MAUI SECOND COMMERCIAL HARBOR NAVIGATION STUDY

ISLAND OF MAUI, HAWAII

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION

FINAL REPORT

Prepared by:

U.S. Army Corps of Engineers
Honolulu District

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TABLE OF CONTENTS

MAUI SECOND COMMERCIAL HARBOR STUDY

TABLE OF CONTENTS

MAUI SECOND COMMERCIAL HARBOR STUDY

TABLE OF CONTENTS (CONTINUED)

MAUI SECOND COMMERCIAL HARBOR STUDY

TABLE OF CONTENTS (CONTINUED)

MAUI SECOND COMMERCIAL HARBOR STUDY

TABLE OF CONTENTS (CONTINUED)

List of Figures

List of Tables

List of Photographs

MAUI SECOND COMMERCIAL HARBOR NAVIGATION STUDY FINAL RECONNAISSANCE REPORT

MAIN REPORT

1. STUDY AUTHORITY

This study was conducted by the U.S. Army Engineer District, Honolulu (HED), for the State of Hawaii, Department of Transportation (DOT), under the authority of the Intergovernmental Cooperation Act, 31 U.S.C. 6505 - Reimbursable Services to State and Local Governments.

In 1991, the State of Hawaii, Sixteenth State Legislature, passed Session Law, Act 296, Section 167, that stated "Provided that of the special fund appropriation for harbors administration, the sum of $200,000 in fiscal year 1991-92 shall be expended to plan and assess the site of a second commercial harbor on Maui."

In response to the act, DOT requested assistance from HED in conducting the study. A Memorandum of Agreement was executed between DOT and HED on October 5, 1992.

2. STUDY PURPOSE AND SCOPE

2.1 Purpose

The purpose of this study is to conduct reconnaissance level investigations to plan and assess alternative second commercial harbor sites on the island of Maui.

2.2 Scope

This study identified and evaluated the problems, needs, and opportunities associated with developing a second commercial harbor to serve the island of Maui. In addition, this study assessed the impacts on the overall environmental, economic, social, cultural, and recreational resources of the area.

Alternative sites and design layouts were developed and the costs and benefits associated with implementing these measures were evaluated. Studies conducted included site investigations, archaeological studies, geologic investigations, engineering designs, economic evaluations, and environmental evaluations.

3. STUDY LOCATION

The Hawaiian archipelago extends some 1,500 miles over the north Pacific Ocean from about 155 to 179 degrees west longitude to around 19 to 28 degrees north latitude. The Hawaiian Island chain consists of 132 islands, reefs, and shoals. Eight major islands (Hawaii, Maui, Kahoolawe, Lanai, Molokai, Oahu, Kauai, and Niihau) encompass 6,425 square miles which accounts for more than 99 percent of the total land area of the State of Hawaii.

The study area includes the entire island of Maui. Maui is the second largest in size of the eight major Hawaiian Islands with approximately 728 square miles of land and approximately 120 miles of coastline (Figure 1). The island of Maui is part of Maui County which also includes the islands of Molokai, Lanai, and Kahoolawe. Maui is the economic center and seat of government for Maui County.

4. PRIOR STUDIES AND REPORTS

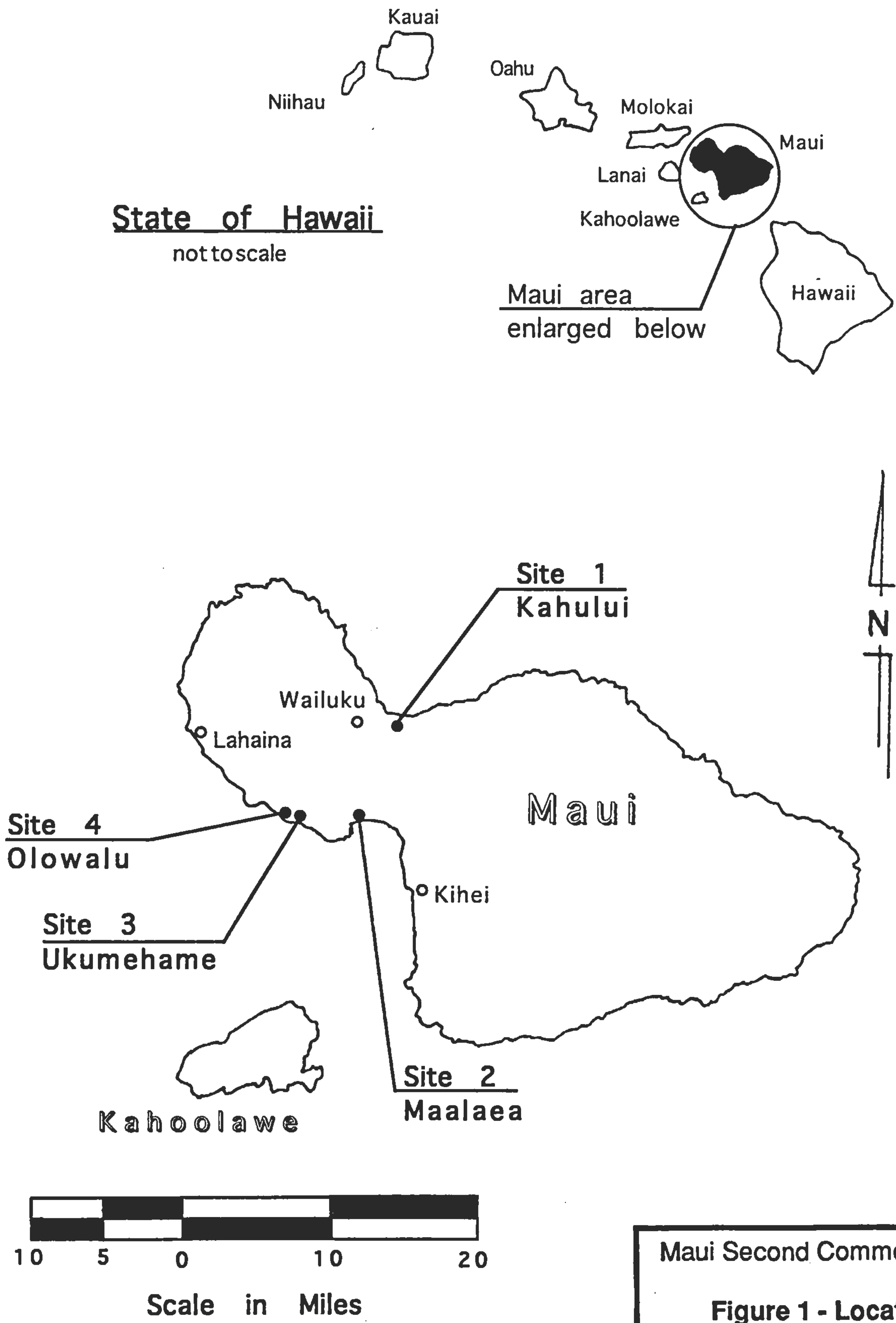
Two prior studies investigating the feasibility of a second deep draft harbor on Maui are were conducted by the Corps. Following are brief descriptions of these and other pertinent navigation studies on Maui.

4.1 Ma'alaea Deep-Draft Harbor

A study of Ma'alaea Harbor was conducted by the Corps under authority of two Congressional resolutions and the Rivers and Harbors Act of 1960 (PL 86-645) .

- The U.S. House of Representatives adopted a resolution in 1951 directing HED to determine the feasibility of developing a deep water harbor at Lahaina.

- A resolution adopted on 17 March 1960 by the U.S. Senate directed HED to determine the feasibility of developing a deep water port in the Kalepolepo-Kihei area. (The U.S. House Public Works Committee also adopted a resolution on 19 May 1960 with a view to providing a deep water harbor in the Kalepolepo-Kihei area.)



Maui Second Commercial Harbor

Figure 1 - Location Map

U.S. Army Corps of Engineers
Honolulu District

- Section 109 of PL 86-645, River and Harbor Act of 1960 authorized and directed the Secretary of Army to investigate the need for a deep water harbor in the Ma'alaea Bay area (according to the Plan of Investigation for Navigation Ma'alaea Bay Area Deep-Draft Harbor dated May 1967, Section 109 approved 14 July 1960).

Since a harbor on the southwest coast of the island of Maui would serve essentially the same area, the three separate authorities were consolidated into a single survey study for the entire Ma'alaea Bay area which was approved on 23 August 1960 by the Chief of Engineers.

The study initially investigated the need for a deep water port. Although a deep-draft harbor could not be economically justified, there was potential federal interest in a medium-draft or barge facility.

The following sites were studied: Mala Wharf, Lahaina, Kalepolepo, Ma'alaea small boat harbor, east side of Ma'alaea Bay, and Kealia Pond. Kealia Pond was identified in the 1967 report as the most desirable and practicable site for a second deep-draft harbor on Maui. Studies were suspended due to environmental concerns on the selection of Kealia Pond and a lack of support by local interests.

4.2 Second Commercial Harbor for the South Shore of Maui

In 1979, HED re-initiated a feasibility study for a second commercial harbor on Maui in response to a request from DOT. The DOT felt that Maui's expanding economy and population justified the need to re-initiate the feasibility studies for additional harbor facilities.

The primary study area was the coastline between the existing Ma'alaea small boat harbor and town of Kihei. The study area limitation accommodated Maui County officials' desire that a harbor not be placed toward Lahaina or south of Kihei.

In a memo dated 6 March 1979, it was recommended that no further studies be undertaken based on lack of well defined need or desire for second harbor expressed by either State or County, local resident opposition, environmental problems associated with three endangered species, and lack of solid economic justification for a second harbor.

4.3 Kahului Harbor

In 1989, HED studied the need, feasibility, and Federal interest in providing commercial light draft navigational improvements at Kahului Harbor. The study culminated in a Final Detailed Project Report and Environmental Impact Statement entitled "Kahului Light Draft Navigation Improvements, Maui, Hawaii," dated July 1989. Plans and specifications are being prepared for the recommended plan.

DOT prepared a report entitled "2010 Master Plan for Kahului Harbor," dated January 1989, and revised in 1993. The Master Plan discusses the current needs and issues on Maui's only commercial port.

4.4 Lahaina Harbor

HED prepared a General Design Memorandum entitled "Lahaina Harbor for Light Draft Vessels, Lahaina, Maui, Hawaii," dated October 1976. The project was placed into the inactive category due to public opposition and a lack of local support.

4.5 Ma'alaea Harbor

HED also completed a General Design Memorandum and Final Environmental Impact Statement entitled "Ma'alaea Harbor for Light-Draft Vessels," dated April 1980. The study describes navigation improvements to the existing Ma'alaea small boat harbor on Maui. The proposed improvements would alleviate adverse navigation conditions and provide additional berthing space. Features of the recommended plan include: dredging for a turning basin, access and entrance channels; extending the south breakwater; and installation of navigation aids. The proposed navigation improvement project is currently in the preconstruction engineering design phase.

4.6 Coasts of the Hawaiian Islands

An interim report, "Review of the Coasts of the Hawaiian Islands Navigation Facilities," was completed by HED in March 1989. A harbor at West Maui (Lahaina/Olowalu) was one of four projects in the State of Hawaii to survive two screening processes. However, the project was dropped because of marginal economic justification and potential social and environmental issues. The report concluded that the Corps should be requested to re-study the proposal for a second harbor for Maui if, after Kahului Harbor's facilities are expanded to their maximum use, additional facilities are still required.

5. PROBLEMS, NEEDS, AND OPPORTUNITIES

Maui, like all of the Neighbor Islands and the entire State of Hawaii, is near total dependency on ocean transportation for its basic sustenance and its economy. However, unlike the major islands of Oahu, Hawaii, and Kauai, Maui is served by only one commercial port. Kahului Harbor, located between the population centers of Kahului and Wailuku, is the only deep-draft commercial harbor servicing ocean cargo shipping for Maui and is the busiest Neighbor Island port.

In their report entitled "2010 Master Plan for Kahului Harbor," the State of Hawaii, Department of Transportation indicated its concern that if Kahului Harbor were to be closed due to a natural disaster or shipping accident, the island's supply line for its needed goods would be cut off. While some goods could be flown in at additional cost, bulk goods such as oil could not be accommodated. In addition, Kahului Harbor currently experiences operational inefficiencies due to lack of sufficient pier space and storage area. The expanding economy continually increases pressure on the harbor's limited facilities and inefficiencies in harbor operations can be expected to increase if measures to improve operational efficiency are not implemented.

A second commercial harbor on Maui could alleviate operational inefficiencies currently experienced at Kahului Harbor as well as provide an alternative port of entry in the event of an accidental closure of Kahului Harbor.

6. CONTINGENCY PLANS

Executing a response to a natural or human-induced disaster capable of rendering Kahului Harbor inoperable would require the coordinated efforts of numerous federal, state, county, and private sector entities.

Neither the State Department of Transportation Harbors Division, State Civil Defense, nor the County of Maui Civil Defense Agency has a written contingency plan that specifically addresses response and recovery in the event of an accidental closure of Kahului Harbor. General guidance on disaster response is contained in two state-wide disaster plans; (1) Supplement to Annex L (Emergency Resources Management), Volume I, Operational Civil Defense, State of Hawaii Plan for Emergency Preparedness and (2) an implementing directive from the Department of Transportation entitled Disaster Preparedness Plan dated November 18, 1986. The County of Maui has its own Emergency Operations Plan.

The U.S. Army Corps of Engineers has a wreck removal program which is coordinated with the U.S. Coast Guard through an interagency agreement. The exercise of Corps authority under Sections 15-20 of the River and Harbor Act of 1899, as amended (33 U.S.C. 409, 411-415) is limited to removal of vessels but does not include things like trucks, train cars, boulders, or debris. Authority is further limited to only those cases where navigation is affected. Procedures for the removal of wrecks are contained in 33 CFR 245 - Removal of Wrecks and Other Obstructions (rev. 1988).

Obstructions which impede or stop navigation; or pose an immediate and significant threat to life, property, or a structure that facilitates navigation; may be removed by the Corps of Engineers under the emergency authority of Section 20 of the Rivers and Harbors Act of 1899, as amended. In cases involving substantial threat to the human environment from pollution, the Coast Guard may exercise its own authority under 33 CFR 153 to remove or destroy a vessel.

Maui's electricity generation is heavily dependent on petroleum as a fuel source and Kahului Harbor is the only point of entry for Maui's supply of petroleum products. Fuel storage facilities are operated as a temporary storage for transferring petroleum delivered at Kahului Harbor to the users rather than a permanent reserve. The facilities have the capacity to hold more than a 30-day supply of petroleum products but they are not full most of the time. The major petroleum companies on Maui contacted for this study do not have written contingency plans in the event of an accidental closure of Kahului Harbor.

Maui Electric Company maintains a 30-day petroleum reserve on island as a precaution against short interruptions in petroleum deliveries. As a harbor closure is expected to last for a prolonged period, Maui Electric would look into alternative means of stretching their fuel reserves such as obtaining more power from bagasse-fueled generators, asking the public to voluntarily curtail its electricity use, airlifting fuel, unloading fuel offshore, or implementing rolling blackouts.

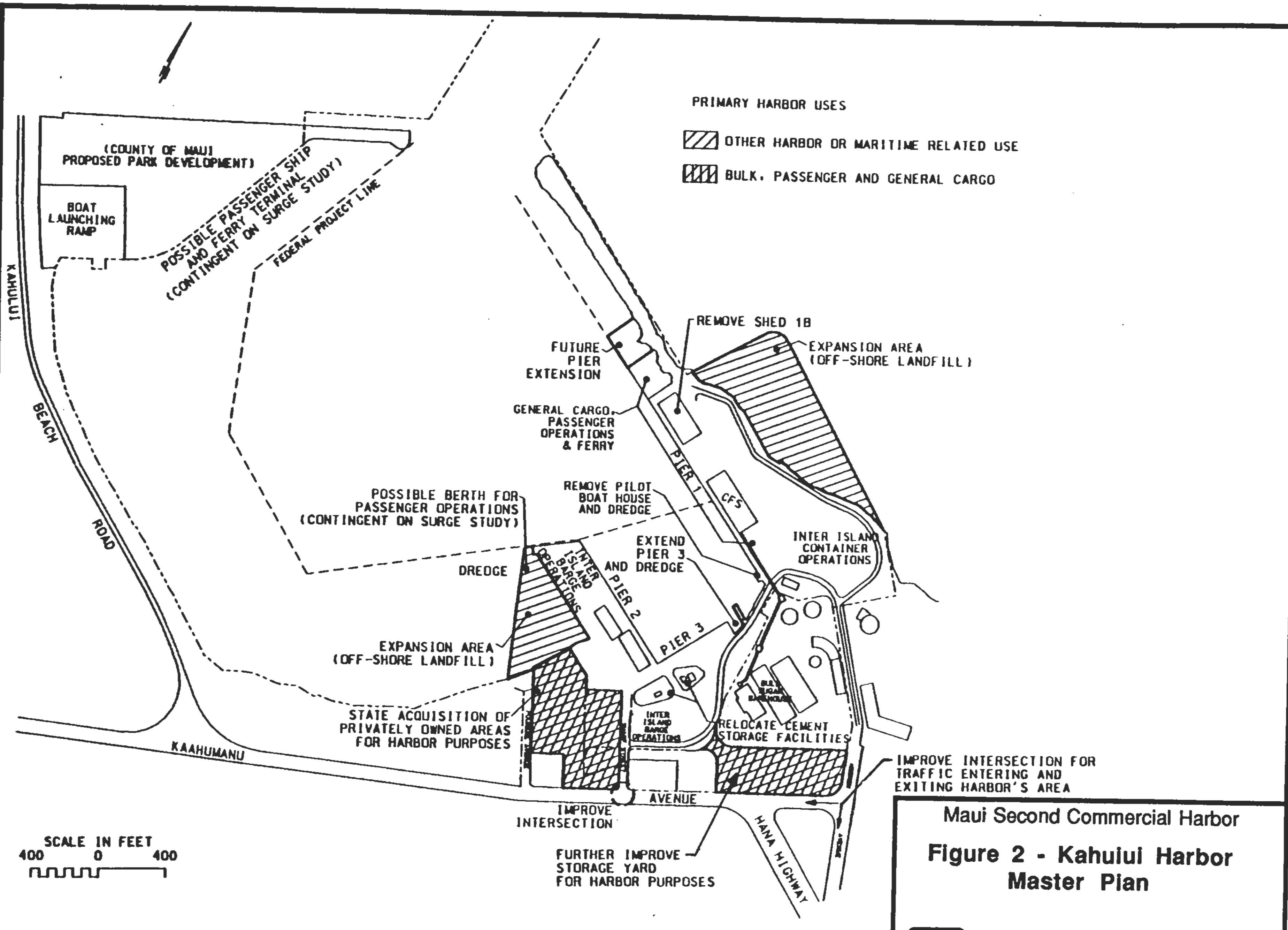
7. WITHOUT-PROJECT PROFILE

Kahului Harbor is located on the north shore of the Isthmus connecting East Maui and West Maui and is centrally positioned in Kahului Bay. The harbor is bordered to the south and east by Maui's principal towns of Kahului and Wailuku. Commercial activities for the island are centered around the Kahului-Wailuku area.

Kahului Harbor is Maui's only deep water port. The harbor features include a 600-foot wide entrance channel; two breakwaters on the east and west side of the entrance channel, 2,800 and 2,300 feet in length, respectively; and a harbor basin 2,050 feet wide, 2,400 feet long, and 35 feet deep. The harbor layout with proposed improvements is shown on Figure 2.

During the dredging for the deepening of Kahului Harbor in 1962, excavated earth materials were stockpiled (spoiled) along the inner near shore portion of the west breakwater. A peninsula of filled land was created along this breakwater. This fill area was turned over to the County of Maui by the State for use as a park, but to date the area remains undeveloped and largely unused. An existing boat launch ramp, small mooring dock, and 70-foot long stub breakwater are located on this filled peninsula at the west corner of the Kahului Harbor. Plans are currently underway to construct a light draft facility in the vicinity of the existing launch ramp.

Three piers with a total length of over 3,019 feet are situated in the eastern corner of Kahului harbor. These piers and their dockside facilities are used by tug and barge and deep-draft vessels to load and unload goods and passengers. The remainder of the harbor has not been developed for deep-draft navigation purposes.



Source: 2010 Master Plan for Kahului Harbor, January 1989

Maui Second Commercial Harbor

Figure 2 - Kahului Harbor Master Plan

U.S. Army Corps of Engineers
Honolulu District

The major users that share Pier 1 include Matson Navigation Company, American Hawaii Cruises, the Hawaiian Sugar Planters Association, and Hawaii Commercial and Sugar Plantation. Containerized cargo, dry and liquid bulk cargo, and cruise passengers are loaded and unloaded at Pier 1. Pier 1 is also used to load raw sugar and unload coal. The schedules of the different users have been coordinated as much as possible to avoid the arrival of more than one user at the port at the same time. Conflicts are rare, but when they do occur the passenger ships have priority. The sugar or coal operations must stop and the vessels moved out of the way to make room for the passenger ships. There is little flexibility in scheduling arrivals for the sugar and coal ships and they must often come in during the weekends.

Pier 2 is occupied by Hawaii Tug & Barge/Young Brothers Ltd. and its interisland barge operations. Break bulk and containerized cargo are handled at this facility's terminal and container yard. The space available for these operations, however, has become inadequate. The terminal does not have enough room for all the break bulk cargo that comes in on the barges. Items are handled more than is optimal as stevedores try to fit as much cargo in the terminal as possible. Some break bulk cargo must be stored outside the terminal because of this space shortage. Some break bulk cargo is temporarily stored at Pier 3 on occasion. The container yard has also become too small for the number of containers coming in on the barges. Due to this lack of space, containers are stacked two-high in the container yard. It is an efficient use of space, but problems can arise during the distribution of the containers for hauling to their final destination. As it is now, excessive cargo handling occurs regularly at Pier 2.

Pier 3 is used for barge deliveries of fuel and cement. The cement storage and distribution facility is located between piers 2 and 3. Scheduling conflicts also occur at this pier. Such conflicts cause delays and congestion in the harbor.

It is assumed that the present conditions existing in the harbor will continue throughout the study period and represent the without-project conditions.

8. PLANNING OBJECTIVES

The following planning objectives and constraints were developed in consultation with local interests to guide the formulation and evaluation of alternative plans:

- Provide an alternative commercial port in the event of closure of Kahului Harbor

- Maximize economic efficiency of waterborne commerce for the island of Maui

- Minimize adverse impacts to the natural environment and social well-being

- Identify and evaluate the adverse and beneficial impacts of alternative plans

9. SCREENING OF POTENTIAL SITES

An evaluation of prior second harbor planning studies, aerial photographs, general knowledge of the coasts and wave climate of Maui, site investigations, and meetings with Harbors Division and Maui County planning personnel resulted in the elimination of certain portions of Maui from further consideration.

Mala Wharf, Lahaina, Kalepolepo, and Kealia Pond were studied in conjunction with the 1967 study for the Ma'alaea Bay area deep-draft harbor. A facility at Mala Wharf was dismissed since the costs to develop a project in that location would be higher than at Kealia Pond. Development in the Mala Wharf area would impact the cultural attributes of the wharf as well as the cemetery landward of the wharf.

A commercial harbor in Lahaina was found to be incompatible with the existing historical district. Backup land would be very costly and expensive offshore breakwaters in water depths over 25 feet would need to be constructed. Excavation into the existing shoreline is not feasible due to existing development.

Kalepolepo was dismissed in the May 1967 study due to high construction costs. The long entrance channel and extensive dredging that would be required for a harbor at this site was found to be cost prohibitive. In addition, sea and navigation conditions at this site are generally less favorable than those at other areas of the bay.

Kealia Pond in the Ma'alaea area was considered the most desirable and practicable site for a second deep-draft harbor on Maui during the 1967 study. Studies were suspended due to environmental concerns and lack of support by local interests. Kealia Pond has since been dedicated as part of a 700-acre national wildlife refuge and thus was eliminated from further consideration.

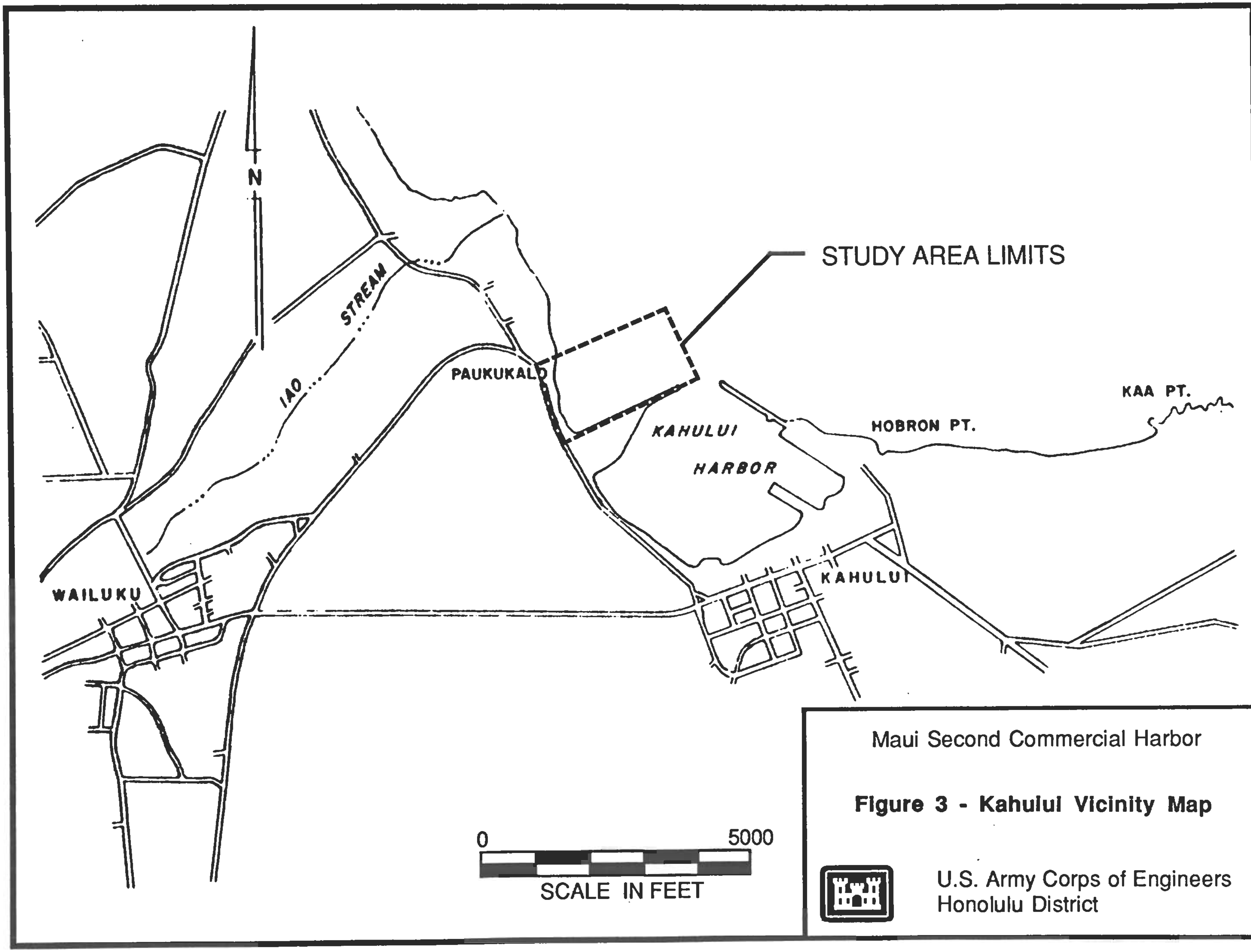
During the 1979 study for a second commercial harbor for the South Shore of Maui, Maui County officials expressed a desire that the harbor not be placed toward Lahaina or Kihei. No current interest in a commercial harbor in these areas was indicated so they were eliminated from further consideration. Areas west of Lahaina and east of Kihei were also eliminated from further consideration since they are too remote and inaccessible to allow efficient harbor operation.

The screening of potential sites resulted in the preliminary selection of four sites for further reconnaissance level evaluation; Kahului, Ma'alaea, Ukumehame, and Olowalu (Figure 1). Kahului is situated on the windward side of central Maui. Ma'alaea, Ukumehame, and Olowalu are located on the leeward side of the island at the base of the West Maui Mountains and are collectively referred to as the 'West Maui' sites.

10. PRELIMINARY SITE SELECTION

10.1 Kahului

The Kahului site is located west of and adjacent to the west breakwater at Kahului Harbor (Figure 3). This area is referred to by local residents as 'Hata Bay'. Hata Bay is exposed to a similar adverse wave climate as Kahului Harbor and a natural disaster capable of damaging Kahului Harbor is likely to also damage a Hata Bay harbor. However Hata Bay could provide an alternative facility if Kahului Harbor were rendered unusable due to a shipping accident at the mouth of Kahului Harbor.



Maui Second Commercial Harbor

Figure 3 - Kahului Vicinity Map

U.S. Army Corps of Engineers
Honolulu District

10.2 Ma'alaea

The Ma'alaea site is located just west of Maui Electric Company, Ltd.'s Ma'alaea Power Plant and east of the Ma'alaea condominium resort area. Ma'alaea is located on the southwest shore of the island (Figure 4), about 7 miles south of the County seat in Wailuku and about 8 miles south of Kahului.

10.3 Ukumehame

Ukumehame is located approximately 4 miles west of Ma'alaea (Figure 5). The coastal areas are relatively flat up to the toe of the West Maui Mountains. Honoapiilani Highway runs through the area parallel to the shoreline. Existing land use in the area includes sugar cane cultivation, Ukumehame Beach Park (County operated), the State Remnant Wayside Park, and the Ukumehame firing range. The closest urban area with permanent residents is at Olowalu.

10.4 Olowalu

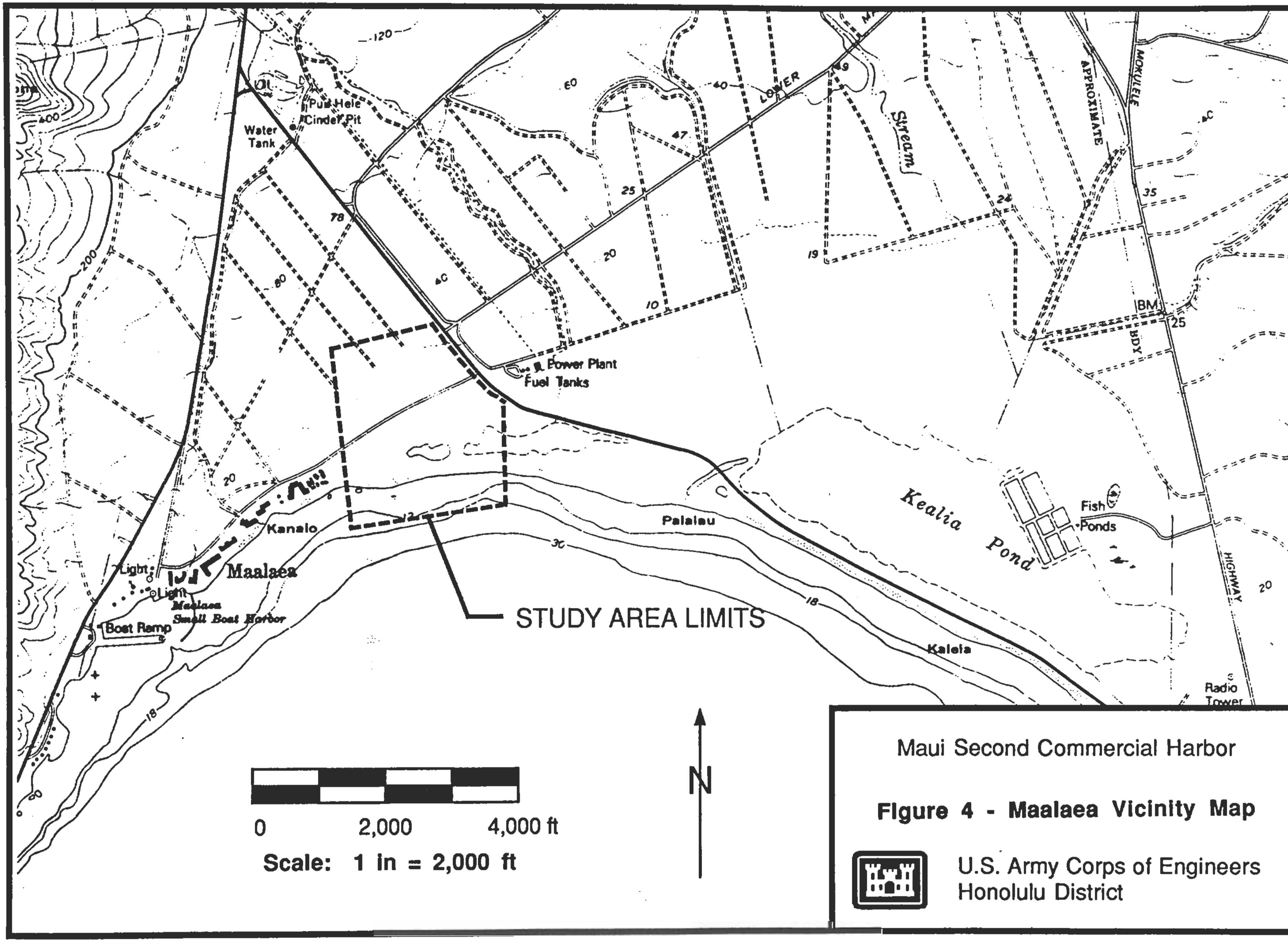
Olowalu is approximately one mile west of Ukumehame (Figure 5). The Olowalu site is located at the flat coastal area seaward of Honoapiilani Highway at the mouth of Olowalu Stream. The area is currently cultivated in sugarcane.

11. PHYSICAL SETTING

11.1 CLIMATE

The mean annual temperature on Maui is 75°F. The daily temperature ranges between 60°F and 90°F, the warmest weather occurring between May and September.

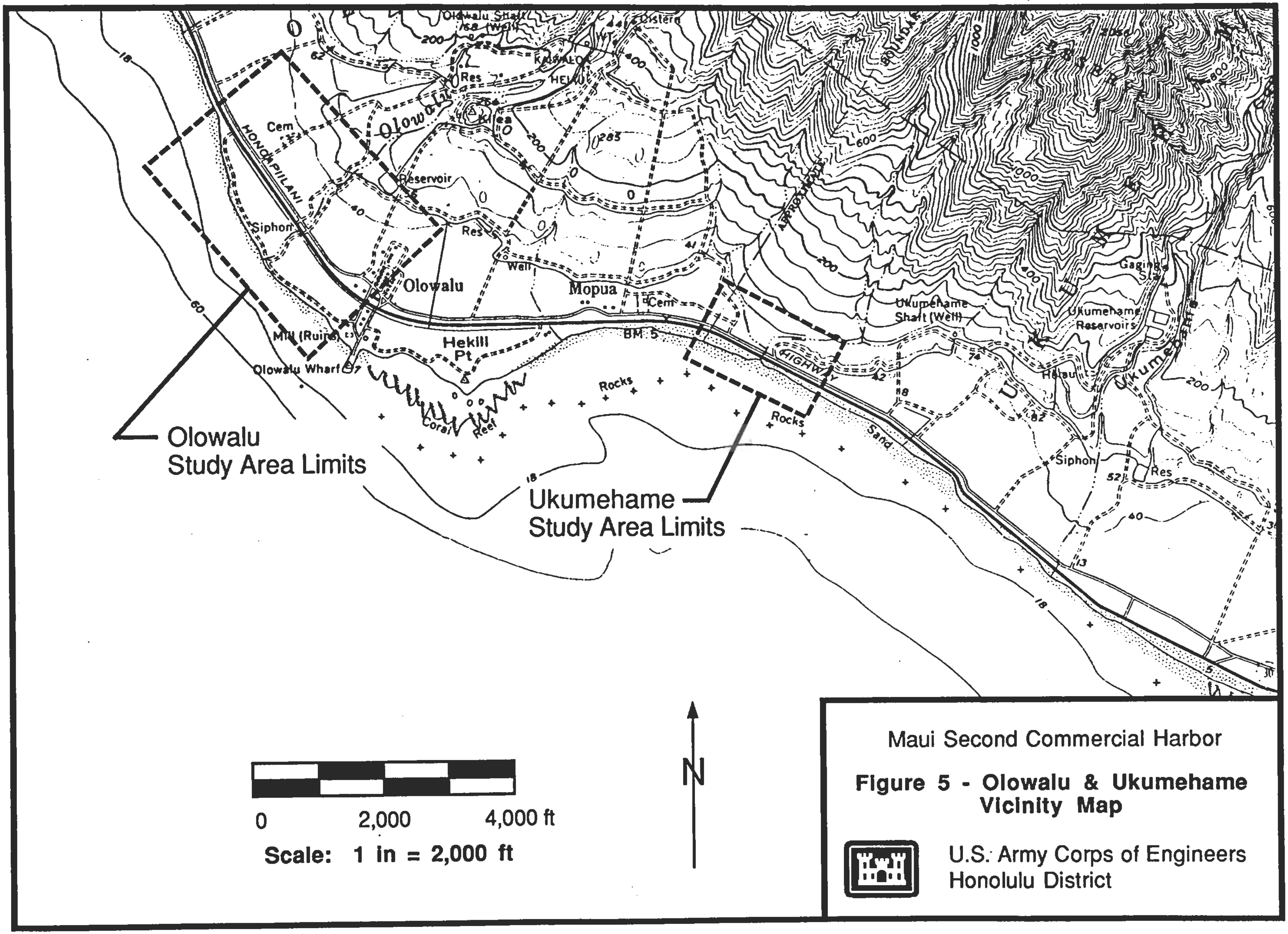
Annual rainfall in Kahului averages less than 20 inches with June being the driest month. The West Maui sites have a mean annual rainfall of approximately 13.8 inches. Most of the rainfall occurs during 'Kona' weather in the winter months between October and April.



Maui Second Commercial Harbor

Figure 4 - Maalaea Vicinity Map

U.S. Army Corps of Engineers
Honolulu District



Maui Second Commercial Harbor

Figure 5 - Olowalu & Ukumehame Vicinity Map

U.S. Army Corps of Engineers
Honolulu District

11.2 TIDES

Tidal benchmarks closest to the proposed sites are located at Kahului Harbor and Olowalu. Tidal data utilized for the Hata Bay site are based on data for Kahului Harbor by the U.S. Coast Guard and Geodetic Surveys. Tidal data for the West Maui sites are based on data for Olowalu and Makena from the U.S. Department of Commerce, National Oceanic Atmospheric Administration and National Ocean Survey. See Appendix C, Design Analysis.

11.3 WAVES

The Kahului site is exposed to waves from the north Pacific swell and tradewind waves from the north and northeast quadrants. West Maui is sheltered from these waves but are exposed to the southern swells and Kona Storms which approach from the south and southwest quadrants. See Appendix C, Design Analysis.

11.4 CURRENTS

11.4.1 Kahului

A report entitled "Study of Pollution in Kahului Bay, Maui, Hawaii," prepared for the State of Hawaii in December 1962, documented an intensive study of the current systems in Kahului Harbor and in the bay. Information on currents in the harbor area can also be found "Littoral Processes and Shore Protection at Kahului Harbor, Maui, Hawaii," completed by the Marine Advisers for the State of Hawaii in March 1965. Currents outside the harbor breakwaters are predominantly east to west and northward along the coast. Within the harbor basin area, a clockwise current prevails during the flood tide, and counterclockwise during ebb tide.

Current velocities vary considerably from location to location and also at one location during the same day. Velocities ranged from less than 0.1 knot to 0.5 knot in the littoral zone, and from less than 0.1 knot to 0.3 knot outside the surf zone. The highest velocities were near the center and in front of the Hukilau Hotel. The littoral currents were very consistent in pattern along the northeast shoreline of the harbor, but were weaker and less uniform on the southwest shoreline. Under conditions of high surf, the littoral current is northeasterly in front of the Maui Palms and Hukilau Hotels at 0.1 to 0.2 knot, whereas just offshore beyond the surf, the current sets southwest with velocities between 0.05 and 0.3 knot under all trade wind conditions. On 9 October 1964, when trade winds averaged 12 knots and no large North Pacific swell entered the harbor, a short period of observation indicated both offshore and littoral currents moving southwesterly along the southeast shoreline.

11.4.2 West Maui

Although only limited current studies have been made along the southwest coast of Maui, a northwestward to westward current along this coast has been reported. Coast and Geodetic Survey observations in 1962 for the Alalakeiki Channel, between Kahoolawe (a rugged, uninhabited island situated 12 miles southwest of the study are) and Maui, show variable currents with maximum velocities of 1 knot and a predominately northwesterly drift of 0.5 knot along the Maui coast. Along-shore currents generated by wave action of approximately 0.4 knot were noted during the January-February 1963 storm.

At Olowalu, currents are dominated by the southwest setting, tradewind-generated surface current. Current speed is estimated to be typically less than 1 knot under normal tradewind conditions and does not cause navigation problems. Significant wave-generated rip currents may exist when high waves are breaking but this phenomenon has not been documented.

11.5 STORMS AND HURRICANES

Major storms in Hawaii are generally the result of cold fronts, low pressure passages, and hurricanes. The cold fronts cause gusty winds which are often accompanied by rain. Low pressure passages are called "Kona" storms which generally approach from the south and southwest.

Hurricanes are an infrequent source of large destructive waves in Hawaii. While there are many recorded tropical storms or hurricanes which have approached the islands, most of these storms pass to the south and only cause high surf or heavy rainfall. However, damaging hurricanes struck the island of Kauai in August 1959 (Dot), November 1982 (Iwa), and most recently in September 1992 (Iniki). Hurricanes Iwa and Iniki flooded coastal areas in the Hawaiian Islands due to high water levels and high surf.

11.6 GEOLOGY

The Island of Maui consists of two volcanic domes, the Haleakala and West Maui mountains. These domes are separated by a low strip of land consisting of overlapping lava flows known as the Isthmus. Haleakala, sometimes called the East Maui volcano, is 10,025 feet high and 33 miles across. The West Maui volcano, Puu Iki, is roughly one-half the size of Haleakala. Eruptions which built most of these two volcanoes ended sometime around the early Pleistocene Epoch, or about 0.8 to 1.3 million years ago. Many smaller phases of volcanism have occurred in recent geologic times (- 10,000 years b.p.) with local eruptions having occurred on Haleakala as late as about 1750. The relative sizes of the mountains in addition to the occurrence of deeply incised amphitheater headed valleys on the West Maui volcano, supports the fact that dormancy was achieved on this volcano before Haleakala. Most of the lava flows on both volcanoes dip gently seaward at about twelve degrees.

The Isthmus was formed by lava flows and ash falls from Haleakala ponding and settling against the older West Maui mountain. Streams on both mountains flow on steep gradients and drop their sediment load upon reaching the comparably flat Isthmus creating large fluvial deposits of alluvium and colluvium. Extensive calcareous sand dunes attaining heights up to 200 feet covers the portions of the Isthmus from Kahului on the north shore to Kihei on the south shore. The dunes diminish rapidly in height and size in the southerly direction. The dune sand consists chiefly of fragmented community coral, shells, and foraminifera with small and variably percentages of basalt sand.

11.6.1 Kahului

Hata Bay is located on the north shore of the Isthmus west of Kahului Harbor and is part of Kahului Bay. It is separated from Kahului Harbor by the port's west breakwater. The mouth of Iao Stream is located approximately one mile north of Kahului Harbor's west breakwater. Iao Stream has meandered throughout the Kahului Bay area in the recent geologic past, incising ancient reefs and lava flows and backfilling the stream valley with basalt sands, gravels, cobbles, and boulders. These sediments have subsequently been reworked by wind current and waves in the bay. A weakly cemented coral/rubble reef covers pahoehoe and a'a lava basalts of the Wailuku Volcanic Series. This deposit is thin nearshore and increases in thickness offshore. The backshore area of Hata Bay and Kahului Bay were subsequently inundated (and buried) by the landward migration of dune sand during the Pleistocene.

11.6.2 Ma'alaea

In contrast to Hata Bay, Ma'alaea is located at the southern edge of the Isthmus. Most of the site is covered with reddish-brown clay ash (silty clay) from Haleakala to depths of approximately 10 to 20 feet. The site is also underlain by hard, vesicular lava basalt of the Wailuku Volcanic Series. Along the shoreline, thin deposits of beach/dune sand and silty sand resulted from wave action in Ma'alaea Bay interacting with the migrating dune sands. Thin coral reefs and beachrock have developed directly offshore.

11.6.3 Ukumehame and Olowalu

These sites are within the same geomorphic setting; a low, flat, and narrow coastal plain on the southwest side of the west Maui mountain. This coastal plain was formed primarily by stream erosion and deposition (Ukumehame and Olowalu Streams) of the lava basalts of the Wailuku series (of the West Maui volcano). The resultant surface soils are unconsolidated, highly stony volcanic sands and silts. Depth to bedrock is unknown but could be shallow (10 - 20 feet). Considerable field stone have been piled by the plantations on the gentle slopes above the sites and could be a source of rock for revetments. The shorelines consist of wave and current deposited/reworked sands and gravel. Young and thin coral and rubble reefs have developed in the shallow near shore zone.

11.7 GROUND WATER

With the exception of Hata Bay, all sites will encounter shallow, brackish ground water. Hata Bay is an off-shore site without ground water. None of the sites are within usable aquifers or have a major impact on potable ground water resources.

11.8 SEISMICITY

The island of Maui is within Seismic Zone 3 which is considered moderate. Earthquakes associated with underground volcanic activity and submarine subsidence are felt occasionally, however, because of their low intensities, they seldom cause even minor damage.

12. ENVIRONMENTAL RESOURCES

Information on the environmental resources of the four potential second harbor sites were obtained through literature searches and field investigations. The field work was undertaken from 7-10 March 1994 by a staff ecologist and included the terrestrial and aquatic environments within the study limits delineated on Figures 3 through 5.

12.1 HATA BAY, KAHULUI

12.1.1 Shoreline and Nearshore Marine Resources

The beach is comprised of smooth, rounded basalt and coral cobbles. There is no beach sand along this reach of coastline until past Nehe Point at Waiehu. The beach is strewn with an assortment of flotsum driven ashore by the normally strong tradewinds.

Recreational use of the beach is limited by the nature of the beach material and weather conditions. Some throw net and shore casting fishing takes place but most of the pole fishing is done from the west breakwater.

The shallow reef flats northwest of Kahului Harbor (including "Hata" Bay) are fished throughout the year, with heaviest use during periods of Kona weather and calm seas.

Coral cover reaches 35% on the irregular reef flanking the western breakwater of Kahului Harbor. Montipora patula is dominant. Algae are generally sparse, but total cover approaches 15% in places. Halymenia formosa and Amansia glomerata are most common. Thalassoma duperreyi, Stegastes fasciolatus, Bodianus bilunulatus, and Plectroglyphidodon imparipennis dominate the fish assemblage. Green sea turtles, Chelonia mydas, may be seen outside the western breakwater.

Coral cover approaches 40% on the outer part of the reef bordering Paukaukalo Beach. Montipora patula is most common. The sea urchin, Echinothrix sp., is abundant. Fleshy algae cover up to 10% of the bottom. Martensia sp. is dominant. Rhinecanthus rectangulus, Chaetodon frembilii, Thalassoma purpureum, Acanthurus dussumieri, and A. triostegus are the most conspicuous fish.

A reef borders the coast northwest of Kahului Harbor. The outer part of this limestone shelf displays high vertical relief off Paukaukalo Beach. Projections of reef rock rise above a 15-foot depth to within eight feet of the surface. Numerous surge channels and small overhangs provide additional relief above pockets of sand.

12.1.2 Water Quality

The waters inside and outside Kahului Harbor are classified "A" under Department of Health water quality regulations. Although no streams enter Kahului Bay, some storm drains discharge into the harbor. Maui Electric Company disposes of heated water used in cooling a power-generating plant east of the harbor. A layer of fresh water floating over seawater has been noted inside Kahului Harbor, indicating seepage from the groundwater table.

Waters at the mouth of the harbor are turbid, with noticeably high concentrations of plankton. Underwater visibility is no greater than five feet. Visibility is just as poor on the outer part of the reef fronting Paukukalo Beach, where strong winds keep water turbulent and murky. Northwest of the harbor, visibility is often poor because of choppy seas whipped by strong trade winds.

12.1.3 Shoreside Resources

Backshore area behind beach berm is well worn by cars and trucks that park along it. Vegetation is limited to some patches of naupaka, beach morning glory, salt grass, and a few tree heliotrope. Across the highway is a narrow tract of undeveloped land vegetated with grasses, weeds, koa haole shrubs, and kiawe trees. Behind this are several churches and residential developments. On the western end of the study limits is a light industrial area. New residential developments are being constructed on the slopes behind and to the west of Hata Bay.

Exotic, urban bird species are found within the study limits. Because of the absence of sand beach habitat, it is unlikely that the shoreline is frequented by migratory shore birds. The close proximity to a busy highway probably contributes to the limited use of the shoreline and backshore areas by birds or small mammals including mice, rats, mongoose, and domestic dogs or cats.

12.1.4 Recreation

Good shoreline access exists here but the recreational use of the beach is limited by the nature of the beach material and prevailing weather conditions.

Recreational fishing along the western breakwater is a popular activity. Shore casting for ulua, papio, oio, and awa is common. Throw netting, gill netting, and spear fishing take place offshore, weather permitting. Ogo, other edible seaweed, and wana (sea urchin) are collected on reef back. The shallow reef flat is considered one of the best octopus grounds on Maui.

Under certain conditions breaking waves in Hata Bay are probably surfable. However, preferred surfing spots are beyond the bay to the east at Paukukalo and in the harbor along the edge of the shallow reef platform on the west side.

The filled land on the northwest side of Kahului Harbor is a public park. At present it is without facilities or improvements considered standard features of a beach park. A boat launching ramp is located on the harbor side of the park. Improvements to the launching facility are anticipated in the near future.

12.1.5 Land Use

Most of the land fronting the proposed harbor site is classified as open space in the County of Maui, Wailuku - Kahului Community Plan. Other parcels of land within this area are classified as public/quasi public and light industrial . Inland of this undeveloped land along the waterfront are a residential subdivision and several churches.

12.2 MA'ALAEA

12.2.1 Shoreline and Nearshore Marine Resources

The foreshore in the study limits is part of a fairly wide (for Maui) long white sand beach that extends from the Ma'alaea condominium resort area west of the potential harbor site to Kihei, spanning Ma'alaea Bay. This beach is used extensively, mainly by tourists who walk along it, often from one end to the other and back. This activity goes on all day but with greater frequency in the morning and late afternoon. The beach is also used for sun bathing and by throw net and pole fisherman. Snorkelers and spear fishers use the waters offshore.

Directly offshore is a shallow limestone bench that is exposed on very low tides. The bench is covered with a variety of benthic algae. In some areas the bench is highly pitted and contains burrowing sea urchins (Edrinometra mathaei). The shallow hard bottom continues for approximately 100-200 feet offshore. There are few corals or topographic features suitable for fish habitat. Fishes in this area are mostly transient itinerants. Beyond this, depth gradually increases to about 20 feet. In this zone, especially on the western side, vertical relief increases notably, with numerous limestone slabs and blocks. Coral colonies, with several species of Porites, Montipora, and Pocillopora being dominant, become abundant in some areas, especially on the slabs and tops of hummocks. Pocillopora colonies are scattered throughout the area. In some places, depressions are filled with sand and occasional patches of sand 10-20 meters in diameter occur on a generally flat limestone pavement. Approximately 400 meters offshore water depth increase to 20-25 feet and within another 100 meters to 30 feet and deeper. The bottom is mostly flat limestone pavement with a veneer of sand in some areas. A very conspicuous feature, a raised limestone ridge approximately 10-15 meters wide, runs parallel to the shoreline for 150-200 meters. Sections of it are solid and continuous with the deeper flat bottom while other parts are fractured resulting in a blocking, slabbing configuration. Large fish populations are associated with the slab complexes. Predominant fishes are large acanthurids (palani, pualu, kala), chubs (nenue), goatfish (weke, moano) and snapper (toau). Interestingly, no parrot fish (uhu) were observed in this area. Two green sea turtles were resting here under ledges created by the slabs.

A previous study of marine resources in Ma'alaea Bay (Maciolek, 1971) concluded that the Kanaio - Palalau sector (which includes the harbor site) possesses the richest (greatest diversity and abundance) assemblage of marine biota in the bay. The study found that, in general, marine resources associated with coral reefs were richest on the west side of the bay and in shallow water (up to 10 meters), decreasing in richness going east and with depth, where a sand and mud bottom dominates.

Ma'alaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale, of which one subpopulation spends approximately 6 months (Dec-May) in Hawaiian waters. A National Marine Sanctuary was established in 1992 specifically as humpback whale sanctuary. Its boundaries include all waters within the 100 fathom line around Maui, Lanai, and Molokai.

The Coastal Barrier Improvement Act of 1990 was established to insure the protection of coastal wetlands. The segment of Ma'alaea Bay fronting Kealia Pond and the Wildlife Refuge is included in the proposed Coastal Barrier Resource System.

12.2.2 Water Quality

State Water Quality Classification (Chapter 37-A) is Class A, exclusive of Ma'alaea Small Boat Harbor which is Class B. It is considered seasonally wet open coastal water (>0.5 but <3 million gallons per day (MGD) fresh water stream discharge/shoreline mile).

The eastern part of Ma'alaea bay is characterized by high turbidity, with more silt in near shore waters than in the western part (Palalau - Kanaio) where water clarity is much greater (10-15 meters horizontal visibility).

12.2.3 Terrestrial Biological Resources

Ma'alaea and Kihei coastal areas are urbanized residential communities. Vegetation consists of typical ornamented trees and shrubs compatible with dry coastal areas. Kealia Pond dominates the central part of the Ma'alaea Bay coast. Beach strand vegetation exists along the vegetation line just shoreward of the beach. Other dominant vegetation types are a pickleweed community mauka of the coastal highway extending approximately 1/2-mile inland around the border of the pond. Behind this is a kiawe (mesquite) community comprising an approximately 1,000 foot-wide band terminating inland at the margin of the cane fields. A pluchea-pickleweed community dominates the western end of the Kealia National Wildlife Refuge from shore inland to the highway.

The western boundary of the study limits is immediately adjacent to a small public park at the eastern end of the condominium development. An unimproved road continues into the open marsh and dune backshore area. Local residents camp and picnic along the dunes behind the beach. The road also provides access for fishermen. A shallow pond used by the endangered Hawaiian Stilt is located on the eastern end of the study limits and is contiguous with the bird refuge. Vegetation in this area is predominantly kiawe trees and pluchea shrubs. A cane haul road cuts across the site diagonally separating the cane land and the unimproved land.

Kealia Pond provides important habitat for Hawaiian water birds including the endangered Hawaiian stilt and coot. A 700-acre National Wildlife Refuge including Kealia Pond and adjacent buffer zone was established in December 1992. The refuge is managed by the U.S. Fish and Wildlife Service. The western boundary of the refuge is contiguous with the study limits.

12.2.4 Recreation/Public Use Values

A high potential for public recreation exists here due to the following factors:

(1) Open, almost continuous sandy beach with immediate public access.
(2) Safe swimming, no strong long-shore currents, safe entry into water.
(3) Water clarity - seasonally clear water for snorkeling and diving.
(4) Proximity to population centers.
(5) Surfing - numerous surf sites. Surf is seasonal and dependent upon south swell.
(6) Boating - Ma'alaea Small Boat Harbor

12.2.5 Land Use and Ownership

Land in the Ma'alaea study area is mostly owned by Alexander and Baldwin with residential areas on either side of the bay at Kihei and Ma'alaea. There are a number of small miscellaneous holdings.

Most of the land in the harbor study limits is in the State land use category - open space. The remainder is classified as agriculture and is presently under sugar cane cultivation.

Land use trends show a significant loss of agricultural lands to urban uses. From 1969 to 1972, 4,000 acres agricultural land converted to urban use. Resort and residential development along beaches are limiting/restricting public access.

12.3 UKUMEHAME

12.3.1 Shoreside Resources

The shoreline within the study limits encompasses much of what is referred to as Olowalu Beach. It is a narrow basalt sand beach exposed on low tide. At high tide the sand beach is awash or under water leaving only a basalt cobble beach.

Although it is almost immediately adjacent to a busy highway, this beach is a surprisingly popular destination among tourists. From morning to evening, dozens of cars are parked along this reach of coastline. Picnicking, sunbathing, and snorkeling in the normally calm sheltered waters are popular activities.

Approximately 300 feet of study area shoreline is eroded back to the shoulder of the highway. A make-shift revetment (drop rock) has been placed here to stem the erosion, and a low concrete barricade has been constructed along the seaward edge of the shoulder.

Vegetation along the shoreline is predominantly kiawe thicket with scattered milo trees and pluchea shrubs. Pickle weed ground cover occurs in some areas. Mauka of the highway is a grove of kiawe trees and sugar cane in a narrow band from the highway inland about 100 yards. Kiawe forest and pasture land continued upslope from there. The area immediately behind the highway, including the cane haul road is below the elevation of the highway and apparently floods during heavy rains. The land slopes upward from the low spot at about 1 vertical to 5 horizontal. Birds and terrestrial mammals do occur in the study area but are not abundant on the seaward side of the Honoapiilani Highway because of the fairly intensive human activity and heavy vehicular traffic. Rats and mongoose are probably fairly abundant in the cane fields across the highway.

12.3.2 Marine Resources

Water depth is very shallow for the first 100 meters. The bottom in this zone is mainly basalt sand and cobbles. Live corals, fish, and other marine life are sparse. Beyond this zone depth gradually increases, bottom relief increases dramatically, live coral cover approaches 90%, and the diversity and abundance of reef fishes increases correspondingly. The study limits and beyond includes a very high quality coral reef ecosystem, by far the best of the four sites being considered in this study. Not surprisingly, it is one of the most popular snorkeling areas on the island.

The reef in the study limits remains shallow (between -10 to -15 feet) for about 1/2-mile offshore. It then gradually slopes into deeper water (between -20 and -30 feet) with occasional ridges and hummocks extending to within 10 feet of the surface.

Humpback whales are usually abundant in the waters off Olowalu/Ukumehame from December through May. Green sea turtles are also common along this coastline. Both species are protected under the Federal Endangered Species Act.

12.3.3 Water Quality

Water quality appears to be very good. There are no stream outlets between Olowalu and Ukumehame streams. The study area is about midway between them. In the immediate shallow nearshore waters out to approximately 50 meters some turbidity was observed. Beyond this sand bottom zone, the water clarity quickly becomes excellent. The State water quality classification is class A.

12.3.4 Recreation

Recreational use of the study area is principally by tourists. Snorkeling is very popular because of the normally quiet placid water and the well-developed shallow coral reef community offshore. Along with this activity go picnicking and sunbathing.

12.3.5 Land Use

The land on the ocean side of Honoapiilani Highway is owned by the State of Hawaii and is part of the beach reserve, with a land use designation as open space. The land mauka of the highway within the study limits is also owned by the State and is classified as agricultural. A narrow strip of it is cultivated in sugar cane. The sloping grass lands behind this are used for grazing beef cattle.

12.4 OLOWALU

12.4.1 Shoreline and Nearshore Marine Resources

The entire project shoreline is a basalt/coral cobble beach that appears to act in high surf conditions as a "dynamic revetment". There is no accumulation of sand anywhere along the shoreline.

Shallow depths (1-1.5 meters) are relatively barren with occasional small colonies of Pocillopora meandrina, P. damicornis and Montipora vesuicosa. The bottom is consolidated reef rock (limestone hard pan) covered with algal turf. Very little sand was observed in this zone. A fine silt coating settles out on the algal turf and is resuspended by wave action and strong currents.

In deeper waters off the west side of Olowalu Pier, bottom features are quite variable. Some areas are flat and barren. In some areas the limestone is overlaid with sand. Other areas have a fair amount of vertical relief - undulating hummocks, limestone slabs and boulders. These are usually covered with corals. Dominant corals are Porites lobata, P. compressa, Montipora verrucosa, and Pocillopora meandrina. Some reef fishes are associated with these areas, but by and large, the entire study site surveyed was depauperate of fish life. One large school of very large kala (Naso unicornis) was observed in shallow water, between Olowalu Stream mouth and the wharf.

The inshore area between Olowalu and Papawai Point is used as a nursery between December and May by endangered humpback whales. Large sharks are occasionally sited along this coast.

12.4.2 Water Quality

State Water Quality classification: Class A.

Waters off Olowalu are considered "seasonally wet open coastal waters" (208 Technical Committee Report, Dec 77) receiving greater than 0.5 MGD but less than 3 MGD fresh water stream discharge per shoreline mile.

Olowalu Stream bisects the study area from north to south. It is not a perennial stream but discharge can be fairly high during the rainy season. The water is murky off the mouth of Olowalu Stream. The bottom is limestone hardpan with lots of basalt river rock cobbles and small boulders, usually coated with turf-like algae. There are no coral colonies in the immediate vicinity of the stream mouth. In general, the shallow waters were murky with about a 10-foot horizontal visibility. In deeper water farther offshore 50 to 60-foot horizontal visibility was prevalent.

12.4.3 Terrestrial Biological Resources

Behind the cobble beach berm on the shoreline is a narrow strip of land that is not cultivated in sugar. Some of it is lower than the surrounding land and ponds after heavy rains or high surf. The salt content of the soil is high here and not much vegetation other than a few salt tolerant coastal plants will survive. Cane cultivation begins right beyond this buffer zone and continues across the coastal plain to the foot of West Maui mountains. Scrub kiawe and grasslands continue from there up the mountain and are used to graze beef cattle.

Wildlife in the study area comprises common exotic birds and mammals, mainly rats, mongoose, and cats. As there is no sandy shoreline within the study area, it is unlikely that shorebirds frequent the site.

No threatened or endangered plants or animals are known to occur in or adjacent to the study area.

12.4.4 Recreation

There is no sand beach within the study area. The entire shoreline is a basalt and coral cobble berm, not amenable to most recreational uses. Shore casting for ulua and papio from behind the cobble berm is said to be popular. A County beach park is located approximately 2.5 miles west of Olowalu.

Eight surf sites are identified by statewide surfing site study. All were rated as seasonally good sites with the two off Olowalu and Hekili Point being the best.

12.4.5 Land Use and Ownership

Most of flat coastal area is cultivated in sugar, with pasture lands on slopes above the cane fields. Amfac owns most land under cane cultivation. The State of Hawaii owns the rest.

The shoreline area below highway is designated as conservation district by state land use maps. Areas above the highway to forest reserve boundary are included in agriculture district. Lands mauka of the forest reserve boundary are in the conservation district. The County of Maui Lahaina Community Plan classifies coastal land as open space or park. Present land use will probably continue for sometime, with no trend toward urbanization or resort development in this area.

Pioneer Mill (Amfac) plantation manager's house and other plantation houses are located in or directly adjacent to the study limits. Honoapiilani Highway bisects the study area, east to west. It is presently the main arterial between the population centers of east and west Maui and is usually quite busy. A store, a restaurant, and several residences are located on the east side of the study area mauka of Honoapiilani Highway.

12.4.6 Aesthetic Considerations

The unobstructed relatively natural shoreline and the scenic vista from coastal highway of Lanai and Kaho'olawe should be preserved.

13. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

An archaeological reconnaissance survey was conducted at the four proposed sites for the Maui second commercial harbor in order to assess the need for Section 106 coordination compliance and potential historic preservation. The field work was undertaken from 7-10 March 1994 which also included preliminary background research of the archival documents housed at the Maui Historical Society in Wailuku. Archival research is an excellent source of information for predicting both historic and prehistoric land use pattern and the potential presence or absence of cultural resources.

Field survey methods at the proposed harbor sites were similar. Field survey in each site began with delimiting the site boundaries as indicated by the study limits on Figures 3 through 5, followed by a brief description of the site, and concluding with non-systematic familiarization pedestrian survey. The pedestrian survey was keyed to searching for and identifying likely areas for surface and subsurface historic properties. The approximate locations of historic properties present in each site were recorded on site plans and maps and each property briefly described. Photographic records of each project site and historic properties present were also maintained. Discussion of the results of the survey of the four proposed harbor sites is contained within the following sections.

13.1 HATA BAY, KAHULUI

Most of the western and immediate southern shoreline is composed of modern and dredged fill material from construction for the Kahului Beach Road (Route 340) and the northern breakwater for the present Kahului Harbor. A former military (World War II era) camp was located in this area (portions of the area have been surveyed for the Defense Environmental Restoration Program/Formerly Used Defense Sites program). The remains from some of this camp are still present south of the highway.

Archival research indicates that the area surrounding Hata Bay is potentially culturally significant, comprising a section of the Maui shoreline traditionally called Makawela (Ashman n.d.). Makawela stretches from the Kanaha ponds at the south end of Kahului Bay to Melekaakoa and Wai'ehu-kai on the north. A fishing shrine, destroyed by the tidal waves of 1876 and

1946, was located at Melekaakoa. Traditionally, the Makawela area was very "kapu" as it provided an "entrance to Iao Valley where kings dwelt" (Ashman n.d.). Makawela was known, as well, as "the sacred burial place". It was also the landing place in 1790 of Kamehameha I's Peleleu Fleet of war canoes from Hawaii Island which partook in the Battle of Ka-paniwai o 'Iao. In that battle, Kamehameha was the victor over Kahekili, the Maui chief, bringing the island of Maui under his rule. Kamehameha I went on after his Maui conquest to unify the Hawaiian islands as one kingdom under a single ruler.

The study area consists of a generally flat spit of land measuring from 18 to 30 meters (55 to 90 feet) wide, bounded on the west by Route 340, or Kahului Beach Road, and on the east by Kahului Bay. The shoreline consists of a cobble and boulder beach 10 meters (30 feet) wide, at most, and littered with modern garbage and debris such as tires, concrete blocks and slabs, plastic containers, and driftwood. Immediately behind the beach is an old unused paved road (maximum width of 3 meters or 10 feet), that extends about three-fourths the length of the study area from the northern end. Vegetation in the study area is mostly low shrubby pluchea bushes intermixed with occasional stands of heliotrope and *naupaka* at the south end with woody *milo* and false *kamani* trees at the north end. Other plants include morning glory, pickle weed, coconut, and unidentified weedy grasses.

Wave action has cut the shoreline, leaving a standing escarpment ranging from 30 centimeters or 1 foot high at the south end to over 1 meter or 3 feet high at the north end. Evident within the escarpment is an old buried surface and cultural layer containing charcoal, basalt flakes, a basalt adze blank, and midden remains (Photo 1). Also observed at the base of the escarpment were coal fragments and probable bovine vertebrae. The cultural layer ranges in thickness from 1 to 25 cm (1/2 to 10 inches) and, for the most part, has been either partially or totally truncated by the unused paved road (Photo 2). The paved road, as well as the subsurface cultural layer, ends in the vicinity of the project area south of Kanaloa Drive and Kahului Beach Road intersection.

This cultural layer constitutes a historic property that needs to be investigated further if Hata Bay is selected as the location for the Maui second harbor. The cultural affiliation and significance of the deposit need to be determined. The cultural items observed in the deposit suggest a prehistoric age, making it potentially significant, at least, for its information content.

13.2 MA'ALAEA

No apparent surface historic properties were observed during the present survey of the proposed site. However, it is highly probable that the area contains remains from both prehistoric and early historic cultural activities including, but not limited to, possible fishponds and salt production. The sandy shoreline strand may also contain human burial remains which would require the enactment of the Native American Graves Protection and Repatriation Act (NAGPRA) procedures.

Archival research indicates that the Ma'alaea area had special significance to prehistoric Hawaiians as several special functional site types (such as a birthing location) are cited for Ma'alaea. The 1954 Ma'alaea Quadrangle shows the project area to contain the Old Maui Airport. Remnants of the old airport would constitute historic properties if they were constructed prior to 1944. During the current survey no apparent surface cultural resources were observed; however, given the nature of the area, absence of surface archaeological sites is to be expected and the probability of subsurface deposits, such as fishpond walls and the like, occurring in the area is relatively high.

13.3 UKUMEHAME

Most of the study area inland of Honoapiilani Highway is in sugar cane plantation production, obliterating any evidence of prior cultural land use. There is however a small section of land in the northwest quadrant of the study area that has not been altered through modern cultivation (Photo 3). This area consists of a gentle slope which is densely vegetated by *kiawe*, *opiuma*, *koa-haole*, and *ilima* and an understory of knee-high unidentified grasses. Remnants of prehistoric structures were evident in this unmodified area covering roughly 30 by 30 meters. These remnants include low boulder walls, terraces, pavements, and a long platform-like structure that may be the remains of a *holua* slide (Photo 4).

At the base of the gently sloping terrain, the area flattens out under the highway to the sandy shoreline. The shoreline may have extended at one time for a greater distance inland than at present. This type of sandy area in East Maui was preferred for burial by prehistoric Hawaiian communities. Therefore, there is a strong possibility that such remains, which would require compliance with NAGPRA as well as Section 106 compliance, may be present in the study area.

Photo 1. Hata Bay. Standing Escarpment from Wave Cut. Portion of old ocean-front land form exposed by wave action and wind erosion, showing layer containing cultural material. View to east.

Photo 2. Hata Bay. Standing Escarpment. Remnants of buried old surface truncated by and lying under the unused paved road. View to west.

Photo 3. Ukumehame. Remnant of a probable *holua* slide. View to east-northeast.

Photo 4. Ukumehame. Base of probable *holua* slide. View to north-northeast.

13.4 OLOWALU

The shoreline area consists of a boulder beach 3 meters wide, at most. Dominant vegetative cover and recent land use in the area is for sugar cane plantation, except for strand areas along the shoreline and stream. Plantation activities have obliterated most traces of prehistoric Hawaiian land use in the area, although subsurface remains probably remain intact between the shoreline and the road and these are not detectable without subsurface test excavations.

The most visible surface cultural remains are along the shoreline just inland of the Olowalu Wharf and on the southeast portion of the study area. These remains consist of historic period structural remnants associated with the early (19th-early 20th century) sugarcane era at Olowalu. The remnants include the manager's house (Photo 5) constructed around 1922 and three other associated cottages (all still in use presently), Olowalu Wharf constructed circa 1918, and foundations (Photo 6) of the old Olowalu Mill and Landing which was constructed in 1881 by James Campbell (Kamehameha III also had an interest in the mill) and abandoned in 1931 (Savage n.d.). Prehistoric subsurface cultural deposits are also likely to be present in the area.

This area of Olowalu also has native Hawaiian cultural significance as it is also the site of the Olowalu Massacre in 1790 when over 100 native Hawaiians were killed and as many wounded by Captain Metcalf and his men from the ship *Eleanor*. The killings occurred in retaliation for the stealing of a skiff from the *Eleanor* and the slaying of its seaman occupant/watchguard. The exact location of the massacre is unknown but is said to be at the end of the point at Olowalu.

West of the point (toward Lahaina) in the study area is a triangular piece of land seaward of Honoapiilani Highway where the shoreline turns inland and converges with the edge of the highway. This area is covered with dense *hau* trees as well as *kiawe* and several very tall coconut palms. A small boulder and cobble platform with a probable traditional well is located at the edge of the shoreline at the eastern end of the triangular area. The platform, half a meter high, measures 2 by 3 meters with the water hole measuring 1 meter square. A low wall was also observed running parallel to the highway at the inland edge of the *hau* thicket. The wall was 2-boulders high, measuring no more than 50 centimeters high, and covered with modern debris. The wall may have been part of an old coastal road to Lahaina.

A Japanese cemetery is located in the middle of the cane field roughly 100 meters inland of Honoapiilani Highway. The cemetery consists of an area measuring roughly 30 by 20 meters and covered with *opiuma* and *koa-haole* trees and unidentified tall grasses. The cemetery has at least 10-15 headstones (Photos 7 and 8). Some of the headstones are relatively high, measuring 75 centimeters, while others have fallen or partially fallen. The writings on several of the headstones were entirely in Japanese. The earliest grave located was that of Ralph H. Fujishiro who died on May 29, 1928. The latest date observed was November 1940 on Michael Masuru Kakazu's headstone.

14. DEVELOPMENT OF ALTERNATIVE PLANS

Alternative measures were developed and evaluated to minimize adverse impacts within the study areas and to fulfill the planning objectives. A questionnaire was sent to fifteen companies that represent the major commercial cargo/passenger carriers and users at Kahului Harbor. Based on responses from eight of the companies (see Appendix E), a composite design vessel was developed. Alternative plans were developed to provide for a medium-draft barge harbor rather than a deep-draft facility.

A standard harbor development plan consists of either an inland excavated harbor or an offshore harbor with protective structures such as breakwaters. Of the four possible sites, only Hata Bay and Olowalu Point seemed amenable to a standard protected harbor approach.

An alternative vessel docking structure consisting of an unprotected pile supported pier across the beach and reef to a calculated water depth was evaluated for the West Maui sites. This approach was investigated to minimize environmental impacts associated with more typical protected harbor construction and operation and to minimize construction costs. The utilization of an unprotected pier has been used successfully at Kaunakakai, Molokai and historically has been used in the Ma'alaea Bay area of Maui at Olowalu Point and Mala Wharf, although the Olowalu and Mala landings are no longer in use. This "pier harbor" approach would have the anticipated benefits of providing a second commercial harbor facility while minimizing impacts to the littoral process and reef environment and minimizing or eliminating the need for dredging.

Photo 5. Olowalu. Manager's House, Olowalu Mill, constructed circa 1922. View to north.

Photo 6. Olowalu. Remnants of Olowalu Wharf, constructed circa 1881 and abandoned in 1931. View to north.

Photo 7. Olowalu. Japanese Cemetery. View to northwest.

Photo 8. Olowalu. Japanese Cemetery. Note at least two more headstones in the shade under the trees. View to north.

15. DESCRIPTION OF ALTERNATIVE PLANS

15.1 Alternative 1, Hata Bay Breakwater Harbor

The Hata Bay Breakwater Harbor alternative would consist of two breakwaters measuring 1,300-feet and 750-feet, a dredged entrance channel, turning basin, and berthing area, a dock, and a back-up area (Figure 6).

The breakwaters (Figure 7) consist of a single armor layer (6.7-feet thick) of 14 ton tribars at a slope of 1V:2H, a first underlayer of 2,000 to 3,500 pound stones in two layers totaling 5.2-feet thick, a second underlayer of 200 to 350 pound stone in two layers totaling 2.4-feet thick, and a core consisting of spalls to 200 pounds. The 14-foot wide crest with concrete rib cap is set at an elevation of +20 feet mean lower low water (MLLW).

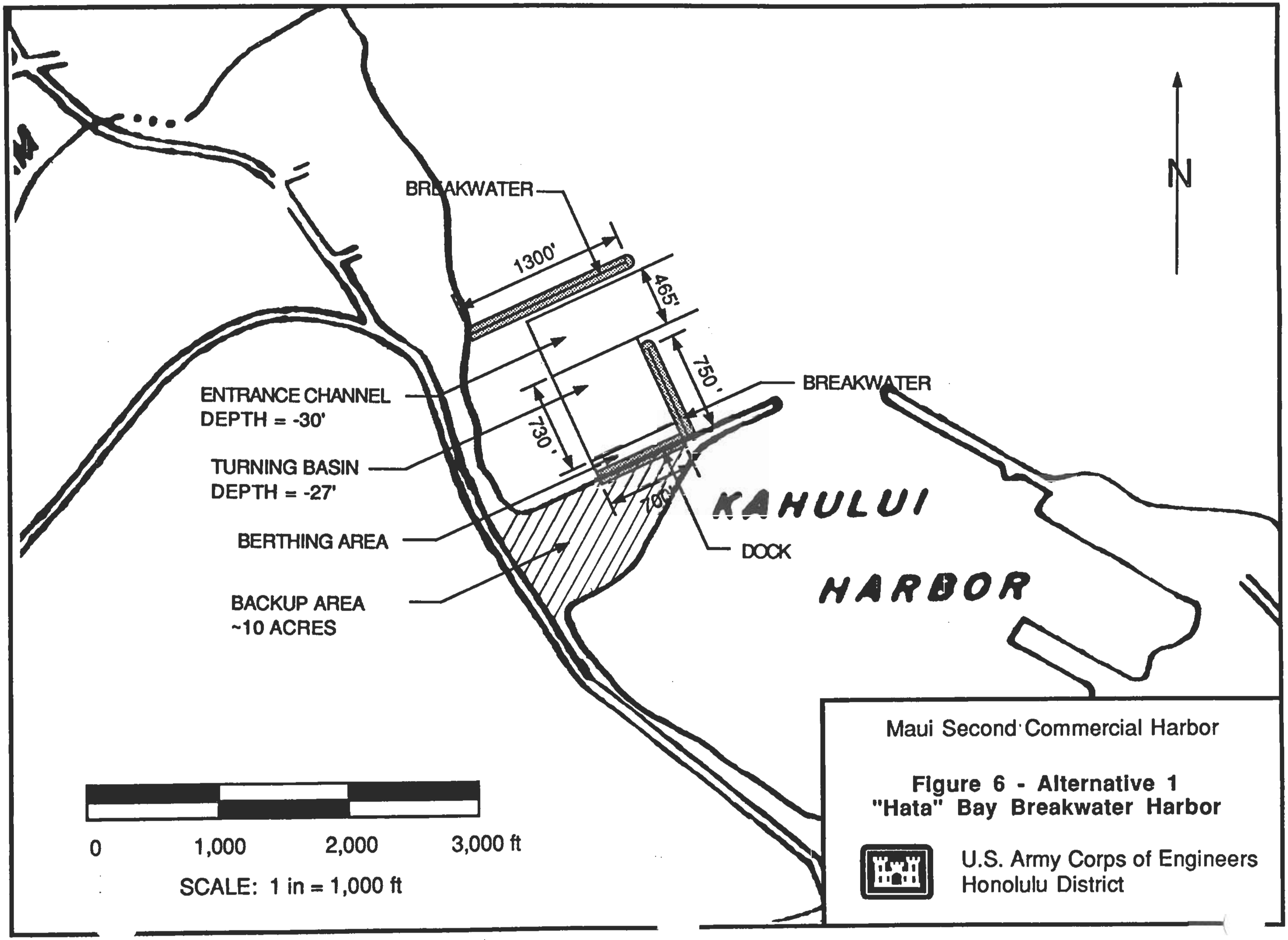
The 465-foot wide entrance channel would be dredged to a depth of minus 30 feet. The 730-foot by 700-foot turning basin would be dredged to a depth of minus 27 feet. A 100-foot wide berthing area would be located adjacent to a 700-foot long dock. Approximately 10 acres of back-up area would be provided on the existing fill at the Kahului Harbor west breakwater.

15.2 Alternative 2, Ma'alaea Pier

The Ma'alaea Pier alternative consists of a long 70-foot wide pier, 200-foot by 200-foot dock, mooring dolphins, elevated causeway, and 10-acre back-up area (Figure 8). The pier would be approximately 975-feet long so that the dock would be located in existing 30-foot deep waters. This pier extension would eliminate the need to dredge an entrance channel or turning basin. The pile supported pier and dock would allow the natural littoral processes to continue uninterrupted. The elevated causeway will preclude the need to backfill areas across an existing marshy bird habitat. The back-up area would be located on existing land currently cultivated in sugar cane.

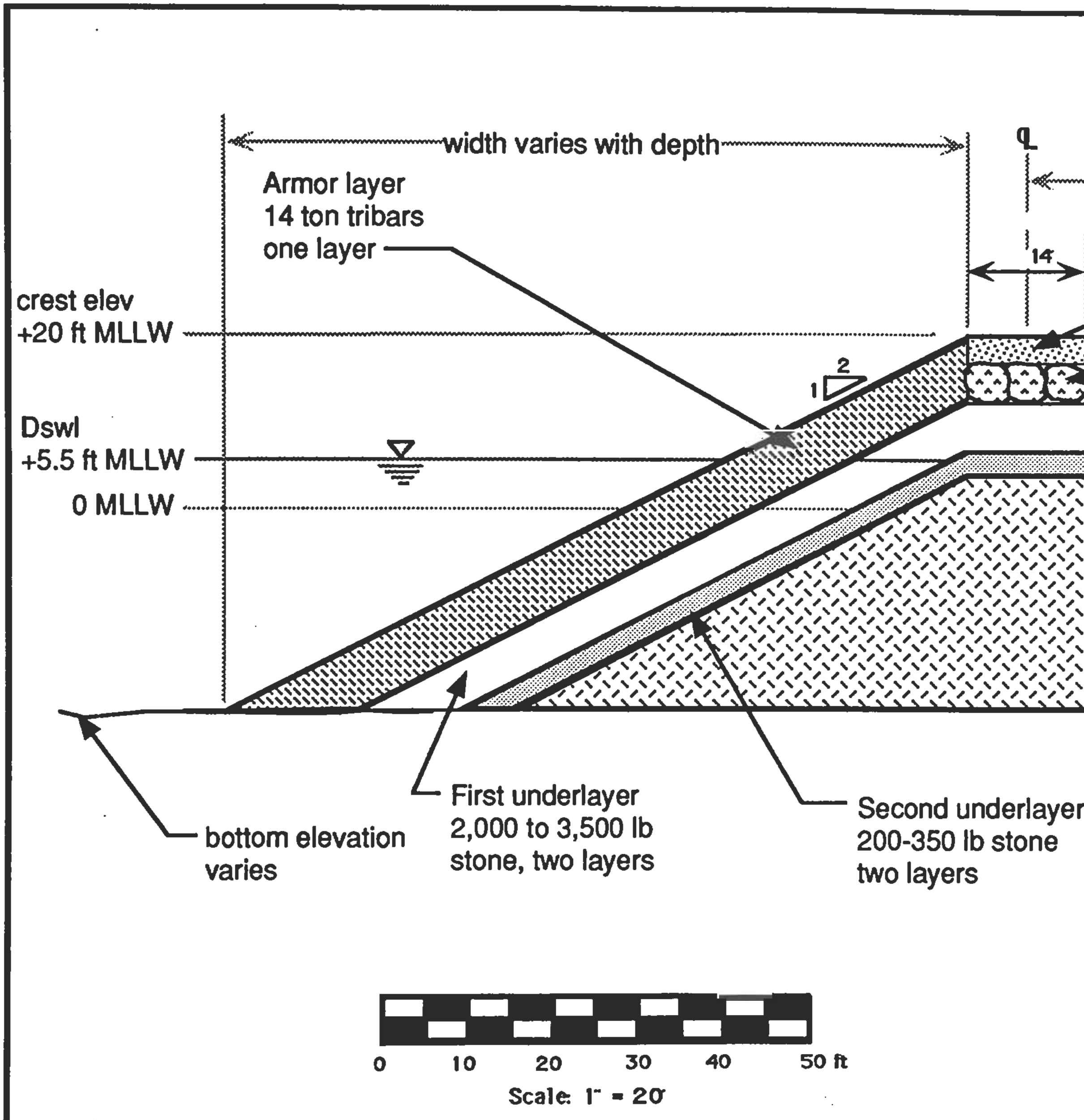
15.3 Alternative 3, Ukumehame Pier

The Ukumehame Pier alternative consists of a long 70-foot wide pier, 200-foot by 200-foot dock, mooring dolphins, signalized intersection, and 10-acre back-up area (Figure 9). The pier would be approximately 400-feet long so that the dock would be located in existing 30-foot deep waters without



Maui Second Commercial Harbor

Figure 6 - Alternative 1
"Hata" Bay Breakwater Harbor



Maui Second Commercial Harbor

Figure 7 - Typical Breakwater Section, Hata Bay

U.S. Army Corps of Engineers
Honolulu District

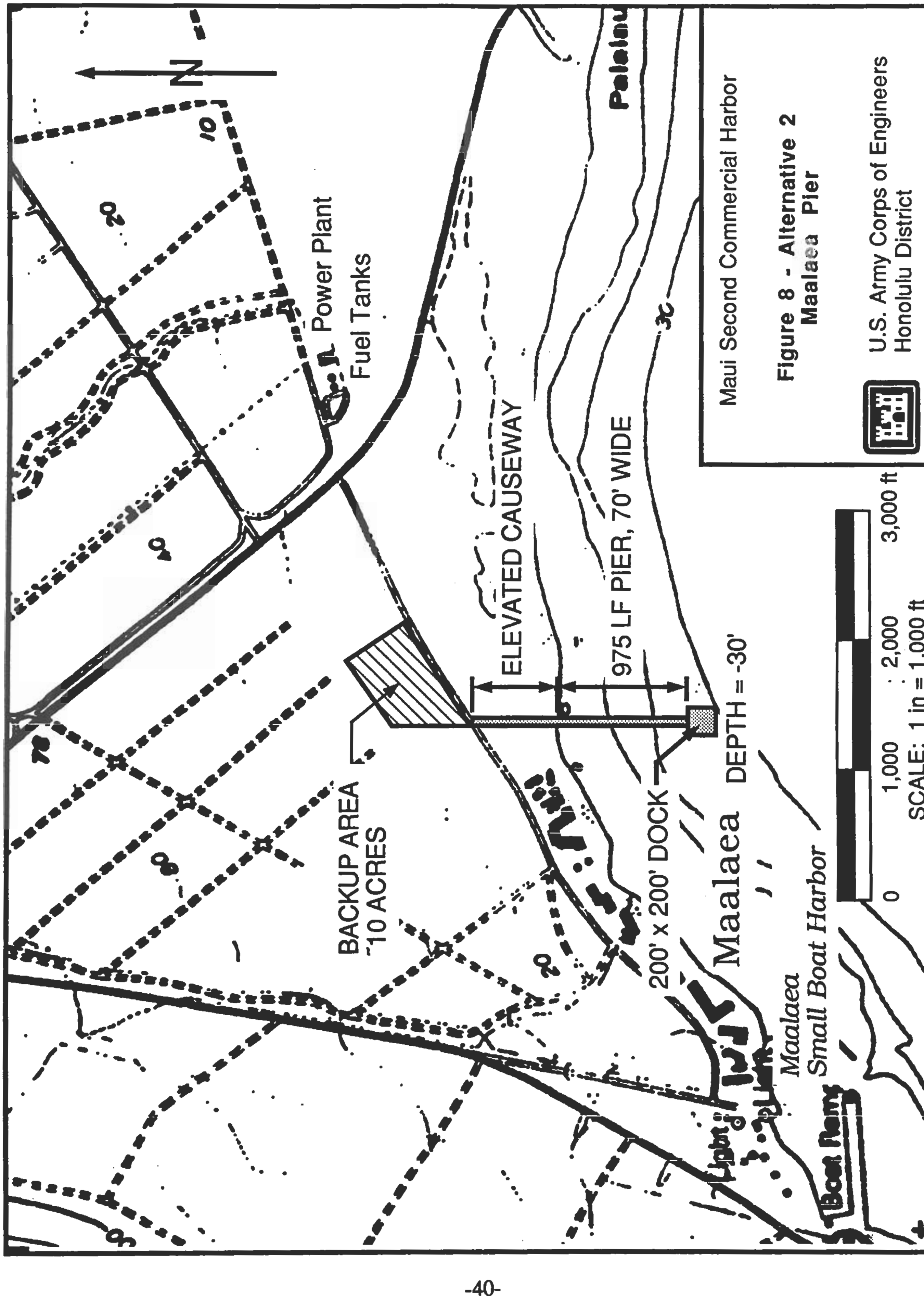
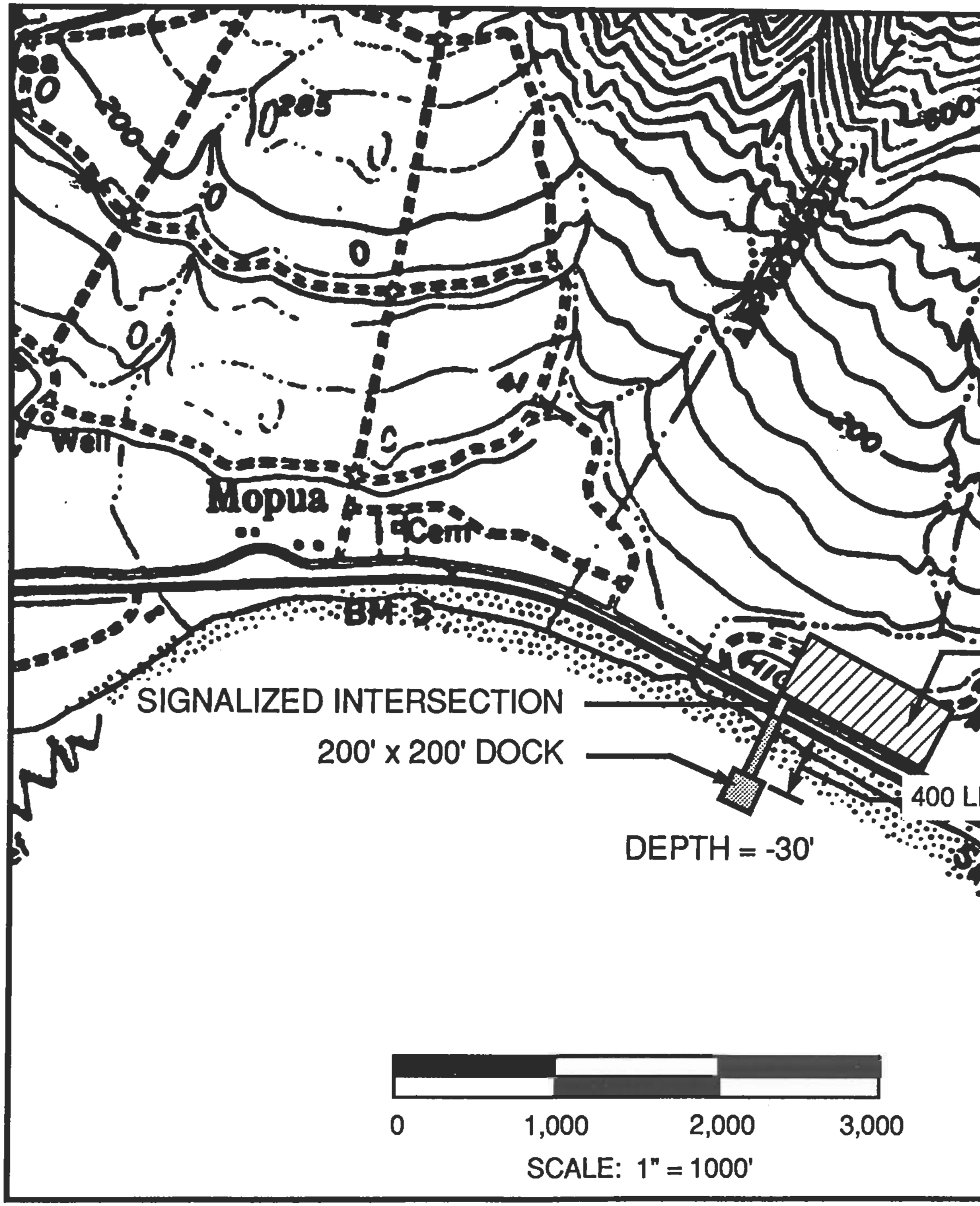


Figure 8 - Alternative 2
Maalaea Pier



MAUI SECOND COMMERCIAL HARBOR

Figure 9 - Alternative 3
Ukumehame Pier

U.S. Army Corps of Engineers
Honolulu District

requiring dredging. The pile supported pier and dock would allow the natural littoral processes to continue uninterrupted. The lack of available land seaward of the Honoapiilani Highway necessitates a signalized intersection, highway overpass, or highway realignment to allow access from the dock and pier to the container yard. For this reconnaissance level evaluation, a signalized intersection at Honoapiilani was used in the cost estimates.

15.4 Alternative 4, Olowalu Pier

The Olowalu Pier alternative consists of a long 70-foot wide pier, 200-foot by 200-foot dock, mooring dolphins, and 10-acre back-up area (Figure 10). The pier would be approximately 400-feet long so that the dock would be located in existing 30-foot deep waters without requiring dredging. The pile supported pier and dock would allow the natural littoral processes to continue uninterrupted. The back-up area would be located on a parcel of land west of Olowalu Stream and seaward of Honoapiilani Highway.

15.5 Alternative 5, Olowalu Dock with Turning Basin

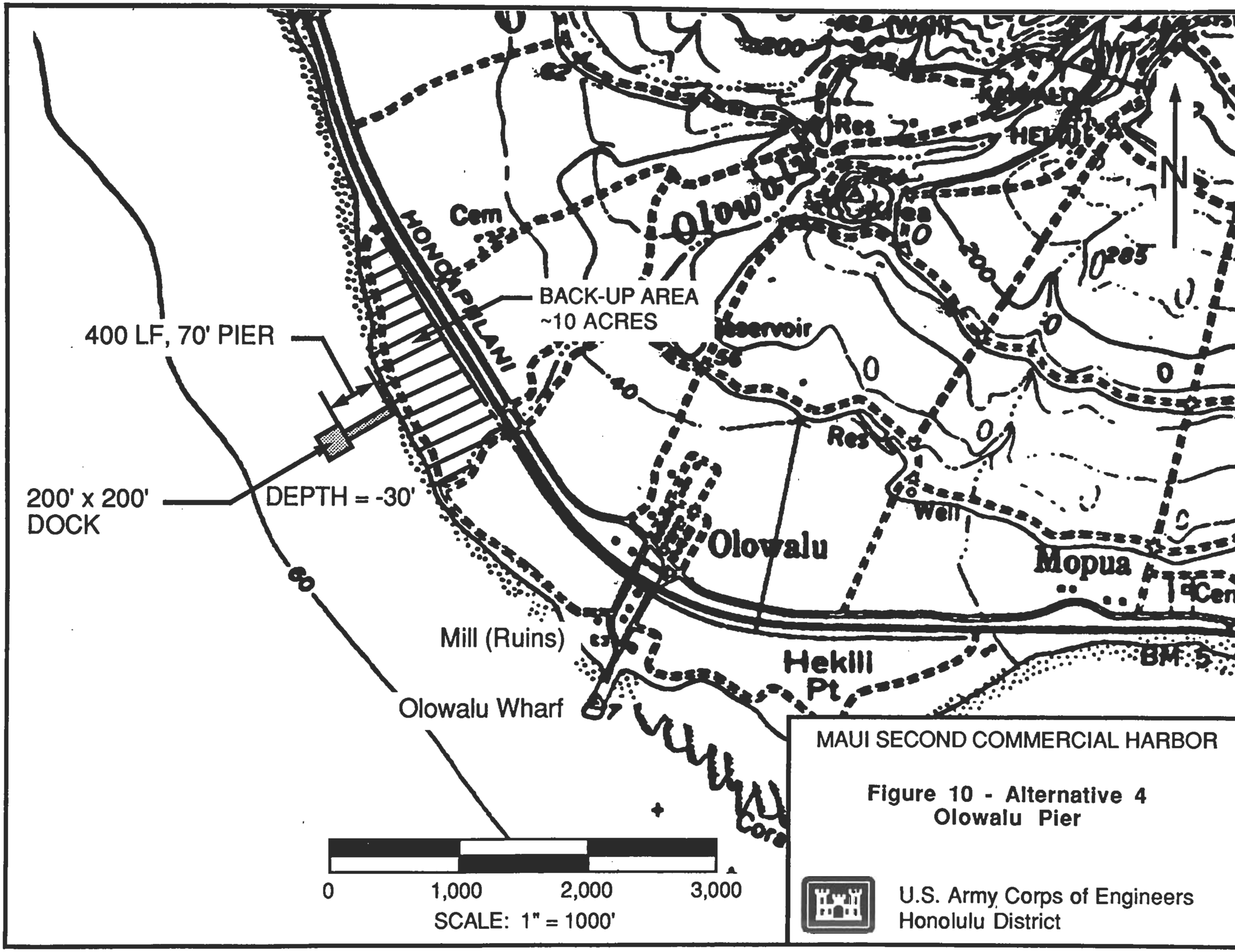
The Olowalu Dock with Turning Basin alternative consists of a 200-foot by 200-foot dock, 700-foot wide turning basin dredged to a depth of minus 30-feet, and 10-acre back-up area (Figure 11). The back-up area would be located on the same parcel of land as the Olowalu Pier alternative.

15.6 Alternative 6, Olowalu Dredged Harbor

The Olowalu Dredged Harbor alternative consists of a dredged entrance channel and turning basin, revetted mole, and 10-acre back-up area (Figure 12).

The seaward portion of the mole (Figure 13) consist of a double layer (3.9-feet thick) of 900 to 1,500 pound armor stone at a slope of 1V:2H and an underlayer of 90 to 150 pound stones in two layers totaling 2.2-feet thick. The inland portion of the mole consists of a double layer of 90 to 150 pound stone (2.2-feet thick) at a slope of 1V:2H. The core of the mole consists of dredged material. The 12-foot wide crest is set at an elevation of +10 feet MLLW.

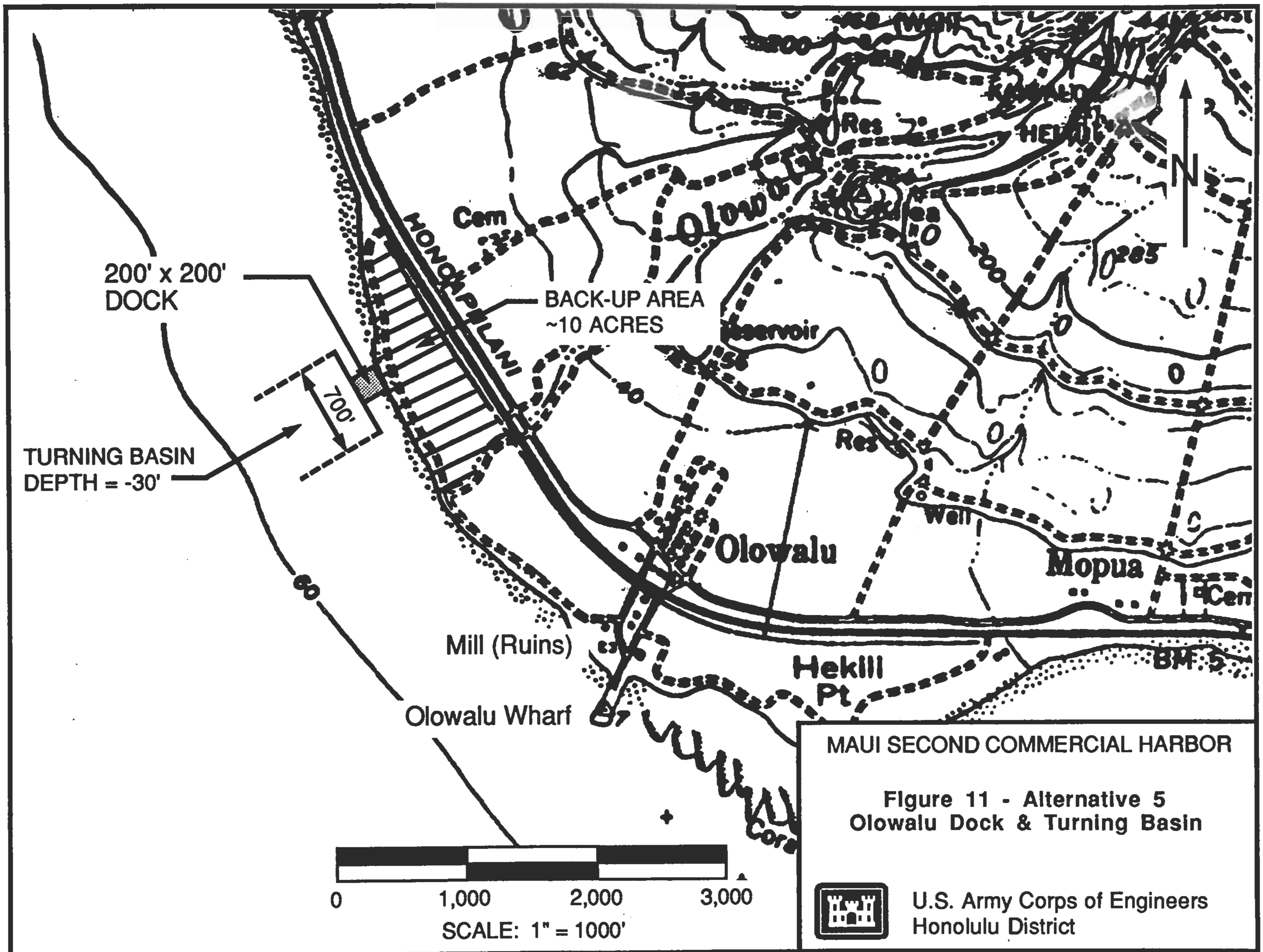
The container yard would be located on approximately 10-acres of land east of Olowalu Stream and seaward of Honoapiilani Highway. A bridge would be required to connect the harbor with the back-up area.



MAUI SECOND COMMERCIAL HARBOR

Figure 10 - Alternative 4
Olowalu Pier

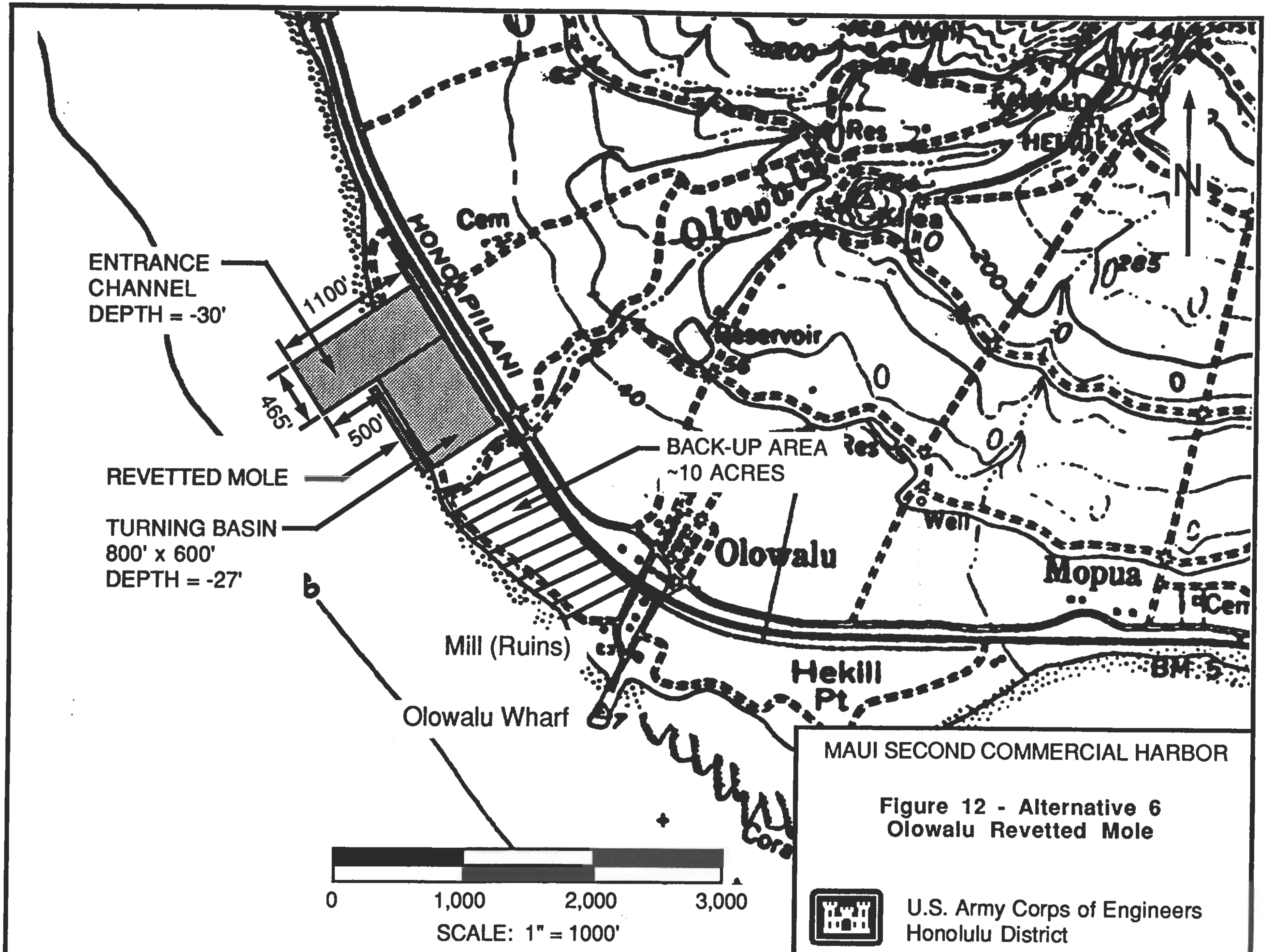
U.S. Army Corps of Engineers
Honolulu District



MAUI SECOND COMMERCIAL HARBOR

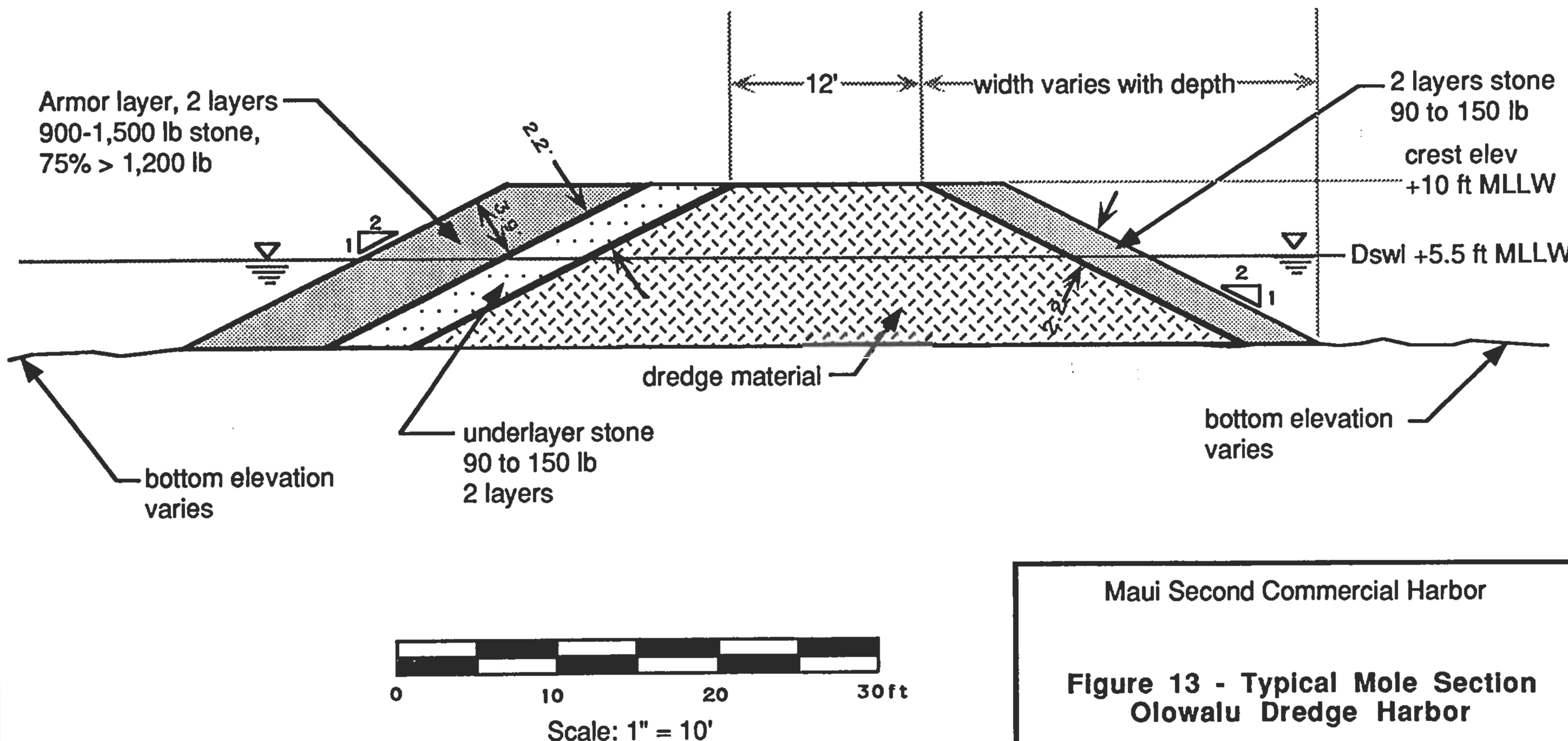
Figure 11 - Alternative 5
Olowalu Dock & Turning Basin

U.S. Army Corps of Engineers
Honolulu District



MAUI SECOND COMMERCIAL HARBOR

Figure 12 - Alternative 6
Olowalu Revetted Mole



Maui Second Commercial Harbor

Figure 13 - Typical Mole Section
Olowalu Dredge Harbor

U.S. Army Corps of Engineers
Honolulu District

16. ECONOMIC ANALYSIS

16.1 General

Appendix C of this report contains the detailed economic analysis for the proposed plans. This section of the report summarizes the findings of the economic analysis.

The economic analysis for a federal navigation improvement study measures a project's contributions to national economic development (NED). Deep-draft navigation improvements contribute to national economic development by improving the efficiency of waterborne transportation services. Efficiency gains result from reductions in the cost of transporting goods and increases in the value of the goods transported. Legitimate benefits to a region, business sector, or company are not considered in a Corps economic analysis because of this NED perspective.

The benefits in this project are the differences in transportation costs and the value of the goods transported under without- and with-project conditions. Benefit calculations were based on the most current data available and were adjusted to an October 1994 price level. The adjustments were done using estimates of the Honolulu Consumer Price Index (CPI-U) for comparison with estimated project costs.

The estimated cost of the proposed improvements were also measured at an October 1994 price level. Costs include all goods and services used in project construction and operation and maintenance.

Any costs or benefits not occurring annually were converted to an average annual equivalent basis over the 50-year period of analysis. This conversion was done using the Federal discount rate prescribed for water resource projects which is currently set at eight percent. The base year of the alternatives is 1996. A comparison of average annual costs and benefits determine the viability of federal participation in a project.

16.2 Benefits

Operating costs under without-project conditions and those under with-project conditions were compared to determine the benefits of developing a second harbor for Maui. A second harbor would alleviate the congestion that now exists at Kahului Harbor and allow users to adjust their operations to eliminate costly inefficiencies. Those who move to the new facility will, likewise, have ample space to set up a system that avoids the present inefficiencies at Kahului Harbor. A second harbor, depending on its location, may also have some site specific advantages over Kahului Harbor. These advantages can be translated into reduced operating costs for users of the second harbor. The savings generated from increased efficiency and locational advantages can be counted as benefits of having a second commercial harbor on Maui.

A second harbor on Maui will also give a measure of security to those dependent on the harbor's services. Nearly every sector of the Maui economy relies either directly or indirectly on the harbor. This being the case, an unexpected and prolonged closure of the harbor would wreak havoc on the Maui economy. With a second harbor in place, the economy will be spared some of the costly consequences of an emergency harbor closure. Avoiding some of the costs associated with a harbor closure can also be counted as benefits of having a second harbor on Maui. For purposes of this reconnaissance level evaluation, a hypothetical closure due to a navigation accident was analyzed to determine its impact on the Maui economy. The estimated time to clear the wreckage, which corresponds to the duration of harbor closure, varied from 23- to 39-days depending on the condition of the wreckage. Because of this, the average annual benefits associated with a harbor closure are expressed as two values corresponding to a 23- and 39-day closure.

The economic analysis measured the savings from increased efficiency, locational advantages, and avoidance of emergency harbor closure costs associated with developing a second harbor. Benefits included reductions in scheduling conflicts, transportation costs, and emergency harbor closure disruptions. The average annual benefits attributable to a second commercial harbor vary according to the duration of an emergency harbor closure. Two emergency harbor closure scenarios were analyzed and resulted in a range of average annual benefits. A summary of the average annual benefits for the project alternatives is included in Table 1.

TABLE 1 - BENEFIT SUMMARY

	Average Annual Benefits			
Cost Reduction Category	Site 1 Hata Bay	Site 2 Ma'alaea	Site 3 Ukumehame	Site 4 Olowalu
Scheduling Conflict				
Coal Operation	36	36	36	36
Sugar Operation	27	27	27	27
Ocean Transportation	0	483	483	483
Petroleum Overland Transportation	0	408	122	122
Emergency Harbor Closure				
23-Day Closure	500	500	500	500
39-Day Closure	983	983	983	983
Total Average Annual Benefits				
23-Day Closure	563	1,454	1,168	1,168
39-Day Closure	1,046	1,937	1,651	1,651

16.3 Costs

The total cost of the project includes the project first costs and maintenance costs. The estimated project first costs for the proposed alternatives were developed using October 1994 price levels, assumptions based on the prevailing physical conditions, and allowances for contingencies, engineering and design, and supervision and administration. Cost estimates and assumptions are provided in Appendix B and are summarized in Table 2.

16.4 Benefit-to-Cost Ratios

The determination of average annual costs for the purposes of the benefit-to-cost comparison includes interest (8%) and amortization (50-years) of the project costs, interest during construction (IDC), and the estimated annual maintenance costs associated with maintaining the project and repairing structural elements. The benefit-to-cost ratios are summarized in Table 2.

TABLE 2 - SUMMARY OF PROJECT BENEFITS AND COSTS

	Alt. 1 Hata Bay Breakwater Harbor	Alt. 2 Maalaea Pier	Alt. 3 Ukumehame Pier	Alt. 4 Olowalu Pier	Alt. 5 Olowalu Dock & Turning Basin	Alt. 6 Olowalu Dredged Harbor
Total Project First Cost	$71,802,000	$42,266,000	$26,254,000	$26,028,000	$32,634,000	$47,748,000
Interest During Construction *	$8,965,000	$4,340,000	$2,128,000	$2,110,000	$3,351,000	$4,903,000
Investment Cost	$80,767,000	$46,606,000	$28,382,000	$28,138,000	$35,985,000	$52,651,000
Amortized Investment Cost**	$6,602,000	$3,810,000	$2,320,000	$2,300,000	$2,942,000	$4,304,000
Annual Maintenance Cost	$132,000	$38,000	$23,000	$23,000	$29,000	$86,000
Total Average Annual Cost	$6,734,000	$3,848,000	$2,343,000	$2,323,000	$2,971,000	$4,390,000
Total Average Annual Benefits						
23-Day Closure	$563,000	$1,454,000	$1,168,000	$1,168,000	$1,168,000	$1,168,000
39-Day Closure	$1,046,000	$1,937,000	$1,651,000	$1,651,000	$1,651,000	$1,651,000
Benefit-to-Cost Ratio						
23-Day Closure	0.08	0.38	0.50	0.50	0.39	0.27
39-Day Closure	0.16	0.50	0.71	0.71	0.56	0.38

* Construction Periods: Alt. 1 = 36 months; Alts. 2, 5, and 6 = 30 months; Alts. 3 and 4 = 24 months. All at 8% interest.

** 8% interest. 50-year project life.

17. PUBLIC INVOLVEMENT

Two public workshops were conducted during the course of this study. The first workshop was conducted on April 20, 1993 at the Maui State Highways District Office in Kahului, Maui. The purpose of the workshop was to explain the scope, schedule, and status of the study. Approximately 55 individuals attended the workshop. Ideas for the site of a second harbor were solicited from the workshop participants and included the following.

- Provide additional berthing to the east or west of Kahului Harbor by constructing a new breakwater parallel to the existing east or west breakwater.

- Construct a groin outside the entrance channel to the existing Kahului Harbor to alleviate surge within Kahului Harbor and make more of the existing harbor usable.

- Construct an offshore harbor by dredging the reef at Ukumehame.

- Construct a new harbor just west of Kealia Pond near the existing power plant.

Numerous concerns were voiced about siting a second commercial harbor on Maui's south shore. Among the concerns were:

- Kealia Pond is a national wildlife sanctuary and its limits are extensive.

- The power plant in Kihei is in a tsunami zone.

- Honoapiilani Highway is very congested.

- Ma'alaea Village is a proposed future Alexander and Baldwin development.

- The Ma'alaea shoreline is heavily used for recreation.

- There are wind and current problems at Ma'alaea.

- The hawksbill turtle and Hawaiian monk seal have beached themselves in the Ma'alaea area.

- Local surfing areas need to be recognized.

- Certain areas are frequently used by tour boats.

A second public workshop was held on October 18, 1994 at the Maui State Highways District Office. The purpose of the workshop was to present the study findings to date and obtain public feedback on the proposed alternatives. Approximately 45 individuals participated in the workshop. The comments expressed by the public included the following:

- The State should look at modifying Kahului Harbor and expanding its facilities rather than constructing a new second harbor.

- Olowalu is a significant archaeological site, contains graves, lo'i, and plantation remains, has high winds, has a wide, pristine reef on the east side of Olowalu Point, and has a Japanese graveyard mauka of the proposed harbor. Olowalu Stream also contains white quartz.

- Many areas in Olowalu and Ukumehame are ceded lands and may become the focus of reclamation in the Hawaiian sovereignty movement. Native Hawaiians have traced their genealogy to Olowalu.

- Emergency landings can be made using articulated devices. The State should investigate the possibility of bringing a barge onto the Kahului Harbor western coral fill under emergency conditions.

- A commercial harbor will change the character of west Maui by bringing additional development.

- A commercial harbor in west Maui will have a negative impact on tourism.

- A pipeline for oil from the Ma'alaea harbor site to the power plant presents an environmental hazard. The Ma'alaea power plant is already in a flood/tsunami hazard area and is a disaster waiting to happen.

- The army dredged portions of the reef at Ukumehame during World War II and the deep spots may be suitable for a harbor.

- Coral heads were excavated from the Ma'alaea mud flats area during World War II and the area was used for amphibious landings.

18. DISCUSSION

18.1. Alternative Site Comparison

Table 3 compares the six alternative plans of improvement. A protected harbor would provide a fairly reliable containment structure in the event of a spill associated with transportation of petroleum products, which is the primary cargo to be off-loaded. The unprotected pier alternatives do not afford this protection. However, the traditional protected harbor alternatives (Hata Bay Breakwater Harbor and Olowalu Inland Harbor) have considerably higher construction costs than the unprotected piers.

The unprotected piers would have the anticipated benefits of providing a second commercial harbor facility while minimizing impacts to the littoral process and reef environment and minimizing or eliminating the need for dredging. However, an unprotected pier is more susceptible to operational difficulties due to the length of the pier, climatic conditions (e.g. surges), and difficulties in maintaining a structurally stable facility. Shortening the pier (Olowalu Dock and Turning Basin) would require dredging the reef. However, this would eliminate the operational difficulties associated with a long pier and the reef formation may provide some protection to the basin and berthing area. Shortening the pier and dredging a turning basin is technically feasible at the Ukumehame and Ma'alaea sites although for this reconnaissance level evaluation, it was only applied at Olowalu.

The Kahului site is located near the hub of the island's commercial activities and largest town. Nearby areas are presently in harbor, boating, and light industrial use. Sandy beaches would not be impacted and recreational use of the beach is limited by weather conditions and the large cobbles which cover the shoreline.

TABLE 3 - COMPARISON OF ALTERNATIVES

Criteria	Kahului Offshore Harbor	Maalaea Pier	Ukumehame Pier	Olowalu Pier	Olowalu Dock and Turning Basin	Olowalu Inland Harbor
Proposed Plan of Improvement	Two breakwaters measuring 1,300' and 750'; dredged entrance channel, turning basin, and berthing area; dock; 10-acre back-up area.	70' wide pier; 200'x200' dock; elevated causeway; 10-acre back-up area.	70' wide pier; 200'x200' dock; signalized intersection; 10-acre back-up area.	70' wide pier; 200'x200' dock; 10-acre back-up area.	200'x200' dock; 700' wide turning basin; 10-acre back-up area.	Dredged entrance channel and turning basin; revetted mole; 10-acre back-up area.
Vehicular Access to Site	Good.	Access road needs to be improved. Central location between Kihei, Kahului and Lahaina.	Good. However, backup area is separated by Honoapiilani Highway.	Access road required.	Access road required.	Access road required.
Technical Attributes	Good wave and wind data available.	Alternative wave climate to Kahului. Central Maui location. Elevated pier would minimize impact to littoral transport, lateral beach access, and reefs.	Alternative wave climate to Kahului. Closer to Lahaina area than Kahului Harbor. Elevated pier would minimize impact to littoral transport, lateral beach access, and reefs.	Alternative wave climate to Kahului. Closer to Lahaina area than Kahului Harbor. Elevated pier would minimize impact to littoral transport, lateral beach access, and reefs.	Alternative wave climate to Kahului. Closer to Lahaina area than Kahului Harbor.	Alternative wave climate to Kahului. Closer to Lahaina area than Kahului Harbor.
Wave Exposure	Exposed to tradewinds and northern swells.	Exposed to Kona storms and southern swells.	Exposed to Kona storms and southern swells.	Exposed to Kona storms and southern swells.	Exposed to Kona storms and southern swells.	Exposed to Kona storms and southern swells.
Existing Harbor Facilities	Adjacent to west breakwater of existing Kahului Harbor.	Close to existing Maalaea small boat harbor.	None.	Olowalu pier and landing no longer in use.	Olowalu pier and landing no longer in use.	Olowalu pier and landing no longer in use.
Area to accommodate landside improvements?	Yes.	Yes.	Overpass, bridge structure and/or traffic control would be required to cross Honoapiilani Highway.	Yes. Additional land available mauka of Honoapiilani Highway however would require overpass, bridge structure, and/or traffic control.	Yes. Additional land available mauka of Honoapiilani Highway however would require overpass, bridge structure, and/or traffic control.	Yes. Additional land available mauka of Honoapiilani Highway however would require overpass, bridge structure, and/or traffic control.

TABLE 3 - COMPARISON OF ALTERNATIVES (CONTINUED)

Criteria	Kahului Offshore Harbor	Maalaea Pier	Ukumehame Pier	Olowalu Pier	Olowalu Dock and Turning Basin	Olowalu Inland Harbor
Existing land use	Area is open space. Light industrial area, residential subdivision and churches are in the vicinity.	Shoreline area is undeveloped. Close proximity to Kealia National Wildlife Refuge, a park, and residential areas.	Shoreline area is undeveloped and is close to Honoapiilani Highway. Inland area is primarily in sugar production. Sloping grass lands are used for grazing beef cattle.	Inland area is primarily in sugar production with a few residences.	Inland area is primarily in sugar production with a few residences.	Inland area is primarily in sugar production with a few residences.
Land Ownership	Coral stockpile area owned by the State of Hawaii. Land fronting North Kahului Beach Road is privtely owned.	Land mostly owned by Alexander and Baldwin with numerous small miscellaneous holdings.	Land mostly owned by the State of Hawaii.	Shoreline owned by State of Hawaii. Most other land owned by Pioneer Mill.	Shoreline owned by State of Hawaii. Most other land owned by Pioneer Mill.	Shoreline owned by State of Hawaii. Most other land owned by Pioneer Mill.
Shoreline and Nearshore Marine Resources	Cobble beach strewn with assorted flotsum adjacent to busy road. No beach sand.	Relatively wide white sand beach. Study site possesses richest assemblage of marine biota in Maalaea Bay.	Narrow basalt sand beach exposed on low tide and awash at high tide leaving only basalt cobble beach. Drop rock revetment placed to stem erosion. Vegetation predominantly kiawe with scattered milo and pluchea. Mauka of highway is kiawe and sugar cane.	Basalt/coral cobble beach with no sand. Shallow depths relatively barren. Murky water off the mouth of Olowalu Stream. Large sharks occasionally sited.	Basalt/coral cobble beach with no sand. Shallow depths relatively barren. Murky water off the mouth of Olowalu Stream. Large sharks occasionally sited.	Basalt/coral cobble beach with no sand. Shallow depths relatively barren. Murky water off the mouth of Olowalu Stream. Large sharks occasionally sited.
Marine Environmental Concerns	Impact to octopus habitat. Potential impacts to whale sanctuary.	Potential impacts to whale sanctuary and Kealia Pond National Wildlife Refuge. Maalaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale.	High quality coral reef ecosystem. Green sea turtles common along this coastline. Potential impacts to whale sanctuary. Maalaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale.	Potential impacts to whale sanctuary. Maalaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale.	Potential impacts to whale sanctuary. Maalaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale.	Potential impacts to whale sanctuary. Maalaea Bay is considered an important breeding, calving, and nursing area for the endangered humpback whale.

TABLE 3 - COMPARISON OF ALTERNATIVES (CONTINUED)

Criteria	Kahului Offshore Harbor	Maalaea Pier	Ukumehame Pier	Olowalu Pier	Olowalu Dock and Turning Basin	Olowalu Inland Harbor
Terrestrial Environment	Backshore area behind beach berm well worn by vehicles. Limited vegetation.	Vegetation largely ornamental trees and shrubs, pickleweed, and mesquite. Study site is east of a park near the condominium development and west of Kealia Pond National Wildlife Refuge.	Area disturbed by sugar production and Honoapiilani Highway	Olowalu Stream bisects the study area. Area disturbed by sugar production, Honoapiilani Highway, and plantation homes.	Olowalu Stream bisects the study area. Area disturbed by sugar production, Honoapiilani Highway, and plantation homes.	Olowalu Stream bisects the study area. Area disturbed by sugar production, Honoapiilani Highway, and plantation homes.
Cultural Resources	Cultural deposit found on shoreline. Archaeologist indicates the area is potentially culturally significant. Further investigation required.	No surface historic properties observed in recon survey. Probability of early historic cultural activities (fishponds, salt production) and may also contain human remains. Further investigation needed.	Remnants of prehistoric structures in a small section of land inland of the highway. Possibility of graves in the area. Further investigation required.	Pier and landing site are historic properties, Japanese cemetery landward of highway, historic buildings in vicinity, site of 1790 massacre, probable subsurface remains.	Pier and landing site are historic properties, Japanese cemetery landward of highway, historic buildings in vicinity, site of 1790 massacre, probable subsurface remains.	Pier and landing site are historic properties, Japanese cemetery landward of highway, historic buildings in vicinity, site of 1790 massacre, probable subsurface remains.
Recreational Resources	Recreational fishing along western breakwater is a popular activity. Coral stockpile is a public park. Boat launch ramp located on harbor side of the park. Potential impacts to recreational fishing.	White sand beach frequented by tourists. Area also used for fishing, surfing, and snorkeling.	Popular destination for picnicking, sunbathing, and snorkeling. Potential impact to beach and snorkeling area	Basalt/cobble beach not amenable to most recreational uses. Potential impact to shoreline fishing and surf sites.	Basalt/cobble beach not amenable to most recreational uses. Potential impact to shoreline fishing and surf sites.	Basalt/cobble beach not amenable to most recreational uses. Potential impact to shoreline fishing and surf sites.
Economics						
Project First Costs	$71,802,000	$42,266,000	$26,254,000	$26,028,000	$32,634,000	$47,748,000
Ave Annual Costs	$6,734,000	$3,848,000	$2,343,000	$2,323,000	$2,971,000	$4,390,000
Ave Annual Benefits	$563,000 to $1,046,000	$1,454,000 to $1,937,000	$1,168,000 to $1,651,000	$1,168,000 to $1,651,000	$1,168,000 to $1,651,000	$1,168,000 to $1,651,000
Benefit-to-Cost Ratio	0.08 to 0.16	0.38 to 0.50	0.50 to 0.71	0.50 to 0.71	0.39 to 0.56	0.27 to 0.38

Constructing a second harbor at Hata Bay would not offer much difference in offshore wave and weather climate from that of the existing Kahului Harbor. Ships which would have problems entering the existing Kahului Harbor would encounter similar conditions at Hata Bay. The archaeological resources identified in the reconnaissance study would need to be investigated in more detail to determine their extent and significance. There would also be impact to one of the better octopus grounds on Maui.

Favorable conditions at the Ma'alaea, Ukumehame, and Olowalu sites are the alternative climatic conditions to the Kahului area, climatic conditions amenable to the unprotected pier approach, proximity to large numbers of consumers of shipped products (i.e. power plant), large population center, availability of land, and economic benefits associated with reduced overland transportation costs and reduced sailing time between ports.

Negative aspects of all the harbor sites are potential impacts to the endangered humpback whale (Megaptera novaeangliae) and potential conflict with the Hawaiian Islands Humpback Whale National Marine Sanctuary. Additional negative aspects associated with the West Maui sites are their location within Ma'alaea Bay which is considered an important breeding, calving, and nursing area for the endangered humpback whale and a major change in land use from that of surrounding areas.

In November 1992, the Hawaiian Islands Humpback Whale National Marine Sanctuary was Congressionally designated by Public Law 102-587 (Oceans Act). The sanctuary covers the marine environment (out to 100 fathoms) surrounding the islands of Maui, Lanai, and Molokai and adjacent to the Kealia National Wildlife Refuge on the island of Kauai. Although the rules and management plan for the sanctuary have not yet been established, Ma'alaea is recognized as a critical humpback whale cow/calf area. Additionally, the West Maui sites are located in areas with relatively pristine coral reefs. As part of the sanctuary, impacts to these valuable aquatic resources due to commercial harbor development would likely encounter considerable opposition.

In July 1990, the National Marine Fisheries Service (NMFS) provided a biological opinion in accordance with Section 7 of the Endangered Species Act, addressing potential impacts of the proposed improvements at Ma'alaea Small Boat Harbor on the Hawaiian population of the humpback whale. The biological opinion states "...NMFS concludes that the adverse effects of the project will not likely jeopardize the continued existence of humpback whales in Hawaiian waters. We also find that future development of new harbors and boat ramps along the west Maui coast may likely exceed the jeopardy threshold. Accordingly, no new moorings outside of state designated mooring areas should be authorized and no new harbors, marinas, or boat ramps should be built in west Maui."

Based on the July 1990 biological opinion, a proposed commercial harbor development in west Maui is likely to result in a jeopardy opinion from NMFS. If NMFS renders a jeopardy opinion for a second commercial harbor in West Maui, the project sponsor may request an exemption from the U.S. Congress. To obtain the exemption, the sponsor must demonstrate an overriding and compelling justification for the selected site over other feasible alternative sites. However, exemptions are seldom granted and the process is time consuming.

18.2. Federal Involvement

The basic legislation which governs the conduct of the Corps' civil works program consists of numerous separate enactments of the Congress. The work of preparing and considering such legislation is done largely in the Senate Environment and Public Works Committee and the House Public Works and Transportation Committee. Resolutions and specific legislation provide basic authorization for survey investigations and other feasibility studies by the Corps. Generally, water resource developments recommended to the Congress in response to study authorities may not be implemented without being specifically adopted in law.

The studies undertaken in response to these authorities are conducted in two phases in accordance with the Water Resources Development Act of 1986 (WRDA 86, PL 99-662).

1) Reconnaissance Phase. The objective of reconnaissance phase studies is to enable the Corps of Engineers to determine whether or not planning to develop a project should proceed to the more detailed feasibility stage. Reconnaissance studies are conducted at full federal cost and may take between 12 to 18 months to complete.

2) Feasibility Phase. The objective of feasibility phase studies is to investigate and recommend solutions to water resources problems. The feasibility report provides the basis for a decision on construction authorization of a project. Feasibility studies are cost shared 50/50 with a non-federal sponsor and typical studies are completed in 18 to 36 months.

The President's fiscal year 1996 budget request includes a new start for a reconnaissance study for the Maui Second Commercial Harbor under authority of Section 209 of the River and Harbor Act of 1962 (Public Law 87-874). The President's budget is pending review and approval by Congress. The final results of the budget review and approval process are not expected until mid-summer.

To establish federal interest in constructing a second commercial harbor on Maui, it must be demonstrated that the harbor is economically justified. The federal interest in conducting improvements is limited to the general navigation features (the entrance channel, basin, wave absorbers, protective structures such as breakwaters and jetties). Section 101 of WRDA 1986 require the following initial non-Federal cost sharing during the period of construction for general navigation features. The cost sharing percentages vary according to the water depth where the work is done.

Depth	Non-Federal Cost Share	
(Feet)	Initial	Additional
To 20 ft.	10%	10%
20 to 45 ft.	25%	10%
> 45 ft.	50%	10%

The project sponsor must also provide an additional 10 percent of the construction costs that are cost shared on completion of construction or over a period not to exceed 30 years, with interest. Credit against this additional 10 percent contribution is allowed for the value of lands, easements, rights-of-ways, relocations, and dredged material disposal (LERRD) provided by the project sponsor.

19. CONCLUSIONS

The development of a commercial harbor is a major undertaking which requires years of planning to successfully implement. Maui's one and only commercial harbor at Kahului currently experiences operational inefficiencies. The expanding economy continually increases pressure on the harbor's limited facilities and inefficiencies in harbor operations can be expected to increase if measures to improve operational efficiency are not implemented. Given the long term nature of commercial harbor planning and development, it is prudent to examine the long term shipping requirements for the island of Maui.

The amount and type of traffic using the harbor, commodities moved, safety, efficiency, reliability, and cost are important considerations in the development of a commercial harbor. This reconnaissance level investigation indicates potential economic viability for a second commercial harbor development on Maui. Appendix D describes the recommended detailed studies to evaluate the engineering requirements, economic feasibility, and environmental impacts of a second commercial harbor development.

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MAUI SECOND COMMERCIAL HARBOR
NAVIGATION STUDY
FINAL RECONNAISSANCE REPORT

APPENDIX A - DESIGN ANALYSIS

APPENDIX A - DESIGN ANALYSIS

1. General

This design analysis for the Maui Second Harbor Study is based on available information and the practices and procedures contained in the Coastal Engineer Research Center's (CERC) Shore Protection Manual and the Automated Coastal Engineering System (ACES). The analysis will provide the rationale used for the design of the proposed harbor at Kahului Harbor (Hata Bay), Maalaea, Olowalu, and Ukumehame. Hata Bay is located immediately adjacent to the north side of the west revetted mole and breakwater of the Kahului Deep Draft Harbor. The remaining three areas are located within the Maalaea Bay area between Kihei and Lahaina.

2. Tidal Data

The primary tidal bench mark for Kahului Harbor is a standard disc stamped "2 1929" and set in the concrete deck floor at the northeast corner of the warehouse at the south end of Pier 2. The tidal data is based on nine years of record from 1952 through 1959 and was taken by the U.S. Coast Guard and Geodetic Surveys. The data presented below will be utilized for the Hata Bay site:

Tide Level	Feet
Highest tide observed (10/12/58 & 6/20/59)	3.6
Mean higher high water (MHHW)	2.3
Mean high water (MHW)	1.90
Mean tide level (MTL)	1.15
Mean low water (MLW)	0.40
Mean lower low water (MLLW)	0.00
Lowest tide observed (6/19/55 & 6/20/55)	-1.2

The remaining sites will utilize the tidal data from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) and National Ocean Survey. The following tidal data is based on benchmarks at Olowalu and Makena, Maui:

Tide Level	Feet
==========	====
Highest tide (estimated)	3.5
Mean higher high water	2.3
Mean high water	1.8
Half tide	1.0
Mean low water	0.2
Mean lower low water	0.0
Lowest tide (estimated)	-1.0

Elevation data in this report are referenced to Mean Lower Low Water (MLLW) unless otherwise stated.

3. **Wave Climate**

Wave data for the Kahului area were obtained from three sources; 1) a wave gage, operated from July 1966 to March 1969, located approximately 1,860 feet north of the head of the east breakwater, 2) CERC's Pacific Coast Hindcast Deepwater Wave Information Study (WIS-14, 1986) for the Hawaiian Islands, and 3) CERC's physical model data for the "Kahului Breakwater Stability Study" (CERC, 1982).

The wave gage data were analyzed and tabulated by the Coastal Engineering Research Center. Tables A-1 and A-2 show the wave climatology for Kahului Harbor as a distribution of wave height in percent versus wave period. The highest wave recorded was 28 feet with a period 16 seconds and occurred during a 4-6 December 1968 storm. Prior to this storm, the maximum recorded wave height was 19 feet. As shown in Table A-1, waves of 9 feet or less were recorded 96.1 percent of the time. Periods of wave gage equipment outages did not coincide with any known occurrences of storm waves at Kahului.

A summary of CERC's wave hindcasts for station 31, located at 21.9N and 155.7W (see Figure A-1), is presented in Table A-3 and Figure A-2. The data presented are based on 20 years of hindcast from 1956 - 1975.

The wave data for the various hydrographs run for CERC's (1982) "Kahului Breakwater Stability Study" are presented in Tables A-4, A-5, A-6, and A-7.

In addition, four pressure sensitive wave gages were installed in March 1993 within and around Kahului Harbor as part of a reimbursable harbor monitoring study by the State of Hawaii, Department of Transportation, Harbor Division. A deep water 3 meter direction wave gage was installed in north Maui on October 1993 by NOAA and was funded by the U.S. Army Corps of Engineers Field Wave Gaging Program. Long term data records are not available due to the newness of the gages and will not be included in this analysis.

Wave data from the Maalaea Bay area are dominated by the southern swell and the "Kona" storm waves.

Southern swell is generated in the southern hemisphere, most frequently during the Antarctic winter months between April and November. After traveling over thousands of miles of open ocean, these waves arrive at the southern shores of the Hawaiian islands as long-period swell. Periods typically range between 14 and 22 seconds with heights generally 1 to 4 feet. In any year, southern swell may occur about 50 percent of the time.

Kona storm waves generally approach Maalaea Bay from the south or south-southwest. Wave periods usually range from 8 to 10 seconds, with heights of 10 to 15 feet. In any year, Kona storms may occur several times or not at all. They most frequently occur during the winter months.

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

4. Design Storm Parameters

The following design storm parameters are based on the characteristics of Hurricane Iwa (16-25 November 1982) obtained from the "Hurricane Vulnerability Study for Honolulu, Hawaii and Vicinity" (HED, 1985):

Max. Sustained Wind Speed, U (knots)	82.5
Forward Speed, Vf (knots)	33.3
Radius of Max. Winds, r (nautical miles)	34.7
Drop in Pressure, $(P_n - P_o)$ (Hg inches)	1.4

5. Design Water Levels

The design stillwater level (d_{swl}) is defined as the level of water above the elevation datum plane when no waves are present. Components of the design still water level are the astronomical tide level (S_a), the rise in water level due to atmospheric pressure reduction (S_p), the rise in water level due to storm surge (S_s), and the rise in water level due to wave setup (S_w).

$$\begin{aligned} d_{swl} &= S_a + S_p + S_s + S_w \\ &= 1.9' + 1.3' + .08' + 1.5' \\ &= 5.5 \text{ feet} \end{aligned}$$

a. **Astronomical Tide, S_a.** The design astronomical tide is based on the mean high water level (mhw) for the project site.

$$S_a = 1.9 \text{ feet}$$

b. **Atmospheric Pressure Reduction, S_p.** The rise in water level due to a reduction in the atmospheric pressure was calculated using the following equation:

$$\begin{aligned} S_p &= 1.41\,(P_n - P_o)\,(1-e^{-R/r}) \text{ (Eq. 3-85, SPM 1984)} \\ &= 1.41(1.4)(1-e^{-34.7/21.7}) \\ &= 1.3 \text{ feet} \end{aligned}$$

where: $(P_n - P_o)$ = central pressure reduction (Hg inches)

R = radius of maximum winds (nautical miles)

r = radial distance from storm center to computational point (n.m.)
= 21.7 n.m. (based on Iwa, HED, 1985)

c. **Storm Surge, S_s.** The rise in water level due to storm surge was calculated using the following equation.

$$S_s = S_i = (540\ k\ U_r^2\ D_x)/d_{mean} \quad \text{(TP-4, 1966)}$$

where: k = 3×10^{-6}
U_r = maximum sustained wind speed
S_i = incremental rise in water level
d_{mean} = mean depth over increment
D_x = incremental distance

Based on the design storm conditions,

$S_s = 0.8$ feet

d. **Wave Setup.** The rise in water level due to wave setup is based on the following equation:

$S_w = (0.15)d_b = 1.5$ feet

6. **Design Wave Heights**

a. **Hata Bay.** For the Hata Bay site the design wave height is based on a depth limited wave evaluation and is calculated as follows:

Wave depth	= 18.0 feet
Design Water Level	5.5 feet
Total Design Water Depth (d_s)	23.5 feet

Design Wave Height (H_b)	= 0.78 d_s
	= 0.78 (23.5)
	= 18.33 feet, use 19 feet

b. **Olowalu.** For revetted mole/breakwater at Olowalu, the design wave height is based on a depth limited wave evaluation and is calculated as follows:

Water depth at toe of structure	= 0.0
Design water level	= 5.5
Total design water depth	= 5.5 feet

Design Wave Height (H_b) = $0.78\ d_s$
= $0.78\ (5.5)$
= 4.1 feet, use 4 feet

7. Protective Structure Design

a. Hata Bay

Armor Layer Design Weight = W for Tribars

$$W = \frac{W_r H^3}{K_d (S_r - 1)^3 \text{Cot } 0}$$

W_r = 145 lbs/cu ft (concrete)
H = 19 feet
K_d = 9
S_r = 2.26
Cot 0 = 2.0
W = 27.620 lbs
W = 14 tons tribars

For the underlayer use two layers of 2,000 - 3,500 lbs with 25% > 2,700 lbs; underlayer thickness = 5.2 feet. For the third layer use 200 - 350 lbs. A two-layer thickness is equal to 2.4 feet. The core material is 1 lb to 200 lbs. The use of the dredged material for the core may be suitable.

b. **Olowalu.** The use of armor stone will be evaluated.

Armor layer design weight = W_{armor}

$$W_{armor\ stone} = \frac{W_r H^3}{K_d (Sr-1)^3 \text{Cot } 0}$$

W_r = 156 lbs/cu feet
H = 4.0 feet
K_d = 1.5
Cot 0 = 2.0
S_r = 2.44
W = 1,115 lbs use 1,200 lbs

Range of size = 900 - 1,500 lbs with 75% > 1,200 lbs

Layer Thickness (2 layers) = 3.9 feet
Underlayer = 90 - 150 lbs
2-Layer thickness = 2.2 feet

8. Crest Elevation

a. **Hata Bay**. For Hata Bay the crest elevation was calculated using the ACES program. The program results are as follows:

WAVE RUNUP AND OVERTOPPING ON IMPERMEABLE STRUCTURES

Item		Unit	Value	
Wave Height at Toe	Hi:	ft	19.000	Monochromatic
Wave Period	T:	sec	12.000	Wave
COTAN of Nearshore Slope			100.000	Rough Slope
Water Depth at Toe	ds:	ft	23.500	Runup
COTAN of Structure Slope			2.000	
Structure Height Above Toe	hs:	ft	30.000	
Rough Slope Coefficient	a:		0.956	
Rough Slope Coefficient	b:		0.398	
Deepwater Wave Height	HO:	ft	17.089	
Relative Height	(ds/HO):		1.375	
Wave Steepness	(HO/gT 2):		0.369E-02	
Wave Runup	R:	ft	25.261	

The crest elevation for a non overtopping structure would be approximately +31 feet. A comparison of the existing structure shows that a +20 elevation was utilized.

A wave transmission from an overtopping wave was also analyzed using the ACES program. The following program results shows that if the crest elevations is set at +20 feet, then the transmitted wave during the design condition would be less than 4 feet. Since this harbor is not being designed as a 100% usable facility, this overtopping during design conditions is considered reasonable and therefore the crest elevation of +20 feet will be utilized.

WAVE TRANSMISSION ON IMPERMEABLE STRUCTURES

Item		Unit	Value	
Incident Wave Height	Hi:	ft	19.000	Rough Slope
Wave Period	T:	sec	12.000	Runup and
COTAN of Nearshore Slope			100.000	Transmission
Water Depth	ds:	ft	23.500	
COTAN of Structure Slope			2.000	
Structure Height Above Toe	hs:	ft	38.000	
Structure Crest Width	B:	ft	15.000	
Rough Slope Coefficient	a:		0.956	
Rough Slope Coefficient	b:		0.398	
Wave Runup	R:	ft	25.261	
Transmission Rate	HT:	ft	3.776	

b. **Olowalu.** For Olowalu, the crest elevation for the revetted mole was calculated utilizing the ACES program. The resultant data are as follows:

Item		Unit	Value	
Wave Height at Toe	Hi:	ft	4.200	Monochromatic
Wave Period	T:	sec	10.000	Wave
COTAN of Nearshore Slope			100.000	Rough Slope
Water Depth at Toe	ds:	ft	6.200	Runup
COTAN of Structure Slope			2.000	
Structure Height Above Toe	hs:	ft	25.600	
Rough Slope Coefficient	a:		0.956	
Rough Slope Coefficient	b:		0.398	
Deepwater Wave Height	HO:	ft	3.061	
Relative Height	(ds/HO):		2.026	
Wave Steepness	(HO/gT 2):		0.951E-03	
Wave Runup	R:	ft	6.933	

Based on this, a crest elevation of +12 MLLW will be utilized.

9. Navigation

Two approaches to vessel docking structures will be discussed in this section. The first will be to provide a pile supported pier structure across the beach and reef to a determined water depth. This approach will allow the littoral process to continue uninterrupted, minimize impacts on the reef, and eliminate or minimize the need for dredging. This approach, the utilization of an unprotected pier, has been used successfully at Kaunakakai, Molokai and historically has been used in the Maalaea Bay area of Maui at Olowalu Point and Mala Wharf. A general schematic design is shown in the main report. A wave climate analysis will be required to determine the feasibility of this approach.

The other is the standard protected harbor approach. The two sites that are amenable to this approach are Hata Bay and Olowalu Point. Preliminary harbor plans are show as Figures 6 and 12 of the main report. The navigation features for the entrance channel and turning basin are designed as follows:

The design vessel will be a tug and barge combination. The barge dimensions are: Beam = 80', Length (L) = 350'. This design vessel was selected from information requested by a questionnaire sent to the major harbor users.

The entrance channel will be designed utilizing one way traffic as follows:

a. Maneuvering Lane = 2 x beam + L sin 10^{o}
2 X 80 + (350 sin 10^{o})
221 feet, use 225 feet

b. Bank Clearance = 1.5 x beam
1.5 x 80
20 feet

c. Channel width for one way traffic = A + 2B
225 + 2(120)
265 feet

Turning Basin: It is recommended that 1.5 to 2.0 L be used. Since we are using a barge which is towed, 2L will be used.

Turning Basin Dimension: 2L
2 x 350
700 feet

Depth of Channel:

Draft	=	21 feet
Min Tide	=	1 feet
Wave Allowance	=	4 feet
Squat & Trim	=	1 foot
Safety Clearance	=	3 feet
Total	=	30 feet MLLW

Depth of Turning Basin:

Draft	=	21 feet
Min Tide	=	1 foot
Wave Allowance	=	1 foot
Squat & Trim	=	1 foot
Safety Clearance	=	3 feet
Total	=	27 feet

TABLE A-1. WAVE CLIMATOLOGY FOR KAHULUI HARBOR

Distribution of Wave Height in Percent as a Function of Wave Period
Observation Period: July 1966 to January 1968
Number of Observations: 1,230

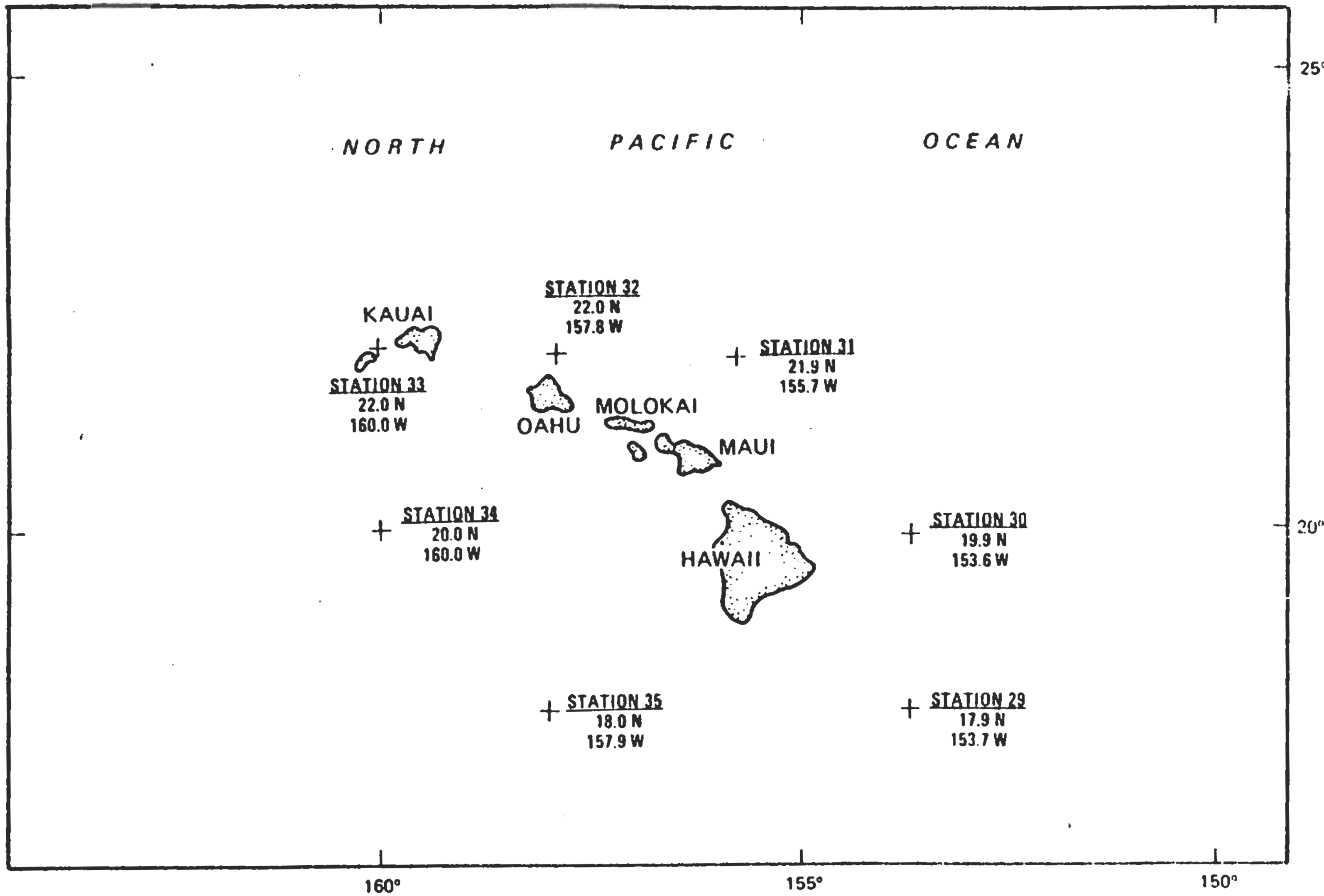
Wave Period (Seconds)	Wave Height (Feet) 0-3	3-6	6-9	9-12	12+	Total
0 - 6.9	2.8	0.0	0.0	0.0	0.0	2.8
7.0 - 9.9	24.8	11.6	1.2	0.0	0.0	37.6
10.0 - 12.9	11.6	25.8	9.0	2.0	0.4	48.8
13.0 - 15.9	1.1	4.3	2.9	0.9	0.9	10.1
16.0 - 18.9	0.0	0.7	0.3	0.0	0.2	1.2
19.0 +	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	40.3	42.4	13.4	2.9	1.5	100.5

Notes:
1. Record obtained with a pressure wave gage located at Kahului Harbor.
2. Departure from 100 percent total results from accumulation of rounding error and is not considered to be significant.

TABLE A-2. STORMS AFFECTING KAHULUI HARBOR

Date	Deepwater Wave Height (Feet)	Period (Seconds)	Direction
3 Jan 1947	23	19	N
5-6 Mar 1954	26	18	NE
27-28 Nov 1956	9	15	N
22 Nov 1958	14	17	NE
18-21 Dec 1960	12.1	14.2	N
29 Jan - 3 Feb 1965	27	17	N
6-7 Oct 1966	14	12	-
27 Aug - 1 Sep 1967*	19	15	N
12-14 Dec 1967*	18	15	N
4-6 Dec 1968*	28	15-16	-
29 Nov - 1 Dec 1969**	20	-	-
22-24 Nov 1970	18	19	NNE

Note: Wave height based on hindcast unless otherwise noted.
* Wave height and period recorded by gages.
** Observed wave height.



Location of WIS Wave Hindcast Stations

FIGURE A-1

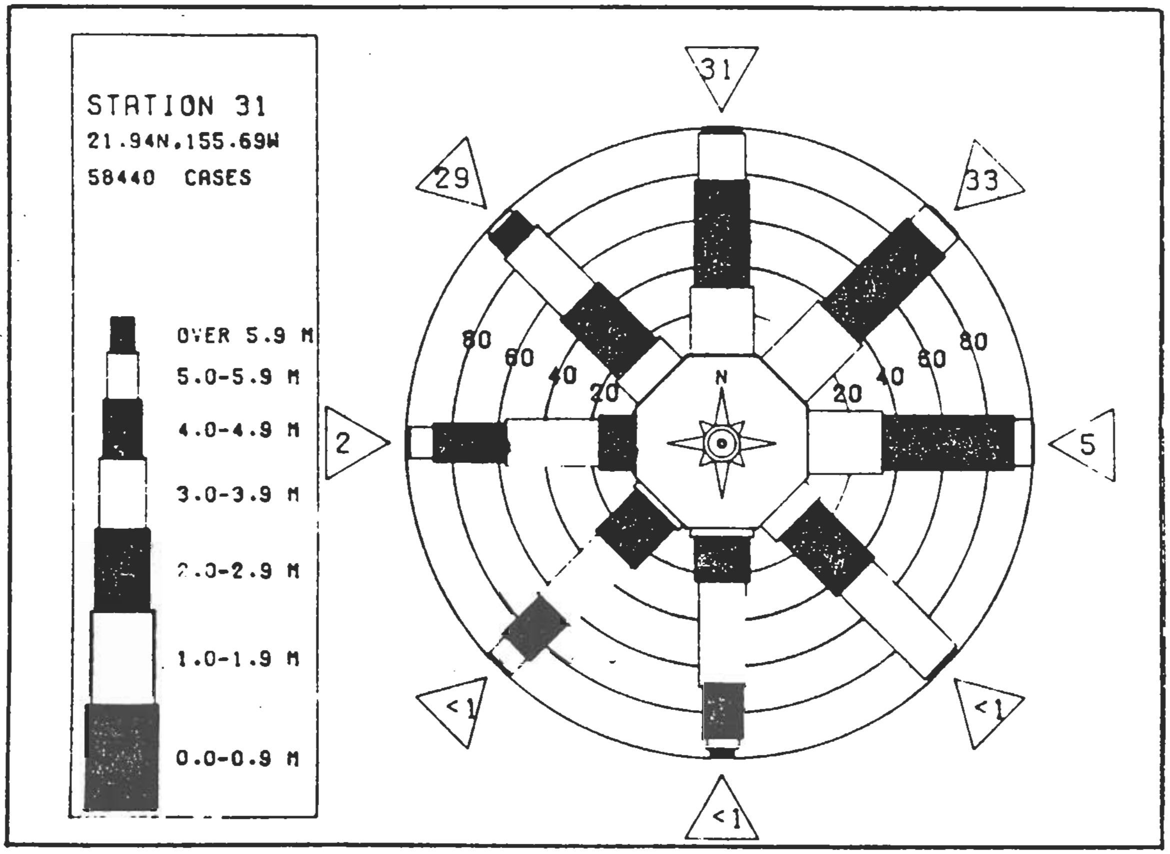
TABLE A-3. WIS HINDCAST WAVE DATA

STATION 31 21.94N 155.69W FOR ALL DIRECTIONS
PERCENT OCCURRENCE (X100) OF HEIGHT AND PERIOD FOR ALL DIRECTIONS

HEIGHT (METRES)	PEAK PERIOD (SECONDS)										TOTAL
	4.4-6.0	6.1-8.0	8.1-9.5	9.6-10.5	10.6-11.7	11.8-13.3	13.4-15.3	15.4-18.1	18.2-22.2	22.3-LONGER	
0. -0.9	36	15	4	.	.	.	.	.	.	.	. 55
1.0-1.9	780	706	739	281	91	20	4	.	.	.	2621
2.0-2.9	317	1420	732	665	946	391	40	5	.	.	4516
3.0-3.9	.	348	97	85	453	961	198	8	.	.	2150
4.0-4.9	.	14	42	4	44	187	200	10	.	.	501
5.0-5.9	.	.	9	4	5	26	54	9	.	.	107
6.0-6.9	.	.	.	1	1	4	12	9	.	.	27
7.0-7.9	.	.	.	.	.	.	.	.	.	.	0
8.0-8.9	.	.	.	.	.	.	.	.	.	.	0
9.0-9.9	.	.	.	.	.	.	.	.	.	.	0
10.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	1133	2503	1623	1040	1540	1589	508	41	0	0	

MEAN HS(M)=2.5 LARGEST HS(M)=7.1 MEAN TP(SEC)=9.2 TOTAL CASES=58440

FIGURE A-2
WIS HINDCAST WAVE ROSE



TABLES A-4 THROUGH A-7.
KAHULUI BREAKWATER STABILITY MODEL STUDY (CERC, 1982)
WAVE DATA.

TABLE A-4
HYDROGRAPH A

Step	swl ft mllw	Test Wave Period sec	Test Wave Height ft	Prototype Duration Hr	Wave Type
	-1.0	16.0	10.0	0.25	Shakedown
1	-1.0	16.0	19.5	0.25	Worst breaking (Sea-side armor)
2	-1.0	18.0	21.0	0.25	Worst breaking (Sea-side armor)
3	+4.0	16.0	24.5	1.0	Worst breaking (Harbor-side armor)
4	+4.0	16.0	25.5	0.5	Worst breaking (Sea-side armor)
5	+4.0	18.0	25.6	1.0	Worst breaking (Sea- and harbor-side armor)
6	-1.0	18.0	21.0	0.25	Worst breaking (Sea-side armor)
7	-1.0	16.0	19.5	0.25	Worst breaking (Sea-side armor)

TABLE A-5
HYDROGRAPH B

Step	swl ft mllw	Test Wave Period sec	Test Wave Height ft	Prototype Duration Hr	Wave Type
	-1.0	16.0	9.0	0.25	Shakedown
1	-1.0	16.0	16.0	0.25	Worst breaking
2	-1.0	18.0	18.0	0.25	Worst breaking
3	+4.0	16.0	20.5	1.0	Worst breaking
4	+4.0	18.0	21.5	1.0	Worst breaking
5	-1.0	18.0	18.0	0.25	Worst breaking
6	-1.0	16.0	16.0	0.25	Worst breaking

TABLE A-6
HYDROGRAPH C

Step	swl ft mllw	Test Wave Period sec	Test Wave Height ft	Prototype Duration Hr	Wave Type
	+4.0	16.0	15.0	0.25	Shakedown
1	+4.0	16.0	30.5	1.00	Worst breaking
2	+4.0	18.0	34.0	1.00	Worst breaking

TABLE A-7
HYDROGRAPH D

Step	swl ft mllw	Test Wave Period sec	Test Wave Height ft	Prototype Duration Hr	Wave Type
	+4.0	16.0	15.0	0.25	Shakedown
1	+4.0	16.0	29.0	1.00	Worst breaking
2	+4.0	18.0	29.8	1.00	Worst breaking

MAUI SECOND COMMERCIAL HARBOR
NAVIGATION STUDY
FINAL RECONNAISSANCE REPORT

APPENDIX B - CONSTRUCTION COST ESTIMATES

APPENDIX B - CONSTRUCTION COST ESTIMATES

Because of the preliminary nature of a reconnaisance level design, the following assumptions were made in the preparation of the reconnaissance level construction cost estimates for the six proposed alternatives.

1. Alternatives 1-6. An October 1994 price level is used.
2. Alternative 1. The dredged material dump site will be offshore about 11 miles to the north of Maui. There will be no requirement for wave absorbers or shore protection other than the two breakwaters. Off-shore dredging will be a drill and shoot clamshell/dragline off of barge operation. Dredge overdepth is 4 ft. The estimated value of bare land is $10.00/sf.
3. Alternative 2. Fuel will be transported from the fuel delivery vessel at the dock to the Maalaea power plant via a six-inch underground pipeline. A pump booster station would not be required since it is assumed that the barge would be equipped with a pump that can maintain sufficient pressure. The estimated value of bare land is $2.50/sf. If tax map tract 2-3-8-5-32 is required, it would add an estimated $1,000,000 to the cost of the site.
4. Alternative 3. The estimated value of bare land is broken down into separate values based on its location. All land between State Road 30 and the ocean has an estimated value of $5.00/sf and land mauka of the road has an estimated value of $1.00/sf.
5. Alternatives 4, 5, and 6. The estimated value of bare land is broken down into separate values based on its location and use. Ocean front land has an estimated value of $22.96/sf, non-ocean front residential lots have an estimated value of $5.00/sf, and sugar cane land has an estimated value of $1.00/sf.
6. Alternative 5. The dredged material dump site will be inland, approximately 2 miles away from the project site. There will be no requirement for wave absorbers or shore protection. Off-shore dredging will be a drill and shoot clamshell/dragline off of barge. Dredge overdepth is 1 ft.
7. Alternative 6. The dredged material dump site will be inland, approximately 2 miles away from the project site. There will be no requirement for wave absorbers or shore protection other than the revetted mole. On-shore dredging will be a drill and shoot clamshell operation. Off-shore dredging will be a drill and shoot clamshell/dragline off of barge operation. Off-shore dredge overdepth is 4 ft.

Alternative 1
HATA BAY DREDGE HARBOR SCHEME

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	3,344,000	334,000	3,678,000
750 FT. BREAKWATER	750	LF	9,147,000	2,287,000	11,434,000
1300 FT. BREAKWATER	1,300	LF	11,110,000	2,778,000	13,888,000
MECHANICAL DREDGING	589,729	CY	15,184,000	3,796,000	18,980,000
LANDS AND DAMAGES	10	ACRE	436,000	109,000	545,000
WHARF	32,500	SF	7,315,000	1,829,000	9,144,000
BACKUP AREA	10	ACRE	2,947,000	737,000	3,684,000
Subtotal			49,483,000	11,870,000	61,353,000
ENGINEERING AND DESIGN (7%)					4,295,000
SUPERVISION AND ADMINISTRATION (9%)					5,522,000
Total Project First Cost					71,170,000

Alternative 2
MAALAEA PIER SCHEME

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	2,078,000	208,000	2,286,000
LANDS AND DAMAGES	10	ACRE	1,089,000	272,000	1,361,000
PRECAST CONC. PILING (CAUSEWAY)	35,840	LF	2,780,000	695,000	3,475,000
TIMBER, FENDERS, BOLLARDS, CLEAT	1	EA	67,000	17,000	84,000
BACKUP AREA	10	ACRE	3,008,000	752,000	3,760,000
PRECAST CONC. PILING (BARGE) 80'	35,200	LF	2,688,000	672,000	3,360,000
CAUSEWAY (ROAD) TO BACKUP AREA	1	EA	875,000	219,000	1,094,000
BEAMS/CAPS AND MISC. CONCRETE	97,000	SF	7,665,000	1,916,000	9,581,000
PRESTRESSED/PRECAST PLANKS	1	EA	3,187,000	797,000	3,984,000
12" C.I.P. CONCRETE DECK	97,000	SF	1,984,000	496,000	2,480,000
PC CONC. PILING (BARGE) 120'+	38,220	LF	2,852,000	713,000	3,565,000
6" UNDERGROUND PIPELINE	4,500	LF	1,125,000	281,000	1,406,000
Subtotal			29,398,000	7,038,000	36,436,000
ENGINEERING AND DESIGN (7%)					2,551,000
SUPERVISION AND ADMINISTRATION (9%)					3,279,000
Total Project First Cost					42,266,000

Alternative 3
UKUMEHAME PIER SCHEME

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	2,021,000	202,000	2,223,000
LANDS AND DAMAGES	10	ACRE	436,000	109,000	545,000
PRECAST CONC. PILING (CAUSEWAY)	35,840	LF	1,810,000	453,000	2,263,000
TIMBER, FENDERS, BOLLARDS, CLEAT	1	EA	68,000	17,000	85,000
BACKUP AREA	10	ACRE	3,050,000	763,000	3,813,000
PRECAST CONC. PILING (BARGE) 80'	35,200	LF	889,000	222,000	1,111,000
BEAMS/CAPS AND MISC. CONCRETE	97,000	SF	4,649,000	1,162,000	5,811,000
PRESTRESSED/PRECAST PLANKS	1	EA	1,822,000	456,000	2,278,000
12" C.I.P. CONCRETE DECK	97,000	SF	1,083,000	271,000	1,354,000
PC CONC. PILING (BARGE) 120'+	38,220	LF	2,364,000	591,000	2,955,000
TRAFFIC INTERSECTION	1	EA	156,000	39,000	195,000
Subtotal			18,348,000	4,285,000	22,633,000
ENGINEERING AND DESIGN (7%)					1,584,000
SUPERVISION AND ADMINISTRATION (9%)					2,037,000
Total Project First Cost					26,254,000

Alternative 4
OLOWALU PIER SCHEME

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	2,021,000	202,000	2,223,000
LANDS AND DAMAGES	10	ACRE	436,000	109,000	545,000
PRECAST CONC. PILING (CAUSEWAY)	35,840	LF	1,810,000	453,000	2,263,000
TIMBER, FENDERS, BOLLARDS, CLEAT	1	EA	68,000	17,000	85,000
BACKUP AREA	10	ACRE	3,050,000	763,000	3,813,000
PRECAST CONC. PILING (BARGE) 80'	35,200	LF	889,000	222,000	1,111,000
BEAMS/CAPS AND MISC. CONCRETE	97,000	SF	4,649,000	1,162,000	5,811,000
PRESTRESSED/PRECAST PLANKS	1	EA	1,822,000	456,000	2,278,000
12" C.I.P. CONCRETE DECK	97,000	SF	1,083,000	271,000	1,354,000
PC CONC. PILING (BARGE) 120'+	38,220	LF	2,364,000	591,000	2,955,000
Subtotal			18,192,000	4,246,000	22,438,000
ENGINEERING AND DESIGN (7%)					1,571,000
SUPERVISION AND ADMINISTRATION (9%)					2,019,000
Total Project First Cost					26,028,000

Alternative 5
OLOWALU DOCK AND TURNING BASIN

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	3,248,000	325,000	3,573,000
MECHANICAL DREDGING	344,816	CY	7,433,000	1,858,000	9,291,000
LANDS AND DAMAGES	10	ACRE	436,000	109,000	545,000
PRECAST CONC. PILING (CAUSEWAY)	50,300	LF	3,381,000	845,000	4,226,000
TIMBER, FENDERS, BOLLARDS, CLEAT	1	EA	142,000	36,000	178,000
BACKUP AREA	10	ACRE	3,050,000	763,000	3,813,000
BEAMS/CAPS AND MISC. CONCRETE	40,000	SF	3,185,000	796,000	3,981,000
PRESTRESSED/PRECAST PLANKS	1	EA	1,278,000	320,000	1,598,000
12" C.I.P. CONCRETE DECK	40,000	SF	741,000	185,000	926,000
Subtotal			22,894,000	5,237,000	28,131,000
ENGINEERING AND DESIGN (7%)					1,969,000
SUPERVISION AND ADMINISTRATION (9%)					2,532,000
Total Project First Cost					32,632,000

Alternative 6
OLOWALU DREDGE HARBOR SCHEME

Project Feature	Quantity	Unit	Contract	Contin-gency	Total Cost
MOB, DEMOB & PREP WORK	1	EA	3,215,000	322,000	3,537,000
REVETED MOLE	800	LF	772,000	193,000	965,000
MECHANICAL DREDGING	1,052,395	CY	17,040,000	4,260,000	21,300,000
LANDS AND DAMAGES	20	ACRE	871,000	218,000	1,089,000
WHARF	30,000	SF	6,752,000	1,688,000	8,440,000
CULVERT @ OLOWALU STREAM	1,400	SF	699,000	175,000	874,000
BACKUP AREA	10	ACRE	2,947,000	737,000	3,684,000
BERTHING AREA DREDGING	72,090	CY	1,018,000	255,000	1,273,000
Subtotal			33,314,000	7,848,000	41,162,000
ENGINEERING AND DESIGN (7%)					2,881,000
SUPERVISION AND ADMINISTRATION (9%)					3,705,000
Total Project First Cost					47,748,000

MAUI SECOND COMMERCIAL HARBOR
NAVIGATION STUDY
FINAL RECONNAISSANCE REPORT

APPENDIX C - ECONOMIC EVALUATION

APPENDIX C
ECONOMIC EVALUATION
TABLE OF CONTENTS

APPENDIX C
ECONOMIC EVALUATION
TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

APPENDIX C - ECONOMIC EVALUATION

1. General

The economic analysis for a federal navigation improvement study measures a project's contributions to national economic development (NED). Deep-draft navigation improvements contribute to NED by improving the efficiency of waterborne transportation services. Efficiency gains result from reductions in the cost of transporting goods and increases in the value of the goods transported. The benefits from navigation improvements come from several sources. According to the federal regulation entitled Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100):

"Specific transportation savings may result from the use of larger vessels, more efficient use of larger vessels, more efficient use of existing vessels, reductions in transit time, lower cargo handling and tug assistance costs, reduced interest and storage costs such as from an extended navigation season, and the use of water transportation rather than alternative land mode."

The benefits in this analysis are the differences in transportation costs and the value of the goods transported under without- and with-project conditions. These benefit calculations are based on the most current data available and are adjusted to an October 1994 price level. The adjustments are done using estimates of the Honolulu Consumer Price Index (CPI-U) for comparison with estimated project costs.

The estimated cost of the proposed improvements are also measured at an October 1994 price level. These estimates are discussed in another section and are the cost of all goods and services used in project construction and operation and maintenance.

Any costs or benefits not occurring annually are converted to an average annual equivalent basis over the 50-year period of analysis. This conversion is done using the Federal discount rate prescribed for water resource projects which is currently set at eight percent. The base year of the alternatives analyzed in this study is 1996. A comparison of average annual costs and benefits determines the viability of federal participation in a project.

2. Background

Maui is the second largest island in the Hawaiian chain measuring 727 square miles. It is part of Maui County which also includes the islands of Molokai, Lanai, and Kahoolawe. Maui is the economic center and seat of government for Maui County. The 1990 census found 91,361 residents living on Maui with the main population centers located at Kahului, Kihei, and Wailuku.

Maui's economy offers a variety of opportunities for its residents. Tourism is Maui's number one industry with the island hosting 2,261,000 visitors in 1993. Other major industries include diversified agriculture, sugar and pineapple cultivation, and scientific and high-technology activities. The economy of Maui County generated 62,750 jobs, $2.7 billion in gross business receipts, and $165 million in state taxes in 1993. Maui County has the second largest economy in the state after the City & County of Honolulu.

Kahului Harbor is an essential part of the Maui economy. Located between the population centers of Kahului and Wailuku, it is Maui's only deep-draft commercial harbor. As such, a majority of the goods imported to and exported from Maui go through Kahului Harbor. In 1993, 2,216,000 tons of cargo moved through Kahului Harbor. That is a six percent decrease from 1992 when 2,357,000 tons of cargo were transported. Since 1970, the amount of cargo has fluctuated with the average through 1993 being about 1,700,000 tons. Most of the commodities delivered at Kahului Harbor are sent from Honolulu Harbor on the island of Oahu. Likewise, most of the items exported through Kahului Harbor are bound for Honolulu Harbor. In addition to cargo deliveries, Kahului Harbor is also a stopover for cruise ships visiting Maui. In 1992, more than 70,000 passengers disembarked at Kahului Harbor for tours of the island and shopping. As Maui's economy grows, so will Kahului Harbor's importance as a point of entry for both goods and visitors.

Kahului Harbor's facilities have adequately handled the flow of goods and visitors in the past, but there are some concerns about its future adequacy. The expanding economy continuously puts more pressure on the harbor's limited facilities and inefficiencies in harbor operations have increased. Also, there is the threat of some kind of navigation accident or other catastrophe closing the harbor. Such a closure will have detrimental effects on the entire island. The purpose of this analysis is to determine the impacts of developing a second commercial harbor for Maui that will alleviate these concerns.

3. Without-Project Conditions

At present, only the eastern corner of Kahului Harbor is used by tug and barge and deep-draft vessels. There are three piers for loading and unloading goods and dropping off and picking up passengers. Piers 1, 2, and 3 are located in this corner along with their accompanying dockside facilities. The rest of the harbor has not been developed for deep-draft navigation purposes.

The major users that share Pier 1 include Matson Navigation Company, American Hawaii Cruises, the Hawaiian Sugar Planters Association, and Hawaii Commercial and Sugar Plantation. Containerized cargo is loaded and unloaded from Pier 1. Cruise passengers are dropped off and picked up from that pier. Raw sugar is loaded and coal is unloaded there. Lumber from the Pacific northwest is also off-loaded at this pier. The schedules of the different users have been coordinated as much as possible to avoid more than one user from arriving at the port at the same time. Conflicts are rare, but when they do occur the passenger ships have priority. The sugar or coal operations must stop and the barges moved out of the way to make room for the passenger ships. There is little flexibility in scheduling arrivals for the sugar and coal ships and they must often utilize a two or three-day window in between scheduled passenger ships.

Pier 2 is utilized by Hawaii Tug & Barge/Young Brothers Ltd. to conduct interisland barge operations. Break bulk and containerized cargo are handled at this facility's terminal and container yard. The space available for these operations, however, has become inadequate. The terminal does not have enough room for all the break bulk cargo that comes in on the barges. Items are handled more than is optimal as stevedores try to fit as much cargo in the terminal as possible. Some break bulk cargo must be stored outside the terminal because of this lack of space even with all the added handling. Some break bulk cargo is temporarily stored at Pier 3 on occasion. The container yard has also become too small for the number of containers coming in on the barges. Due to this lack of space, containers are stacked two-high in the container yard. It is an efficient use of space, but problems can arise during the distribution of the containers for hauling to their final destination. As it is now, excessive cargo handling occurs regularly at Pier 2.

Pier 3 is used by the fuel barges, the barges delivering cement, and for the off-loading of scrap metal. The cement storage and distribution facility is located between piers 2 and 3. Scheduling conflicts also occur at this pier. Such conflicts cause delays and congestion in the harbor.

It is assumed that the present conditions existing in the harbor will continue throughout the study period and represent the without-project conditions.

4. With-Project Conditions

The development of a second commercial harbor on Maui will relieve some of the congestion and inefficiencies presently occurring at Kahului Harbor. At this time, however, it is uncertain which users will move to the new facility and which users will stay at Kahului Harbor. For this reason, the following analysis assumes that both break bulk and containerized cargo shipments will take place at the second harbor. It is also envisioned that fuel will be delivered at the second harbor and piped or trucked to storage facilities at the power plant. Moving these operations to the second harbor will relieve some of the pressure on Kahului Harbor's facilities. Efficiency gains and reduced operating costs are expected for the users remaining at Kahului Harbor and also for those users moving to the new facility.

5. Benefit Calculations

Operating costs under without-project conditions and those under with-project conditions are compared to determine the benefits of developing a second harbor for Maui. A second harbor will alleviate the congested conditions that now exist at Kahului Harbor and allow users to adjust their operations to eliminate costly inefficiencies. Those who move to the new facility will, likewise, have ample space to set up a system that avoids the present inefficiencies at Kahului Harbor. A second harbor, depending on its location, may also have some site specific advantages over Kahului Harbor. These advantages can be translated into reduced operating costs for users of the second harbor. The savings generated from increased efficiency and locational advantages can be counted as benefits of having a second commercial harbor on Maui.

A second harbor on Maui will also give a measure of security to those dependent on the harbor's services. Nearly every sector of the Maui economy relies either directly or indirectly on the harbor. This being the case, an unexpected and prolonged closure of the harbor would wreak havoc on the Maui economy. With a second harbor in place, the economy will be spared some of the costly consequences of an emergency harbor closure. Avoiding some of the costs associated with a harbor closure can also be counted as benefits of having a second commercial harbor on Maui.

This study measures the savings from increased efficiency, locational advantages, and avoidance of emergency harbor closure costs associated with developing a second harbor. The following sections detail the derivation of benefits from reductions in scheduling conflicts, transportation costs, and emergency harbor closure disruptions.

5.1 Inefficiency Cost Reduction

Excess cargo handling and scheduling difficulties are the main sources of inefficiency at Kahului Harbor. The effect of a second harbor facility on the excess cargo handling problem will be discussed in a later section. Scheduling difficulties occur from both conflicting schedules and shippers loading or unloading at less than optimum times. These scheduling conflicts are kept to a minimum through the concerted efforts of the present harbor users, but they still happen occasionally. These conflicts are costly as the loading or unloading of vessels already at the pier must be stopped to make room for incoming vessels.

Pier 1 is the designated area for unloading the coal delivered to Maui. Approximately 30,000 tons of coal are brought to Maui annually. Scheduling conflicts can arise when a passenger ship arrives at the port during the unloading. When this occurs, the unloading operation must stop to make room at the pier for the passenger ship. Only after that ship leaves the pier can the coal unloading restart. Such interruptions occurred twice in 1993 and created additional vessel, demurrage, labor (overtime), and trucking costs. These interruptions in the unloading process cost an estimated $10,000 to $25,000 for each occurrence.

It is assumed that without a second harbor in place two such interruptions will occur annually and generate a total of $35,000 in additional cost. It is also believed that a second commercial harbor, along with Kahului Harbor, will alleviate the present scheduling conflicts at Pier 1. The two facilities will provide enough pier space to eliminate the interruptions in coal unloading and the $35,000 cost. This $35,000 cost avoidance can be attributed as a benefit of developing the second harbor. At a 1994 price level, that cost avoidance will be about $36,000.

Scheduling conflicts also impose high costs on the sugar operation. Raw sugar is shipped out of Kahului Harbor once or twice a month for refining in California. In the harbor's present configuration, the ship docks at Pier 1 as it takes on sugar. That part of Pier 1 is also used by the passenger ships when they call on Kahului Harbor. To avoid both ships from coming into the harbor at the same time, the sugar ship usually comes in on the weekends. It must take on its cargo by Monday to make room for the passenger ships. The loading procedure is efficient and the equipment is normally run at capacity, but there are high labor costs. Due to the scheduling constraint of having to come in on the weekends, overtime rates must be paid to laborers. The total labor cost per visit comes to about $6,000. The sugar ship visits Kahului Harbor approximately 13 times a year. The total annual labor cost associated with sugar loading is, then, approximately 13 x $6,000 = $78,000.

These overtime costs can be avoided with a second harbor in place. Moving the break bulk and some of the containerized cargo operations to the new facility will release facilities at Kahului Harbor for alternative uses. Those facilities can be an alternate berthing site whenever a scheduling conflict arises at Pier 1. Having the additional berthing area will give Pier 1 users more flexibility in scheduling their arrivals. To reduce costs, the schedule for the sugar ship's arrivals can be rearranged to avoid the weekends. The associated labor will be paid at the regular hourly rates instead of the overtime rate. This reduction in the labor cost of transferring the sugar onto the ship can be counted as a benefit of developing a second harbor.

The total cost per visit at regular hourly rates is approximately $4,000. At 13 visits per year, the total annual labor cost will be 13 x $4,000 = $52,000. This $78,000 - $52,000 = $26,000 reduction in labor costs can be attributed to building a second commercial harbor on Maui. Adjusting the 1993 savings of $26,000 by the estimated increase in the CPI-U gives a savings of approximately $27,000 at a 1994 price level.

5.2 Ocean Transportation Cost Reduction

The availability of a second harbor on the south shore of Maui will give shippers the option of using a different route to reach the island. The present route from Honolulu Harbor to Kahului Harbor takes about 12 hours for a tug and barge to complete. It is estimated that the route to a harbor on Maui's south shore would take approximately eight hours, saving four hours per trip. The distance between Honolulu Harbor and Kahului Harbor and between Honolulu Harbor and a harbor on Maui's south shore area is about the same. The difference in sailing time arises from the prevailing conditions of the two routes. The Honolulu to Kahului route is exposed to the open ocean. Tugs and barges taking this route must contend with the strong winds and heavy sea conditions that predominate. The Honolulu Harbor to south shore route is more sheltered. Maui, Molokai, and Lanai shield this route from the strong winds and heavy seas associated with the open ocean. The smoother conditions will facilitate the transportation of cargo from Honolulu Harbor to Maui.

An estimate of the savings from reduced shipping time can be calculated assuming that a major interisland carrier moves its operation to the second harbor. At three trips a week, the carrier makes 156 round trips per year. The estimated 1993 operating cost of a tugboat including its crew is approximately $380 per hour. Given this data, the annual cost of shipping cargo from Honolulu Harbor to Kahului Harbor comes to 156 trips x 2 ways x 12 hours/trip x $380 per hour = $1,422,720. The cost of shipping between Honolulu Harbor and a facility on the south shore of Maui comes to 156 trips x 2 ways x 8 hours/trip x $380 per hour = $948,480. The savings attributable to the second harbor is the difference between these annual transportation costs or $1,422,720 - $948,480 = $474,240. Approximately $474,000 will be saved in operating cost with the development of a second harbor on Maui's south shore. Adjusting this figure to 1994 dollars brings the total ocean transportation cost savings to about $483,000.

5.3 Petroleum Overland Transportation Cost Reduction

Kahului Harbor plays a vital role in Maui's power generation system. All the fuel needed to generate Maui's electricity is delivered at Kahului Harbor for trucking to the power plant in Maalaea. Only Kahului Harbor has the necessary equipment to efficiently transfer the fuel to trucks for the overland haul. Without Kahului Harbor, the fuel would have to be brought in by more expensive and less efficient means.

The disadvantage of Kahului Harbor being the delivery point for fuel shipments is its distance from the power plant. The power company presently spends between $400,000 and $500,000 in trucking costs annually. In an attempt to reduce overland transportation costs, a study was recently conducted on the feasibility of piping the fuel from Kahului to Maalaea. Despite the seemingly high trucking cost, the study concluded that building a pipeline over that distance would be prohibitively expensive. At present, trucking is the lower cost method of transporting the fuel between the harbor and the power plant.

A second harbor developed in or near the Maalaea area could change the situation. Equipped with the proper facilities, the second harbor could take over as the delivery site for fuel oil. The proximity of the harbor to the power plant would either significantly reduce overland transportation or eliminate it. It would be cost effective to construct and operate a pipeline connecting the power plant directly to a harbor located along the Maalaea coastline. This would eliminate the need for trucking and its associated costs. For other locations on the south shore, a pipeline would probably not be feasible but, the cost of trucking the fuel would still be greatly decreased. In either case, a second harbor somewhere on the south shore would greatly reduce the cost of transporting fuel between the harbor and the power plant.

To estimate this savings, it is assumed that all the fuel will be delivered to a properly equipped second harbor. It is also assumed that a harbor located in Maalaea will be equipped with a pipeline running directly from the harbor to the power plant. A harbor in Maalaea will, then, not require any overland transportation and save the power company the $400,000 it now spends on trucking. In 1994 dollars, that savings amounts to about $408,000.

It is assumed that a harbor located outside the Maalaea area will not be connected to the power plant by a pipeline. It has been estimated that locating a harbor on the south shore of Maui without a pipeline hookup will still save the power company 30 percent to 40 percent in trucking cost. Using the $400,000 now being paid by the utility company, that savings will amount to $120,000 a year in 1993 dollars or $122,000 in 1994 dollars.

In either case, the savings can be counted as benefits of developing a second harbor facility for Maui.

5.4 Emergency Harbor Closure Cost Reduction

An extended closure of Kahului Harbor will be devastating given its role as the main transfer point for most of Maui's imports and exports. The entire island community is totally dependent on Kahului Harbor to provide this service. Several studies in the past have investigated the feasibility of developing a second harbor, but none have been implemented. Environmental, economic, or other factors made developing a second harbor at the sites proposed unworkable. Without an alternate facility, any closure of Kahului Harbor will have severe impacts on the Maui community.

Kahului Harbor has never been completely closed for an extended length of time, but could be closed for a variety of reasons. These include natural disasters, damage to the breakwater, and environmental hazards.

For the purpose of this study, a hypothetical closure due to a navigation accident is analyzed to determine its impact on the economy of Maui. The accident involves the sinking of a large vessel in the entrance channel in such a way that it totally blocks access to the harbor. With the economy of Maui growing, the use of Kahului Harbor is increasing and so are the chances of such an accident closing the harbor.

The U.S. Army Corps of Engineers in partnership with the Coast Guard has the authority to remove wrecks considered navigation hazards. The time needed to remove such a wreck depends on the condition of the ship. Salvaging a wreck that is in fairly good condition will take about two weeks. If there are complications, such as the ship has a ruptured fuel chamber, it could take as long as a month to remove the wreck. It is estimated that 23 to 39 days are needed to declare that a sunken ship is a navigation hazard and to remove it.

There is no actual data on the impacts of an extended closure of Kahului Harbor due to a navigation accident. To determine its possible impacts, the effects of shipping strikes on Hawaii's economy were studied. During shipping strikes of sufficient size, there is little or no movement of cargo in or out of Hawaii. Hawaii's ports are effectively closed. Studies on the impacts of these strikes show everyone is eventually affected. Individuals, businesses, and government all suffer during the closure of a harbor due to a strike. It is hypothesized that a harbor closure caused by a navigation accident will have similar impacts to that of a shipping strike. And like shipping strikes, the longer Kahului Harbor is closed, the greater the impacts on Maui's economy.

The impact of a harbor closure immediately affects those involved in its operation. Stevedores and other harbor employees who are paid by the hour are affected during harbor closures. Truckers that are paid by the hour also feel the effects of a harbor closure as the flow of goods out of the harbor temporarily ceases. Along with these individuals, the companies they work for suffer a drop in revenues due to the loss in business. State government also loses out on the revenue from user fees that would have been collected had the harbor been open.

As the closure of the harbor continues, the impacts spread throughout the economy. Retail businesses lose revenue as their inventories are used up and they start running out of merchandise. Construction work slows down as materials become scarce. Food prices rise as more costly methods of transportation are utilized. Businesses wanting to ship their goods off the island lose revenue because they cannot get their products to market. These businesses also have to pay additional storage costs as their goods sit waiting to be shipped. Utility company fuel reserves may be depleted. This could lead to costly conservation strategies such as rationing and rolling blackouts. Maui consumers may engage in panic buying and hoarding of certain goods as the supply of those goods diminishes. The prices for certain commodities may rise as their demand increases and the supply shrinks. In the long run, the State of Hawaii will suffer a reduction in tax collections due to reduced business activity. The closure of Kahului Harbor will affect every segment of the Maui economy.

The disruptions associated with a closure of Kahului Harbor and the resulting cost increases and revenue losses can be alleviated by developing a second harbor. The following sections attempt to measure the impacts of a harbor closure on Maui's main economic sectors with and without a second harbor in place. The benefits of having a second harbor on Maui are measured by the differences between the without-project impacts and with-project impacts.

5.4.1 Transportation Cost Reduction

Delivering goods to Maui's residents and businesses involves the coordinated effort on the part of shippers, stevedores, and truckers. Shippers maintain schedules that keep the flow of goods coming into and leaving the island. Stevedores are responsible for unloading and loading the cargo once it reaches the harbor. Truckers are the link between the harbor and the community. Together, their efforts keep Maui supplied with the desired goods in an efficient manner.

A harbor closure will interfere with this system and cause additional transportation costs to be incurred. Without an alternative to Kahului Harbor, shippers will not be able to deliver goods to Maui. Air transportation, which is far more expensive, is the only alternative means of getting goods to Maui. There will be no cargo for stevedores at the harbor to unload or load. Truckers will have fewer deliveries to make and trucking rates for the goods that are flown into Maui will be higher than normal. Interruptions caused by a harbor closure will decrease the efficiency of cargo delivery to the island and generate additional transportation costs.

A second commercial harbor will alleviate these additional costs by providing an alternate site for cargo delivery. For the purpose of this study, it is assumed that the second harbor will have similar cargo handling facilities as Kahului Harbor. Also, the necessary support, such as stevedore and trucking services, are already available. These assumptions follow from the second harbor having its own regularly scheduled cargo deliveries with or without a closure of Kahului Harbor. The benefits from reduced transportation costs are determined in this section using these assumptions.

5.4.1.1 Transportation Cost Reduction - Shipping

Ocean transportation is an inexpensive, reliable method of getting goods to Maui. Most items imported to the island are delivered by barge through Kahului Harbor. In the event of a closure of Kahului Harbor, the only other alternative is to fly goods into Maui. Air transportation is reliable and much quicker, but also much more expensive than ocean transportation. Despite the higher cost, the need to transport essential goods, especially food items, by air will arise almost immediately. Supermarkets only have about a one-week supply of most goods in their inventories. To maintain those inventories during a closure of Kahului Harbor, goods will have to be flown in by commercial air carriers. A second commercial harbor will offer another alternative to air transportation and its higher cost. Avoiding these costs can be counted as a benefit of having the second harbor.

Several assumptions are made in computing this benefit. It is assumed that the same amount of food normally shipped to Maui will need to be transported by air during a harbor closure. Information in the 1993 Pacific Region Freight Traffic Tables indicates that on average 3,385 tons of food are typically shipped to Maui every week. It is assumed that the food is shipped in 40-foot containers and that each container holds, on average, 44,000 pounds of food. Commercial airlines will dedicate their total cargo capacity to air freighting food that would normally be shipped by barge. Food distributors will arrange for air shipments to begin immediately after the first week of a closure because of the limited inventory on island. Food shipments will be a priority once the harbor is reopened, so air shipments will stop immediately after the harbor becomes operational. It is estimated that the cost of transporting a 40-foot container by barge between Oahu and Maui is $880. The estimated cost of air freighting cargo is about $600 per ton, $700 per ton, or $1,100 per ton depending on the carrier.

Using these assumptions, the cost of delivering food to Maui by surface and by air are estimated for a 23-day period. According to 1993 data, during times of normal operations at Kahului Harbor, 3,385 tons of food are delivered per week. For a 23-day period, approximately 11,122 tons will arrive at Kahului Harbor. The cargo capacity of the commercial airlines serving Maui, however, cannot handle that much cargo. The commercial airlines have the capacity to transport up to 209 tons of cargo a day. During a 23-day emergency closure of the harbor, no food will be delivered during the first week. After that week, food will be delivered by air. At 209 tons of food per day, 3,344 tons of food will be delivered by air during the remaining 16 days of the closure. The 3,344 tons of food can be transported in 152 40-foot containers aboard a barge. At $880 per container, the total cost comes to approximately $133,760. The cost of delivering 3,344 tons of food by air comes to about $2.9 million. Such air shipments will not be necessary with a second harbor in place. The savings in transportation cost comes to $2,900,000 - $133,760 = $2,766,400 or about $2.8 million.

The savings in food transportation cost for a 39-day closure are calculated in the same way as for a 23-day closure. After the first week, 6,688 tons of food will be flown in during the remaining 32 days that Kahului Harbor is closed. It will take 304 40-foot containers to transport that much food. The cost to ship those containers by barge comes to $880 x 304 = $267,520. Transporting 6,688 tons by air costs $5.8 million. A second harbor will eliminate the need for air shipments and their higher cost. The savings in transportation cost in this case is $5,800,000 - $267,520 = $5,532,480 or about $5.5 million.

5.4.1.2 **Transportation Cost Reduction - Handling**

A closure of Kahului Harbor not only affects the shippers, it also impacts the cargo handlers that tend to the cargo delivered at the harbor. There are presently about 70 stevedores and other harbor employees directly involved in the break bulk and container cargo operations who are paid by the hour. During a typical work week, these employees put in between 40 and 45 hours doing their various jobs. A closure of Kahului Harbor will disrupt the normal operation of the harbor and affect the schedules of the hourly employees. It is assumed that no cargo is delivered at the harbor during the closure. As a result, after about a week to accommodate the cargo already in the harbor, there will be very little additional work until the harbor reopens. Workers' schedules will be adjusted to reflect this lack of shipping activity.

Without a second harbor, lay-offs will begin after the first week of a harbor closure. Laid-off workers will receive unemployment insurance benefits until cargo starts arriving at the harbor again. The State Department of Labor and Industrial Relations (DLIR) uses a formula to compute the amount of unemployment benefits to be paid. The total wages of an applicant for one quarter are calculated and divided by 21. The applicant receives the resulting amount or $322, whichever is less, per week. Unemployment payments to the 70 employees of the various companies closely related to the harbor equal about $23,000 per week using the DLIR formula. For a 23-day closure, the total unemployment payments equal (23 days/7 day per week) - 1 week = 2.29 weeks x $23,000 per week = $52,670 or about $53,000. A 39-day closure will generate (39 days/7 days per week) - 1 week = 4.57 weeks x $23,000 per week = $105,110 or about $105,000 in unemployment payments.

An operational second harbor will prevent the work stoppage associated with a closure of Kahului Harbor. Cargo deliveries will be transferred to the second harbor and there will be no interruption in the flow of cargo. There will be no lay-offs and no unemployment payments. This will save the State the $53,000 in payments calculated for a 23-day closure and the $105,000 calculated for a 39-day closure. These savings are a benefit of developing a second harbor.

5.4.1.3 **Transportation Cost Reduction - Trucking**

In addition to the higher cost of flying food items into Maui, there will also be a higher trucking cost. Maui has been divided into nine zones to determine the rate charged for cargo trucked from Kahului Harbor. The rate charged is determined by the zone in which the destination of the cargo is located. Generally speaking, the farther away the zone is from Kahului Harbor, the higher the rate. Trucking company's charge by the hour for transporting goods from any other location on Maui including the airport. The hourly rate charged for trucking goods from the airport is higher than the zone rates charged for goods trucked from Kahului Harbor.

To determine the increased trucking cost during a harbor closure, several assumptions are made. According to the Western Motor Tariff Bureau, 75 percent of the goods trucked on Maui go to the Kahului/Wailuku area. Of the remaining 25 percent, 15 percent goes to West Maui and 10 percent goes to the rest of Maui. It is assumed that food deliveries will follow this general distribution pattern. It is also assumed that the food items delivered at the airport are in crates, while those delivered at the harbor are in containers.

The cost of trucking food items delivered during the 23-day closure of Kahului Harbor is calculated using cost data from a Maui trucking company. The cost of delivering cargo from the airport to the Kahului/Wailuku area is about $25 per ton. The cost of delivering cargo to West Maui is about $50 per ton. Delivering cargo from the airport to the rest of Maui will cost $35 per ton. It has been estimated in a previous section that 3,344 tons of cargo will be flown to Maui during a 23-day closure. The cost of trucking food items throughout Maui comes to about $99,000. For a 39-day closure, the amount of food delivered by air grows to 6,688 tons. This air cargo will be distributed throughout Maui as discussed earlier. The cost associated with trucking the cargo out of the airport is estimated to be about $199,000.

With a second harbor in place, the increase in trucking cost can be avoided. It is likely that another rate system based on dividing Maui island into zones will be set up for a second harbor. The trucking costs under with-project conditions are calculated assuming that such a system is in place and that the rates are similar to those for Kahului Harbor.

With a second harbor as an alternative, air transportation will not be necessary. The 3,344 tons of food items will be delivered at the second harbor. The cost of trucking that cargo is estimated to be about $50,000. The benefits from reduced trucking costs are then, $99,000 - $50,000 = $49,000 for a 23-day closure.

The cost of trucking the food items imported to Maui during a 39-day closure will also be reduced with a second harbor in place. A rate system based on zones will already be in place for the second harbor. The cost of trucking the 6,688 tons of food delivered at the second harbor during a 39-day closure of Kahului Harbor is estimated to be about $100,000. The savings in trucking costs of having a second harbor as an alternate port is $199,000 - $100,000 = $99,000.

The flow of cargo coming in through the airport will not be enough to keep the entire workforce of the trucking companies busy. It is estimated that the limited volume that can be flown in will only be enough to keep 20 percent of the trucking company employees working. The remaining workforce will be temporarily laid-off until the harbor is open again.

During the period that some of the workers are laid-off, they will receive unemployment insurance payments. Discussions with trucking company officials indicate that employees can respond to a work slowdown in a variety of ways. The probable response is that workers will take their vacation time in the beginning and then apply for unemployment payments. The average accumulated vacation time is about two weeks. It is assumed that this will be the typical response of workers temporarily laid-off.

The unemployment benefits for the laid-off trucking company employees is calculated using the formula for computing unemployment payments discussed earlier. There about 110 employees of the major trucking companies on Maui that are paid by the hour. About 21 of these employees will continue to work during the harbor closure. The remaining 89 employees will apply for unemployment benefits once their two weeks of vacation time are used up. Based on the wage and employment data provided by the various trucking companies, unemployment payments will total about $25,000 a week. For a 23-day closure, the total unemployment payments will be (23 days/7 days per week) - 2 weeks = 1.29 weeks x $25,000 per week = $32,250 or about $32,000. A 39-day closure will generate unemployment payments equal to (39 days/7 days per week) - 2 weeks = 3.57 weeks x $25,000 per week = $89,250 or about $89,000.

A second harbor on Maui will eliminate the work shortage associated with a closure of Kahului Harbor under without-project conditions. Cargo bound for Kahului Harbor will be redirected to the second harbor. There will be no need to transport cargo by air. There will not be any slowdown in the trucking business or lay-offs. The State will save $32,000 or $39,000 in unemployment benefit payments that would occur during a 23-day or 29-day closure, respectively, without a second harbor in place. These savings are benefits of the project

5.4.1.4 **Transportation Cost Reduction Benefits**

Benefits for reduced transportation costs attributable to the second harbor equal the sum of the savings to shipping, stevedoring, and trucking costs. Tthe sum of these savings, as discussed in the previous sections, for a 23-day closure comes to $2,800,000 + $53,000 + $49,000 + $32,000 = $2,934,000 or about $2.9 million. The total for avoiding the interruptions associated with a 39-day closure comes to $5,500,000 + $105,000 + $99,000 + $39,000 = $5,743,000.

5.4.2 Petroleum Shortage Cost Reduction

Kahului Harbor is the only point of entry for Maui's supply of petroleum products including gasoline, diesel fuel, and jet fuel. In 1992, 392,000 tons of petroleum products were delivered through Kahului Harbor. Maui is heavily dependent on the steady delivery of petroleum and any extended disruption will have serious consequences for the economy. The major petroleum companies on Maui contacted for this study do not keep a large supply in reserve on island. Their facilities are operated more as temporary storage for efficiently transferring the petroleum delivered at Kahului Harbor to the users. These facilities have the capacity to hold more than a 30-day supply of petroleum products, but they are not full most of the time.

To be conservative, it is assumed that the petroleum companies have enough product at the onset of a harbor closure to meet Maui's needs. They may not be filled to their maximum capacity, but combined with voluntary conservation measures by the public, the available supply will be enough. No impacts from petroleum shortages are computed for this study.

5.4.3 Power Generation Disruption Cost Reduction

Maui's electricity generation is heavily dependent on petroleum as a fuel source. In 1991, petroleum produced 84 percent of Maui's 1,028 million kwh of electricity. Biomass produced another 14 percent, while hydroelectric and other sources produced the remaining two percent. Maui Electric Company keeps a 30-day petroleum reserve on island as a precaution against short interruptions in petroleum deliveries. A closure of the harbor lasting less than 30 days will not affect the supply of electricity to users on Maui. As long as Maui Electric can coordinate the delivery of fuel oil soon after the harbor reopens, the impact on customers will be minimal.

Harbor closures extending beyond 30 days can have more severe impacts on electricity users. Upon notification of the expected closure period, Maui Electric will look into alternative means of stretching their fuel reserves. Options include getting more power from bagasse-fueled generators and asking the public to voluntarily cut back on electricity use. There is no other major source of fuel oil on Maui that can be tapped. Alternative means of delivering fuel to the island will be investigated such as airlifting which is expensive and unloading offshore which is risky. "Rolling blackouts" lasting between 30 minutes to an hour will be a last resort.

Under favorable conditions, it is possible to stretch the 30-day fuel supply to cover a harbor closure lasting 39 days. It is believed that voluntary conservation and added production by bagasse-fueled generators will be sufficient to meet Maui's energy needs during a closure. Rolling blackouts and expensive or risky methods of delivering fuel oil will not be necessary. The negative effects to economic productivity that accompany power outages whether unexpected or planned will be minimized. It is estimated that there will be no added cost due to the impact of a harbor closure on power generation for this study.

5.4.4 **Construction Industry Disruption Cost Reduction**

Construction is one of Maui's major industries which is heavily dependent on Kahului Harbor. Data compiled by the State DLIR in cooperation with the U.S. Department of Labor reveals that this industry accounted for 2,500 jobs in the economy in 1994. In 1993, construction activity generated about $198 million in taxable revenue for Maui County. There is very little local production of building materials on Maui, so nearly all such materials must be imported by barge. Almost 900,000 tons of construction materials arrived at Kahului Harbor in 1993. Construction companies rely on this flow of supplies to stay in business. Any prolonged closure of the harbor will directly impact these companies as well as the whole industry.

During a harbor closure, the delivery of construction materials will be interrupted. A result of this disruption is that construction workers will be unable to perform their jobs after the supplies on Maui are used up. It will be difficult for construction companies to maintain typical work schedules for their employees without the steady flow of materials coming into Kahului Harbor. Companies will be forced to temporarily lay off their employees until more construction materials arrive. These workers are expected to collect unemployment payments during the time they are laid off. The costs associated with disruptions in the flow of construction materials are calculated in this section.

Several simplifying assumptions are made in this study to estimate the cost of the disruptions in the flow of construction materials to Maui. It is assumed that there is enough construction material on island to keep the construction industry going for a week. It is also assumed that a closure of

Kahului Harbor will impact all those employed in the construction industry. Construction workers will be called back to their jobs once the harbor reopens to prepare for the arrival of construction materials.

The number of construction workers affected by a harbor closure is estimated using the 1994 job count and unemployment rate. It is assumed that the 2,500 construction jobs are filled by 2,500 workers. It is also assumed that not all of the 2,500 workers are employed at the time of the closure. The 1994 unemployment rate was 6.9 percent. Applying this rate to the 2,500 workers in the construction industry indicates that about 200 workers are unemployed at any given time. A harbor closure will, then, impact the remaining 2,300 workers in the construction industry. Other data from the State DLIR and the U.S. Department of Labor reveals that the average hourly earnings for construction workers was about $24 in 1994. That year construction workers put in about 37 hours a week on average at their various jobs.

It is anticipated that the 2,300 workers in the construction industry will be laid off after the materials already on Maui are used up. Laid off construction workers will receive unemployment insurance benefits during the remaining days of the harbor closure.

The State DLIR formula for computing unemployment payments discussed in an earlier section is used here. The quarterly earnings of construction workers who put in 37 hours a week on average and earn an average hourly wage of $24 is $24 per hour x 37 hours per week = $888 per week x 13 weeks per quarter = $11,544 per quarter. Dividing the total quarterly wages by 21 gives the weekly unemployment payment of $11,544/21 = $550. This amount exceeds the $322 per week limit, so laid off construction workers will receive $322 per week for the duration of the closure.

The total unemployment payments made for a 23-day closure of Kahului Harbor under without project conditions is (23 days/7 days a week) - 1 week = 2.29 weeks x $322 per week x 2,300 workers = $1,695,974 or about $1.7 million. The corresponding payments for a 39-day closure are (39 days/7 days a week) - 1 week = 4.57 weeks x $322 per week x 2,300 workers = $3,384,542 or about $3.4 million.

Having a second harbor in place will eliminate the disruptions in the delivery of construction material to Maui. There will be no work stoppages with a steady flow of materials coming into Maui and no lay-offs during a closure of Kahului Harbor. The unemployment payments of $1.7 million for a 23-day closure and $3.4 million for a 39-day closure will not be necessary. Avoiding these payments are benefits of developing a second harbor on Maui.

The impacts of a harbor closure on companies doing business in the construction industry are more difficult to measure. The size, number, and types of projects, the particular phase of construction they are in, and the inventory of available construction materials will affect the severity of a harbor closure. Without an adequate supply of materials, construction activity will grind to a halt. Construction companies will suffer reductions in revenues and profits and incur additional costs from delays and rescheduling. Construction related business such as material and equipment suppliers and contracting firms will, likewise, suffer reduced revenues and profits. The final impact of a harbor closure will be influenced by the manner and pace in which these businesses can recover.

The repercussions from a slowdown in the construction industry will also be felt by those businesses and individuals for whom projects are being built. For example, if the delayed project is an office building, the owners will lose the rent that could be collected from tenants. Tenants having to push back their start-up times could lose revenues and experience higher costs of doing business. Holding up residential construction will cost some individuals and families additional rent as the completion of their homes are delayed. All such indirect effects can be attributed to a closing of the harbor, but they are very difficult to measure.

5.4.5 Wholesale and Retail Sales Maintenance

Retailers and wholesalers depend on Kahului Harbor as a point of entry for a majority of their goods. Even those goods produced on Maui have some components that are probably imported through the harbor. This dependency leaves retailers and wholesalers extremely vulnerable to the effects of a harbor closure. Especially troublesome is the unexpected nature of the event. Unlike shipping strikes for which retailers and wholesalers can prepare, there is no lead time for a sudden shutdown of the harbor. Retailers and wholesalers are forced to get by with whatever they have on hand. As their stock of available goods is depleted, retailers and wholesalers begin to lose sales they would have made had the port remained open. Even with the availability of alternative transportation methods, sales will suffer. Missed retail and wholesale transactions will increase the longer Kahului Harbor is closed.

Gross business receipts from retailing and wholesaling activity are used to estimate the impact of a harbor closure on these sectors. In 1992, gross business receipts for Maui County totaled over $2.5 billion. The wholesaling and retailing sectors of the economy generated $1.2 billion of that total. (Maui County gross business receipts are used in this study because a majority of the economic activity in the county takes place on Maui island.) To compute the impact of a harbor closure on retailing and wholesaling, the average monthly gross business receipts over the last three years was calculated. The amount from the least active month was used to determine the loss in retail and wholesale activity to be conservative. That month turned out to be April when an average of about $81 million worth of retail and wholesale transactions took place.

Several assumptions are necessary in order to calculate the retail and wholesale losses using the April gross business receipt figure. It is assumed that Maui retailers and wholesalers have only one week of inventory on the island. Once these inventories run out, retailers and wholesalers must depend on less available, more expensive means of having their goods delivered. It is also assumed that the $81 million in transactions is spread evenly throughout the month and equals $2.7 million per day. Given these assumptions, the loss to the retail and wholesale sectors of the Maui economy due to the closure of Kahului Harbor are estimated.

Retailers and wholesalers will be able to conduct business as usual during the first week of a closure. After that, merchants will begin to run out of some goods in their inventories and will miss some transactions. Even with alternative modes of transportation, retailers and wholesalers will not be able to maintain their inventories at adequate levels. The revenue from these missed transaction will be lost. A survey of retailers taken after a severe West Coast dock strike in 1971 shows retail sales dropped between three and 17 percent during the strike. There is no indication that sales picked up after the strike was over. In effect, those sales were lost. It is assumed that a three percent drop in revenue from wholesaling and retailing activity will occur after the first week of a harbor closure.

During a 23-day harbor closure, there will be a 16-day period of inadequate supply of some goods. It is during this time that revenues will drop by three percent. That comes to 16 days x $2.7 million per day x .03 = $1.296 million at a 1992 price level or approximately $1.4 million at a 1994 price level. The drop in revenue during the 39-day closure will take place during the 32 days after the pre-closure inventories have been reduced. The total revenues lost in this case come to 32 days x $2.7 million per day x .03 = $2.592 million in 1992 dollars or approximately $2.7 million in 1994 dollars.

Retailers trying to get their goods to markets off-island will also be impacted by a harbor closure. Without a means to transport their goods, the affected retailers will lose out on sales and must deal with added storage costs.

5.4.6 Total Benefits and Average Annual Benefits Calculations

The development of a second harbor will mitigate most of the impacts of a closure of Kahului Harbor. The second harbor may not have the same capacity as Kahului Harbor, but it will be a viable alternative during emergency situations. The second harbor will alleviate the need for flying food into Maui. Petroleum shipments can be unloaded in a more acceptable setting. The flow of construction materials will experience only minor disruptions. Deliveries of merchandise for retailers and wholesalers will, for the most part, continue uninterrupted. All this activity will keep the truckers and dock workers employed. There will be some inefficiencies associated with these emergency operations, but they will be minimal when compared to the without-project costs.

The benefits of developing a second harbor are the avoided emergency closure costs. For this study, the residual costs are expected to be minimal, so the benefits equal the estimated cost without a second harbor in place. Table 1 gives the benefits estimated for the two closure periods analyzed in this study.

The conservative estimate of the cost of a 23-day closure of Kahului Harbor is $6 million at a 1994 price level. The cost to the Maui economy of a 39-day closure is about $12 million.

TABLE 1.
EMERGENCY CLOSURE COST REDUCTION BENEFITS
($000)

Category	23-Day	39-Day
Transportation Cost	2,900	5,700
Construction Industry Disruption Cost	1,700	3,400
Wholesale & Retail Sales Loss	1,400	2,700
TOTAL	6,000	11,800

To convert these figures to an average annual basis, the probability of a harbor closure must be determined. There has never been a harbor closure in Hawaii of the duration investigated in this study. Statistics on such closures are difficult to find at the national level as well. A figure was found for the number of shipping accidents per harbor calls on a worldwide basis. According to a reference source entitled Port Engineering, 4th Edition, there is one navigation accident for every 16,667 harbor calls. Over the last five years, Kahului Harbor has had an average of 1,385 calls per year. It would take approximately 12 years for Kahului Harbor to register 16,667 harbor calls at 1,385 calls per year. This implies that there is a 1/12 chance of a navigation accident happening at Kahului Harbor in any given year. Multiplying this probability by the total benefits of avoiding a 23-day and 39-day harbor closure gives the average annual benefits in Table 2.

TABLE 2.
AVERAGE ANNUAL BENEFITS
FOR EMERGENCY CLOSURE COST REDUCTION

	Average Annual Benefits
23-Day Closure	$500,000
39-Day Closure	$983,000

The average annual benefits of reducing the cost of a 23-day emergency closure comes to approximately $500,000 according to Table 2. The average annual benefit of avoiding the costs associated with a 39-day closure comes to about $983,000.

5.4.7 Additional Considerations

This study attempts to quantify the impacts of building a second harbor from a National Economic Development (NED) perspective as discussed in Section 1 of this appendix. As such, this report does not include many of the costs associated with an emergency harbor closure or the benefits of avoiding those costs. These are legitimate benefits to the region, business sector, or company, but are not considered in a Corps economic analysis because of this NED perspective.

An example of a benefit of developing a second harbor that is not included in this study is preventing the loss of cruise ship passenger expenditures.

Kahului Harbor is the port of call for cruise ships visiting Maui. In 1992, 70,000 passengers visited Maui aboard these interisland passenger ships for an average of 1,350 passengers per week. The money spent by these visitors are an important source of income for the Maui economy.

In 1992, all westbound visitors spent $117 a day while in Hawaii. Visitors arriving by cruise ship will probably not spend that entire amount while on Maui. They have already paid for lodging, most meals, interisland travel, and other miscellaneous items as part of their cruise and will not duplicate those purchases. It is estimated that of the total visitor expenditures, approximately 31 percent is spent on items not included as part of the cruise. It is assumed that cruise ship passengers will spend 31 percent of $117, or $36 a day, while visiting Maui. Visitors on these cruises usually spend two days on the island. Multiplying the average passenger count per week with the expenditure per passenger gives 1,350 passengers x $36 per day x 2 days = $97,200 per week of visitor expenditures from cruise passengers. These visitor expenditures will be lost during a closure of Kahului Harbor as the passenger vessels adjust their routes to bypass Maui. A 23-day closure will cost Maui about $319,000 in visitor expenditures. A 39-day closure will result in a loss of $542,000 in visitor expenditures.

The second harbor may not have the specific facilities to accommodate passengers, but an acceptable passenger arrival and departure system can probably be formulated. Passenger ships will continue to call on Maui and the economy will not lose out on visitor expenditures. The benefit for avoiding a 23-day closure is $319,000, while avoiding a 39-day closure will produce a $542,000 benefit. At a 1994 price level, the benefits come to $335,000 for avoiding a 23-day closure and $570,000 for avoiding a 39-day closure.

Expenditures from cruise ship passengers are an important source of revenues for Maui merchants. Preventing the loss of these revenues during a closure of Kahului Harbor is a definite benefit to those merchants and the Maui economy. It is, however, a regional benefit, not a NED benefit, and cannot be attributed to developing a second harbor in a Corps study. The purchases not made on Maui by cruise ship passengers will be made elsewhere during the cruise. There will be a transfer of expenditures from Maui to the other islands visited by the cruise ship. Preventing transfers of expenditures is not an NED benefit. This goes for other types of transfers that might take place in the event of a harbor closure. Including these transfers would substantially increase the impact of a closure of Kahului Harbor.

In addition to focusing on NED benefits, the economic analysis is based on lower cost estimates of a harbor closure's impact on Maui. The estimates are based on conversations with representatives from the various sectors and available data, but they are also mostly guesswork. With no data from an actual harbor closure to work with, conservative assumptions and cost estimates were used whenever possible in this study. Also, several impacts of a harbor closure were too difficult to measure at this stage and were not included in the total. This implies that the actual cost of a harbor closure can be much higher.

The impact of a lengthy harbor closure can be dramatically increased should it occur at an inopportune time. For instance, the effects of interrupted petroleum shipments on the economy can be much worse than that discussed in this study. A harbor closure occurring at a time when petroleum supplies are low presents a serious threat to the productivity of Maui's economy. Some form of rationing system will probably be imposed on the community during the closure to stretch the available supply. The queuing difficulties, quantity restrictions, and nonavailability problems that ensue will adversely affect the economy's performance. The added expenditures in time and resources to obtain fuel will take away from the resources available for production. Even with a rationing system in place, it is possible that the available fuel supply will eventually run out and most economic activity will stop. The alternatives to shipping the petroleum into Maui are either too expensive or too risky for any large scale movement of product. Only enough petroleum will probably be delivered by these alternative means to keep Maui's most critical facilities operational. The rest of the economy will have to do without until the harbor is reopened. Should this come about, a harbor closure will be much more costly than estimated in this study.

Interruptions in the supply of electricity will also increase the cost of a harbor closure. Such interruptions are unlikely because the electric utility has its reserve petroleum supply to tap during emergencies. This supply will last through a harbor closure of less than 30 days and can even be stretched beyond 30 days. The length of time that the reserve lasts past 30 days, however, is sensitive to the time of year the harbor closes. A closure during high-demand periods will shorten the length of time the reserve can go beyond 30 days. A closure during the time of the year when the amount of power from alternative sources is low will also shorten the reserve's life span. Rationing schemes which cause costly interruptions in service will have to be implemented should a harbor closure occur during these times of the year.

Rolling blackouts are such a rationing scheme. Rolling blackouts will only be used as a last resort, but there is a good possibility that they will occur. Once started, they will cause work stoppages and productivity losses even though they are expected and contingency plans are made. The longer the rolling blackouts are used, the more costly it will be for the Maui economy.

The cost of fuel shortages and rolling blackouts can be estimated using the gross business receipts for Maui. In 1992, the county generated $2.6 billion in gross business receipts, a majority of which was produced on Maui island. On average that comes to approximately $7 million a day. Inadequate fuel supplies or rolling blackouts will reduce the economy's ability to maintain that level of productivity. That $7 million will be reduced everyday that there is fuel rationing or rolling blackouts. The most costly situation is the simultaneous occurrence of both a depleted fuel supply and rolling blackouts. This combination could be enough to halt most economic activity on the days they occur. This could raise the cost of a harbor closure up to as much as $7 million a day for as long as these conditions persist.

A harbor closure could be devastating even without totally shutting down the economy. As calculated in this study, over $1 million and almost $3 million is lost during a 23-day and 39-day closure, respectively, in retail and wholesale transactions. These figures are based on the conservative estimate of monthly retail and wholesale receipts and can be much higher. The determining factor will be the timing of the closure. Doing without the normal services of Kahului Harbor during high sales months or critical buying seasons, such as Christmas, can be particularly costly. Many businesses depend on these sales to get them through the year. A disruption in merchandise deliveries during important buying periods may be more than some wholesalers and retailers can take. The result could be more than lost sales, but bankruptcies and business closures as well.

Bankruptcies and business closures would not only be limited to retail and wholesale businesses. Those companies that get a majority of their work from the harbor, such as trucking companies, would also be threatened by an extended closure. The conditions of each company and the economy as a whole at the time of the closure will determine the number of business failures that occur.

The effects of a harbor closure may even extend beyond the shores of Maui. Tourists planning to visit the island may change their itineraries because of the uncertainties caused by the harbor closure. The visitor industry will lose the revenue from those visitors that decide not to come to Maui at all. Investors interested in Maui may be unnerved by the fragility of the economy as demonstrated by the harbor closure. The cost in terms of the lost revenue and investment dollars from these sources can also be attributed to such a closure.

The costs described in this section are difficult, if not impossible, to measure without an actual harbor closure. For that reason, they have not been included in the total emergency closure cost estimate in this report. They have been measured for shipping strikes and there is little doubt that they will occur during a prolonged harbor closure. This implies that additional costs exist and that the total cost estimated in this section is conservative.

5.5 Indeterminate Benefit Categories

Due to a lack of available data, the benefits attributable to building a second harbor on Maui from several sources could not be estimated. A discussion of these indeterminate benefits is presented here.

5.5.1 Multiple Cargo Handling Cost Reduction

The shipping companies that use Kahului Harbor are having to handle their cargo more than they would like to for a variety of reasons. A major reason is that the existing facilities are being pushed to the limit by the volume of incoming cargo. The resulting crowded conditions force the shipping companies to store the delivered cargo in less than optimal configurations. These configurations require multiple cargo handling which results in added equipment and labor costs. This situation exists for both break bulk and containerized cargo.

At present, break bulk cargo is unloaded from the barge and placed in a designated area. The normal procedure would be to leave the cargo in its designated area until it is picked up. But with the constant flow of cargo coming into a terminal with inadequate space, that is not what usually happens. It is often necessary to rearrange the cargo already in the terminal to make room for incoming cargo. Workers and machinery that must be dedicated to that task could be used elsewhere. In addition, cargo is sometimes placed closer together than is optimal. Often times it is necessary to move other pieces of cargo out of the way to reach the desired item. This also takes labor and machinery away from other tasks. The congestion in the terminal makes this multi-handling inevitable.

There is a similar situation for containerized cargo. Growth in the number of containers has outpaced the growth in the size of the harbor's container yards. There is not enough room to put all the incoming containers on chassis for hauling. A large number of containers are having to be put on the ground stacked two or three high. This stacking is a more efficient use of space, but it takes more handling to get stacked containers out of the container yard. Not only does the desired container need to be lifted onto a chassis, but often times the nearby containers must be moved first. All this handling causes delays, increased cargo damage, and adds labor and machinery costs to the shipping companies.

There is little doubt that the congested conditions in the storage areas contribute to higher cargo handling costs. The extent to which these conditions contribute to higher costs, however, is difficult to determine. Several factors make the use of less efficient cargo handling methods necessary besides inadequate port facilities. A second harbor can alleviate the problems caused by inadequate harbor facilities, but it will not completely eliminate inefficient cargo handling practices and their costs. So, while it is acknowledged that a second harbor will reduce handling costs, the extent of these benefits could not be calculated for this study.

5.5.2 Overland Transportation Cost Reduction

The major trucking companies are headquartered in the Kahului/Wailuku area and distribute the cargo delivered at the harbor throughout the island. Trucking services are an integral part of Maui's harbor system and any new harbor development on Maui will be accompanied by adjustments in trucking services.

The majority of the cargo entering Maui through Kahului Harbor is bound for Kahului or Wailuku. It is estimated that 75 percent of the incoming cargo is delivered to this area. Another 15 percent of the incoming cargo is delivered to west Maui while the remaining 10 percent goes to the rest of the island.

The rates charged by Maui truckers are regulated by the Public Utilities Commission and administered by the Western Motor Tariff Bureau. Depending on the amount of cargo, the nature of the cargo, and its origin and destination, truckers can charge by the zone or by the hour. Maui island is divided into 18 geographic zones. Kahului Harbor is located in Zone 2. Generally, the further away a zone is from Zone 2, the higher the trucking rate. The heavier the load, the lower the rate per 100 pounds. Hourly rates are charged for hauling goods from a point of origin other than Kahului Harbor. The hourly rate charged is determined by the type of equipment needed to do the hauling. The larger the piece of equipment used, the higher the hourly rate. It is usually less expensive to be charged by the zone rather than by the hour.

Under the present set up, trucking anything coming out of a harbor facility other than Kahului Harbor will be charged the appropriate hourly rate. This will be more costly than trucking goods out of Kahului Harbor. It is probable that another zone rate schedule will be set up for a second harbor facility similar to the one for Kahului Harbor.

It is highly unlikely that the present shippers servicing Maui will operate out of both harbors. Given the high cost of running duplicate operations, the shippers will probably work out of one or the other harbor. The decision by the shipping companies to either stay at Kahului Harbor or move to a new facility will be based on several factors. The new harbor's navigability, its available dockside facilities and space, and its proximity to population centers will influence the decision to move or stay.

The Kahului/Wailuku area is presently the population center of Maui. Between 1980 and 1990, the population of this area grew by 26 percent from about 26,000 residents to nearly 33,000 residents. It is also the location of much of Maui's light industrial complex and the seat of county government. Kahului Harbor and its accompanying trucking services are well situated to deliver cargo to this part of Maui.

This situation could change as the population in other parts of Maui catch up to Kahului and Wailuku. The combined population of south and west Maui is increasing at nearly three times the rate of Kahului and Wailuku. Since 1980, the population of Kihei, Maalaea, Lahaina, and the rest of west Maui has increased by 68 percent from 16,000 residents to 27,000 residents. At their present rate of growth, the population of south and west Maui will overtake the population of Kahului and Wailuku in about five years. Some adjustment in the distribution of cargo out of Kahului Harbor will accompany this shift in population distribution.

With the ongoing shifts in the population centers, it is unclear whether or not a second harbor on Maui will lower overland transportation costs. A major carrier moving out of Kahului Harbor to a new facility will deliver its cargo closer to some customers, but farther away from others.

Total trucking costs will depend on the proximity of the new facility to the shifting population centers and a shipper's customers. Trucking cargo out of a new harbor under these conditions may decrease, increase, or have little impact on overland transportation costs.

5.5.3 Agricultural Revenue Loss Reduction

Sugar is the most important export crop on Maui. In 1993, a total of 83,000 tons of sugar passed through Kahului Harbor. A sugar transport ship visits the harbor every three or four weeks. The outgoing sugar is stored in warehouses located right at the harbor and loaded on to ships using equipment specifically designed for that purpose. With one of the more successful plantations in the state on Maui, sugar will continue to be an important export commodity in the near future.

A closure of Kahului Harbor, as discussed in an earlier section, will disrupt the sugar export operation by blocking access to the sugar loading facilities. It is likely that a 23-day closure will interfere with at least one scheduled stop. A 39-day closure will probably block two sugar ships from making their usual stops at Kahului Harbor. At an average of 14,250 tons of sugar per ship call, a 23-day closure will impede the pick up of 14,250 tons of sugar, while 28,500 tons will need to be warehoused during a 39-day closure.

To make up for the missed visits, the sugar ship will probably have to make additional trips to Kahului Harbor. The additional trips will be necessary because there is a limitation on the amount of sugar the ship can load per visit. The sugar ship is constrained by the operating depth of the harbor and is normally loaded with as much sugar as that depth will allow. There is little excess capacity to accommodate larger shipments. Instead of carrying more sugar per trip on subsequent trips to make up for the missed visits, extra trips will have to be scheduled.

The construction of a second harbor may not eliminate the need for these additional trips. It is doubtful that the facilities needed to load the sugar onto a ship will be available at Kahului Harbor and a second harbor site. Should the sugar operation remain at Kahului Harbor and there is a closure, the second harbor will not be adequately equipped for sugar loading. Normal sugar shipments will be disrupted and additional costs incurred even with an operational second harbor.

Maui's other agricultural commodities will also be hurt by a closure of Kahului Harbor. Even with proper storage and refrigeration, the products that are transported off Maui through the harbor will probably not last through the closure. Growers will take a loss on those items that spoil during the long delay. Livestock growers depend heavily on the shipments of hay, fodder, and prepared animal feed that come into Maui through the harbor. These growers could be negatively impacted should the harbor closure cause a shortage of feed.

It was not possible to calculate the revenues that Maui's crop and livestock growers might lose during a harbor closure for this study. There is a lack of data on the agricultural output of Maui island alone. The agricultural production for Maui, Lanai, and Molokai are presented together in the available data. Given the level of agricultural activity on Molokai, it is not clear what portion of the total can be assigned to Maui growers. There is also the seasonality factor to consider. Depending on the time of year, certain crops will be more adversely affected by a harbor closure. Given these uncertainties, the benefits to the agricultural sector of maintaining shipping services during a closure of Kahului Harbor was not calculated.

6. Benefit Summary

The benefits of developing a second harbor equal the without-project average annual costs for each category less the residual with-project average annual costs. Table 3 gives the average annual benefits by category. Table 4 gives the total benefits for each site taking into consideration the benefits of avoiding a 23-day or 39-day emergency harbor closure.

TABLE 3 - BENEFIT SUMMARY
($000)

	Benefits			
Cost Reduction Category	Site 1 (HAT)	Site 2 (MPP)	Site 3 (UKU)	Site 4 (OLO)
Scheduling Conflict				
Coal Operation	36	36	36	36
Sugar Operation	27	27	27	27
Ocean Transportation	0	483	483	483
Petroleum Overland Transportation	0	408	122	122
Emergency Harbor Closure				
23-Day Closure	500	500	500	500
39-Day Closure	983	983	983	983

TABLE 4 - TOTAL AVERAGE ANNUAL BENEFITS
($000)

Site	Benefits 23-Day Closure	39-Day Closure
1 (Hata Bay)	563	1,046
2 (Maalaea Near Power Plant)	1,454	1,937
3 (Ukumehame)	1,168	1,651
4 (Olowalu)	1,168	1,651

7. **Benefit-Cost Ratio**

Table 5 lists the associated benefits, costs, and benefit-cost ratios for each of the alternatives. The 23-day closure benefit figures are used in Table 5. Based on those benefit figures, the benefit-cost ratios for Alternatives 1, 2, 3, 4, 5, and 6 are 0.08, 0.38, 0.50, 0.50, 0.39, and 0.27 respectively. Table 6 includes the 39-day closure benefit figures. The benefit-cost ratios for Alternatives 1, 2, 3, 4, 5, and 6 are 0.16, 0.50, 0.71, 0.71, 0.56, and 0.38 respectively.

TABLE 5 - BENEFIT-COST CALCULATIONS 23-DAY CLOSURE
($000)

Alternative	Average Annual Benefits	Average Annual Cost	Benefit-Cost Ratio
1 Hata Bay Offshore Harbor	563	6,734	0.08
2 Maalaea Pier	1,454	3,848	0.38
3 Ukumehame Pier	1,168	2,343	0.50
4 Olowalu Pier	1,168	2,323	0.50
5 Olowalu Dock & Turning Basin	1,168	2,971	0.39
6 Olowalu Inland Harbor	1,168	4,390	0.27

TABLE 6 - BENEFIT-COST CALCULATIONS 39-DAY CLOSURE
($000)

Alternative	Average Annual Benefits	Average Annual Cost	Benefit-Cost Ratio
1 Hata Bay Offshore Harbor	1,046	6,734	0.16
2 Maalaea Pier	1,937	3,848	0.50
3 Ukumehame Pier	1,651	2,343	0.71
4 Olowalu Pier	1,651	2,323	0.71
5 Olowalu Dock & Turning Basin	1,651	2,971	0.56
6 Olowalu Inland Harbor	1,651	4,390	0.38

8. Future Cargo Shipments

The preceding analysis keeps harbor usage constant throughout the study period, but there are indications that usage will increase over time despite recent fluctuations. Increased shipments will be necessary to support Maui's growing population and economy.

In an attempt to estimate the future flow of cargo through Kahului Harbor, two-variable regression models based on time-series data were developed. These models relate the movements of a dependent variable to the movements of an independent variable. Past trends are, then, extrapolate into the future using these models to come up with cargo tonnage forecasts.

A total of 14 independent variables were tested to determine their ability to explain movements in the dependent variable: total cargo shipments. The independent variables investigated had to have a logical relationship to the dependent variable. The available historic data had to come from a reliable source. There had to be a reliable source for forecasts of future values. All 14 independent variables satisfied these requirements.

Changes in three of the 14 variables tested explain 80 percent or more of the changes in the dependent variable. These variables are power sold in kilowatt-hours, job count, and real total personal income in millions of 1982 dollars. Power sold is a proxy for economic activity in that as the economy grows or slows it requires more or less electricity. At the same time, a growing economy spurs increased cargo movement through the port, especially for an island community like Maui. The opposite is true for a declining economy. Job count is also a good indicator of the economic health of Maui. Large increases indicate an economy on the rise, while small increases or decreases denote an ailing economy. Real total personal income is a measure of the affluence of those living on Maui, population growth, and the status of the local economy. All these factors can affect the amount of cargo moving through the harbor.

The quantitative relationships between the three independent variables and the dependent variable are based on historic data from 1970 to 1991. All three independent variables are statistically significant at the five percent confidence level. The three models, along with their corresponding R2 which measures goodness of fit, are as follows:

1) Cargo Tonnage = 2.10159 x (Power Sold) + 649,768.5

R2 = 0.826

2) Cargo Tonnage = 34.43594 x (Job Count) + 366,884.8

R2 = 0.823

3) Cargo Tonnage = 1,333.1 x (Real Total Personal Income) + 366,884.8

R2 = 0.799

It is believed that the first model, which relates power sold to cargo tonnage, is the most reliable for forecasting future cargo shipments. That model has the highest R2 and the smallest standard error of the estimate of the three models.

Forecasts for power sales were obtained from Maui Electric Company for the period 1993 to 2013. Future cargo movements are estimated by plugging these forecasts into the regression model. The results of combining the forecasted power sales with the regression model are given in Table 7.

TABLE 7 - FORECASTED CARGO TONNAGE

Model: Cargo Tonnage = 2.101599 x (Power Sales) + 649,768.5

Year	Forecasted Power Sales (KWH)	Forecasted Cargo Tonnage
1995	945,800	2,637,461
2000	1,040,800	2,837,113
2005	1,110,500	2,983,594
2010	1,198,600	3,168,745
2013	1,255,700	3,288,746
2020	1,402,000 (p)	3,596,210
2040	1,921,000 (p)	4,686,940

(p) - Projected powers sales using the 1.5 percent rate of growth that is estimated for the last eight years of the official forecast.

As Table 7 shows, the model relating power sales to cargo tonnage forecasts a 78 percent increase in cargo movements between 1995 and 2040. That comes to an average annual increase of approximately 1.7 percent.

Point estimates of future values computed from a single linear regression model are useful as initial forecasts, but inevitably provide limited forecast accuracy. To supplement these point estimates, confidence intervals were calculated. Table 8 gives the 95 percent confidence intervals based on the available data.

TABLE 8 - 95 PERCENT CONFIDENCE INTERVALS
(Tons)

	Bounds	
Year	Lower	Upper
1995	2,212,000	3,063,000
2000	2,390,000	3,284,000
2005	2,520,000	3,448,000
2010	2,681,000	3,656,000
2013	2,785,000	4,144,000
2020	3,048,000	4,144,000
2040	3,961,000	5,413,000

Based on the available data, there is a 95 percent chance that the future cargo tonnage will fall between these bounds for a given year.

It must be pointed out that these cargo forecasts appear to be very conservative. The annual growth trend in cargo tonnage moving through Kahului Harbor averaged 5.7 percent between 1970 and 1991. In comparison, an average of 1.7 percent growth is forecasted between 1995 and 2040. A similar trend is reflected in the actual and forecasted power sales figures. During the period 1970 to 1991, power sales averaged 16.9 percent growth annually. During the forecast period, the average annual rate of increase is estimated to be 2.2 percent. As much as power sales mirror economic activity, projected sales indicate that Maui's economy will be growing at slower rates in the future. A slow growing economy will in turn dampen the growth of cargo coming into the harbor.

It must be emphasized that the forecasts for cargo tonnage computed in this section are only rough estimates. They are adequate for the purposes of this study, but a more rigorous analysis is warranted.

In any case, more usage of Kahului Harbor will only exacerbate the present difficulties and uncertainties associated with having only one commercial harbor. Inefficiencies will intensify and the chances of a navigation accident closing the harbor will increase. The State is in the process of expanding the available facilities to accommodate this growth. This will go a long way to alleviating the present congestion in the harbor and avoiding further congestion in the future. On the other hand, it will do little to alleviate the impacts of a harbor closure on the Maui economy. In order to address this concern, an alternative harbor is necessary. Without another harbor, the Maui economy will remain vulnerable to disruptions from a harbor closure.

MAUI SECOND COMMERCIAL HARBOR
NAVIGATION STUDY
FINAL RECONNAISSANCE REPORT

APPENDIX D - ADDITIONAL STUDIES

APPENDIX D - ADDITIONAL STUDIES

1. **General.** The following detailed studies are recommended to evaluate the engineering requirements, economic feasibility, and environmental impacts of a second commercial harbor development. The estimates are based on the assumption that further investigations would be conducted as a cost shared federal/state feasibility study under one of the Corps' study authorities. This cost estimate assumes that alternatives provided in the Reconnaissance Report would have been screened and one site and design selected. Costs are based on the analysis of a single site and design.

2. **Engineering Requirements**

2.1. **Wave Climatological Study.** This study will provide the wave climate and will be used to develop the proposed facility's usability. The wave climatological study for the entire Maalaea Bay could be used for the Maalaea, Ukumehame, and Olowalu study alternatives.

2.2. **Topographic and Bathymetric Surveys.**

2.3. **Current Modeling.** Utilizing the ADCIRC model, the circulation of the entire Maalaea Bay should be modeled. This model also allows a detailed look at the selected sites and will be used for the Maalaea, Ukumehame, and Olowalu alternatives. Current modeling is not anticipated to be required for the Hata Bay alternative.

2.4. **Numerical Modeling for Dredged Plans Only.** Recommended for the Hata Bay and Olowalu Dredge Harbor alternatives to provide the frequency of seiching and possible "hot spots" within the harbor.

2.5. **Wave and Current Measurements.** This will provide calibration for the above models.

2.6. **Coastal Design and Technical Management.**

2.7. **Cost Estimates.**

2.8. **Geotechnical Investigations.** Geotechnical investigations are required to evaluate in-situ material engineering properties for design of the breakwater/revetted mole, backup areas, slopes of cut and fill, docks and, causeways/piers and to determine and analyze the characteristics of the material to be excavated from the entrance channel and turning basin. Borings must be done during the months with calmer waters from about May to September. Drilling is impractical at other times of the year. The scope of work for the geotechnical investigations includes the following.

- Site reconnaissance to determine the general characteristics and layout of the proposed project areas.

- Preparation of boring plan and drilling contract scope of work.

- Subsurface drilling investigations and drilling contract inspection.

- Laboratory testing of material and full size boring logs and location plan.

- Geotechnical report and analyses including bearing capacity for breakwater/revetments and backup areas, cut and fill slope stability analyses, characteristics and excavatability of foundation materials, and utilization of excavated material.

3. Economic Studies

Economic studies are required to determine the economic feasibility, benefits, and justification for implementation of a second commercial harbor development. These studies should include the following.

3.1. **Economic Study Area.** Conduct an in-depth assessment of the shipping companies that call on Kahului Harbor. Delineate the area of service along with the frequency of service to that area. Ascertain the type of vessels used. This may entail sending out a questionnaire or conducting interviews with the shippers. Identify competing harbors and alternative modes of transporting cargo within the study area

3.2. **Types and Volume of Commodity Flow.** Collect data on present cargo movements into and out of the study area. Determine commodities and quantities moved. This may entail sending out a questionnaire or conducting interviews with the shippers and major receivers. Examine the new harbor's impact on the existing flow of commodities into and out of the study area.

3.3. **Waterborne Commerce.** Forecast potential future cargo movements within the study area for with- and without-project conditions.

3.4. **Present Fleet Operations.** Calculate operating costs for the existing fleet and the future fleet under without- and with-project conditions. This may entail interviews with shipping company executives.

3.5. **Commodity Movements.** Measure the complete cost of the origin-to-destination movement of cargo within the study area for both the without- and with-project conditions. This includes shipping, handling, transfer, storage, and other accessory charges.

3.6. **Alternative Movements.** Determine the complete origin-to-destination cost of moving cargo by alternative means (air transportation).

3.7. **Future Cost of Commodity Movements.** Compute the complete origin-to-destination cost for projected future cargo movements for without- and with-project conditions.

3.8. **Harbor Closure.** Estimate the frequency of a harbor closure and identify the economic sectors that will be affected by this closure. Estimate the types and quantities of cargo impacted by a closure.

3.9. **Contingency Plans.** Formulate viable alternative cargo delivery methods. Estimate the cost of transporting cargo by these alternative modes.

3.10. **National Economic Development (NED) Benefits.** The difference betewen the total cost of transporting existing and future cargo both without and with the new harbor in place will be a benefit of developing a second harbor. The total cost of alternative cargo delivery methods during a harbor closure will be compared with an estimate of the cost of transporting that cargo by barge to determine the NED benefits of easing the impacts of a harbor closure. Avoiding the costs associated with other disruptions in the economy caused by a closure of the harbor will be counted as another benefit of developing a second harbor.

3.13. **Sensitivity Analysis.** Determine the measurable effects of variability in the assumptions and projections of the study to determine the amount of risk and uncertainty in the analyses. This will entail changing some of the numbers and redoing the analysis. An assessment of the sensitivity of the study's conclusions will be made based on the outcome of this investigation.

4. Environmental Studies

4.1. General

The scope of the proposed project and anticipated impacts on the coastal and marine environments will necessitate preparation of a Federal Environmental Impact Statement (EIS) per 33 CFR 230.6(b). It is assumed that the harbor project would be accomplished as a joint (State and Federal) project and thus would also be subject to Hawaii State EIS law (Chapter 343, Hawaii Revised Statutes) and Administrative Rules (Title 11, Chapter 200). Thus the project would require, to the fullest extent possible, preparation of joint environmental documentation which would satisfy both State and Federal laws (per Council on Environmental Quality regulations at 40 CFR 1506.2).

U.S. Army Corps of Engineers regulations for implementing the National Environmental Policy Act (33 CFR Parts 230 and 325) allow for direct preparation of an EIS without an environmental assessment (EA) where it is obvious an EIS is needed. Thus a notice of intent to prepare a Federal draft EIS can be published fairly quickly in the Federal Register. However, an environmental assessment would be required under Hawaii law (Chapter 343, HRS). The EA would be prepared and filed with a notice of determination that an EIS is required (which would then be treated as a state EIS preparation notice).

4.2. **Environmental Coordination.** In addition to filing environmental documents with the appropriate State and Federal authorities, environmental coordination would be required with the following agencies:

a. U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), for compliance with Section 7 of the Endangered

Species Act of 1973, as amended (ESA) and the Fish and Wildlife Coordination Act (FWCA).

(1) Transfer of funds to the USFWS under an existing agreement for study and report preparation under the FWCA would be required.

(2) As a result of required coordination under Section 7 of the ESA, a baseline study of marine turtles will likely be required. In addition, monitoring during in-water work (especially blasting) will likely be required.

(3) Also as a result of required coordination under Section 7 of the ESA, in-water construction may need to be curtailed during months when humpback whales are in Hawaiian waters (December thru May).

b. Hawaii State Coastal Zone Management (CZM) Program, for concurrence with Federal determination of consistency with the Hawaii's Federally approved CZM Program.

c. Hawaii State Historic Preservation Office and the Advisory Council on Historic Preservation, for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

d. A Department of the Army permit would not be required for the Federal (Congressionally authorized) portion of the project, although any additional work in the water by others may require such a permit. A Section 404b(1) evaluation and a Section 401 State Water Quality Certification would be required for the Federal project in compliance with the Clean Water Act.

4.5. **Environmental Studies.** Necessary environmental studies would include:

4.5.1. **Water Quality.** A water quality baseline study would be necessary to support EIS preparation and compliance with State water quality standards. The design and scope of the water quality study would be developed taking into consideration the findings of the previous studies conducted for existing harbors and any changes in State of Hawaii requirements, e.g., possible use of light extinction coefficents to monitor water quality and the possible establishment of a zone of mixing for the project. Monitoring of water quality during construction would also be required to document compliance with state water quality standards.

4.5.2. **Marine Biological Study.** A baseline marine biological study would be needed to support preparation of the EIS. It is anticipated that the study would also include baseline evaluation of ciguatera organisms and hazards. Based on recent scientific literature (Lobel et al., 1988), it is anticipated that the ciguatera survey would focus on thorough sampling and testing of only one or two species of macroalgae known to serve as substrates for ciguatera organisms, and that multiple baseline (pre-construction) samplings would be conducted. Ciguatera monitoring should be repeated following construction (for example, at 1, 3, 7, and 15 months following construction).

4.5.3. **Marine Turtle Survey.** A baseline marine turtle survey would be needed to ascertain the occurrence of threatened and endangered species of turtles in the project area. In addition, monitoring of sea turtles during in-water project construction, particularly during blasting), would almost certainly be required as a mitigation measure as a result of consultation under Section 7 of the ESA.

4.5.4. **Botanical Survey.** A botanical survey would be needed for vegetated areas which would be affected by harbor construction, to ascertain the presence or absence of plant species which are candidate, proposed, or listed as threatened or endangered.

4.5.5. **Archaeology.** The proposed second commercial harbor alternatives may impact cultural resources and therefore will require compliance with Section 106 of the National Historic Preservation Act of 1966, as implemented by 36 CFR 800. Section 106 of the National Historic Preservation Act requires that federal agencies take into account the effect of their undertakings on properties included in, eligible for, or potentially eligible for listing in the National Register of Historic Places. The potential for such sites have been identified at Hata Bay, Maalaea, Ukumehame, and Olowalu.

4.5.5.1. **Hata Bay, Kahului.** If this site is selected for construction of the new commercial harbor, further archaeological investigations would be necessary for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Cost for data recovery in compliance to Section 106 will be additional, should that become necessary.

4.5.5.2. **Maalaea Power Plant Area.** If this site is selected for the new commercial harbor construction, a more intensive archaeological investigation would be required to accomplish the tasks necessary for compliance to Section 106 of the National Historic Preservation Act, as amended. The thrust of this investigation would be subsurface test excavations and recordations. Any NAGPRA undertakings and/or possible data recovery in compliance to Section 106 will incur additional cost.

4.5.5.3. **Ukumehame.** If this site is selected for the new commercial harbor construction, the cultural resources identified may be avoided entirely by designating the area surrounding the historic properties as an archaeological preserve. No inshore harbor modification will intrude into the preserve area. Nevertheless, a more intensive archaeological investigation would be required to identify, locate, and record any other surface and subsurface significant historic property in the project area to accomplish all the necessary tasks to comply with Section 106 of the National Historic Preservation Act of 1966, as amended. Any NAGPRA undertakings and/or possible data recovery in compliance to Section 106 will incur additional cost.

4.5.5.4 **Olowalu Point.** The historic properties identified in this site during the present survey are significant under various criteria of the National Historic Preservation Act of 1966, as amended. If this site is selected for the new commercial harbor, a planning strategy may be to isolate these historic properties into areas of cultural resource preserve and all inshore modification for the harbor will work around the preserves to avoid any adverse effect. A more intensive archaeological investigation will also have to be undertaken to record other surface and subsurface potentially significant historic properties to carry out the necessary tasks for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Data recovery for any cultural resource in compliance to Section 106 would be additional.

5. **REAL ESTATE.** Real Estate Directorate (CEPOD-RE) study input will include preparation of preliminary Real Estate Cost Estimates for the project which includes; right-of-way requirements, participation in pre-Local Cooperation Agreement activities, preparation of a Real Estate Plan/Real Estate Supplement for inclusion in the feasibility report, preparation of a Gross Appraisal Report, preparation of Baseline Cost Estimate for Real Estate, and preparation of Scopes of Work outlining Real Estate activities beyond the feasibility phase for input into the Project Management Plan.

5.1 **Coordination.** This activity includes, but is not limited to, participation in team meetings, negotiation of work agreements, coordination with other offices on project data needed for CEPOD-RE's major study products, and monitoring of progress and findings associated with CEPOD-RE's study products.

5.2. **Preliminary Real Estate Cost Estimates.** This activity includes the development of preliminary (reconnaissance level of detail) cost estimate(s) of total Real Estate costs associated with the six alternatives for the proposed project scenarios. The Real Estate Cost Estimate(s) will include a value estimate of the project's real property requirement, an estimate of any PL 91-646 relocation payments required as a result of the project's real property acquisitions, an estimate of the local sponsor's administrative cost to accomplish the project's real property requirements, and an estimate of the Corps' administrative cost to assist and monitor the local sponsor's real property acquisition program.

5.3. **Real Estate Plan/Real Estate Supplement.** This activity includes preparation of the Real Estate Plan (REP) which is an overall plan describing the minimum real estate requirements for the project requirements (see ER 405-1-12, Draft Chapter 12).

5.4. **Gross Appraisal.** This activity includes preparation of a Gross Appraisal Report and the Appraisal Review which provides a detailed estimate of all real estate costs associated with acquisition of the project's real property requirements.

5.5. **Review and Revisions.** This activity includes all CEPOD-RE activities involved in reviewing the feasibility report and responding to headquarters' real estate comments.

MAUI SECOND COMMERCIAL HARBOR
NAVIGATION STUDY
FINAL RECONNAISSANCE REPORT

APPENDIX E - QUESTIONNAIRE RESPONSES

QUESTIONNAIRE FOR COMMERCIAL PASSENGER CARRIERS

1. **Is Kahului Harbor adequate for your present needs? If not, what is it lacking?**

COMPANY

American Hawaii Cruises	Kahului Harbor is inadequate to service passenger vessels. It lacks passenger terminal and adequate parking for guests returning to the vessel.
Waldron Steamship Co., Ltd.	Passenger ship facilities separate from the cargo operations. Lacking sufficient pier space availability due to the American Hawaii Passenger vessels have the berth the majority of the time. The draft is a limiting factor and should be dredged to a minimum working draft of 35 feet. (In other words ships could enter the ports laden to a 35 ft draft)

2. **Has your company's operating costs and/or revenues been affected by a lack of adequate facilities at Kahului Harbor? If so, how has it been affected? Can you give an estimate of the additional costs paid and/or the additional revenues lost annually?**

COMPANY

American Hawaii Cruises	The lack of passenger terminal effects our revenues as it discourages passengers from booking cruises due to poor quality and presentation of the islands as a destination. In addition, lack of a passenger terminal and adequate parking effects our ability to market onboard rent a car sales and shore excursions.
Waldron Steamship Co., Ltd.	It is hard to measure the lost revenue of probable cruise ships which would call if the facilities and infrastructure were in place. It is similar to the question of where the "egg comes from". Unless Hawaii asserts itself and works quickly to put the proper facilities in place to attract prospective cruise liners, they are going to look to other markets and other destinations.

QUESTIONNAIRE FOR COMMERCIAL PASSENGER CARRIERS

3. **What was your usage of Kahului Harbor in 1992?**

COMPANY	NUMBER OF PASSENGERS	FREQUENCY OF TRIPS TO KAHULUI HARBOR
American Hawaii Cruises	70,000	Once per week for each of two ships.
Waldron Steamship Co., Ltd.	1,055 passengers on the Rotterdam	About 8 ships from our agency called Kahului Harbor.

4. **What type of vessels do you now use at Kahului Harbor?**

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises				
Length	680 ft	680 ft		
Beam	89 ft	89 ft		
Draft	30 ft	30 ft		
Check if appropriate:				
Single Screw				
Twin Screw	X	X		
Bow Thrusters	X	X		
None of these				
Other (specify)				
Waldron Steamship Co., Ltd.				
Length	750	560	390	650
Beam	90	75	60	85
Draft	28	32.5	24	32.5 (limited to max)
Check if appropriate:				
Single Screw	N	Y	Y	Y
Twin Screw	Y	N	N	N
Bow Thrusters	Y	N	Y/N	N
None of these				
Other (specify)				

5a. At the present time, are these your preferred vessel sizes? Yes __. No __.
If not, what size vessels would you like to use at Kahului Harbor?

COMPANY

American Hawaii Cruises — Yes

Waldron Steamship Co., Ltd. — Yes and No

	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
Length	750			
Beam	101			
Draft	40			
Check if appropriate:				
Single Screw	Y			
Twin Screw	N			
Bow Thrusters	N			
None of these				
Other (specify)				

5b. What is preventing you from using such vessels at Kahului Harbor?

COMPANY

American Hawaii Cruises	Not applicable.
Waldron Steamship Co., Ltd.	Limiting draft and pier availability.

6. **What are your plans for the use of Kahului Harbor with its current available facilities?**

COMPANY	TIME PERIOD	NUMBER OF PASSENGERS	FREQUENCY OF TRIPS TO KAHULUI HARBOR
American Hawaii Cruises	Short Term (1-5 years)	75,000-90,000	Once per week per ship.
	Middle Term (5-10 years)	100,000-120,000	Twice per week per ship.
	Long Term (over 10 years)	120,000	Once per week per ship.
Waldron Steamship Co., Ltd.	Short Term (1-5 years)	Ships per year (4) x Avg 700 pass call = 2,800 yr	12 ships of varying cargos.
	Middle Term (5-10 years)	Ships per year (8) x Avg 700 pass call = 5,600 yr	16 total ships of varying cargos.
	Long Term (over 10 years)		

7. What size vessels do you anticipate using at Kahului Harbor with its current available facilities?

a. Short Term (1-5 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises				
Length	680 ft	680 ft		
Beam	89 ft	89 ft		
Draft	30 ft	30 ft		
Check if appropriate:				
Single Screw				
Twin Screw	X	X		
Bow Thrusters	X	X		
None of these				
Other (specify)				
Waldron Steamship Co., Ltd.				
Length	750	560	390	650
Beam	90	75	60	85
Draft	28	32.5	24	32.5 (limited by max)
Check if appropriate:				
Single Screw	N	Y	Y	Y
Twin Screw	Y	N	N	N
Bow Thrusters	Y	N	Y/N	N
None of these				
Other (specify)				

b. Middle Term (5-10 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises	Same as 7a.			
Waldron Steamship Co., Ltd.	Same as 7a.			

c. Long Term (over 10 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises				
Length	700 ft	700 ft		
Beam	100 ft	100 ft		
Draft	30 ft	30 ft		
Check if appropriate:				
Single Screw				
Twin Screw	X	X		
Bow Thrusters	X	X		
None of these				
Other (specify)				
Waldron Steamship Co., Ltd.	Same as 7b.			

8. What will your back-up area and infrastructure requirements be to support your operations?

COMPANY	a. SHORT TERM (1-5 YEARS)	b. MID TERM (5-10 YEARS)	c. LONG TERM (> 10 YEARS)
American Hawaii Cruises	Passenger terminal and backup parking area.	Passenger terminal and backup parking area.	Passenger terminal and backup parking area.
Waldron Steamship Co., Ltd.	A passenger cruise ship pier and terminal unique to the cargo piers. Parking, bathrooms, rent-a-cars, taxis, visitor info booths, leis stands, restaurants, observation deck, and tour bus station facilities.	Same as 8a.	Same as 8b.

9. **What would your plans be if the inadequacy mentioned in Question 1 was corrected?**

COMPANY	TIME PERIOD	NUMBER OF PASSENGERS	FREQUENCY OF TRIPS TO KAHULUI HARBOR
American Hawaii Cruises	a. Short Term (1-5 years)	unknown	
	b. Middle Term (5-10 years)		
	c. Long Term (over 10 years)		
Waldron Steamship Co., Ltd.	a. Short Term (1-5 years)	20 to 50% increase	20% increase in overall traffic.
	b. Middle Term (5-10 years)	Same as 9a.	Increase by 20%.
	c. Long Term (over 10 years)	100% increase from 9a.	Increase of 100% from present.

10. What size vessels would you use if the inadequacy was corrected?

a. Short Term (1-5 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises				
Length	680 ft	680 ft		
Beam	89 ft	89 ft		
Draft	30 ft	30 ft		
Check if appropriate:				
Single Screw				
Twin Screw	X	X		
Bow Thrusters	X	X		
None of these				
Other (specify)				
Waldron Steamship Co., Ltd.	Same as in previous years also.			
Length	750	900		
Beam	90	120		
Draft	28	35		
Check if appropriate:				
Single Screw	N	N		
Twin Screw	Y	Y		
Bow Thrusters	Y	Y		
None of these				
Other (specify)				

b. Middle Term (5-10 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises	Same as 10a.			
Waldron Steamship Co., Ltd.	Same as in previous years and per 10a.			

c. Long Term (over 10 years)

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
American Hawaii Cruises	Same as 10a.			
Waldron Steamship Co., Ltd.	Same as in previous years and per 10a.			

11. **What would your back-up area and infrastructure requirements be to support your operations if the inadequacy was corrected?**

COMPANY	a. SHORT TERM (1-5 YEARS)	b. MID TERM (5-10 YEARS)	c. LONG TERM (> 10 YEARS)
American Hawaii Cruises	Passenger terminal and backup parking area.	Passenger terminal and backup parking area.	Passenger terminal and backup parking area.
Waldron Steamship Co., Ltd.	Cruise ship type facilities as previous mentioned. Possibly an unloader system as now in place at Barbers Point.	Same as 11a.	Same as 11a.

12. **If there were to be another commercial harbor on Maui, where would you like to see it built and why?**

COMPANY	
American Hawaii Cruises	Most of our passengers wish to visit Lahaina and Haleakala. A location on the Leeward side of the island would be more attractive. It would allow passengers easier access to these sites and would be better protected for ship berthing.
Waldron Steamship Co., Ltd.	Maalaea Harbor.

13. **What contingency plans do you have in the event of a closure of Kahului Harbor? For example, would you lighter people to shore or not visit the island? What economic impacts would your company sustain from a closure of Kahului Harbor?**

COMPANY	ONE-WEEK CLOSURE	TWO-WEEK CLOSURE	ONE-MONTH CLOSURE
American Hawaii Cruises	There are no specific contingency plans, however, in the past we have bipassed islands when facilities were not available and extended our port calls at other islands. It is likely we would do the same in this case.	There are no specific contingency plans, however, in the past we have bipassed islands when facilities were not available and extended our port calls at other islands. It is likely we would do the same in this case.	There are no specific contingency plans, however, in the past we have bipassed islands when facilities were not available and extended our port calls at other islands. It is likely we would do the same in this case.
Waldron Steamship Co., Ltd.	No impact.	No impact.	If booked passenger vessel would call to Lahaina.

14. **Additional Comments-**

COMPANY	
American Hawaii Cruises	A facility to receive passenger ships is sorely needed in Kahului Harbor. Presentation of Hawaii as a destination for cruise ship guests requires the best facilities that can be constructed inthe harbor.
Waldron Steamship Co., Ltd.	Although Lahaina is not under the harbors present jurisdiction believe the present facilities are not sufficient or adequate. Hawaii needs to be more accomodating to the passenger cruise ship industry.

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

1. Is Kahului Harbor adequate for your present needs? If not, what is it lacking?

COMPANY	
Brewer Environmental Industries	Kahului Harbor is congested, is too shallow for deep draft bulk freighters and dedicated piers cause costly berthing and reberthing for other users.
GASCO, Inc.	Somewhat. Too congested at times.
Hawaiian Sugar Planters Association	Harbor needs to be dredged to additional draft of 38' from present 35'. Need additional berthing for passenger vessels to free-up berth for sugar loading.
Matson Navigation Company	No, the pier structure is substandard and except for 400' at the makai end is not capable of sustaining modern stevedoring equipment such as cranes, front end loaders and straddle trucks. The pier should be rebuilt to modern terminal standards to support the heaviest wheel loadings of equipment in use. The pier structure should be designed to permit gantry crane rail installation. The pier should be extended to by approximately 750 ft to permit simultaneous multiple vessel operations---bulk sugar vessels, passenger ships and container/roll-on, roll-off ships and barges. CY space is insufficient to efficiently handle present volume. The container facility must be expanded immediately by demolition of the under-utilized, inefficient pier sheds. The long-range plan to expand CY onto the reef should be initiated to begin construction as early as possible.
Maui Electric Co., Ltd.	Yes.
Young Brothers, Ltd.	No. There is inadequate backup and staging areas. Terminal space, layout, barge operations, and customer operations are beyond capacity. This situation creates congestion inefficiencies for all parties and diminishes safety margins. Significant additional yard area is required for staging and laying out for containerized and ro-ro cargo as well as additional terminal space for dry and refrigerated general cargo.
Young Brothers, Ltd.	Kahului Harbor lacks adequate staging areas. Presently truckers, individual customers, and barge stevedores operate in the same area causing congestion and unsafe conditions. larger, segregated staging areas are required for containerized cargo, bulk cargo (e.g. lumber), deck cargo, refrigerated, and perishable cargo. Terminal space is at capacity.

2. **Has your company incurred additional costs due to a lack of adequate facilities at Kahului Harbor in the past? How often? What caused the added expense?**

COMPANY	
Brewer Environmental Industries	Twice, vessels unloading coal have had to leave port for dedicated vessels. Costs of overtime, demurrage and ship movements are incurred.
GASCO, Inc.	No.
Hawaiian Sugar Planters Association	Yes. Due to limited draft, the Moku Pahu has to go to Honolulu to complete loading. This happens almost every three weeks. Also, conflict with passenger vessels at Berth 1A requires adjustment of vessel schedule, with net result of additional cost to HST Co.
Matson Navigation Company	Yes. Associated C&H Sugar Company bulk vessel cannot load 8,000 tons sugar due to 32' maximum draft. Harbor should be dredged to allow vessels drawing at least 35'. Matson vessels call 3 times per week and incur additional cost each voyage due to the heavily congested CY. Obsolete facilities with substandard pier encumbered by narrow apron and underutilized pier sheds in way of efficient container and RO-RO operations. This results in long hauling containers from ship's hook to CY. Inefficient operations are costly in terms of increased vessels stay in port and increased labor cost, reduced service to customers increasing trucking costs.
Maui Electric Co., Ltd.	No.
Young Brothers, Ltd.	Yes. Congestion is a continuous problem. Single or double barges call three times weekly. Cargo handling operations are performed in congested areas resulting in reduced operating efficiencies, higher labor costs, and greater likelihood of damage to cargo.
Young Brothers, Ltd.	Barge discharging and backloading operations, which occur three times per week, are at reduced efficiency due to freight yard congestion. Cargo handling operations are performed in confined area resulting in slower operations (resulting in increased labor costs) and damaged cargo (resulting in increased damaged cargo claims).

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

3. What is your present usage of Kahului Harbor?

COMPANY	TYPE OF CARGO SHIPPED	QUANTITY	FREQUENCY OF SHIPMENT
Brewer Environmental Industries	Coal, sand, liquid bulk cargos.	Coal - 15,000 T. Others vary.	Coal and sand twice, liquid 4 times per year (barges).
GASCO, Inc.	Liquefied Petroleum Gas (L.P.G.)	10,000 BBL.	1 to 2 times per month.
Hawaiian Sugar Planters Association	Sugar	Approximately 24,000 tons.	Every 3-4 weeks.
Matson Navigation Company	Automobiles, rolling stock, container freight all kinds (20', 24' & 40'), dry and refrigerated.		3 barge calls per week.
Maui Electric Co., Ltd.	#2 diesel, #6 fuel oil.	54,000 bbls.	Two or three times a month.
Young Brothers, Ltd.	20'-45' containers, autos, Ro-Ro, breakbulk, palletized cargo, refrigerated containers, and other loose cargo.	1 million tons annually, approx. 7,000 tons per sailing.	3 scheduled calls weekly (3-5 barges).
Young Brothers, Ltd.	Containerized (20'-45'), automobiles and other Ro-Ro, breakbulk, skipped cargo (palletized), refrigerated, loose cargo, bulk cargo (lumber).		Average 3-5 barges per week.

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

4. <u>What type of vessels and/or barges do you now use at Kahului Harbor?</u>

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
Brewer Environmental Industries				
Type	Barge	Bulk carrier		
Length	350	± 560-625		
Beam	75	75-95		
Draft		28-34		
Single Screw		X		
Twin Screw		X		
Bow Thrusters		X		
None of these	X			
GASCO, Inc.				
Type	Barge	Tanker ship		
Length	229'	up to 580'		
Beam	44'	up to 85'		
Draft	9.5'	up to 30'		
Twin Screw		X		
Bow Thrusters		X		
None of these	X			
Hawaiian Sugar Planters Association				
Type	Bulk carrier			
Length	685'			
Beam	84'			
Draft	35.5'			
Twin Screw	X			
Bow Thrusters	X			
Matson Navigation Company				
Type	1 RO-RO Barge	2 LO-LO Barges	Note: LO-LO barges fitted with rotating container crane 20'-40' telescopic lifting beam S.W.L. 40 tons.	
Length	345	350		
Beam	76	64.67		
Draft	19	20.5		
Other (specify)	Stern thruster	Stern thruster		

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

COMPANY	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
Maui Electric Co., Ltd.				
Type	Tugboat	Tank Barge		
Length	113 ft	340 ft		
Beam	32 ft	78 ft		
Draft	14 ft	19 ft		
Single Screw		n/a		
Twin Screw	x 3,900 HP	n/a		
Bow Thrusters	none	n/a		
None of these		n/a		
Other (specify)	Dbl winch 2"x2000' wire	Tank barge of 60,000 bbls capacity.		
(2)				
Young Brothers, Limited				
Type	Tugboats	Unmanned barges		
Length	118'-120'	200'-286'		
Beam	34'	52'-78'		
Draft	14'-17'	12'-18'		
Twin Screw	Yes			
Bow Thrusters		No		
Young Brothers, Limited				
Type	Barge	Barge	Tug	
Length	286'	250'	120'	
Beam	76'	68'	34'	
Draft	14'	14'	18'	
Twin Screw			X	
None of these	X	X		

5a. **At the present time, are these your preferred vessel sizes?** **Yes __. No __.**
If not, what type and size vessels would you like to use at Kahului Harbor?

COMPANY

Brewer Environmental Industries — Yes

GASCO, Inc. — Yes

Hawaiian Sugar Planters Association — Yes

Matson Navigation Company — Yes. Long-term potential - direct vessel calls.

	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
Type	LO-LO /RO-RO	Container		
Length	826'6"	835'5"		
Beam	110'	95'		
Draft	30'9"	34'6"		
Single Screw	X	X		
Bow Thrusters	X	X		

Maui Electric Co., Ltd. — Yes

Young Brothers, Limited — No. Larger barges in the 320 foot maximum length would be preferable.

Young Brothers, Limited — No. Barges to accept additional containerized cargo (i.e. 40'+ containers).

	VESSEL 1	VESSEL 2	VESSEL 3	VESSEL 4
Type	Barge			
Length	320'			
Beam	78'			
Draft	16'			

5b. What is preventing you from using such vessels at Kahului Harbor?

COMPANY	
Brewer Environmental Industries	Not applicable.
GASCO, Inc.	Too shallow near Pier 2A (location of transfer pipe).
Hawaiian Sugar Planters Association	No response provided.
Matson Navigation Company	Pier structure cannot support cranes and modern stevedoring equipment. Narrow apron congested with obsolete pier sheds. Insufficient space in CY. Harbor should be dredged to a 35' MLLW to allow deep draft vessels alongside. Bulk sugar vessel calling regularly cannot load to its capacity.
Maui Electric Co., Ltd.	Nothing.
Young Brothers, Limited	Inadequate facilities and capital costs.
Young Brothers, Limited	Lack of berthing space and location of warehouse facilities. We (YB) need to consider use of larger barges to accept increased containerized cargo (YB, Sealand & Matson) and possible large bulk cargo (e.g. lumber, cement). Need also consider JTB needs.

6. What are your plans for the use of Kahului Harbor?

COMPANY	CARGO	QUANTITY	FREQUENCY
Brewer Environmental Industries			
a. Short Term (1-5 yrs)	Same, no change.		
b. Middle Term (5-10 yrs)	Same, no change.		
c. Long Term (> 10 yrs)	Unknown.		
GASCO, Inc.			
a. Short Term (1-5 yrs)	L.P.G.	10,000 BBL.	1-2 times per month.
b. Middle Term (5-10 yrs)	L.P.G.	15,000 BBL.	1-2 times per month.
c. Long Term (> 10 yrs)	L.P.G.	15,000 BBL.	1-2 times per month.
Hawaiian Sugar Planters Association			
a. Short Term (1-5 yrs)	Sugar	24,000 tons	Every 3-4 weeks.
b. Middle Term (5-10 yrs)	Same.	Increased tonnage per load.	Every 3 weeks.
c. Long Term (> 10 yrs)	Sugar.	Not known.	Not known.
Matson Navigation Company			
a. Short Term (1-5 yrs)	See #3.	Containers W/B 14,623 E/B 8,225 1992 Autos W/B 9,226 E/B 12,938	3 calls per week.
b. Middle Term (5-10 yrs)	Freight all kinds except bulk liquids.	2-3% growth projected per year.	Service level depends on volume, direct calls or transshipments over Honolulu.
c. Long Term (> 10 yrs)	Freight all kinds.	2-3% growth projected per year.	With direct shipment from mainland twice weekly.
Maui Electric Co., Ltd.			
a. Short Term (1-5 yrs)	#2 diesel #6 fuel oil	54,000 bbls.	2-3 times a month.
b. Middle Term (5-10 yrs)	#2 diesel #6 fuel oil	54,000 bbls.	4-5 times a month.
c. Long Term (> 10 yrs)	#2 diesel #6 fuel oil	54,000 bbls.	5-8 times monthly or larger barge.

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

COMPANY	CARGO	QUANTITY	FREQUENCY
Young Brothers, Ltd.			
a. Short Term (1-5 yrs)	Same mix with increase in containerized cargo.	1.1 million tons annually in 5 years.	3 times weekly, 4-6 barges.
b. Middle Term (5-10 yrs)	Same with further increase in containerized cargo.	1.25 million tons annually in 10 years.	3 times weekly, 5-6 barges.
c. Long Term (> 10 yrs)	Same with further increase in containerized cargo.	1.5 million tons annually after 10 years.	4 times weekly, 6-8 barges.
Young Brothers, Ltd.			
a. Short Term (1-5 yrs)	Same mix, with increase in containerized cargo.		From 3-5 barges/wk to 5-6 barges/wk.
b. Middle Term (5-10 yrs)	Same mixes, with increased containerization.		5-6 barges/wk.
c. Long Term (> 10 yrs)	Same mixes, with increased containeriza-tion.		

7. <u>What type and size vessels or barges do you anticipate using?</u>

<u>COMPANY</u>

Brewer Environmental Industries	Same except deeper draft.
GASCO, Inc.	Generally same as in past.

Hawaiian Sugar Planters Association

a. Short Term (1-5 yrs)	VESSEL 1
Type	Bulk Carrier (twin screws, bow thrusters)
Length	685 ft
Beam	84 ft
Draft	35.5 ft
b. Middle Term (5-10 yrs)	Same
c. Long Term (> 10 yrs)	Unknown

Matson Navigation Company	See paragraph 5, Barges.
a. Short Term (1-5 yrs)	Single screw, stern thruster.
b. Middle Term (5-10 yrs)	Single screw, bow thrusters.
c. Long Term (> 10 yrs)	Single screw, bow thrusters.

Maui Electric Co., Ltd.	Same information detailed in item #4.

Young Brothers, Ltd.

a. Short Term (1-5 yrs)	Tug vessels: same as item 4. Barge vessels: dimensions: (200'x320')x(52'x78')x(12'x20')
b. Middle Term (5-10 yrs)	Tug vessels: same as item 4. Barge vessels: dimensions: (225'x320')x(58'x78')x(15'x20')
c. Long Term (> 10 yrs)	Tug vessels: same as item 4. Barge vessels: dimensions: (225'x360')x(58'x100')x(15'x24')

Young Brothers, Ltd.

a. Short Term (1-5 yrs)	VESSEL 1	VESSEL 2	VESSEL 3
Type	Barge	Barge	Tug (twin screws)
Length	286 ft	250 ft	120 ft
Beam	76 ft	68 ft	32 ft
Draft	14 ft	14 ft	18 ft
b. Middle Term (5-10 yrs)			
Type	Barge	Barge	Tug (twin screws)
Length	320 ft	286 ft	120 ft
Beam	78 ft	76 ft	32 ft
Draft	18 ft	14 ft	18 ft
c. Long Term (> 10 yrs)			
Type	Barge		
Length	320 ft		
Beam	78 ft		
Draft	18 ft		

8. What will your back-up area and infrastructure requirements be to support your operations?

COMPANY

Brewer Environmental Industries

a. Short Term (1-5 yrs)
Same as present - pipelines and trucks.
b. Middle Term (5-10 yrs)
Same.
c. Long Term (> 10 yrs)
Same.

GASCO, Inc.

a. Short Term (1-5 yrs)
Currently no back-up area since we are limited by the access to our transfer valve at Pier 2A. Relocation of our transfer valve or a secondary transfer valve on another pier would be ideal. This will increase flexibility on size of ship we can schedule and also improve scheduling since an alternate pier would be available.
b. Middle Term (5-10 yrs)
c. Long Term (> 10 yrs)

Hawaiian Sugar Planters Association

a. Short Term (1-5 yrs)
Sugar storage warehouses at Kahului Harbor and bulk sugar loading facility already in place at Pier 1A.
b. Middle Term (5-10 yrs)
Same.
c. Long Term (> 10 yrs)
Unknown at this time.

Matson Navigation Company

a. Short Term (1-5 yrs)
Wide apron with open CY approximately 17 acres of back up area (removal of under-utilized pier shed required). Pier to be structurally strengthened to 600' to allow for modern stevedoring operations to be performed; i.e., front-end loading container handling equipment. Dredging harbor and alongside pier to project depth of 35 feet at MLLW (currently about 32').
b. Middle Term (5-10 yrs)
Expand CY (offshore landfill) to provide approximately 20 acres of open CY. Demolish Pier 1 shed leaving open structure to protect sugar gantries. Construct 10,000' off dock break bulk storage shed. Rebuild inner pier 800 feet to sustain modern cargo handling operations including crane rail supports extending full 1400' of pier.
c. Long Term (> 10 yrs)
Extend pier 1 approximately 750' seaward to provide 2100' of pier to permit simultaneous dry bulk cargo ships, passenger ships and container/ro-ro cargo ships. Provide for expansion of container and automobile storage to off dock marshalling yards.

COMPANY

Maui Electric Co., Ltd. - No response provided.

Young Brothers, Ltd.

a. Short Term (1-5 yrs)
   4-6 acres of yard area for landing containers, Ro-Ro, and staging cargo. Approximately one-half acre covered ice house facility for perishable/refrigerated cargo with reefer plugs. Possibly additional covered shed for break bulk cargo (1/4-1/2 acre).
b. Middle Term (5-10 yrs)
   Same as 8a, plus additional 2 acres yard area.
c. Long Term (> 10 yrs)
   Same as 8a, plus 4 additional acres yard area. Additional pier facilities required to handle increased frequency of vessel sailings and larger barges.

Young Brothers, Ltd.

a. Short Term (1-5 yrs)
   Staging area (containers, Ro-Ro) will require additional 100k sf. Perishable/refrigerated will require additional 50k sf and 10 additional reefer plugs (total of 30). Terminal will require additional 15k sf (150'x100') covered terminal (break bulk cargo), plus 7,500 sf shade shed for perishables (produce).
b. Middle Term (5-10 yrs)
c. Long Term (> 10 yrs)

9. How important is frequency of service to your company presently and in the future?

COMPANY

Brewer Environmental Industries	Young Brothers and Matson shipments are crucial to our business.
GASCO, Inc.	Very important. Our LPG services many using it as a utility.
Hawaiian Sugar Planters Association	It is critical that the sugar loading facility be available on a regular basis to allow efficient scheduling of vessel. It is anticipated that Kahului will become a more critical sugar loading port as sugar production increases on Maui.
Matson Navigation Company	Matson's frequency of service to Maui is now the highest in the world. Transshipment cargo over Honolulu connects with long haul ships insuring a West Coast to Maui transit within 7-10 days.

COMPANY	
Maui Electric Co., Ltd.	Essential to produce electricity for the island of Maui.
Young Brothers, Ltd.	Regular frequency is extremely important to meet the needs of the community. It is also critical to have adequate areas to conduct barge and terminal operations safely and efficiently.
Young Brothers, Ltd.	Frequency (and reliability) extremely important. We (YB) needs adequate area to offload, stage, locate, and deliver cargo safely and efficiently.

10. **How important are larger vessels or barges to your company presently and in the future?**

COMPANY	
Brewer Environmental Industries	May use deeper draft bulk carriers for sand, coal and dry fertilizer.
GASCO, Inc.	Very important, especially when LPG is imported.
Hawaiian Sugar Planters Association	Bulk sugar carrier in use is suitably sized for present and future use.
Matson Navigation Company	Matson's long range plans to 20 years vessels designed to provide for future growth. Four of our vessels have had mid-bodies installed; others may be refitted as growth demands. The new ship R.J. PFEIFFER with capacity of 1820 TEU's is an ideal size for Hawaii Service.
Maui Electric Co., Ltd.	Presently not too important; in the future, it might be.
Young Brothers, Ltd.	YB's present vessel sizes are adequate to meet demands. However, barges are expected to be larger in the future, especially as containerization increases and container sizes migrate from 20' to 40' plus.
Young Brothers, Ltd.	Dependent on State economy (and U.S. economy) but it's only a matter of time that larger barges (i.e. 320'x78') will be a necessity.

11. Which is more important to your company - frequency of service or larger vessels or barges?

COMPANY	
Brewer Environmental Industries	Frequency of commercial carriers.
GASCO, Inc.	Frequency of service.
Hawaiian Sugar Planters Association	Frequency of service. Kahului does not have sufficient draft for use of a larger vessel.
Matson Navigation Company	Service frequency and vessel capacity are both important and are driven by customer demand and cargo volume moving west and eastbound.
Maui Electric Co., Ltd.	Frequency and quantity of service.
Young Brothers, Ltd.	Frequency is most critical to provide service.
Young Brothers, Ltd.	Frequency of service - majority of businesses operate on "just in time" delivery of cargo.

12. What role do you see Kahului Harbor playing for your company?

COMPANY

Brewer Environmental Industries

a. Short Term (1-5 yrs)
   No change.
b. Middle Term (5-10 yrs)
c. Long Term (> 10 yrs)

GASCO, Inc.

a. Short Term (1-5 yrs)
   Same as current.
b. Middle Term (5-10 yrs)
c. Long Term (> 10 yrs)

QUESTIONNAIRE FOR COMMERCIAL CARGO CARRIERS

<u>COMPANY</u>

Hawaiian Sugar Planters Association

a. <u>Short Term (1-5 yrs)</u>
   Maui is the largest producer of sugar in our State at this time and will most likely remain so.
b. <u>Middle Term (5-10 yrs)</u>
   Same.
c. <u>Long Term (> 10 yrs)</u>
   Unknown at this time.

Matson Navigation Company

a. <u>Short Term (1-5 yrs)</u>
   We expect to continue to be the principal ocean carrier calling at Maui.
b. <u>Middle Term (5-10 yrs)</u>
   Matson has served Hawaii for 111 years and is here to stay.
c. <u>Long Term (> 10 yrs)</u>
   As above.

Maui Electric Co., Ltd.

a. <u>Short Term (1-5 yrs)</u>
   Essential for barges and vessels to dock and unload their products.
b. <u>Middle Term (5-10 yrs)</u>
   Same as item 12a.
c. <u>Long Term (> 10 yrs)</u>
   Same as item 12a.

Young Brothers, Ltd.

a. <u>Short Term (1-5 yrs)</u>
   Will continue to be busiest NI port. One additional barge calling per week (double tow). Larger barge in service to Kahului. Increasing requirement for backup space.
b. <u>Middle Term (5-10 yrs)</u>
   Same as a.
c. <u>Long Term (> 10 yrs)</u>
   Same as a. Increased frequency of 4 weekly sailings.

Young Brothers, Ltd.

a. <u>Short Term (1-5 yrs)</u>
   Increased barge schedule from 3-5/week to 5-6/week. Increased staging areas to result in improved service (and safer operations).
b. <u>Middle Term (5-10 yrs)</u>
   Larger barges/same frequency of service.
c. <u>Long Term (> 10 yrs)</u>

13. If there were to be another commercial harbor on Maui, where would you like to see it built and why?

COMPANY

Brewer Environmental Industries	Prefer Kahului because of proximity to customers and BEI main plant/tank farm.
GASCO, Inc.	No response provided.
Hawaiian Sugar Planters Association	Would prefer to have Kahului Harbor expanded to meet future needs. It is advantageously located and all infrastructure is in place.
Matson Navigation Company	Kahului Harbor is exposed to heavy tradewinds and strongly N'ly and NE'ly gales and heavy northerly swells making the entrance dangerous. The harbor is small with a limited turning basin. A harbor on the lee side at Maalaea would provide protected approaches. Pier alignment should be into the prevailing wind and not across the wind as at Kahului.
Maui Electric Co., Ltd.	Maalaea. We might then be able to construct a fuel oil pipeline directly from Maalaea Pier to our power plant at Maalaea.
Young Brothers, Ltd.	Leeward side of the island due to shorter transit time from Honolulu and more protected side of the island. Needs to be located where there is adequate backup property for industrial area. Access roadways need to be adequate.
Young Brothers, Ltd.	Leeward side. Shorter transit from Honolulu. Could be designed/planned for the long term. Safer ocean conditions.

14. Additional Comments

COMPANY

Brewer Environmental Industries	Expansion of Kahului past the north breakwater would seem a viable alternative.
Matson Navigation Company	Building a secondary harbor on Maui would be an extremely expensive undertaking and probably be rarely used (Barbers Point) unless it were designed as the principal port. An alternative option may be to build a first-class harbor on the sheltered (leeward) side of Maui to replace Kahului Harbor, leaving Kahului to be the secondary harbor. This would change the structure of business on the island. The center of commerce is now around the town of Kahului, Wailuku and environs.