12	Do.
S. S. Manukai	9, 547	Kaanapali	May 15	General	May 16	Hilo.
S. S. Wilhelmina	6, 947	Honolulu	May 17	do	May 19	Honolulu.
S. S. Makaweli	2, 512	San Francisco	May 23	Lumber	May 23	San Francisco.
S. S. Manulani	6, 085	Honolulu	May 30	General	May 30	Honolulu.
S. S. Manoa	9, 556	Hilo	June 4	do	June 7	San Francisco.
S. S. Manulani	9, 547	Honolulu	June 12	do	June 13	Hilo.
S. S. Wilhelmina	6, 947	do	June 14	do	June 16	Honolulu.
S. S. Mukilteo	1, 230	Eureka	June 16	Lumber	June 17	Do.
S. S. J. R. Hanna	7, 095	Honolulu	June 25	Gasoline	June 26	Hilo.
S. S. Manoa	6, 085	do	June 28	General	June 29	Honolulu.
S. S. City of Los Angeles	12, 643	do	July 1	do	July 1	Hilo.
S. S. Carrabelle	5, 030	New Orleans	July 3	None	July 6	Mobile.
S. S. Wilhelmina	6, 947	Honolulu	July 11	General	July 13	Honolulu.
S. S. Makena	2, 729	Seattle	July 14	Lumber	July 14	Mala.
S. S. Manulani	9, 556	Hilo	July 16	General	July 21	San Francisco.
Schr. S. Christenson	675	Seattle	July 17	Lumber	July 31	Kaanapali.
S. S. Manoa	6, 805	Honolulu	July 26	General	July 27	Honolulu.
S. S. City of Los Angeles	12, 643	do	July 29	do	July 29	Hilo.
S. S. Mahukona	2, 512	Tacoma	July 30	Lumber	July 30	Honolulu.
S. S. R. J. Hanna	7, 095	Hilo	Aug. 7	General	Aug. 7	Do.
S. S. Wilhelmina	6, 725	Honolulu	Aug. 8	do	Aug. 9	Do.
S. S. Calawaii	7, 270	do	Aug. 11	do	Aug. 11	Hilo.
S. S. Dryden	5, 816	do	Aug. 13	None	Aug. 13	New Orleans.
S. S. Manukai	9, 547	do	Aug. 18	General	Aug. 21	Hilo.
S. S. Sagadahoc	6, 223	Honolulu	Aug. 20	do	Aug. 20	San Francisco
S. S. Manoa	6, 805	do	Aug. 23	do	Aug. 24	Honolulu.
S. S. Makaweli	2, 552	Hilo	Aug. 24	Lumber	do	Do.
S. S. City of Los Angeles	12, 643	Honolulu	Aug. 25	General	Aug. 25	Hilo.
S. S. Makena	2, 729	Hilo	Sept. 4	do	Sept. 4	Honolulu.
S. S. Wilhelmina	6, 725	Honolulu	Sept. 5	do	Sept. 6	Kaanapali.
S. S. Calawaii	7, 270	do	Sept. 8	do	Sept. 8	Hilo.
M. S. Theodore Roosevelt	7, 116	Hilo	Sept. 10	do	Sept. 11	Honolulu.
S. S. Steel Mariner	5, 686	Honolulu	Sept. 12	do	Sept. 12	New York.

List of trans-Pacific vessels arriving and departing from the port of Kahului, Maui, January 1 to December 31, 1924—Continued

Name of vessel	Gross tons	Where from	Date of arrival	Cargo in	Date of departure	Destination
S. S. Hanover	5,816	Honolulu	Sept. 13	General	Sept. 13	New Orleans.
S. S. Manulani	9,556	do	Sept. 14	do	Sept. 15	Hilo.
S. S. Manoa	6,805	do	Sept. 19	do	Sept. 20	Kaanapali.
S. S. City of Los Angeles	12,643	do	Sept. 22	do	Sept. 22	Hilo.
S. S. Santa Cruz	4,826	San Pedro	Sept. 24	Nitrate	Sept. 29	Port Allen.
S. S. Mahukona	2,512	Honolulu	Sept. 29	Lumber	Sept. 30	Hana.
S. S. Radnor	7,699	do	Oct. 3	General	Oct. 3	New Orleans.
S. S. Circeus	5,568	Hilo	do	do	do	San Francisco.
S. S. Wilhelmina	6,725	Honolulu	Oct. 4	do	Oct. 5	Kaanapali.
S. S. Calawai	7,270	do	Oct. 6	do	Oct. 6	Hilo.
S. S. Lubrico	6,882	San Pedro	Oct. 7	Fuel oil	Oct. 9	San Pedro.
S. S. Wilmington	9,900	Honolulu	Oct. 11	Lumber	Oct. 11	San Francisco.
S. S. Manoa	6,805	do	Oct. 17	General	Oct. 18	Kaanapali.
S. S. Goodfellow	6,886	do	Oct. 19	do	Oct. 20	San Francisco.
S. S. City of Los Angeles	12,643	do	Oct. 21	do	Oct. 21	Hilo.
S. S. Makaweli	2,552	Port Allen	do	Lumber	Oct. 24	Honolulu.
S. S. Manukai	9,547	Hilo	Oct. 22	General	do	San Francisco.
S. S. Wilhelmina	6,725	Honolulu	do	do	Nov. 1	Honolulu.
S. S. Makena	2,729	do	Nov. 1	Lumber	Nov. 2	Hana.
S. S. Calawai	7,270	do	Nov. 3	General	Nov. 3	Hilo.
S. S. Victorious	7,597	do	Nov. 5	do	Nov. 5	New Orleans.
S. C. T. Dodd	7,054	Mahukona	do	Gasoline	do	Honolulu.
S. S. Manoa	6,805	Honolulu	Nov. 14	General	Nov. 15	Kaanapali.
S. S. Mahukona	2,512	do	Nov. 15	Lumber	Nov. 16	Ahukini.
S. S. Robin Adair	6,895	do	Nov. 17	General	Nov. 17	San Francisco.
S. S. Manukai	9,547	Port Allen	Nov. 28	do	Nov. 29	Hilo.
S. S. Wilhelmina	6,725	Honolulu	Nov. 29	do	Nov. 30	Kaanapali.
S. S. Calawai	7,270	do	Dec. 1	do	Dec. 1	Hilo.
S. S. Makiki	6,096	do	Dec. 2	do	Dec. 2	Mahukona.
M. S. H. F. Harper	3,803	Hilo	Dec. 5	Gasoline	Dec. 5	Honolulu.
S. S. Makaweli	2,552	Mala	Dec. 7	Lumber	Dec. 9	Do.
S. S. Manoa	6,805	Honolulu	Dec. 12	General	Dec. 14	Kaanapali.
S. S. Horda	4,300	do	Dec. 16	Nitrate	Dec. 19	San Francisco.
M. S. Challenger	7,590	do	Dec. 17	General	do	Manila.
S. S. Makena	2,729	Port Allen	Dec. 22	Lumber	Dec. 23	Kaanapali.
S. S. Wilhelmina	6,725	Honolulu	Dec. 27	General	Dec. 28	Honolulu.
S. S. Borgland	4,893	Hilo	Dec. 29	Cement	Dec. 31	Do.
S. S. Calawai	7,270	Honolulu	do	Passenger	Dec. 29	Hilo.

Total, 98 vessels (94 steamers, 3 motor ships, and 1 schooner).

In addition to trans-Pacific steamers, 179 interisland trips were made during the year, an average of 15 per month.

The draft of the 97 trans-Pacific steamer and motor-ship trips was as follows:

30 feet	1	23 feet	6
29 feet	2	22 feet	10
28 feet	3	21 feet	10
27 feet	4	20 feet	5
26 feet	8	Under 20 feet	22
25 feet	12		
24 feet	14	Total	97

All interisland trips were made at drafts less than 20 feet.

The passenger traffic was as follows:

	Arrived	Departed	Total
Trans-Pacific	1,603	1,426	3,029
Interisland	9,506	10,201	19,707
Total	11,109	11,627	22,736

The growth of trans-Pacific shipping using the harbor in recent years will be seen from the following record:

Period	Number of trans-Pacific steamers	Total gross tons
July 1, 1920, to June 30, 1921	79	436,379
July 1, 1921, to June 30, 1922	68	463,782
July 1, 1922, to June 30, 1923	66	411,919
July 1, 1923, to June 30, 1924	70	427,888
July 1, 1924, to June 30, 1925	117	740,684

The extinct crater of Haleakala, the largest in the world, at an elevation of 10,000 feet, is one of the chief attractions to tourists in the Hawaiian Islands. When the harbor has better breakwater protection and ample room for maneuvering, the large round-the-world steamers will doubtless make it a port of call. While such ships do not add to the cargo tonnage credited to the port they are not an inconsiderable source of profit to the community.

(D) PREVIOUS HARBOR IMPROVEMENTS AT KAHULUI

15. *Improvements by Territory of Hawaii and private interests.*—In its original condition, the harbor of Kahului was merely an inlet in a coral reef, exposed to the prevailing northeast trade winds and to high seas from the north, which often occur unaccompanied by local high winds, as the result of storms at sea. Prior to 1910 the Kahului Railroad Co. constructed 1,800 feet of the east breakwater and dredged about 300,000 cubic yards from the basin in its lee, providing an area of about 11½ acres with a depth of 35 feet. The expenditures of the Kahului Railroad Co. on this work and more recent terminal facilities amounted to \$357,000.

The Territory of Hawaii has expended \$177,000 on dredging in the harbor and is planning more dredging in connection with the extension of terminal facilities at the Claudine Wharf.

16. *Improvements by the United States.*—The first Federal project was adopted in 1910. Under its terms the United States took over without cost the 1,800 feet of east breakwater previously constructed by the Kahului Railroad Co., and extended it to 2,200 feet (its present length). The basin in lee of the east breakwater was also enlarged to a width of 900 feet and a total area of 31 acres, with a depth of 35 feet below mean lower low water. This work was completed in 1913.

In 1916 provision was made for the west breakwater, which was completed to a length of 1,950 feet in 1919.

Total expenditures by the United States amount to \$785,000. The attached map shows the present condition of the harbor.

17. *Terminal improvements.*—The Claudine Wharf was built in 910 by the Kahului Railroad Co. at a cost of over \$30,000. It has recently been taken over by the Territory and plans have been made to extend it by dredging along its base and lengthening it. The proposed improvements are shown on the attached map. Due to the small size of this wharf and the shallow water adjoining it (about

22 feet), its use in the past has been confined to interisland steamers, all of which draw less than 20 feet. The Territory expects to dredge this portion of the harbor to full depth and to develop a terminal at the Claudine Wharf that will take care of one trans-Pacific vessel in addition to one interisland vessel. This will facilitate pineapple traffic, which requires the shipment inward of one ton of supplies—such as sugar, shocks, and tinplate—for each three tons of canned pineapples packed.

The bulkhead wharf at the head of the harbor has been abandoned. It was built by the Kahului Railroad Co. and up to the opening of the new Territorial wharf on October 31, 1924, all trans-Pacific cargo was lightered between the bulkhead wharf and ships moored in the basin. All lighterage has been abandoned since the completion of the new Territorial wharf.

The new Territorial Wharf was completed on October 31, 1924. It is of concrete construction, 500 feet long, with capacity for storing 4,500 tons of sugar in addition to general merchandise, and is equipped with modern electrically driven conveyors for loading sugar from storage piles into ships. An improved highway connects it with the highway system of the island and railway terminal facilities are adequate. Pipe lines are provided for fuel oil, molasses, kerosene, gasoline, distillate and water. All trans-Pacific freight is now handled over this wharf. It is open to all on equal terms. The total expenditures of the Territory for wharves amount to \$755,850.

The Territorial legislature has lately appropriated \$600,000 for further terminal improvements at Kahului, and has approved projects that will involve the appropriation of \$750,000 additional. The proposed improvements include dredging to 35 feet of a considerable area inside the pierhead line, the construction of a new concrete wharf 500 feet long to the west of the present Territorial wharf, and the development of greater terminal facilities at the Claudine Wharf. At the present time only one trans-Pacific vessel can be berthed. When the Territorial improvements are completed, three trans-Pacific vessels can be berthed simultaneously, in addition to one interisland vessel.

18. Summary of harbor and terminal expenditures.—

United States harbor improvements.....		\$785, 000
Kahului Railroad Co., harbor and terminals.....	\$357, 000	
Territory, dredging.....	177, 000	
Territory, wharves to date.....	756, 000	
Expended to date by Territory & Kahului Railroad Co.....		1, 290, 000
Appropriated by Territory for further improvements.....	\$600, 000	
Estimated cost of improvements projected by the Territory in addition to above.....	750, 000	
Total estimated future expenditures by Territory.....		1, 350, 000
Total expended, appropriated, and proposed, by the Territory and private interests.....		2, 640, 000

19. *Ownership of water front.*—The Territory controls the entire water front and owns all terminal facilities. All are open to the public on equal terms.

(E) ADEQUACY OF PRESENT HARBOR

20. *Minimum requirements.*—The minimum requirements of a harbor adequate for the traffic at Kahului are:

(1) Sufficient breakwater protection to insure that vessels may be worked at the wharves in any weather.

(2) A dredged basin of sufficient area to enable vessels to maneuver safely while entering and leaving the harbor.

21. *Adequacy of breakwater protection.*—The present breakwaters, with a width of 1,600 feet between the ends, furnish adequate protection from the northeasterly swell set up by the prevailing trade winds. There are many days, however, particularly during the winter, when heavy swells come down directly from the north, often unaccompanied by local high winds. These swells sometimes attain a height of 8 to 9 feet at the entrance and are very often 4 to 6 feet in height. The present wide entrance allows these swells to enter the harbor with a sufficient volume and force to set up a tremendous disturbance over the entire harbor. The Claudine Wharf becomes untenable for interisland vessels and larger vessels at the Territorial wharf—the least disturbed portion of the harbor—break their lines and are held only with difficulty. The use of the electric conveyers for loading sugar into a ship requires that the vessel have comparatively little motion and it frequently happens that loading is interrupted for considerable periods by swells of no unusual height.

The new wharf that the Territory plans to build to the west of the present wharf will experience even more disturbed conditions than the present one, due to its closer proximity to the harbor entrance. The development of the Claudine Wharf as a trans-Pacific terminal, which is proposed by the Territory, will require additional breakwater protection, as it will be noted from the following records that the use of the Claudine Wharf even by the small interisland vessels has repeatedly been interfered with by rough weather.

During the winter of 1924–25 the weather was more favorable than usual, but the following difficulties were experienced:

November 17, 1924: Heavy blow and high seas from the north. Steamship *Mahukona* forced to anchor outside, as steamship *Robin Adair* occupied the Territorial wharf and it was too rough to moor the *Mahukona* at the Claudine Wharf.

November 18, 1924: Harbor very rough. Pipe-line dredge working for the Territory, opposite inner end of Territorial wharf, broke a spud.

November 20 and 21, 1924: Harbor too rough for dredge to work. No vessels in port.

November 22, 1924: Interisland steamer *Maruna Kea* unable to use Claudine Wharf.

November 23, 1924: Dredge unable to work, due to rough weather. No vessels in port.

November 24, 1924: Interisland steamer *Likelike* unable to use Claudine Wharf.

November 25, 1924: Interisland steamer *Maruna Kea* unable to use Claudine Wharf.

The foregoing covered a period of nine consecutive days, during which two trans-Pacific and several interisland steamers were seriously inconvenienced. During the last seven days of this storm no trans-Pacific vessels had occasion to enter the port, otherwise the loss of time would have been greater.

When the harbor is too rough for handling trans-Pacific ships, Honolulu is advised by radio and steamer schedules are rearranged to meet the conditions and reduce the delays to a minimum. This naturally results in an increase in the cost of handling freight to and from the Hawaiian Islands in general.

December 15, 1924: Harbor very rough. No vessels in port.

December 16, 1924: Still rough. The steamship *Horda*, 4,300 gross tons, carried away all her lines during the night while at the Territorial wharf.

December 17, 1924: Still rough. *M. S. Challenger*, 7,590 gross tons, bound for Manila, arrived off port but refused to enter until steamship *Horda* went outside at 10 a. m. and anchored while *Challenger* discharged freight at Territorial wharf. *Challenger* carried away one wire spring line while lying at the wharf.

December 18, 1924: Steamship *Horda* remained at anchor outside and did not finish discharging and leave until the 20th.

The construction of an additional wharf by the Territory will obviate the necessity of a second vessel anchoring outside, but since the second wharf will be even more exposed than the first, considerable delay will be inevitable.

February 10, 1925: Steamship *Manulani* carried away five lines while lying at the Territorial wharf. Loading by conveyors was impossible. Interisland steamers *Kinau* and *Hornet* unable to use Claudine Wharf.

February 11, 1925: Surging of steamship *Manulani* at Territorial Wharf continued. Had to breast off by running two lines across to Claudine Wharf to avoid damage to vessel and wharf.

March 24, 1925: Interisland steamer *Mauna Kea* had difficulty at Claudine Wharf. No vessels at Territorial Wharf.

April 14, 1925: Interisland steamer *Mauna Kea* unable to use Claudine Wharf and was worked with difficulty at Territorial Wharf.

April 15, 1925: Steamship *Makiki* had difficulty working at Territorial Wharf.

April 16, 1925: Still rough. No vessels in port.

April 17, 1925: Steamship *Wilhelmina* had difficulty at Territorial Wharf.

April 18, 1925: Rough.

April 19, 1925: Steamship *Santa Cecilia* had difficulty at Territorial Wharf.

May 3, 1925: Steamship *Manulani* (9,556 gross tons) forced to berth at moorings, as steamship *Manoa* occupied Territorial Wharf and Claudine Wharf too small.

May 6 and 7, 1925: Steamship *Manulani* had difficulty lying at Territorial Wharf.

The foregoing instances, scatter over a period of six months, cover over 20 days when difficulty, mostly serious, was experienced due to the disturbed condition of the harbor. The loss occasioned during

this winter by interruptions and delays to shipping, dredging, and other interests, was estimated at \$40,000, as follows:

Delays and damage to dredge.....	\$5, 083
Loss to Territory (tolls and damage to wharf).....	2, 976
Delays to trans-Pacific shipping.....	16, 753
Delays to interisland shipping.....	91
Losses to terminal company.....	597
Loss to community due to suspension of monthly visits of steamship <i>City of Los Angeles</i> , carrying about 200 tourists on each visit.....	14, 000
Marine Insurance Co.....	500
	40, 000

The Matson Navigation Co. estimates the loss due to one day's delay to one of their vessels at from \$600 for the smallest to \$4,000 for the largest. It is apparent that the arrival of two large steamers during a protracted period of rough weather would result in a serious loss in the course of a few days.

In addition to the direct losses listed that are due to delays in handling shipping, there are many indirect losses that inevitably result from the lack of safety and facility in handling shipping at any port. Shipping people naturally become prejudiced against a harbor that has a record of serious delays and this is reflected in both shipping and insurance rates. Both of these rates are constant for practically all Hawaiian ports, whether open roadsteads like Kaanapali or safe harbors like Honolulu. This means that the rates have to be high enough, even at the safe harbors, to cover the losses at the others.

Improvements already authorized at Nawiliwili, on Kauai, and Hilo, on Hawaii, will make these ports safe and convenient in any weather. The addition of Kahului to the safe and convenient list will mean that each of the larger islands—Kauai, Oahu, Maui, and Hawaii—will have a safe, adequate, and convenient harbor, thereby reducing marine losses and delays in shipping in the Hawaiian Islands to a minimum. This should ultimately result in a reduction of both shipping and insurance rates. It is estimated that the cost of shipping and insurance in and out of Hawaiian ports, amounts to about \$15,000,000 per year. A reduction of 10 per cent would mean a saving of \$1,500,000 per year.

Improvements in harbor facilities in the Hawaiian Islands during the last few years have reduced the operating costs of shipping companies to such an extent as to make unnecessary an increase in freight rates between the islands and the Pacific coast that would otherwise have been rendered necessary by the increase in the price of fuel oil.

The authorized improvements at Nawiliwili and Hilo, mentioned above, will leave Kahului the only important port in the Hawaiian Islands at which probable delays and danger to shipping will have to be taken into account as a factor in fixing shipping and insurance rates for the islands. Consequently, the improvement of Kahului is a potential factor of no mean importance in determining the future trend of such rates. It may be an important factor in securing an actual reduction of these rates—a reduction of even 5 per cent would mean a saving of \$750,000 a year to the Islands—or it may preclude, as previous improvements already have, the necessity for raising rates, which would mean just as real a saving although it would not appear upon the balance sheets.

During the present year, a new factor in Kahului shipping has developed. For the first time a foreign vessel has taken a shipment of 56,000 cases of canned pineapples direct to London and Liverpool, thereby saving \$6,800 in freight, as compared with the previous routing of foreign exports through San Francisco. More shipments of this kind are expected and they will facilitate the development of a European market for pineapples. As the future of the Hawaiian Islands is entirely dependent upon the continuing prosperity of the sugar and pineapple industries, it is obvious that no factor that tends to improve the condition of these industries should be neglected.

The same sort of difficulties as those listed at the beginning of this paragraph, some of them even more serious, have occurred every winter ever since the completion of the breakwaters in 1919.

In October, 1922, while the Territorial Wharf was under construction, concrete forms were damaged and washed away. During the same period interisland steamers were unable to use the Claudine Wharf and the steamship *Lurline*, 6,572 dead weight tons—was only held in place by her anchors and numerous lines run to mooring buoys.

At that time and up to October 31, 1924, when the Territorial Wharf was finished, trans-Pacific steamers were moored to buoys in the basin, west of the Territorial Wharf site, and all freight was lightered.

Shippers have repeatedly been put to serious inconveniences and loss by reason of delays in receiving or dispatching freight.

Records of previous winters are not as complete as that of the winter of 1924, given above. Following are some of the more important difficulties since the completion of the west breakwater:

January 6, 1921, the steamship *Eastern Guide* was afraid to enter the harbor on account of rough weather and had to proceed to Honolulu.

January 17, 1921, the steamship *Manoa* was unable to work at Kahului and had to leave her freight at Honolulu for transshipment.

November 12, 1921, the steamship *Manoa* had to leave the harbor without discharging her cargo.

January 15, 1923, the steamship *Manoa* was obliged to discontinue work and leave the harbor, which she did with difficulty, proceeding to Honolulu.

October 1, 1923, the steamship *Mahukona* was obliged to discontinue work.

In view of the exposure of the harbor, its comparatively small area, and the short distances from the entrance to the wharves, the entrance is too wide to afford the minimum protection essential to the safe and economical handling of shipping. This opinion is borne out by the records and is concurred in by all who are familiar with the harbor.

22. *Adequacy of dredged basin.*—The present dredged basin has a width of only 900 feet. The prevailing northeast trade winds blow directly across the basin and across the path of incoming and outgoing ships. All trans-Pacific ships hug the east breakwater coming in so as to have as much deep water to leeward as possible. There is no protection from the wind until the ship is alongside the Territorial Wharf, and many vessels, particularly single-screw vessels riding high out of the water, have difficulty in maneuvering to the

dock. If anything happens, anchors must be dropped at once to prevent the ship grounding on the shoals to the southwest. This danger was illustrated by the *City of Los Angeles*, a vessel 560 feet long, of 12,642 gross tons. On July 28, 1924, she got out of control while entering the harbor and grounded on a shoal on the southwest side of the basin, about 400 feet out from the Claudine Wharf. As a result of this accident, visits of the *City of Los Angeles* were discontinued indefinitely, pending improvement of the harbor.

Vessels leaving are in more danger than those entering, due to the restricted space available for turning around after leaving the Territorial Wharf. Twin-screw steamers are usually handled without great difficulty, but single-screw steamers often have trouble. There is not a tug at Kahului capable of handling a large vessel, and the maintenance of such a tug would be quite expensive.

Greater width of dredged basin is essential not only to afford single ships greater facility and safety in entering and leaving, but also to permit the anchoring of other large vessels in a place where they will not seriously interfere with traffic in and out of the harbor. Ships may need to enter the harbor as a refuge from storms, or if they come with cargo may have to anchor while waiting their turn to discharge at the Territorial wharves (present and proposed).

23. *Comparison of Kahului with other Hawaiian ports.*—The general policy that has been followed in the 21 years during which Federal improvements have been carried on in the Hawaiian Islands is to provide a safe and adequate harbor on each of the four larger islands—Kauai, Oahu, Maui, and Hawaii. The harbors chosen for development are as follows:

- Nawiliwili, on the island of Kauai.
- Honolulu, on the island of Oahu.
- Kahului, on the island of Maui.
- Hilo, on the island of Hawaii.

It does not appear that Federal aid for the development of harbors other than these will ever be required.

Of the four harbors listed, only one—Honolulu—is situated on the southern or leeward side, and consequently requires no breakwater protection. Kahului and Hilo are the most exposed of the four. Nawiliwili will require 2,150 feet of breakwater. This will be completed early in 1926. Honolulu required no breakwater. Kahului now has two breakwaters of a total length of 4,000 feet and requires 1,240 feet additional to provide adequate protection, making a total of 5,240 feet. Hilo now has (almost completed) about 6,700 feet of breakwater and the new project authorized this year will provide about 3,000 feet more, making a total of 9,700 feet.

24. The cost of Federal improvements at the four harbors, including those completed to June 30, 1925, and those authorized by Congress, is as follows:

(1) Harbor	(2) Cost to June 30, 1925	(3) Authorized by Con- gress but not yet completed	(4) Total completed and authorized	(5) Possible future work in ad- dition to that authorized	(6) Estimated ultimate cost of Federal im- provements
Nawiliwili.....	\$582,000	\$1,562,000	\$2,144,000	Maintenance only.....	\$2,144,000
Honolulu.....	2,405,000	288,000	2,693,000	Now under consideration....	¹ 2,693,000
Kahului.....	783,000	None.	783,000	\$1,270,000, as shown by this report.	2,053,000
Hilo.....	1,508,500	2,300,000	3,808,500	Maintenance only.....	3,808,500
Total.....	5,278,500	4,150,000	9,428,500	² \$1,270,000.....	² 10,698,500

¹ Plus.

² Plus such new work as may be decided on for Honolulu.

The expenditures to the end of the fiscal year 1925 (\$5,278,500) cover a period of 21 years.

Taking into consideration the wealth and importance of the Hawaiian Islands, the estimated ultimate cost of Federal improvements (\$10,698,500, exclusive of such further work as may be found necessary at Honolulu to take care of increased traffic in the future) is certainly not excessive.

The order of importance of the four ports, from the standpoint of tonnage and value, is Honolulu, Hilo, Kahului, Nawiliwili.

From the table given above it will be seen from column (4) that the total of completed and authorized work at Kahului is about one-third of that at Nawiliwili, one-fourth of that at Honolulu, and one-fifth of that at Hilo. The importance of Kahului from a shipping standpoint entitles it to adequate protection. Such protection does not exist now and, owing to the exposed position of the harbor, it can not be secured by an expenditure less than that estimated in this report (\$1,270,000).

(F) IMPROVEMENTS ESSENTIAL TO MAKE THE HARBOR SAFE AND ADEQUATE

25. *Extension of breakwaters.*—It has been shown that quieter water must be secured in the harbor to make it safe in all weather and obviate serious delays to traffic due to disturbance of the water near the wharves.

The only feasible method of accomplishing this is by reducing the width of the entrance between the breakwaters. The present width of deep water across the entrance is about 1,600 feet (somewhat less than the surface width shown on the accompanying map).

The observations of the district engineer, the reports of those familiar with the harbor for years, and a theoretical study of the effect upon wave height of a reduction in width of harbor entrance indicate that a very considerable reduction in the present width will be necessary to accomplish the desired result.

No instrumental observations have been made, but the maximum height of waves in the present entrance is estimated at 8 feet. A theoretical study of the effect of narrowing the entrance upon wave heights at the point x , opposite the entrance and 2,100 feet from it, gives the following results:

(1) *Theoretical height at x under present conditions.*—Stevenson's formula for reduction of wave heights is—

$$x = h\sqrt{\frac{b}{B}} - \frac{\left(h + h\sqrt{\frac{b}{B}}\right)^4 \sqrt{D}}{50}$$

Where x = wave height at point x ,
 h = wave height at entrance, 8 feet,
 b = width of entrance, 1,600 feet,
 B = width of harbor at point x , 3,400 feet,
 D = distance from entrance to point x , 2,100 feet,

$$X = 8\sqrt{\frac{1,600}{3,400}} - \frac{\left(8 + 8\sqrt{\frac{1,600}{3,400}}\right)^4 \sqrt{2,100}}{50}$$

= 3.6 feet, or 45 per cent of the wave height at the entrance

(2) *Theoretical wave height at X if east breakwater only were extended 650 feet along its present axis, reducing entrance to 1,100 feet.*

$h = 8$
 $b = 1,100$
 $B = 3,400$
 $D = 2,350$

$$X = 8\sqrt{\frac{1,100}{3,400}} - \frac{\left(8 + 8\sqrt{\frac{1,100}{3,400}}\right)^4 \sqrt{2,350}}{50}$$

= 2.8 feet, a reduction of only 22 per cent from the theoretical height at X under present conditions.

(3) *Theoretical wave height at X if the east breakwater were extended 650 feet and the west breakwater 590 feet, along their present axes, reducing the entrance to 600 feet.*

$h = 8$
 $b = 600$
 $B = 3400$
 $D = 2400$
 $X =$

= 1.8 feet, a reduction of 50 per cent from the theoretical height at X under present conditions.

Due to variations in depth and irregularities of the bottom, the theoretical values given may vary considerably from those actually to be found at the point X , and there is no doubt that wave heights in the basin between the Claudine and Territorial wharves are less than the theoretical values calculated for the point X . The relation of wave heights at X under existing conditions (1) and assumed conditions (2) and (3), however, may be accepted as fairly accurate.

It is apparent that the reduction of the entrance to 1,100 feet by extending the east breakwater only (see (2) above) will not secure the desired result, since to decrease the wave height at X by only 22 per cent would probably decrease the wave surge effect near the wharves by a no greater percentage. Reducing the entrance to 600 feet by extending both breakwaters along their present axes, as shown in (3) above, would have a very considerable effect, as it

reduces the wave height at X by 50 per cent and would effect at least a corresponding reduction in the basin between the wharves.

Consideration for the safety of ships entering and leaving the harbor requires that the entrance should be at least 600 feet wide.

In view of the fact that the heaviest seas come from the north, better protection could be secured by extending the east breakwater about 1,400 feet, almost overlapping the present west breakwater, and leaving an entrance 600 feet wide facing northwest. However, there is shoal water north of the west breakwater which ships avoid as much as possible in entering the harbor. On this account it is advisable that the entrance face north and that it be so situated that it will not force ships to go more than a short distance to the westward of the path they now use. To accomplish this it is necessary that both breakwaters be extended. Such extension may take place either along the present axes of the breakwater or on a line joining their ends. Both methods are indicated on the accompanying map. It is apparent that first method—extension along the present axes—will involve a greater tonnage of stone than the second. The estimates, which are given later, show a cost of \$944,000 for extension along the axes, as against \$772,000 for extension along the line joining the ends. The first method is believed to be preferable, in spite of its greater cost (172,000), for the following reasons:

(1) The heaviest seas, which come from the north, will strike both breakwaters at a considerable angle (as at present), whereas the extensions, if made along the line joining the present ends, will be struck broadside, which is undesirable from considerations of security. The end of the breakwater is the part that will fail first; a broadside wave striking the end is much more likely to damage it than one striking the end at an angle and being deflected toward the base.

(2) The seas from the north will be broken at a distance 400 feet farther from the Territorial wharf than if the second method is employed. This represents an increase of over 20 per cent in distance over the second method and consequently is a factor of some importance in securing quiet water at the wharf. The percentage of increase is still greater with reference to the proposed new wharf.

3. A vessel backing out from the Territorial wharf and turning around preparatory to leaving the harbor has in the second case only about 1,300 feet in which to get under way before her bow is at the entrance and exposed to the full force of the waves. This distance is increased 400 feet, or 30 per cent by making the extensions along the present axes as proposed.

At best the harbor is small and a low-powered vessel leaving in rough weather needs all the distance possible in which to get under way.

After consideration of all the factors involved, it is concluded—

(a) That reduction of the entrance width to 600 feet (from 1,600 feet), will quiet the water near the wharves to an extent sufficient to obviate all serious delays even when the highest waves are running at the entrance; and

(b) That the best method of effecting this reduction is to extend both breakwaters along their present axes.

26. *Enlargement of dredged area.*—It has been shown in paragraph 22 that the present dredged basin is inadequate to permit the safe maneuvering of ships.

The following considerations govern the determination of the amount and location of the enlargement needed:

(1) Ships backing out from the Territorial wharf (and the proposed wharf adjoining it on the west) should have in the neighborhood of 1,400 feet of width in which to turn, instead of 900 as at present.

(2) Ships entering the harbor should have at least 1,000 feet of deep water to leeward in order to obviate the danger of grounding on the shoals to the southwest in case of accident.

(3) There should be room for vessels to anchor in emergency or while awaiting their turn at the wharves without interfering with traffic.

(4) Ships entering and leaving the harbor should not have to make a sharp turn at the entrance.

(5) Ships wishing to dock bow out at the Territorial wharf should have room to make a long turn, drop anchor, and warp into the dock.

(6) The Territory has taken over the Claudine Wharf and plans to continue it in use, with the addition of terminal facilities at its base and a possible addition to its present length.

Having in view the accomplishments of those objects with the minimum of dredging, and taking into consideration the plans of the Territory, the line A B C D E has been selected as the best location for the southwest boundary of the harbor. No change in the present harbor lines is involved.

(G) ESTIMATED COST OF IMPROVEMENTS RECOMMENDED

27. *Cost of extending breakwaters.*—The two methods outlined on the map for reducing the width of the entrance to 600 feet may be designated:

Project A: Extending both breakwaters along their axes:

East breakwater, 650 feet, 177,000 tons of stone, at \$2.75.....	\$486,750
West breakwater, 590 feet, 135,000 tons of stone, at \$2.75.....	371,250
Approximately 10 per cent for superintendence and contingencies	86,000

Total..... 944,000

Project B: Extending both breakwaters along a line joining their present ends:

East breakwater, 470 feet, 120,000 tons of stone, at \$2.75.....	\$330,000
West breakwater, 590 feet, 135,000 tons of stone, at \$2.75.....	371,250
Approximately 10 per cent for superintendence and contingencies..	70,750

Total..... 772,000

Compared with current breakwater costs in other Hawaiian harbors, the figure of \$2.75 per ton of stone placed is a favorable one in spite of the fact that the depth of water at Kahului is considerably greater than at other harbors where breakwaters are in progress of construction, which naturally tends to reduce the cost per ton. This figure (\$2.75 per ton) is based upon a definite offer by the Kahului Railway Co. to undertake the construction under contract.

This company has a good quarry 6 miles from the harbor, with which it is connected by railroads and has the equipment necessary for economical construction.

28. *Cost of dredging.*—The yardage between the present 35-foot depth line in the harbor and the proposed boundary of the dredged

basin is 336,000 cubic yards to 35 feet and 126,000 cubic yards for 2 feet overdepth, which should be allowed in order to take care of unavoidable variations in dredging depth. The total involved is 456,000 cubic yards:

Estimated cost of dredging 456,000 cubic yards, at 65 cents.....	\$296, 400
Approximately 10 per cent for superintendence and contingencies..	29, 600
Total.....	326, 000

29. *Estimated total cost of projects.*—The amount of dredging involved is the same in both projects A and B:

Project A: Extending breakwaters along their axes:	
Breakwaters.....	\$944, 000
Dredging.....	326, 000
Total.....	1, 270, 000
Project B: Extending both breakwaters along line joining their present ends:	
Breakwaters.....	772, 000
Dredging.....	326, 000
Total.....	1, 098, 000

The latest approved estimate for annual maintenance is \$10,000, which is considered adequate for either project A or B.

(H) BENEFITS TO BE DERIVED FROM PROPOSED IMPROVEMENTS

30. The prosperity of Maui, as of the other islands of the group, is based upon sugar and pineapples. Sugar growing is necessarily a large-scale industry, due to the large capital requirements for irrigation, cultivation, and milling. On this account the growing of sugar on small areas by independent farmers is not practiced anywhere in the islands, with the exception of a few homesteads, whose owners lease to the large corporations. The prosperity of a considerable portion of the population is dependent directly or indirectly upon the sugar industry. In addition to basic wages or salaries, all sugar employees receive a bonus that varies with the price of sugar.

The pineapple industry permits to a much greater extent the participation of small independent landowners. Irrigation is unnecessary, and while the small grower can not operate his own cannery, he can contract to sell his crop to the canners. This practice is quite common.

Truck farming is carried on by a considerable number of small landowners. Corn, potatoes, and beans are the principal products.

Stock raising on the west slope of Haleakala is also an important industry.

The financial standings of the three sugar plantations and the largest pineapple cannery that ship exclusively through Kahului are as follows:

Hawaiian Commercial & Sugar Co.—December 31, 1924

Assets.....	\$17, 046, 539. 38
Liabilities.....	421, 031. 82
Capital paid in.....	10, 000, 000. 00
Surplus.....	5, 225, 507. 56
Other liabilities, reserve for taxes.....	1, 400, 000. 00

Maui Agricultural Co. (Ltd.)—December 31, 1924

Assets.....	\$12,240,449.21
Liabilities.....	360,321.47
Capital paid in.....	5,000,000.00
Surplus.....	6,370,127.74
Other liabilities, reserve for taxes.....	510,000.00

Wailuku Sugar Co.—December 31, 1924

Assets.....	\$4,944,146.16
Liabilities.....	299,238.15
Capital paid in.....	3,000,000.00
Surplus.....	1,430,648.61
Other liabilities, reserved for taxes.....	214,259.40

Haiku Fruit & Packing Co. (Ltd.)—December 31, 1924

Assets.....	\$3,404,147.92
Liabilities.....	661,658.48
Capital paid in.....	2,250,000.00
Surplus.....	425,489.44
Other liabilities, reserve for taxes.....	67,000.00

There are approximately 1,700 individuals who own stocks in these four corporations. Information concerning the Pauwela pineapple cannery, a smaller concern adjoining the Haiku Co., is not available.

The three sugar companies listed above paid in Federal taxes for the years 1917 to 1924, inclusive, the sum of \$11,433,096.83.

While the immediate beneficiaries of the proposed improvements will be the large corporations mentioned, it is apparent that the prosperity of the general public on Maui is practically dependent upon that of the corporations.

The proposed improvements will facilitate the development of the pineapple industry on Maui and so increase the wealth of the island.

The Hawaiian Islands in general will benefit from increased production on Maui and from the addition of Kahului to the list of harbors known to be safe and convenient under all weather conditions.

The addition of a safe and convenient harbor will obviously be a factor of importance in connection with naval plans for the defense of the islands.

(I) RECOMMENDATIONS

31. After careful consideration of all available data, it is recommended:

(1) That project A, referred to in paragraph 27, be adopted. This involves:

Extension of breakwaters:

East breakwater, 650 feet, 177,000 tons stone, at \$2.75.....	\$486,750
West breakwater, 590 feet, 135,000 tons stone, at \$2.75.....	371,250
Approximately 10 per cent for superintendence and contingencies.....	86,000

Total.....	944,000
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Dredging:

456,000 cubic yards, at 65 cents.....	296,400
Approximately 10 per cent for superintendence and contingencies.....	29,600

Total.....	326,000
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Total estimated cost of project.....	1,270,000
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(2) That an original appropriation of \$400,000 be made to start the work, with authority for entering into one continuing contract to complete both breakwaters and a second continuing contract to cover all the dredging.

(3) That authority be granted to use appropriated funds for the purchase of dredging equipment if favorable bids for dredging are not received.

(4) That in view of the large expenditures made and contemplated at Kahului by the Territory of Hawaii and private interests, no local cooperation be required.

W. H. LANAGAN,
Major, Corps of Engineers, District Engineer.

[First indorsement]

OFFICE, DIVISION ENGINEER, HAWAIIAN DIVISION,
Honolulu, November 15, 1925.

To: The Chief of Engineers, United States Army.

SYLLABUS

The division engineer concurs with the district engineer in recommending the extension of both breakwaters at Kahului Harbor, Maui, leaving an entrance of about 600 feet width, and in dredging an inner area to 35 feet depth, at a total estimated cost of \$1,270,000, with \$10,000 annual maintenance.

1. Kahului Harbor, on the north shore, is by far the most important port of the Island of Maui, the next commercial points being Kaanapali at the extreme western end, and Hana at the extreme east. An important passenger port is at Lahaina (Mala). No United States improvements have been made except at Kahului.

2. The area of Maui is 728 square miles (second largest island of the group) and the population is 37,385 (1920), an increase of over 50 per cent since 1900. The present estimate is 43,500 population. The county seat is Wailuku. The immediate area tributary to Kahului contains 80 per cent of the producing area of the island and about 69 per cent of the population. The assessed valuation of property of Maui County is over \$52,000,000, or about 14.8 per cent of the Territory.

3. The area under cane production is about 74,520 acres, with 155,000 tons of sugar of value \$18,000,000. The average price of sugar was 5.964 cents in 1924. The present area in pineapples is 14,000 acres, producing about 33,000 tons packed fruit of value \$4,200,000. Projects now under way will increase the pine acreage by 15,000 acres, with an additional future of 16,000 acres. Cane and pines thus cover at present about 23 per cent of the island. In addition there are about 100,000 acres set aside as forest reserve.

4. The commerce of Kahului has ranged in the last five years from 228,000 tons (1920) to 304,000 tons in 1924, and 335,000 tons, estimated, 1925. The value in 1924 was about \$30,000,000. This traffic is about 80 per cent of the whole island and is divided into 138,669 tons received and 165,742 tons shipped. Of this, 90 per cent was trans-Pacific and nearly all with the United States. The largest receipts were 37,351 tons fuel oil, 15,136 tons lumber, 7,537 tons hay and feed, 8,096 tons gasoline, 5,106 tons ironware, 4,672 tons

fertilizer, and 3,355 tons rice. The principal shipments were 120,644 tons sugar, 19,547 tons molasses, and 18,497 tons canned pineapples.

Passenger traffic in 1924 was 22,736, of which 87 per cent was interisland.

5. The trans-Pacific steamers for the year ending June 30, 1921, were 79; gross tonnage 436,000; increasing in year ending June 30, 1925, to 117 vessels, with 740,000 gross tonnage. The average draft of vessels was 20 to 30 feet. The number of vessels in calendar year 1924 was 97, with 740,000 tons gross. The largest vessel was the *Los Angeles*, 12,643 tons, five trips. There were 17 vessels over 9,500 tons, with 42 vessels of 24 to 30 feet. The interisland trips numbered 79.

6. *Wharves and dredging.*—There are two wharves at Kahului. The old Claudine wharf cost about \$30,000, has a depth of 22 feet and was recently taken over by the Territory. Plans are now in hand to extend it and dredge along its length. This will allow one trans-Pacific vessel for pine shipments, lumber receipts, etc., as well as interisland service. The bulkhead wharf to the right, heretofore used for trans-Pacific shipments by lighter, has been abandoned.

The other wharf (500 feet long), recently completed by the Territory, is new and up to date. It will store 4,500 tons of sugar plus general merchandise. It has electrically driven conveyors and railroad and highway connections. Pipelines for fuel oil, molasses, etc., are provided. The total expenditures by the Territory have been about \$756,000 for wharves and \$177,000 for dredging. In addition, \$600,000 is now available for modern extensions to Claudine wharf and a projected expenditure of \$750,000 for extension of wharf facilities and dredging.

The Kahului Railroad Co. built originally about 1,800 feet of the east breakwater, and ceded this in 1910 to the United States. The total spent to date by the railroad company on the breakwater and dredging is \$357,000.

The territory controls the entire water front and owns all terminal facilities.

(a) The total expenditures by the Territory and railroad to date are thus.....	\$1, 290, 000
(b) Now appropriated for additional wharf and dredging.....	600, 000
(c) Projected further improvements, \$750,000.	

Total cooperation to date (exclusive of (c)).....	1, 890, 000
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7. The United States has expended on the two breakwaters and dredging about \$785,000. The project adopted in 1910 was the east breakwater, with a total length of 2,200 feet. The west breakwater, about 1,950 feet long, was provided for in 1916 and completed in 1919. The basin was dredged to 35 feet and enlarged to a width of 900 feet, and contains about 31 acres. Due to storms, the breakwater ends have been damaged, especially the west breakwater, which now has a top length of about 1,740 feet.

8. The interests to be benefited are local and national. The local interests using the harbor exclusively are three sugar companies and the largest pineapple cannery, with a capital and surplus of over \$33,000,000. The three sugar companies paid in Federal taxes from 1917 to 1924 a total of \$11,000,000. The harbor is used by the vessels

of the Interisland Steamship Co., and is of general benefit to the Island of Maui and the Territory of Hawaii.

The national interest is the encouragement and safety of trans-Pacific shipping, transfer of cargo, and reduction in freight rates.

9. *Adequacy of present harbor.*—The district engineer presents this in paragraphs 20 to 23 and 25 of his report. The present opening between breakwaters is 1,600 feet, which furnishes protection from the northeast but not adequate safety from the north. Heavy swells may reach 8 to 9 feet and are often 4 to 6 feet in height at the entrance. These swells cause great disturbance in the harbor and render the Claudine Wharf untenable and the Territorial Wharf difficult of use. The extension of these wharves requires more protection from wave action.

During the winter of 1924–25 there were nine days, November 17 to 25, with serious interruptions to shipping and vessels. From December to May there were 16 additional days of interruption. The loss to shipping by delays, etc., is estimated at \$40,000, not considering vessels that avoid the harbor entirely due to probable difficulty. There are many indirect losses. The steamer *Los Angeles* refused to enter the harbor in the winter months. Other circumstances of delay and difficulty are also given for the years 1919 to 1923. With the other Hawaiian harbors nearing completion, Kahului remains at a disadvantage without further dredging and breakwater protection.

10. An inspection of the small insert map and particularly of the Coast Survey Chart No. 4116 shows the exposed position of Kahului Harbor, which faces directly to the north. Deep water of the ocean lies very close—the 5,000-foot depth being 24 miles out, the 1,000-foot at 10½ miles, the 500-foot at 6 miles, and 100-foot at 1¼ miles. This allows the heavy swells of distant storms to enter the 1,600-foot opening into the rather small harbor area and quickly cover the short distance to the wharves. Vessels in entering are also peculiarly exposed to the north and northeast winds. The present 900-foot width inside is too small for safe maneuvering of large vessels. An illustration is the grounding of the *City of Los Angeles* on July 28, 1924.

There can be no doubt that a reduction of the opening between breakwaters will reduce the present wave action and swells at the wharves. Quieter water will be produced by lengthening the breakwaters as indicated by the district engineer. Freedom of maneuvering will be secured in heavy winds by larger dredged area.

An 8-foot wave at the present entrance, 1,600 feet wide, is reduced to 3.6 feet at the wharves. If narrowed to 1,100 feet width by 650 feet extension of east breakwater, the reduction will be to 2.8 feet. If the width is narrowed to 600 feet by extension of both breakwaters, the wave height is reduced to 1.8 feet. The above are theoretical calculations and the actual reductions will probably be greater.

The 600-foot width between breakwaters is considered the minimum for vessels to enter freely and safely.

The dredged width for proper and free maneuvering is considered to be 1,400 feet.

11. The estimated cost for project A, in which I concur, is:

Breakwater extension

East breakwater, 11 feet above mean low water, 650 feet, 177,000 tons, at \$2.75-----	\$486, 750	
West breakwater, 13 feet above mean low water, 590 feet, 135,000 tons, at \$2.75-----	371, 250	
Superintendence and contingencies-----	86, 000	\$944, 000
<hr/>		
Dredging 456,000 cubic yards, at 65 cents-----	296, 400	
Superintendence and contingencies-----	29, 600	
<hr/>		326, 000
<hr/>		
Total-----		1, 270, 000
Annual maintenance, \$10,000.		

The work should be completed in three years with a first appropriation of \$400,000.

12. From personal observation, and the experience of all shipping, the need of greater harbor protection is evident. The future tonnage will no doubt show a steady and gradual increase. The pineapple production is over four times greater than in 1913 and over twice as great as 1919, and is growing rapidly. The population is increasing, the interchange of general merchandise is greater, larger vessels and more round-the-world ships enter and desire to enter the port, and there is every reason why Maui should have one good, safe harbor for its steadily increasing commerce. The necessity of breast-ing vessels and using anchor buoys, and the interruptions to commerce caused by vessels being unable at times to enter the harbor or being compelled to leave before completion of cargo, should be obviated. The work proposed will practically free the harbor of obstructions and of delays and dangers now existing.

The local cooperation of over \$1,890,000 already expended or appropriated, with an additional \$750,000 projected, is conclusive evidence of the community's desires and interest in this project.

The present breakwater project is incomplete. A glance at the plan will show that the opening is too large for the harbor's safety and the dredged area is too small. The harbor should be reasonably commodious and safe, and this can be secured by the project recommended.

I concur in the district engineer's report.

EDWARD H. SCHULZ,
Colonel, Corps of Engineers,
Division Engineer, Hawaiian Division.

