NANTUCKET AND MADAKET HARBORS ACTION PLAN

Prepared by the Nantucket Harbor Planning and Advisory Committee
And
The University of Rhode Island Coastal Resources Center
For the Town of Nantucket, Massachusetts

June 1993

ACKNOWLEDGMENTS

Funding for this project was provided by the Town of Nantucket, Massachusetts Coastal Zone Management Program, Executive Office of Environmental Affairs, the Nantucket Land Council, and Rhode Island Sea Grant.

The people of Nantucket care intensely about the quality of their island and its harbors. As a consequence, the community was involved throughout the entire process of the development of the Nantucket Harbors Action Plan. We would therefore like to thank the numerous community members who attended evening meetings and public hearings held through the development of the Plan.

Nantucket Harbor Planning Advisory Committee

Walter Barrett, Chairman

Geoff Bartlett
George Bassett
Steven Bender
Francine Bovers
Alan Brown
Prentice Claflin
Robert Cole
Diane Coombs
Cheryl Creighton
Raymond DeCosta
Dave Fronzuto
Robert Garrison
Joe Grochowski
Jim Gross
James Hayes
Allen Holdgate
Roger Jette
Ken Kelley
Sanford Kendall
Virginia Kinney
William Klein
Donald LaHaye
James Lengyel
Joe Lopes
John Manning
Tony Marks
Ben McKelway
Jessica MacVicar
Tracey Mayhew
Dennis Metcalfe
Tom Pochman
Richard Ray
George Rezendes
Edward Sanford
Steve Scannel
Ron Shepherd
John Stackpole
Dave Sweeney
Christopher Vander Wolk
Henry Wasierski
Lynn Zimmerman

Our special thanks extend to Pam Rubinoff and Laurel Rafferty of Coastal Zone Management for their mutual patience and assistance through the planning process.

We would like to acknowledge the contribution of URI Coastal Resources Center consultants, Pamela Pogue, Thomas Brillat, and Virginia Lee. In addition thanks to Dan Martin who, with Rhode Island Sea Grant funding, developed the GIS maps of the harbors. A special note of thanks is due to Jean Krul and Annette Burgess for their care and skill in producing the final document.

DEDICATION

The Harbor Planning Advisory Committee dedicates Nantucket's first Harbors Action Plan to Walter S. Barrett, our Chairman for five years, whose steadfastness and mariner's knowledge inspired the completion of this Plan.

TABLE OF CONTENTS

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY 1
HARBOR VISION STATEMENT 2

CHAPTER 1: OVERVIEW

A. Definition and Purpose of Harbors Action Plan 3
B. Planning Process 3
1. The Harbor Planning Advisory Committee 3
2. Community Participation Program 5
C. Managing Growth and Use Conflicts 6
1. Issues 6
2. Planning Needs 7

CHAPTER 2: INVENTORY AND ANALYSIS OF HARBOR RESOURCES AND USES

A. Historic Background 8
B. Physical Setting 9
1. Geography 9
2. Harbor Boundaries 9
3. Bathymetry 10
4. Dredging 10
5. Tides and Currents 12
6. Flood Zones 12
C. Natural Resources 14
1. Biological Habitats 14
2. Wildlife 19
3. Fish and Shellfish 19
D. Water Quality 24
1. Pathogen Contamination 24
2. Nutrients and Eutrophication 31
3. Toxic Contaminants 36
4. Jurisdictional Authority 37
E. Harbor Facilities and Uses 38
1. Recreational Boating (Docks, Slips, Moorings) 38
2. Shoreline Access and Recreational Areas 45
3. Waterfront Land Use and Zoning 47
4. Commercial Boat Traffic 49
5. Commercial Fishing Fleet 55
6. Recreational Uses 56

CHAPTER 3: ISSUES, GOALS, OBJECTIVES, POLICIES AND ACTION

A. Water Quality Protection 58
B. Natural Resource Protection 62
C. Commercial and Recreational Fishing 65
D. Harbor Safety, Navigation and Moorings 66
E. Public Access 69
F. Tourism and Recreation 71
G. Downtown Waterfront District 72

CHAPTER 4: IMPLEMENTATION

A. Local Administration of the Harbors Action Plan 74
1. Role of the Marine Department 75
2. Role of the Conservation Commission 75
3. Role of the NP&EDC 75
4. Role of the Planning Board 76
5. Role of the Board of Health 76
B. Harbor Planning and Implementation Oversight 76
1. Establishment of a Harbor Planning Adv. Comm. 77
C. Financing 78
1. Capital Expenditures 78
D. Integrated Implementation Strategies 79
1. Water Use Classification 79
2. Waterfront Overlay District 87

REFERENCES 89

APPENDICES 92

Appendix A Maps
Map A: Natural Resources, Nantucket Harbor
Map B: Natural Resources and Water Uses, Madaket Harbor
Map C: Water Uses, Nantucket Inner Harbor
Map D: Water Uses, Nantucket Harbor
Map E: Water Use Classification, Nantucket Harbor
Map F: Water Use Classification, Madaket Harbor
Appendix B Glossary of Acronyms
Appendix C Definitions
Appendix D Harbor Management Authorities and Applicable Laws
Appendix E Mooring Data and Recommendations
Appendix F Nantucket Government Institutions
Appendix G Recommendations for Changes to Nantucket Town Code, Chapter 137: Town Wharves and Waterways
Appendix H Requirements for Federal No-Discharge Application
Appendix I Marine-Related Businesses
Appendix J Proposed Downtown Waterfront District Boundaries
Appendix K Policies and Formulas for Determining Allowable Numbers of Boats
Appendix L Grid System for Rental Mooring Area within General Anchorag
Appendix M Five-Year Action Plan

LIST OF FIGURES

Figure 1.	Map of Surface Currents for Nantucket Harbor	13
Figure 2.	Map of Eelgrass Beds for Nantucket Harbor	15
Figure 3.	Nantucket Annual Commercial Shellfish Harvest	21
Figure 4.	Nantucket Annual Recreational Shellfish Harvest	21
Figure 5.	Nantucket Commercial Bay Scallop Landings Compared to Commercial Shellfishing Licenses	22
Figure 6.	Nantucket Shellfish Licenses, 1978-1989	23
Figure 7.	Geometric Mean of Fecal Coliform Count in Nantucket Boat Basin	29
Figure 8.	Geometric Mean of Fecal Coliform Count in General Anchorage Area	29
Figure 9.	Seasonal Fecal Coliform Concentrations in Boat Basin and Anchorage Areas	30
Figure 10.	Seasonal Fecal Coliform Concentrations in East and West Polpis Harbors	33
Figure 11.	Fecal Coliform Concentrations in Madaket Harbor	34
Figure 12.	Existing Mooring Fields in Nantucket Harbor	40
Figure 13.	Nantucket Building Permits	50
Figure 14.	Heating Fuel Deliveries	54

LIST OF TABLES

Table 1.	Dredging History	11
Table 2.	Wetland Restriction Resource Areas	18
Table 3.	Massachusetts Surface Water Classification Standards	25
Table 4.	Beach Closures	32
Table 5.	Moorings and Slips - 1989 Availability and Estimated Usage	41
Table 6.	Acres of Non-profit and Government-owned Lands	48
Table 7.	Barge Traffic	52

EXECUTIVE SUMMARY

The Nantucket and Madaket Harbors Action Plan is the result of a five-year community effort, coordinated by the Nantucket Harbor Planning Advisory Committee under the direction of the Board of Selectmen and Massachusetts Coastal Zone Management. The mission of the broad-based group was: (1) to examine the current condition of Nantucket's harbors and their waterfronts and (2) to write a comprehensive plan, including recommended policies and actions, which -- when implemented by the Nantucket Town and County boards, commissions and departments -- will preserve the multiple interrelated uses of today's viable harbors far into the future.

Nevertheless, the Plan is meant to be a dynamic, on-going document, and will be revised every five years to keep pace with changing harbor conditions and community needs. In fact, a number of the action items recommended in Chapter 3 of the Plan have already been implemented. For example the goal of having Nantucket Harbor designated as a "Federal No-Discharge Zone" was first articulated during the harbor planning process, and the Harbor Planning Advisory Committee advocated the installation of additional pumpout facilities. The Marine Department then took the ball and ran with it, achieving the designation in 1992.

All harbor activities are literally contingent on very good water quality. The planning process illuminated for us that all harbor issues directly relate to water quality and resource protection, thus they became the overall themes around which action items were developed. This comprehensive planning document considers various interrelated harbor aspects:

* water quality
* natural resources
* commercial and recreational fishing
* harbor safety and navigation
* public access
* tourism and recreation
* downtown waterfront

Action items and policies are identified under each of the seven aspects providing the Town a charted course of harbor management and education over the next five years. The ultimate directive prioritizes perpetuation of plentiful and marketable island shellfisheries as well as for clean, unobstructed waters for small craft recreational boating and to beckon tourists to the Island's shores.

HARBOR VISION STATEMENT

Standing on the upper deck of the "Steamship" as it glides between the jetties and enters Nantucket Harbor, one senses the rare beauty of the place -- a special blend of pristine natural environment and historic architecture -- and hopes it will be kept from degradation.

Situated 30 miles at sea, Nantucket uniquely depends on Nantucket Harbor to service its year-round commercial needs for transportation and delivery of food, fuel, and other goods. Today, tourism provides the island's economic basis and the second home market has grown significantly; consequently, during the extended summer season, Madaket and Nantucket Harbors and their shorelines are intensively used for recreational activities. Additionally, the scallop fishery within both harbors, which depends on excellent water quality, offers significant off-season employment and harbor utilization.

Action items and policies in Chapters 3 and 4 address these issues that relate to the intensity and diversity of multiple and sometimes competing uses recently borne upon Nantucket and Madaket Harbors. The overall effort of this Harbors Action Plan is to assure continued viability of the Island's harbors by balancing natural resource protection with competing water-dependent and nonwater-dependent uses.

Examples of resolutions to some of the issues covered during the planning process are as follows: Mooring areas have been increased and in some cases reconfigured based upon navigability, safety, size of anchorage area, accessibility to existing support facilities, and intensity of use in relation to water quality and natural resources protection. A Water Use Classification strategy was developed to alleviate areas of conflicting activities by establishing policies which protect harbor uses characteristic to Nantucket and define sustainable limits for future growth. Also, a new Downtown Waterfront District is recommended to protect the Town's commercial zone for water-dependent uses, which are imperative to the operations of Nantucket's water highway and marine-related businesses.

Implementation of the 1993 Harbors Action Plan will be carried out by both the public and private sectors. Planning, health and safety, management, operations, education, and enforcement of regulations to adequately protect Nantucket's healthy marine ecosystem will be the responsibility of local departments and agencies. Support must also come from private marine-related waterfront businesses, civic associations, environmental organizations, waterfront property owners, and the citizens of Nantucket. Working together to preserve the harbor resources as defined in this Plan, the Nantucket community can realistically ensure that the Island's harbors -- priceless community assets -- truly will be preserved for the future.

CHAPTER 1. OVERVIEW

A. Definition and Purpose of the Harbors Action Plan

The Harbors Action Plan is a comprehensive document prepared for Nantucket, Polpis and Madaket Harbors which:

(1) Identifies the issues associated with the harbor areas and waterways;
(2) Provides an inventory and analysis of harbor resources and uses;
(3) Suggests goals, objectives and policies for guiding public and private use of land and water in the defined harbor areas; and
(4) Sets forth an implementation program which specifies strategies for achieving the desired patterns of use on and adjacent to the harbors.

Within the Harbors Action Plan, major issues pertaining to land-side and water-side uses and the relationships among them are addressed. Relevant technical information pertaining to water quality, navigational hazards, mooring inventory and configuration, current use inventory and natural resource areas is collected and analyzed in developing goal and policy objectives. In addition, all harbor user groups, as well as the general public, are actively involved throughout the planning process.

By adopting this comprehensive Harbor Action Plan, the Town of Nantucket can implement its vision for the harbor areas and waterways. The Harbors Action Plan will place the Town's harbor policies at the forefront of management decisions regarding harbor development and protection and avoid the need to react to each problem and project as it arises. The Nantucket Harbors Action Plan and maps in Appendix A will provide guidance to the Town government, boards, and commissions throughout the decision-making process for waterfront development projects. The Nantucket Harbors Action Plan will also provide a reference for state decision-making bodies reflecting the desires of the town regarding coastal development and other proposed waterfront projects.

B. Planning Process

1. The Harbor Planning Advisory Committee

In March of 1988, the Board of Selectmen, at the request of the former Marine Superintendent, approved a program proposal for completing a Harbors Action Plan for Madaket and Nantucket Harbors. (Polpis Harbor is included within the boundary and definition of Nantucket Harbor as used in this Plan.) Part of this program requested the Board of Selectmen to approve a local planning group to represent the varied interests of the harbors in overseeing the completion of a Harbors Action Plan. This committee would also

apply for Massachusetts Coastal Zone Management (MCZM) funds necessary to complete the Harbors Action Plans and would follow harbor planning guidelines drafted by MCZM.

Later that month, the Nantucket Board of Selectmen voted to approve the Harbor Planning Advisory Committee (HPAC). The committee was composed of:

7 members from the Shellfish and Harbor Advisory Board
2 members of the Marine Department
1 person from the Nantucket Land Council
1 person from the Conservation Commission
1 person from the Planning Board
2 people from the Health Department
1 person from the Boat Basin;

and representatives from harbor-related businesses, charter boat captain, commercial fishermen, recreational boater and a boatyard manager. In April 1988, state representatives attended the first meeting of HPAC.

Over time, the composition of the HPAC changed. Although many members originally appointed did not take part in the Harbor Planning Committee meetings, several interested members attended on a regular basis. In May of 1989, the Selectmen voted to appoint all 32 members for a one-year term. In July of 1990, the Selectmen appointed 19 members for a one-year term, 18 of whom had previously served on the committee. The core working group were still representative of the myriad of user groups of the harbors, and were also key members and local officials who were in positions to help carry through the adoption of the harbor plan.

Harbor Planning Advisory Committee Goals. The goals of the Committee for the Town of Nantucket are: (1) to provide a comprehensive, long-term evaluation of the activities within or adjacent to Nantucket's and Madaket's harbor boundaries; (2) to achieve higher standards of water quality to protect recreational boating and shellfishing in the harbors; (3) to advocate implementation of existing controls on building design and configuration, in order to encourage visual and physical access to the waterfront; (4) to determine the extent and location of water dependent uses on and along the water to avoid overcrowding or squeezing out of maritime uses; (5) to establish by-laws and regulations to strengthen existing management consistent with applicable regulatory authority and management program requirements of the Commonwealth of Massachusetts; and (6) to recommend a permanent committee with primary authority for overseeing implementation of the Harbors Action Plan.

Award of the Harbor Planning Grant. At the 1989 Annual Nantucket Town Meeting, approval was voted to appropriate $20,000 in free cash and to borrow, in anticipation of state grants, the

sum of $10,000 to develop a Harbors Action Plan. The Town of Nantucket was awarded a Harbor Planning Grant of $15,000 in March 1990, from the Commonwealth's Executive Office of Environmental Affairs (EOEA), Massachusetts Coastal Zone Management Program.

The Town is administering its planning effort through the Board of Selectmen's HPAC as an in-kind service. From September 1990 through May 1991, the Town contracted with The University of Rhode Island Coastal Resources Center to develop a draft Harbors Action Plan. The Plan is based on processes CRC had developed in harbor planning in Rhode Island and is consistent with MCZM Harbor Management Guidelines. CRC's primary task included the synthesis and evaluation of many environmental reports completed for the Town ranging from the study of growth patterns to fish landings and water quality trends. Nantucket and Madaket Harbors issues, goals, objectives, action items and policies were written by CRC based on the public meeting minutes, interaction with the members of the HPAC, and many personal interviews conducted by the consultants. Interviews were held by CRC with local officials, commercial fishermen, waterfront businesses, boatyard and mooring businesses and several other user groups of the Nantucket and Madaket Harbor areas.

The draft Harbors Action Plan was submitted to the Massachusetts Coastal Zone Management Program in July 1991; MCZM accepted the draft in March 1992 as adequately completed for partial grant reimbursement. Since that time HPAC and MCZM have worked together closely to revise this final Nantucket and Madaket Harbors Action Plan.

2. Community Participation Program

In addition to the diverse representation of the HPAC, in September 1989, a public meeting was held to receive input and identify issues of concern. As a result of the issues identified at the meeting, three working groups were formed: (1) Tourism and Recreation; (2) Conservation and Natural Resources; and (3) Commercial Fisheries. Community members who had attended September's public meeting worked with committee members and using available reference material and working guidelines, formulated goals and objectives. One group wrote discussions to alternative strategies. A second public meeting was held in November 1990 to refine issues, goals and objectives. In December 1990, an expanded mailing list was generated to provide notice of committee meetings and drafts of issues, goals, objectives, policies and action items to 68 citizens, business leaders, and town officials. Largely due to the direct mailings, four public meetings were well-attended during January and February 1991, to refine the wording of objectives and action items. A public hearing was held in April 1991 to receive comments on the comprehensive draft of the Nantucket and Madaket Harbors Action Plan. As a result of the public hearing in April, CRC incorporated additional comments and

revisions. CRC finalized their contract obligation by submitting a final copy of the draft Plan to HPAC on May 21, 1991, which contained a new section on Water Use Classifications and Waterfront Overlay District. HPAC met four times during June 1991, to make revisions, prior to submitting it to the Board of Selectmen who forwarded the draft to MCZM in July. A public hearing was held in March 1993 for the final Nantucket and Madaket Harbors Action Plan.

C. Managing Growth and Use Conflicts

1. Issues

The attractiveness of the numerous unique natural, historical and recreational characteristics of Nantucket Island has made it one of the premier tourist destinations of coastal New England and the United States. These features have also been the reasons for an increasing year-round population and the cause of multi-use conflicts in the island's harbors. Preservation of the harbors will protect the economy of the Island by preserving tourism. The Island's harbors, in particular, are focal points of tourism and that fact underscores the importance of achieving the goals of this Harbors Action Plan.

During the 1980s a considerable amount of research and study was conducted on the island. It is important to mention a few of these projects in order to put the current harbor planning effort and its related activities into perspective.

1979 -	Nantucket Planning and Economic Development Commission: Commercial Fishing...Can We Bring It Back?
1983 -	Goals and Objectives for Balanced Growth
1983 -	Growth Trends on Nantucket
1987 -	Nantucket Open Space Plan
1988 -	Energy Planning on Nantucket: Options for Bulk Storage
1989 -	Fiscal & Economic Impacts of Growth on the Island of Nantucket
1989 -	Nantucket & Madaket Harbors: Draft Harbor Waters Inventory
1990 -	Nantucket Water Resources Management Plan

Planning and assessment continued in 1990. The Town updated the 1983 Goals & Objectives for Balanced Growth: A Broad Policy for the Island's Future; Woods Hole Oceanographic Institution began its water quality analysis project for the Island; the State Division of Waterways completed a report entitled, "The State of Our Harbors;" and work commenced on this action plan for the harbors.

After reviewing the data, it is evident that Nantucket is experiencing increasing development pressures, and intensifying use conflicts. It is important to put these findings into context

concerning the specifics of managing the island's multiple-use harbors. Demands for increased uses of Nantucket and Madaket harbors include the following: moorings; slips/docks; coastal access points (boat ramp areas and walking access areas); barge traffic; ferry traffic; services for recreational, commercial and charter boats; shoreline development projects; and other uses, such as jet skis, swimming, windsurfing and aquaculture projects. In general, most of the harbor use trends are directly related to two factors: 1) the overall growth of the year-round and second-home population of the island; and 2) the number of visitors and freight arriving by ferry, barge, plane or private boat. Both factors increased during the 1980s and are expected to continue to grow over the next twenty years.

2. Planning Needs

Over the next twenty years Nantucket and Madaket harbors can expect continued increasing activity by a diverse group of users. Present conditions and future expectations indicate that recreational boating will continue to be the predominant summertime use of both harbors, with seasonal shellfishing the second most popular. This will place added stress on the mooring fields, existing shoreside docking facilities, and the environment. National statistics indicate that the size of boats at marinas and on moorings is getting larger and that more and more boats are being trailered (International Marina Institute). This presents at least four problems which will need to be addressed and prioritized in context with all multiple uses and the harbors carrying capacity. First, pressure will continue for more and better boat ramps, including adequate shoreside parking. Second, existing mooring fields will need to be redesigned and/or expanded in order to accommodate the same number of boats. Pressure will be exerted to place moorings in more and more locations, many of which may not be safe or appropriate for that purpose. Adequate dinghy dock space must be provided. Third, the moorings fields will need to be monitored for unauthorized discharging of wastes that may present health hazards to people as well as to the harvestable marine resources in the harbors. Fourth, adequate shoreside facilities will need to be provided and maintained for boaters, including fresh water, restroom and shower facilities, pumpout and fuel stations, trash containers, and hazardous waste receptacles.

Ferry and barge traffic, critical to the economic survival of the community, can also be expected to increase. (Note: Doubling of freight on ferries, growth of day-trip passengers, larger population, increase of fuel consumption.) More tourists, and a larger seasonal and year-round population will provide the impetus for more ferry service. Unless other sources of energy such as wind and solar are developed for the island, transportation of liquid fuel products will also continue to grow to meet the demands of expanding year-round and seasonal island population. More frequent large commercial vessel traffic may require the development and

implementation of a comprehensive harbor safety and vessel traffic management system, as well as commercial wharves to service large cargo and commercial fisheries.

Madaket and Nantucket Harbors are facing stress from numerous user groups and this pressure for multiple uses will continue to become more pronounced during the next twenty years. As vital components of the character of the island, the harbor areas require the same degree of attention and professional management as the rest of the island. If left unattended certain uses may disappear and user conflicts will harm the attractiveness of the island for residents and visitors alike.

CHAPTER 2. INVENTORY AND ANALYSIS OF HARBOR RESOURCES AND USES

A. Historic Background

Maritime industry defined Nantucket Harbors built environment from the construction on Straight Wharf in 1715 until the reconstruction of the 1960s adapted the area for recreational use. From the early eighteenth to the middle of the nineteenth centuries, whaling dominated the Island's economy. As the whale fishery grew, early residences located at the foot of the wharves were converted to businesses, or moved to residential areas. Oil refineries, cooperages, warehouses, outfitting facilities, slaughter houses and rooming houses were typical. Boxmakers, livery stables, bakeries, ropewalks, foundries, textile mills, and, later, steam mills occupied adjacent waterfront sites north and south of the wharves.

The great fires of 1838 and 1846 destroyed most of the industrial waterfront, from Washington Street Extension to the present Yacht Club location. Post-fire reconstructions reproduced the industrial building types, but the by then rapidly declining whaling industry resulted in a severe economic depression on Nantucket. The post-fire buildings deteriorated. Many were considered useless and later demolished when Nantucket was discovered as a tourist haven in the last quarter of the nineteenth century. In the 1920s, Steamboat Wharf was rebuilt. Straight, Old South, and Commercial Wharves were reconstructed during the 1960s. Old North Wharf is not the only remaining resource to reflect the waterfront's 250 years of industrial use. Several significant historic buildings are intact. The Macy Warehouse, built in 1846 on Straight Wharf is presently used as a museum by the Nantucket Historical Association; the mid-nineteenth century Coffin Warehouse on Washington Street, now the American Legion headquarters, and the Pacific Club, located at the north end of Main Street since 1775, all survived fire and deterioration because of masonry construction. A handful of less imposing, but contributing small shacks, built as much as a century ago, are also cultural reminders

of the waterfront's changing pattern, and can be seen on Old North Wharf.

B. Physical Setting

1. Geography

Nantucket Island lies off the coast of Massachusetts, 25 miles south of Cape Cod and approximately 38 miles southeast of Woods Hole. Nantucket is 14 miles long and varies in width from 3 to 6 miles. The total area is 49.56 square miles or 31,691 acres.

"Nantucket's topography is the result not only of the final stages of glaciation, but also of the effects of weathering, which have sculpted her surface over the past 10,000 years. Post-glacial processes are responsible for the erosion of the south shore by the sea, as well as the deposition of sand which created the Gauls, Great Point, Coatue, and Eel Point." West of Nantucket Town, sand cliffs facing Nantucket Sound have been carved by the sea." (From Nantucket's Open Space Plan, 1987). The two harbors are shallow embayments. The larger of the two is Nantucket Harbor connected to the sea by a narrow inlet. The smaller harbor on the west end of the island is Madaket.

2. Harbor Boundaries

Nantucket Harbor. Boundaries of the harbor as designated by HPAC are shown on Map A. Boundaries encompass the surface waters from the northern end of the jetties in the main channel, up harbor to the eastern end of Wauwinet. Surface waters also include Polpis Harbor, Coskata Pond, fringing salt marshes, and other coastal and inland wetlands within the landside harbor boundaries as listed in Table 3. Landside boundaries are from the tip of the west jetty running south on Jetties Road, east on Hulbert Avenue, west on Easton Street, southeast on South Beach Street, South Water Street and Washington Street, west on Francis Street, southeast on Union Street and Orange Street to the rotary, east on Milestone Road, northeast on Monomoy Road, northwest on Boston Ave, northeast on DeWolf Ave, on the 25 foot contour and on South Valley Road, southeast on Gardner Road, northeast turning southeast on Shimmo Road, northeast on Polpis Road, north on Wauwinet Road to the Wauwinet Gatehouse, north on the eastern most shoreline of Wauwinet to the point just south of the Galls and tracking a line west to the northwest shoreline of Coatue, following the northern shoreline of Coatue to the north tip of the East Jetties.

Madaket Harbor. Boundaries of the harbor as designated by HPAC are shown on Map B. Boundaries encompass the surface waters landward of a line drawn from the northwest tip of Eel Point to the northwest tip of Esther's Island, including creeks, salt marshes and other coastal wetlands within the landside harbor boundaries. Landside boundaries include Eel Point to Eel Point Road south to

Nantucket Conservation Foundation's east boundary (map/parcel #38-12) through the northwestern section (map/parcel #59, 4-10) to Washington Street southwest to the end of Madaket Road, and north to include all of Smith Point and Esther Island.

3. Bathymetry

Nantucket Harbor. March 1984 information from NOAA Chart 13241 indicates that water depths range from zero to over 18 feet at mean low water (MLW). Water depths less than 2 to 5 feet MLW extend hundreds of yards seaward of the harbor shoreline. Three areas of natural basins are referenced, one off of Second Point, the second off of Quaise, and the third in Head of the Harbor. A 15-foot federal navigation channel through the jetties to the downtown harbor and a navigation channel into Polpis Harbor are maintained with state and federal financial assistance.(Map A).

Madaket Harbor. Most of Madaket Harbor is very shallow with a 7' deep MLW. A 50'-70' wide channel is maintained with state financial assistance from Warren's Landing into Hither Creek. Information on NOAA Chart 13241 indicates that depths range between 7-10 feet south of Eel Point (Map B). The Harbor's south-southwestern exposure to the Atlantic Ocean make it vulnerable to intense storms causing continually shifting sands and shoaling. The channel shown on the NOAA Chart was shoaled over within six months of being dredged in 1970. The location of the existing channel in Madaket Harbor is more accurately depicted on Map F. NOAA should make this correction on their next Chart revision.

4. Dredging

Nantucket Harbor. The U.S. Army Corps of Engineers maintains the federal navigation channel through the jetties and around Brant Point. This channel serves as the primary transportation and shipping route to and from Nantucket. Maintenance of the channel dimensions (15' deep, 300' wide, 1.5 mile long) is essential for safe navigation of passenger and freight boats and as a harbor of refuge particularly for the numerous large fishing boats that find refuge from storms.

Polpis Harbor channel has been maintained with state and local financial assistance since 1940. This channel is maintained to provide access to a one acre mooring field.

Madaket Harbor. This channel provides access to Hither Creek's 1.5 acre mooring field, a boatyard, and two public access points. The channel as shown on the NOAA Chart was shoaled over within six months time of the 1970 dredging. In 1961 Hurricane Esther severed Smith Point in two and the western-most portion was named Esther Island. From 1961 until 1985 Esther Island remained separated from Smith Point during which time Madaket Harbor's exposure to intense southwestern winds and hurricanes was

Table 1. Dredging History

Nantucket Harbor and Federal Channel

Year	Volume Dredged (cu yd)	Activity
1829-1832	Dredging Attempted	Create Channel
1905	7,039	Create Channel
1906	187,024	Improvement
1910	32,874	Improvement
1911	110,841	Improvement
1912	299,542	Improvement
1914	162,026	Improvement
1915	126,448	Improvement
1925	22,000	Maintenance
1929-30	113,494	Maintenance
1936	34,770	Maintenance
1937	96,890	Maintenance
1953	60,000	Maintenance and Create Anch. Basin
1959	70,547	Maintenance
1963	47,235	Maintenance
1968	54,000	Maintenance
1989	40,000	Maintenance

POLPIS HARBOR CHANNEL

Year	Volume Dredged (cu yd)	Activity
1940	??	Create Channel
1965	32,500	Maintenance
1992-1993	32,500 (est'd)	Maintenance Scheduled

MADAKET HARBOR and HITHER CREEK

Year	Volume Dredged (cu yd)	Activity
1965	30,963	Create Channel and Mrg Basin
1970	43,723	Maintenance
1985	34,570	New Channel Location

Sources: Mass. Dept. of Environmental Management and Nantucket Conservation Commission

amplified. Sediment transport during storms and prevailing southwesterly winds continually altered the harbor bottom contours and shoaling extended well into the middle of the harbor. Esther Island was reconnected in 1985 when the dredged material was placed in its opening to rebuild the barrier beach. Since 1985 Esther Island has breached and reconnected two times during hurricanes. The newly located channel dredged in 1985, basically follows the shape of the shoreline and a 6'-7' mean low water depth has been achieved.

5. Tides and Currents

Nantucket Harbor. Surface current velocities are shown in Figure 1. Tides in Nantucket Harbor are semi-diurnal with a mean range of one meter and a one and a half hour lag between the tide levels in the west and east ends of the harbor (Rosen, 1972). Tidal currents circulate in a clockwise direction in Nantucket Harbor. The highest current velocities occur between the harbor entrance and Second Point. Currents in the Head of the Harbor are weak due to the large size of the basin compound with a small volume of tidal flow (Rosen, 1972).

Madaket Harbor. No information is available for Madaket.

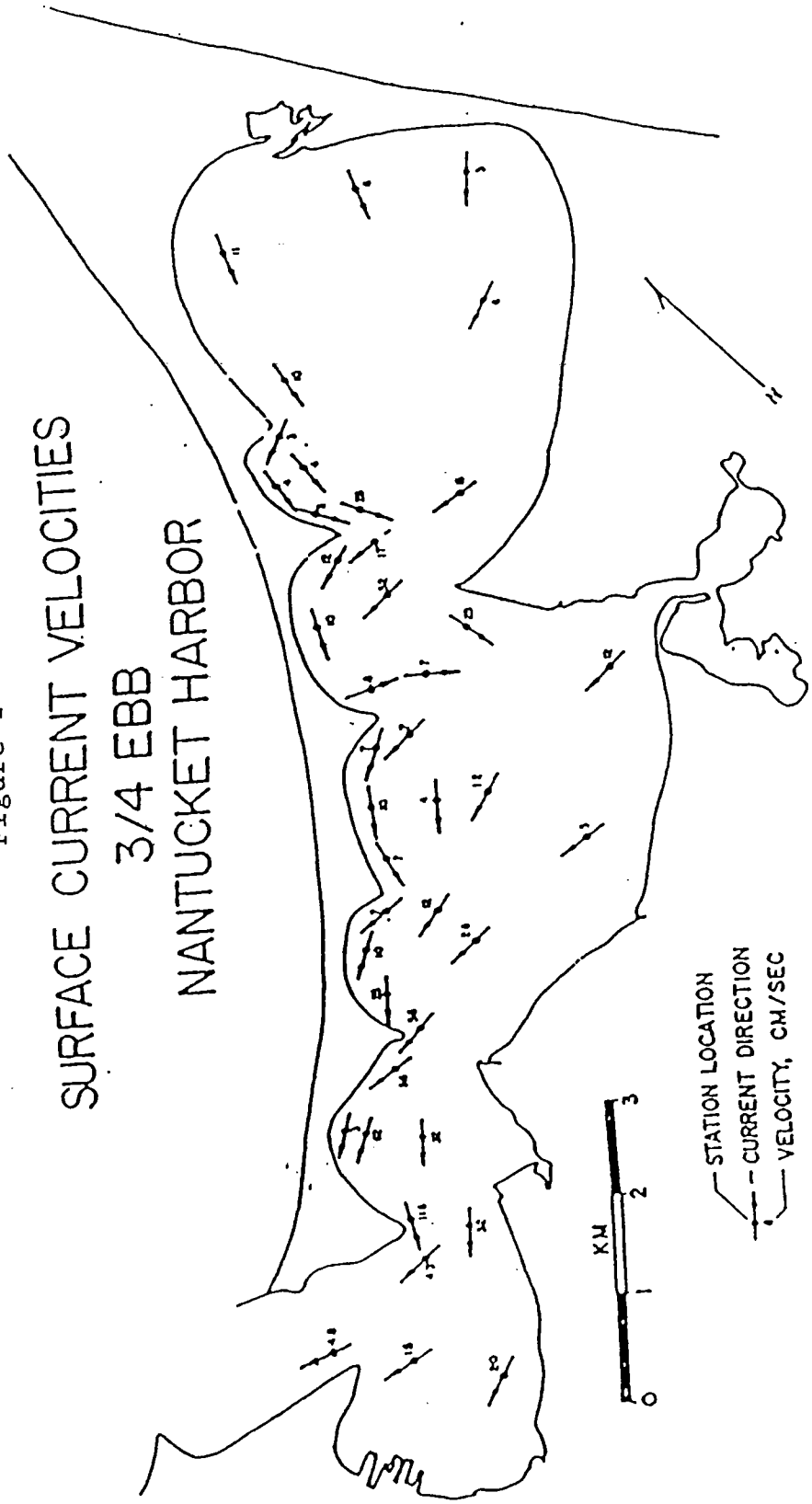
6. Flood Zones

"The principal type of flooding on Nantucket is coastal and is primarily caused by northeasters and hurricanes. Tidal levels along the coastline are greatly influenced by the force, duration and direction of the winds that accompany these storms, as well as the distance or fetch across open water over which the winds act." (Nantucket Open Space Plan, 1987, pg 33.)

The Federal Emergency Management Agency (FEMA) has mapped flood hazard zones on the Island of Nantucket as part of their 1986 National Flood Insurance Study. Hazard zones were determined based on 10-, 50-, 100-, or 500-year flood events. FEMA has identified these flood frequencies to be significant for establishing minimal flood management criteria. High hazard zones were determined for coastal areas subject to three-foot or greater waves during a 100-year flood. The Corps of Engineers has identified this as the minimum size wave with enough force to damage wood and brick structures.

Section 139-12 of the Code of the Town of Nantucket established a Flood Hazard District for the Island based on FEMA's 1986 study. The Code requires building design in the "AO" and "V" zones to comply with Massachusetts State Building Code but does not discourage building within the 100-year flood zone.

Figure 1


SURFACE CURRENT VELOCITIES
3/4 EBB
NANTUCKET HARBOR
KM
0
1
2
3
STATION LOCATION
CURRENT DIRECTION
VELOCITY, CM/SEC

Nantucket Harbor. Over the past two centuries wetlands were filled and Brant Point was built as a dense summer residential area within the 100-year flood zone. Areas of commercial and residential structures along and behind the wharves, Beach Streets, Easy Street and Washington Street are also subject to 100-year floods. The 1991 Halloween storm and the December 1992 nor'easter caused significant flooding and structural damage to these areas. Residential development continues to expand in flood zones down harbor.

Madaket Harbor. Residential homes on the waterfront of Smith Point and Hither Creek are within or just behind the 100-year flood zone. The Boatyard is entirely within the 100-year flood zone.

C. Natural Resources

1. Biological Habitats and Resources

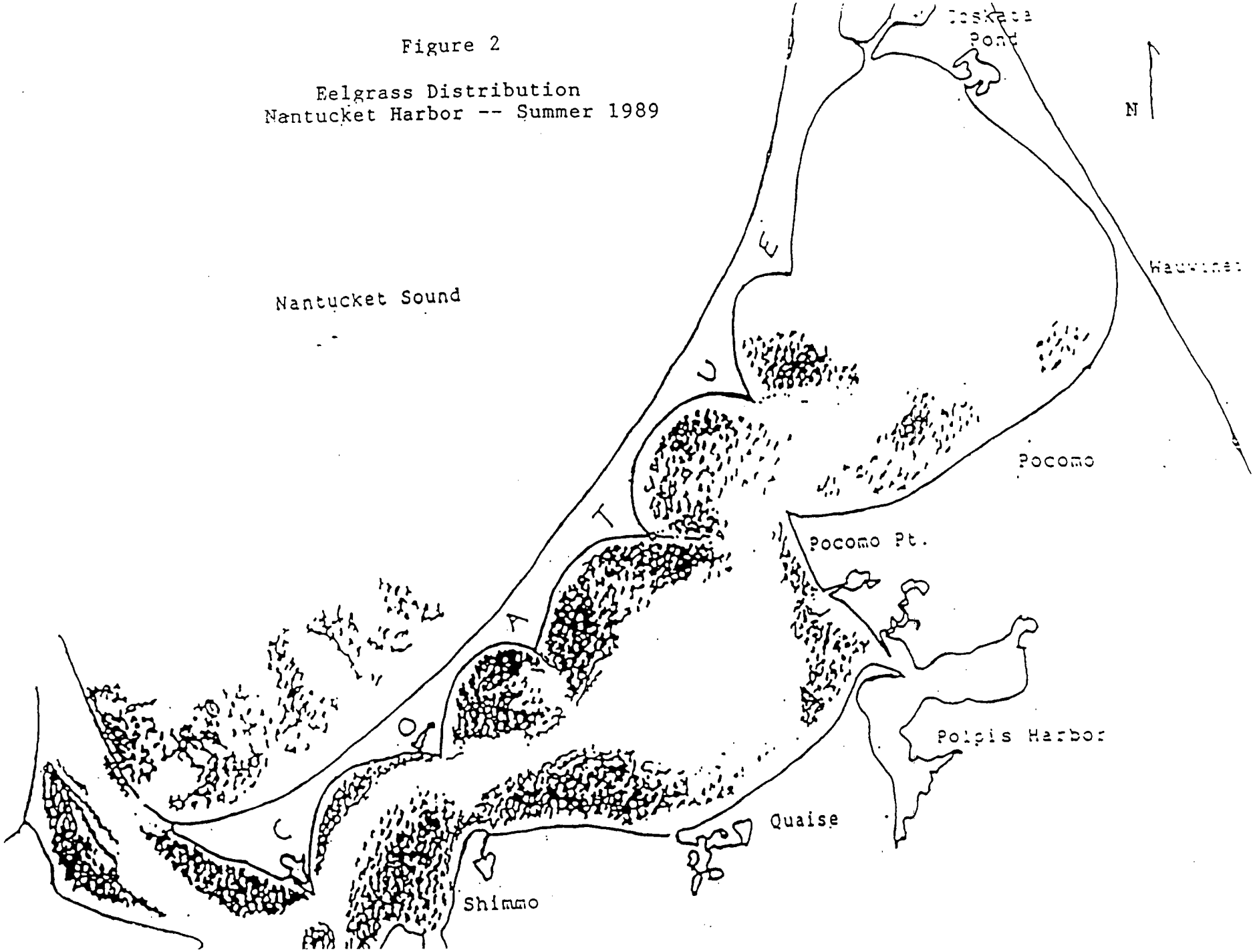
The following describes several of Nantucket and Madaket Harbors' habitats that are important to the integrity of natural resources in the harbors. Categories of critical resource areas to be mapped for continued harbor planning efforts are identified under the Action Items Section of this Plan. Several of those categories (shellfish beds, salt marshes and tidal flats) were mapped as part of this Plan and appear on Maps A and B. At a minimum, critical resource areas should be the focus of education and information efforts to increase the public's knowledge of interdependent land-water issues.

Eelgrass Beds. Eelgrass beds are prime habitat for bay scallops and other benthic species. During the summer of 1989, the distribution of eelgrass in Nantucket Harbor was mapped by Kelley (1989) using scuba and snorkel gear and an aerial photographic survey. Figure 2 represents density and distribution of eelgrass in Nantucket Harbor and correlates with Kelley's (1985) documentation of primary scallop beds. Kelley's comparison of the 1989 eelgrass survey to a 1982 eelgrass survey reflects density and distribution in decline off Pocomo and in Polpis Harbor, while it is expanding in new areas off Madaket (no map available for Madaket). Growth of epiphitic algae on eelgrass beds was more widespread in 1989 with heaviest fouling observed off the west side of Pocomo Point and Head of the Harbor. The 1989 photographs portray dredging swaths visible inside Second Point, possibly caused by intensive fishing in that area during the 1988-1989 scallop season.

Salt Marshes. Biological productivity in salt marsh ecosystems contribute essential nutrients and oxygen to provide a life-support basis for marine aquatic life. Scientists have estimated that a salt marsh is four times more productive per acre than a wheat field. They also provide significant food, shelter, breeding, migratory and overwintering areas for wildlife.

Figure 2

Eelgrass Distribution
Nantucket Harbor -- Summer 1989



Establishment of cord grass and peat work to resist wave damage and erosion to the marsh and upland sites, prevent pollution and protect ground water supply.

The following salt marshes have been identified as critical resource areas providing primary support to the harbors' ecosystems. These areas are also listed in Nantucket's Oil Spill Contingency Plan (1991) as "Highly Vulnerable Areas", especially sensitive to longterm entrainment of toxics from oil spills which would alter the economic and biological productivity of these areas.

In Nantucket Harbor extensive salt marshes include the Creeks, Shimmo Creek, Abrams Creek Harbor, Folger's Marsh, Medouie Creek, Polpis Harbor, Coskata Pond, Haulover Pond, First Point Marsh, and Second Point Marsh. In Madaket Harbor extensive salt marshes include Eel Point, Warren's Landing and near the bridge over to Smith Point. (Maps A and B).

Coastal Beaches and Tidal Flats. Coastal beaches and tidal flats dissipate wave energy and provide flood control to protect upland areas from storm damage. Beaches serve as a sediment source for dunes and downdrift areas sustaining public safety interests. The ability of the sands to shift and migrate with the tides and storms should not be compromised or altered by coastal structures. Beaches and tidal flats also provide habitat for marine organisms which contribute to the food chain of fisheries and wildlife.

Barrier Beaches. The Massachusetts Wetlands Protection Act defines Barrier Beach as "a narrow low-lying strip of land generally consisting of coastal beaches and coastal dunes extending roughly parallel to the trend of the coast." The sediment and vegetation of these resource areas are significant to storm damage protection, flood control, protection of marine fisheries, land containing shellfish, and wildlife habitat. Due to their narrow shape surrounded by water on three sides, barrier beaches are in a delicate balance with winds and waters shifting their form and volume.

Coatue and Wauwinet barrier beaches are significant to the formation of Nantucket Harbor's estuarine ecosystem. These areas are primarily open space conservation land, with the exception of a few camps on Coatue and summer residences on Wauwinet. Eel Point, Smith Point and Esther Island are significant to Madaket Harbor's estuarine ecosystem. Management to protect the native vegetation and to allow for natural-occurring dynamics of wind and waters are basic elements to estuarine preservation.

Rare & Endangered Species Habitat. The Massachusetts Natural Heritage & Endangered Species Program (MNHESP) has mapped estimated habitats of rare wetland wildlife species. Areas are estimated based on the presence of wildlife in the resource area in addition

to other significant resource characteristics which provide important food, shelter, breeding, migratory or overwintering areas. The resource areas are protected from habitat alteration through provisions stated in the Massachusetts Wetlands Protection Act Regulations (310 CMR 110.00).

Within Nantucket Harbor boundaries, sections of Coatue, Wauwinet, Squam and Quaise are estimated rare species habitat. Within Madaket Harbor boundaries, Eel Point, Smith Point, and Esther's Island are included in the program.

Most of these existing estimated habitat areas are owned by the Nantucket Conservation Foundation, the Trustees of Reservations, the Nantucket Land Bank, and the Conservation Commission. These areas are primarily managed for passive recreation in order to sustain the balance of resource characteristics critical to habitat protection.

Jurisdictional Authority. The Massachusetts Wetlands Conservancy Program administers the Coastal Wetlands Restriction Act (MGL c.130, s.105). This Act protects public safety, private property, wildlife, water supplies, and fisheries by limiting activities which can damage wetlands. The limitations established by the Program are contained in permanent restriction orders which are recorded at the Registry of Deeds. The HPAC subcommittee on Natural Resources used a planimeter to roughly calculate acreage of wetlands having direct surface feed to the harbors' surface waters and of wetland resource areas abutting the harbors. Table 2 lists totals by category of wetland-type. Calculations were made from the Department of Environmental Management's Wetland Restriction Maps based on 1978 aerial photography.

The Massachusetts Wetlands Protection Act (MGL c.131, s.40) is implemented by Nantucket's Conservation Commission and the Department of Environmental Protection (DEP). Work proposed within the 100-foot buffer zone around any coastal and inland wetland requires filing with the Conservation Commission. Projects are reviewed for potential adverse impacts to environmental and public health interests protected by the State Act and Nantucket's Wetlands Bylaw (Nantucket Code, c. 136). Wetland functions serve to protect public and private drinking water supplies, provide as a natural filter against water pollution, control floods and prevent storm damage, and provide habitat for fish and wildlife. Coordination of project review is established between the local Conservation Commission, Department of Environmental Protection, Coastal Zone Management Program, and Natural Heritage & Endangered Species Program.

MGL Chapter 91 is the Commonwealth's waterways licensing program administered through the Department of Environmental Protection. This Program regulates activities to construct, dredge or fill in tidelands. Primary interests are to accommodate public

Table 2

Wetland Restriction Resource Areas

Nantucket Harbor (including Polpis Harbor and Coskata Pond)
Total Harbor Acreage: 1,207.86
Total Wetland Resource Acreage: 2,707.72

Saltwater Resource	Acres
Barrier Beaches	760.69
Coastal Beaches	921.71
Coastal Dunes	98.21
Marshes	782.85
Ponds	57.53
Sea Cliffs	16.41
Subtotal	2,637.50

Freshwater Resource	Acres
Shrub Swamps	49.37
Wood Swamps	20.01
Marshes	.84
Subtotal	70.22

Madaket Harbor (including Hither Creek)
Total Harbor Acreage: 199.08
Total Wetland Resource Acreage: 413.75

Saltwater Resource	Acres
Barrier Beaches	150.61
Coastal Beaches	64.65
Coastal Dunes	101.98
Marshes	90.24
Ponds	2.27
Total	413.75

benefit, protect the waterfront for water-dependent uses, and to give additional protection to Areas of Critical Environmental Concern.

2. Wildlife

Waterfowl. "Nantucket is a haven for shorebirds and waterfowl. Wintering bay ducks and waterfowl on Nantucket include the black duck and green-winged teal, bufflehead and golden eye. Nesting sites are predominant in the island's coastal wetland areas. There is a wide variety and abundant population of shorebirds including rare and endangered species. Piping plovers, least and common terns nest on Nantucket. Great Point, Coatue, Siasconset, and Tuckernuck Island are important nesting sites for terns. The most common shorebirds on Nantucket are gulls. Herring and black-back gulls, the most common, increased in great numbers over the past two decades before stabilizing recently. They nest in areas of low shrub and coastal grasses, and are very resilient." (Nantucket Open Space Plan, 1987. p. 36)

Mammals. "The most unusual small animal is the Muskeget vole, whose only known habitat is Muskeget. The vole is named after Muskeget Island, which was nominated as a "Nationally Significant Unique Wildlife Ecosystem" because of the vole and the only known colony of grey seals south of the Gulf of Maine." (Nantucket Open Space Plan, 1987, p. 36)

3. Fish and Shellfish

Bay scallops, quahogs, soft-shell clams, blue mussels, and American oysters are the major recreational and commercially popular shellfish inhabiting Nantucket and Madaket Harbors. Bay scallop populations fluctuate, but overall have proved to be a long-term commercial fishery in both harbors. Bay scallops contributed an average harvest value of $1,700,000 per year between 1981 and 1990 (Nantucket Marine Dept. 1981-1990). Recreational harvests of quahog, soft-shell clam, and American oyster provide an important source of food to island residents.

Two crustaceans, among others, found in Nantucket's waters are the American lobster and the blue crab. The lobster has some limited commercial return, while the blue crab has declined in range and number all along the Atlantic seaboard. (Nantucket Open Space Plan, 1987)

Finfish found around the Island and in the Harbor include the American eel, white hake, tomcod, alewife, striped bass, rock bass, scup, and bluefish. The most significant recreational finfish are the striped bass and bluefish.

Fishing has played an important role in the Island's history and continues to be an important use of the harbor and a valued

activity for both summer and year-round residents. The healthy diversity of fin and shellfish is a symbol of the quality of life for islanders. Moreover, shellfishing in particular is an essential source of income for year-round residents during the down season of the pulsed tourist economy of the island. Shellfish beds are shown on Maps A and B according to information supplied by HPAC and SHAB.

Commercial Fisheries. The commercial offshore finfishing fleet, once a major presence in Nantucket harbor has been in a dramatic decline over the last 60 years due to changes in the market and shifts to larger vessels and new technologies.

The bay scallop fishery is the major commercial fishery on the island followed by hard clams (quahogs) and mussels. Surf clams are also harvested commercially but to a lesser extent. The commercial shellfish harvest is graphed on Figure 3 and compared to recreational harvest in Figure 4. Note that the landings are depicted on a log scale--the commercial harvest is three times larger than the recreational. Intensive scallop fishing occurs during November and December, then decreases through March 31, the end of the commercial scallop season.

The market value for bay scallops fluctuates so that in years of high catch, the dollar value may be down. Regional market value for a pound of bay scallops in Boston has dropped steadily in time as the market is flooded with other kinds of scallops. The dropping market value has a negative effect on the economy of the community.

Average value of a pound of bay scallops in Boston wholesale market:

1986 $7.50/lb	1988 $6.00/lb	1990 $5.00/lb
1987 $7.00/lb	1989 $6.00/lb	

Figure 5 depicts trends in commercial scallop landings compared to trends in fishing effort, estimated as commercial shellfishing licenses (98 percent are for scallops). The catch per unit effort was dropping throughout the 1980s, with the exception of 1987 and a good harvest reported but not yet officially recorded for 1990.

Recreational Fisheries. Shellfishing is an extremely popular recreational past-time and supplemental food source. The recreational harvest of quahogs, softshells, bay scallops, mussels and blue crabs reported by Massachusetts DFWLE is on the rise. In 1989, recreational fishing was valued at an estimated $13,000 for quahogs, $14,000 of bay scallops and $531 of blue mussels and $2,250 of softshell clams. (This compares to a commercial harvest of $15,000 for quahogs, $1,112,000 for bay scallops and $1,000 for mussels in the same year.) (DFWLE Annual Report 1990).

Figure 3. Nantucket Annual Commercial Shellfish Harvest

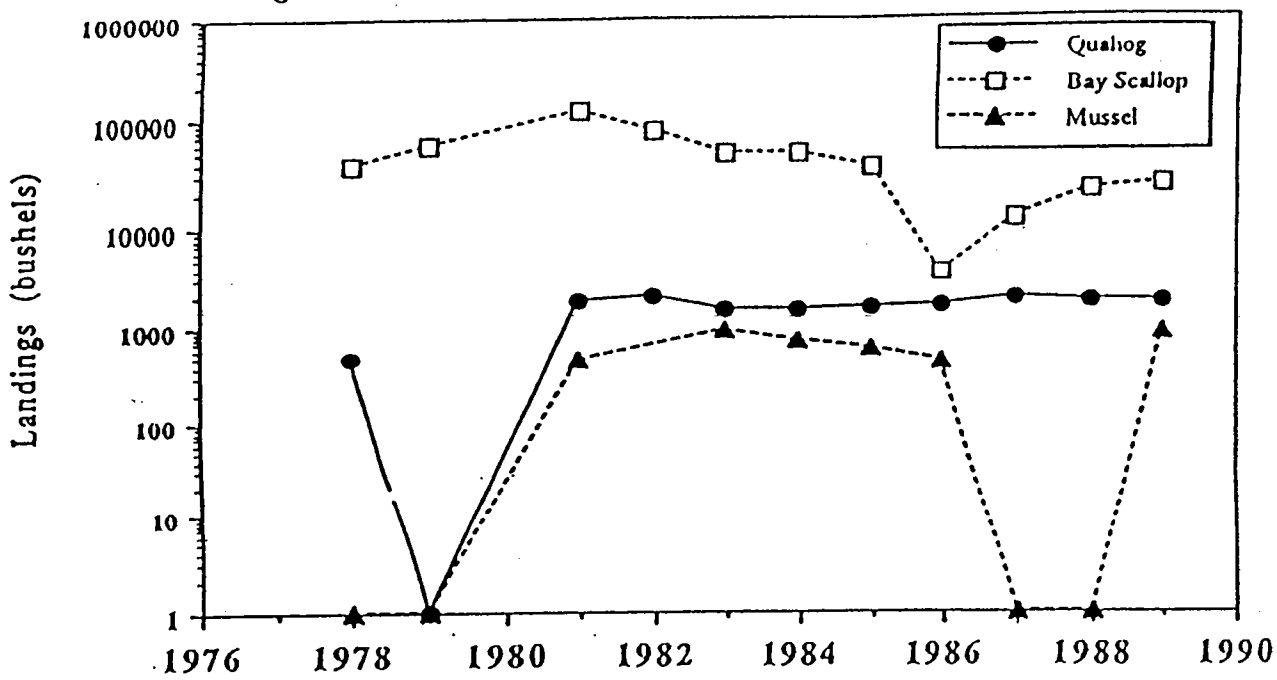
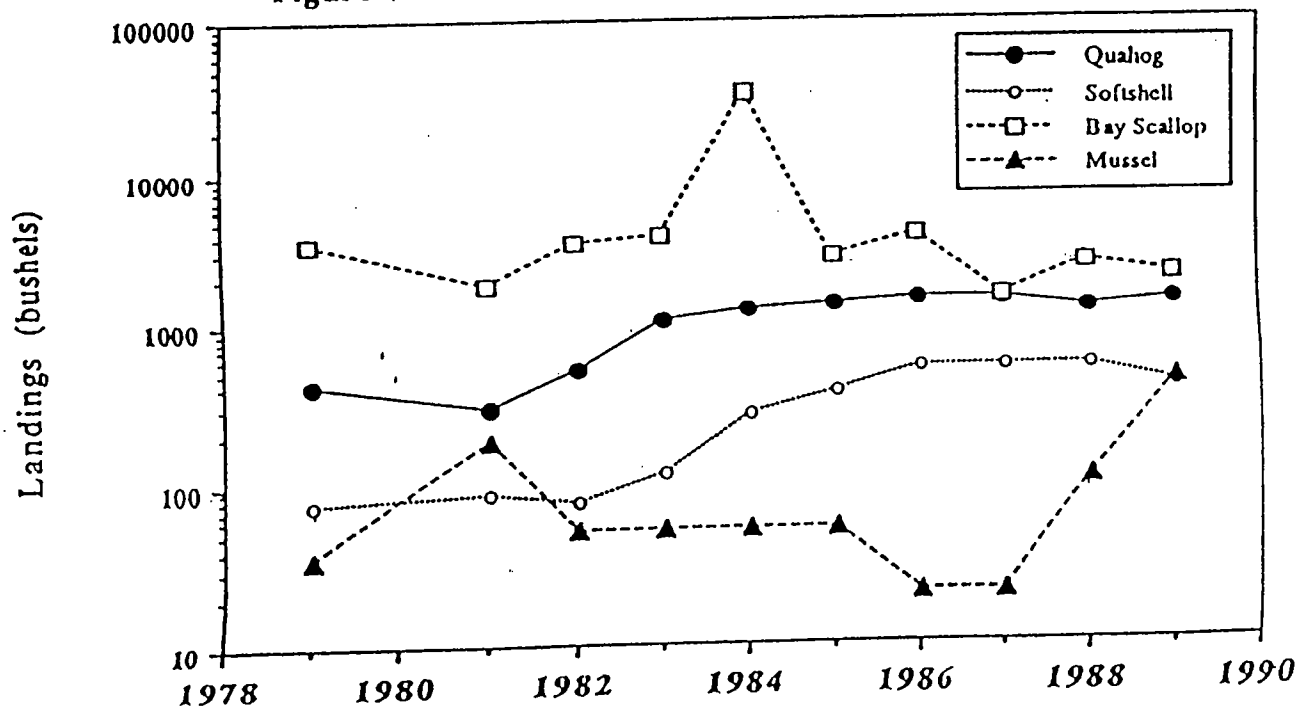
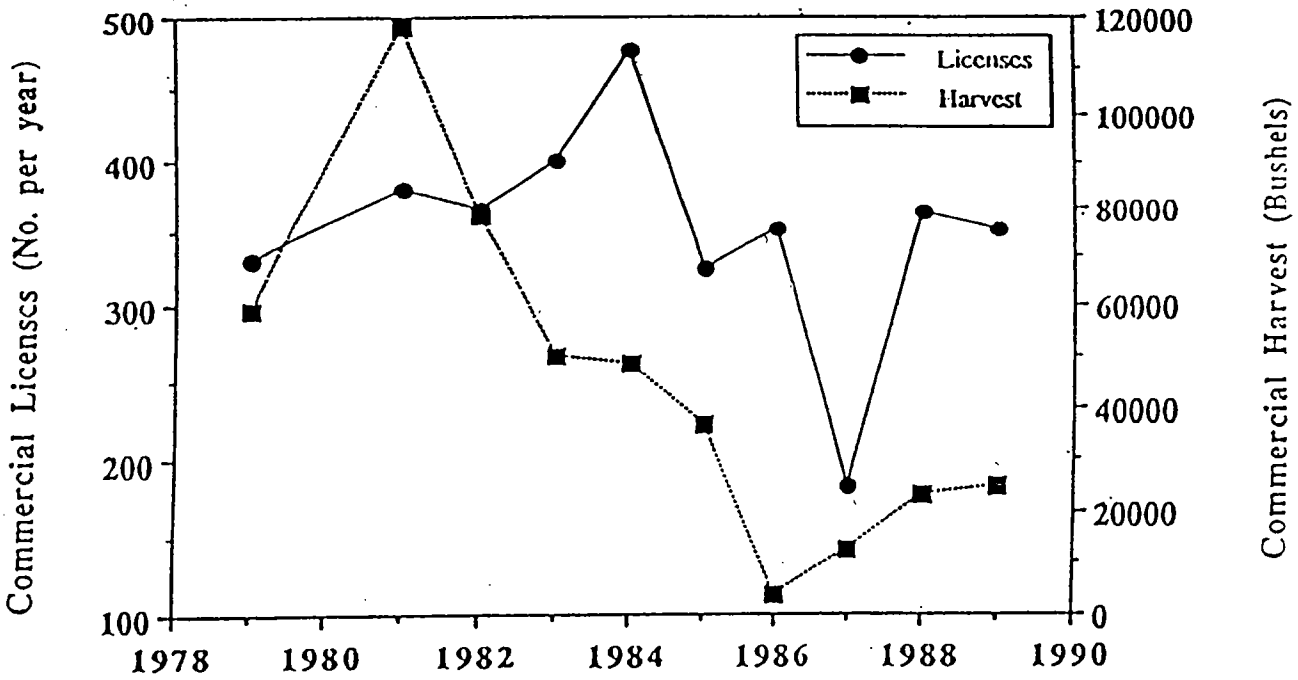


Figure 4. Nantucket Annual Recreational Shellfish Harvest



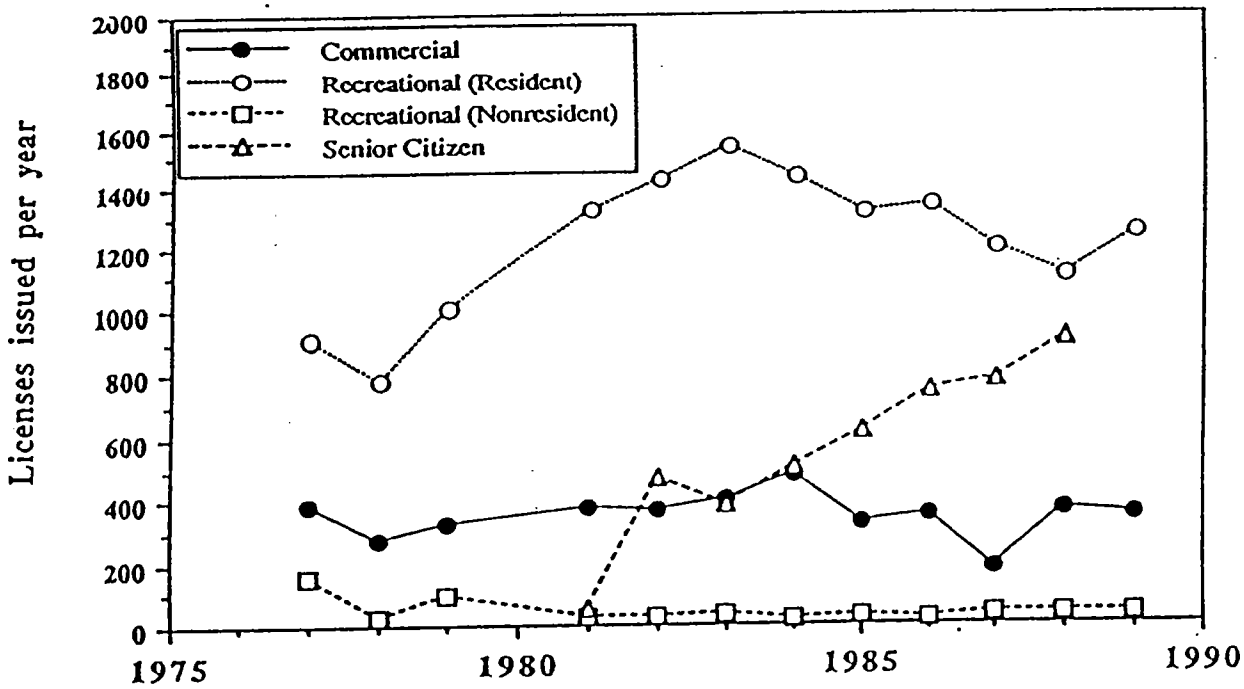
Source: Massachusetts DFWLE Division of Marine Fisheries Reports

Figure 5. Nantucket Commercial Bay Scallop Catch Compared to Effort



Source: Mass DFWLE Division of Marine Fisheries Reports
Note: 98% of commercial licenses are for bay scallops

Figure 6: Nantucket Shellfish Licenses, 1978 -1989



Source: Mass. DFWLE, Division of Marine Fisheries 1990

Recreational shellfishing principally targets quahogs, softshell clams, bay scallops and mussels (Figure 4). There is an increasing trend in activity and number of recreational shellfishing licenses issued for resident families and senior citizens (Figure 6). Even though the commercial catch is much larger than the recreational, there were more people licensed for recreational shellfishing than for commercial shellfishing. (In 1988, there were 2,000 recreational shellfishing licenses and 364 commercial shellfishing licenses.)

The recreational harvest should be accounted for and management techniques developed in the fishery management plan.

Aquaculture. Aquaculture projects are already under management schemes at various levels of government. Like many other water-related activities, aquaculture projects require dedicated space and good water quality. This necessitates site location planning that must consider not only the biological and business success of the project, but its compatibility with surrounding uses.

D. Water Quality

Several potential pollution problems have been identified as issues in Nantucket and Madaket Harbors: 1) pathogen contamination and the impact on public health and shellfishing; 2) excessive nutrient enrichment (eutrophication) and the impact on fishery habitat and ecosystem health; 3) toxic contamination from gas and oil leaks and spills, and from residues of pesticides applied to the watersheds and lands bordering the harbor. Studies of the sources and impacts of each of these water quality problems are currently underway by various groups and the results will need to be synthesized and incorporated into future pollution prevention and environmental protection initiatives.

1. Pathogen Contamination

Introduction. The potential pollution of harbor waters by pathogens, disease-causing microorganisms, is a primary public health issue for Nantucket and Madaket Harbors.

The Massachusetts criteria for water quality classification based on fecal coliform bacteria and dissolved oxygen are summarized in Table 3. Fecal coliform are a form of bacteria found in the gut of warm-blooded animals which is the current national standard as an indicator of sewage contamination of water bodies.

Nantucket and Madaket Harbors' waters are ranked in the highest Surface Water Classification Standard, Class SA, designated by the State. This "excellent" water, habitat and aesthetic value allows for water-contact recreation and harvest of shellfish without depuration. These attributes have enhanced the seasonal

Table 3
Surface Water Classification Standards of the Commonwealth of Massachusetts for Coastal and Marine Waters
(314 CRM 4.03)

Class	Dissolved Oxygen	Fecal Coliform
SA These waters are designated as excellent habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting without depuration. These waters shall have excellent aesthetic value.	6 mg/l or greater or 75 saturation or greater	Shellfishing: 14 MPN/100 ml or less (geometric mean) nor 10% of samples exceed 43 MPN/100 ml Non-shellfishing: 200 MPN/100 ml or less (geometric mean) nor 10% samples exceed 400 MPN/100
SB These waters are designated as habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In approved areas they shall be suitable for shellfish harvesting with depuration. These waters have consistently good aesthetic value.	5 mg/l or greater or 60% saturation or greater.	Restricted shellfishing: 88 MPN/100 ml (geometric mean) nor 10% samples exceed 260 MPN/100 ml Non-shellfishing: 200 MPN/100 ml or less. (geometric mean) nor 10% of samples exceed 400 MPN/100 ml
SC These waters are designated as habitat for fish, other aquatic life and wildlife and for secondary contact recreation (boating, fishing). They shall also be suitable for certain industrial cooling and process uses. These waters shall have a good aesthetic value.	4 mg/l or greater or 50% saturation or greater	1,000 MPN/100 ml or greater nor 10% of samples exceed 2,000 MPN/100 ml

Note: MPN means most probable number.

SA Waters are suitable (safe) for habitat, for shellfishing and for water contact recreation.

SB Waters are not suitable for shellfishing but are suitable for habitat and water contact recreation.

SC Waters are not suitable for shellfishing or for water contact recreation but are for habitat.

profits of local fishermen and lured hundreds of thousands of recreational boaters and tourists to the Island. Degradation of Nantucket's Class SA water quality standards would minimize the shellfish and tourist economies resulting in economic downturn. Costs to restore degraded water quality and Nantucket's tourist image would be exorbitant and possibly not attainable. Consistently high concentrations of fecal coliform bacteria resulted in permanent closure to shellfishing in Nantucket's downtown harbor (west of a line drawn from Brant Point to the Shipyard) in 1932 (Map A). The area has since been developed to cluster mooring fields in the downtown area near boating support services. A permanent shellfish bed closure was placed on Madaket's Hither Creek in 1988 (Map B). DMF suspected the contaminating source was waterfowl, due to high elevations found during the winter season. Hither Creek is a constricted water body with dense residential housing, septic systems, and a shallow ground water table along one side of the Creek. A temporary shellfish closure was instituted in 1990 to the Warren's Landing area. High counts of fecal coliform were discharging from a pipe in that area, but the source has not yet been identified.

State and federal standards for acceptable fecal bacteria concentrations are the most stringent for waters that support shellfish harvests, 14 fecal coliform per ml of water. If bacterial contamination is more severe, public health issues become a concern. For Nantucket, this may jeopardize recreational shellfishing, an increasingly popular use of the harbor, and commercial scalloping which many Island families depend on for their winter economic base.

Children's Beach and Francis Street Beach have been repeatedly closed to swimming. State and federal standards for acceptable fecal bacteria concentrations for swimming beaches are 200 fecal coliform per ml of water. Beyond this level, closures to swimming are mandated. On Nantucket, closures have been due to multiple storm drains which directly discharge into the same area as the swimming beaches.

There is concern that more areas in both harbors will be closed due to incompatible uses which include but are not limited to vessel discharge, direct stormwater discharge, and waterfowl concentrations. All goals within this Action Plan come under the umbrella of maintaining Nantucket's excellent Class SA water quality standards.

Methodologies. Fecal coliform bacteria densities are measured by either of two methods, a multiple tube procedure or a membrane filtration procedure. Although both are measures of the densities of coliforms in 100 ml of water, the two methods do not necessarily yield identical results and must be carefully intercalibrated to demonstrate comparability. The membrane filtration technique is easier and less expensive to use, is highly reproducible and gives

results more rapidly than the multiple tube procedure. For these reasons, it is the method used by the Town Board of Health surveys of harbor waters. However, because it has limitations, especially in waters of high turbidity or background bacteria, the State of Massachusetts, in conformance with U.S. Food and Drug Administration (FDA) regulations for commercial shellfishing waters, uses the multiple tube method.

Unfortunately, state water quality classifications are based only on the results of the multiple tube method and membrane filtration results are not accepted to assess whether waters meet safety standards for shellfishing or swimming. In a conversation with Santo Fugaro, senior staff at the New England Regional Office of the Federal Food and Drug Administration Laboratory at Davisville, Rhode Island, the membrane filtration technique usually gives lower results than the multiple tube method. If membrane filtration results exceed water quality safety standards, then it is a good indication that there is a problem of bacterial contamination.

In Nantucket and Madaket Harbors, water quality surveys have been conducted by the Division of Marine Fisheries, Massachusetts DFWELE. They sample five stations in the inner harbor, one in the inlet near Jetties Beach, several stations at the Head of Harbor including two stations in Polpis Harbor and several stations in Madaket. Coliform concentrations are determined by a method (serial dilution) approved by the FDA for monitoring commercial shellfishing waters. This method gives results as a "Most Probable Number" (MPN/100 ml) with lower and upper limits of 1.7 and 64 MPN/100 milliliters of water. The state surveys are conducted three to five times a year. Since 1987, only ten sets of samples have been taken between the months of June and September. Five of these are from consecutive days in August 1987. The sporadic nature of the summer sampling means that these data are of limited value for assessing water quality in the months when recreational shellfishing and water contact sports are at their peak.

In the Inner Harbor and at several beaches, the Nantucket Board of Health has surveyed fecal coliforms more frequently, beginning in 1982, using a different method (membrane filtration), which gives results as "Colony Forming Units" (CFU/100 ml). These results are only roughly comparable to Massachusetts water quality standards which are based on the serial dilution (Most Probable Number) method. Since the same method has been used consistently by the town, and in a study by Burden (1979), these results provide a basis for examining changes in bacteria concentration over time. Because the Board of Health is concerned about safe swimming beaches, they sample approximately once a week throughout the summer, which provides sufficient consistent data to assess

geometric means.[1]

Nantucket Harbor. The geometric means for fecal coliform concentrations are plotted June through August, for six year between 1979 and 1990, at stations in the Boat Basin and the Anchorage (Figures 7 and 8). In the Boat Basin, fecal coliform concentrations were much higher between 1982 and 1990, than they were in 1979, but they are down from concentrations in 1983 and 1984, so there is no clear trend over time. The Boat Basin installed pumpout facilities in 1987 and sewage hydrants in 1990 for usage by cruise vessels, tugs and barges.

The geometric mean of summer fecal coliform concentrations in the Boat Basin since 1984 exceed 200 CFU/100 ml. Although the membrane filtration method which was used gives results only roughly equivalent to those defining state standards, they exceed equivalent safety standards for shellfishing (14 MPN/100 ml) and may exceed limits for water contact recreation as well (200 MPN/100 ml).

At the Anchorage station, which is located in what are perceived as clean waters outside the area closed to shellfishing, fecal coliform concentrations have steadily increased. By 1989 and 1990, geometric mean fecal coliform concentrations in town samples exceeded 15 CFU/100 ml. The town data suggests that shellfishing near the Anchorage may reach unsafe levels June through August. It would be helpful if the state would increase monitoring of recreational shellfishing and bathing waters in Nantucket Harbor during the summer months coordinated as a comparative study with Board of Health methods. The Anchorage area does meet SB criteria for water contact sports (less than 200 MPN/100 ml) year-round. Safety for shellfishing could not be determined because there was not a sufficient number of samples taken in winter and spring, when recreational boats are not present and coliform concentrations may be lower (Figure 9).

Since bacteria concentrations drop in the "off season" winter months, it is reasonable to assume that recreational boat sewage is a primary polluting source. Educational awareness and effective use of the newly installed pumpout facility at Town Dock and two pumpouts at the Boat Basin should improve conditions considerably (Map C).

---

[1] The geometric mean is a statistic which is more useful than a simple average (arithmetic mean) for describing highly-variable data such as coliform concentrations. It is the antilogarithm of the average of the logarithms of the data. It is preferable to have at least 10 samples in order to calculate the geometric mean and the percentage of samples exceeding the cut-off limits. In order to calculate geometric means and plot the data logarithmically, negative results (0 CFU/100 ml) were treated at 1 CFU/100 ml.

Goemetric mean - antilog [(logx1 + log x2 +. . . log xn)/n]

Water quality at inner harbor beaches improved in 1987, compared to previous years. The Health Department credits this to the addition of a diverter added to one problem storm drain discharging to Children's Beach and altering diversion to Brant Point where there is more flushing and circulation. Also a barrier was placed on one problem drain at Francis Street Beach to block discharge. (Table 4)

Further east, in East Polpis Harbor near the mooring field (Figure 10), show coliform sampling by the state indicates that water quality is generally good and bacteria levels are usually below detection limits (1.7 MPN/100 ml). DMF's station 3A, just inside West Polpis Harbor near the bulkhead and tidal flat, shows episodic fecal coliform concentrations above state performance standards for shellfishing (14 MPN/100 ml of water). Seagulls inundate this area frequently and may be a contributing factor. Residential houses with septic systems have also increased over time in this area which has somewhat limited flushing and circulation rates.

Primary sources of bacterial contamination appear to be storm drains, especially due to sewer cross-ties from the downtown historic district and sewage discharge from boats in the harbor during the recreational boating season. Older septic systems that were not constructed to modern code or have failed, and birds, including starlings, pigeons, sea gulls, herons and waterfowl, may be additional sources of episodic fecal coliform pollution. Residential septage waste from pre-code or failed systems may increase dramatically during peak summer seasonal use of houses and birds may flock into the shallow protected waters of the harbors during spring and fall migration or may spend winter in Nantucket's moderate climate.

Madaket Harbor. For Madaket Harbor, there are not sufficient samplings to appropriately calculate a geometric mean, nor are there enough samples to adequately determine a trend in water quality. There are occasional high values which indicate that more extensive sampling is warranted (Figure 11). Approximately 100 boats are moored or at slips in Hither Creek. Overnight usage is not allowed at any of these areas. Madaket Marine boatyard has a portable pumpout facility for public use at a nominal charge.

2. Nutrients and Eutrophication

Throughout many New England coastal communities there is increasing awareness and concern about excessive nutrient discharges to coastal embayments and consequent eutrophication. Symptoms of eutrophication include: noxious blooms of phytoplankton, nuisance growth of macroalgae and consequent damage to eelgrass beds, increasingly muddy sediments in once "hard" bottom and loss of shellfish grounds and fisheries habitat. In

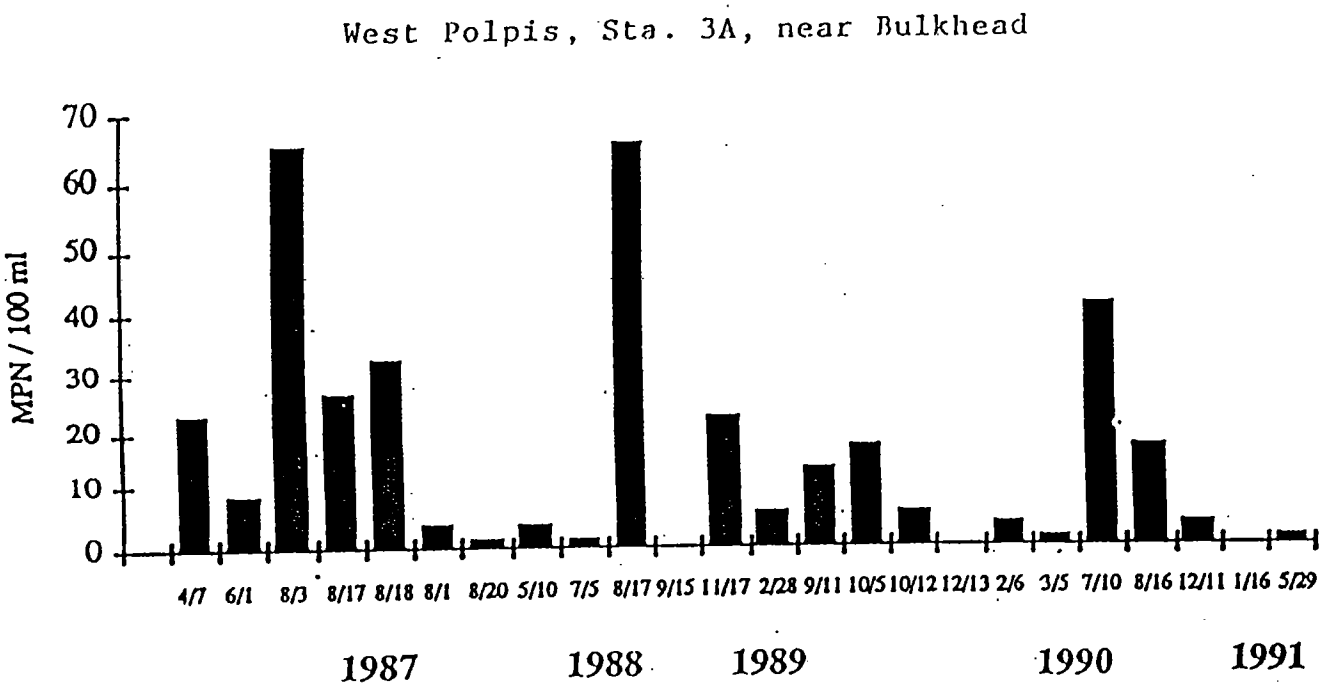
Table 4
Beach Closures

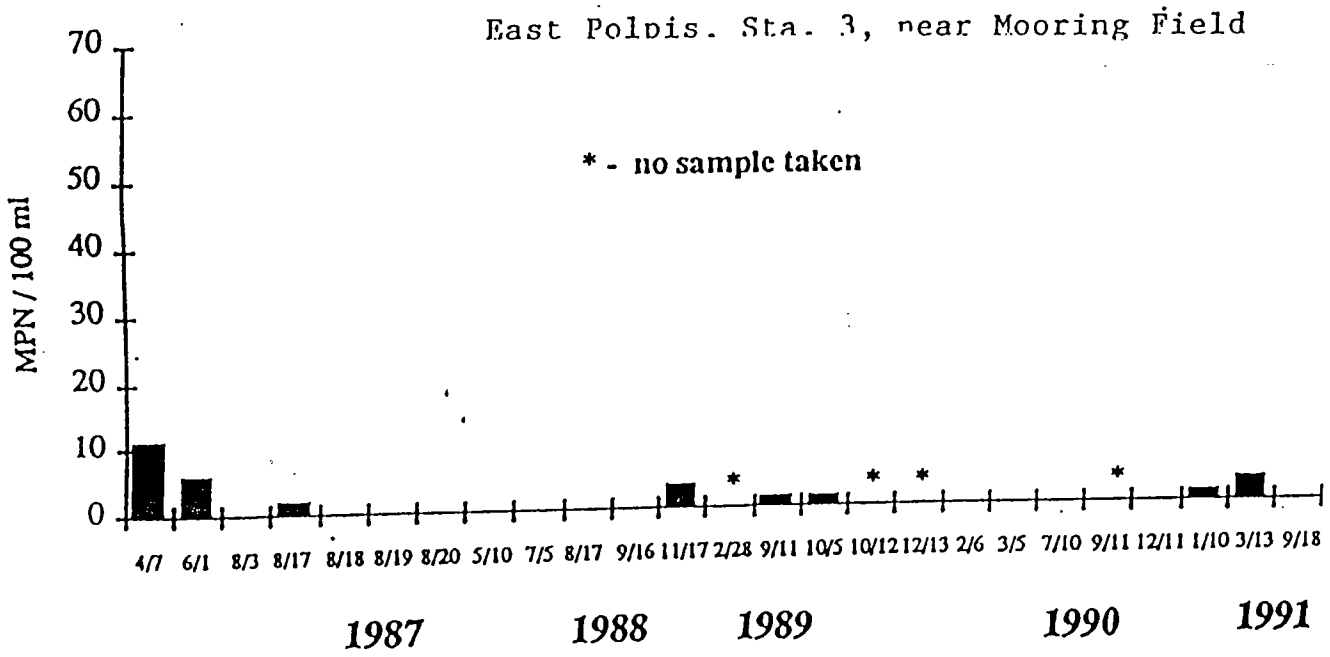
	Children's Beach	Francis Street Beach
1982		X1
1983		X2
1984	X3	X4
1985	X5	X6
1986	X7	
1987		
1988		
1989		
1990	X8	
1991		
1992	X9	

1. Sewer pipes cleaned out, cross-connection to storm drain.
2. Drain pipe discharging directly from neighboring bathroom to beach.
3. Storm drain north of beach area had two private sewer cross-connections and one main sewer cross linked to its pipe.
4. Bacterial source not identified. Suspect are vessel discharges within harbor and numerous storm drain outfalls in beach area.
5. Due to removeal of sewer line which directly connects to outfall pipe.
6. Bacterial source not identified. Possible sewer line leak, marina, anchorage, waterfowl bacteria.
7. Break in sewer line due to heavy rain. Effluent flowed into storm drain and discharged at Children's Beach.
8. Potential residential sewer cross-tie.
9. Wooden diverter was removed from pipe leading to Brant Point outfall after 10/30/91 northeaster to relieve excessive discharge and flooding in area. Diverter was not replaced until high levels of fecal coliform bacteria was noticed 7/21/92.

Source: Town Annual Reports 1982-1992.

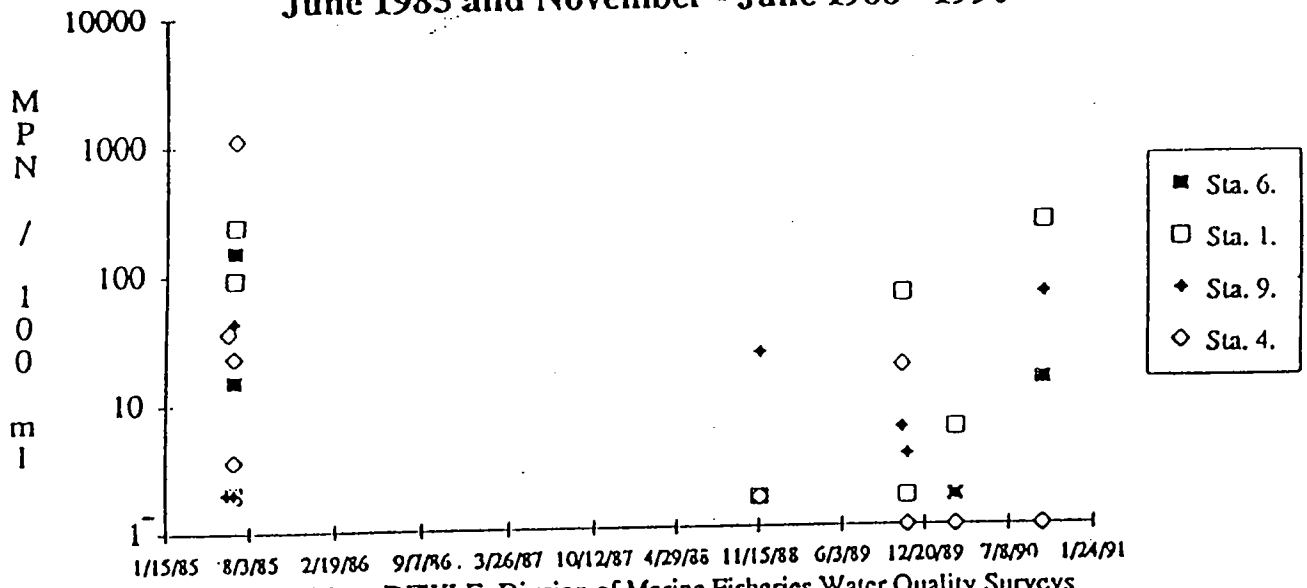
Figure 10. State of Massachusetts Survey, fecal coliform concentrations, Nantucket Harbor, 1987 - 1991





Source: Mass. DFLWE, Division of Marine Fisheries Water Quality Surveys

Figure 11 .Madaket Harbor, fecal coliform concentrations, June 1985 and November - June 1988 - 1990



Source: Mass. DFWLE, Divsion of Marine Fisheries Water Quality Surveys

extreme conditions, as the plants die and decay, oxygen is drawn out of the water and fish and shellfish suffocate and die.

The results of unmanaged development and eutrophication of coastal waters are evident in studies in Waquoit Bay and Buttermilk Bays on Cape Cod and Buzzards Bay, the salt pond lagoons in Rhode Island, Great South Bay on Long Island and Delaware's Inland Bays. Massive macroalgae growth or phytoplankton and loss of eelgrass are being documented. So far, there are only suggestions of these problems on Nantucket: increased fouling of eelgrass reported by Kelly in Wauwinet in a 1989 survey; possibly increased nuisance algae growth (Costa, 1987); occasional depleted oxygen in Coskata Pond and Polpis Harbor in July of 1988 and in September of 1989 (Howes and Goehringer, 1989).

Although there are no federal or state standards for nutrient loading or acceptable concentrations in marine waters, there are standards for dissolved oxygen, a symptom of eutrophication (Table 3).

According to preliminary results of the Woods Hole Oceanographic Institution's water quality survey, with the exception of the inner Nantucket Harbor which is closed to shellfishing and is subject to street drain discharges (Map C), in general, Nantucket Harbor and Madaket Harbor appear to have remarkably good water quality and high oxygen levels (Howes and Goehringer, 1989). This good water quality is an important factor in the remarkable continuity of the bay scallop fishery, a fishery that has been lost from similar, more polluted embayments along the New England coast. There is awareness that development and associated septage plumes in ground water or fertilizer application within the watershed may jeopardize the water quality and currently productive resources in the harbor. Because the harbor is generally well mixed, as evidenced from an average water salinity of 31 ppt throughout the harbor, the nutrient concentrations are low and dissolved oxygen is high (above 80 percent saturation in the summer) (Howes and Goehringer, 1989). With the exception of the downtown harbor, Polpis and parts of Head of Harbor, eelgrass is extensive and vigorous especially in the areas with strong currents. For the most part, the bottom sediments are "clean" sand and gravel. As a consequence, within the harbor boundaries there are abundant fish and shellfish resources and a diverse mix of coastal habitats.

Except for the downtown harbor, development of the shoreline and within the drainage basin is relatively recent, so the sources of nutrient enrichment have been few. However, this may be changing as the residential population of the island grows and development intensifies along the shores and the drainage basin of the harbor. Eutrophication of the harbors may become more of a problem as development increases and additional quantities of fertilizers and septic system leachate are carried into the harbors

by nutrient-enriched ground and surface water runoff.

Land management strategies will be developed in 1994-1995 as part of the final component of the three-year harbor project "Circulation and Nutrient Cycling as Controls of Water Quality, Plant and Animal Communities", coordinated by the Nantucket Health Department with Woods Hole Oceanographic Institution.

As further studies are conducted and results incorporated into planning and policy decisions, it is useful to think of a total pollution "budget of loadings to the harbor." The aquatic ecosystem will respond to the sum of the inputs, and the response may be removed in space and time from a given discharge source. In the case of nutrients, the seagrasses, phytoplankton and other organisms will respond to increased nutrient enrichment from ground water (septic discharge, fertilizer), from surface water, (streams, runoff from streets, parking lots, etc.), precipitation directly on the surface of the water (acid rain is enriching rainfall with nitrogen and phosphorus), and from offshore waters (in coastal bays offshore waters can be a major source of nutrients).

3. Toxic Contaminants

A third concern for water quality in Nantucket and Madaket Harbors involves pollution from compounds that are toxic to marine organisms. Although there are many potential problems, those identified at present include toxics from paints, finishes, and anti-fouling chemicals (i.e., tributyltin), as well as pesticides, herbicides and fungicides which are applied to agricultural lands, gardens and lawns adjacent to the harbor. There is an ongoing study underway by the Marine Department to evaluate the fate and effects of chemical applications to the Windswept Cranberry Bog which feeds into Polpis Harbor.

Gasoline and fuel oil are known to be highly toxic especially to larval forms of marine organisms. Constant low level seeps of oil are less obvious than oil spills but can be just as harmful. Sources to the harbor include seepage from oil saturated soils in the old oil storage sites, seepage from storm drains from streets or parking lots, recreational and commercial vessel operational discharge (daily fuel and oil residue), and seepage from corroded underground storage tanks. The Health Department has identified the corrosion of household heating oil tanks as a major potential hydrocarbon source and has instituted a replacement program. (Board of Health Regulation 70.00)

Oil spills from accidents associated with transfer of fuel from barges to facilities in the harbor is a potential danger as are all accidents associated with fueling commercial and recreational boats. Implementation of Nantucket's 1991 Oil Spill Contingency Plan, should minimize the effects of spills in the harbor.

4. Jurisdictional Authority

The authority to manage the harbor to protect or restore water quality is multijurisdictional. The Federal Clean Water Act and its various amendments provides the overall framework administered by the Environmental Protection Agency with a national objective of "restoring and maintaining the chemical, physical, and biological integrity of the nation's waters" (commonly referred to as fishable/swimmable) and sets forth regulatory standards for discharges (NPDES program) to achieve this goal. The Federal Food and Drug Administration sets bacteria standards for waters for safe commercial shellfish harvesting and oversees state bacteria monitoring programs and assists in the application of National Shellfish Sanitation Commission guidelines for controlling numbers of boats permitted to moor or dock in commercial shellfish waters. (Appendix K) With the recent reauthorization of the federal Coastal Zone Management Act, CZM authority administered through each state will increasingly be involved in implementing water quality and fisheries habitat protection regulations in addition to the traditional CZM activities.

There are state counterparts to each of the federal programs. For instance, the Massachusetts Division of Marine Fisheries conducts regular sanitary surveys of the harbors to monitor bacteria levels. The Division of Water Pollution Control sets water quality standards for the state's surface waters and administers the pollution discharge elimination system permits.

State Law 314 CMR 4.00 charges the Division of Water Pollution Control with the duty to "protect the public health and enhance the quality and value of the water resources of the Commonwealth." The Division has adopted surface water quality standards which designate the most sensitive uses of the waters; it has prescribed minimum water quality criteria required to sustain these uses and it has set forth federal regulations for permitting or, if necessary, prohibiting discharges to these waters (Table 3).

In response to heightened awareness of the interaction of public health and safety and environmental quality, the management of Nantucket Harbor's water quality is increasingly an interdisciplinary issue among several town authorities; most notably, the Marine Department, Health Department, Conservation Commission, Planning Department, Department of Public Works, and the Shellfish and Harbor Advisory Board. For instance, the Marine Department and Health Department currently share one staff position and cooperate in bacterial surveys of shellfish areas, swimming beaches and storm drain discharges into the harbor. Water quality and habitat research is coordinated closely with members of the Shellfish and Harbor Advisory Board. Marine Department staff are currently monitoring water quality impacts on Polpis Harbor from use of herbicides and pesticides at Windswept Cranberry Bog. In 1990, the Conservation Commission funded WHOI to do a water

analysis of nutrients flowing from Windswept Bog into Polpis Harbor. The Health Department is directing a cooperative study with the Woods Hole Oceanographic Institution on water quality of the harbor. The results of all of these studies will have potential application to policy decisions by various boards and commissions.

E. Harbor Facilities and Uses

Most coastal communities do not have an historic statistical data base on the multiple uses of their local waters, and Nantucket is no exception. The following is an inventory and analysis of harbor facilities and uses. State and federal agencies, and various private businesses and organizations have provided some of the following information, but much of it came from piecing together individual town department's records, conversations with local residents and studying old photographs.

1. Recreational Boating

Nantucket Harbor Docks and Slips

Marinas, yacht club, boatyard and commercial mooring operators service the boating community in Nantucket Harbor. The majority of marina clientele are large power vessels, in contrast to the commercial moorings, which are most often used by sailboats. According to the Marine Department there is a summertime weekend turnover rate of approximately 100 boats per day in Nantucket Harbor.

Town Dock - The town dock can handle 56 boats with a maximum length of 30'. There is a sewage pumpout facility, dinghy docks, ice, potable water, public restrooms and showers, trash and recycling barrels. The Nantucket Marine Department is located at the dock. The town parking lot is across the street.

Winthrop Boat Basin - Dockside pumpout stations are located on Straight Wharf and Swain's Wharf which also has a fuel dock. The Boat Basin has deck drains and sewerage hydrants and is capable of servicing all recreational slips and areas where large cruise ships, tugs and barges dock. Eighteen bathroom/showers are provided, two of which are handicap accessible and two of which are open to the public on Straight Wharf in cooperation with Hy-Line Cruises. An ice machine and laundry room are provided. The Boat Basin accepts used oil from all boaters in the harbor for a nominal fee. For slip renters they have waste containers for paint cans, oil filters, oily rags, etc. The Basin's maximum slip capacity is 240, 40' boats; beam slip sizes range between 8' and 20'.

Island Marine Service, Inc. - Services at this boatyard include: hauling, storage, mechanical, plumbing, electric, general maintenance, carpentry and painting. Dockside gas and diesel is

available to the public. Winter storage capacity is between 200 and 250 boats (150 stored inside, 100 stored outside), no rack storage is available as of April 1991. The boatyard accepts used oil that they originally sell. Boatyard generated hazardous waste is stored on-site in very small quantities and transported to Harbor Fuel Corp., a large quantity generator, for shopment off-island according to Massachusetts Hazardous Waste Regulations (310 CMR 30.00).

Nantucket Yacht Club - Water services all provided to members from mid-June through mid-September. No dockside gasoline facilities are available, and no overnight boaters are permitted. Facilities include 19 slips on permanent piers, 29 dinghy lines, 5 small floats and 11 moorings. The Yacht Club provides launch service to its members, mid-June through mid-September.

Madaket Harbor Docks and Slips

Madaket Marine, Inc. - Boatyard services include: hauling, storage, mechanical, plumbing, electric, general maintenance, carpentry, painting, and maintenance of private moorings. Dockside gas (no diesel) and sewage pumpout facilities are open to the public. Winter dry dock storage, including rack storage, ranges between 175 and 200 boats. A float system is maintained and can handle approximately 64 boats at full capacity. Boat lengths up to 30' can be accommodated, but 24' pleasure boats are more common to Hither Creek. The boatyard accepts used oil that they originally sell. Boatyard-generated hazardous waste is stored on-site in very small quantities and shipped off-island by a state licensed hazardous waste transporter.

Madaket Harbor - Boating services in Madaket Harbor include a marina/boatyard and commercial moorings. These facilities service smaller power boats and sail boats.

Nantucket Harbor Existing Mooring Fields and Anchorages

Existing mooring fields for Nantucket Harbor with COE General Permit approval, are shown on Figure 12. A 1989 survey showed Nantucket has approximately 1,300 private moorings and 135 commercial moorings. Of these, approximately 1,200 private moorings and 120 commercial moorings are located in Nantucket Harbor, the remainder are located in Madaket Harbor (Table 5). Commercial vendors are permitted to operate up to 25 moorings per vendor and are responsible for operating within federal, state and town regulations. The Town leases no more than 125 moorings to commercial vendors in Nantucket Harbor. Commercial and private mooring holders are required to get an annual permit from the town. Exact boat tallies and descriptions will be accurately documented only after the Marine Department conducts their field survey in the summer of 1991.

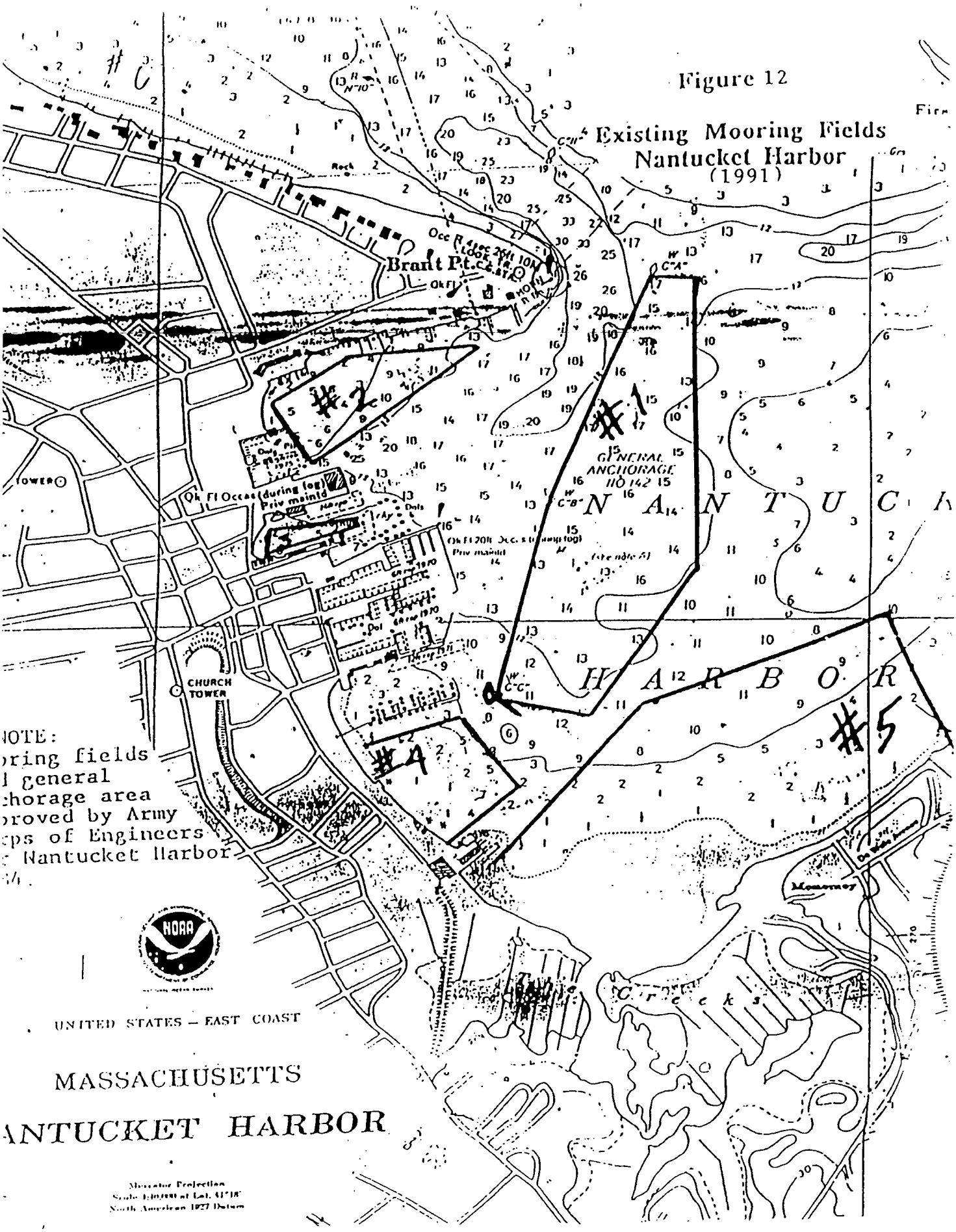


Figure 12
Existing Mooring Fields
Nantucket Harbor
(1991)
Brant Pt.
#1
#2
#4
#5
GENERAL ANCHORAGE
NANTUCK
HARBOR
CHURCH TOWER
TOWER
Monomoy
Creeks
NOTE:
oring fields
l general
chorage area
proved by Army
rps of Engineers
Nantucket Harbor
UNITED STATES — EAST COAST
MASSACHUSETTS
ANTUCKET HARBOR
Mercator Projection
North American 1927 Datum

Table 5

MOORINGS AND SLIPS

Number of Moorings and Slips and Estimated Usage Based on 1989 Estimates

	TOTAL SLIPS & MOORINGS		1989 ESTIMATES USAGE Breakdown by Category		
LOCATION	Permanent & Transient Slips	Prv & Comm Moorings	Commercial Boats Fishing/Charter)	Recreational Boats (Sail and Power)	Passenger/ Ferry Service
Nantucket Harbor					
Nant. Boat Basin	240	NA	170	2980	NA
Nant. Yacht Club	19	11	NA	30	NA
Town Dock	60	NA	NA	60	NA
Commercial Moorings	NA	122	NA	3500	NA
Private Moorings	NA	1211	NA	1211	NA
General Anchorage	NA	275	NA	275	NA
Steamship Authority	2	NA	NA	NA	6
Hy-Line Cruises	1	NA	NA	NA	4
Subtotal	(322)	(1619)	(170)	(7996)	(10)
Madaket Harbor					
Madaket Marine, Inc.	64	13	12	64	NA
Private Moorings	NA	73	13	60	NA
Subtotal	(64)	(86)	(25)	(124)	(0)
TOTAL	386	1705	195	8120	10

NOTE: "Commercial Boats" includes scallop boats for the purpose of Table
Source: HPAC Preliminary HMP

Mooring Field #1 - (General Anchorage Area) This area is 61.3 acres with mean low water depths ranging from 12 to 17 feet. Transient boaters, commercial rental moorings and live-aboards use this area. Approximately 250 boat may be harbored in this area including commercial rentals.

Mooring Field #2 - Located in front of Children's Beach in Nantucket Harbor this field is 4.5 acres, has a mean low water of 3 to 11 feet and allows boats up to 35 feet. The area is presently at full capacity given present configuration and tackle (approximately 275 boat moorings).

Mooring Field #3 - Located in Easy Street Basin this field is two acres and has a mean low water depth ranging from 2 to 5 feet. The area is at full capacity given present configuration and tackle (approximately 50 boat moorings).

Mooring Field #4 - is located between the Town Dock and Island Marine Services, Inc. off of Francis Street Beach. This area is 2.9 acres and has mean low water depths from one to five feet. Boats less than 25 feet are permitted. This area is at full capacity given present configuration and tackle (approximately 210 boat moorings).

Mooring Field #5 - Located southeast and east of the Shipyard, and north of Monomoy. This area is 17 acres and has a mean low water depth ranging from 1 to 10 feet. Approximately one-third of this area is deep enough for boats larger than 30 feet. There are approximately 90 boats assigned to this area.

Moorings are also located in other locations throughout the waters of Nantucket. These sites include: the waterfront adjacent to property along Hulbert Avenue; in between the Town Dock and the Boat Basin; the waters between Monomoy and Pimneys Point; on Polpis Harbor; within the harbor at Wauwinet and Quaise.

Madaket Harbor Existing Mooring Fields

Hither Creek - This mooring field is 1.5 acres. Fishing and recreational power boats use this area. It is recommended that the Town request formal designation of this area as a mooring field from the Army Corps of Engineers as depicted on Map B.

Boats are occasionally moored off Warren's Landing and Eel Point. Due to the soft sandy bottom and overlap with shellfish beds, these areas are not recommended for mooring field designation.

Overnight Visitors on Recreational Boats. The number of overnight visitors is a classic measurement of a tourist community and in a maritime setting that includes visitors on private vessels. The Nantucket 1978 Basic Data Report estimated that there

was an average of 1,900 overnight visitors on boats in Nantucket harbor during a peak summer day. This represented 7.6 percent of the Island's total peak overnight population and accounted for 380 boats with an average of five persons per boat. However, it appears that the 1978 estimates may have been high. Based on recent information supplied by the Marine Department, Nantucket Boat Basin and independent work conducted by CRC an average of four persons per boat instead of five is more accurate for a destination harbor such as Nantucket. Boats in the Boat Basin and those on moorings in the general anchorage area never reach 100 percent occupancy. (The Marine Department estimates rates of 67 percent and 90 percent, respectively.) This computes to approximately 1,200 overnight boaters or 4.8 percent of the total peak overnight population.

By the summer of 1990, although recreational boating was in the second year of a regional decline, the number of boats on Nantucket with sleeping accommodations on a peak night was 638, considerably greater than 1978, a decade earlier. (The 1990 "Update of the Growth Trends on Nantucket") Using occupancy ratios for 1990, peak overnight boat occupancy was approximately 2,200 individuals or 6.3 percent of the total peak overnight Island population. This represents an 83 percent increase in the number of overnight boaters in twelve years, and a greater percentage of visitors using vessels as accommodations, rather than shoreside facilities.

Recreational Vessel Activity. The economic boom of the 1980s resulted in tremendous growth for recreational and leisure activities, with boating being one of the largest beneficiaries. From 1979 to 1989 the number of people in the United States who participated in boating increased from 60 million to 73.3 million, nearly 22 percent (National Marine Manufacturers Association 1990). In Massachusetts the rate of increase in recreational boating was much higher than the national average. The numbers of boats registered in Massachusetts grew from 170,000 in 1977 to 350,000 in 1989, a 105 percent increase in a decade. (Cavanaugh and Lewis 1990). Although no specific figures are available for Nantucket, a similar, if not greater, percentage increase is likely to have taken place.

Aerial photographs, local residents, waterfront business entrepreneurs and town officials all indicate that Nantucket harbor has experienced substantial changes in harbor activity during the past twenty five years, with rapid changes taking place in the mid to late 1980s. The promotion of Nantucket as a destination harbor for tourists, the construction of the Boat Basin, and the reconstruction of the downtown waterfront area have made recreational boating a dominant summertime harbor activity.

The figures kept by the Marine Department are presented in Appendix E and suggest that 45 percent of the boats on moorings are

under 20 feet in length, and 17 percent of these boats are sail. The Nantucket Yacht Club has maintained records of the boats used by its members and these figures offer one perspective on the trends of the types of recreational boats being used in Nantucket waters. In 1979 there were approximately 145 boats with an association to the Yacht Club. In 1990 this number had increased by 169 percent to 390 boats. The growth is not surprising considering the economic boom of the 1980s, however, what is interesting is that the ratios among sailboats over twenty feet, power boats over twenty feet, and all other boats under twenty feet, remained nearly identical for both years. Approximately 50 percent of all the Yacht Club boats are under twenty feet in length, 17 percent are sailboats over twenty feet and 33 percent are power boats over twenty feet (see Moorings and Slips Inventory, Table 5).

Monitoring the changes and ratios of the type, number, and size of vessels within a particular harbor provides important information about the intensity of harbor use. Nantucket's inner harbor and Madaket harbor are limited in their ability to accommodate more and more vessels by their size, geography, water depth and crowding of other uses, such as federal anchorages or navigation channels and fishery areas. Restrictions on the type of vessels the harbor can accommodate is very different for Nantucket Harbor as compared to Madaket.

The type and size of vessels that can be expected to visit Nantucket at any given time, as compared to regular Yacht Club memberships, varies with the economy. As slip space and moorings become more expensive small boats will move to trailers, and as fuel prices rise small power boats will be replaced by sailboats. The Nantucket Boat Basin has seen the average numbers of boats docked in the basin reduced by 23 percent since the early 1980s, however, the average length of each boat has increased by nearly ten feet in this same period.

The demand for moorings by island residents, property owners and visitors, can be expected to continue to increase. In spite of the decline in the economy, people are still moving to Nantucket and one of the reasons they come is to enjoy being in a location where they can use a boat. Mooring fields and anchorage areas have been and are continuing to become more congested. Current regulations require that permission is obtained from the Harbor Master to place and maintain a mooring within the waters of Nantucket. A waiting list is kept for areas where no additional spaces are available. Consideration given to expanding to or adding new mooring fields or anchorage areas should not exceed the harbors' carrying capacity to maintain high water quality standards, to protect resource areas, and to support multiple-use areas.

2. Shoreline Access and Recreational Areas

Nantucket Harbor Public Shoreline Access Areas. The following numbered areas describe points of access located on Map D. The numbered areas coincide with access locations on the map starting in the upper left corner and moving counterclockwise around the harbor.

Jetties Beach (1) - located west of the channel at the entrance to Nantucket Harbor, this site consists of a wide, sandy public beach with many amenities. The facilities at this site include a playground, public parking, seasonal showers and bathrooms, concessions, and tennis courts. Owned by the Town of Nantucket.

Charles Street (2) - located off of Hulbert Avenue, this site is a 16 foot wide public right-of-way. No parking is available.

Brant Point (3) - located at the end of Easton Street, this historical lighthouse is a well-known landmark to boaters entering the harbor. The area is used for sightseeing, bathing and fishing. No parking is available. Owned by the U.S. Coast Guard.

Children's Beach (4) - located south of Brant Point, this site is a bathing beach and buoyed swimming area with a lifeguard available during the summer months. Facilities include a boat ramp, dock, playground, and public parking. Owned by the Town of Nantucket.

Easy Street (5) - located one block south of the Steamship Authority, this site is a nicely bricked area consisting of picnic benches, trash and recycling barrels, and has one of the only streetside views of Nantucket Harbor.

Town Dock (6) - the Marine Department is located on Washington Street, facilities include an 834' long dock, dinghy dock, pump-out station, potable water, ice, public bathrooms/showers, trash and recycling barrels. Public parking is located across the street. Owned by the Town of Nantucket.

Francis Street Beach (7) - located on Washington Street, this small bathing beach is town-owned property.

Shore Reservation (8) - located south of the shipyard, contiguous with a large salt marsh known as "the Creeks." This area is owned by the Town.

Winthrop Road (9) - this site is a permanent town easement with a footpath leading to a beach jointly owned by the

residents of Monomoy Heights.

Off Polpis Road (10) - located at the corner of Wauwinet Road, this site offers boat access at the courtesy of the landowners and is not permanent. The site consists of a 20' wide dirt road and a small parking area.

Polpis Harbor Launching Area (11) - a sand launch area and a 30' x 35' parking area is provided for boat access to Polpis Harbor. Permanent easement granted to the Town of Nantucket.

Pocomo Point (12) - a rocky beach used for swimming, bathing, windsurfing, and panaromic viewing of the harbor. Parking available.

Wauwinet Gatehouse (13) - permit sales and check point to Coatue-Wauwinet-Great Point barrier beaches. An Oversand Vehicle permit is required. Pedestrian access is free-of-charge. There is a half-mile walk to reach the public access area and an additional half-mile walk in loose sand to reach the water. Sections of these refuges may be closed to vehicle and pedestrian traffic by the refuge managers to protect sensitive coastal resources and/or nesting shorebirds. Owned and operated by the Nantucket Conservation Foundation and the Trustees of Reservations.

Madaket Harbor Public Shoreline Areas. The following numbered areas describe points of access located on Map B. The numbered areas coincide with access locations on the map starting in the upper left corner and moving counterclockwise around the harbor.

Eel Point (1) - a barrier beach surrounded by a large salt marsh, Madaket Harbor and Nantucket Sound. It is a primary site for observing coastal flora and fauna. Sections of this refuge may be closed to vehicle and pedestrian traffic by the landowner to protect sensitive coastal resources and/or nesting shorebirds. Owned by the Nantucket Conservation Foundation.

Warren's Landing (2) - a dirt road leads down to this sandy coastal beach. Pedestrian access only. Owned by the Town of Nantucket.

Little Neck (3) - comprised of coastal dune and beach, this tidal-influenced open land offers a key vantage point of Madaket Harbor and Hither Creek. Owned by the Nantucket Conservation Foundation.

Madaket Town Pier (4) - located in Hither Creek, at the end of F Street, this site consists of a public pier, boat ramp, on/off loading area, and street side parking. Owned by the Town of Nantucket.

Massachusetts Avenue (5) - this site is a bulkhead with a hard-packed sand parking lot for on/off loading of boats. Owned by the Town of Nantucket.

Smith's Point (6) - a wide and sandy beach with a small soft sand parking turnout at the head of the footpath. Owned by the Town of Nantucket.

3. Waterfront Land Use and Zoning

Land Use. Of Nantucket Island's 31,000 acres, approximately one-third is conservation land, one-third is developed, and one-third is unprotected. Most development is concentrated in downtown Nantucket. Land uses on the Island broadly include: residential, commercial, industrial, transportation, institutional and other conservation.

Conservation Land. Nantucket has over 10,925.40 acres of conservation lands. The coastal properties include beaches, marshes, ponds, and tidelands. The amount of conservation land owned by non-profit organizations and governmental agencies is itemized in Table 6. These properties contain critical conservation land, including protected habitat types such as barrier beaches and rare wildlife and plant species habitat. Selected areas are used for low-impact, passive recreation activities that are compatible with sensitive natural resources, such as beach exploration, walking, picnicking, birding, and fishing.

An inventory of parcels abutting the shoreline was documented to depict detail of land uses. Fiscal Year 1988 information was researched for parcel size, building size, septic systems, underground fuel storage tanks, and open space. The inventory depicts buildings as of fiscal year 1988, zoning, wetland file numbers, and conservation land. This inventory is on record with HPAC files and will be utilized as a reference to compare changes in shoreline development and land use activities upon future five-year Harbor Plan updates.

Nantucket Harbor Zoning. The Nantucket Harbor downtown waterfront area consists primarily of commercial land uses such as retail, car and bike rentals, grocery stores, restaurants and lodging. Zoning for this area includes Limited Use General (LUG) 1 & 3, Residential 1 and Residential Commercial. Boating services include the Boat Basin, U.S. Coast Guard, the Shipyard, boat repairs, and a launch service.

Most of the rest of the land surrounding Nantucket Harbor is zoned LUG 1 (40,000 sq. ft. lot size) or LUG 3 (120,000 sq. ft. lot size).

Table 6
Acres of Non-Profit or Government-Owned Lands on Nantucket Island

Agency	Acres
Maria Mitchell Association	13.3
The "Sconset Trust, Inc.	26.5
Open Land Fund, Inc.	76.3
The Trustees of Reservations	792.4
Massachusetts Audubon Society	905.2
Commonwealth of Massachusetts	88.7
Nantucket Land Bank Commission	1,060.9
Town of Nantucket	142.0
Nantucket Conservation Foundation	8,220.0
TOTAL	11,325.3

Conservation/Recreation Areas
(includes parcels abutting shoreline only)

Nantucket Harbor

The Trustees of Reservations	787.59
Nantucket Conservation Foundation	536.48
Town of Nantucket	35.53
University of Massachusetts	106.98
U.S. Coast Guard	4.70
TOTAL	1,472.28

Madaket Harbor

Nantucket Conservation Foundation	152.37
Town of Nantucket	24.18
Nantucket Land Bank	40.80
TOTAL	217.35

Madaket Harbor Zoning. The land surrounding Madaket Harbor is LUG 2 (80,000 sq. ft. lot size), LUG 3 (120,000 sq. ft. lot size), and Residential 2 (20,000 sq. ft. lot size). Land around Hither Creek is zoned Residential 2 and a portion of Residential Commercial (5,000 sq. ft. lot size).

Residential Development. The permanent population of Nantucket is expected to increase over the next 20 years (RKG 1989) The island has experienced a three percent annual growth rate since 1970 (RKG 1989). According to a national report on our nation's coastal populations published by NOAA, Nantucket will be the ninth fastest growing county in the northeast (Virginia to Maine) and the fourth fastest in New England, behind Barnstable (Cape Code), and Dukes (Martha's Vineyard) in Massachusetts and Rockingham, New Hampshire (Culliton et al. 1990). Although the pace of development levelled off from 1986 to 1989 according to new house construction building permits, intensification of uses (which includes waterfront development, building activity, and increased water uses) is expected to increase again upon economic recovery of the region (Figure 13).

Tourism. Nantucket's seasonal daily peak population is also expected to increase. Between 1978 and 1989 it rose approximately 40 percent, from 25,000 to 35,000, (RKG 1989). Any new restrictions on growth and economic conditions are likely to reduce this somewhat, but even a rate of 25 percent over the next decade, will result in more than 43,000 people being on Nantucket on any given day through the year 2000. These numbers support a national trend of more people living in and moving to the coastal zone, of which all of Nantucket Island is included. More importantly for the purposes of this review, increases in population will account for greater demands on the services and activities that occur in, on and around the island's harbors.

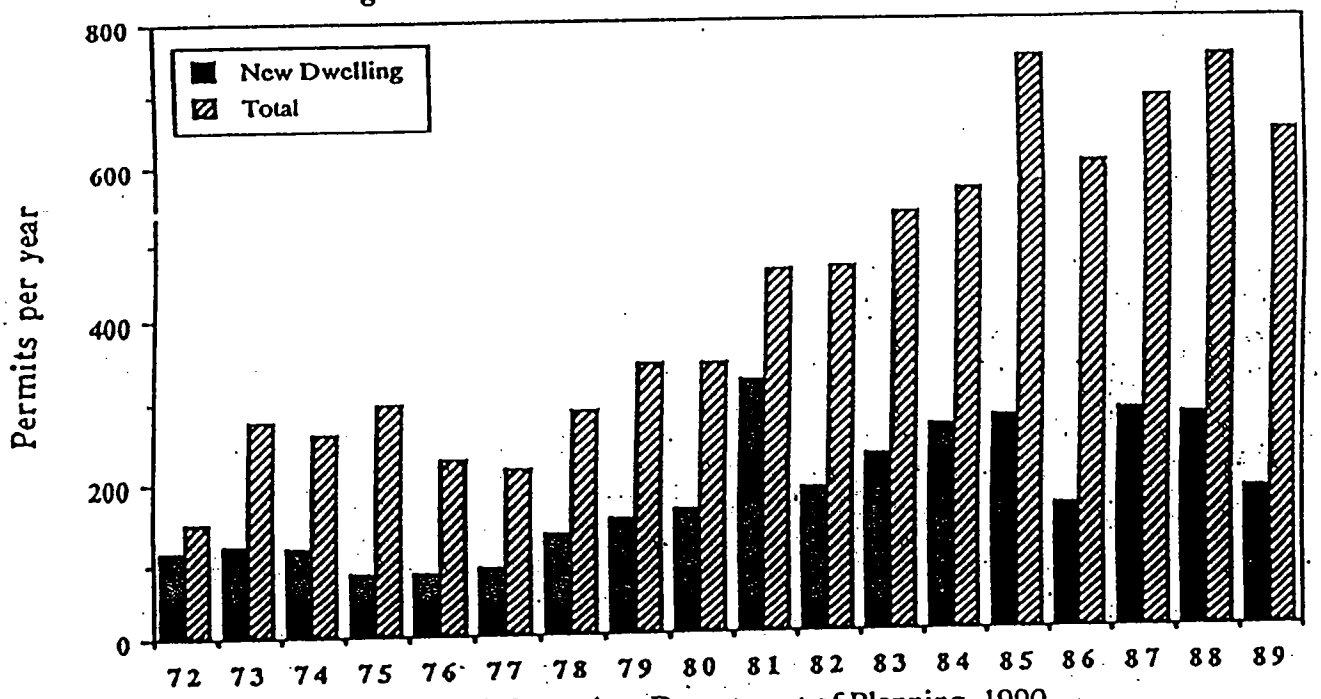
4. Commercial Boat Traffic

Passenger and Freight On/Off Loading. Passenger ferry service is shared between the Nantucket Steamship Authority and the Hy-Line Cruise Company. Facilities at the Steamship Authority and Nantucket Boat Basin provide dockage for ferry boats, which operate 12 roundtrips during the summer season. Hy-Line is authorized for operation by the Steamship Authority and offers service only during the busy season.

Commercial Vessel Activity. There are a variety of commercial vessels that can be found in Nantucket Harbor, whereas Madaket's size limits commercial boats almost exclusively to scallop boats.

Passenger Ferries. As the island population continues to increase the goods and services received from the mainland will also increase. The most visible sign of commercial vessel activity related to population growth is ferry activity. The Nantucket

Figure 13. Nantucket Building Permits, 1972 -1989



Source: Town of Nantucket, Department of Planning, 1990

Steamship Authority and the Hy-Line Cruise Company have shared in the steady growth of passenger business since the mid 1970s. Between 1979 and 1989 passenger boardings rose by 19 percent, from 609,920 to 725,678. An increase in the frequency of vessel calls was necessary to accommodate this growth, with summer season daily visits between the two carriers going from 8 in 1979 to 12 in 1989. During those years the Steamship Authority added a second slip and completely rebuilt Steamship Wharf to handle anticipated future growth in passengers and vessel berthing needs. In addition to the 19 percent increase from 1979 to 1989, there is a marked seasonal increase in growth. The Steamship Authority's passenger and freight service is doubled each year throughout the months of June, July and August.

In 1989, a high-speed catamaran service was attempted between Nantucket and Boston. Due to low passenger numbers and frequent incidence of seasickness during the trips, the service did not run a full season.

Freighter Ferries and Dry Cargo Barges. In addition to passenger service, the Steamship Authority provides the only freighter ferry to the island, and it uses its facility to off-load liquid and dry bulk products. The freighter operates once a day during the busy summer season and although its schedule increases in frequency during the fall and spring, the summer represents the time of the greatest potential for conflict with other harbor and waterfront activities. Freight volumes carried on the ferries doubled in ten years from 63,497 tons in 1980 to 130,307 tons in 1989 (Nantucket Steamship Authority). Although growth in commercial freight can be expected to continue, it is unlikely that it will double again within the next ten years. Based on projected population figures, however, a 50 percent increase would be within reason by the year 2000.

At the present time Steamship Wharf is the only waterfront dock capable of handling commodities like construction aggregate and modular homes. Most of the aggregate shipments are directly related to local road construction projects and the number of barges can vary greatly in any given year. For instance in 1989 there were nine barges, whereas in 1990 there were twenty-nine (Table 7). As more housing developments are established this commodity can be expected to increase. Since 1987, modular home barges have increased from two to nineteen. If housing costs continue to remain high in proportion to wages, and there is every reason to believe they will, then this alternative may become more common as one means of providing more affordable housing for the island's population. Data from 1986 through 1990 indicates a total of 218 barges, or an average of 43 per year (one every 8.5 days), arrived at the Steamship Wharf.

Fuel Deliveries. As the island grows, so too does fuel consumption and fuel barge traffic into the harbor. Two sites

Table 7
Barge Traffic at Nantucket Steamship Terminal

Year	Barge Type	Number of barges	Tons	
1986	Gravel	10	6,381	tons
	Aviator Fuel	37	312,000	gallons
1987	Gravel	42	32,626	tons
	Aviator Fuel	14	360,005	gallons
	Modular Homes	2		
1988	Gravel	19	13,179	tons
	Aviator Fuel	15	454,179	gallons
	Modular Homes	1		
	Cranes	2		
1989	Gravel	9	5,424	tons
	Aviator Fuel	11	426,570	gallons
	Modular Homes	8		
1990	Gravel	29	22,866	tons
	Modular Homes	19		
Total	**Gravel**	**109**	**80,476**	**tons**
	Aviator Fuel	**77**	**1,552,754**	**gallons**
	Modular Homes	**30**		
	Cranes	**2**		

Source: Nantucket Steamship Authority

provide off-loading facilities for barges.

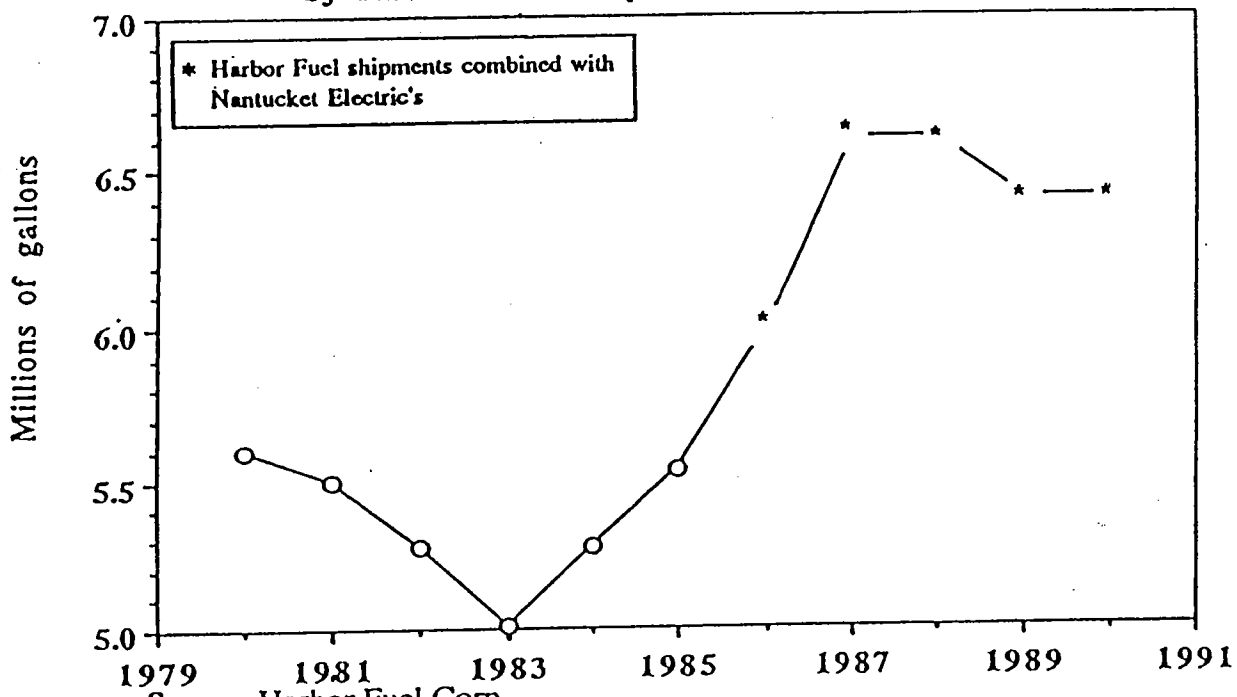
Aviation fuel is delivered by barge to a temporary pipeline located at the southeastern edge of the inner harbor. Fuel products are pumped through a pipeline extending over salt marsh flats into trucks waiting on Washington Street. Prior to 1990, these products were transported by Steamship Authority's cargo freight boat and off-loaded at Steamship Wharf. In 1989, 13 deliveries were made delivering 474,000 gallons of aviation fuel. The Use Permit for the Airport's temporary fuel off-loading facility expires July 1993. The facility will then need to be renewed or an alternative for transporting and delivering aviation fuel products will need to be implemented. In 1991 the Airport Commission signed a temporary lease with Harbor Fuel to barge and store the jet fuel component of their shipments to the New Whale Street Tank Farm. Jet fuel comprises approximately two-thirds of the Airport's annual fuel deliveries. Aviation gas comprises the remaining one-third delivery and is still being off-loaded adjacent to the boatyard.

The other major liquid bulk operation that takes place in Nantucket Harbor is the transfer of automobile and home heating fuels. Harbor Fuel Company and Nantucket Electric Company fuel deliveries are barged to the New Whale Street finger dock located within the Nantucket Boat Basin. Fuel is put into one of six valves and directed to one of five grounded pipelines running under the dock and then under New Whale Street into the Tank Farm. Between both companies, approximately 28 barges carried slightly more than 9 million gallons of home heating oil and gasoline to Nantucket in 1979. By 1989 these figures had increased to approximately 28 barges carrying 12.8 million gallons. (Exact numbers are difficult to establish because the Electric Company shares barge service with Harbor Fuel about 75-80 percent of the time, but each organization counts the split voyage as one barge visit for their company). Figure 14 depicts the trends in fuel deliveries from 1980-1990 to Nantucket Harbor. There was a dramatic increase in deliveries until 1987, since then it has been fairly level.

The tugs and barges providing the liquid bulk services must navigate through the inner harbor to reach their terminals. This has proven particularly hazardous for barges navigating the shallow depths and tidal flats in front of the Airport's temporary pipeline. One barge grounded on an outgoing tide. A small window of time exists for the barge to enter, off-load and exit the harbor with the tide. Although the barges come and go throughout the entire year, larger barges are used only during the off-season, usually in the fall and winter.

The water around Nantucket, Muskegat and Tuckernuck Islands is designated Ocean Sanctuary (See NOAA chart #13241.), and there is a federal prohibition on transport of cargoes of oil or hazardous

Figure 14. Heating Fuel Deliveries to Nantucket by Harbor Fuel Corp. 1980- 1990



Source: Harbor Fuel Corp.

materials and all other vessels of more than 1,000 gross tons (MSC IMO XLIII/18). The area consists of navigational hazards such as rip currents, shoaling and sand bars, rendering it unsafe for transport of hazardous materials. Based on this water transport of hazardous materials including fuel to the island appears possible only through the federal navigational channel into Nantucket Harbor.

Committees and reports have reviewed options for a permanent fuel off-loading location but a permanent location and consolidation of deliveries has yet to be made.

Resolution of a permanent bulk fuel off-loading and storage site must be achieved by the Electric Company, Airport Commission and Harbor Fuel. The location must be sited for public safety and marine resource protection.

Other Commercial Vessel Activities. A handful of boats are chartered on a quasi-regular basis for sportfishing, sailing, and power boating. These enterprises all form part of the activities normally associated with a recreational marine tourist destination, however, they have not been able to succeed to the degree that similar businesses have in other locations. Without further study of these operations it is difficult to speculate as to the reason they have not been able to flourish in an environment that appears to be suited for such activities.

A harbor tour boat and small cruise ships are also part of the island's commercial maritime business. Cruise vessels have been visiting the island for many years, but after reaching a peak of 50 days during 1988, visits have steadily declined. In 1989 there were 42 days, 33 in 1990, and the schedule for 1991 is only 18 days. Nantucket remains a desirable port for small cruise ships and this business is likely to increase as the economy improves. However, visits are also contingent upon vessel draft. The shallow channel makes it difficult, even for small coastal cruise ships to make Nantucket a regular port-of-call.

5. Commercial Fishing Fleet

Scallopers. Approximately 100 scallop boats work out of Nantucket on a seasonal basis and fish productive scallop beds primarily within the harbor boundaries of Madaket and Nantucket Harbors. Over the last decade, commercial scallop landings have been decreasing. From a high of 117,600 bushels harvested in 1981, annual harvest declined to 25,000 bushels in 1989 according to Massachusetts DFWLE, Division of Marine Fisheries Statistics (Figure 3). According to the Nantucket Marine Department, the annual number of licenses issued for commercial shellfishing during 1990-91 was 254. Of these 97.5 percent are scalloping licenses (per. communication with the Marine Department, 4/18/91). Action on the part of the Shellfish Harbor Advisory Board and the Marine

Department to assess the status of the scallop resource in Nantucket waters, and the amount of effort necessary to sustain the resource is on-going.

Commercial scallop boats, and licensed scallopers that work on them, form a key component to the character of the island. The trend most often associated with commercial scalloping is one directly related to the overall status of the economy. During boom years, there tend to be fewer commercial scallopers because people can earn a living doing other things. When times get bad, and workers are laid off or lose their jobs, they frequently turn to fisheries resources to sustain their income. It can be expected that during early 1990s the numbers of individuals seeking to work as commercial scallopers will rise, unless the economy makes a rapid recovery.

Offshore. Until the late 1960s Nantucket served as the home port to a small but viable off-shore fishing fleet. Today, however, only one year-round commercial dragger and a few offshore commercial fishing boats continue to call Nantucket home. Market conditions, competition from mainland fleets, costs of berthing and processing facilities, product transportation costs and the shift to a recreational tourism-based economy has made Nantucket unattractive to off-shore commercial fish boats. There is no indication that this trend will shift. Commercial fishing boats need a shoreside infrastructure that offers adequate docking, processing facilities and services, as well as markets. Without this support network fishing boats will go elsewhere and it is not likely that these conditions can be met on Nantucket in the foreseeable future.

6. Recreational Uses

Within the harbors of Nantucket Island there are numerous other uses, including, but not limited to recreational activities such as: sailing, swimming, windsurfing, jet skiing, water skiing, and bird watching. Many of these activities are directly related to a growing population with more leisure time and discretionary money. Recreational water uses are directly related to Nantucket's tourist economy.

Sailing. From yachts at anchor in Nantucket Harbor or at the Boat Basin to sunfish and catboats sailing up harbor or participating in a Yacht Club weekend race, sails of all colors and sizes blanket the harbors' waters throughout the summer. Sailing is a primary recreational activity in Nantucket's waters.

Windsurfing. Windsurfing is another popular harbor use. Regattas are held throughout the summer, and people participate throughout the year depending upon wind conditions. Although not inexpensive, windsurfing has a better potential for continued growth than water skiing. The boards are easier to transport than

a boat and, commercial development of racing events and other promotional ideas is a possibility in a location like Nantucket. Although these activities are not the leading uses of Nantucket's harbors, they must be factored into the management of the town's waters.

Swimming. There are three public swimming beaches in the downtown area, Jetties Beach, Children's Beach and Francis Street Beach. Jetties and Children's Beaches both have playgrounds and concessions and are within walking distance of the numerous inns downtown. These areas are heavily used during the summer months.

Water-skiing. Although the older sport of water-skiing continues to grow by about 100,000 new participants nationally each year (National Marine Manufacturers Association), estimates for Nantucket indicate a dedicated and steady number of approximately 25 ski-boats on the water during the busy season for the past few years. It is not expected that water-skiing will see any appreciable growth on Nantucket during the next ten years.

Jet Skiing. It is estimated that during 1990, there were 100 jet skis that operated within Nantucket Harbor. (Personal communication with the Nantucket Marine Department, 1991.) Most of these came off of large yachts visiting the island and very few were used by local residents or shoreside guests. Jet skis impede with safe swimming and boating and many communities are pursuing ways to limit or restrict their use.

Birdwatching. Birdwatching is a primary recreational activity around the harbors. Locations frequented for sightings are Coatue, Coskata, Wauwinet, Polpis and Quaise in Nantucket Harbor; and Eel Point, Hither Creek, Smith's Point and Esthers Island in Madaket Harbor. Large groups of people come from off-island to participate in the annual Christmas bird count. Weekly bird walks are lead by naturalists from the Maria Mitchell Association spring, summer and fall.

CHAPTER 3. ISSUES, GOALS, OBJECTIVES, POLICIES, AND ACTIONS

The issues addressed in the Harbors Action Plan were originally identified at a public hearing held in September 1989. Subcommittees were formed to expand on the issues and to formulate goals and objectives addressing these areas of concern. Additional public meetings were held and written public comments were received which further discussed the issues affecting both harbors, and suggested goals and objectives.

Using the information obtained in the preceding stages of the planning process, the HPAC developed goals and objectives to meet

point and non-point discharge which may significantly contribute potential water quality degradation in both harbors. App pollution abatement methods where necessary to maintain existi high water quality standards. (Marine Department, Board of Healt Department of Public Works, NP&EDC)

(8) Investigate the need and methods for improving wat circulation in areas including but not limited to the Monom Creeks, Folgers Creeks, Coskata Pond. (Board of Selectmen)

(9) Analyze the feasibility and need for instituting a zoni bylaw for a waterfront overlay district, where the zoni regulations incorporate state standards for coastal protection a water quality. (Planning Board and NP&EDC)

Public Education

(1) Develop and distribute public education materials for boate on the locations and use of pump-outs, toxic waste, recycling a: trash receptacles, and environmentally safe cleaning agent: Information will be distributed by the Marine Department, Board Health, Boat Basin, Yacht Club, other marine-related businesse: and the Chamber of Commerce. Funding may be sought from grou such as Maria Mitchell, Chamber of Commerce, Nantucket Guide, a: water-related businesses. (Harbor Planning Advisory Committee)

(2) Develop and distribute public education materials for la owners within the watersheds of both harbors. Topics shou include appropriate use of fertilizers, siting and maintenance septic systems and in-ground household fuel tanks, and t importance of natural vegetated buffers. Funding may be sought fr groups such as the Nantucket Land Council , Nantucket Conservati Foundation, Nantucket Garden Club and the Rotary. (Town Depts.)

(3) Continue to develop educational materials and field trips water quality protection and environmental awareness to be used the school curriculum. Encourage town employees, business owner: and non-profit organizations to continue working with the school: (School Committee)

Boat Pollution Abatement

(1) Implement and' enforce existing regulations to prohib: pollution from boats. These include but are not limited to:

- The Board of Health Regulation 32.00 adopted in 1989 to impose a $200 fine for discharge of sewage;
- Chapter 137-14 of the Town Code adopted in 1982 that prohibits boats without legally approved waste and sewa treatment equipment or holding tanks from using the harbo
- Board of Health Regulation 31.00 requiring permission fr the Board of Health for resident vessels, rafts and float The Board of Health permit should enforce Town Code 137.1
- 40 CFR110 - Federal Water Pollution Control Act.

- 33 CFR - Oil and Plastic Pollution, and Related Facilities
- 49 CFR - Hazardous Materials
- Chapter 21 MGL - Water Pollution
  (Marine Department, Board of Health and U.S. Coast Guard)

(2) Pursue the designation of both harbors as no-discharge harbors. (Federal designation under the Clean Water Act, Appendix H) (Board of Selectmen, Marine Department)

(3) Recommend the use of environmentally safe cleaning agents and boat maintenance products in place of hazardous contaminants. (Marine Department, Nantucket Boat Basin, Nantucket Yacht Club, Island Marine Services, Inc., Madaket Marine, Inc.)

(4) Develop an action plan to enforce the use of pump-out facilities. Consider and encourage cooperation between the Board of Health, Marine Department, and Boat Basin to provide a private enterprise floating barge facility to supply water, ice and pump-outs.(Marine Department, Health Department, Nantucket Boat Basin)

(5) Provide sufficient trash and recycling barrels at public and private boating facilities.(Marine Department, Department of Public Works, Nantucket Boat Basin, Island Marine Services, Inc., Madaket Marine Inc., U.S. Coast Guard, Nantucket Yacht Club)

Non-Point Source Pollution Control

(1) Implement and enforce existing Conservation Commission, Fire Department, Board of Health, and zoning regulations and rules to mitigate pollution from land use around the harbors.

These regulations and by-laws include but are not limited to:
- Setbacks between septic systems, drinking water wells and surface water bodies (Conservation Commission and Board of Health)
- Pesticide/fertilizer application setback standards (Conservation Commission)
- Sediment erosion control standards (Conservation Commission)
- Septic system inspection and upgrade (Board of Health)
- Gasoline, diesel, and household heating fuel storage facilities should be installed and maintained according to the Fire Department Code. Existing in-ground tanks should be replaced according to the existing regulations. (Fire Department program and Board of Health)
- Enforce state plumbing code requiring the use of water conservation devices for both residential and commercial use (Plumbing Inspector)

(2) Marinas, boatyards, recreational areas, and waterfront businesses will provide containers for appropriate disposal of lubricants, paints, litter, boat sewage and other contaminants.

Facility operators are responsible for disposal according to 310 CMR 30.00 Massachusetts Hazardous Waste Regulations.(Marine Department, Department of Public Works, Nantucket Boat Basin, Nantucket Yacht Club, Island Marine Services Inc., Madaket Marine, Inc., U.S. Coast Guard)

(3) Amend existing bylaws to minimize non-point source pollution from new or expansion development within all harbors watersheds.

a) Storm water drainage systems should include catch basins that terminate into vegetated swales instead of discharging directly into harbor waters. (Planning Board)
b) Adopt uniform policy to discourage the use of impervious surfaces within the watersheds of the harbors. (Planning Board and Conservation Commission)
c) Prohibit the use of asphalt as a pavement abutting all harbors to minimize pollution from storm water runoff. (Conservation Commission and Planning Board)
d) Expand natural vegetated buffers along the edge of the ponds and harbors. (Conservation Commission)

(4) Finalize and implement the oil spill contingency plan to all harbors. (NP&EDC, Fire Department, Marine Department, Board of Health and others)

(5) Adopt new bylaws to minimize the residential use of herbicides, fertilizers, and pesticides. (Board of Selectmen, Conservation Commission)

(6) Designate critical habitat protection areas that are not suitable for development. (NP&EDC, Conservation Commission, Harbor Planning Advisory Committee, SHAB)

B. Natural Resource Protection

Issue

As a result of the Island's coastal development, increased tourist population in recent years, and overcrowding in all harbors, there is much concern about protecting and preserving the fragile ecosystems,' wildlife habitats, and open space around all harbors.

Goal

To establish and manage a harbor-wide network of publicly and privately held open spaces within the boundaries of the harbor intended to protect critical land and water resources, habitats, and scenic vistas.

Objectives

(1) Preserve open space to enhance the protection of surface and groundwater quality, wetland resource areas, and wildlife habitat.

(2) Continue to site new residential and commercial development in a manner that protects the following critical environmental resources: wetland resource areas, flood-prone areas, estuarine systems, endangered species habitats, scenic coastal vistas, and other coastal fragile habitats or environmentally sensitive areas.

(3) Identify critical resource areas and protection strategies for shellfish beds, tidal flats and salt marshes in siting the future construction of docks and piers.

(4) Investigate the possibility of a zoning change throughout the harbor in order to preserve ecologically sensitive areas outside of the downtown waterfront.

(5) Educate the public, including all appropriate citizens' groups about the importance of preserving and protecting open space and environmentally sensitive areas around both harbors.

(6) Protect natural resources from toxic and hazardous contaminants.

Policy

Therefore, it shall be the policy of the Town to protect and preserve coastal habitats, wildlife corridors and all other environmentally sensitive resources to maintain Nantucket's quality of life.

Action Items

(1) All new residential and commercial development to be sited abutting any environmentally sensitive area should be sited in a manner that protects the following critical environmental resources, and unique and fragile landforms:

- marshes, ponds, and estuaries
- hurricane flood prone areas
- rare and endangered species habitats
- coastal scenic views
- barrier beaches
- coastal dunes

This action item should also be incorporated into the Open Space Plan. (Conservatioh Commission, Planning Board, Board of Health)

(2) Support enforcement of Nantucket Board of Health regulation 63.0, Toxic and Hazardous Materials. This regulates the storage, control, registration and inventory of toxic or hazardous materials stored in quantities totaling more than 25 gallons liquid volume or 50 pounds dry weight.

(3) Support enforcement of Nantucket Board of Health Regulation 70.00, Underground Fuel and Chemical Tank Regulations. This regulates the installation, registration, testing and removal of tanks to protect ground and surface waters from potential

contamination.

(4) Pursue public educational materials warning all waterfront property owners or renters, and summer visitors, as to the dangers of pollution to the waters by: cleaning agents containing phosphates and hazardous wastes, lawn fertilizers, failing septic systems, and other potential sources of non-point source pollution. Public education materials should include signs, posters, mail-out flyers, and pamphlets. (Board of Selectmen, Realtors Association, Chamber of Commerce, Tourist Information Bureau)

(5) Produce a document describing environmentally responsible building on the shores of Madaket and Nantucket Harbors to be geared for potential home builders. (Conservation Commission, NP&EDC, Building Department)

(6) Inventory and map the Island's critical resource areas around the harbors including: wetlands, flood prone areas, estuarine systems, endangered species habitats, scenic coastal vistas, and other coastal fragile habitats or environmentally sensitive areas. (Conservation Commission, Harbor Planning Advisory Committee)

(7) Establish and implement protection policies (including policies under the Water Use Classification section) and performance standards for siting docks and piers outside of the commercial district. Performance standards should include but not be limited to length, depth, location, construction materials and methods, and critical resource areas.

When impacting critical resource areas, docks and piers will not be allowed outside of commercial districts. Critical resource areas include but are not limited to salt marshes, tidal flats, shellfish beds, eelgrass beds, endangered species habitat, and scenic coastal vistas. (Conservation Commission).

(8) Support town and state endorsement of conservation restrictions within the watersheds of the harbors as cost effective means of achieving the benefits of natural resource protection. (Board of Selectmen, Massachusetts Division of Conservation Services)

(9) Maintain an ongoing inventory of existing open spaces that have been preserved within the harbor boundaries as begun in parcel inventory on file with HPAC records. (NP&EDC)

(10) Pursue an open space program that includes strategic acquisitions of land, easements, or restrictions which serve to protect surface water quality, ground water quality, environmentally sensitive areas, and fragile natural wildlife habitats. (Nantucket Land Bank, Conservation Commission, Nantucket Conservation Foundation, Nantucket Land Council)

(11) Enforce implementation of local wetland by law and Massachusetts DEP regulations for wetlands protection. (Conservation Commission)

C. Commercial and Recreational Fishing

Issue

Both commercial and recreational fishing are important components of the Nantucket economy. A portion of Nantucket's population is dependent on this activity as a source of income. There is concern that adequate shoreside commercial fishing facilities such as affordable slip and dinghy dock space, ice and fresh water, and a truck off-loading area are lacking. Access for recreational fishing also needs to be improved.

Goal

To adopt policies, and take actions to ensure the continued viability and to promote the revitalization of the historically and economically important fishing activities in Nantucket's harbors.

Objectives

(1) Provide and improve waterfront access points, including boat ramps, parking, affordable slip space, and dinghy docks for all harbors.

(2) Designate areas on the shore specifically zoned and dedicated to activities such as fishing access as well as water dependent activities such as unloading, processing, packing and shipping for Nantucket Harbor.

(3) Ensure that moorings, slip space and dinghy docking facilities for commercial fishing interests are available and easily accessible.

(4) Support aquaculture projects as a viable component of commercial fishing in Nantucket and Madaket Harbors.

(5) Develop and implement a fisheries management plan for both Nantucket and Madaket Harbors.

(6) Investigate the economic viability and need of a commercial fishing pier. (NP&EDC, Marine Department, SHAB, Board of Selectmen, and others)

Policy

In recognition of the importance of commercial and recreational fishing for the maintenance of the marine heritage of the Town, it shall be the policy of the Town to maintain fisheries as part of the balance of uses of Nantucket and Madaket Harbors.

Action Items

(1) Prepare a fish and shellfish management plan which will

strengthen the Island's commercial and recreational fisheries. (Marine Department and SHAB)

(2) Implement the fish and shellfish management plan through adopting regulations and non-regulatory initiatives. (Marine Department and SHAB)

- Implement lab and hatchery management for fish and shellfish propagation.
- Adopt a field management component including a survey of existing shellfish beds and designation of existing fishery management areas.

(3) Secure funding for achieving shellfish resource and infrastructure enhancement. Available funding sources should be pursued in areas such as grants (Coastal Facilities Improvement Program, Public Access Board, Land and Water Conservation Funds), developing cooperative programs with interested universities and research institutions, and collecting fines from violations of the town Wharves and Waterways Code.(Marine Department, NP&EDC))

(4) As mentioned in the public access section, develop a program to improve, maintain and locate additional boat ramps and launches in Madaket and Nantucket Harbors.(Parks and Recreation, NP&EDC)

(5) Include conditions for commercial fishing boat slips and off-loading accessibility through local special permits for Major Commercial Developments on the waterfront and Chapter 91 licensing. (Planning Board, Conservation Commission)

(6) Continue to place additional dinghy docks at the Town Dock, Children's Beach Dock, and areas where there is a demand. The Town should continue to accept donations as they have recently accepted two docks from the Nantucket Yacht Club for placement at Town Dock and the Marine Department lab at the Boathouse.(Marine Department)

(7) SHAB should work with the NP&EDC to determine the need and economic viability for a commercial fishing pier. If a need is determined, SHAB should work with the Conservation Commission to 9find a location. (SHAB, NP&EDC, Conservation Commission, Fishing Association)

D. Harbor Safety, Navigation and Moorings

Issue

Harbor safety and navigation in the waters of the small resort town of Nantucket need to be addressed in a more comprehensive manner due to: increased numbers of boats, overcrowded mooring areas, substandard mooring tackle, derelict boats, and unskilled people piloting boats at unsafe speeds.

Goal

To manage harbors for boating safety and efficiency of navigation, and to safely accommodate multiple uses in Nantucket's harbors.

Objectives

(1) Develop a safe and efficient mooring grid system and management strategy.

(2) Designate and maintain clearly demarcated channels and fairways leading to and from all mooring areas and all harbors.

(3) Enforce safe harbor traffic control.

(4) Designate water use zones to accommodate multiple uses of the harbor.

Policy

Therefore, it shall be the policy of the Town to regulate the use of all harbors, in a manner which provides for the safe, orderly and efficient use of the water and waterfront.

Action Items

(1) Establish Official Mooring Fields and Anchorages. Based on a review of site location and accessibility of existing mooring facilities and assessment of available data on number of moorings, location and types of boats, it is recommended that changes be made to mooring fields and anchorages. Recommended mooring fields and anchorages are depicted on Map C for Nantucket Harbor and Map B Madaket Harbor and discussed in Appendix E. A prototype rental mooring grid system for within the General Anchorage, field #1, is presented in Appendix L. It is recommended that mooring grids be established for each recommended mooring field based on the results of the 1991 boating season mooring and use survey by the Marine Department. The recommended mooring fields are located according to the following criteria:

a. Only necessary changes are made to existing mooring fields.

b. Larger boats (20 feet or more) to deeper water (greater than 6 feet depth), and smaller boats (under 20 feet) to shallow water.

c. In all cases mooring fields should be relocated off of tidal shallows into two feet or more of mean low water depth to establish a buffer between the mooring field and the shore. The buffer is important to protect productive intertidal zones from damage by mooring gear and potential pollutants associated with gas, oil and bottom paints and to provide a buffer for minimizing damage to boats in storms.

d. All mooring fields and anchorage areas must be designed to avoid infringing on federal navigation channels and local fairways.

e. Private moorings have been located along the shore of Hulbert Avenue for many years; the Town of Nantucket (TON) should request a General Permit through the Army Corps of Engineers (COE) to officially designate this area as a mooring field. The General Permit will give the TON administrative jurisdiction and enforcement capabilities for moorings within the specified boundaries. Exact size and shape of this area should be determined by the Marine Department pending 1991 survey data. A public hearing will be held for proposals which exceed traditionally used mooring boundaries in that area. These concerns were expressed by many individuals at the Harbor Planning Advisory Committee's April 9, 1991 public hearing. (Maps C, D, and E show a maximum area for this "proposed mooring field".)

f. Nantucket Harbor should have a designated overflow anchorage area for use when the primary inner-harbor area is full. Two locations (not accurately reflected on Maps C, D, and E) are proposed for this use:

(1) a narrow strip directly west and adjacent to the navigation channel; and
(2) the area inside (east) of First Point on Coatue.

Limits on the numbers of boats using either area shall be set in order to avoid safety and health conflict with other recreational uses in that area.

(2) Examine the possibility of classifying the various mooring users into the following categories: 1) resident, 2) resident commercial, 3) nonresident, 4) nonresident commercial. The Town should also examine the restructuring of its mooring fees by the various user classifications listed above, and/or by vessel footage, or by mooring weight. (Marine Department, SHAB, Board of Selectmen)

(3) Develop a harbor guide or chart which clearly illustrates all mooring fields, anchorage areas, channels, fairways, areas of shoaling and any other unforeseen potential hazards not immediately familiar to Nantucket's visitors. This should be funded and distributed by water-related businesses as listed in Appendix I. (Marine Department, SHAB)

(4) Analyze the feasibility and need for instituting a harbor and watersheet overlay management plan designed to regulate the conflicting harbor uses in a manner which provides for the safe, orderly, and efficient use of the waterfront and harbor waters. (NP&EDC)

(5) Enforce all local laws and regulations relating to harbor safety and navigation. Federal, state and local authorities should work cooperatively to achieve this as catalogued in Appendix D. This catalogue should be updated annually. (Enforcement: federal, state and local officials listed in Appendix D; cataloguing: BOS or designee)

(6) Recommend mooring tackle or the equivalent as outlined in Chapter 137 of the Town Code. Including 1) holding ability of the mushroom anchors; 2) uniform tackle for ease in inspections; and 3) tackle specifications for various size vessels. All mooring tackle should be inspected a minimum of once every 3 years. (Marine Department)

(7) Support the Marine Department's enforcement of Nantucket Code 137-7: Abandonment of Vessels, Moorings. (Marine Department)

(8) Pursue the recommended changes of Ch. 137 Town Code of Nantucket as necessary to improve safety, control, enforcement and environmental conditions of the Wharves and Waterways of the Town of Nantucket. (See App. G) (Marine Department and SHAB)

(9) Cooperation of local, state and federal agencies to maintain Nantucket Harbor's Federal Navigation Channel. (Board of Selectmen)

(10) Maintain channel markers and siting buoys. (Marine Department)

(11) Quantify Nantucket and Madaket Harbors carrying capacity by determining the number of moorings that can be handled in relation to protecting multiple-use water sports, natural resources and high water quality. (Health Dept., Marine Dept., Conservation Comm.)

(12) Minimize the use of jet skis by prohibiting commercial rentals through town regulation. (Board of Selectmen)

E. Public Access

Issue

As the shoreline of all harbors become more developed, opportunities for public access diminish and conflicts over appropriate use and maintenance of existing access sites increase.

Goal

Provide more public access to all harbors in the form of boat ramps, public dinghy docks, pedestrian activity, adequate parking and the future establishment and maintenance of right-of-ways.

Objectives

(1) Inventory existing coastal public access sites to all harbors, maintain and preserve those sites and seek to establish new public

access sites.

(2) Identify sites for water-dependent or accessory uses (i.e., sites where additional parking is needed, improvement of boat ramps, potential coastal park sites). Surface and construction materials and designs, for both public and private projects, must comply with Best Management Practices for non-point source pollution.

(3) Pursue state or federal funding opportunities for public access site improvement projects.

(4) Improve, maintain and locate additional boat ramps, and launch areas in Madaket and Nantucket harbors for safe public use.

Policy

Therefore, it shall be the policy of the Town to pursue opportunities for improving existing and providing new areas for public access to the waters of both harbors consistent with a policy of wise stewardship.

Action Items

(1) Require public access easements, when determined to be appropriate and safe, on all new waterfront development or expansion of existing waterfront development projects that require Planning Board approval. (Planning Board)

(2) The Town and any relevant private or public agencies, boards and/or commissions should work together to pursue an aggressive open space and right of way acquisition program that protects public access and wetland resource interests.

(3) The Town will work with the Massachusetts Department of Environmental Protection Division of Waterways to ensure adequate public access is provided for projects requiring Chapter 91 licensing. (Cons. Comm, Planning Board, DEP)

(4) Right of Way Subcommittee should:

(a) Verify the inventory of all public harbor access sites which was compiled by HPAC and is part of this Action Plan.
(b) Report existing access sites that are in need of maintenance or development.
(c) Develop a listing of potential coastal access sites ideal for acquisition.
(d) Develop a list of those sites that may require further legal research as to their potential for becoming a public right-of-way.
(e) Research the legal status of any appropriate street ends or public roads.

(5) Develop a plan to permanently acquire additional and maintain

all public rights-of-way to the shores of Nantucket and Madaket Harbors. Such a plan should include a procedure for securing funds from the state to clear title and acquire land to preserve and improve development of public coastal access sites for passive and active recreation. (R-O-W, DPW, Board of Selectmen)

(6) Sign all coastal public access sites. (DPW)

(7) Develop a public coastal access guide to include maps, site information and a matrix of natural resources, services and facilities available at each site. (Chamber of Commerce)

F. Tourism and Recreation

Issue

Tourism and recreation are crucial for Nantucket's economy. Providing adequate support facilities such as public bathrooms, hot water showers, and fresh water is essential. There is also a need for additional public dinghy docks, handicap facilities, waterfront parking, and shoreside recreational areas.

Goal

To provide adequate support facilities, services and sites for tourism and recreation in Nantucket and Madaket Harbors.

Objectives

(1) Generate an awareness of available shoreside services, facilities and recreational areas.

(2) Provide adequate shore based sanitary facilities for recreational boaters.

(3) Adopt an enforcement plan for the Marine and Health Departments to enforce existing local regulations controlling vessel discharge. Provide educational material and programs to promote the use of the pump-outs.

(4) Give highest priority and preference to water-dependent uses in suitable waterfront locations.

(5) Provide adequate public dinghy dock space in downtown waterfront area for the recreational boating population.

(6) Provide adequate areas and safety for swimming, bathing, sailboarding, walking and bird watching.

Policy

Therefore, it shall be the policy of the Town to encourage and provide for tourism and recreation.

Action Items

(1) Develop and distribute a waterfront guide to include but not

be limited to: easily readable charts of the harbors, public access areas, parking, public telephones and rest rooms, emergency telephone numbers, tide charts, fishing locations, boat rental information, location of boat ramps, pumpout information, launch service, shoreside support services, fuel dock, VHF, A&P, Marine Department. (Visitor Services, Chamber of Commerce, Information Services)

(2) Provide improved public service facilities in the central business district (to include: showers, rest rooms, telephones etc.) New or improved Major Commercial Developments on the waterfront should be conditioned to provide these public services as appropriate. It is recommended that the Marine Department and Parks and Recreation Department should make their best effort to provide facilities adequate to meet the demand. (Planning Board, Marine Department, Parks and Recreation Department)

(3) Analyze the feasibility and need for a harbor and watersheet overlay management plan designed to regulate the conflicting harbor uses in a manner which provides for the safe, orderly, and efficient use of the waterfront and harbor waters. (NP&EDC)

(4) Coordinate efforts for the purpose of promoting fishing as an important tourist activity in both harbors. (Marine Department, Chamber of Commerce, local fishing associations)

(5) Implement a data collection system that records the types and intensities of harbor uses on a quarterly (seasonal) basis. Data should include numbers and usage of moorings, slips, anchorage, boat ramps, launch areas, parking, swimming, windsurfing, water skiing, jet skiing, sailing, and power boats. (Marine Dept.)

G. Downtown Waterfront District

Issue

There is a growing concern regarding Nantucket's downtown waterfront area, including the conversion of water-dependent uses to non-water related uses, the displacement of traditional maritime waterfront activities, the loss of Nantucket's architectural utilitarian maritime character, and the need for a commercial waterfront facility.

Goal

To manage Nantucket's downtown waterfront district in a manner that promotes the utilitarian architecture of historic maritime character which provide areas for marine-related and marine-dependent activities.

Objectives

(1) Analyze the feasibility and need for establishing a downtown waterfront overlay district for zoning purposes.

(2) Maintain or improve the ability of fuel suppliers to maneuver and dock their vessels, thereby providing safety.

(3) Provide infrastructure and services required by small commercial vessels of water-related businesses.

(4) Assure that the architecture of future waterfront development fit the function of the proposed facility that reflects Nantucket's maritime tradition.

(5) Preserve and encourage water-dependent uses and activities.

Policy

Therefore, it shall be the policy of the Town to ensure basic public utilities can be provided on a continual basis for the citizens and visitors of Nantucket in a manner that is sensitive to the historic maritime character of the downtown waterfront area. It shall be the policy of the Town of Nantucket to preserve and maintain commercial facilities as necessary to sustain the economic lifeline of the Town.

Action Items

(1) Review options to address and promote maritime-related uses, activities and traditional designs of the downtown commercial area.

Options include, but are not limited to:

a) Further planning analysis of the boundaries for a proposed Downtown Waterfront District within the zoned Residential Commercial area as mapped in Appendix J. The area is encompassed by a line drawn from the Breakers Hotel (42.4.1-21) through the center of Easton Street and south on North Beach Street and south on South Water and Washington Streets to end at the boatyard (55.1.4-8).

(2) Identify scenic views of landscape or waterscape associated with the area and develop accompanying protection policies. (Historic District Commission, Conservation Commission, Planning Board)

(3) Inventory existing structural and non-structural (open space) harborfront resources to evaluate what exists, what is needed, and where needs may be met to provide adequate facilities for water-dependent uses. (NP&EDC)

(4) Adopt waterfront property assessment policies that provide incentives for water-dependent uses. (Finance Committee, Board of Selectmen)

(5) Investigate and document the feasibility of a commercial facility to support the needs of fishing and marine-related work boats. This should include permitting, funding, location, and

included facilitating the public process of drafting Nantucket' Goals & Objectives for Balanced Growth and an accompanying Actio Plan, Groundwater Protection studies, and the sponsorship of zonin by-laws. The NP&EDC is the lead island public planning entit responsible for carrying out studies and making recommendations o land use, environmental protection, public access, and tourism related economic development planning issues. As a regiona planning agency, the NP&EDC can coordinate with the other twelv regional planning agencies in the Commonwealth on matters o regional concern, such as coastal waterways, as well as with stat agencies. It can also apply for state and federal grant monies fo which towns are not eligible.

4. Role of the Planning Board

The Planning Board is responsible for all current planning an permitting of subdivisions and major commercial developments, a well as for the review of proposed zoning changes. As such, it i the critical agency in setting conditions for permitted waterfron development, such as the adequacy of septic and runoff contro measures, as well as ensuring the maintenance of legal rights-of way and access to the waterfront. The Planning Board may act as Special Permitting Authority which it is empowered to do at presen only in the case of major commercial developments.

5. Role of the Board of Health

The Board of Health is responsible for protecting publi health and safety. Like the Marine Department and the Conservatio Commission, the Board of Health is also concerned with monitorin water quality, boat pollution abatement, and non-point sourc pollution control. Its enforcement of existing local by-law concerning the regulation, storage, and control of toxic an hazardous substances is a critical component of the Town's goal o water quality protection. The Board will also share a role wit the Marine Department and Conservation Commission in assessing th number of moorings that Nantucket Harbors can maintain whil sustaining safe levels of water quality.

B. Future Planning and Oversight of Action Plan Implementation

The Nantucket and Madaket Harbors Action Plan is designed t be a progressive document which actively addresses the resource an management issues in the harbors. As with most action plans, thi document should be amended over time as the harbor uses change diversify and intensify, as awareness of the problems and issue associated with the harbors evolve, and as results of variou studies are published. Future planning initiatives should includ additional amendments to the Action Plan in order to keep it usefu in making town land and water use planning and developmen decisions, and policy debates, for continued wise management of th harbors.

1. Establishment of a Harbor Planning Advisory Committee

Purpose. It is the intent of the Town of Nantucket to establish a Harbor Planning Advisory Committee to work through the Board of Selectmen and with town departments for a transition period of one year.

Accountability. The Harbor Planning Advisory Committee will report to the Board of Selectmen.

Committee Structure and Meeting Procedures

a) Upon Plan adoption the Harbor Planning Advisory Committee will be appointed by the Board of Selectmen, each member to serve for a term of one year.

The Committee will be comprised of eleven (11) members who are registered voters of the Town of Nantucket. One (1) member will be from the Board of Selectmen, at least three (3) will be town staff (ex-officio) who will serve and provide technical assistance to the Committee, and seven (7) will be citizens representative of the diversity of harbor users and businesses. A majority of the citizen members will be comprised of active members of the existing Harbor Planning Advisory Committee. The remaining citizen members will be representative of varied interests of the harbors, including but not limited to the following:

Departments, Boards, Commissions	At Large
Board of Selectmen	Conservation Organizations
Conservation Commission	Recreational Users
Dept. of Public Works	Steamship Authority
Health Department	Waterfront Businesses (recreational/marine-related)
Historic District Commission	Waterfront Property Owners
Marine Department	Others
Parks and Rec. Department	
Planning Board	
Planning & Econ. Dev. Comm.	
Shellfish Harbor Adv. Board	
Visitor Services Committee	
Others	

b) A chairperson and secretary will be elected by the members of this Committee; the Committee will follow the State Open Meeting Law and Robert's Rules for governance.

c) The Committee will meet at the request of the chairperson or a quorum. All meetings of the committee will be open to the public. The Committee will keep a record of its proceedings and actions which will be kept on file and open to the public at the office of the Town Clerk.

d) Six (6) of the members of the Harbor Planning Advisory Committee constitute a quorum. The concurring vote of a simple majority of members present and eligible to vote is required to pass on any issue.

C. Financing

Implementation of new initiatives will be difficult in many cases without proper funding. Action items which qualify as capital expenditures are identified in this section. To go forward with any of these expenditures, review and approval will need to be sought from the Capital Expenditure Committee, the Finance Committee and Town Meeting. Items recommended in the Harbor Action Plan which will need additional funding include:

1. Capital Expenditures. ($100,000+, or $50,000 in aggregate over a period of years for one project.)

a) Water Quality

Determine the sources and extent of nutrient loading to Nantucket Harbor for policy development to be established in a water quality managaement plan by Woods Hole Oceanographic Institution. (Project cost is complete--County Commissioners and private donations)

Dredging Polpis Harbor. (Project cost is partially complete--Town of Nantucket and Mass. Dept. of Environmental Management)

Inventory storm drains, sewer outfalls and other sources of discharge which contribute to water quality degradation. Implement corrective pollution abatement methods where necessary to maintain existing high water quality standards. (Seek funding through DEP's Division of Water Pollution Control and U.S. Environmental Protection Agency)

b) Natural Resources Protection

Pursue a comprehensive open space program to protect critical habitat, resource interests, viewsheds, and public rights-of-way. (Seek funding through the Self Help Program, DCS)

c) Fishing, Public Access, Downtown Waterfront District

Boat ramp and launch improvement, maintenance and location program to include acquisition or easement for site location, parking, and ramp/launch construction adequate to meet the needs of users. (Seek funding through the State Public Access Board, DFWELE; Land and Water Conservation Fund, DCS; or cooperative agreements with private landowners)

Develop and pursue a plan to obtain and legally secure public

rights-of-way for shoreside access to Nantucket and Madaket Harbors. (Seek funding through the Public Access Board, DFWELE; and Town of Nantucket)

Investigate the feasibility (need, permits, funding, location) of a multipurpose pier to accommodate fishing and marine-related work boats. (Seek funding through Harbor Facilities Improvement Program, CZM; Land and Water Conservation Fund, DCS; and Town of Nantucket)

Finalize consideration of relocation of the fuel discharge site for Harbor Fuel, the Electric Company, and Airport. (Seek funding through private companies, and the Federal Aeronautics Board)

d) Tourism and Recreation

Provide improved public service facilities in the downtown district to include: showers, restrooms, fresh water, etc. (Seek funding through the Town of Nantucket)

Provide adequate dinghy dock space. (Seek funding through the Town of Nantucket)

Capital expenditure funding should be sought through various federal and state grants, local government, and cooperative agreements with businesses, individuals, and environmental groups.

D. Integrated Implementation Strategies

Two strategies are recommended for integrating future activities in the harbor waters and adjacent lands: (1) water use classifications and (2) a waterfront overlay district.

1. Water Use Classifications

Context and Issues. As harbor uses intensify and diversify, it is useful to consider separating these different uses in space and time in order to minimize conflicts while at the same time promoting safety and a reasonable balance of uses. Because there is a direct link between the land and the harbors' waters, the uses taking place on the abutting shoreline should directly complement activities occurring on the water. Good water quality, a healthy ecosystem, and a balance of a variety of uses are primary concerns.

During the discussions and workshops to develop this Harbor Action Plan, participants prioritized Nantucket's resource areas and coastal waters for their high water quality. The following policies are established to maintain Nantucket's exceptional water quality which directly enhances water-contact and recreation activities which supports tourism and which is directly linked to

superior habitat conditions for shellfish productivity.

Purpose. The purpose of water management and planning is to sustain a variety of uses of the harbor. It addresses the safety and health issues of multi-use areas such as recreational and commercial fishing, boating and board activities, mooring fields, channel and fairway navigation, swimming beaches, and stormwater drains. The objective is to separate potential areas of user conflict.

Water Use Classifications.

Type 1 Conservation Use
Type 2 Low-Intensity Use
Type 3 High-Intensity Use
Type 4 Multipurpose Use
Type 5 Commercial Use
Type 6 Navigation Channel Use

(Water Use Classification boundary lines are represented on Maps F and G for Nantucket and Madaket Harbor respectively and are described under each Water Use section.)

Type 1 Conservation Use.

Purpose: To preserve and protect Type 1 waters from activities and uses that have the potential to degrade scenic, wildlife, and plant habitat values, or which may adversely impact water quality and the diversity of natural shoreline types.

Area Description: Type 1, Conservation Use areas abut shorelines of natural undisturbed condition, where alterations, including the construction of docks and any dredging, are unsuitable. This category includes water areas that (1) are within the boundaries of designated wildlife refuges and conservation areas; (2) have retained undisturbed natural habitat or maintain scenic values of unique or unusual significance; and (3) are particularly unsuitable for structures due to their unique significance or exposure to severe wave action, flooding and erosion.

The boundary line designation for Type 1 waters runs along the shoreline reach parallel to the general shoreline trend as represented on Maps E and F and extends from mean high water to 500 feet seaward of mean high water.

Type 1 waters in: Nantucket Harbor extend from the northern end of east jetty to the northwest side of the Wauwinet House (11-17); and from the northwest side of Winthrop Road (Monomoy) public access (T.O.N. permanent easement between 54-153 and 43-46) to the northeast side of Shore Reservation (55-276); Madaket Harbor extend from the northwest tip of Eel Point to the southeast end of the Eel Point salt marsh; from the southeast end of Jackson Point

Reservation (60-11) to the northwest end of Jackson Point Reservation (60-11); and from the shoreline point parallel the west end of Massachusetts Avenue to the north tip of Esther's Island.

Policies:

New dredging projects or expansion of existing dredging projects shall be considered when a substantial public benefit can be demonstrated (i.e. to enhance fish or shellfish habitat, improve water circulation, or make necessary improvements to navigational safety).

In order to preserve scenic, conservation and natural resource values, protect natural storm buffer functions and maintain water quality and circulation of the areas' barrier beaches and salt marshes, activities and alterations which include structural shoreline protection and the construction of docks and piers shall not be allowed.

Beach nourishment using native species revegetation and non-structural shoreline protection are preferred methods for preservation of Conservation Use areas as natural storm buffers to protect or enhance plant and wildlife habitat values and not adversely impact downshore coastal resources.

Activities and alterations contiguous to public parks, public beaches, public rights-of-way to the shore, and conservation areas abutting Type 1 waters shall not significantly interfere with public use and enjoyment of such facilities.

No new direct, untreated stormwater discharges shall be permitted. Existing stormwater discharges shall be upgraded as necessary to maintain existing high water quality standards. The local Department of Public Works, Health Department and Conservation Commission should work cooperatively to ensure that stormwater is no longer diverted directly into resource areas or coastal waters.

Acquisition of land and permanent conservation restrictions on land abutting Type 1 waters shall be encouraged and pursued.

Type 2 Low-Intensity Use.

Purpose: To maintain and, where possible, restore the high water quality, and scenic and natural habitat values of these areas, while providing for low-intensity uses that will not detract from these values.

Type 2 Low-Intensity Use areas are adjacent to predominantly residential areas, several large salt marsh ecosystems, and extensive shellfish beds, where intense forms of alterations, including construction of marinas, docks, piers or structural

shoreline protection and new dredging projects (excluding maintenance dredging), would significantly change the area's unique character and alter the established balance among uses. This use area includes unobstructed shorelines and waters in areas with high scenic value that support low-intensity recreational and residential uses. Primary uses are maintenance of good water quality and fish and wildlife habitat; and protection of open and unobstructed waters.

The boundary line designation for Type 2 waters runs along the shoreline reach parallel to the general shoreline trend as represented on Maps E and F and extends from mean high water to 500 feet seaward of mean high water.

Type 2 waters in: Nantucket Harbor are from the northwest side of the Wauwinet House (11-17) to the northwest side of Winthrop Road (Monomoy) public access (T.O.N. permanent easement between 54-153 and 43-46); and from the northeast side of Shore Reservation (55-276) to the southeast side of the Boatyard (55.1.4-8); Madaket Harbor are from the southeast side of Eel Point salt marsh to the northwest side of Madaket Marine (39-15) in Hither Creek; and from the northwest end of Jackson Point Reservation (60-11) to the shoreline point parallel the west end of Massachusetts Avenue.

Policies:

Shellfish habitat and nursery grounds are given highest priority for area expansion and protection from incompatible activities and/or development due to their significant value to Nantucket's shellfish industry and fishing traditions.

Mooring fields shall be limited to the boundaries shown on maps B, C and D, and densities stated in Appendix E of this Harbors Action Plan.

Private non-commercial moorings may be available to waterfront property owners and individuals with legal shoreside access. Placement of moorings is under the jurisdiction of the Harbormaster. This policy shall be in compliance with policies established in this Action Plan to protect open and unobstructed waters for recreation and by the Shellfish and Harbor Advisory Board to protect shellfish habitat and access to public fishing grounds (i.e. seasonal mooring removal).

Discourage the construction of private docks, piers and floats. Alternatives include a) moorings and b) community docks and piers, if it is determined it will not negatively impact a critical resource area, each to service a minimum of five contiguous waterfront lots. Contiguous lots in common ownership shall be considered one lot for the purpose of this policy. Reasons to discourage the construction of private docks, piers and floats are to protect the: high scenic value of Nantucket and Madaket Harbors'

unobstructed shoreline which is notably unique to the northeast region and has aesthetic and economic value as a tourist attraction; multiple recreation activities and extensive shallow waters that occur along the shoreline and are enjoyed by thousands of harbor users annually; shellfish beds which prosper in the shallow waters and bottom sediments and which significantly contribute to recreation and the off-season local economy. Docks and piers damaged or destroyed by storms may be replaced not to exceed the prestorm footprint or dimensions and in accordance with state and local regulations.

New dredging projects or expansion of existing dredging projects shall not occur unless a substantial public benefit is demonstrated (i.e. to enhance fish or shellfish habitat, improve water circulation, or make necessary improvements to navigational safety).

Beach nourishment using native species revegetation and non-structural shoreline protection are preferred methods for preservation of Low-intensity use areas as natural storm buffers to protect or enhance plant and wildlife habitat values and not adversely impact downshore coastal resources.

Activities and alterations contiguous to public parks, public beaches, public rights-of-way to the shore and conservation areas abutting Type 2 waters shall not significantly interfere with public use and enjoyment of such areas and facilities.

No new direct, untreated stormwater discharges shall be permitted. Exis8ting stormwater discharges shall be upgraded as necessary to maintain existing high water quality standards. The local Department of Public Works, Health Department and Conservation Commission should work cooperatively to ensure that stormwater is no longer diverted directly into resource areas or coastal waters.

Type 3 High-Intensity Recreational Use.

Purpose: To preserve, protect, and where possible, enhance Type 3 areas for high-intensity boating and services that support this activity.

Area Description: High-Intensity Recreational Use areas include waters where recreational boating activities and water-dependent uses, such as mooring fields and anchorages, navigation channels and fairways, recreational boating and windsurfing dominate.

The boundary line designation for Type 3 waters runs along the shoreline reach parallel to the general coastal trend as represented on Maps E and F and extends from mean high water to 500 feet seaward of mean high water, and includes the anchorage area as

represented on Map E.

Type 3 waters in: Nantucket Harbor are from the northeast end of Children's Beach Boat Ramp (42.4.2-9) to the north end of west Jetties; Madaket Harbor are from the northwest side of Madaket Marine (39-15) in Hither Creek to the southeast end of Jackson Point Reservation (60-11).

Policies:

Proposed activities or alterations will be permitted to the extent that they are water-dependent and enhance recreational boating activities or values.

Planning and management decisions of Type 3 waters and adjoining land areas will prioritize mooring fields, public boat launching ramps, waterfront parks, beaches and other water-dependent facilities that support recreational boating and enhance public access to the tidal waters.

No new direct, untreated stormwater discharges shall be permitted. Existing stormwater discharges shall be upgraded as necessary to maintain existing high water quality standards. The local Department of Public Works, Health Department and Conservation Commission should work cooperatively to ensure that stormwater is no longer diverted directly into resource areas or coastal waters.

Ensure that appropriate educational signage is posted and maintained regarding speed, no-discharge zone, etc. Signs should be posted in locations most visible to visiting boaters.

Type 4 Multipurpose Use.

Purpose: To maintain a balance among diverse activities that must co-exist in Type 4 waters. The large expanses of unobstructed water in Nantucket and Madaket Harbors annually attract thousands of recreational water enthusiasts to sail, windsurf, paddle, waterski, motorboat and fish.

Large areas of Type 4 waters include productive fishing grounds and fishery habitats, which sustain the local commercial fishing economy and provide an important food source to local residents.

Area Description: Multipurpose Use areas support a variety of commercial and recreational water-dependent activities. Maintaining good water quality and a healthy ecosystem for recreation, fish and wildlife habitat are primary concerns.

The boundary line designation for Type 4 waters comprise all the central waters 500 feet seaward of mean high water, with the

exception of the anchorage Type 3 and navigation channel Type 6, as represented on Maps E and F.

Type 4 waters in: Nantucket Harbor are from the east side of Hussey Shoal to Head of the Harbor; Madaket Harbor are landward of a straight line running from the tip of Esther's Island to the tip of Eel Point and to the entrance of Hither Creek.

Policies:

The changing characteristics of traditional activities and the development of new water-dependent uses shall, where possible, be accommodated in keeping with the principle that ecological systems continue to be preserved and restored.

Unobstructed waters shall be maintained for seasonal sailboat and windsurfing races, and for near shore navigability of all wind and paddle watercraft.

Maintain designated mooring field boundaries and densities as identified in this Plan and keep moorings from encroaching into areas designated for watersports.

Planning and management decisions of Type 4 waters will prioritize protection of fishing grounds, fishery habitat, and open, unobstructed waters for multiple water-dependent recreational activities from alterations and activities that threaten their vitality.

Type 5 Commercial Use.

Purpose: Maintain a balance among diverse harbor-related activities, including recreational boating, commercial fishing, and other water-enhanced businesses, to promote the efficient use of these water areas, and to protect the scenic characteristics that make these areas economically valuable to the community via tourism.

Area Description: Commercial use areas support a vibrant mix of commercial and recreational water-dependent facilities and uses. This area is adjacent to waterfront areas that support a variety of tourist, recreational, and commercial activities. Competition for space is intense in all Type 5 waters. Commercial fishing vessels, recreational boats, and ferries compete for limited water space, while waterfront businesses of many varieties vie for a position on the waterfront. The visual quality of this area is important, since this area is the center for tourism.

The boundary line designation for Type 5 waters runs along the shoreline reach parallel to the general coastal trend as represented on Maps E and F and extends from mean high water to 500 feet seaward of mean high water.

Type 5 waters in: Nantucket Harbor are from the southeast side of the Boatyard (55.1.4-8) to the northeast side of Childrens Beach Boat Ramp (42.4.2-9); Madaket Harbor does not have classified Type 5 waters.

Policies:

Planning and management decisions of Type 5 waters will prioritize the following water uses and associated design, maintenance and operational needs: a) berthing, loading and unloading, and servicing of recreational craft, commercial fishing vessels, freighters and ferries; b) water-dependent and water-enhanced commerce; c) depth and clearance maintenance of navigational channels and fairways; and d) activities that maintain or enhance water quality and scenic qualities, including the preservation of historic features.

Encourage the provision of necessary support services for the commercial fishing community.

No new direct, untreated stormwater discharges shall be permitted. Existing stormwater discharges shall be upgraded as necessary to maintain existing high water quality standards. The local Department of Public Works, Health Department and Conservation Commission should work cooperatively to ensure that stormwater is no longer diverted directly into resource areas or coastal waters.

Where appropriate, waterfront fuel handling facilities should be upgraded and maintained to ensure that best management practices are used to avoid adverse impacts to water quality and permanent sites shall be located away from Highly Vulnerable Areas as designated in Nantucket's state approved Oil Spill Contingency Plan dated June 1991.

Type 6 Navigation Channels Use.

Purpose: To maintain safe water depths and channel clearances for commercial and recreational boating.

Area Description: The boundary line designation for those four areas (federal, Polpis, Madaket, Hither Creek) represented on Maps E and F.

Type 6 waters in: Nantucket Harbor are from the north end of the jetties around Brant Point into the commercial area and Polpis Channel; Madaket Harbor are from an area rounding Eel Point circuiting near the inner shore of Madaket Harbor circuiting into Hither Creek.

Policies:

Federal and navigation channels will be kept unobstructed of all conflicting uses.

The highest priority uses for Type 6 waters are: a) safe navigation for commercial shipping, and fishing and boating transit; and b) maintenance of navigation channels.

Every effort should be made by the Town of Nantucket to procure state and federal funds to maintain these navigation channels.

2. Waterfront Overlay District

Context and Issues. During the 1980s, many waterfront communities in New England experienced an economic boom. One common effect of this boom is that once largely ignored shorefront lands are suddenly in great demand for uses such as housing, retail shops, offices, restaurants and other non-water dependent uses. Strong economic incentives have been created for the displacement of traditional water dependent uses such as commercial fishing, fish processing, and boat servicing and repair facilities. Also, as private development of non-water dependent projects continued, the shoreline became privatized, the common result being a decrease in public access to the shore.

Purpose. The purpose of a waterfront overlay district is to ensure that water-dependent uses be accommodated around the harbors and that future development occurs in a manner consistent with harbor uses and does not imperil water quality or critical habitats. The overlay district is intended to be adopted as part of the zoning by-law of the town.

Definition. The waterfront overlay district is composed of (1) tidal waters and coastal salt ponds; (2) shoreline features including coastal beaches and dunes, barrier beaches, coastal cliffs, bluffs, and banks, rocky shores, and manmade shorelines; and (3) areas contiguous to shoreline features extending inland for two hundred (200) feet. Coastal resources have great and varied commercial, industrial, recreational, ecological, and aesthetic values which are threatened with destruction by unplanned and poorly planned development. It is the policy of the Nantucket Harbors Action Plan and the Town of Nantucket to preserve, protect, develop, and restore coastal resources and their ecological systems in the interests of the public health, safety, and general welfare of the community.

Development Standards. Any proposed use or development in a waterfront overlay district should comply with the following development standards:

(a) The proposed project will not interfere with public access to or use and enjoyment of tidal waters and shoreline features;

(b) The proposed project will not degrade the aesthetic and recreational values of tidal waters or diminish the natural diversity of shoreline features;

(c) The proposed project will not degrade existing water quality or adversely affect the circulation and flushing patterns of tidal waters or exacerbate the potential for shoreline erosion or flooding;

(d) The proposed project will not increase the volume or velocity of stormwater runoff or sedimentation of tidal waters or exacerbate the potential for shoreline erosion or flooding;

(e) The proposed project will not diminish the value of any shoreline feature as a storm and hurricane buffer;

(f) Any filling, grading, excavating, and other land alteration will be the minimum necessary to construct the proposed project;

(g) The proposed project will not pose any threat to public health, public safety, or property;

(h) All structures (except boat-launching ramps, docks, piers, and wharfs), roads, individual sewage disposal systems, and underground utilities will be set back at least two hundred (200) feet from the edge of all tidal waters, tributaries to and wetlands associated with coastal resources, and Type 1 and 2 waters as those waters are defined in the "Waterfront Zoning" section. A two hundred (200) foot-wide area adjacent to tidal waters, coastal wetland resources, and Type 1 and 2 waters shall be maintained as a natural, undisturbed, vegetated buffer zone;

(i) Except for water-dependent activities and structures, all grading and filling, excavation, construction of buildings and roads, and installation of individual sewage disposal systems and underground utilities will be set back at least one hundred (100) feet from the inland edge of any coastal wetland resource area abutting tidal waters.

(j) The proposed project will refer to Building With Nantucket In Mind as a design resource.

Zoning Categories. The Nantucket Planning and Economic Development Commission shall work with all interested parties to analyze applicable zoning categories as part of the Waterfront Overlay District feasibility analysis process.

REFERENCES

Annual Reports of the Town and County of Nantucket, Massachusetts. 1982-1991.

Board of Health, Nantucket Massachusetts, Water Quality Testing Reports, 1983-1990.

Bulk Fuel Storage Task Force, 1988. "Energy Planning on Nantucket: Options for Bulk Fuel Storage." Report to the Town of Nantucket.

Burden, David, 1979. "Quality of Shellfish / Recreational Waters." Report to the Town of Nantucket. Cook College, Rutgers University.

Burden, David, 1977. "The Monitoring of Coliform and Streptococcus Levels and Coliform Drift in Nantucket Harbor." Rutgers University.

Burden, David, 1979. Report to the Nantucket Public Health Officer, Rutgers University.

Buzzards Bay- Comprehensive Conservation and Management Plan, 1990. Massachusetts Executive Office of Environmental Affairs, Boston, MA.

Cavanaugh, Eugene and Leslie Lewis, "The State of Our Harbors", Report for the Massachusetts Department of Environmental Management, Division of Waterways, Hingham, Massachusetts, May 1990. 54 pgs.

Ceely, Martin and Michael Takacs, 1980. "Aquacultural Study of Juvenile Quahogs on Nantucket Island, MA." Student Report to the Town.

Commonwealth of Massachusetts, 1977. "Massachusetts Fisheries." A Report of the 200 mile Fisheries Work Group. 53 pgs.

Commonwealth of Massachusetts, Office of The Attorney General, 1990. Regulations to Implement MGL, Chapt. 91. 53 pgs.

Costa, Joseph, 1987. Nantucket Nuisance Alga. EPA Report. Massachusetts Department of Environmental Protection. 134 pgs.

County of Nantucket, Wharves and Waterways, General Code, 1984. Publisher, Corp. Rochester, NY.

Creighton, Cheryl, 1988. "Natural and Man-made Resource Inventory of Nantucket and Madaket Harbors." Report to the Town of Nantucket. 44 pgs.

Culliton, Thomas, et al., 1990. "50 Years of Population Change Along the Nation's Coasts 1960-2010", Report for the National Oceanic and Atmospheric Administration, Rockville, MD.

Duerring, Christine and Catherine O'Riordan, 1990. Nantucket Harbor Water Quality Survey, Massachusetts Department of Environmental Protection, Division of Water Pollution Control. 48 pgs.

Energy Planning On Nantucket: Options For Bulk Storage. A Report to the Town of Nantucket, 1988. 45 pgs.

Fougere, Mark John, 1987. Nantucket Open Space Plan. 124 pgs.

Grochowski, Joe, Nantucket Marine Department Montyly Biologist's Reports, 1989 and 1990.

Gutman, Andrew, et al., 1979. "Nantucket Shoreline Survey, An Analysis of Nantucket Shoreline Erosion and Accretion Trends Since 1846," MIT Sea Grant, 51 pgs.

Horsley, S., Witten, J. and Hegemann, 1990, "Nantucket Water Resources Management Plan," Consultant proposal to the Town of Nantucket. 147 pgs.

Howes, Brian, et al., 1990. "A Quantitative Assessment of the Environmental Health of Nantucket Harbor." WHOI, Woods Hole, MA. 44 pgs.

Howes, Brian and Goehinger, D., 1989. "Preliminary Water Quality Survey, Nantucket Harbor to Wauwinet Harbor." WHOI, Woods Hole MA. 18 pgs.

Kelley, Kenneth, 1981. "The Nantucket Bay Scallop Fishery: The Resource and Its Management." Report to the Town of Nantucket. 108 pgs.

Kelley, Kenneth, 1985. "An Update on the Management of the Nantucket Bay Scallop Resource." Report to the Town of Nantucket. 43 pgs.

Kelley, Kenneth, 1986. "A Report on the Soft-Shell Clam Resource on Nantucket Island." Report to the Town of Nantucket. 18 pgs.

Kelley, Kenneth, 1989. "Distribution of Eelgrass in Nantucket Harbor, MA." Report to the Town of Nantucket Health Department.

Massachusetts Department of Health. "Safe Summertime Fun," Brochure, Lakeville MA (undated).

Massachusetts Department of Environmental Protection, Division of Marine Fisheries, Annual Shellfish Catch Reports, 1977-1989.

Massachusetts Department of Environmental Protection, Division of Marine Fisheries, Shellfish Growing Area Data, 1985-1990.

Massachusetts Department of Environmental Management, Division of Water Pollution Controls, Massachusetts Surface Water Quality Standards, 1990.

National Marine Manufacturer Association (NMMA), personal communication, November 1990.

Nantucket Island, Massachusetts, 1990. "Goals and Objectives for Balanced Growth: A Broad Policy for the Island's Future," 1983 Town Meeting Approved Public Hearing Draft. 45 pgs.

Nantucket Planning & Economic Development Commission, 1979. "Commercial Fishing...Can We Bring it Back?", Nantucket, MA. 150 pgs.

Nantucket Planning & Economic Development Commission, 1983. "Growth Trends on Nantucket." 20 pgs.

RKG Associates, 1989. "The Fiscal and Economic Impacts of Growth on the Island of Nantucket: Final Report", for The Nantucket Land Council. 90 pgs.

Rosen, Peter, 1972. "Evolution and Processes of Coatue Beach, Nantucket Island, Massachusetts: A Cuspate Spit Shoreline," Master's Thesis.

Town of Nantucket, "Nantucket Coastal Oil Spill Response Plan," June 1991.

Town of Nantucket, You Can Play a Big Part In Helping Nantucket Protect Its Harbor Water Quality. Undated brochure.

United States Coast Guard, Federal Requirements for Recreational Boats.