Navigation Improvement Study
Reconnaissance Report

Oak Bluffs Harbor
Oak Bluffs, Massachusetts

US Army Corps
of Engineers
New England Division

REPORT DOCUMENTATION PAGE

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13. ABSTRACT (Maximum 200 words)
This Reconnaissance Report for Oak Bluffs Harbor in Oak Bluffs, Massachusetts consists of a Main Report summarizing the existing conditions, problem identification, plan formulation, cost/benefit analysis and appended supporting documentation for the Economic Analysis and Pertinent Correspondence. Two concerns were expressed: 1) storm waves enter through the harbor entrance causes damage to the bulkheads, piers, floats, and the moored vessels; 2) the entrance channel to the harbor has experienced some severe shoaling. To reduce the effects from storms, involves the extension of the existing jetty 110 feet and then adding another 220 foot long dogleg in a southeasterly direction. The second solution was establishing a Federal channel (80 feet wide, 500 feet long, and 10 feet deep at mean low water) in the harbor entrance.

At this time, the New England Division Engineer recommends no further activity.

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15. NUMBER OF PAGES
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NAVIGATION IMPROVEMENT STUDY

OAK BLUFFS HARBOR

OAK BLUFFS, MASSACHUSETTS

RECONNAISSANCE REPORT

OCTOBER 1991

EXECUTIVE SUMMARY

This Reconnaissance Report for Oak Bluffs Harbor in Oak Bluffs, Massachusetts, was prepared under the authority of Section 107 of the 1960 River and Harbor Act, as amended, for the purpose of navigation improvement. The report consists of a Main Report summarizing the existing conditions, problem identification, plan formulation, cost/benefit analysis and appended supporting documentation for the Economic Analysis and Pertinent Correspondence. The study, conducted using Federal funds, accomplished the following:

- assessed the extent of the navigation problem;
- determined if there is an economically viable solution;
- determined if there is an opportunity for Federal assistance in a solution;
- and determined if there is a willingness on the part of the local interests to share the cost of the final phase of the study and construction of a project.

Local officials expressed two concerns regarding Oak Bluffs Harbor. First, that storm waves enter through the harbor entrance and cause problems for the vessels and shore structures in the harbor. The harbor shore is lined on several sides with bulkheads and as waves deflect off the structures wave energy is redirected. This causes damage to the bulkheads, piers, floats, and the moored vessels. Second, since last being dredged in 1979, the entrance channel to the harbor has experienced some severe shoaling. As the channel continues to shoal, the vessels that use the harbor will see an increase in damages. The three small passenger ferries that offload at Oak Bluffs are now being affected and if the shoaling continues could be forced to discontinue their services.

To reduce the effects from storms, a jetty extension on the existing north jetty at the harbor entrance was evaluated. The plan would involve extending the existing jetty 110 feet and then adding another 220 foot long dogleg in a southeasterly direction. This new configuration would protect the harbor from prevailing northeasterly storm waves. The jetty would have a crest elevation of 9 feet at Mean Low Water (MLW) and a crest width of 12 feet. Non-Federal interests would be responsible for upgrading the existing structures as part of the project. The total cost of the Federal improvement is estimated to be $1,235,000 with an annual cost of $115,000. Average allowable annual benefits were estimated to be $90,000 resulting in a benefit/cost ratio of 0.8.

The second plan examined was the establishment of a Federal channel in the harbor entrance. The channel dimensions would be 80 feet wide, 500 feet long, and 10 feet deep at MLW. The total cost of completing this work is estimated to be $78,000, with an annual cost of $11,000. Average allowable annual benefits were estimated to be $6,000 resulting in a benefit/cost ratio of 0.6.

Based on this analysis, the New England Division Engineer recommends no further activity under the Section 107 Authority at this time.

OAK BLUFFS HARBOR
OAK BLUFFS, MASSACHUSETTS

RECONNAISSANCE REPORT

INTRODUCTION

The Oak Bluffs Harbor study area is located in the town of Oak Bluffs, Dukes County, on the northeast side of the island of Martha's Vineyard. It is approximately fifty (50) miles southeast of Providence, Rhode Island, and sixty-five (65) miles south of Boston, Massachusetts. See Figure 1, Location Map. The study area faces Nantucket Sound to the northeast, exposing the harbor to destructive storm waves propagating from that direction.

Oak Bluffs Harbor is experiencing damages caused by storm waves traveling directly into the harbor and is also experiencing shoaling of the existing entrance channel. Shoaling contributes to delays to marine traffic and could threaten to close the channel to passenger ferries. This study has considered several alternatives for providing storm protection and for dredging the existing entrance channel.

STUDY PURPOSE AND SCOPE

The purpose of this study is to determine the justification for undertaking further planning to alleviate the storm damage and shoaling problems at Oak Bluffs Harbor. The town of Oak Bluffs requested Federal assistance in solving these problems in a letter dated July 13, 1989.

The reconnaissance level study estimates tidal delays and vessel and facilities damages that would occur to the study area if no project were constructed. The intent of the reconnaissance phase effort is to determine whether Corps' involvement should proceed based on an appraisal of the appropriatness of Federal assistance. This was accomplished through a multi-disciplined analysis of alternative plans of improvement. This effort encompassed engineering feasibility, costs, and economic justification.

STUDY AUTHORITY

This report was prepared under the authority of Section 107 of the River and Harbor Act of 1960, as amended.

PRIOR STUDIES AND IMPROVEMENTS

1) c. 1985 - Construction of new steel sheet pile bulkheads at the south side of the harbor along Lake Avenue.

2) 1981 - Oak Bluffs Harbor: A Study, C. E. Maguire - Planning study of the harbor prepared for the Town of Oak Bluffs.

3) 1980 - Small Navigation Project Reconnaissance Report, U.S. Army Corps of Engineers - New England Division. This report recommended

further detailed study of alternatives to protect the harbor area. However, no further study was accomplished.

4) 1970 - Construction of a steel sheet pile bulkhead along Circuit Avenue and dredging of the area just south of the harbor entrance.

5) 1965 - Beach Erosion Control Report Cooperative Study of Martha's Vineyard, Massachusetts, U.S. Army Corps of Engineers - New England Division. A study to determine the most practicable method of restoring and stabilizing beaches and bluffs between East Chop and Edgartown Harbor.

6) 1951 - Construction of a timber sheet pile bulkhead and a timber pile supported wooden deck along the east side of the harbor. Dredging of the eastern portion of the harbor area.

7) 1899 - Construction of jetties at the entrance to the harbor by the Commonwealth of Massachusetts. Jetties were constructed to stabilize the entrance and provide a navigable channel.

PLAN FORMULATION

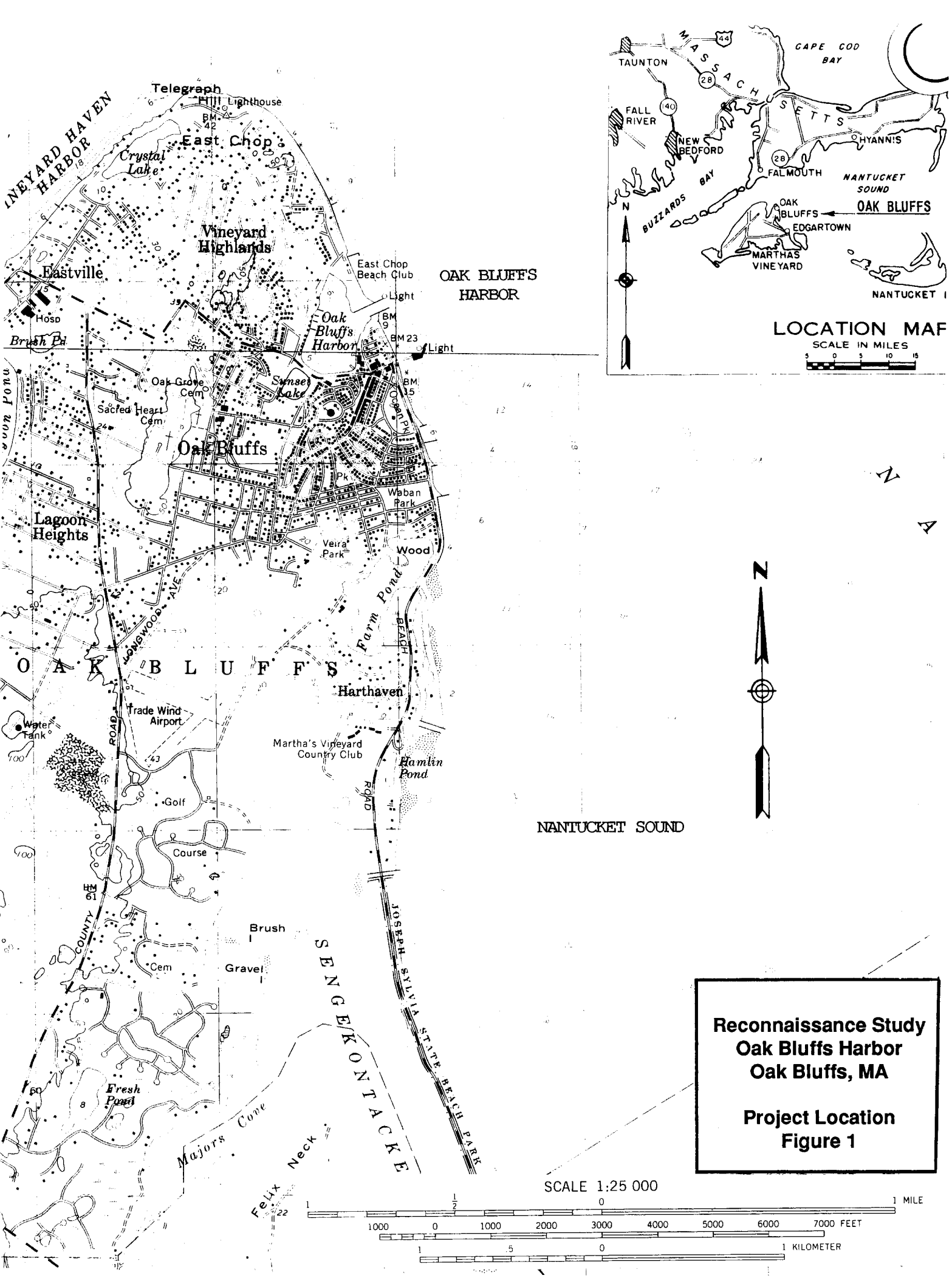
Reconnaissance level planning involved:

- problem identification,
- developing alternative plans,
- assessing their economic merits,
- and determining justification for further Federal involvement.

Problem Identification

Through meetings with town officials and local interests, it was determined that there are two problems associated with Oak Bluffs Harbor. These include: 1) storm waves damaging the commercial fishing fleet, recreational boats, and harbor facilities; and, 2) shoaling of the entrance channel to the harbor.

The study completed in 1981 by CE Maguire, Inc. titled "OAK BLUFFS HARBOR: A Study", details the potential for storm waves to cause damage to vessels moored in the harbor. This is primarily caused by wave reflection off of the bulkheads along the harbor's perimeter. Storm waves entering the harbor from the northeast have caused considerable damage to vessels within the harbor in the past. Wave heights are decreased and lose energy when they propagate through the relatively narrow harbor entrance and enter the deeper water of the harbor. This is known as diffraction of the waves which dissipates wave energy. However, the presence of vertical bulkheads encompassing about 75% of the perimeter has an amplifying effect on the incident wave heights. Waves are reflected off the bulkheads forming a standing wave condition. This phenomenon can cause severe vertical and horizontal water displacements resulting in



Reconnaissance Study
Oak Bluffs Harbor
Oak Bluffs, MA

Project Location
Figure 1

damage to vessels moored alongside the bulkheads. This wave reflection condition has historically occurred along the bulkhead forming the southern boundary of the harbor.

Shoaling of the entrance channel is causing navigation problems. Incidents to date include congestion in the channel due to the narrowness of the passage and a few near groundings of the deep draft passenger ferries. Today, many of the commercial and recreational vessels are not severely impacted by the channel shoaling. Town officials are concerned that further shoaling of the channel will begin to have more of an impact on these shallower draft vessels by causing increased grounding damages. Some of the deeper draft recreational vessels and the ferries may no longer be able to use the harbor and cause the town to lose valuable tourist business.

Existing Conditions

Oak Bluffs Harbor is located on the north side of Martha's Vineyard and faces Nantucket Sound. The harbor area covers approximately 30 acres. The harbor was originally separated from Nantucket Sound by a barrier beach which was opened in the late 1800's. The inlet is stabilized with two rubble mound jetties constructed by the Commonwealth of Massachusetts.

The entrance to the harbor is orientated at approximately N 61 degrees E. The harbor is exposed to damaging storm waves and the orientation allows these waves from Nantucket Sound to propagate between the jetties and into the harbor.

The 1965 study completed by the Corps states that "the jetties are about 160 feet apart..., were originally constructed by the Commonwealth in 1899 to stabilize the entrance..., and, have a top width of about 5 feet with side slopes of 1:1.5." This same study also stated that "the condition of the north jetty generally is good, while that of the south jetty is poor. The south jetty needs to be rebuilt." According to local officials, the north jetty is also presently in need of repair. The stones have been displaced, allowing wave transmission and sediment to pass through and around the end of the jetty. The littoral transport in this area is from north to south and shoaling of the channel may be due to wave transmission and sediment transport over and through the deteriorating north jetty. The south jetty is in a similar physical condition. See Figure 2. Town officials are concerned about the conditions of the two jetties and the protection they offer to the harbor. Ownership of the jetties has been transferred to the town and maintenance is their responsibility. However, the work has not been completed due to a lack of available funding.

The present harbor configuration is characterized by numerous bulkheads defining its perimeter (see Figure 3). These bulkheads consist of steel and timber sheet piling. The south side of the harbor contains a steel sheet-pile bulkhead constructed in 1985 along Lake Avenue which is in good condition. The east side of the harbor contains a timber sheet pile bulkhead approximately 500 feet long and a steel sheet pile bulkhead (600 feet long) constructed in 1970 along Circuit Avenue. There is also a

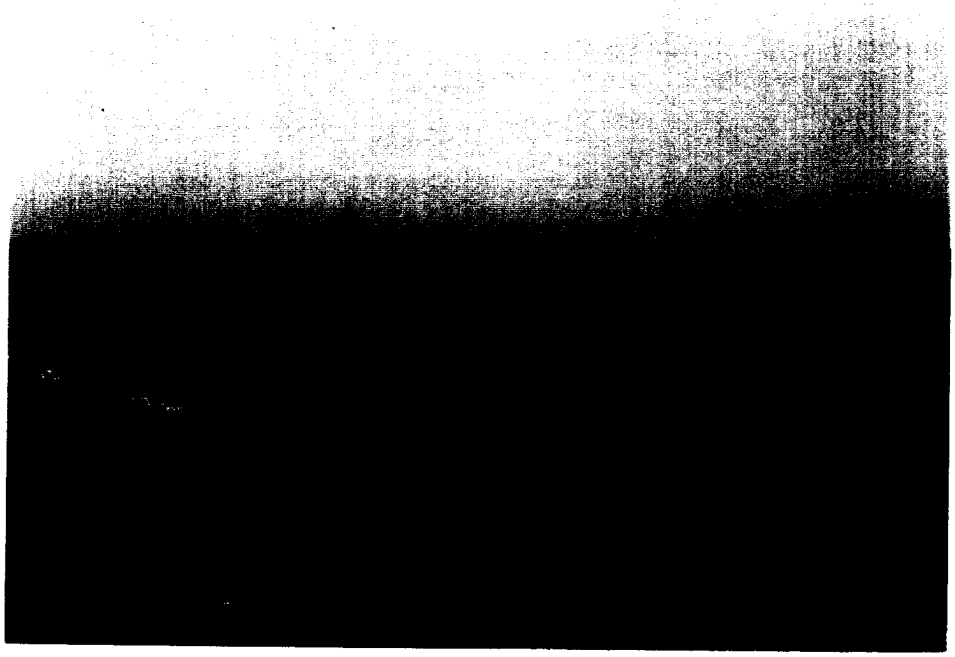
timber sheet pile bulkhead in the northern section of the harbor near the East Chop Yacht Club. According to the study conducted by CE Maguire in 1981, "observational data from the harbormaster and harbor users indicate that waves in excess of two feet, possibly up to three feet, may move across the harbor." These waves reflect off the numerous bulkheads causing serious damage to vessels and harbor facilities.

The timber sheet pile bulkhead along the eastern portion of the harbor is where the commercial fishing fleet and passenger ferry services dock. It is also the area least susceptible to damaging storm waves propagating into the harbor. However, town officials are concerned about the condition of this bulkhead because of the continuing loss of backfill. Abnormal high tides and accompanying wave action caused considerable damage to this portion of bulkhead in early December, 1990. The storm reportedly caused wave heights within the harbor from 3 to 4 feet. Numerous areas exhibited a loss of backfill due to localized failures of the timber bulkhead. Some of these holes were 2-3 feet deep and over 3 feet across. This condition was also noted in the 1981 CE Maguire planning study. The town routinely fills the holes created by the loss of backfill and the timber decking was recently replaced along this portion of the dock. Town officials stated the need for a replacement bulkhead and are considering replacing the existing one with used steel sheet pile.

Oak Bluffs Harbor contains approximately 400 recreational vessels which are located at the 400 moorings and boat slips in the harbor. The recreational fleet consists of sail and power boats, with the largest boats 85 feet to 90 feet long with drafts of 5 to 6 feet. The harbor contains nine commercial fishing vessels which berth along the bulkhead at the entrance to the harbor on the eastern side. The nine vessel commercial fleet includes two draggers, one combination lobster boat-trawler, and six lobster boats. These vessels have drafts between three and eight feet. There are also three passenger ferry services serving the harbor during the summer season. They are the Hy-Line out of Hyannis, Massachusetts, the Island Queen out of Falmouth, Massachusetts, and a ferry service from Montauk, New York. These ferries are extremely important to the town because of the business revenue generated by visiting tourists who disembark in Oak Bluffs. The harbormaster stated that these vessels sometime scrape the bottom of the entrance channel, particulary at the beginning of the summer season.

The harbor is very active in the summer months. A sample of vessel traffic in the channel taken by the harbormaster on September 1, 1990, showed 84 vessels entering the harbor in one hour. This heavy traffic includes recreational boats entering the harbor to stay overnight at moorings, transient recreational boats entering to visit the island for the day, fishing vessels, and passenger ferries. In the peak season, the passenger ferries make over ten trips to the harbor per day.

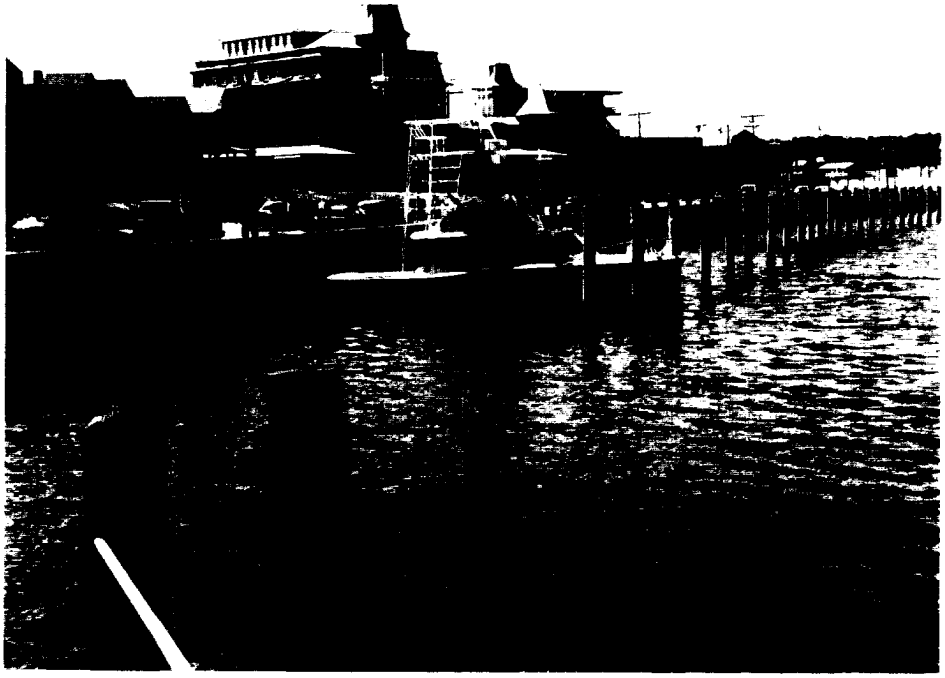
The channel depth has been determined from a hydrographic survey of the harbor entrance (September 1990) that shows its shoalest point to be about 6 feet at MLW. According to town officials the channel entrance to the harbor has shoaled to a depth of 5.5 feet in some spots. The channel was last dredged approximately 12 years ago by the town. The channel is not a state maintained project.



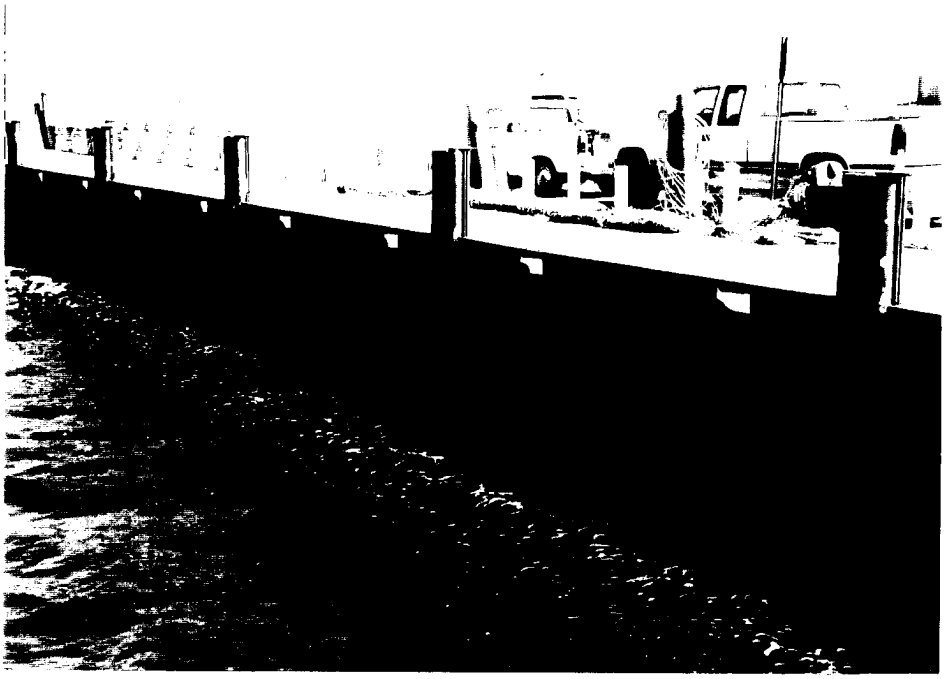
View of Oaks Bluffs' Harbor Entrance.

View of South Jetty

Photographs
Oak Bluffs Harbor
Oak Bluffs, Massachusetts
Figure 2



View of steel sheet pile bulkhead along south side of the harbor.



View of steel and timber sheet pile bulkhead along east side of the harbor.

Photographs
Oak Bluffs Harbor
Oak Bluffs, Massachusetts
Figure 3

Local officials predict that within three to five years the north jetty could have deteriorated enough to begin hampering access to the harbor also. Both jetties are in disrepair. Some of the rocks of the north jetty have already fallen out of place. According to the harbormaster, sand drifts through holes and gaps in both jetties and fills in the channel. Neither the town nor the state currently have plans to repair the jetties.

Although the shoaling problem is causing only some minor problems now, town officials are extremely concerned about it. If the channel shoals in to a depth which prevents the passenger ferries from using the harbor, town officials fear that the town would suffer severe economic losses due to lost tourist business.

The northeast winds and waves cause significant problems in the harbor. Northeast is the only direction from which the harbor is not protected and storm waves from the northeast are able to propagate directly into the harbor. Boats docked in the innermost section of the harbor collide against the steel bulkhead, thereby incurring damages. In severe storms, moored boats break free and collide with other vessels or the various bulkheads, causing severe damages. Vessels have also sunk or been so damaged that they are completely lost. There have been no significant damages from northeast storms to the commercial fishing boats or the ferries since they berth at the front section of the harbor which is more protected.

Northeast storms cause other damages in the harbor as well. Shorefront property along the western shore of the harbor is often damaged in bad storms, damages which include lost topsoil, lost grass work, and other ground damage. There are 10 private homes located along the west harbor shore which are affected. The town also reports increased maintenance costs to the bulkhead due to northeast storms. The stretch of wooden bulkhead is especially vulnerable to damage. Recently the town has been having serious problems with strong waves undermining the wooden bulkhead and causing dangerous sinkholes next to the boardwalk. Last year the town spent $20,000 to repair the wooden bulkhead. The town plans to replace the wooden bulkhead section with a steel bulkhead. The town also reports increased repair costs to harborside utilities due to northeast storms. Storm damages include damages to boats, sidewalks, floats, ramps, and utilities.

Without Project Condition

Without a federal project the channel will continue to shoal in and there will continue to be damages in the harbor from northeast storms. As the channel shoals in further, it is projected that eventually the ferries will no longer be able to use the harbor, commercial fishing vessels will experience grounding damages, and the deeper draft recreational vessels will be prevented from using the harbor. Without a project, the northeast winds and waves will continue to cause the current level of damages to boats, shore property, harborside utilities, and the bulkhead. A detailed description of the "Without Project Conditions" is provided in Appendix A -Economic Analysis, on page 4.

Plans Developed to Address Identified Problems

Information gathered during the study was used to formulate improvement plans that would adequately address the problems at Oak Bluffs Harbor. The plans considered were:

(1) an extension of the north jetty,
(2) establishing a Federal navigation entrance channel.

Plan 1 consists of extending the existing north jetty to deflect storm waves and provide more suitable protection for the harbor during storms. This would include adding a 220-foot long dogleg extension to the existing north jetty. The jetty alignment would be on a bearing 57 degrees southeast, normal to the direction of prevailing storms. The extension would have a crest elevation of 9.0 feet above MLW and a width of 12.0 feet; a base elevation varying from -7.5 feet MLW to -12.6 feet MLW; an armor stone layer 8.2 feet thick on the sea side of the jetty; a 1.5 foot thick bedding layer under the full length of the structure; and side slopes of 2 horizontal to 1 vertical (see Figure 4). This plan may also require some work to rebuild portions of the existing jetties. The non-Federal cost of this effort was not calculated at this stage of study.

Plan 2 consists of establishing a Federal entrance channel to the harbor. This plan would restore the 1951 channel to its original dimensions of -10 feet MLW, 500 feet in length and 80 feet wide. Based on boat statistics provided by the harbormaster and engineering regulations, a 10-foot deep channel provides sufficient underkeel clearance for the vessels using the harbor. The channel will have side slopes of 3 horizontal on 1 vertical. A plan and cross section of the channel layout can be seen in Figure 4.

Construction Cost Estimates

The cost of modifying the jetty is based on recent construction estimates for a similar structure. In this case the added costs of barging all the equipment and materials to the island have been included. The estimated time of construction is 8 months.

The channel dredging estimate is based on using a 10" hydraulic pipeline dredge operating 24 hours per day, 7 days per week. Dredged material will be pumped approximately 1000 feet and used as beach nourishment material. The estimated time of construction is 1 month.

A summary of the construction cost estimates can be found in tables 1 and 2. A 25% contingency factor has been included to account for varying soil conditions; potential impacts due to weather; variations in quantities used, rehandled, or removed; and potential site access difficulties. The estimates are based on a September 1990 hydrographic survey.

MAINTENANCE COSTS

Upon completion of the jetty periodic maintenance would be required to

CORPS OF ENGINEERS

A B C D

E183500 E184000

N168500 N168000 N167500

1 2 3 4 5 6 7 8

GENERAL NOTES

Soundings and elevations are in feet and tenths and are relative to the N.G.V.D. datum of 1929.

Topography from survey of September 1990.

B.M. #1 (1928) is set in drill hole on top of outcropping rock in Ocean View Park, near south curb of Ameskeag Avenue, between Ocean and Sea View Avenues, 112 feet (34.1m) from Sea View Avenue, 40 feet (12.2m) from Ocean Avenue and 3 feet (0.9m) from curb of Lake Avenue.

Elevation is 15.26 feet above M.L.W.

Coordinates are based on the Lambert Grid System for the Commonwealth of Mass., mainland zone and N.A.D. 1927.

"The sounding information depicted on this map is from hydrographic surveys conducted during Sept. 1990. This information should NOT be used for navigation purposes.

"The information depicted on this map represents the results of surveys made on the dates indicated, and can only be considered as indicating the general conditions existing at that time."

Fieldbook: R B H 4009.

Depthsounder Roll: 90-158

Survey by: A. Hey

REWORK EXI
230' APPRO
VARIES-EX

Flood
Ebb

OAK BLUFFS HARBOR

OAK BLUFFS HBR. MARTHA.S VINEYARD MA

OAK

MAKEPEACE P-6164

B C D E F G

RAL NOTES

undings and elevations are in feet and tenths and are to the N.G.V.D. datum of 1929.
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M. #1(1928) is set in drill hole on top of outcropping rock View Park, near south curb of Ameskeag Avenue, between d Sea View Avenues, 112 feet (34.1m) from Sea View Avenue, 12.2m) from Ocean Avenue and 3 feet (0.9m) from curb of nue.
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REWORK EXISTING JETTY
230' APPROX. CREST ELEV. VARIES-EXISTING TO 9.0' M.L.W.
EXTEND JETTY
100' APPROX.
CREST ELEV. 9.0' M.L.W.

JETTY DOGLEG S 57° E
220' LONG CREST ELEV. 9.0' M.L.W.

NORTH JETTY

UNDERLAYER STONE

ARMOR STONE

DREDGING LIMITS

SOUTH JETTY

Flood
Ebb

VT.
MASSAC
HARTFORD
CONN

HARBOR

N 167500

SAFE
PAYS

GRAPHIC SCALES
25 0 25 50 75 MI.
1" = 37.5 MI.
50' 0 50' 100
1" = 50'

BOX

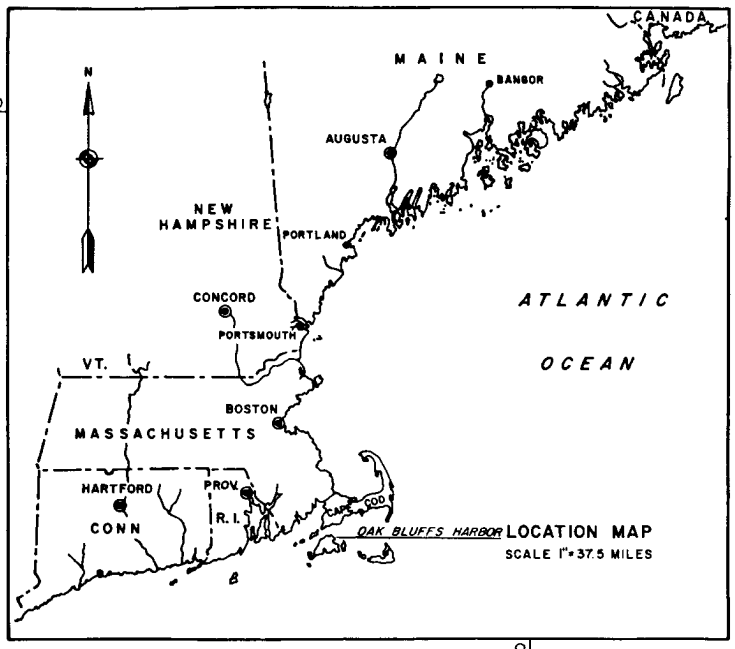
OAK BLUFFS

E184000 E184500

F G H U. S. ARMY

E184500

N 168500



E185000

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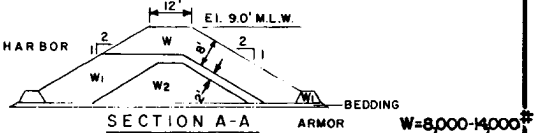
JETTY DOGLEG S 57°E
220' LONG CREST ELEV 9.0 M.L.W.

UNDERLAYER STONE

ARMOR STONE



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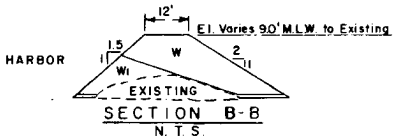
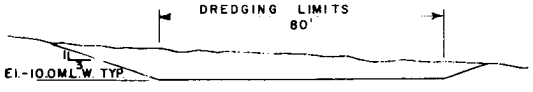
CORE W2=80-350#





E185000

N 167500

SAFETY PAYS

GRAPHIC SCALES

1"=37.5 MI. 25 0 25 50 75 MI.

1"=50' 50' 0 50' 100'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY E. J. K.	DR. BY E. J. K.	CK. BY

SUBMITTED: PROJECT MANAGER

REVIEWED: CHIEF, COAST. ENG/SUR BR

APPROVAL RECOMMENDED: CHIEF, DESIGN DIVISION

OAK BLUFFS HARBOR
MARTHAS VINEYARD, MASS.
CONDITION SURVEY

APPROVED DIRECTOR OF ENGINEERING

DATE JUNE 1991

RECONNAISSANCE STUDY
SECTION 107
NAVIGATION

SCALE: 1"=50' SPEC. NO. DACW 33

FIGURE 4

E184500

SEE NOAA CHART 13238

TABLE 1
OAK BLUFFS HARBOR
OAK BLUFFS, MASSACHUSETTS

CONSTRUCTION COST ESTIMATE
PLAN 1 - JETTY EXTENSION

*Jetty:					
Armor Stone	4,800	ton	@	$82.00	$394,000
Unerlayer	2,600	ton	@	$58.00	151,000
Core	4,400	ton	@	$33.00	145,000
Rehandling	270	ton	@	$90.00	24,000
Bedding	1,300	cy	@	$77.00	100,000
Contingencies					204,000
Planning, Engineering, and Design					90,000
Construction Management					95,000
TOTAL INITIAL CONSTRUCTION COST					$1,203,000
Interest During Construction					32,000
TOTAL INVESTMENT COST					$1,235,000

* The unit costs shown includes mobilization, demobilization, contractor's overhead, bond cost, and profit. Estimated time of construction is 8 months. Costs were based on January 1991 price levels.

TABLE 2
OAK BLUFFS HARBOR
OAK BLUFFS, MASSACHUSETTS

CONSTRUCTION COST ESTIMATE
PLAN 2 - NAVIGATION CHANNEL DREDGING

* Dredging Ordinary Material	2,400 cy at $16.00/cy	$38,000
Contingencies		10,000
Planning, Engineering, and Design		20,000
Construction Management		10,000
TOTAL INITIAL CONSTRUCTION COST		$78,000
Interest During Construction		0
TOTAL INVESTMENT COST		$78,000

* The unit cost shown includes mobilization, demobilization, contractor's overhead, bond cost, and profit. Estimated time of construction is 1.0 month. Costs were based on January 1991 price levels.

replace stone that becomes dislodged from heavy wave activity. A typical average annual maintenance figure of $5,000 has been included in the annual costs of the plan and can be seen in Table 3.

Following initial dredging, the channel will shoal or fill in due to littoral drift and settlement of material from side slopes. The channel has historically needed dredging conducted every twelve to fifteen years. For purposes of this study it was estimated that every twelve years the channel will require maintenance dredging. The cost for each dredging effort during the 50 year economic life of the project was converted to an annualized figure. The annual costs for maintaining this alternative plan is shown in Table 4.

BENEFIT COST ANALYSIS

By providing one or both of the two navigation projects, recreational and commercial vessels and various shoreside facilities will attain certain economic benfits.

The construction of an extension on the existing north jetty will provide added protection against wave and swell attack caused by northeast storms. This will result in prevention of damages to harborside property and utilities and recreational vessels. The small commercial fleet ties up to the eastern side of the bulkhead and does not experience the wave damages experienced by vessels which moor at the back of the harbor. An average damage benefit was calculated for the recreational fleet. Without dredging of the entrance channel some of the larger recreational boats will not be able to access the newly protected harbor. As a result of the port's popularity, it is expected that the additional mooring spots will be filled by shallower draft vessels and a reduction of this average benefit need not be made.

Establishing a Federal navigation channel into the harbor will require the removal of existing shoaling and maintaining the channel to the appropriate project depth in the future. Benefits resulting from this project would include preventing grounding damages to the commercial vessels and increasing the value of the recreational experience for pleasure boat users and ferry boat passengers. Increased recreational value involves determining the change in recreational value per user between the with and without project condition.

A more detailed explanation of the benefits can be found in the attached Economic Analysis and is summarized as follows:

	Annual Benefits
Plan 1 - Jetty Extension	
Commercial/Public Benefits	$45,000
Recreational Benefits	75,000
TOTAL	$120,000

TABLE 3

PLAN 1 - JETTY EXTENSION
ANNUAL COSTS

Interest and Amortization of Total Investment Cost @ 8 3/4% - 50 yrs	$110,000
Maintenance	5,000
TOTAL ANNUAL COST	$115,000

TABLE 4

PLAN 2 - NAVIGATION CHANNEL DREDGING
ANNUAL COSTS

Interest and Amortization of Total Investment Cost @ 8 3/4% - 50 yrs	$7,000
Maintenance Dredging	4,000
TOTAL ANNUAL COST	$11,000

Plan 2 - Navigation Channel	
Commercial Benefits	$ 3,000
Recreational Benefits	139,000
TOTAL	$142,000

Based on the full recreational benefit the following benefit/cost analysis can be calculated:

	Annual Benefits	Annual Costs	Benefit/Cost Ratio	Net Annual Benefits
Plan 1 (Jetty Extension)	$120,000	$115,000	1.04	$5,000
Plan 2 (Navigation Channel)	$142,000	$ 11,000	12.9	$131,000

In order for a proposed plan to be economically justified, it must have a benefit/cost ratio equal to 1.0 or greater. Currently, in considering funding for project implementation, commercial navigation benefits are favored as a priority output while recreation navigation benefits are not. Corps of Engineer Regulations state that for those projects that include both commercial and recreational benefits, project justification must be demonstrated on the basis of recreation benefits limited to 50 percent of the total project benefits. The following benefit/cost analysis is based on the maximum allowable recreational benefits:

	Annual Benefits	Annual Costs	Benefit/Cost Ratio	Net Annual Benefits
Plan 1 (Jetty Extension)	$90,000	$115,000	0.8	0
Plan 2 (Navigation Channel)	$ 6,000	$ 11,000	0.6	0

CONCLUSIONS

The navigation problems at Oak Bluffs Harbor, Oak Bluffs, Massachusetts have been studied and plans to alleviate these concerns have been formulated. Several meetings with officials and other local interests have been held. Based upon reconnaissance level engineering and economic study and review of the problems, two possible solutions were developed. Both plans have average annual benefits that exceed their average annual cost. In fact it should be noted that the benefits for Plan 2 far exceed its costs. However, as can be seen, a majority of the benefits to be garnered from these alternative projects are recreational in nature. Given the Federal priority for commercial navigation benefits, these projects are not favored for Federal assistance.

RECOMMENDATION

The Division Engineer recommends that no further study of navigation improvements in Oak Bluffs Harbor be conducted at this time.

ACKNOWLEDGEMENT AND IDENTIFICATION OF PERSONNEL

This report was prepared under the supervision and management of the following New England Division personnel:

Colonel Philip R. Harris, Division Engineer
Joseph L. Ignazio, Director of Planning
Paul E. Pronovost, Chief, Plan Formulation Division
John T. Smith, Chief, Coastal Development Branch

The study and report were developed by Christopher L. Hatfield and John Kedzierski, Study Managers. Project team members are: Karen Fredrickson, Economist; Catherine Demos, Environmentalist; Kate Atwood, Archaeologist; Al Lemire, Coastal Engineer; Anthony Firicano, Geotechnical Engineering; and Chris Lindsay, Cost Engineering.

APPENDIX A

ECONOMIC ANALYSIS

Oak Bluffs Harbor
Section 107 Reconnaissance Study
Oak Bluffs, MA
Economic Analysis

Introduction

The purpose of this analysis is to identify and evaluate the economic impacts of constructing a federal channel and breakwater in Oak Bluffs Harbor, Oak Bluffs, Massachusetts. The town of Oak Bluffs is located in Dukes County on Martha's Vineyard, an island located south of Cape Cod. The town of Oak Bluffs is located on the northeast side of the island.

This analysis was performed at the reconnaissance level of detail. All benefits and costs are stated in September, 1990 prices, and are converted to present value equivalents based on a 50 year project life and the fiscal year 1991 federal interest rate for water resources projects of 8 3/4 percent.

Economic Setting

Martha's Vineyard is a summer resort island off the southern coast of Massachusetts. The island is characterized by a relatively small number of year round residents, a larger number of summer residents, and hundreds of thousands of day visitors and vacationers. Oak Bluffs has a year-round population of approximately 2,900, and grows to approximately 27,500 in the summer. The town has many attractions, including a large, picturesque harbor and boardwalk, fine restaurants and shops, beaches, bicycle paths, and other recreational opportunities.

The economy of Oak Bluffs is based primarily on tourism, with the wholesale and retail trade sector and the service sector providing the largest portion of employment in the town, especially in the summer months. Year-round employment is in the services and trades, government, construction, and a smaller amount of employment in manufacturing, agriculture, and fishing.

Study Area

The study area consists of Oak Bluffs Harbor. The study area contains 300 moorings, 100 recreational boat slips, and berthing facilities for commercial fishing vessels and passenger ferries. A large portion of the harbor is lined by a new steel bulkhead, with one portion lined by an older wood bulkhead. Two stone jetties are located at the entrance to the harbor, and a large wooden pier is located outside of the Harbor. The pier is used in good weather by the Martha's Vineyard Steamship Authority and occasionally by large cruise ships.

Vessels in the Study Area

On peak summer weekends, Oak Bluffs Harbor contains approximately 400 recreational vessels which are located at the 400 moorings and boat slips in the harbor. The recreational fleet consists of sail and power boats, with the largest boats 85 feet to 90 feet long with drafts of 5 to 6 feet. The harbor

contains nine commercial fishing vessels which berth along the bulkhead at the entrance to the harbor on the eastern side. The nine vessel fleet includes two draggers, one combination lobster boat-trawler, and six lobster boats. The following table, Table 1, shows the current breakdown of the Oak Bluffs commercial fishing fleet by type of vessel, length and draft.

Table 1
Oak Bluffs Commercial Fishing Fleet

Type	length	draft
Dragger	63′	8′
Dragger	63′	8′
Combination	43′	5′
Lobster boat	40′	5′
Lobster boat	30′	4′
Lobster boat	30′	4′
Lobster boat	32′	3′
Lobster boat	25′	3′
Lobster boat	25′	3′

Source: Oak Bluffs Harbormaster

Three passenger ferry companies run ferries into Oak Bluffs Harbor, bringing a total of nearly 200,000 passengers a year from Falmouth, MA, Hyannis, MA, and Montauk, NY. The companies have five ferries which make trips into the harbor, with lengths of 50′, 101′, 108′, 110′, 121′, and 134′, and drafts of 7′, 7′, 6′, 6′, and 7′, respectively.

The harbor is very active in the summer months. A sample taken by the harbormaster of vessel traffic in the channel on September 1, 1990, showed 84 vessels entering the harbor in one hour. The heavy traffic includes recreational boats entering the harbor to stay overnight at moorings, transient recreational boats entering to visit the island for the day, fishing vessels, and passenger ferries. In the peak season, the passenger ferries make over ten trips to the harbor per day.

Fishing Industry

The fishermen based in Oak Bluffs fish primarily lobster, codfish, flounder, fluke, scup, and other shellfish. They offload their catch at the commercial dock in the harbor and sell to wholesalers located on the island. The fishing industry is important to the town as it is a year-round industry which provides income and employment to the town independent of the tourist industry.

Existing Conditions

There are two primary problems in the study area: 1) shoaling in the entrance channel to the harbor; and 2) lack of protection from northeast storms. The entrance channel was dredged by the state twelve years ago, but has not been dredged since. The northern jetty is in disrepair, with some of

the rocks fallen in. According to the harbormaster, sand drifts through holes and gaps in the jetty and fills in the channel. The state does not have plans to dredge the channel again; the channel is not part of any regular state maintenance plan. Repairs to the jetties would be very expensive, and neither the town nor the state currently have plans to repair them.

The shoaling problem is causing some minor problems now, including congestion in the channel due to restricted passageway and three incidents in which the ferries have bumped the bottom of the channel. The owners of the passenger ferries are aware of the shoaling problem but do not view it as an immediate threat to their business. According to the harbormaster, the commercial fishermen are not currently experiencing any problems with depth in the channel. However, town officials are extremely concerned about the shoaling problem. If the channel shoals in to a depth which prevents the passenger ferries from using the harbor, town officials fear that the town would suffer severe economic losses due to lost tourist business.

The northeast winds and waves cause significant problems in the harbor. Northeast is the only direction from which the harbor is not protected. Northeast waves run directly into and across the harbor. Boats docked in the innermost section of the harbor bang against the steel bulkhead, incurring damages. In severe storms, boats at moorings break free of their mooring and collide with other boats or collide into the bulkhead, causing severe damages. In severe storms, boats have sunk or been so damaged that they are completely lost. The harbormaster reports damages to recreational vessels from northeast storms of $50,000 to $100,000 per year. There are no significant damages from northeast storms to the commercial fishing boats or the ferries since they berth at the front section of the harbor which is more protected.

Northeast storms cause other damages in the harbor as well. Shorefront property along the western shore of the harbor is often damaged in bad storms, damages which include lost topsoil, lost grass work, and other grounds damage. There are 10 private homes located along the west harbor shore which are affected. Town officials estimate this damage at approximately $10,000 per year, although the actual yearly figure varies depending on the strength and frequency of northeast storms. The town also reports increased maintenance costs to the bulkhead due to northeast storms. The stretch of wooden bulkhead is especially vulnerable to damage. Recently the town has been having serious problems with strong waves undermining the wooden bulkhead and causing dangerous sinkholes next to the boardwalk. Last year the town spent $20,000 to repair the wooden bulkhead. The town plans to replace the wooden bulkhead section with a steel bulkhead, although the exact time this will be funded is not known. The town also reports increased repair costs to harborside utilities due to northeast storms. Town officials estimated these costs as costing approximately $15,000 per year. As further evidence of recurring damages to the harbor from northeast storms, in 1979 the town reported total damages to the harbor from northeast storms of $153,000. These damages included damages to boats, sidewalks, floats, ramps, and utilities.

Without Project Conditions

Without a federal project, it is likely that, in the future, the channel will continue to shoal in and there will continue to be damages in the harbor from northeast storms. As the channel shoals in further, it is projected that eventually the ferries will no longer be able to use the harbor, commercial

fishing vessels will experience grounding damages, and the deeper draft recreational vessels will be prevented from using the harbor. Without a project, the northeast winds and waves will continue to cause the current level of damages to boats, shore property, harborside utilities, and the bulkhead.

The projections that follow were made for the purpose of this analysis only. It is necessary to make specific projections to quantify the economic effects the shoaling problem will have on harbor users. The following projections were made based on the best available information from town officials, and based on data collected from Corps studies in similar harbors.

Without a federal project to protect the harbor from northeast storms, it is projected that the following damages will occur: 1) damages to recreational boats of $75,000 per year; 2) grounds damages to shorefront property averaging $10,000 per year; 3) damages to harborside utilities averaging $15,000 per year; and 4) damages to the bulkhead and eventual replacement of the bulkhead, estimated as averaging $20,000 per year. This yields total annual storm damages to the harbor of $120,000. Further information and documentation of the damage figures would be required at the detailed project study phase.

Without a federal project establishing a federal channel, the channel will continue to shoal in, causing increasing problems for harbor users. As the shoaling continues, the channel will be of insufficient depth to allow safe, regular access to the harbor by the passenger ferries. When the ferries can no longer use the harbor, the ferry companies will either make arrangements to use facilities in other harbors on the island, or be forced out of business. According to the harbormaster, the ferry companies would not be able to use the large pier outside the harbor for two reasons. First, the pier is completely unprotected from waves, virtually unusable in bad weather, and the ferries cannot have their schedules subject to weather conditions. Second, the pier is owned by the main competitor to the ferry companies, the Martha's Vineyard Steamship Authority, and that company would not likely rent its pier to its competitors. It is not projected that the ferries will experience an extended time of problems such as tidal delays and groundings before they relocate to another harbor, since the ferries are commercial business which must keep reliable, regular schedules and are regulated by the Coast Guard for safety.

As the channel shoals in, the larger commercial fishing vessels will likely begin to experience grounding damages, increasing their operating costs by increasing their repair expenses. Based on data on grounding damages obtained from fishermen in similar Corps studies, a single grounding incident is likely to cost a fisherman approximately $500. It is projected that, when the shoals becomes a problem, the two 8' draft fishing boats will experience three grounding incidents a year, for a cost of $1,500 per boat, $3,000 for both boats. It is also projected that the two 5' fishing boats will experience one grounding incident per year, for a cost of $500 per boat, $1,000 for both boats. This is a total cost for grounding damages of $4,000 per year. The remaining commercial fishing vessels with shallower drafts will not be significantly affected by the shoaling.

Recreational users of the harbor will also be adversely affected as the shoaling continues. When the depth in the channel is insufficient for deep draft recreational vessels such as large sail boats, these boat users will be forced to moor in other harbors. The harbormaster reports that very large recreational vessels, vessels over 90', already do not use the harbor because

of the depth problems. The users of the boats which are displaced in the future will suffer a lower quality recreational experience since the users would have preferred to moor at Oak Bluffs. Similarly, when the channel is not deep enough for the ferries, the ferry passengers will be forced to access the island via other harbors, most likely via Vineyard Haven Harbor. The displaced passengers will suffer a lower quality recreational experience since they would have preferred to enter into Oak Bluffs.

For the purpose of determining the economic impacts of the shoaling problem in this analysis, it is estimated that the navigation problems outlined above will occur within five years.

With Project Conditions

The with project condition is the construction of a channel into the harbor to ensure continued safe access into the harbor in the future, and the construction of a breakwater extending at an angle from the northern jetty to protect the harbor from northeast storms. The local sponsor would be responsible for repairs to the existing jetty. With the construction of the breakwater, the damages from northeast storms to the harbor and harborside property and utilities would be prevented. With the construction of the channel, the harbor would remain fully usable by the passenger ferries and the larger recreational vessels, and future damages to commercial fishing vessels would be prevented.

Calculation of Benefits

Commercial and public benefits to the project are calculated based on information provided by town officials. Recreational benefits are calculated using the Unit Day Value method to estimate the value of the improved recreational activity with the project. To estimate the dollar value of the increase in the value of the recreational activity, the Unit Day Value method was used. This method attempts to estimate the change in the value of the recreational activity per user between the without and with project conditions.

Benefits to the Breakwater

Benefits to the breakwater equal the damages from northeast storms which are projected to occur under the without project conditions but which would be prevented with the project. The following damages prevented are annual benefits to the breakwater:

1. Damages Prevented to Recreational Vessels: $75,000/yr
2. Damages Prevented to Shorefront Property: $10,000/yr
3. Damages Prevented to Harborside Utilities: $15,000/yr
4. Damages Prevented to the Bulkhead: $20,000/yr

TOTAL ANNUAL BENEFITS TO THE BREAKWATER = $120,000

Benefits to the Channel

Benefits to the channel equal the value of the estimated future grounding damages to commercial vessels which would be prevented with the project, as outlined in the without project conditions, and the increase in the value of the recreational experience for recreational boat users and ferry passengers with the project. The increase in the value of the recreational experience for the recreational boat users and the ferry passengers is estimated using the Unit Day Value method. In using the Unit Day Value method, points are assigned for five characteristics of a recreation activity - recreational experience, availability of opportunity, carrying capacity, accessibility, and environmental quality. Points are assigned for both the without and with project condition, shown below in Table 2. The lower value of the characteristic "Recreational Experience" without the project, reflects the condition that, without the project, some recreational boaters are not able to use their first choice harbor. The lower value of the characteristic "Carrying Capacity" without the project reflects the increased congestion which would occur in the alternative harbor without the project due to the transfer of ferry and recreational traffic from Oak Bluffs. The higher value of the "Environmental Quality" characteristic with the project reflects the esthetic appeal and pleasant character of Oak Bluffs Harbor.

Table 2
Assignment of Unit Day Values

Criteria	Without Project	With Project
Recreation Experience	11	25
Availability of Opportunity	10	10
Carrying Capacity	8	11
Accessibility	11	11
Environmental Quality	7	15
TOTAL	47	72
$ VALUE	$4.36	$5.38

The increase in the unit day value per recreational user between the without and with project conditions is $1.02 ($5.38 - $4.36). This increase applies to both the ferry passengers and the users of the larger recreational boats, since both would be displaced to another harbor without the project.

1. Prevention of Grounding Damages to Fishing Vessels:

$ 500/boat/year X 2 5′ draft boats = $1,000/yr
$1500/boat/year X 2 8′ draft boats = $3,000/yr
TOTAL = $4,000/yr

$4,000/yr years 5 - 50
Present Worth of the series = $29,364
Annual Benefit = $ 2,610

2. Recreational Benefits to Ferry Passengers:

Annual recreational benefits to ferry passengers are calculated based on the approximately 200,000 ferry passengers which visit Oak Bluffs per year. The increase in unit day value (UDV) per user of $1.02 is used.

200,000 users/year X $1.02 UDV	=	$204,000/yr
$204,000/yr years 5 - 50		
Present Worth of the series	=	$1,497,582
Annual Benefit	=	$133,045

3. Recreational Benefits to Recreational Boaters

Annual benefits to recreational boaters are based on the following information. The harbormaster provided information showing an average of approximately 290 recreational vessels in the harbor on peak summer weekends, and approximately 200 vessels on other days during the summer season. Assuming a 14 week season from Memorial Day to Labor Day, an 8 weekend peak season between July and August, and 25% inclement weather, it is estimated that the total number of recreational vessels which visit Oak Bluffs in a season is approximately 14,000. Of these 14,000, it is estimated that 20%, or 3000, are larger vessels with deep drafts which would eventually not be able to use the harbor if the shoaling continued. Based on an average number of 3 users per boat, 3000 boats displaced per season equals 9000 users displaced per season. Benefits are calculated based on 9000 users displaced per year and the increase in unit day value (UDV) with the project of $1.02.

9,000 users/year X $1.02 UDV	=	$ 9,180/yr
$9,180/yr years 5 - 50		
Present Worth of the series	=	$67,391
Annual Benefit	=	$ 5,987

TOTAL ANNUAL BENEFITS TO THE CHANNEL	=	$141,642

Other Benefit Categories

Several other benefit categories were examined for possible benefits to the project, but is was determined that none of these benefits were allowed under current Corps regulations. The primary concern of the town of Oak Bluffs is that, when the channel shoals in further and the passenger ferries are not able to use the harbor, businesses in the town will suffer a significant drop in revenue from tourists and visitors, hurting the town's economy. Although it is true that the town would be hurt economically, the Corps cannot count these benefits toward the project since these are secondary benefits. Corps regulations permit only primary user benefits to the project to be included in the cost-benefit analysis.

Another benefit category examined was benefits to the operation of the commercial ferries. Possible benefits examined included the prevention of increased operating costs if the ferries are forced to move their operations to another harbor on the island, and benefits if the ferries are not able to move to another harbor and are forced out of business. The most likely harbor for the ferries to relocate to would be Vineyard Haven. Several large ferries already operate in Vineyard Haven. It is not known if the ferries actually could move their operations there, since the ferries do not own dock facilities there and since that harbor already has a very large amount of vessel traffic. Whether they could go to Vineyard Haven or not, it was determined that there are no allowable benefits. If the ferries could relocate, Vineyard Haven is close to Oak Bluffs Harbor and the move would not result in significantly increased operating costs. If the ferries were not able to relocate and instead were forced out of business, ferry passengers would most likely travel to the island using the other ferries which go into Vineyard Haven. Those companies would experience an increase in their business. This would be a transfer of business income from one set of companies to another and would not be a net change in the national economy. Corps regulations prohibit taking transfers in income from one region to another, or from one company to another, as benefits to a federal project.

Benefit Summary

The table below, Table 3, shows the benefit summary for the project. Annual benefits are shown, broken into the categories commercial/public benefits and recreational benefits.

Table 3
Benefit Summary

	Annual Benefits
Breakwater	
1. Commercial/Public Benefits	$ 45,000
2. Recreational Benefits	$ 75,000
TOTAL	$120,000
Channel	
1. Commercial/Public Benefits	$ 2,610
2. Recreational Benefits	$139,032
TOTAL	$141,642

APPENDIX B

PERTINENT CORRESPONDENCE

October 19, 1990

Joseph L. Ignazio
Director of Planning
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Ma. 02254-9149

RE: Proposed Federal Navigation Improvement Project, Oak Bluffs Harbor, Martha's Vineyard

Dear Mr Ignazio:

Thank you for your inquiry, received September 20, 1990, requesting information on historic and archaeological properties relevant to the project referenced above.

The wreck of the schooner "Island City", which sank during the 1898 hurricane, appears to be in the vicinty of the proposed project area. (Source: "Unfinished Voyages" (1989) by John Perry Fish).

Review of MHC files indicates that the area outside the harbor may contain additional unidentified wrecks. Since the area has not been systematically examined by archaeologists, it is possible that unreported archaeological resources may actually be present. The MHC requests the opportunity to review a more detailed description of the proposal and project plans in order to evaluate whether the project is likely to affect previously unreported archaeological properties.

This initial consultation to identify resources in the project area has been undertaken in accordance with 36 CFR 800, the Advisory Council Regulations for the Protection of Cultural Resources.

If you have any additional questions, please feel free to contact Connie Crosby of this office.

Sincerely,

Brona Simon
State Archaeologist
Deputy State Historic Preservation Officer
Massachusetts Historical Commission

BS/CC

xc: Victor Mastone, BUAR

Town of Oak Bluffs, Massachusetts
Selectmen
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JESSE B. LAW III
Chairman
ROGER W. WEY
GEORGE G. MARTIN

July 13, 1989

Daniel M. Wilson
Colonel, Division Engineer
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Colonel Wilson,

This letter is to seek the assistance of the U.S. Army Corps of Engineers under Section 107 of the 1960 River and Harbor Act, as amended, in implementing navigation improvements in Oak Bluffs Harbor on the island of Martha's Vineyard.

The harbor is extensively used for pleasure craft, commercial fishing boats and ferries. The channel entrance to the harbor has shoaled in to a depth of 6', due to deterioration of the entrance breakwater. In previous years, larger commercial fishing boats of 60' length and 9' to 12' draft were able to use the harbor for commerce and storm refuge, as well as larger pleasure craft. Our harbor is considered by many to be the best hurricane refuge on the island. The Town's economy benefits by the commerce generated by visiting boaters. We also utilize the Harbor for basic transportation, as we are located on an island. For navigational reasons, dredging of the channel and rebuilding of the north jetty are considered imperative. Environmentally, we could speculate on the benefits from increased circulation. We are sure that there will be no negative environmental impacts.

We consider that our needs are for dredging of the entrance channel and rebuilding of the north jetty. You should have plans on file for the jetty project. We would like your assistance in determination of dredging yardage and methods.

Thank you for your anticipated cooperation.

Sincerely,
Board of Selectmen

Jesse B. Law III

Roger W. Wey

George G. Martin

RGS/jb