Pleasant Bay Resource Management Plan 2013 Update

Arey's Pond Cat Gathering
Photo by Anita Winstanley Roark

April 2013

Pleasant Bay Resource Management Alliance

Ridley & Associates, Inc.

PLEASANT BAY RESOURCE MANAGEMENT PLAN 2013 UPDATE

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Special thanks to Paul Lagg, GIS Coordinator for the Town of Chatham, for developing the maps included in this update.

The Alliance also wishes to express its appreciation to our tireless water quality monitoring volunteers and many others who have contributed in countless ways to the accomplishments outlined in this report, including:

Friends of Pleasant Bay, Inc.
Orleans Pond Coalition
Friends of Meetinghouse Pond, Inc.
WHOI Sea Grant
Barnstable County
Friends of Chatham Waterways, Inc.
Friends of Arey's Pond, Inc.
Provincetown Center for Coastal Studies

The Alliance greatly appreciates the technical and financial support provided by the Alliance Towns of Orleans, Harwich, Chatham and Brewster.

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List of Terms and Abbreviations

ACEC – Area of Critical Environmental Concern

ACMH – Areas of Critical Marine Habitat

CCNS – Cape Cod National Seashore

CWMP – Comprehensive Wastewater Management Plan

Eutrophication Index –

HAB – Harmful Algal Blooms

MassDEP – Massachusetts Department of Environmental Protection

MEP – Massachusetts Estuaries Project

NDA – No Discharge Area

NHESP – Massachusetts Natural Heritage and Endangered Species Program

NWZ – No Wake Zone

QAPP – Quality Assurance Project Plan

Rules of the Road

SAV – Submerged Aquatic Vegetation

SLR

SMAST - School of Marine Science and Technology, University of Massachusetts-Dartmouth

TMDL – Total Maximum Daily Load

SECTION I. OVERVIEW OF RESOURCE MANAGEMENT PLAN UPDATE

Chapter 1.
Introduction

1.0 Overview

A little more than twenty-five years ago a group of citizens and officials from the Towns of Orleans, Chatham, Harwich and Brewster petitioned the state Executive Office of Environmental Affairs to designate Pleasant Bay and Area of Critical Environmental Concern (ACEC). That visionary step signified an important acknowledgement among the towns that the beauty and health of Pleasant Bay could not be taken for granted as something secure and unchanging. It also reflected awareness that the towns shared responsibility for safeguarding the Bay's health for future generations.

A decade later, in 1998, the Towns of Orleans, Chatham and Harwich adopted the Pleasant Bay Resource Management Plan and formed the regional Alliance to implement the plan. The Alliance pledged to update the resource management plan every five years, and issued update reports in 2003 and 2008. This 2013 report fulfills the update requirement on the fifteen-year anniversary of the plan. This report summarizes implementation actions taken by the Alliance and the member towns to date, with emphasis on achievements in the last five years, and presents additional issues and recommendations for action. It is intended to describe progress, and to chart a course for the coming five years of coordinated management activity.

Much has changed since the plan was initially adopted. At that time much of our attention was focused on the increasing number of private docks, an influx of jet skis, and burgeoning aquaculture grants. Today, management pressures from these issues have receded or been addressed and our attention is focused on new challenges. These new challenges include understanding how the dual inlet-barrier beach system is affecting the Bay's resources and coastline, and how to put in place measures to cut in half the amount of nitrogen coming from more than 5,000 individual septic systems in our watershed.

Over the coming five years the Alliance will join with its member communities, interested citizens and organizations, institutions and state, county and federal agencies, to address these and other challenges. With a solid record of accomplishment, a clear course for the future and the dedication of all four-watershed communities, the Alliance is well positioned to accomplish the work ahead.

1.1 Guiding Principles

This 2013 update carries forward the same planning principles that guided the 1998, 2003 and 2008 documents. These principles reflect a commitment to

stewardship that cuts across many distinct and often competing activities and interests, as well as town boundaries:

> **T**o sustain and, wherever practicable, regenerate the health and productivity of the Bay's eco-system, including its water quality, diverse animal and plant life, tidal marshes, ponds, rivers, bays, islands, and beaches;
>
> **T**o encourage levels of recreational, residential, and commercial activity in the Bay and its watershed, including physical structures, that are consistent with resource sustainability and that promote a high degree of public safety and enjoyment;
>
> **T**o enhance opportunities for public access to and enjoyment of the Bay, in balance with resource sustainability and private property rights; and
>
> **T**o preserve the features that contribute to the Bay's unique character including its natural beauty, tranquility, history and accessibility.

1.2 Planning Area

The study area for the resource management plan and this update remains unchanged, and includes the boundary of the ACEC and the entire marine water re-charge area (watershed) for the Bay (Figure 1).

The ACEC designation is a formal state designation directed principally to the actions and jurisdictions of state environmental agencies. The ACEC regulations generally direct state environmental agencies to take actions, administer programs, and revise regulations in order to preserve, restore or enhance the resources of an ACEC. An ACEC designation does not create new regulations to implement the goals of the designation, but works through the existing state environmental regulatory framework.[1]

The boundary of the Pleasant Bay ACEC covers 9,240 acres including the Bay's waters and a perimeter of land approximately one hundred feet in from shore (Figure 2). The area within the ACEC boundary is generally protected by more stringent state environmental reviews for certain projects other than single-family homes. The rationale for the protections afforded an ACEC is based on the area's extensive resources and its value as an eco-system. Pleasant Bay met all fourteen ACEC criteria established by the state, far more than the five criteria needed to qualify for the designation.

[1] More information on the ACEC program can be obtained at www.mass.gov/dcr/stewardship/acec

The watershed encompasses 21,600 acres located in Orleans, Chatham Harwich and Brewster (see Table 1.) The watershed feeds overland run-off and groundwater into Pleasant Bay and its sub-embayments and tributaries.

Table 1. Pleasant Bay Watershed Area by Town

Watershed Area	Orleans	Brewster	Harwich	Chatham	Total
Land	5,293 (35%)	3,527 (23%)	2,643 (17%)	3,655 (24%)	15,118 (100%)
Estuary Surface	3,528 (54%)	--	153 (2%)	2,802 (43%)	6,483 (100%)
Land & Estuary	8,822 (41%)	3,527 (16%)	2,795 (13%)	6,456 (30%)	21,600 (100%)

Source: Cape Cod Commission

1.3 Organization of the Plan Update

The update is organized into three main sections, each of which contains one or more chapters.

Section 1: Overview of the Resource Management Plan Update provides background on the original plan, a description of the process undertaken to develop the plan update, and a key highlights of the plan update.

Section 2: Update on Resource Management Plan Issues and Recommendations contains in-depth discussion on resource management issues, implementation activities and new or updated recommendations. The section has seven chapters, which encompass the management areas outlined in the 1998 plan and prior updates. The seven chapters in this section of the update are:

Chapter 3: Biodiversity and Habitat Protection
Chapter 4: Wetlands Protection
Chapter 5: Watershed Planning
Chapter 6: Fisheries Management
Chapter 7: Coastal Processes and Structures
Chapter 8: Waterways Safety and Navigation
Chapter 9: Public Access and Historic Resources

Section Three: Implementation, addresses the issues and accomplishments associated with the Alliance's administrative and organizational structure. A summary or management recommendationsis included.

As with the original resource management plan and prior updates, the 2013 update provides a blueprint for action, requiring on-going steps to implement recommendations, monitor progress, and provide for adjustments as needed.

1.4 Community Review Process

The plan update was developed over the past year by the Alliance Steering Committee, Technical Resource Committee and work groups, with input on various sections from representatives of the Cape Cod Commission, Massachusetts Coastal Zone Management, Massachusetts Department of Environmental Protection, Massachusetts Division of Marine Fisheries, Cape Cod National Seashore, Barnstable County, and other local municipal and civic organizations.

A public review draft of the plan update was released in March 2013. The draft plan update was posted on the Alliance's website, www.pleasantbay.org. A public comment period was established, and a public hearing was held to solicit comments and answer questions. During this time each Board of Selectmen was asked to sponsor an article at their Annual Town Meeting to adopt the plan update and, if required by town charter, renew the Memorandum of Agreement forming the Alliance.

The Alliance reviewed input received from the public comment process and modified the draft plan update accordingly. In April 2013 the Alliance forwarded the final plan update to the Towns. Copies of the plan update are available at the Town Hall and main public library in each Alliance town and on the Pleasant Bay Alliance website www.pleasantbay.org.

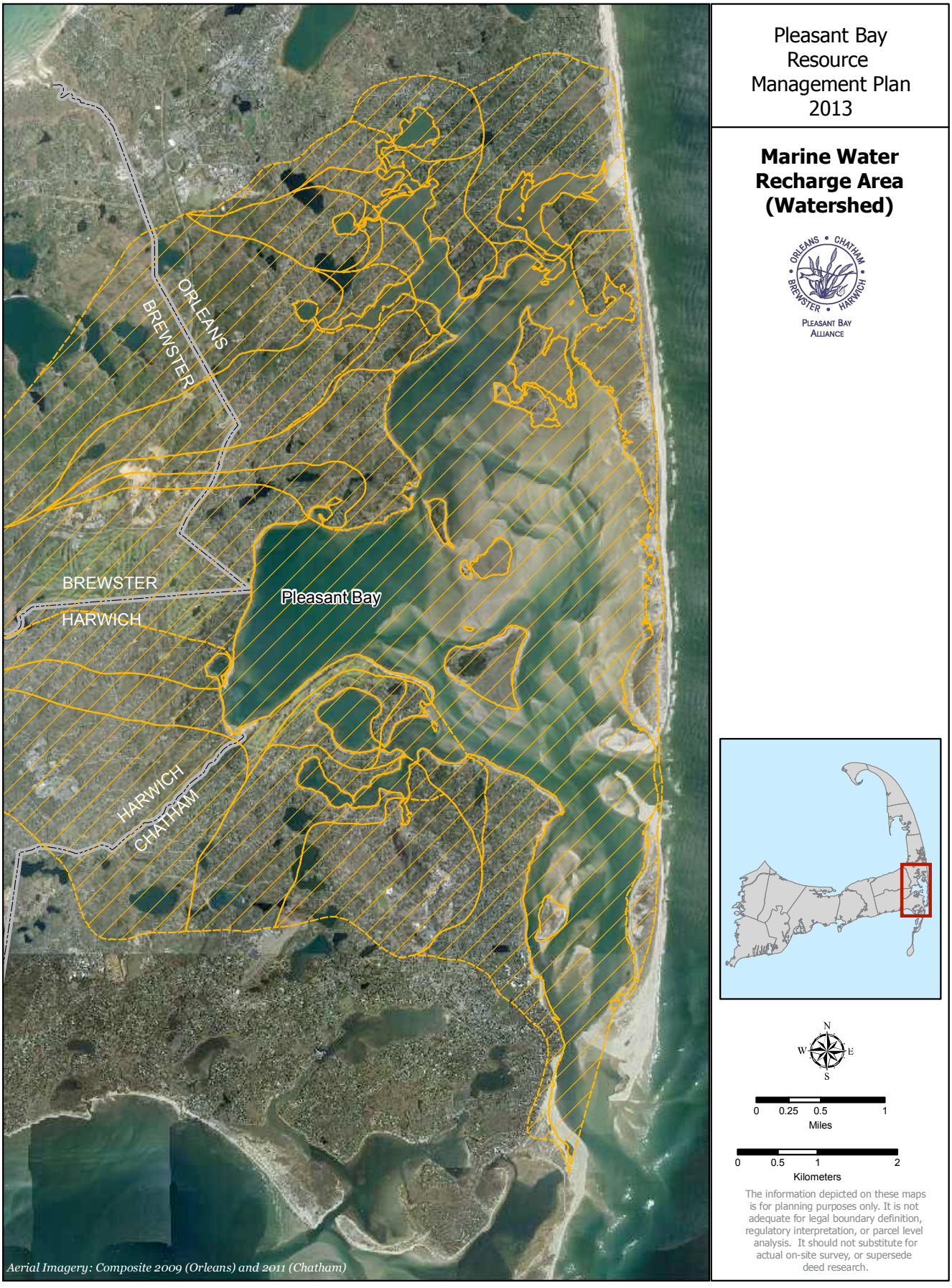


Figure 1. Pleasant Bay Marine Water Recharge Area (Watershed)

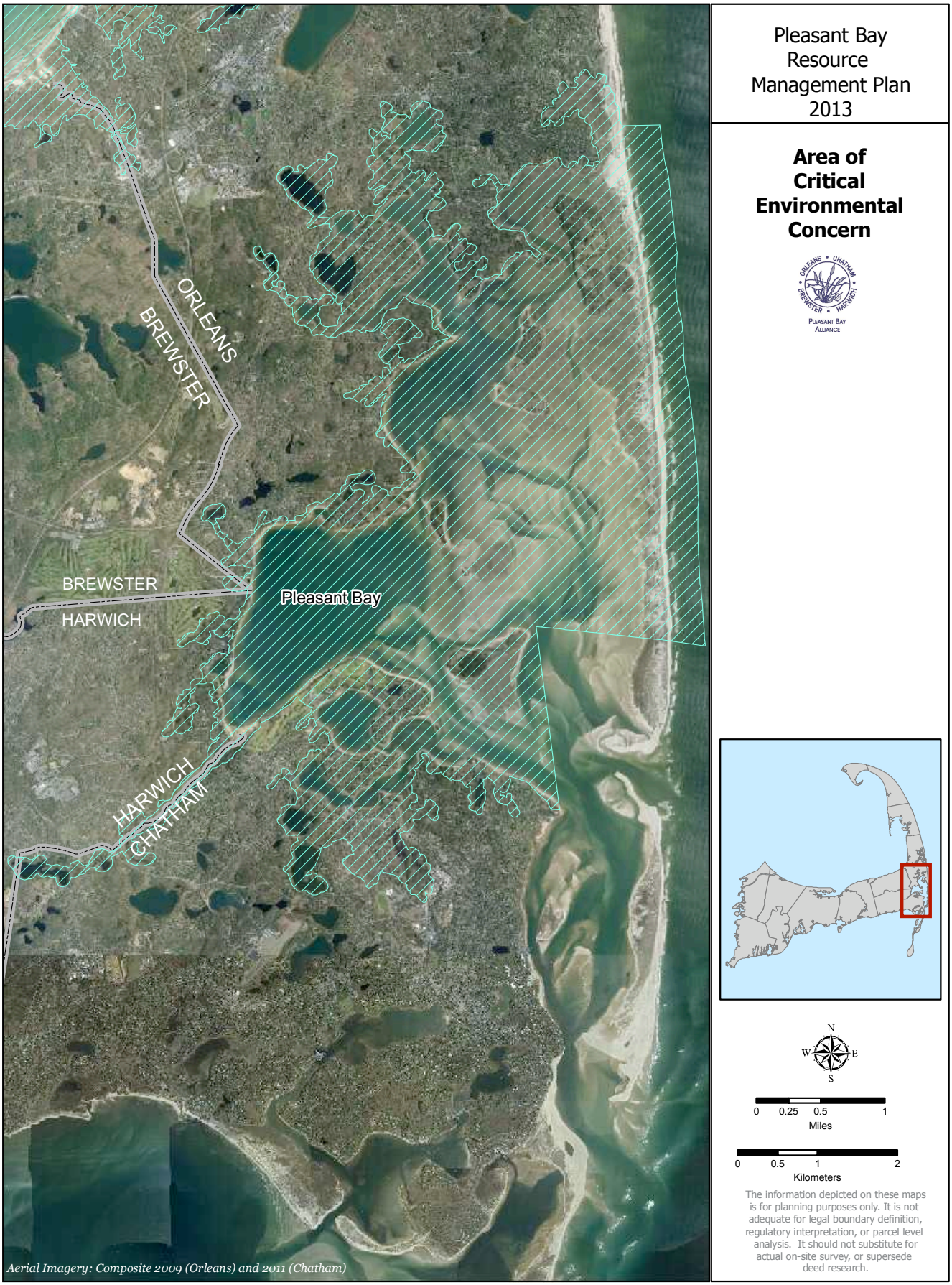


Figure 2. Area of Critical Environmental Concern

Chapter 2
Summary of Accomplishments and Recommendations

2.0 Overview

This chapter provides a summary of progress on the previous recommendations of the approved resource management plan and updates and sets forth the recommended action plan for the coming five years of proposed activity. The accomplishments and recommendations described below reflect highlights of program activities. More detail and additional activities are described in the following chapters and summary of proposed recommendations found in Chapter 10.

2.1 Summary of Accomplishments

2.1.1 Biodiversity & Habitat Protection

The Alliance continued it progress in understanding the habitats that support diverse species in the study area.

- The *Pleasant Bay Citizens Water Quality Monitoring Program* has completed thirteen consecutive monitoring seasons with a sample recovery rate above 90 percent in each season. Samples were collected at 16-20 stations over the past five years. More than 100 citizen volunteers from the Chatham Water Watchers, Orleans Water Quality Task Force, and the Towns of Harwich and Brewster have been trained to participate in the program. Nutrient-related water quality data collected through the program supported the nitrogen threshold modeling and analysis conducted through the Massachusetts Estuaries Project (MEP). The data are essential to the watershed towns of Orleans, Chatham, Harwich and Brewster as they develop plans to reduce nutrient loading in Pleasant Bay. Ongoing, the data will be used to monitor progress in achieving targeted nitrogen reductions.

- The *Pleasant Bay Alliance Citizen Water Quality Monitoring Program Interim Report 2000-2008* was released in December 2009. The report compiled data from 2000, the first year of monitoring, through 2008, and provided basic statistics on the reported data.

- In October 2010 the Alliance released the *Statistical Analysis of Multi-year Water Quality Monitoring Data*, which reported any bay-wide and location specific trends that were discernable from statistical analysis of data collected from 2000 through 2009. The report showed that water quality is improving at some sites, but declining at others. However, most sites did not demonstrate any statistically significant trend. In general, those sites showing improvement in water quality tended to be located in the open water areas of the Bay, while those sites showing declining water quality tended to be located in ponds.

2.1.2 Wetlands Protection and Restoration

Wetlands protection and restoration continued to be a major focus of the Alliance.

- *Guidelines for Permitting Shoreline Structures on Freshwater Lakes and Ponds in the Pleasant Bay Area of Critical Environmental Concern (ACEC*) were developed and submitted to town Conservation Commissions for review and comment. The guidelines provide performance standards and design criteria for licensing docks on the eleven freshwater ponds in the ACEC. The guidelines also are intended to provide guidance to local permitting authorities and to MassDEP in its review of Chapter 91 license applications within Great Ponds in the ACEC. At their discretion, local permitting authorities may choose to apply the guidelines to other freshwater lakes and ponds within their jurisdiction.

- The *Muddy Creek Wetland Restoration*, a multi-year effort led by the Pleasant Bay Alliance, studied resource impacts and the optimal design for replacing the culverts under Route 28 at Pleasant Bay and Muddy Creek. Initial hydrodynamic and water quality modeling demonstrated that replacing the culverts with a 24-foot opening would be optimal. The Alliance applied to the Cape Cod Water Resource Restoration Project (a federally-funded project of the USDA Natural Resource Conservation Service that is administered by the Cape Cod Conservation District) to fund an assessment of resource impacts associated with the 24-foot opening. The resulting study evaluated impacts to wetlands, shellfish, finfish, rare species and water quality with a wider opening under Route 28. The study confirmed that the wider opening would improve degraded wetlands, water quality and overall ecological health in Muddy Creek without negatively impacting the rest of Pleasant Bay. The study also presented a conceptual design for a single span bridge and estimated cost for design and construction.

2.1.3 Coastal Processes

Continuing developments in the barrier beach and inlet system underscore the importance of the Alliance's work in this area.

- The Alliance sponsored *A Geomorphological Analysis of Nauset Beach/Pleasant Bay/Chatham Harbor for the Purpose of Estimating Future Configurations and Conditions*, a study by Dr. Graham Giese of the Provincetown Center for Coastal Studies. Dr. Giese's report analyzes current aerial photography and more than 150 years of historical data to assess the likely future movement of the outer beach and inlet. The data show that the formation of the second inlet in 2007 is a continuation of an historical cycle that occurs in two distinct stages: an inlet development stage where a new

breaching event launches a period of multiple inlets and changes in tides and tidal channels (which we are now experiencing) and an inlet migration phase, where the system stabilizes and a single dominant inlet begins a southward migration. Under this trend a single stable inlet could be in place in 20 years and begin a southward migration in 30 years, potentially ending up somewhere between Minister's Point and Chatham Light in 50 years.

- The Alliance released the *Coastal Resource Guide for Pleasant Bay and Chatham Harbor*. The Guide was developed by the Alliance in partnership with the Provincetown Center for Coastal Studies, Woods Hole Sea Grant/Cape Cod Cooperative Extension Service and Cape Cod Commission. The Guide draws from recent technical studies, as well as existing regional and state resources, to describe trends in barrier beach migration, tidal dynamics, flushing, water quality, wildlife, fisheries and related processes and resources. Much of the information is depicted on GIS-based maps. The Guide is intended as a resource to Conservation Commissions, planners, resource managers, property owners and interested citizens, and will be used by the Alliance to develop management recommendations and best practices for coastal erosion protection, beach nourishment, and dredging, and for long-term planning to protect coastal resources and minimize coastal hazards.

- A study entitled *Analysis of Tidal Data from Meetinghouse Pond, Chatham Fish Pier and Boston: with Application to Management*, by Dr. Graham Giese of the Provincetown Center for Coastal Studies, revealed that the volume of water flowing in and out of Pleasant Bay in 2012 is about the same as it was right after the second inlet formed in 2007. This is due to the fact that the increase in tidal range experienced after the 2007 inlet reached a peak in March of 2010, and experienced a slight but steady decrease in the two years after the peak. Tidal range in 2012 was less than at any time since soon after the formation of the second inlet in 2007, and mean high water was lower than it had been since 2009. The report provides important information for local and regional resource managers, and provides further information to help assess options for addressing nutrient loading throughout the system, and for evaluating proposals for coastal structures.

2.1.4 Watershed

Watershed planning activities have continued to include technical analysis of nutrient loading along with measures to reduce overall nitrogen load from the watershed. A complementary focus has been on fostering a collaborative regional approach to nutrient management planning, implementation and monitoring.

- The Alliance released the *Pleasant Bay Fertilizer Management Plan* in 2010. The plan builds on the Massachusetts Estuary Project findings that nitrogen

from fertilizers accounts for 15% of watershed-based or controllable nitrogen load. Reductions in this source of watershed nitrogen load could reduce nitrogen loading into Pleasant Bay and augment wastewater planning efforts in each Alliance town. To that end, the plan recommends three measures that have a combined potential to reduce existing controllable nitrogen load from fertilizers by approximately 5%. These steps are to:

- Implement best management practices for municipal turf management;
- Work with golf courses in the watershed to achieve a targeted nitrogen reduction; and
- Coordinate public education efforts aimed at reducing fertilizer use.

The plan indicates that additional nutrient reductions may be possible with:

- Limiting the size of lawns for future lots created in the watershed;
- Continued enforcement of "no disturb" buffers to wetland resource areas; and
- Increased turf management training courses.

- The Alliance developed a *Municipal Policy to Reduce Nutrients in Municipal Turf Managemen*t. The recommended municipal policy is the first implementation measure recommended in the fertilizer management plan. The policy provides best management practices aimed at reducing the amount of nitrogen resulting from municipal fertilizer use on town properties. The policy is intended to apply to all town properties except golf courses (which are to be addressed in a separate policy). The policy provides flexible treatment of turf areas based on nature and intensity of use; encourages incremental adoption of alternatives to traditional synthetic fertilizer programs; and is proposed to apply town-wide, since the effects of nitrogen documented for Pleasant Bay are similar to those documented for other regional embayments.

- The Alliance provided comment on local nutrient management plans, land use regulations and open space acquisitions designed to address nutrient loading in Pleasant Bay.

2.1.5 Navigation

The Alliance continues its work to preserve historic access to navigation in balance with resource protection measures.

- In 2009 the Alliance commissioned Coastal Engineering Company to conduct hydrographic survey to measure controlling depths of all major navigation channels throughout the Pleasant Bay system. This study was intended to provide a baseline for monitoring navigation depths and potential dredging needs. The survey indicated that navigation access is maintained in all channels, although in some cases access is constrained at low tide.

- The Alliance applied to the United States Environmental Protection Agency (US EPA) through Massachusetts Coastal Zone Management (MCZM) to designate Pleasant Bay and Chatham Harbor as a *No Discharge Area* for discharge of treated or untreated boat sewage. US EPA granted the designation in July 2010. NDA status makes it illegal to discharge treated sewage from a vessel's Marine Sanitation Devise (MSD) within the waters of Pleasant Bay and Chatham Harbor. Prior to the designation only the dumping of untreated sewage was illegal.

- In 2011 the Alliance released an *Assessment of Need, Impacts and Regulatory Feasibility Associated with Limited Improvement Dredging in the ACEC*. The assessment evaluates the potential need for, impacts from, and feasibility of improvement dredging in areas where shoaling is limiting traditional navigation access. The assessment found that dynamic shoaling in the vicinity of the 2007 inlet could potentially impede traditional navigation in the future. Because no part of that area had previously been permitted for dredging, future dredging would be considered improvement dredging and therefore prohibited under state law. The Alliance proposed a resource management plan amendment to allow the Town of Chatham to seek state and local permits for improvement dredging *within a specified zone* affected by the 2007 inlet, and provided the proposal is:
  - Sponsored by a municipality;
  - Intended to maintain or restore navigation access which has been impeded by natural sediment movement; and
  - The minimum amount of dredging needed to maintain historic access.

The amendment was adopted by Town Meetings in all four Alliance towns in May 2012.

2.1.6 Public Outreach and Education

- The Alliance co-produced the *2010 Boaters Guide to Cape Cod* with the Nantucket Soundkeeper, Provincetown Center for Coastal Studies and Cape Cod Commercial Hook Fishermen's Association. The guide included tide charts, best practices for boat maintenance, information concerning No Discharge Area requirements, contact information for harbormasters and pumpout services, and descriptions of natural resources affected by boating. The guide was mailed to all mooring permit holders in Pleasant Bay and distributed to local boating clubs, marine suppliers and through local harbormasters.

- The Alliance continued to host public forums on topical issues and to share information and gather community feedback on key initiatives. Forums included:
  - The 2009 Coastal Symposium featuring presentations on the barrier beach and inlet configuration, tidal flushing, and relative sea level rise;

- Alternative landscaping and turf management forums were held in 2010 and 2011;
- Statistical trend analyses of water quality data collected over nine years were presented in 2010;
- In 2012 findings were presented from an assessment of resource impacts and conceptual design for a single span bridge to restore ecological health in Muddy Creek;
- Presentations were given to Boards of Selectmen, waterways committees, shellfish committees, and Conservation Commissions on a variety of reports including: the Pleasant Bay Fertilizer Management Plan, proposed municipal turf management policy, barrier beach and inlet study, improvement dredging assessment and plan amendment, water quality study and Muddy Creek restoration project.

- The Alliance completed a comprehensive website upgrade in 2011 to make it easier for interested citizens to access reports and studies and to keep track of Alliance programs and activities. The website address is www.pleasantbay.org.

2.2 Recommendations 2013-2018

The Alliance will proceed in implementing recommendations in each of the seven areas identified in this plan update and described in the following chapters. The following recommendations are priorities for implementation upon adoption of the plan update by the towns and the state. Some of the recommendations call for immediate actions, and others provide the foundation for future phases of action or further research. A complete list of recommendations is located at the end of Chapter 10.

1. Continue to Facilitate Watershed-based Collaboration to Address Nitrogen Loading

Support and encourage the four watershed towns to make progress in developing and implementing comprehensive wastewater management plans (CWMPs) that encompass the Pleasant Bay watershed.

Promote watershed-based collaboration to achieve total nitrogen Total Maximum Daily Loads (TMDLs) through the efforts of the Alliance's watershed work group:

- Coordinate wastewater planning by undertaking plans and studies that will benefit multiple towns and coordinating relevant sections of towns' CWMPs.
- Sponsor technical studies and model runs that explore system-wide issues and conditions and help to identify cost effective solutions to achieve targeted thresholds.

- Work with MassDEP, MEP and regional entities to develop protocols for monitoring, analysis and documentation of eelgrass health, benthic infauna health and water column nitrogen concentrations.
- Explore strategies to equitably allocate cost and responsibility for planning, monitoring, and implementing facilities and other management strategies.
- Promote regional strategies to achieve TMDLs.
- Promote a watershed approach to reducing nutrient load from stormwater.
- Continue to implement the Pleasant Bay Fertilizer Management Plan.
- Promote smart growth land use strategies as a way to reduce nutrient load in the watershed.
- Act as communication link on key implementation issues between the watershed communities, and state and regional entities.

2. Develop Guidelines for Permitting Erosion Control Structures

The Alliance will develop performance standards and design criteria for erosion control structures in the study area to guide local and state permitting authorities. In cases where the use of hard structures is deemed the only feasible alternative, the standards and criteria would be used to minimize negative environmental impacts. Standards and criteria would also be developed for fortified soft structures. Until such time as performance standards and design criteria are developed and implemented locally and adopted by the state, MassDEP is urged to apply regulatory discretion allowed under 310 CMR 9.3.2 (2) when reviewing applications for Chapter 91 licenses that would fall under the categorical restriction. In so doing, MassDEP is urged to consider the issues enumerated in the resource management plan update.

3. Promote Strengthening of Wetland Protections

The Alliance will continue to work to strengthen local wetlands protection regulations and review procedures by recommending modifications to local conservation regulations and bylaws as needed to:

- Develop guidelines to promote application of the state regulatory standard of "no adverse effect" for wetland resources in the ACEC. These guidelines could include:
    - A recommendation to treat the ACEC as a resource area;
    - A goal of no loss of wetlands within the study area, which would apply to the direct loss of wetlands through filling or encroachment, as well as the loss of functionality due to cumulative impacts from adjacent uses or activities;
    - Recommendations to limit impacts resulting from projects within the ACEC granted limited project status under state wetland protection regulations;
    - Measures to ensure consistent and documented application of MassDEP wetlands delineation guidelines, and allowance for periodic review and revisions to boundaries as needed;

  - A 2:1 mitigation ratio for encroachment within the 50-foot buffer zone to the wetland resource area in an ACEC (currently there is no MassDEP requirement);
  - Develop performance standards for activities within the area of jurisdiction, including the potential for establishing no build and/or limited activity zones.
- Support adoption of a Flood Plain Bylaw in towns where one does not exist, and review existing flood plain bylaws for consistency and comprehensiveness;
- Support policies to limit landscaped coverage and develop best management practices for land clearance that address the issue of clear cutting;
- Disseminate best management practices and performance standards for landscaping and restoration of lawn areas;
- Promote use of *Guidelines for Planting Within the 100 Foot Buffer* developed by the Barnstable County Cooperative Extension Service, for re-vegetation and restoration of vegetation within the 100-foot buffer;
- Support legislative amendments to allow conservation commissions to levy more meaningful fines for significant violations of clear-cutting or of orders of conditions;
- Develop a definition of Inland Bank as the first observable break above mean annual high water.

4. Develop Best Management Practices to Protect Biodiversity

The Alliance will develop best management practices designed to protect and enhance the biodiversity within the study area:

- Develop best management practices to control or eradicate invasive species in fresh and marine resource areas;
- Promote studies of fisheries and fisheries habitat; and
- Develop best management practices for the clearance or alteration of large areas of previously undisturbed vegetation.

5. Continue Monitoring Programs.

Continue the Citizens' Water Quality Monitoring Program in concert with the TMDL Monitoring and Compliance protocols being developed by MassDEP/MEP/Alliance. Provide regular data reports, and detailed statistical analysis of trends every five years.

Address needs for eelgrass and benthic monitoring and reporting, in concert with the TMDL Monitoring and Compliance protocols being developed by MassDEP/MEP/Alliance.

Continue to monitor tide levels and changes in the Nauset barrier beach and inlet system.

Continue aerial flyovers of the entire Pleasant Bay system every five years, or more frequently as needed, and use aerial data to support other monitoring and management activities.

Support ongoing monitoring of water quality conditions in freshwater ponds in the ACEC and in the Pleasant Bay watershed.

Support on-going collection of bacterial water quality data at established locations throughout the Bay.

Continue to support research and monitoring efforts designed to deepen knowledge about intertidal and subtidal habitats.

6. Build Stewardship through Public Education

Continue to develop and disseminate periodic water quality and other resource reports for public information.

Continue to promote public information and education on issues and initiatives through enhancements to the Pleasant Bay Alliance website, www.pleasantbay.org.

Develop a Citizen's Guide to the Ecology of Pleasant Bay.

Continue to build public support and awareness of the need for nitrogen management strategies and adherence to the TMDLs through publication of *Citizens Guides to Estuarine Protection* for additional subwatersheds.

SECTION II. RESOURCE MANAGEMENT ISSUES AND RECOMMENDATIONS

Chapter 3.
Protecting Biodiversity and Habitat

3.0 Overview

It is widely recognized that Pleasant Bay is one of the richest and most diverse eco-systems in the northeast region. Pleasant Bay's biodiversity encompasses the health, productivity and variety of its natural resources: its marine and fresh waterbodies (Figures 3,4), its wetlands and vegetation, and its marine and terrestrial animal life. The Bay's biodiversity reflects the size and vitality of this estuarine system. Biodiversity supports our ability to enjoy the Bay's abundant resources for shellfishing, finfishing, scenic viewing, swimming, and boating, among other activities.

The 1998 plan and subsequent updates identify a number of threatened resources, which are key to the health and diversity of Pleasant Bay's ecology. These include:

- Water quality, the foundation of resource vitality as well as our use and enjoyment of the Bay, is threatened by excessive nutrients from land uses within the watershed, as well as impacts from marine uses such as boating.
- Wetland resources that cleanse groundwater of pollutants and provide critical animal habitats, are being encroached upon by surrounding land development, sea level rise, development of shoreline structures, and trampling from public uses.
- The tremendous diversity of terrestrial and aquatic animal and plant life is threatened by conflicts with and secondary impacts from a number of Bay uses, including land development, pollution, turbidity, and noise.

In light of these trends the plan calls for development of programs to inventory and monitor the extent and health of key resources: water quality, salt marsh, intertidal areas, and eel grass, among others. The 2013 plan update will report on the status of these efforts as well as new initiatives.

3.1 Resource Management Issue: Water Quality and MEP Modeling

The Pleasant Bay Citizen Water Quality Monitoring Program is an outgrowth of the 1998 plan. The plan identified the need for consistent and comprehensive water quality data to gage nutrient inputs from the watershed and other sources. In 1999, with grant support from the Executive Office of Environmental Affairs and the Friends of Pleasant Bay, Inc., the Alliance designed the bay-wide monitoring program, developed a Quality Assurance Project Plan (QAPP)[1], and purchased state-of-the-art monitoring equipment.

[1] The Massachusetts Department of Environmental Protection approved a final QAPP in 2000.

Since that time, the Alliance, the Friends of Chatham Waterways and the Orleans Water Quality Task Force have recruited and trained more than 150 volunteers to monitor field conditions and collect water quality samples throughout the Bay. Samples are transported to the School for Marine Science and Technology (SMAST) Laboratory of University of Massachusetts-Dartmouth for nutrient analysis.

Monitoring occurred at sixteen locations from 2000-2001. In 2002 five more stations were added by the Alliance to provide data necessary for modeling of the Bay through the Massachusetts Estuaries Project (MEP). These stations were augmented by additional stations maintained by the Towns of Orleans and Chatham. As shown in Figure 5, at the height of monitoring for the MEP there were 36 stations located throughout the Bay. Following the release of the MEP Technical Report for Pleasant Bay in May 2006, the number of stations was reduced to nineteen and then to sixteen in 2007. In 2010, based on local interest in restoring data collection at select locations, the numbers of stations was increased to 20 and has remained at that level.

Figure 5. Water Quality Monitoring Stations at the heigh of monitoring for the MEP (courtesy SMAST)

Data from the monitoring program are reported in periodic *Interim Reports*. The reports compile average readings for all parameters for all stations for the years covered. The data are used to calculate the eutrophication index for each of the monitored subembayments. The index[2] is widely accepted as a tool for describing the impact of excessive nutrients from surrounding land uses and for monitoring the general condition of the Bay's water quality. The latest interim report was issued in 2010 and covered data through 2009.

Data collected by the water quality monitoring program were incorporated in modeling of Pleasant Bay through the MEP. The MEP analysis confirmed and illuminated many of the same findings demonstrated by the Alliance's Interim Reports. Notably, the report documented signs of nutrient-related stress throughout the system and found that thirteen of seventeen subembayments exhibited some level of impaired or degraded habitat health

[2] The Buzzards Bay Baywatcher's program developed and has used the index since 1992.

due to overloading of nitrogen[3]. The report also documented excessively low dissolved oxygen levels in some subembayments such as Muddy Creek, Paw Wah Pond, Lonnie's Pond, Areys's Pond, Quanset Pond and Meetinghouse Pond, where surrounding land is densely developed and tidal flushing is restricted. The MEP report provided the basis for establishing total nitrogen Total Maximum Daily Loads (TMDLs) for sixteen subembayments in Pleasant Bay. The TMDLs provide the nutrient targets for local and regional nutrient management planning.

With thirteen years of monitoring completed, the Pleasant Bay Water Quality Monitoring Program has made a significant contribution to our understanding of nutrient-related water quality impacts in Pleasant Bay. As a major component of the MEP Technical Report and subsequent TMDL analyses, the water quality data have provided a foundation for planning nutrient management strategies on a watershed-wide basis. In the coming years the program will continue to collect baseline data and develop protocols for long-term monitoring needed to evaluate the effectiveness of nutrient management strategies.

3.2 Recommendations to Address Water Quality and MEP Modeling

3.2.1 *Continue the Citizens' Water Quality Monitoring Program in concert with the TMDL monitoring and compliance protocols being developed byMassDEP, MEP, and the Alliance.* Baywide water quality monitoring through the Alliance will continue on an annual basis. Modifications to the number or location of stations or selected parameters could occur in light of TMDL monitoring and compliance protocols, or as needed for future modeling. It will be important to review and, as necessary, revise the program QAPP to ensure that it reflects any new or modified strategies or methods for data collection, analysis or quality control.

3.2.2 *Update Statistical Analysis of Water Quality Data Every Five Years.* Statitical analysis of water quality data was undertaken in 2005 as part of the MEP Technical Report. In 2010, the Alliance contracted with the Cadmus Group to conduct an extensive statistical analysis of trends incorporating all data collected through 2009. As more data become available, statistical trend analysis will become stronger. It is recommended that a statistical analysis of trends be conducted every five years.

3.2.3 *Update MEP water quality model as needed to reflect changing conditions*. One of the great advantages of the MEP model is that it enables communities to adjust the assessment of nutrient impacts and nutrient reduction thresholds in light of changing conditions. The Alliance will identify additional modeling scenarios to support watershed-based nutrient management planning. In addition, the Alliance will work with MEP and member towns to evaluate whether

[3] For more information see Table VIII-1, Massachusetts Estuaries Project, Final Report, 2006.

or under what conditions the model should be re-run to reflect significant changes in conditions, or as part of efforts to monitor progress toward achieving TMDLs.

3.2.4 *Continue to develop and disseminate periodic water quality reports for public information.* The Alliance will continue to publish periodic reports on water quality conditions and data analysis from the monitoring program. These could include interim reports, as well as other public educational brochures explaining the nature and implications of water quality conditions in the Bay.

3.2.5 *Address needs for eelgrass and benthic monitoring and reporting, in concert with the TMDL monitoring and compliance protocols being developed by MassDEP, MEP, and the Alliance*. The main purpose of the MEP is habitat restoration. In order to assess whether nutrient management strategies are having a beneficial impact on habitat conditions, MassDEP will also require surveys of eelgrass and benthic animals. It is expected that the protocols being developed for monitoring will rely on state generated eelgrass monitoring, and state or regional benthic monitoring. The Alliance will support and participate in these monitoring efforts as needed, and will assist in compiling all monitoring data for compliance reporting and public information.

3.2.6 *Support ongoing monitoring of water quality conditions in freshwater ponds in the ACEC and in the Pleasant Bay watershed.* The ACEC includes eleven freshwater ponds and lakes, and many more freshwater bodies are located in the watershed. Among other things, these water bodies play an important role in taking up nitrogen from groundwater before it reaches the Bay. The health of these resources is of critical importance. The Alliance will support on-going pond monitoring efforts, and will work with the Cape Cod Commission, local pond support groups, and Alliance towns to track and assess available water quality data for ponds in the ACEC and watershed.

3.2.7 *Track bacterial and other water quality issues.* Bacterial contamination is a continuing concern for the communities surrounding Pleasant Bay. The Alliance will continue to build awareness of bacterial water quality trends and measures to address problem areas (See recommendations 5.11.1-5.11.3):

- Monitoring data collected through the Massachusetts Beaches Act do not reveal a chronic problem at any swimming location. However, changing conditions that include a growing seal population underscore the need for on-going monitoring. As a result of changes in the Beaches Act in 2009, the state now only sponsors bacterial testing in designated public swimming areas. The Alliance will work with the Towns to ensure on-going monitoring at all previously tested sites, whether they are designated swimming areas covered under the Beaches Act, or informal swimming areas. The Alliance will also evaluate whether bacterial monitoring should be incorporated into the Citizen Water Quality Monitoring Program;

- To help prevent bacterial contamination, the Alliance will continue to work with the Orleans Pond Coalition, Town of Chatham and other groups to maintain Mutt Mitt placements at public and private access locations on Pleasant Bay. The Alliance also will generate materials regarding the importance of pet clean up for distribution with pet licenses;
- The Alliance will also work with the watershed communities to promote application of best management practices for stormwater management.

3.2.8 *Suport the Geographic Response Plan (GRP) for oil spill preparedness*. GRP are oil spill response plans tailored to protect a specific sensitive area from impacts following a spill. These response plans are map-based strategies that can save time during the critical first few hours of an oil spill response. A GRP has been developed for Pleasant Bay and Chatham Harbor.

3.3 Resource Management Issue: Salt Marsh Dieback

Salt marshes play an important role in the ecology of Pleasant Bay. Approximately 1,100 acres of salt marsh in the Pleasant Bay system provide storm damage prevention, pollution attenuation, flood storage, and fisheries and wildlife habitat. As described in Chapter 7, the Alliance sponsored a shoreline change study based on maps and aerial photography dating from 1868 to 2005. The study found that, although there was little change in the shoreline of Pleasant Bay measured from the High Water Line over the 137-year period, there were areas of marshline growth and depletion during this time period. It is widely believed that the long-term geomorphology of Pleasant Bay may include increased salt marsh formation as the Nauset barrier beach erodes over the long term.

There is growing concern that the viability of salt marshes is threatened by rising sea level, pollution, encroachment and disease. Numerous studies have documented instances of salt marsh dieback along the East Coast of the U.S, although the exact causes are still under study. Limited areas of degrading salt marsh have been identified in Pleasant Bay. Stephen Smith, Plant Ecologist with the National Park Service, Cape Cod National Seashore (CCNS) is one of the scientists tracking and analyzing salt marsh trends in the U.S. Dr. Smith and CCNS have been monitoring salt marsh conditions on the backside of Nauset Beach for several years and helped the Alliance select sites and develop a protocol for monitoring salt marsh conditions in Pleasant Bay. Transects were installed at marsh areas adjacent to Jackknife town landing in Chatham and Sparrowhawk town landing in Orleans. Several years of monitoring, coupled with aerial surveys of the Bay, will be needed to discern trends in salt marsh growth or degradation in these two areas.

3.4 Recommendations to Address Shoreline/Salt Marsh Monitoring

3.4.1 *Develop a plan to resume monitoring of the Jackknife and Sparrowhawk salt marsh sites*. Monitoring data will be shared with the CCNS monitoring program. Monitoring in future years should include vegetation as well as pore water salinity. The benefits of expanding the monitoring program to include additional sites in future years also should be evaluated.

3.4.2 *Continue aerial flyovers of the entire Pleasant Bay system every five years, or more frequently as needed*. Use the aerial data to periodically update the shoreline and marshline change study.

3.5 Resource Management Issue: Understanding and Managing Ecological Diversity

Pleasant Bay and the surrounding watershed area are renowned for an abundance of vegetation and terrestrial, aquatic and avian wildlife. The Bay's varied topography and vegetation – including stands of pitch pine, scrub oak, and cedar -- provide a number of significant and increasingly rare forms of habitat. Human activities can conflict with the functioning or quality of the habitats. Several of the Bay's habitats are threatened by encroaching land uses and the emergence of invasive species. There is concern, for example, that excessive clear cutting of large land areas that remove the vegetative understory and destabilize topsoil even when trees remain, may have significant impacts on wildlife habitat, as well as drainage patterns and erosion. The growing presence of invasive species of vegetation and aquatic life is also of concern. Invasive species pose a management challenge in freshwater and marine habitats within the Pleasant Bay study area. Invasive species tend to consume limited food supplies and overpower native species, leading to the creation of a monoculture that undermines biodiversity.

The viability of the many diverse habitat types and species found throughout the study area is essential to biodiversity. This issue is underscored by the presence of a number of rare and endangered species in the Pleasant Bay study area. According to the Massachusetts Natural Heritage and Endangered Species Program (NHESP), there are twenty-three rare plant and animal species that occur in the Pleasant Bay watershed area that are listed as either *Endangered, Threatened* or *of Special Concern* (Table 2). Founded in 1978, NHESP is responsible for the conservation and protection of Massachusetts' biodiversity, with particular focus on approximately 178 species of vertebrate and invertebrate animals and 264 species of native plants and their habitats that are officially listed as *Endangered*, *Threatened* or of *Special Concern* under the Massachusetts Endangered Species Act.

Table 2. MA Endangered Species Act (MESA)-Listed Species in the Pleasant Bay Watershed

Scientific Name	Common Name	Taxonomic Group	State Status
Anax longipes	Comet Darner	Dragonfly/Damselfly	Special Concern
Charadrius melodus	Piping Plover	Bird	Threatened
Dichanthelium ovale ssp. Pseudopubescens	Commons's Panic-grass	Plant	Special Concern
Enallagma laterale	New England Bluet	Dragonfly/Damselfly	Special Concern
Enallagma pictun	Scarlet Bluet	Dragonfly/Damselfly	Threatened
Enallagma recurvatum	Pine Barrens Bluet	Dragonfly/Damselfly	Threatened
Enallagma daeckii	Attenuated Bluet	Dragonfly/Damselfly	Threatened
Isoestes acadiensis	Acadian Quillwort	Plant	Endangered
Lachmanthes caroliana	Redroot	Plant	Endangered
Liatris scariosa var. novae-angliae	New England Blazing Star	Plant	Special Concern
Lipocarpha micrantha	Dwarf Bulrush	Plant	Special Concern
Malaclemys terrapin	Diamondback Terrapin	Reptile	Threatened
Papaipema sulphurata	Water-willow stem Borer	Butterfly-Moth	Threatened
Persicaria setacea	Strigose Knotweed	Plant	Threatened
Rhynchospora scirpoides	Long-beaked Bald-sedge	Plant	Special Concern
Sabatia kennedyana	Plymouth gentian	Plant	Special Concern
Sagittaria teres	Terete Arrowhead	Plant	Special Concern
Sterna antillarum	Least Tern	Bird	Special Concern
Sterna dougallii	Roseate Tern	Bird	Endangered
Sterna hirundo	Common Tern	Bird	Special Concern
Sterna paradisaea	Artic Tern	Bird	Special Concern
Terrapene Carolina	Eastern Box Turtle	Reptile	Special Concern

Source: MA Natural Heritage and Endangered Species Program, Division of Fisheries and Wildlife, 2012

NHESP maintains the Natural Heritage Atlas, which identifies statewide areas of Priority Habitat and Estimated Habitat for state-listed species data in a GIS format. Figure 6 shows areas of Priority and Estimated Habitat as mapped by NHESP.

3.6 *Recommendations for Managing Ecological Diversity*

3.6.1 *Promote compliance with the NHESP.* The Alliance will work with member towns to ensure that projects not requiring a Notice of Intent but located within areas of Priority or Estimated Habitat, as mapped on the 2006 NHESP Atlas, are

required to file a request for information with NHESP to determine which species may be mapped on the site, and how that might inform project design.

3.6.2 *Develop best management practices to control or eradicate freshwater and marine invasive species.* A comprehensive and coordinated approach to managing invasive species in the study area is needed. The Alliance will work with state, regional and local organizations to inventory and prioritize invasive species in the study area, and to develop and disseminate best management practices. In developing best management practices for invasive species, the Alliance will consult the latest scientific research and will incorporate regional resources such as the *Invasive Plant Atlas of New England* and Massachusetts Coastal Zone Management's Aquatic Invasive Species Program, among others. The best management practices will incorporate an understanding of the types of invasive plant and animal species in the Pleasant Bay study area, identification of new species or small populations that could be addressed through early intervention, as well as recommended management guidelines for established species.

3.6.3 *Develop Best Management Practices for Site Clearance or Alteration*. The Alliance will develop best management practices for clearance or alteration of vegetation on large land areas. The management guidelines will address protection of natural features and native species, protection of wetlands and upland wildlife habitat, filling and earth removal, drainage, stormwater management, and erosion and sedimentation control.

3.6.4 *Develop Citizen's Guides to the Ecology of Pleasant Bay*. The guide or guide series would be geared toward acquainting citizens and Bay users with aquatic and terrestrial vegetation and wildlife in the Pleasant Bay study area. The role of species diversity in overall ecosystem health would be a major theme.

3.6.5 *Support ongoing research*. The Alliance will continue to support and collaborate with other scientific and advocacy groups involved with research and monitoring efforts aimed at understanding population dynamics and trends associated with a variety of species found in the Pleasant Bay study area, including but not limited to:

- Gray seals and their impact on Pleasant Bay;
- Horseshoe crabs;
- Piping plovers;
- Least terns;
- Diamond-backed Terrapin;
- Razor clams;
- The relationship between mussels and Eiders, and
- Double-crested Cormorants.

3.6.5 *Promote Open Space and Habitat Protection*. The Alliance will continue to support a range of measures aimed at accomplishing protection of meaningful open space and particularly areas identified as priorities by local towns, land trusts or the Cape Cod Commission. Measures the Alliance will undertake include:

- Advocacy for land purchases and adoption of conservation restrictions in the study area;
- Support for expanded use of policies such as the Natural Resource Protection District adopted in Brewster's portion of the Pleasant Bay watershed, which could help to limit impervious surface area, reduce nutrient loading and facilitate centralized wastewater treatment, and protect areas of undisturbed habitat throughout the study area; and
- Identification of significant wildlife areas and creation of overlay protection areas for inclusion in local bylaws, open space plans and local comprehensive plans.

3.7 Resource Management Issue: Areas of Critical Marine Habitat

The 1998 plan designated ten intertidal areas of significant habitat value as Areas of Critical Marine Habitat (ACMH). The designated areas encompass several distinct intertdal habitat types including sandy tidal flats, muddy tidal flats, eelgrass beds, fringe marsh, and areas of freshwater up-welling, among other areas of relatively unaltered shoreline. Many ACMH were selected because of their adjacency to undisturbed uplands that were inhabited by species that rely on both land and water access for survival. ACMH serve as habitats, feeding areas, nesting areas, spawning areas and nursery areas for hundreds of species of marine invertebrates and vegetation that are food sources for other species, as well as amphibians, shellfish, fin fish, migratory shorebirds, and some species of upland fauna. Protection of these areas was deemed necessary for the sustainability of several species and the potential re-introduction of some lost or endangered species, such as the Diamond-backed Terrapin.

The 2008 plan update modified and condensed the list of areas based on new observations and studies of different species, including diamond-backed terrapin, horseshoe crabs and shore birds (Figure 7). The modified list of ACMH included:

1. The intertidal zone, marsh and tidal flats surrounding Tern Island and Minister's Point, west of the channel, including any tidal flats newly formed due to shoaling. This area has experienced an increase in bird use for feeding and roosting. Plovers and Roseate Terns are among the species that frequent these intertdial areas. The formation of the new inlet is also expected to have an ongoing influence on habitat characteristics in this area and may result in an increase in tidal flats due to shoaling.

2. The intertidal zone, marsh and tidal flats in the area west of Nauset Beach from the Chatham breakthrough northward to the headwaters of Pochet Creek, and extending westward to include the western sides of Hog, Sampson's and Little Sipson's Islands, and the western and southern sides of Strong Island. This area is a composite of ACMH 2, 7 and 8 as listed in the 1998 plan, and now also includes Pochet Creek. This area includes the relatively remote and pristine environments of the backside of the barrier beach and the shoreline of several bay islands, which provide unique or significant habitat value for a wide range of species, including horseshoe crabs, shore birds, and migratory birds.

3. The intertidal zone along the conservation property on the south side of Kent's Point, and along both sides of The River from Kent's Point to the entrance of Meetinghouse Pond (east of Lucy Snow's Point), including Frost Fish Cove. This area adjacent to conservation lands was previously listed and is stilled considered an important habitat for birds as well as for the Diamond-backed Terrapin.

4. The following intertidal areas (noted in the 1998 plan as ACMH 3, 4, 5, 6 and 9) are no longer considered ACMH. The significance of these areas as habitat has been diminished due to development of adjacent upland.
   - Nickerson's Neck from the Strong Island town landing to the southeastern tip of Fox Hill;
   - Nickerson's Neck from the Chatham Yacht Club north to the 7th tee of Eastward Ho! Country Club;
   - Pleasant Bay from the southwest entrance of the Narrows westward to the eastern end of the Winslow revetment;
   - Little Pleasant Bay from Namequoit Point west to the entrance to Paw Wah Pond; and
   - Along Barley Neck.

3.8 Recommendations: Areas of Critical Marine Habitat

3.8.1 Continue to provide the following guidance with respect to activities within ACMH 1-3. To ensure that these sensitive habitat areas continue to be protected from adverse impacts, the following guidance is provided for activities within ACMH 1-3:

- Placement of a new shoreline structure should be prohibited (with no effect for existing licensed structures). ACMH are not suited to placement of new structures due to their unique habitat value. It is recognized that ACMH 2 includes the shoreline of bay islands. Structures located on the shoreline of bay islands should only be considered where they are necessary to provide safe and reasonable access, and only when it has been demonstrated that all alternative forms of access are impractical. In such cases where a structure

is deemed necessary to provide reasonable access, it should be the minimal size necessary and must meet all applicable performance standards and design criteria as defined in the Pleasant Bay Management Alliance Dock and Pier Guidelines (1999) and local and state regulations. Multiple structures on a single island or otherwise within 1,000 feet of another structure are strongly discouraged, and steps to promote sharing of structures among multiple user groups should be a condition of approval.

- Placement of additional moorings in the intertidal zone should be prohibited (no effect for existing moorings approved by the harbormaster).
- Expansion or addition of aquaculture grants within ACMH should only be allowed if:
    - Compliance with all applicable local, state and regional regulations, policies and best management practices can be demonstrated;
    - It can be documented and demonstrated that there will be no negative impact on marine invertebrates, shorebirds, migratory birds, or other rare or endangered species; and
    - Based on historical harvest data and an objective site investigation there is no likelihood of a natural recurrence of wild shellfish population.
- Shellfishing should be prohibited in areas other than those permitted by the local shellfish official in cooperation with the Pleasant Bay Management Alliance.

3.8.2 Add Muddy Creek in its entirety as ACMH 4. The 2013 update recommends the addition of Muddy Creek in its entirety as a fourth ACMH (Figure 7). Due to its expansive wetlands, relative lack of public access, and the undeveloped character of much of the bordering land, Muddy Creek provides critical habitat for a range of fish, birds and other wildlife. Muddy Creek's 56 acres of estuarine, riverine and freshwater wetlands provide vital habitat for several High Prioirity migratory waterfowl and migratory bird species. The creek is also a migratory passage for diadromous fish, and formerly a robust habitat for hardshell clam. Replacement of existing culverts with the proposed bridge will increase tide range approximately two feet and this change is expected to expand tidal flats, which will colonize with marsh grass. Designation as an ACMH will ensure that these sensitive resources areas are protected during the process of transition.

3.8.3 *Provide the following guidance with respect to activities within ACMH 4.* To ensure that these sensitive habitat areas continue to be protected from adverse impacts, the following guidance is provided for activities within ACMH 4:

- Placement of a new shoreline structure should be prohibited (with no effect for existing licensed structures). For the purposes of this section, shoreline structures does not refer to the propsed bridge to replace existing culverts. ACMH are not suited to placement of new structures due to their unique habitat value.

- Placement of additional moorings should be prohibited (no effect for existing moorings approved by the harbormaster).
- Aquaculture should only be allowed if:
    - Compliance with all applicable local, state and regional regulations, policies and best management practices can be demonstrated;
    - It can be documented and demonstrated that there will be no negative impact on marine invertebrates, shorebirds, migratory birds, or other rare or endangered species; and
    - Based on historical harvest data and an objective site investigation there is no likelihood of a natural recurrence of wild shellfish population.
- Shellfishing should be prohibited in areas other than those permitted by the local shellfish official in cooperation with the Pleasant Bay Management Alliance.

3.8.4 Continue research and monitoring efforts designed to deepen knowledge about ACMH. The following research and restoration efforts within ACMH are recommended:

- Creation of a map of intertidal habitats based on tidal regime, sediment type and vegetative cover, to deepen our understanding of how intertidal habitats may be changing over time, especially due to changes in the inlet configuration, which are likely to influence these intertidal areas.

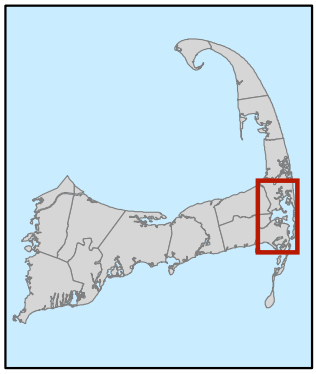
- Evaluation of the potential for a quahog nursery restoration project, possibly creating a spawning sanctuary that would help sustain an adult population capable of generating sufficient amounts of larvae. This would also protect razor and softshell clams, as well as birds, horseshoe crabs, and other species; and

- Other research and initiatives aimed at understanding the role of the Bay as a spawning and nursery area, the natural and man-made impacts on that role, and efforts to mitigate negative impacts on these important habitat functions.

Pleasant Bay Resource Management Plan 2013

Marine Features

Pleasant Bay Alliance



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The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

Figure 3. Marine Features

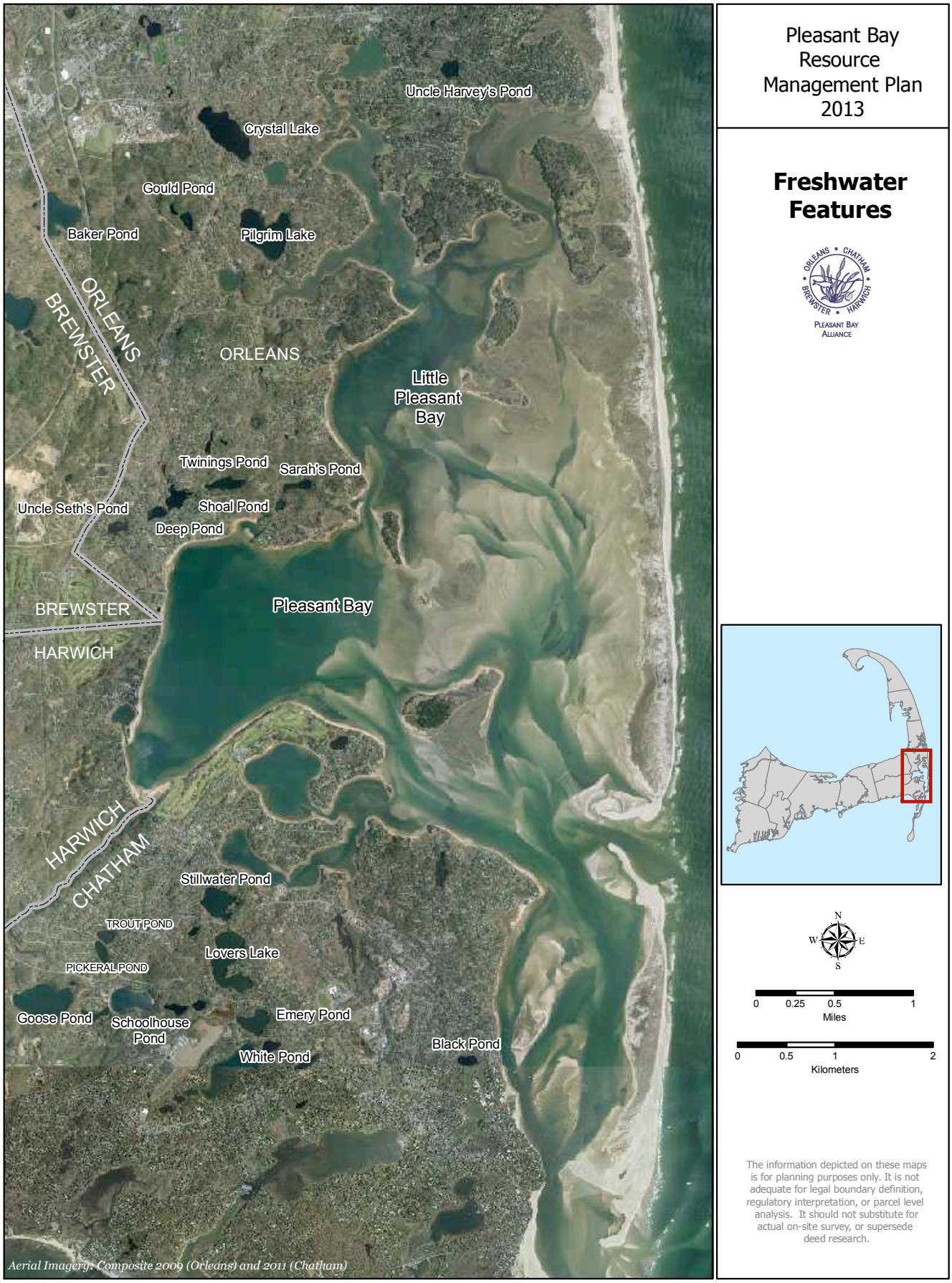


Figure 4. Freshwater Features

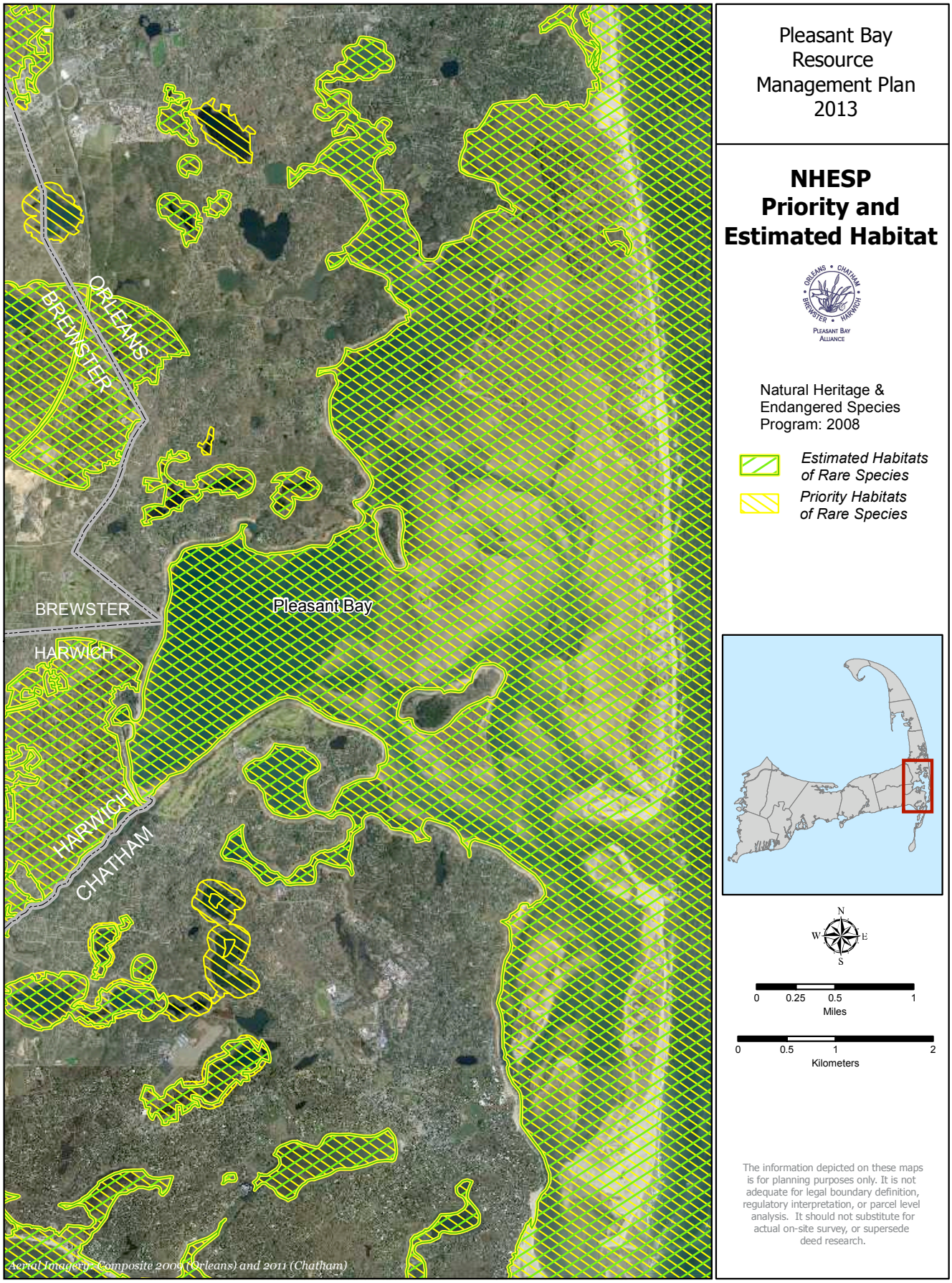


Figure 6. NHESP Priority and Estimated Habitats

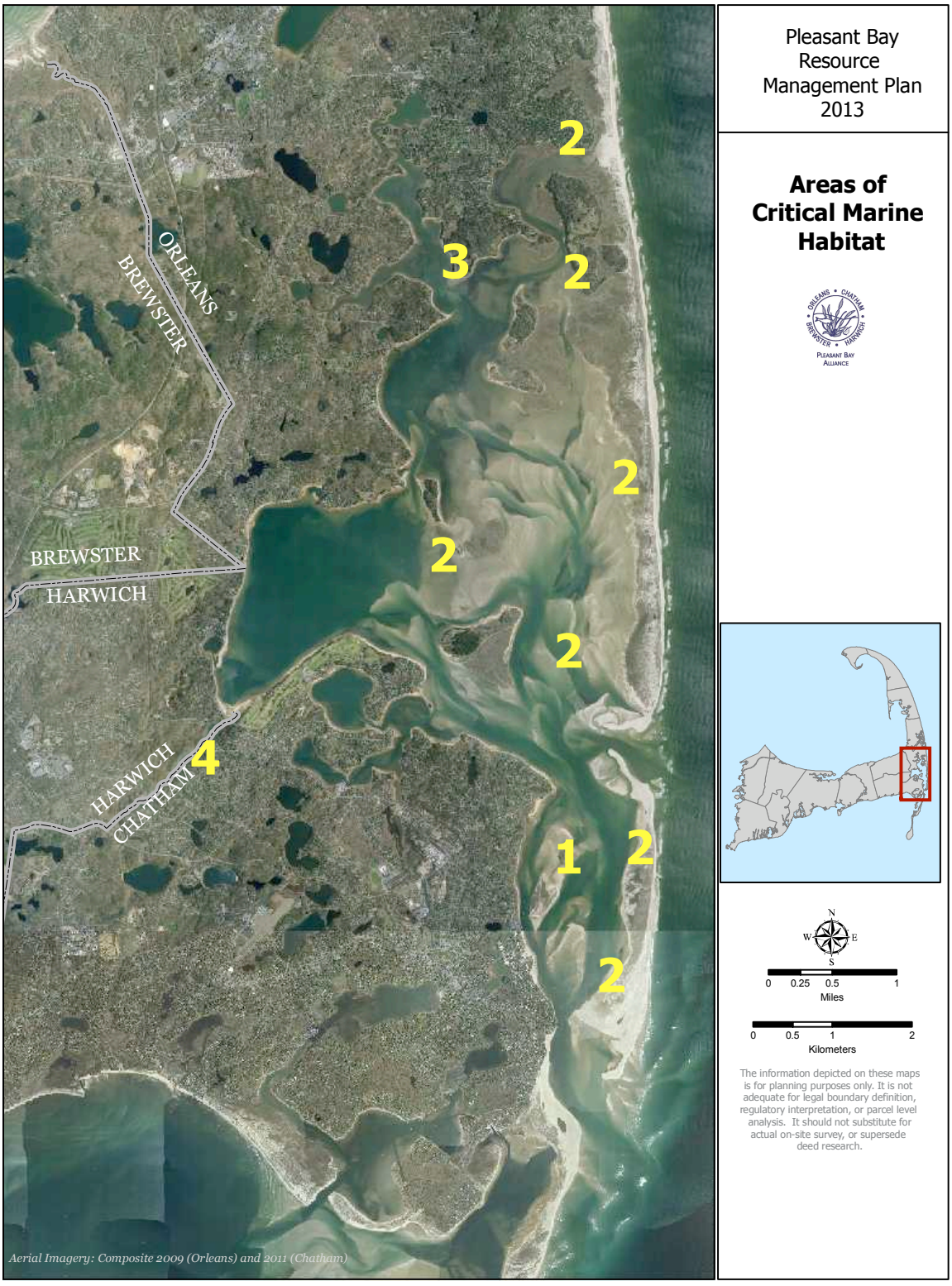


Figure 7. Areas of Critical Marine Habitat

Chapter 4
Wetlands Protection

4.0 Overview

The watershed of the Pleasant Bay estuary is rich in wetland resources that are vital to the area's ecology, its natural beauty, and its commercial and recreational values. Wetland resources cover more than 3,451 acres (Table 3, and Figure 8). When open water bodies are included, wetlands cover more than 11,000 acres, or half of the area of Pleasant Bay and its watershed. The abundance of Pleasant Bay's wetland resources is matched by the variety and condition of those resources. Seventeen categories of wetland resources have been identified in the study area, and most are in generally healthy condition. Each type of wetland resource acts as a building block in the ecology of the estuarine system. Loss or degradation of one or more types of wetland resources can easily upset the system's delicate ecological balance.

Table 3. Wetland Resources in the Pleasant Bay Study Area

Wetland Resource Type	***Acreage (2007)***
Coastal Bank	96
Coastal Beach	113
Coastal Dune	85
Rocky Intertidal Shore	1
Salt Marsh	1,391
Tidal flat	225
Barrier Beach System	41
Barrier Beach-Coastal Beach	259
Barrier Beach-Coastal Dune	650
Wooded swamp – deciduous trees	116
Wooded swamp – coniferous trees	38
Wooded swamp – mixed trees	41
Shrub swamp	264
Shallow marsh, meadow or fen	48
Deep marsh	20
Cranberry bog	59
Bog	4
Total Acres of Wetlands	3,451
Marine Water Surface Area	7,000
Fresh Water Surface Area	657
Total Wetland Acres	11,108

Source: Coastal Resource Guide for Pleasant Bay and Chatham Harbor, 2011

Marine and freshwater wetlands serve many critical environmental functions. They act as pollution filters, buffers against storm damage and flooding, and habitat for many spawning and juvenile species. Wetland resources are protected by federal, state and local regulations. The Massachusetts Wetlands Protection Act (WPA) identifies the following eight statutory interests or values provided by wetlands that are protected under the WPA:

- public/private water supply
- groundwater supply
- flood control
- storm damage prevention
- prevention of pollution
- protection of land containing shellfish
- protection of wildlife habitat
- protection of fisheries

Under the Massachusetts WPA, the standard for protecting wetland resources in Areas of Critical Environmental Concern (ACEC) is "no adverse effect" (310 CMR 10.24(5)(b)). The 1998 Resource Management Plan and subsequent plan updates have recommended actions to strengthen local regulations and increase their consistency in applying this standard.

One of the ways the Alliance has addressed wetland protection is through the development of permitting guidelines for structures in wetland resource areas. The guidelines, which are available for downloading from the Alliance's website www.pleasantbay.org, include:

- *Guidelines and Performance Standards for Permitting Docks and Piers in Pleasant Bay* (1999);
- *Guidelines for Private Walkways and Stairways in Fresh and Marine Resource Areas in Pleasant Bay* (2002, revised 2007); and
- *Guidelines for Permitting Shoreline Structures on Freshwater Lakes and Ponds in the Pleasant Bay Area of Critical Environmental Concern (draft 2012).*

Each set of guidelines was developed based on a comprehensive understanding of resource conditions and the threats imposed by either unmanaged access or a proliferation of structures. The guidelines seek to balance resource protection with recognition of the benefits of access to resource areas for a wide range of recreational pursuits (e.g., kayaking, canoeing, bird watching, fishing, nature viewing) as well as stewardship activities such as monitoring water quality, salt marsh or animal species. Local Conservation Commissions and MassDEP use the respective guidelines in reviewing and administering permits for structures in wetland resource areas in the Pleasant Bay ACEC.

The permitting guidelines offer a consistent resource-based approach to providing access to sensitive wetland resource areas. However, as outlined below, further steps can be taken to strengthen local wetland protection regulations in the ACEC and watershed, and these will be the focus of the Alliance's wetland protection efforts in the coming five years.

4.1 Resource Management Issue: Strengthening Wetlands Regulations and Compliance

As noted above, wetlands resources provide important ecological functions that include storm protection and flood control, pollution filtration and habitat for a wide variety of species. It is widely accepted that once wetlands are degraded or destroyed, restoration of the resource, if feasible, is more costly and less effective than prevention measures to protect naturally occurring resources. Therefore, regulations to protect wetland resources have a significant economic benefit as well. Cape Cod is fortunate in that one in four acres of land is a wetland resource.[1] However, the vast expanse of wetland resources on Cape Cod means that local Conservation Commissions have a huge task in reviewing and administering the variety of projects that are located within wetland resource areas and buffer zones. As demonstrated by their adoption of the permitting guidelines listed above, the Conservation Commissions in the Pleasant Bay watershed have made strides in bringing consistency to their respective regulations for coastal and pondshore wetland resources in the Pleasant Bay ACEC. However, on a broader level, Commissions face several additional challenges in their efforts to provide necessary protection of wetland resources. A comparison of local wetland regulations conducted for the 1998 plan and subsequent updates identified differences in the treatment of several issues:

- *Additional Interests and Resources Protected*. Additional interests are those community values not addressed in the Massachusetts WPA that should be protected in the administration of local regulations. Some towns have included additional interests not covered in the WPA, such as aesthetics (Orleans and Brewster); water quality (Harwich, Orleans, Chatham, Brewster), rare and endangered species (Harwich, Chatham); recreation (Harwich, Orleans, Chatham); erosion and sedimentation control (Harwich, Orleans, Chatham), and marshland and eelgrass beds (Chatham). Consistency among towns in terms of protected values is desirable.

- *Buffers and Setbacks.* One way to strengthen protection of wetland resources is to increase the buffer area of jurisdiction. Increased buffer width enhances water quality by filtering sediments and pollutants, particularly nitrogen, before they reach ponds and embayments. Buffers also increase the associated wildlife habitat value of the resource area.

[1] Cape Cod Regional Policy Plan, 2003, Cape Cod Commission, page 53.

Designations of setbacks *for no disturb areas* and/or *limited activity areas* within the buffer zone also serve to enhance protection of these wetland values. Each Alliance town has enacted a form of buffer, no build or no disturb zone. Differences between and benefits of these various requirements should be evaluated to determine if a preferred buffer or setback regulations should be recommended. Consistency of enhanced buffer and setback requirements may be desirable to protect resources.

- *ACEC Standards*. Within the ACEC, the standard that an activity may be allowed as long as it has no adverse effect on wetlands resources is incorporated in local regulations. However, there are no specific criteria for conservation commissions to rely on in applying the *no adverse effect* standard. Development of specific criteria for the ACEC no adverse effect standard remains a priority.

4.2 Recommendations to Strengthen Wetlands Regulations and Compliance

4.2.1 *Strengthen local wetlands protection regulations and review procedures*. The Alliance will continue to review existing wetlands protection regulations in the Alliance communities and, where advisable, work with conservation agents and commissions to strengthen regulations in the following areas:

- Develop guidelines to promote application of the state regulatory standard of “no adverse effect” for wetland resources in the ACEC. These guidelines could include
    - a recommendation to treat the ACEC as a resource area;
    - a goal of *no loss of wetlands* within the study area, which would apply to the direct loss of wetlands through filling or encroachment, as well as the loss of functionality due to cumulative impacts from adjacent uses or activities;
    - recommendations to limit impacts resulting from projects within the ACEC granted limited project status under state wetland protection regulations;
    - measures to ensure consistent and documented application of MassDEP wetlands delineation guidelines, and allowance for periodic review and revisions to boundaries as needed;
    - A 2:1 mitigation ratio for encroachment within the 50-foot buffer zone to the wetland resource area in an ACEC (currently there is no MassDEP requirement);
    - Develop performance standards for activities within the area of jurisdiction, including the potential for establishing n*o build* and/or *limited activity* zones.
- Support adoption of a Flood Plain Bylaw in towns where one does not exist, and review existing flood plain bylaws for consistency and comprehensiveness;

- Support policies to limit landscaped coverage and develop best management practices for land clearance that address the issue of clear cutting (see recommendation 3.6.3);
- Disseminate best management practices and performance standards for landscaping and restoration of lawn areas;
- Promote use of *Guidelines for Planting Within the 100 Foot Buffer* developed by the Barnstable County Cooperative Extension Service, for re-vegetation and restoration of vegetation within the 100-foot buffer;
- Support legislative amendments to allow conservation commissions to levy more meaningful fines for significant violations of clear-cutting or of orders of conditions; and
- Develop a definition of Inland Bank as the first observable break above mean annual high water.

4.3 Resource Management Issue: Muddy Creek Restoration

Muddy Creek is a tidal river and subembayment of the Pleasant Bay estuarine system. Muddy Creek serves as a boundary between the Towns of Chatham and Harwich and is shared by the two towns. Dual culverts under Route 28 separate Muddy Creek from the main basin of Pleasant Bay. The culverts restrict tidal flow, which exacerbates threats to water quality that include bacterial contamination from wildlife and nitrogen loading from surrounding land uses. These conditions prompted concerns about degraded water quality in Muddy Creek, and its effects on wetlands, fisheries and other natural resources.

In 2005 a Total Maximum Daily Loads (TMDL) for bacteria was established for Muddy Creek. In 2006 TMDLs for total nitrogen were established for upper and lower Muddy Creek. The nitrogen TMDLs call for a 75% reduction in watershed septic load in upper Muddy Creek and a 100% reduction in septic load in lower Muddy Creek.

Over the past several years the Towns of Harwich and Chatham and the Pleasant Bay Alliance have been exploring the replacement of the culvert as an option for improving water quality and restoring wetlands and habitat in Muddy Creek.

In 2008 the Alliance petitioned the Massachusetts Wetlands Restoration Program to name the Muddy Creek culvert study a priority wetlands restoration project. The Muddy Creek restoration was designated a priority wetlands restoration project in 2012.

In 2009, MassDER commissioned hydrodynamic modeling to identify the optimal size for an inlet opening. The modeling demonstrated that a single 24-foot wide opening is optimal in terms of increasing tidal exchange while maintaining a current velocity that would prevent the opening from filling in.

In 2010, the Pleasant Bay Alliance commissioned the School for Marine Science and Technology (SMAST) at UMASS Dartmouth to assess changes in water quality resulting from a 24-foot wide opening.

In 2011 the Towns and the Alliance applied to the Cape Cod Water Resource Restoration Project to fund an assessment of resource impacts associated with the 24-foot opening. The study, conducted by Fuss & O'Neill, Inc., evaluated impacts to wetlands, shellfish, finfish, rare species and water quality with a wider opening under Route 28. The study confirms that a wider opening would improve degraded wetlands, water quality and overall ecological health in Muddy Creek without negatively impacting the rest of Pleasant Bay.

The study also presents a conceptual design and estimated cost for the wider opening. Benefits of the preferred bridge design include its cost effectiveness and availability of clearance under the bridge for kayaks and other non-motorized boats. The study recommended a single span bridge as the most cost effective way to increase tidal flow to improve water quality, restore wetlands and increase the overall ecological health of Muddy Creek. The Muddy Creek Restoration Bridge Project is being undertaken by the Towns of Chatham and Harwich with support from the Pleasant Bay Alliance.

The prospect of a bridge in place of the existing culverts raises wetlands management issues that need to be addressed in the coming five years. These issues include:

- Ensuring that design and construction of the bridge is undertaken in a manner that minimizes temporary impacts to resources, and maximizes long term ecological restoration benefits;
- Ensuring that enhanced public access facilitated by the bridge does not compromise resource conditions or the habitat values of Muddy Creek. Muddy Creek is a narrow waterway with shallow depths. Due to a lack of public access and steep slopes along most of the shoreline, recreational use of the Creek has been very limited. As a result, the area is a valued refuge for a wide range of birds. Concerns have been raised that an increase in noise and disturbance resulting from an influx of kayakers or small boats could disturb birds and other animals. An additional concern is renewed demand for shoreline structures, which currently are restricted under state regulation.

4.4 Recommendations: Muddy Creek Restoration

4.4.1 Support and Provide Comment on the Muddy Creek Restoration Bridge Project being undertaken by the Towns of Harwich and Chatham.
The Alliance has expressed conceptual support for the Muddy Creek Restoration Bridge Project based on the findings of the Fuss & O'Neill Technical Memorandum, as well as prior technical studies. As the bridge project moves

forward through phases of design, permitting, construction and monitoring, the Alliance will continue to review plans and submissions carefully and to offer comments to local, state and federal agencies involved in permitting and review, including but not limited to the Massachusetts Highway Department, US Army Corp of Engineers, Massachusetts DEP, Harwich and Chatham Conservation Commissions and Massachusetts Department of Environmental Protection.

4.4.2 Continue the Categorical Restriction on licensing of new private docks and piers in Muddy Creek. It is recommended that the Categorical Restriction on new Chapter 91 licenses for private docks and piers in Muddy Creek continue to remain in effect. Muddy Creek is a resource sensitive area based on several of the criteria used to evaluate the appropriateness of shoreline areas for new docks. Features of Muddy Creek include: shallow water depth, presence of extensive fringing salt marsh, and physical features such as narrowness of the water body. (Same recommendation as 7.3.9.1)

4.4.3 Evaluate Restrictions on Motorized Vessels
The narrow and shallow nature of the Muddy Creek, coupled with its habitat values and lack of land based public access suggest that it is not an appropriate setting for motorized vessel traffic. The Alliance will work with the Harbormasters and Waterways Committees of Harwich and Chatham to evaluate policies or regulations to limit vessel access in Muddy Creek to non-motorized vessels.

4.5 Resource Management Issue: Impacts on Wetlands Resulting from Sea Level Rise (SLR)

The rate of Sea Level Rise (SLR) will continue to be a factor in shaping our coastlines and coastal resources. Global Sea Level Rise is the increase in sea level resulting from thermal expansion of oceans (as temperatures rise, water expands) and melting of ice sheets, glaciers and ice caps. Relative Sea Level Rise considers Global Sea Level in relation to adjacent land, and so it also factors in the change in sea level due to subsidence (settling) of land masses. Relative Sea Level is the relevant measure to refer to when assessing changes in coastal environments due to changes in Sea Level. (Titus et al, 2009)

Recent reports indicate that Sea Level could increase one meter (approximately three feet) by the end of the current century. (Theiler, 2009) This increase will result in different impacts on different areas of coastline, depending on many factors. Recent NOAA tide data for Boston, for example, indicate that Mean Sea Level actually had decreased in recent years. (Giese, 2012) Nevertheless, the upward trend in Sea Level, coupled with potential for storm surges, is of concern because over time it could result in erosion of public access points, coastal landforms and coastal wetlands. Coastal areas respond to SLR by growing vertically (by deposition of sediments), migrating inland, or growing

laterally. If these coastal processes are not able to keep pace with sea level rise, then they may become eroded or submerged. (Titus et al, 2009)

4.6 Recommendations: Impacts on Wetlands Resulting from Sea Level Rise (SLR)

4.6.1 *Conduct an assessment of impacts to wetlands, public access points and other coastal resources and infrastructure resulting from potential changes in relative sea level*.

4.6.2 *Based on the assessment called for under 4.6.1, develop management strategies to prepare for the anticipated effects of changes in relative sea level.* Strategies could include:

- Acquiring coastal property to protect access, reduce property and infrastructure damage and improve the functioning of coastal processes;
- Relocating vulnerable infrastructure;
- Removing unnecessary, dangerous or damaging coastal armoring;
- Developing improved regulations to protect coastal systems and beaches;
- Encouraging landowners to obtain conservation easements for unarmored bluffs that provide sediment to down drift beaches. (Theiler, 2009)

4.7 Resource Management Issue: Tidal Restriction at Frost Fish Creek

Like Muddy Creek, Frost Fish Creek discharges into Pleasant Bay through an undersized culvert under Route 28. Hydrodynamic and water quality studies conducted as part of the MEP for Chatham embayments documented the water quality impacts due to tidal restrictions and modeled potential water quality improvements resulting from culvert improvements and other measures.

4.8 Recommendation: Tidal Restriction at Frost Fish Creek

4.8.1 Support efforts by the Town of Chatham and Massachusetts Department of Transportation to evaluate design alternatives to increase flushing and improve water quality, habitat and other natural resources in Frost Fish Creek.

4.9 Resource Management Issue: Protection of Freshwater Ponds In the ACEC

The Pleasant Bay ACEC contains eleven freshwater ponds that are hydrologically connected to the estuary (see Table 4). Five of the eleven water bodies are ten acres or larger and, therefore, are considered Massachusetts Great Ponds. Great Ponds fall under the jurisdiction of state waterways regulations (Chapter 91) administered by the Massachusetts Department of Environmental Protection (MassDEP). According to state regulations, MassDEP

may not issue a Chapter 91 license for a dock or other type of shoreline structure in an ACEC unless it is compliant with an approved resource management plan.

In accordance with the approved Pleasant Bay resource management plan, the Alliance developed *Guidelines for Permitting Shoreline Structures on Freshwater Lakes and Ponds in the Pleasant Bay Area of Critical Environmental Concern (ACEC)* to provide guidance to local authorities involved in permitting piers/docks on all eleven freshwater lakes and ponds in the Pleasant Bay ACEC. At their discretion, local permitting authorities may choose to apply the guidelines to other freshwater resource areas within their jurisdiction. The guidelines are currently under review by Conservation Commissions in the Towns of Brewster, Harwich, Chatham and Orleans.

Table 4. Lakes and Ponds in the Pleasant Bay ACEC

Water Body	Size (Acres)	Town
Crystal Lake*	36	Orleans
Pilgrim Lake*	39	Orleans
Gould Pond	6	Orleans
Meadow Bog	3	Orleans
Sarah's Pond	6	Orleans
Uncle Seth's Pond	5	Orleans
Fox Pond	5	Chatham
Lover's Lake*	36	Chatham
Mill Pond*	22	Chatham
Minister's Pond	5	Chatham
Stillwater Pond*	16-18	Chatham

Habitat values and critical resources located along the shorelines of ponds in the ACEC have been documented (Horsley Witten, 2004). These include:

- Coastal Plan Pondshore communities, According to NHESP, coastal plain pondshores are considered an Exemplary Habitat and are ranked S2, meaning they are state imperiled with only six to twenty occurrences statewide. Coastal plain pond shores also are considered a globally rare ecosystem occurring only in Southeastern Massachusetts. Coastal Plain Pondshores have gradually sloping shorelines. Coastal plain pond shores and ponds provide habitat for at least 43 rare animal and plant species. Coastal plain pond shores are important habitat for over 45 species of dragonflies and damselflies. They are also important habitat for painted, musk, spotted, snapping, and the federally endangered Plymouth red belly turtles.

- Atlantic White Cedar Swamp communities are forested wetland communities characterized by a dense, primarily evergreen canopy, a deciduous shrub layer, and a sparse herb layer dominated by mosses.

These areas provide important forested wetlands habitat, including amphibian habitat, and can function as vernal pool habitat under certain conditions.

According to NHESP, Atlantic white cedar swamp communities also are ranked S2, meaning they are state imperiled with only six to twenty occurrences statewide.

- Bordering Vegetative Wetlands are freshwater wetlands which border creeks, rivers, streams, lakes and ponds[2]. BVW are areas where soils are saturated or inundated such that they support a predominance of wetland indicator plants. BVW are probably the Commonwealth's most important inland habitat for wildlife.

Water quality and wetland resources in and around lakes and ponds within the ACEC are subject to environmental stresses that impair conditions. Like marine waters, freshwater can become eutrophied if excessive amounts of nutrients enter the water through runoff or groundwater. In freshwater systems, phosphorous is the type of nutrient that, in excess, can cause eutrophication. Eutrophication leads to a loss of oxygen needed to support aquatic life. It can also change the balance of vegetation and contribute to algal blooms and a proliferation of invasive species.

Water quality conditions in lakes and ponds within the ACEC have been studied through the *Cape Cod Lake and Pond Atlas* (Cape Cod Commission, 2003), *Action Plan for the Town of Chatham Ponds* (Stearns Wheler et al, 2003), and *Review and Interpretation of Orleans Ponds Volunteer Monitoring Data Final Report* (Orleans Fresh and Marine Water Quality Task Force, 2007). These studies provide evidence of eutrophication, loss of aquatic biodiversity and growth in invasive species in some ponds within the Pleasant Bay ACEC. Vegetation management, invasive species eradication, phosphorous inactivation, and pond aeration are techniques that have been studied or proposed for Lovers Lake, Stillwater Pond, and Fox Pond in Chatham, among others. Eutrophication is facilitated by excessive nutrients from watershed runoff. It is important to understand the extent to which watershed land uses contribute to degraded lake and pond conditions, and ensure that adequate measures are taken to reduce or eliminate land use impacts before resorting to more costly or complex solutions.

4.10 Recommendations to Protect Freshwater Ponds in the ACEC

4.10.1 Adopt and Implement Freshwater Dock Guidelines

The Alliance will continue to work with Conservation Commissions and agents in the Alliance towns to adopt and implement *Guidelines for Permitting Shoreline Structures on Freshwater Lakes and Ponds in the Pleasant Bay Area of Critical*

[2] (310 CMR 10.55(2)(a)

Environmental Concern (ACEC). Following local adoption, the guidelines will be submitted to EOEEA for approval.

4.10.2 Evaluate and Implement Lake and Pond Management Alternatives
Alternatives to address eutrophication, invasive species or other management challenges need to be assessed on a case-by-case basis, in light of recent data and documentation. The following issues are among those that the Alliance will consider when evaluating management strategies and programs:

- Do the benefits of treatment outweigh the risks associated with treatment?
- Have adequate watershed management actions been undertaken prior to or are proposed coterminous with the treatment?
- Have the long-term effects of treatments been adequately studied and presented? This is particularly important when chemicals (e.g., pesticides, alum) or organisms (e.g., loosestrife beetles) are proposed to be introduced into the water body.

4.10.3 Evaluate the Need to Update the Horsley Witten Pond Shore Survey
The 2002 Horsley Witten survey provides valuable documentation of habitat and rare species along the pond shores in the ACEC. Ten years have lapsed since the survey was undertaken, during which time there were seasons of high and low water levels. It is timely to update the survey and provide the revised information to Conservation Commissions for consideration.

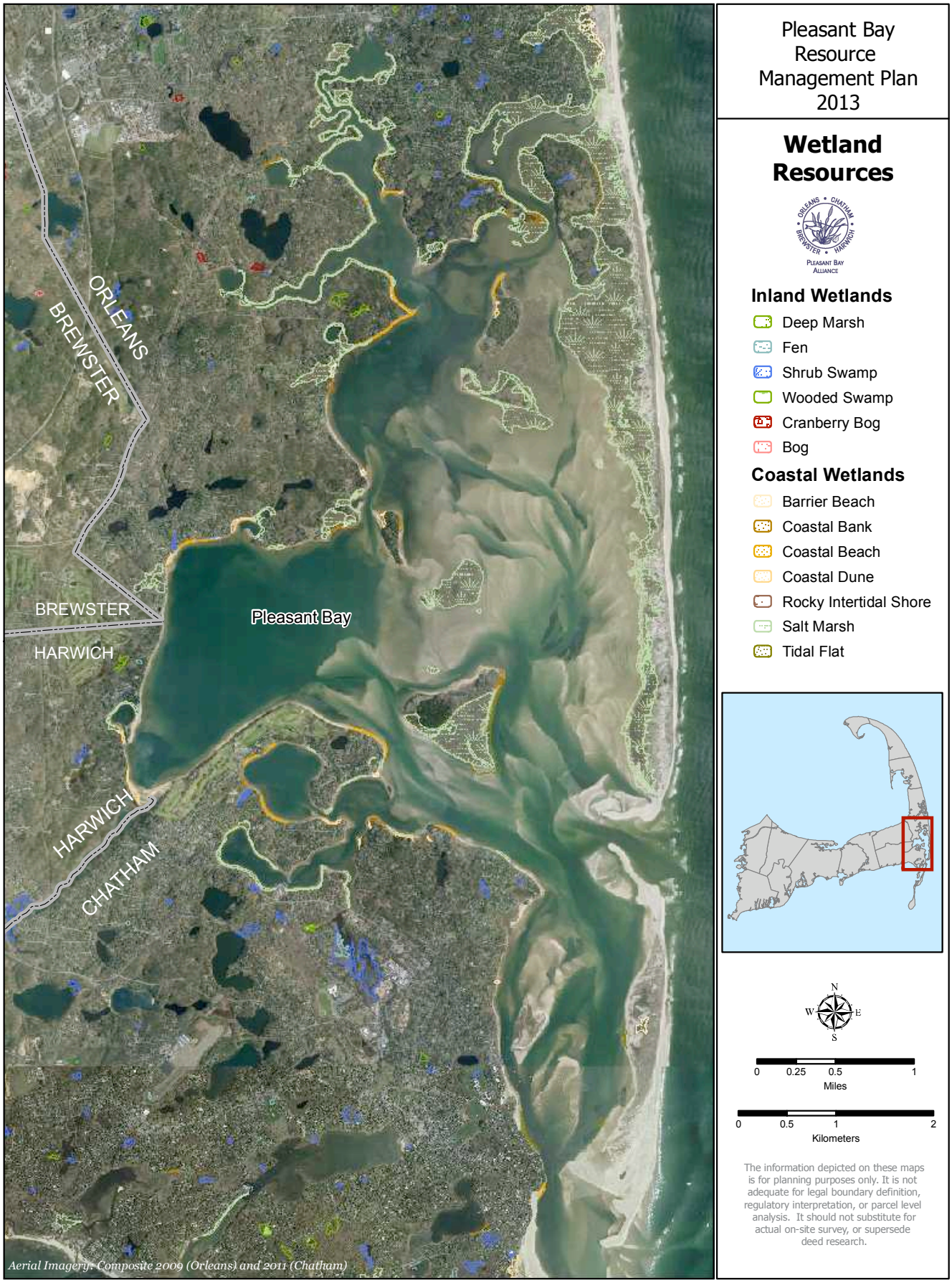


Figure 8. Wetland Resources

Chapter 5.
Watershed Planning

5.0 Overview

Recognizing that land use in the watershed is perhaps the most important influence on water quality and marine habitat in the Bay, the 1998 resource management plan defined the study area as encompassing the entire contributing watershed for the Bay.[1] The Pleasant Bay watershed consists of approximately 21,600 acres[2] located in four towns: Orleans (41%), Chatham (30%), Harwich (13%) and Brewster (16%) (See Table 1, Chapter 1 and Figure 10 below.) The western-most boundary of the watershed extends nearly two miles from the shoreline of the Bay.

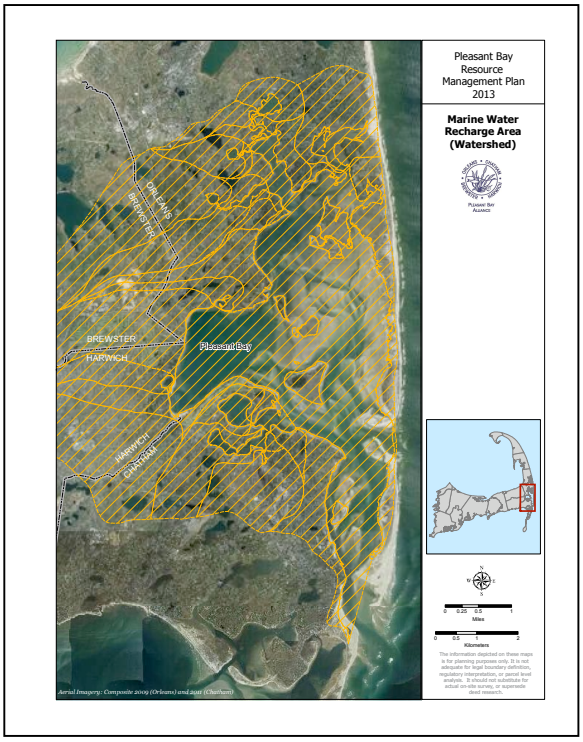


Figure 10 Watershed Area

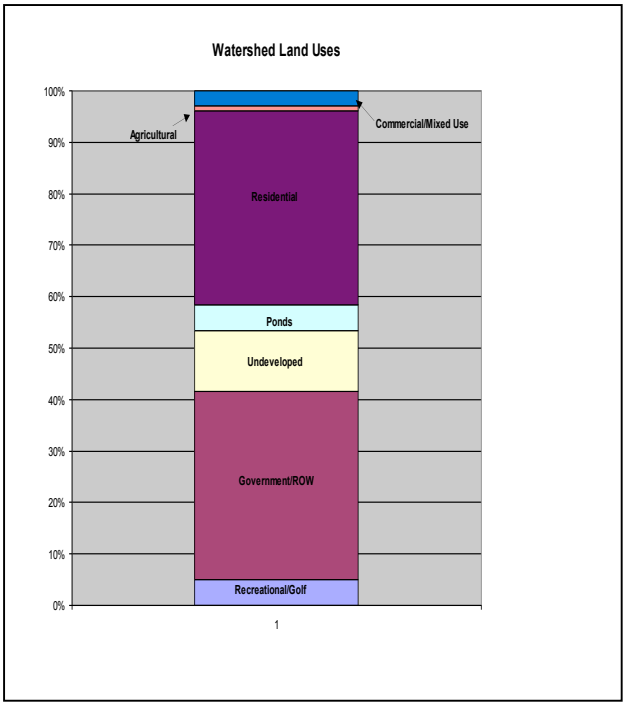


Chart 1. Watershed Land Uses

Land use in the watershed is primarily residential. Residences account for 38% of the total land area in the watershed. Of those residences, 90% are single-family dwellings. The next largest land use category is government-owned land, buildings, roads and rights of way. Golf courses and recreational areas account for 5% of total land area, and mixed use, commercial and industrial land uses

[1] A watershed is an area of land that contributes groundwater or surface water to a stream, river, pond, estuary or other water body. On Cape Cod, groundwater elevations generally determine watersheds or recharge areas rather than land surface elevations. Smaller watersheds within larger watersheds are referred to as sub-watersheds.
[2] Refers to total land area and estuarine surface area.

account for less than 5% of total land area in the watershed. Twelve percent or 2,500 acres of land in the watershed is undeveloped although not all of it will remain that way. Current open space in the watershed is shown on Figure 9.

Land use in the watershed is an important factor in the health of the Bay because certain land uses contribute to nitrogen loading. The 1998 Plan and the 2003 and 2008 Plan Updates note that the overloading of nitrogen from watershed sources is one of the most significant threats to the overall health of the Pleasant Bay system. Estuaries are extremely sensitive to the effects of nitrogen. An overabundance of nutrients leads to excessive plant growth. Certain algae—opportunistic seaweed and phytoplankton—become so abundant that they shade the bottom and decrease light penetration. As the plants decay they use up oxygen and the decayed plant material settles to the bottom. The excessive production and decay can reduce the amount of oxygen in the water column and can ultimately lead to anoxic (no oxygen) or hypoxic (low oxygen) conditions. Even short periods of low oxygen can cause serious damage to bottom dwelling organisms and eventually lead to “fish kills” and losses of other plant and animal species. Phosphorous is a type of nutrient that poses similar problems in freshwater ponds and lakes. The Alliance’s emphasis has been on understanding and addressing nitrogen as a key threat to estuarine water quality.

Over the past decade, a major thrust of the Alliance’s watershed management efforts has been to study the extent of nitrogen loading in the watershed, and to work with our member communities to develop effective nitrogen management strategies. In the coming five years, the Alliance will continue to work with communities in support of regional strategies to reduce nutrient loading into Pleasant Bay.

5.1 Massachusetts Estuaries Project (MEP)

One of the primary ways the Alliance has learned more about the extent of nutrient loading in Pleasant Bay has been through its participation in the Massachusetts Estuaries Project (MEP). The main objective of the MEP is to restore and protect estuaries from the degradation that results from excessive nutrient loads. The MEP was launched in 2001 by the Massachusetts Department of Environmental Protection (MassDEP) and the School of Marine Science and Technology at UMASS-Dartmouth. The purpose of the program is to provide communities with a quantitative tool (the Linked Watershed – Embayment Management Model) for nutrient management of their coastal embayments. The program uses actual water quality, hydrodynamic, and land use data in a model to determine critical nitrogen loads in estuaries. When first announced by MassDEP, the program did not list Pleasant Bay in its entirety as being among the first or second level of priority embayments for modeling. In fact, modeling within the Bay was focused on the Orleans and Chatham sub-embayments only. In 2004 the Alliance secured $120,000 in matching funds from

the communities of Orleans, Chatham and Harwich to extend the MEP study to encompass the entire Pleasant Bay system.

The final MEP Technical Report[3] for Pleasant Bay, released in May 2006, was the culmination of more than two years of research, computer modeling, and data analysis undertaken by the MEP, and incorporated five years of water quality data collected by the Alliance through the Pleasant Bay Citizen Water Quality Monitoring Program. Key findings of the Technical Report included:

- **Watershed Delineations.** Because groundwater and surface waters are conduits to nitrogen flowing into the Bay, delineations of the entire Pleasant Bay watershed and subwatersheds were updated and refined as part of the MEP. Using USGS simulated groundwater flows and particle-tracking program to delineate subwatersheds, the MEP identified 95 subwatershed areas within the Pleasant Bay watershed, including 25 freshwater ponds and 7 public water supply well fields.

- **Nitrogen Loading.** The MEP measured nitrogen inputs into Pleasant Bay from key sources including: land-based nitrogen loading (primarily from septic systems, fertilizers and runoff, and factoring in attenuation through ponds and wetlands); nitrogen that settles into bottom sediments and re-circulates in the Bay; and nitrogen from atmospheric sources. The report found that nitrogen from wastewater sources (septic systems) accounts for 42% of nitrogen in the Bay from all sources, and 75% of the share of nitrogen that can be controlled through local action.

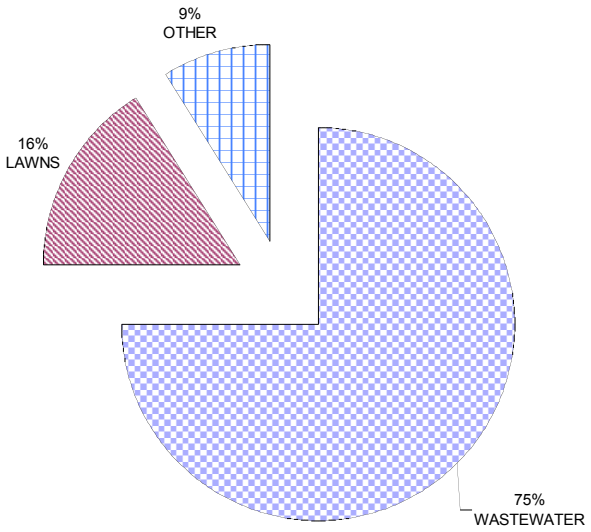
  The levels of nitrogen in Bay waters from all sources were calculated at the then current (2004) level of watershed development and at full "build out"[4]. The MEP Technical Report concluded that watershed nitrogen load at full build out would be 30.1% higher than nitrogen loads under the current level of watershed development [5].

[3] The Technical Report, entitled *Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich, Massachusetts*, can be downloaded from the Alliance's website, *www.pleasantbay.org.*

[4] Build out is a term that refers to the maximum amount of development that could occur under current zoning laws.

[5] Massachusetts Estuaries Project, Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich MA, May 2006, Table VI-5, p. 144.

Chart 2. Controllable Nitrogen Sources,
Pleasant Bay Watershed



- **Ecological Health**. The MEP Technical Report contained a detailed assessment of water quality conditions and the respective health of the Bay's eelgrass and shellfish communities, which are sensitive to the effects of nitrogen and serve as indicators of the Bay's overall health. The report documented signs of nutrient-related stress throughout the system and found that 13 of 17 subembayments exhibited some level of impaired or degraded habitat health due to nitrogen[6]. The report found excessively low dissolved oxygen levels in some salt ponds, particularly those where surrounding land is densely developed and tidal flushing is restricted. The MEP report also cited a 24% decline in the number of acres of eelgrass in the Bay over thirty years as evidence of the degrading effects of nitrogen. The remaining 1,807 acres of eelgrass continue to represent a valuable resource with strong potential for restoration (Figure 11).

5.2 Total Maximum Daily Loads (TMDLs)

The MEP Technical Report documents the sources and amount of nitrogen entering Pleasant Bay, and the impacts of that nitrogen on water quality and ecosystem health. The report provides the scientific basis for the *Pleasant Bay System Total Maximum Daily Loads for Total Nitrogen (TMDL) Report* developed by MassDEP in accordance with the Federal Clean Water Act. The

[6] Massachusetts Estuaries Project, Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich MA, May 2006, Table VIII-1, p. 203.

TMDL report indicates the threshold amounts of nitrogen the waters can receive and remain healthy, and how much of the current nitrogen load needs to be removed in order to meet the threshold. While the MEP report demonstrates that not all of the nitrogen entering Pleasant Bay comes from the watershed, it points out that only the watershed sources are considered *controllable* for the purposes of achieving targeted reductions. The Technical Report and TMDL report together provide the foundation for comprehensive wastewater planning that is underway in the watershed towns.

The TMDL report indicates that system wide, 36% of the controllable watershed load needs to be reduced in order to achieve a targeted level of water column nitrogen that is associated with a healthy estuarine system. The TMDL report contains thresholds for nineteen separate areas of the Bay. Reductions needed to achieve thresholds range from a high of 83% in Meetinghouse Pond, to 0% in Chatham Harbor. It is important to note that the TMDLs represent one combination of load reductions among the Bay's subembayments. Because the Bay is an integrated system, what happens in one area ultimately will affect other areas. Therefore a comprehensive and coordinated approach to achieving threshold nitrogen levels is necessary.

5.3 Adaptive Management

Pleasant Bay is a dynamic coastal system and it is not surprising that significant changes in the system have occurred since 2004-06 when the MEP analysis was undertaken. The most noticeable of these changes was the creation of a second inlet in 2007. As discussed in Chapter 7, the inlet resulted in an increase in tidal flow. A hydrodynamic study undertaken right after the 2007 inlet (ACRE, 2008) showed an increase in tide range and the volume of water flowing in and out of the system (tidal prism). Water quality modeling incorporating the updated flushing information (SMAST 2008) showed a reduction in nutrient concentrations in well-flushed areas such as Little and Big Pleasant Bay, but little improvement in the terminal ponds. Overall, changes in water quality were insufficient to meet nitrogen thresholds (TMDLs).

As the 2007 inlet became more established, many wondered if water quality would continue to improve. A recent analysis of tide data (Giese, 2012) demonstrates that the flow of water in and out of Pleasant Bay reached a peak in early 2010 and has declined since that time. This is due to a confluence of local and regional factors, according to the study. Tidal range is now less than at any time since soon after the formation of the second inlet in 2007, and mean high water is lower than it has been since 2009. The reduction in tide range means that the volume of water flowing in and out of Pleasant Bay has decreased since 2010, with implications for water quality.

Based on these findings, increased flushing cannot be relied on as a sufficient strategy for addressing nutrient loading in Pleasant Bay. The more

robust flushing experienced following the 2007 inlet may continue to decline as that inlet migrates southward as studies indicate it will (Giese 2009). However, the dynamic nature of the system calls for ongoing study of tidal dynamics and implications for water quality. Other changes in the type or intensity of land development in the watershed also could influence nitrogen loading. The implications for land use development throughout the watershed and its implications for water quality and need to be monitored.

The concept of adaptive management provides for modifications to nutrient management strategies in light of changing conditions. In the development of local and regional nutrient management plans, adaptive management means that plans remain flexible enough to allow for modifications to reflect changing conditions and technological developments. Adaptive management provides flexibility in the event that the effectiveness of non-structural alternatives such as fertilizer controls, land use, and stormwater management reduces the amount of sewering needed to achieve water quality goals. Conversely, if monitoring shows insufficient progress in meeting nutrient reduction targets, then adaptive management would allow for a sewer system to be expanded or augmented. The concept of adaptive management is integrated into the nutrient management planning efforts of the four towns, which are briefly described below.

5.4 Resource Management Issue: Nutrient Management

Since 2008, all four towns have made substantial progress in developing plans and strategies to address excessive nitrogen loading in the Pleasant Bay watershed:

Chatham. The Town of Chatham has begun implementation of their Comprehensive Wastewater Management Plan (CWMP). Permitting of the CWMP was completed in 2009, and construction began in 2010. The CWMP calls for sewering all properties in town over a thirty-year period. Phase 1 of the CWMP calls for sewering of those areas needed to meet total nitrogen TMDLs over a twenty-year period. The remaining properties in Town would be sewered in the following 10 years. Initial implementation of Phase 1, which is now operational, included upgrading and expanding the capacity of the Town's wastewater treatment facility to include enhanced nitrogen removal, and extending sewer service along a significant portion of Route 28 and several side roads. This expansion provides a backbone for further expansion of service to other areas. Sewering of parcels in the Pleasant Bay watershed is scheduled to occur in Phase 1 or Phase 2 depending on their location.

Orleans. Permitting for the Orleans Comprehensive Wastewater Management Plan (CWMP) concluded in 2011. The CWMP calls for sewering approximately half of all parcels in town, and removing 58% of

the septic load from properties within the Pleasant Bay watershed. Sewering in the Pleasant Bay watershed is not expected to occur until phase 4 of 6 possible phases, or roughly 2030 to 2040, consistent with timing of implementation in the Chatham CWMNP. To compensate for later phasing, the Orleans CWMP calls for construction of package treatment plants with de-nitrification to 15 mg/l at the headwaters of Paw Wah, Lonnie's and Arey's Ponds. As stated in the Alliance's comment letter to EOEEA Secretary "[t]he installation of plants would provide the basic collection system for later sewering, and the initial treatment provided by these plants would represent a step toward nitrogen removal in the watershed until phasing allows for sewering to occur." Implementation of the CWMP has been on hold pending an evaluation of the relative costs of centralized versus decentralized systems. The resulting study, conducted by the engineering firm of Weston and Sampson, demonstrated that the costs of centralized and decentralized approaches to treatment systems are equivalent for Orleans, but the operating and maintenance costs are higher for the decentralized approach. This conclusion supports the centralized approach outlined in the CWMP.

Harwich. Harwich released a draft CWMP in late 2012. The assessment of need for the CWMP determined that of the 1,900 Harwich properties in the Pleasant Bay watershed, 1,300 would require nitrogen removal to achieve the 70-80% nitrogen removal rates needed to meet TMDLs. A privately owned sand pit in East Harwich has been identified as one of the final recommended sites for wastewater treatment and/or treated water recharge. One regional option under discussion is piping wastewater from East Harwich to the Chatham wastewater treatment facility, and returning treated water to the East Harwich site for recharge.

Brewster. Brewster is in the process of developing its Integrated Water Resources Management Plan (IWRMP). The Town is currently working with consultants Horsley Witten to conclude a Needs Assessment. The analysis suggests that much of Brewster's nitrogen reduction can be achieved through land use controls, open space acquisition, and fertilizer reductions at Captains Golf Course. Large-scale wastewater treatment is not envisioned for Brewster's portion of the Pleasant Bay watershed, though some neighborhood-scale treatment may be required. As currently planned, Brewster's IWRMP should be concluded by 2014-2015.

Over the past decade the Alliance has helped to foster coordination and communication among the nutrient management efforts of the four watershed towns. The Alliance convenes a regional watershed work group which meets monthly to discuss strategies and actions and pursue projects in support of development and implementation of wastewater management plans for the

Pleasant Bay watershed. This role will continue to be a focus in the five years ahead.

5.5 Recommendations: Nutrient Management

5.5.1 *Continue to support comprehensive nutrient management planning*. The Alliance will continue to support and encourage all four watershed towns to make progress in developing and implementing comprehensive nutrient management plans that encompass the Pleasant Bay watershed. The Alliance will continue to act as a clearinghouse for towns to share information and communicate progress to each other. Through the activities outlined below, the Alliance will provide resource analyses in support of nutrient management planning and implementation.

5.5.2 *Continue to promote watershed-based collaboration to achieve TMDLs*. The Alliance will continue to convene the Watershed Work Group in support of projects and activities designed to:

- *Coordinate planning for nutrient management plans*. This encompasses promoting plans and studies that will benefit multiple towns as well as looking at ways to coordinate relevant sections of watershed towns' nutrient management plans.
- *Explore model scenarios*. The Alliance will sponsor and support technical studies and model runs that explore system-wide issues and conditions and will help to identify the most cost effective solutions to achieve targeted thresholds and to augment nutrient management plan development.
- *Provide ongoing monitoring and reporting*. The Alliance will continue to work with MassDEP, MEP and regional entities to develop protocols for monitoring, analysis and documentation of eelgrass health, benthic infauna health and water column nitrogen.
- *Explore strategies to equitably allocate cost and responsibility*. The Alliance will promote exploration of equitable ways to allocate costs and responsibility for planning, monitoring, and implementing facilities and other management strategies.
- *Act as communication link on key implementation issues*. The Alliance will continue to work with the watershed communities, MassDEP and the Cape Cod Water Protection Collaborative to address on-going questions concerning permitting, point of compliance, reporting and adaptive management.

5.5.3*. Continue to support regional solutions to achieving TMDLs in the Pleasant Bay Watershed*

The Alliance supports full exploration of regional solutions to wastewater treatment and disposal to achieve TMDLs. Regional solutions currently under discussion include:

- Treatment of Harwich-generated wastewater at the Chatham wastewater treatment facility, with discharge back into the Pleasant Bay watershed;

- Development of one or more satellite treatment facilities to serve South Orleans and Brewster, with potential effluent disposal options that incorporate beneficial reuse of effluent for golf course irrigation.

Other regional nutrient management solutions encompassing restoration and natural attenuation projects, infrastructure projects, land acquisitions and land use strategies, should be identified, evaluated and pursued if feasible and beneficial.

5.5.4 *Continue to build and support public awareness of the need for nitrogen management strategies and adherence to the TMDLs.* To accomplish this the Alliance will:

- Continue to review projects within the ACEC and watershed where there are significant potential nitrogen loading or other resource impacts;
- Develop public education materials such as the *Citizen's Guides to Estuarine Protection* for selected sub-watersheds. The scope of materials should include lawn care practices, proper disposal of animal waste, phosphates, bacterial contamination and testing;
- Increase public education efforts to limit nitrogen and phosphate loading from fertilizer and other household or commercial products, and promote water conservation;
- Support land acquisition and Smart Growth land use strategies such as the Natural Resource Protection District adopted in Brewster as tools to reduce and manage nutrient loading. In addition to their potential to reduce nitrogen load, these strategies protect open space and sensitive natural resources areas and provide cost effective opportunities for wastewater management.
- Encourage coordination among health, conservation, planning and public works departments involved in the review and permitting of public and private projects and developments.
- Support open space purchases and land use policies that serve to protect open space, to further reduce nitrogen inputs and protect habitat.

5.5.5 *Periodically update system-wide models of hydrodynamics and water quality.* The MEP model is structured to enable updated model scenarios to be calculated. These scenarios could reflect changes in system-wide hydrodynamics due to inlet or barrier beach migration, or new assumptions about natural attenuation, which could in turn affect nutrient concentrations. The Alliance will work with MEP and member towns to evaluate whether or under what conditions the model should be re-run to reflect significant changes in conditions, or as part of efforts to monitor progress toward achieving TMDLs.

5.5.6 *Monitor, evaluate and, as appropriate, implement non-structural nutrient management strategies and technologies*. There are a number of non-structural nutrient management strategies that have unquantified potential to reduce nutrient concentrations in the water column. Examples include: nutrient harvesting (shellfish or algal); use of conservation moorings; stormwater

management; and compostable toilets. Many alternative strategies and technologies are being studied by other organizations on Cape Cod and elsewhere. The Alliance will monitor new information about these strategies and technologies as it becomes available, and propose additional study or implementation as is appropriate based on demonstrated success.

5.6 Resource Management Issue: Fertilizer Management

Nitrogen from fertilizers account for 16% of controllable watershed nitrogen load. Reductions in this source of watershed nitrogen load could reduce nitrogen loading into Pleasant Bay and augment wastewater planning efforts in each Alliance town. In recognition of this potential, the Alliance obtained a grant from the Cape Cod Water Protection Collaborative to develop a fertilizer management plan for the Pleasant Bay watershed. The objective of the plan was to identify the main sources of fertilizer nitrogen load, and to identify policies and best practices that could achieve measurable reductions in that load, and thereby allow the towns to receive credit toward meeting TMDLs.

The plan found that nearly all of the 16% of controllable nitrogen load from fertilizers was coming from two land use groups: golf courses (8.3%) and residences (6.8%). A third user group, municipal properties, was address in the plan because it was understood that town turf management practices provide an important source of public education and awareness.

The resulting plan recommends three measures that have a combined potential to reduce existing controllable nitrogen load from fertilizers by approximately 5%. These steps are:

1. Implement best management practices for municipal turf management. This first step would result in a small reduction in load (.2%). However, the policy was identified as a vital step because it demonstrates local commitment to fertilizer controls and establishes a firm foundation for public education and outreach to other fertilizer user groups;
2. Work with golf courses in the watershed to achieve a targeted nitrogen reduction. This step could achieve the largest load reduction (3.5%) and will be the focus of the Alliance on-going implementation efforts;
3. Coordinate with other groups in the region in undertaking public education efforts aimed at reducing fertilizer use. Residential fertilizer use accounts for nearly half the controllable nitrogen load from fertilizers. However, achieving measureable reductions in this user category is a difficult task. The fertilizer management plan establishes a modest goal of a potential 1.5% reduction in load resulting from comprehensive education. Public education efforts are underway by a number of organizations, including the Alliance, Chatham and Orleans Conservation Commissions, Orleans Ponds Coalition, Friends of Pleasant Bay and Friends of Chatham Waterways, and regional garden clubs.

In addition, the plan recommends continued enforcement of “no disturb” buffers to wetland resources, which are implemented through local Conservation Commission regulations, and increased turf management training opportunities.

The measures outlined above are focused on the reduction of existing nitrogen load. The plan identifies a further step aimed at reducing future nitrogen load by limiting the size of lawns for future lots created in the watershed. This step has the potential to reduce nitrogen load by 1.3%.

5.7 Recommendations: Fertilizer Management

5.7.1 Municipal Policy

The Alliance presented each watershed town with a recommended *Policy to Reduce Nutrients in Municipal Turf Management*. The policy provides best management practices aimed at reducing the amount of nitrogen resulting from municipal fertilizer use on town properties (excluding golf courses, which are to be addressed with a separate policy.) Over the coming five years the Alliance will work with each town to adopt and implement the municipal policy.

5.7.2 Public Education

The Alliance will continue to work with the local and regional organizations to promote public awareness of the impacts of fertilizer use, and to provide information on alternative best management practices for turf management and landscaping. Public education efforts will be crafted to reach different user groups, including homeowners, landscape companies, and municipal personnel involved in turf management. Every effort will be made to leverage existing resources and avoid duplicated efforts. Outreach activities are delineated in the fertilizer management plan, and may include:

- Special programs and training sessions on alternative practices that offer certification for landscape professionals;
- Development and implementation of a public relations/information campaign that seeks to “brand” preferred best management practices for lawn care and landscaping; and
- Development and distribution of informational materials electronically (via website) and through print media.

5.7.3 Golf Courses

The fertilizer management plan identifies golf courses as accounting for half of all controllable nutrient load from fertilizers. However, the plan also documents that management practices voluntarily adopted by the golf courses already account for a substantial reduction in nutrient loads compared to the load attributed to golf courses in the MEP Technical Report for Pleasant Bay. For example, the fertilizer management plan documents a 14% reduction in nutrient fertilizer load for Cape Cod National, and a 19% reduction for Captains Golf Course in Brewster. The Alliance has convened meetings with golf course managers to discuss further

load reductions beyond those already achieved. In the coming five years the Alliance will work with golf course managers to evaluate and implement strategies to achieve further load reductions. Steps in this process may include:

- An achievable load reduction target, and a timeframe for achieving the target. In initial discussions and goal in the range of 5-10% has been discussed;
- Best management practices and strategies to achieve the targeted reduction while allowing flexibility needed for course management;
- A form of agreement that will document the shared commitment by the golf courses and their host communities, to facilitate measurement and application of reductions toward TMDLs;
- Clear and reasonable monitoring protocols.

5.7.4 Other Fertilizer Controls

The Alliance will promote other recommended measures to control nutrients from fertilizer use, as outlined in the fertilizer management plan:

- A bylaw to limit the size of lawns in future subdivisions in the watershed. Limits on the size of future lawns is under discussion by the Orleans Planning Board and is incorporated in draft regulations for the Brewster Natural Resource Protection District; and
- Enforcement of existing regulations to protect or restore natural buffers along wetlands and water bodies.

5.8 Resource Management Issue: Stormwater Management

Stormwater runoff from rainfall and snowmelt poses a threat to water quality in ponds and estuaries. According to MassDEP, road run-off is a major source of phosphorous loading in freshwater bodies, and the MEP indicated that surface runoff accounts for 9% of controllable nitrogen load in Pleasant Bay. Controlling nutrient loads from stormwater has been identified as a strategy in local wastewater management plans, but no detail is provided as to how reductions would be achieved. Stormwater is categorized as coming from a point source, such as a discharge pipe from a municipal stormwater system, or a non-point source, which emanates from diffuse sources such as rooftops, driveways and roads. In the Pleasant Bay watershed, stormwater runoff comes from non-point sources and is therefore more difficult to manage.

Many layers of federal, state and local regulations govern stormwater discharges. As a result, local stormwater management often is not coordinated and regulations and standards are not always applied in a consistent or comprehensive manner. MassDEP and local conservation commissions regulate stormwater impacts to wetlands and water quality within areas of jurisdiction of the Wetlands Protection Act and local wetland bylaws. In addition, local subdivision regulations regulate drainage requirements for development projects. At the Federal level, the National Pollutant Discharge Elimination System (NPDES) Phase II administered by US EPA requires small municipalities with populations under 100,000 to prepare and implement stormwater management

plans. The plans are required to address stormwater impacts from municipal separate storm sewer systems (MS4s) and construction sites that disturb one acre or more. Phase II requirements are applicable to communities in the Pleasant Bay watershed. However, the communities have not achieved full compliance with Phase II requirements, in part due to the costs of installing and maintaining stormwater management infrastructure.

In 1996 MassDEP developed a series of stormwater management policy documents to assist towns in managing stormwater and in achieving compliance with NPDES Phase II. The policy documents address site planning, non-structural measures and best management practices to prevent or reduce pollutants and reduce runoff volume, and provide other technical assistance. A number of towns in Massachusetts have gone beyond the state guidance and adopted stormwater management bylaws and regulations.

All four towns in the Pleasant Bay watershed have undertaken measures to control stormwater impacts. Orleans adopted a bylaw regulating drainage, erosion and sediment control for development and redevelopment sites. Brewster has adopted a bylaw governing discharges to the municipal storm drainage system. These and other measures undertaken in the towns, such as street sweeping, are beneficial in addressing stormwater impacts from sedimentation, volatile compounds, petrochemicals and bacteria. However, insufficient resources have been directed to controlling nutrient loads from stormwater runoff.

5.9 Recommendations: Stormwater Management

5.9.1 *Phase II Stormwater Management Compliance*. Encourage the Alliance towns to complete and implement Phase II Stormwater Management Plans as required by the EPA and MassDEP. Components of the plans include mapping the towns' stormwater management system, identifying impacts to resources from stormwater discharges in specific areas; and remediation of negative impacts to resources.

5.9.2 *Promote adherence to MassDEP's Stormwater Management Policy and Best Management Practices for Protection of Wetlands and Water Quality*.

5.9.3 *Promote a Comprehensive Approach to Controlling Nutrient Loading from Stormwater in the Pleasant Bay Watershed*. Evaluate the feasibility of developing a plan to control nutrient loading from stormwater in the Pleasant Bay watershed. The plan would build on the initial measures addressed in local comprehensive nutrient management plans, and would be intended to complement stormwater management measures being undertaken in compliance with Phase II requirements and other state and local stormwater management regulations.

5.9.4 *Evaluate the benefits of adopting a stormwater management bylaw*. Some towns in Massachusetts have adopted stormwater management bylaws. The various model bylaws and experiences of these communities should be compiled and evaluated for potential application to Pleasant Bay communities.

5.9.5 *Encourage Towns to fund implementation and maintenance of stormwater management infrastructure*. Long term funding for implementation and maintenance of stormwater management infrastructure poses a major challenge to towns. Maintenance of existing facilities and planned improvements is critical in order for improvements in the treatment of stormwater to be realized. The Alliance towns are encouraged to explore means of ensuring adequate funding on an ongoing basis. The creation of a stormwater utility, or other dedicated funding mechanism, are among the financing options that should be explored.

5.10 Resource Management Issue: Bacterial Contamination

Bacterial contamination is an on-going concern for the communities surrounding Pleasant Bay. The *Massachusetts Beaches Act* (2001) requires weekly testing of swimming beaches, and closure of a beach after one reading of higher than acceptable bacteria counts.[7] The prime indicator of bacterial contamination associated with the beach closings is enterococcus, commonly found in warm-blooded mammals. Since 2001, 27 out of 1,300 or roughly 2% of water samples taken at public or semi-public swimming areas on Pleasant Bay have registered levels of enterococci above the state standard of 104 cfu/100 ml.[8] Based on this data, beach closures from bacterial contamination are infrequent and often are tied to a rain event. However, on-going monitoring is warranted as conditions evolve. For example, it is not clear what impact, if any, the burgeoning seal population in Pleasant Bay could have on water quality.

Any sustained occurrence of exceedances should trigger testing to determine the source of bacterial contamination. Stormwater and overland run-off may be a carrier of the bacteria. Heavy rains following periods of dry, hot weather may result in excessive run-off carrying fecal matter from birds and other animals down gradient to coastal embayments. Outmoded, malfunctioning or overloaded septic systems – even if located close to coastal waters -- are not likely to be a source of bacterial contamination because of the ability of soils to thoroughly filter bacteria. The type and source of bacteria may vary for different waters. Knowing the primary type of bacterial contamination is necessary to pinpoint the source and plan effective mitigation measures and policies.[9]

[7] Barnstable County Coastal Resources Committee. Coastal Resource Protection Update. Barnstable, MA. 2002.
[8] Data were compiled from annual beach monitoring reports for 2001-2011 inclusive, published by the Massachusetts Department of Public Health, Bureau of Environmental Health, Environmental Toxicology Program. http://www.mass.gov/eohhs/consumer/community-health/environmental-health/exposure-topics/beaches-algae/annual-beach-reports.html
[9] Ibid.

5.11 Recommendations to Address Bacterial Contamination

5.11.1 *Continue to monitor bacteria levels at all previously tested locations if they are frequently used for public swimming.* Testing should continue whether or not they are licensed as public beaches.

5.11.2 Monitor trends in bacterial monitoring data. If any areas are found to experience sustained high levels of bacterial contamination, the Alliance will encourage efforts to identify sources of bacteria. Methods used to identify bacteria sources could include detailed sanitary surveys, DNA testing, or other appropriate method of evaluation.

5.11.3 *Mutt Mitt Dispensers and Public Education Regarding Pet Waste*. Through a state ACEC stewardship grant, the Alliance obtained funding to place Mutt Mitt dispensers at 19 public access points along the entire Bay. The Orleans Pond Coalitions added 15 more dispensers at public and private beaches, walking trails, landings and other public use areas in Orleans. Volunteers from the Orleans Pond Coalition and Town of Chatham restock the dispensers throughout the year.

- The Alliance will continue to support maintenance of existing Mutt Mitt placements.
- To promote public awareness of the ecological impacts of pet waste, the Alliance will revise its Pet Waste brochure and provide copies to Town Clerks to hand out with dog licenses.

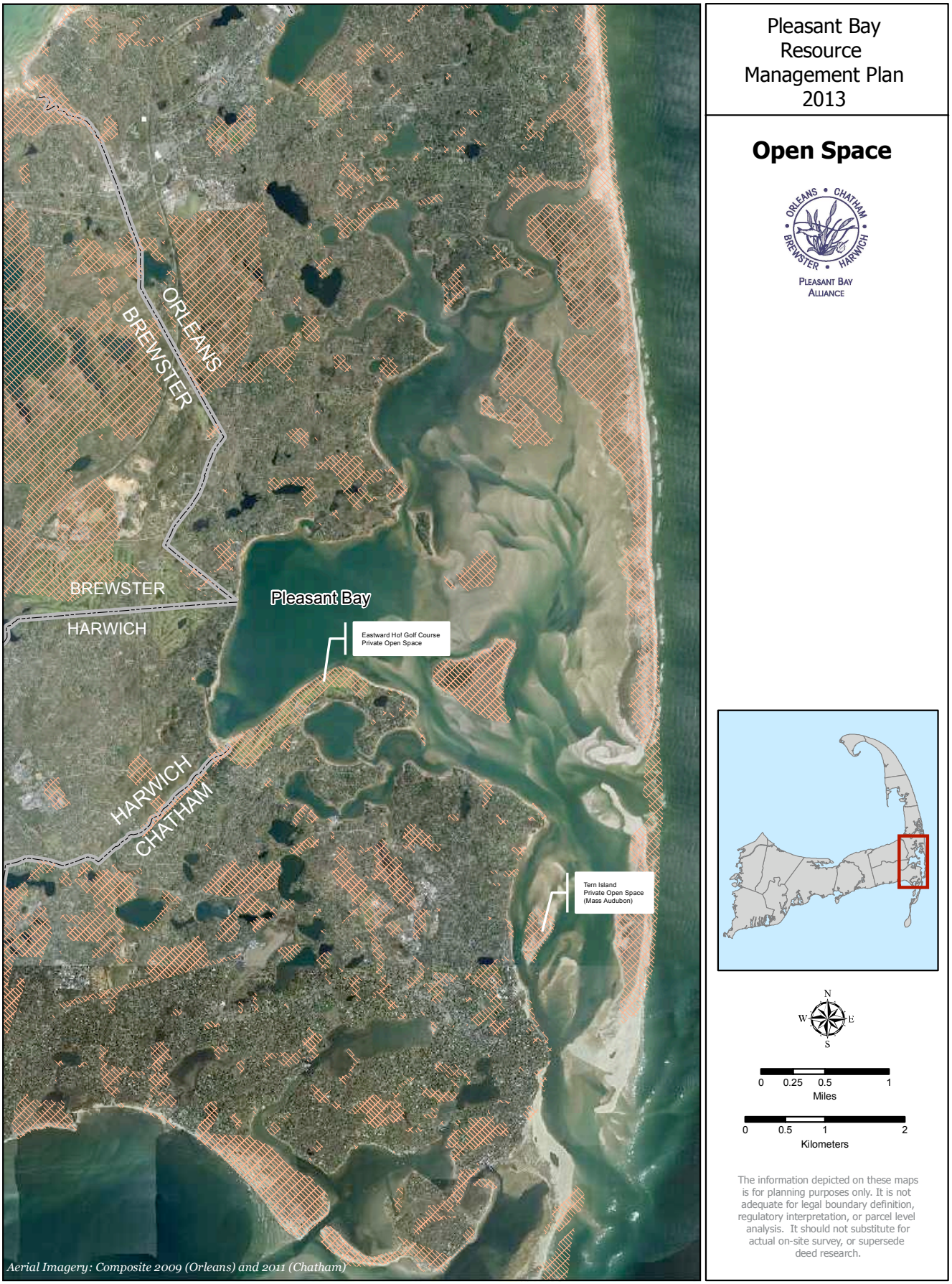


Figure 9. Open Space

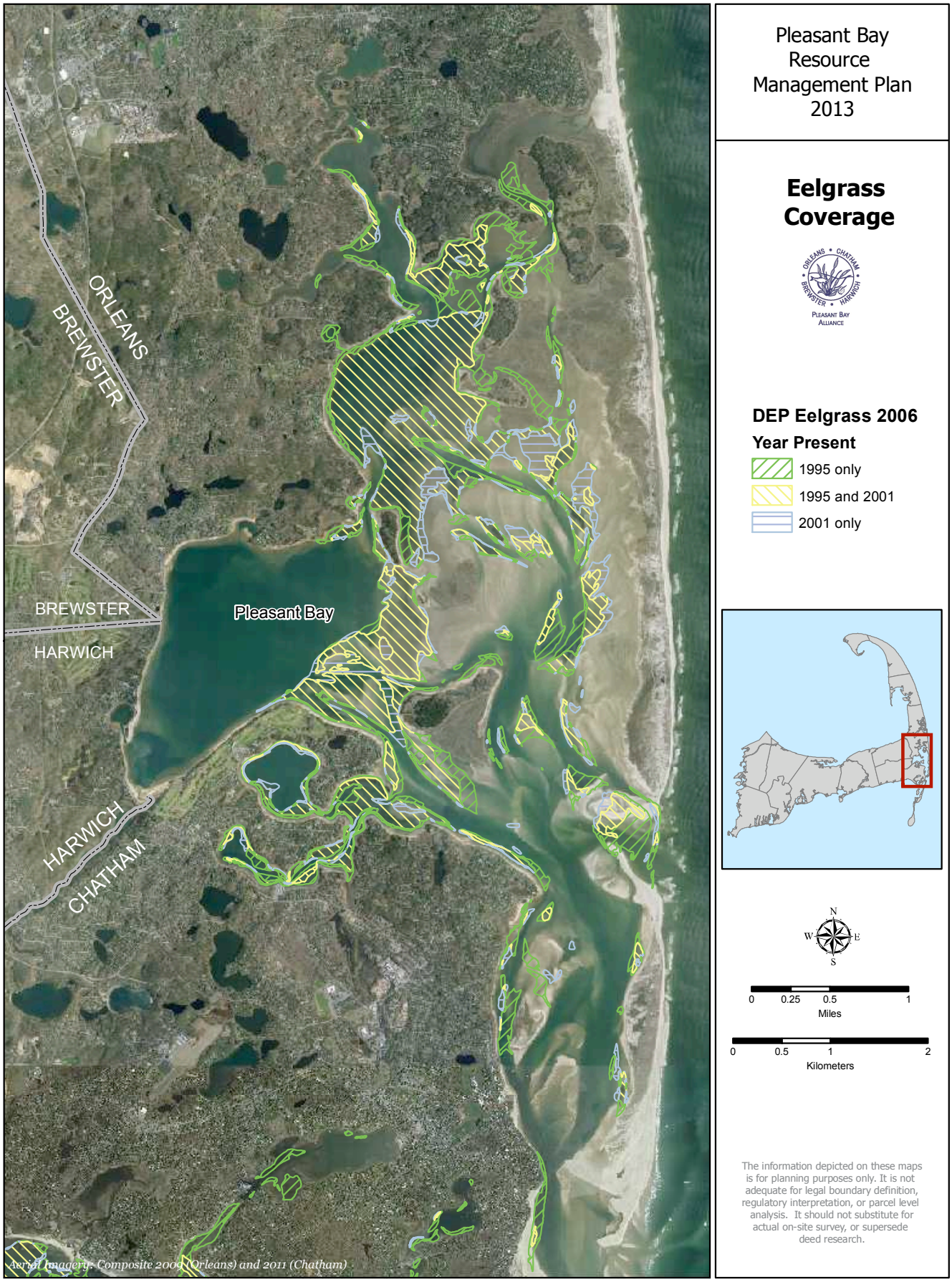


Figure 11. Eelgrass Coverage

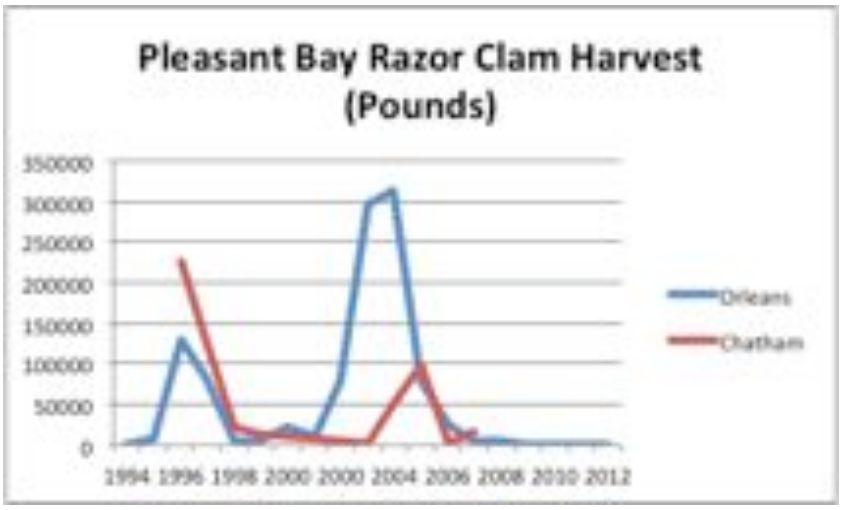
Chapter 6.
Fisheries Management

6.0 Overview

Shellfishing and finfishing are important commercial and recreational activities in Pleasant Bay. Of the numerous species of shellfish in the Bay, quahogs, scallops and soft shell clams are, historically, the most popular for commercial and recreational fishing. Quahogs, softshell clams and scallops were noted in the 1998 plan as the primary commercial species. However, in the last decade razor clams and mussels, have emerged as a significant commercial species.

6.1 Status of the Fisheries

Chart 3



Source: Chatham and Orleans Shellfish Departments

Razor Clams

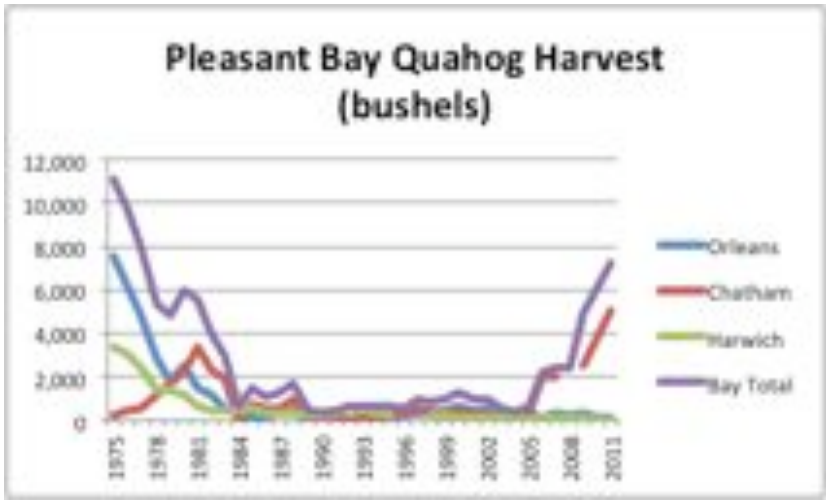
Harvests of razor clams spiked in the early part of the decade and are now beginning to decline (Chart 3). A combination of a prolific natural set and the increased market popularity of this species are credited with influencing the larger harvest.

Figure 12 shows razor clam bed area and reflects an increase over the area mapped in 2008. The identification of more areas of the Bay as razor clam beds may be due in part to the use of salting as a harvesting technique. Salting, which involves injecting or spraying a saline solution into or onto the substrate to

draw out the animals, has made harvesting in subtidal areas more accessible, and also has allowed harvesting to occur year-round.[1]

Rapid increases in harvests have raised concerns about possible overfishing of razor clams. Field observations conducted through the Barnstable County Cooperative Extension Service indicate a regular supply of larvae for razor clams and softshell clams in Pleasant Bay waters, based on observed settlement of both species in areas protected from predation[2]. This abundance of larvae suggests that fishing large populations of these species is sustainable. The drop-off in harvest after 2005 may be due in part to a resurgence of other more commercially valuable species such as soft shell clams. However, currently there are no size limits or catch limits for razor clam harvesting, although a permit is required.

Chart 4



Source: Chatham, Harwich and Orleans Shellfish Departments

Quahogs

Catch report data compiled for the 1998 plan show a continuous bottoming out of quahog harvests since the mid-1980's. This trend continued for a decade, but more recent harvest data show a rebound in harvest levels, though not to prior high levels of the 1970's and early 1980's (Chart 4). At that time Pleasant Bay, particularly in the center of Big Bay, was one of the most productive quahog fisheries on the East Cost. Several factors have been linked to the decline in

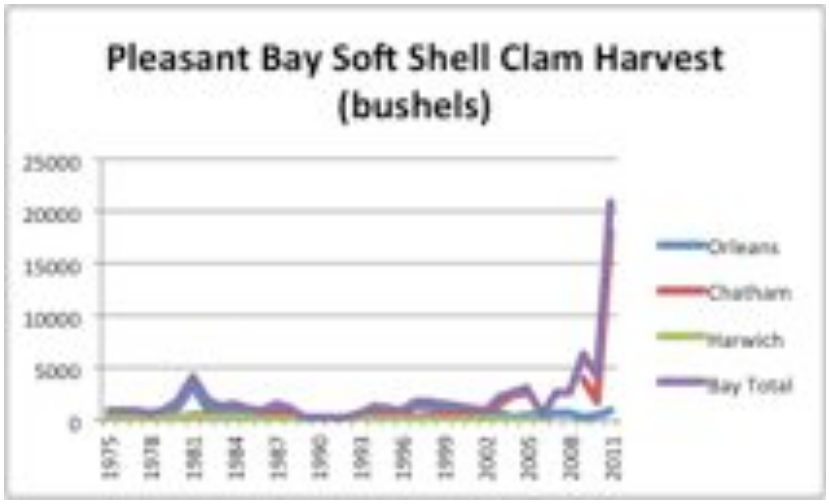
[1] Salting tidal flats or injecting saline water into tidal flats to draw razor clams to the surface has been called into question as a viable harvesting technique. Research by the Orleans Shellfish Department and Dr. Dale Leavitt of Roger Williams University indicated no adverse impacts to the razor clams or surrounding benthic animals from salting.

[2] Comment by William Walton, Barnstable County Cooperative Extension Service and WHOI Sea Grant, at a public forum on Pleasant Bay Fisheries held June 28, 2007, Orleans Town Hall.

quahog harvests, although none are confirmed. One theory is that an increase in salinity after the 1987 break, coupled with reduced freshwater inflows from upland areas, created a less hospitable environment for these freshwater loving animals. In addition, a change in state regulation of gauge size resulted in smaller animals being harvested, before they reach prime reproductive age.

Currently most quahog larval productivity in Pleasant Bay is generated by the standing natural population. Private aquaculture grants are another source of larvae, but the tendency to harvest farmed quahogs at as early a stage as possible due to higher market value tends to limit larval production. An increase in predator and pest populations such as green crabs, sulfur sponge, and spider crabs is also noted as a possible cause for the decline in quahogs. Figure 13 shows the location of quahog beds in Pleasant Bay.

Chart 5

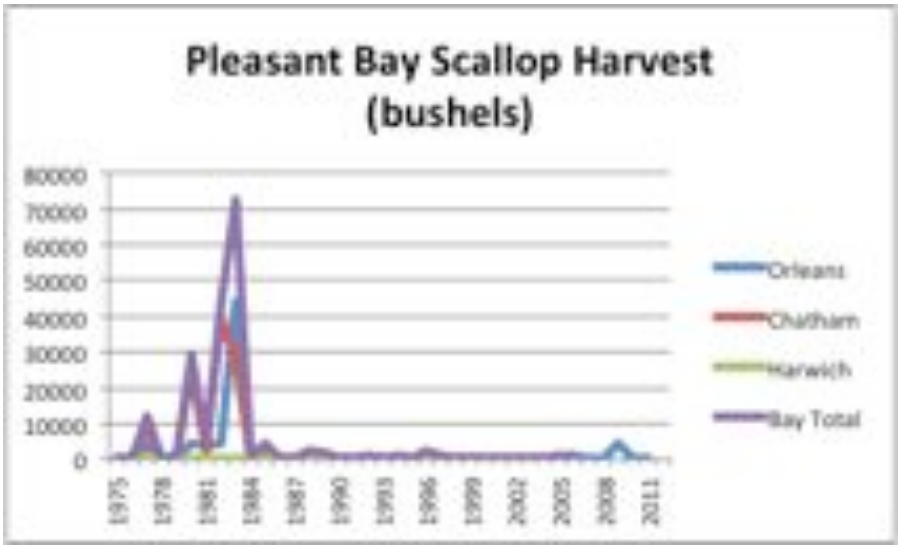


Source: Chatham, Harwich and Orleans Shellfish Departments

Soft Shell Clams

Bay-wide harvests of soft shell clams have been rising since 2002, driven by a spike in Chatham waters (Chart 5.) Like razor clams, soft shell clams appear to be generating large amounts of larvae, which enhance the wild population. Figure 14 shows soft shell clam beds in Pleasant Bay.

Chart 6



Source: Chatham, Harwich and Orleans Shellfish Departments

Scallops

Scallop harvests have been nearly non-existent in Pleasant Bay for nearly two decades (see Chart 6 above.) As with other species, the causes of the decline are unclear. Loss of eelgrass habitat has been cited as a possible influence on populations of this highly mobile species. Eelgrass coverage in Pleasant Bay declined 24 percent from the 1950's to the 1990's, according to the MEP. The complex predator community may also play an important role in the decline of this species. Field observations from the Barnstable County Cooperative Extension Service have noted the presence of seed scallops in some areas, but fewer adults.[3] The reason could be lack of eelgrass to provide a nursery for juveniles. Figure 15 shows scallop habitat in Pleasant Bay.

Mussels

The presence of mussels has increased since 2008 Mussel beds have been identifed in the area south of Strong Island and in Chatham Harbor (Firugre 16). As discussed below, consumption of mussels by common eiders has prompted further study of the balance between this species as a food source for migrating birds, and one for recreational or commercial harvest.

Finfish

The Bay's thirty-six finfish species are also a highly valued and ecologically significant resource. Pleasant Bay is well known as a popular sport fishing area

[3] Comment by Diane Murphy, Barnstable County Cooperative Extension Service at a public forum on Pleasant Bay Fisheries held June 28, 2007 at Orleans Town Hall.

Flounder, eel, and lobster are among the Bay's commercial fisheries. Several offshore commercial species -- American eel, winter flounder, white hake, pollock, and menhaden -- rely on the Bay's warm waters and extensive marshes to provide nursery areas. Numerous conditions influence the productivity of the Bay's finfish species. Significant trends include the virtual disappearance of winter flounder, and the resurgence of bass and blue fish stocks. Also, there are two active diadomous fish runs, and four historic, but inactive, runs.

In summary, Pleasant Bay continues to support a vibrant recreational fishery for several species. Commercial shellfishing of quahogs and scallops has diminished over the past decade, while other species such as razor clams and soft shell clams have provided new opportunities. Within the Bay, finfishing is almost entirely a recreational activity, focused on bass and bluefish.

The exact causes for the decline in harvests are unknown, but it is widely believed that dwindling harvests reflect diminished populations of most of these species. Possible causes for the apparent declines in shellfish and finfish populations include:

- Fishing pressure, caused by over-fishing in certain areas;
- Juvenile mortality;
- Loss of predatory-prey equilibrium;
- Increase in invasive species;
- Environmental stress;
- Presence of non-point source pollutants in the water column and bottom;
- Natural species growth cycles;
- Emergence of alternative species; and
- Loss of habitat, primarily eelgrass.

In response, the plan calls for enhanced fisheries management, continued active propagation, and further study on the status of shellfish and finfish habitat and populations. As described below, the Alliance and the towns individually have made progress in implementing the plan's earlier recommendations, and in identifying and addressing emergent issues, such as disease and invasive species.

6.2 Resource Management Issue: Shellfish Management and Propagation

Shellfish populations live in a dynamic environment that is subject to constant change. One change on a grand-scale is the formation of the second inlet in 2007. More information is needed to determine how this physical change may have altered habitat conditions for many species. On another front, significant efforts are underway to reduce the negative effects that sustained nitrogen loading may have on shellfish and finfish habitats in the Bay. These efforts should result in improved water quality and more vibrant eelgrass growth

throughout the Bay, but may occur slowly over a period of several years. It remains to be seen how shellfish and finfish populations will respond to changing conditions and whether species such as quahogs and scallops will ever regain populations needed to support commercial fishing. Nevertheless, recreational shellfishing is an important part of the Pleasant Bay experience, and is an important form of stewardship.

As noted above, a more recent management challenge is posed by the relationship between shellfish and migratory shorebirds and waterfowl. According to a proposal summary prepared by Massachusetts Audubon, "during the winter, large flocks of common eiders are present in Chatham Harbor, presumably feeding on blue mussels as well as crabs and other benthic invertebrates. The Town has expressed concern that the eiders are depleting commercially valuable mussel beds, and have sought permission to scare the eiders away from the beds using sound cannons and other methods. Given the complex relationship between shorebirds, mussels, and commercial shellfishing in Chatham, we are proposing a study to explore ways of managing mussels that will benefit birds and people alike." The study, a cooperative effort involving Mass Audubon and the Town of Chatham, will examine the interaction between blue mussels, common eiders and shorebirds, and identify areas of overlap. Ultimately the study is intended to provide guidance for management strategies that will allow the mussels and birds to co-exist and thrive.

The thrust of shellfish management recommendations over the next five years will continue to be on increasing the productivity of the wild shellfisheries for recreational or commercial harvesting, through strengthened shellfish management and enhanced propagation efforts.

6.3 Recommendations to Enhance Shellfish Management and Propagation

6.3.1 *Enhance wild fisheries. Evaluate the potential for enhancing the wild quahog fishery through the following measures*:

- Establishing a spawning sanctuary centrally located in the Bay, which would help sustain an adult population capable of generating sufficient amounts of larvae. This would also protect razor and soft shell clams, as well as birds, horseshoe crabs, and other species;
- Rotating heavily used shellfishing areas for closure, to allow time for stocks to replenish;
- Establishing one or more private aquaculture grants that are not harvested or are minimally harvested for the purpose of generating quahog larvae.

6.3.2 *Support local propagation efforts*. Continue to support the towns' efforts to increase the effectiveness of propagation, and strengthen enforcement of shellfishing regulations.

6.3.3 *Mark town boundaries.* Pursue the re-establishment of a series of buoys to demarcate town boundaries, particularly at Strong Island, North Beach and Big Bay. On-going monitoring of boundary markers will be required

6.3.4 *Explore Nutrient Harvesting*. There is growing interest in the role shellfish can play in removing nutrients and other pollutants from the water column. The Alliance will continue to monitor research to understand the effectiveness of shellfish in removing pollutants, as well as other ecological benefits they provide. Pilot projects for nutrient harvesting using shellfish in Pleasant Bay should be explored.

6.3.5 *Monitor and Support Studies to Protect Biodiversity*. Continue to support studies, such as the mussel project underway by Mass Audubon and the Town of Chatham, to address species interactions based on a thorough examination of the causes and consequences of species populations and behaviors.

6.4 Management Issue: Disease, Pest and Invasive Species

The massive New England Red Tide[4] Bloom of 2005 was a sober reminder of the uncontrollable factors that influence the viability of Pleasant Bay's fisheries. An all time record of 1,351,265 acres or 77.4% of Massachusetts's marine waters in forty-two communities were closed to shellfishing, including all of Pleasant Bay. Fortunately, the closure was precautionary and Pleasant Bay was not contaminated by this red tide outbreak.

Another disease management issue concerns Quahog Parasite Unknown (QPX). It is fortunate that to date, QPX has not yet been identified in any public shellfishing areas in Pleasant Bay. QPX has only been observed in selected private grant areas in the northern portion of Pleasant Bay. However, Orleans shellfish managers are concerned about the incidence of QPX and continue to work with the Division of Marine Fisheries, the County, and regional scientific institutions to understand the causes of QPX and develop a management response.

Another management issue is the emergence of invasive species, which pose threats to the viability of shellfish. One long-established invasive species is the green crab. It is believed that the green crab was unintentionally transported to the US East Coast from Europe in the early 1800s. The crabs are voracious consumers of all varieties of shellfish, including mussel and scallop seed, making a comeback of these species more of a challenge. The crabs also cause damage to eelgrass, which is critical habitat for scallops and other species. There is some interest within the fishing community in exploring the creation of a bait market for green crabs that could serve the purpose of thinning out the population.[5]

[4] Alexandrium fundyense is the scientific name for the toxic strain.
[5] Comment by Renee Gagne, Chatham Shellfish Constable, December 18, 2012.

Another invasive species, Codium, is an aquatic plant that attaches to objects on the bottom. A characteristic of Codium is its ability to reproduce an entire plant from a tiny fragment. As a result, the algae is rapidly overtaking sections of bottom in parts of Pleasant Bay. More recently the Japanese shore crab has become established in the waters of the Bay, and its effects are not yet known.

The Massachusetts Coastal Zone Management has developed the Massachusetts Aquatic Invasive Species Management Plan, which should be consulted in the development of strategies for managing invasive species in Pleasant Bay.

6.5 Recommendations to Address Disease, Pest and Invasive Species

6.5.1 *Develop management responses to invasive species and diseases*. The Alliance should continue to work with the towns, Massachusetts Division of Marine Fisheries, the County Extension Service, Massachusetts Coastal Zone Management and regional scientific institutions to study and develop effective management response to QPX, red tide and invasive species. Best management practices and possibly predator and invasive species control measures should be evaluated for their effectiveness, including impacts on shellfish and other aspects of the Bay's ecology.

6.6 Management Issue: Monitoring Fisheries

Questions about the reliability of shellfish harvest data as an indicator of species decline prompted a recommendation to conduct a shellfish and finfish assessment. The assessment was intended to update a 1967 survey conducted by the Massachusetts Division of Marine Fisheries. While it was felt that such a study could produce interesting data on shellfish densities, greater long-term benefit would result from a greater understanding of the types and quantities of, and the natural and man-made influences on, shellfish and finfish habitat. A deeper understanding of habitat conditions would enable shellfish managers to focus on promoting conditions under which shellfish and finfish thrive.

Growth in the seal population in Pleasant Bay has raised concern that seals are consuming finfish, and drawing in predators such as the Great White shark. Continued monitoring of seal populations and impacts is warranted.

6.7 Recommendation to Monitor Fisheries Habitat

6.7.1 Conduct research on the status of Pleasant Bay's fisheries habitat. The Alliance should work with the Division of Marine Fisheries, Barnstable County and regional scientific institutions to determine the best approach to long term monitoring of the Bay's finfish and shellfish habitat. The recommended approach should:

- Inventory shellfish and finfish species in the Bay, and assess density and productivity of various species;
- Develop a framework for long-term habitat monitoring;
- Evaluate impacts on wild shellfish and finfish, including those related to water quality or from the construction, maintenance, or presence of shoreline structures; sustained fishing of marginal stocks; loss of predatory equilibrium; cyclical abundance phenomenon; non-point source pollutants in the water column and sediments; juvenile mortality; environmental stresses; and the productivity of alternative species;
- Evaluate the potential for restoration of habitat for finfish species such as white perch, yellow tail flounder;
- Study seal habitat and population trends, including potential impacts on fisheries; and
- Study cormorant population trends and their impact on fisheries.

6.7.2 *Investigate, Monitor and Improve Anadromous and Catadromous Fish Passage.* Fish runs provide passage for anadromous fishes such as alewife or river herring between freshwater spawning sites and the ocean where adult fish spend their lives. Active anadromous and/or catadromous fish runs in Pleasant Bay currently exist between Kescayongansett (Lonnie's Pond) and Pilgrim Lake, and between Ryders Cove, Stillwater Pond and Lover's Lake. Muddy Creek dividing Harwich and Chatham provides habitat and migratory passage for catadromous fishes such as the American eel, and potential spawning habitat for anadromous fishes such as herring as well. The Alliance will support efforts to investigate, monitor, maintain or improve fish passage in these and other areas. The Alliance supports efforts between Massachusetts Division of Marine Fisheries and the Towns of Orleans, Chatham and Harwich to study the feasibility of improving American eel migration in Muddy Creek, the Pilgrim Lake run, and hydrologically connected freshwater ponds.

6.7.3 *Study Intertidal Habitats.* The Alliance will support work by ecologists and scientists from the Cape Cod National Seashore to develop a GIS mapping project of intertidal areas categorized by tidal regime, sediment type, and vegetative cover. This information should provide valuable information on the conditions and dynamics affecting shellfish habitat areas. (See also recommendation 3.8.4)

6.8 Management Issue: Managing Private Aquaculture

Private aquaculture remains only within the areas specified in the plan. Since the plan was adopted, no new grants have been permitted, but several existing grants have expanded contiguous to existing licensed areas. Currently there is a total of twenty-eight acres of private grant area with the potential for an additional twelve acres. The entire forty acres of current and potential grant area is located in Orleans (see Figure 17.)

Since the adoption of the plan the Town of Orleans has been working with the Massachusetts Division of Marine Fisheries, the Barnstable County Cooperative Extension Service, and regional scientific institutions to develop best management practices for grant holders, as recommended in the plan.

6.9 Recommendation to Manage Private Aquaculture

6.9.1 Encourage adherence to aquaculture best management practices developed by the Massachusetts Division of Fisheries.

6.9.2 Guidelines for aquaculture expansion. Develop guidelines for evaluating proposals for expanded or new aquaculture grants within ACMH (see recommendations 3.8.1-3.8.4.) The guidelines would ensure that alteration of a grant within an ACMH would only be allowed if:

- Compliance with all applicable local, state and regional regulations, policies and best management practices can be demonstrated;
- It can be documented and demonstrated that there will be no negative impact on other marine invertebrates, shorebirds, migratory birds, or other rare or endangered species; and
- Based on historical harvest data and an objective site investigation there is no likelihood of a natural recurrence of a wild shellfish population.

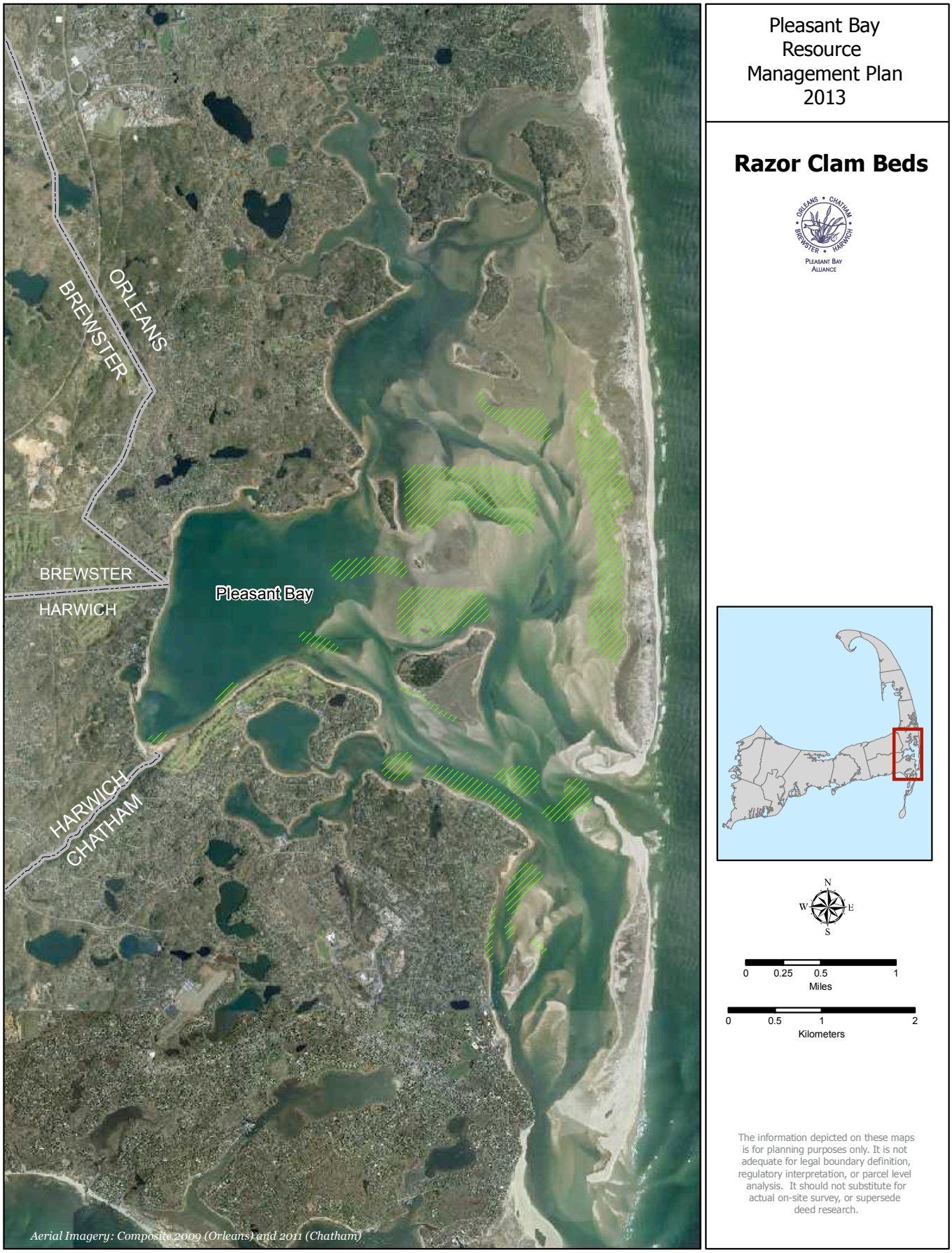


Figure 12. Razor Clam Beds

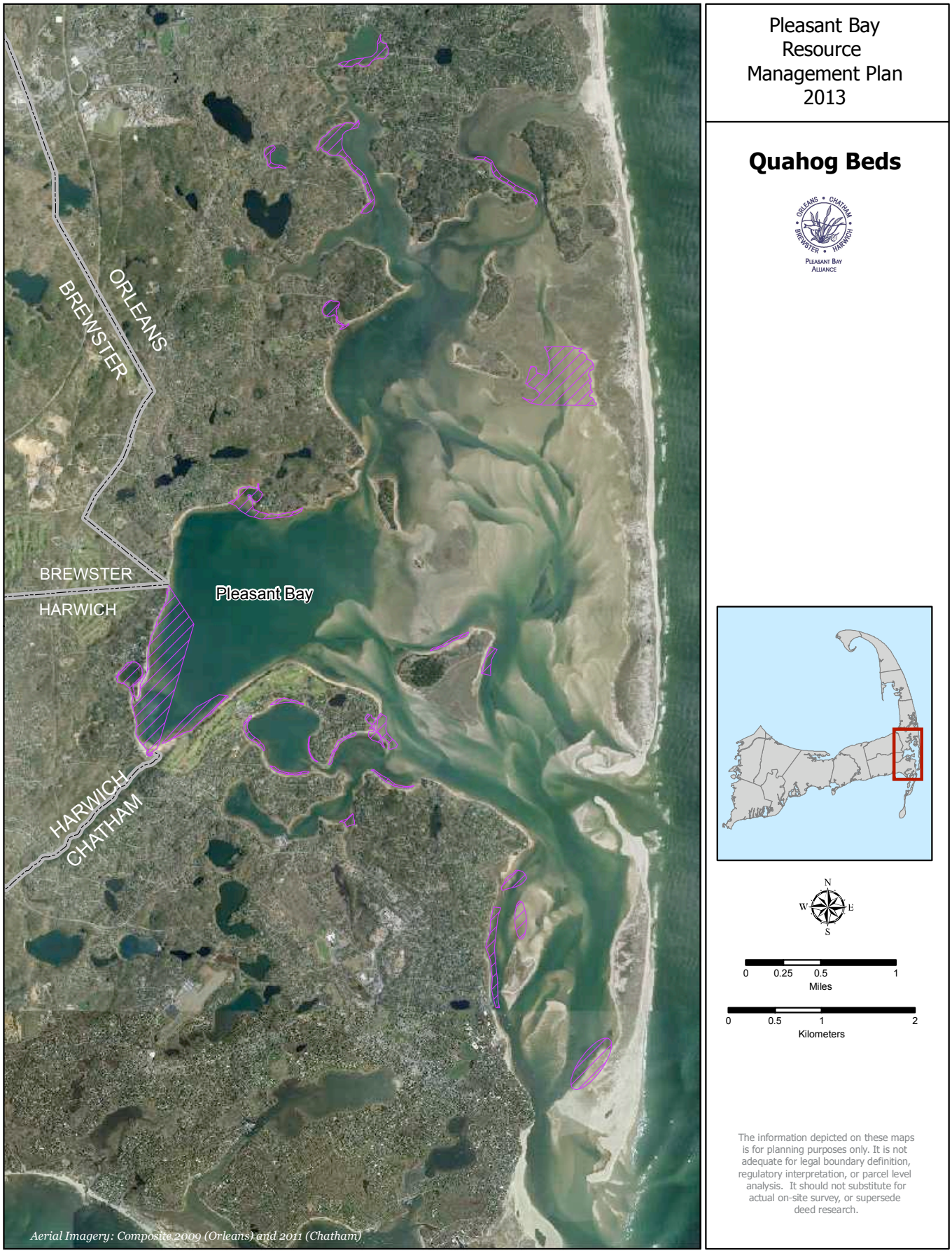


Figure 13. Quahog Beds

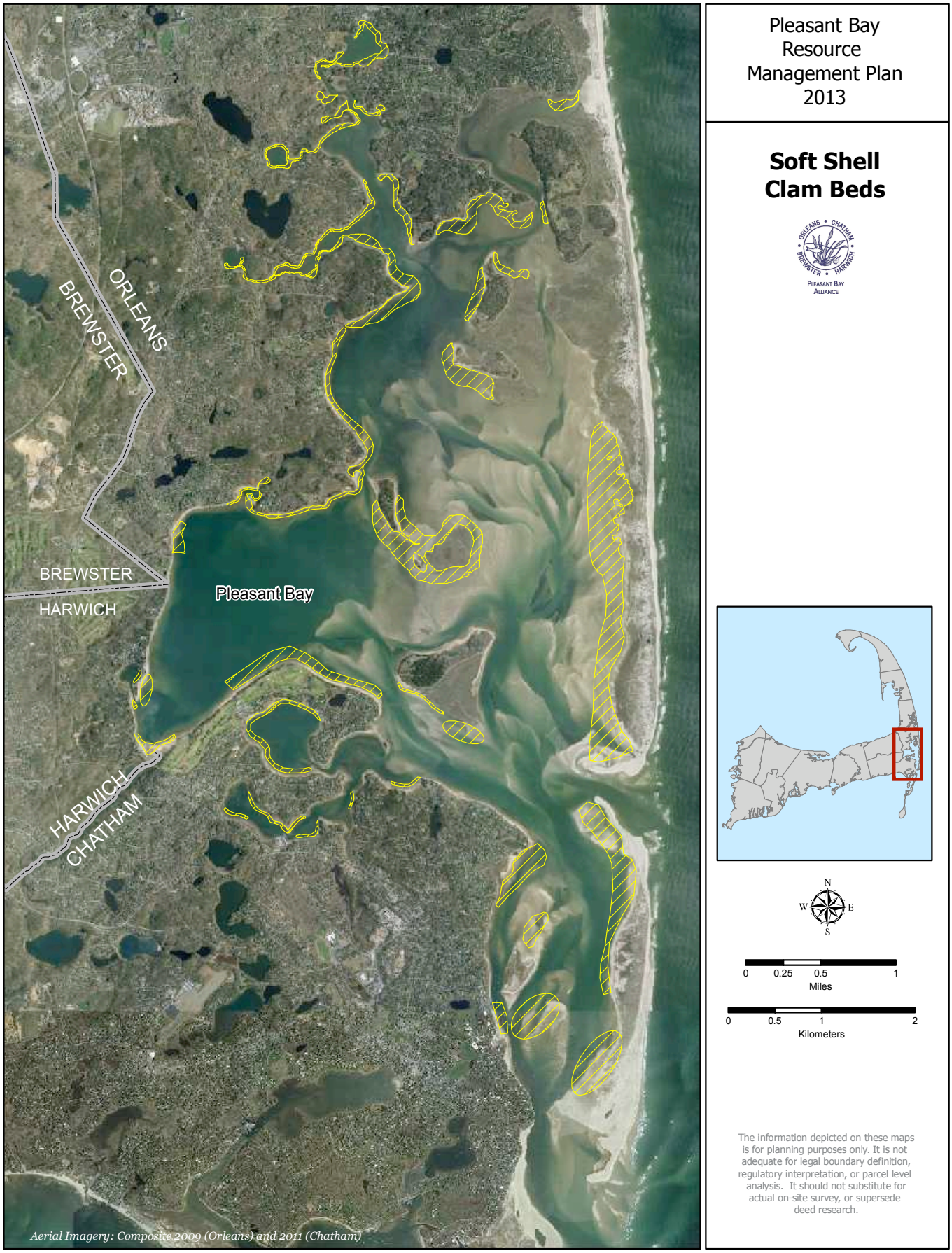


Figure 14. Soft Shell Clam Beds

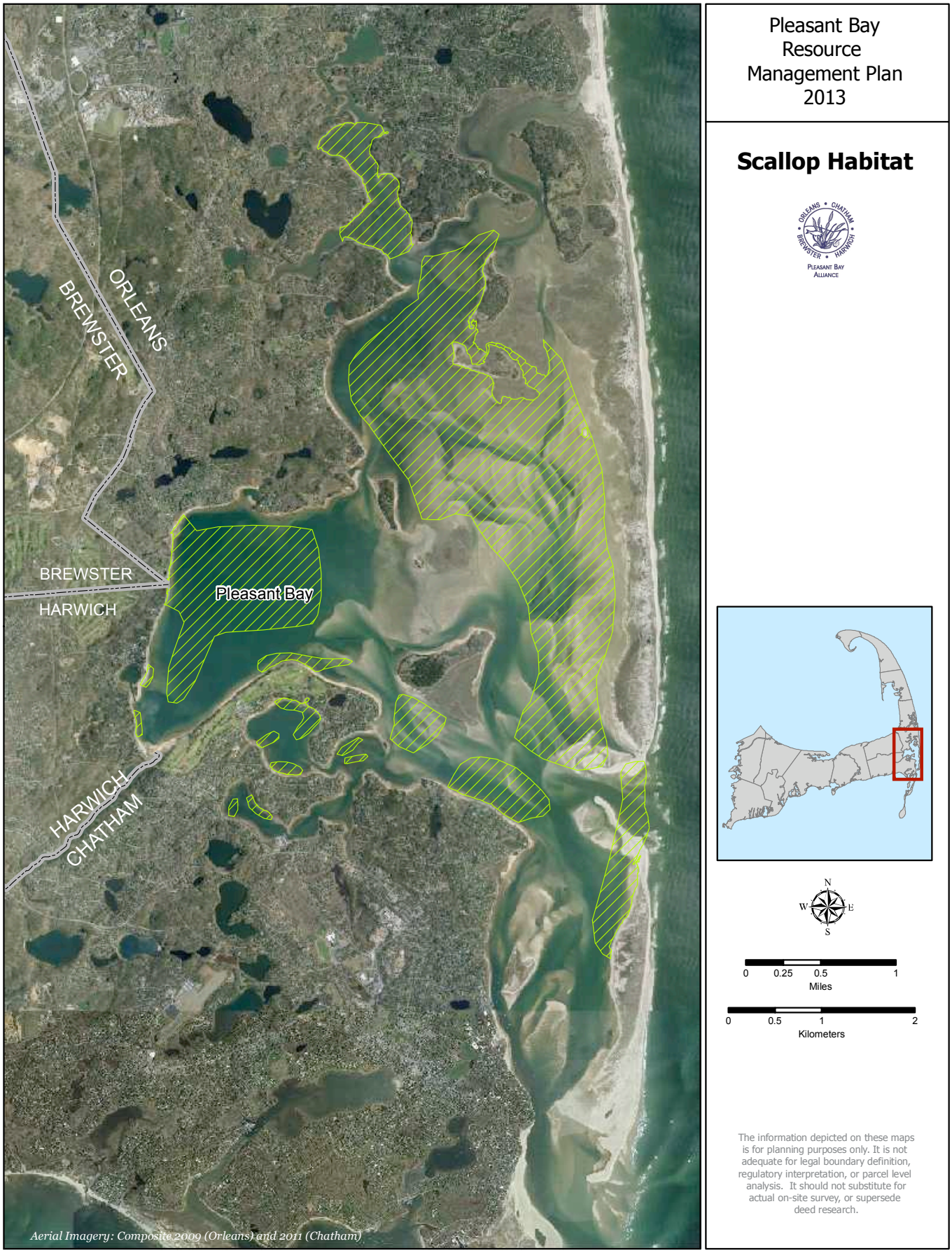


Figure 15. Scallop Habitat

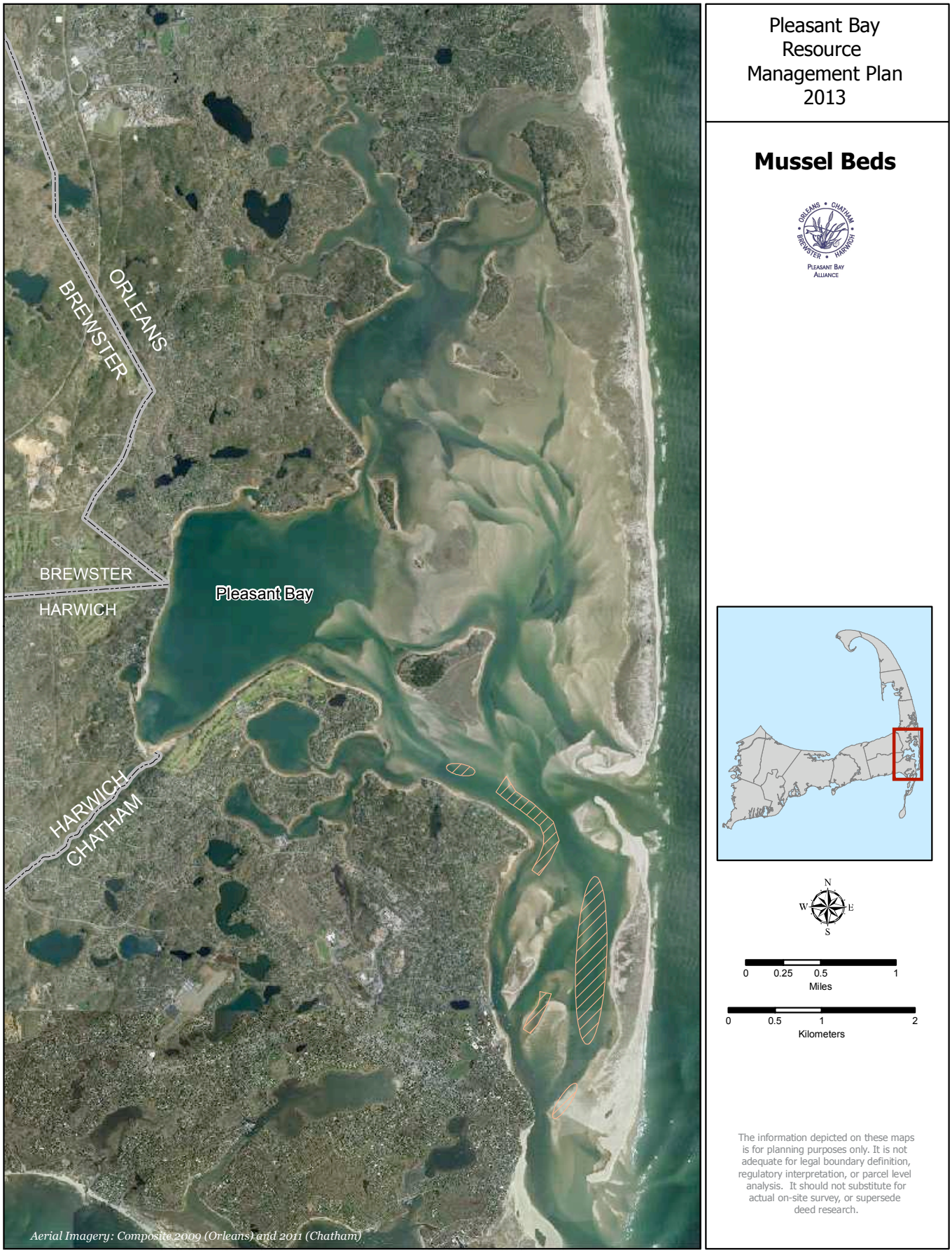


Figure 16. Mussel Beds

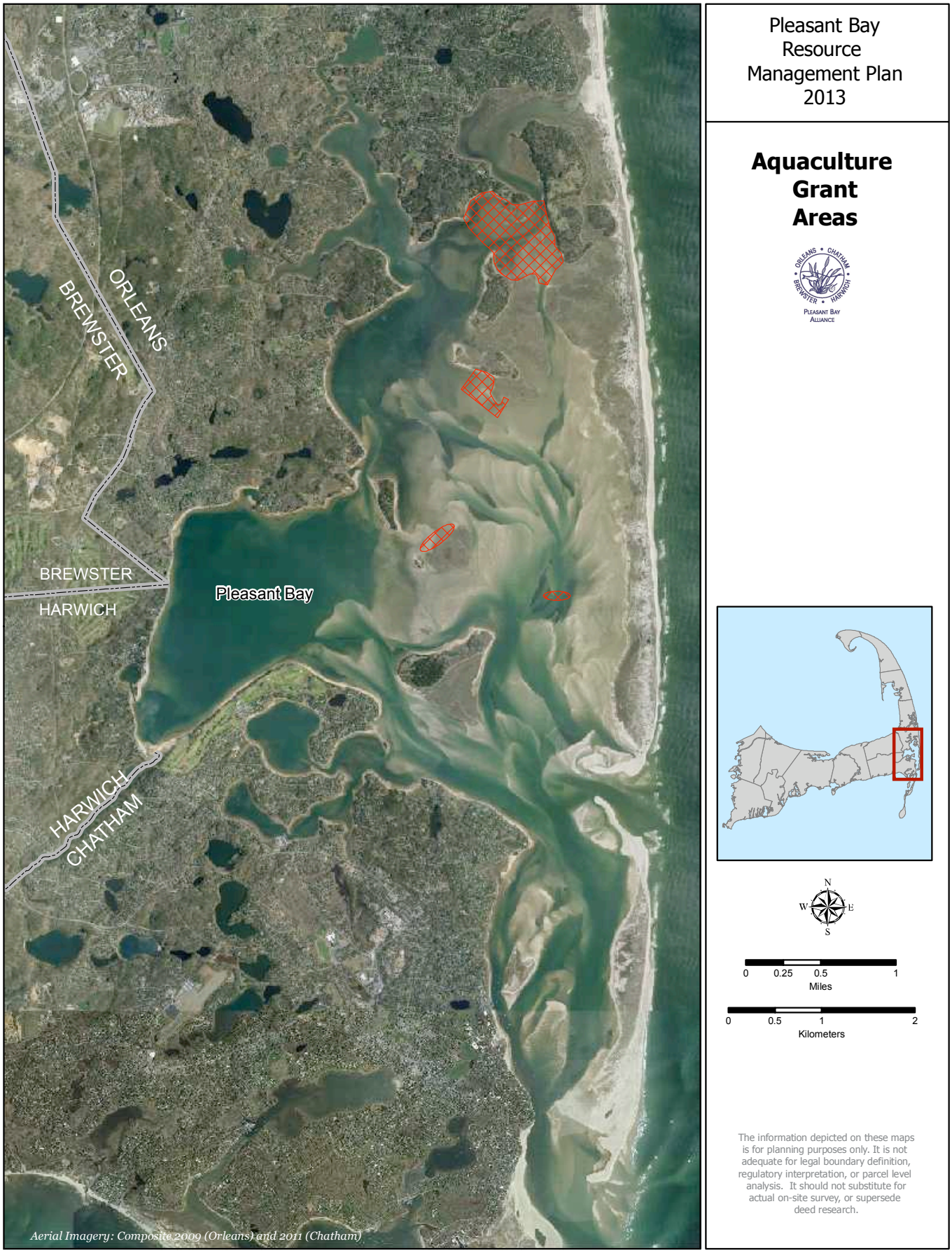


Figure 17. Aquaculture Grant Areas

Chapter 7.
Coastal Processes and Coastal Structures

7.0 Overview

The outer barrier beach and inlet system that divides Pleasant Bay from the Atlantic Ocean continues to be the most significant physical feature in determining the health of the estuary. The barrier beach protects the Bay from the harsh impact of ocean waves, while the inlets control the ebb and flow of ocean waters. The configuration of the beach and inlets influences the volume, current strength and tidal range of water flushing in and out of the Bay. In turn, these factors determine shoaling patterns that affect navigation, and the deposition and erosion of sediments along the shoreline. By influencing flushing, the configuration also affects the Bay's water quality, eelgrass, salt marshes and other natural resource conditions.

Awareness of the close link between the barrier beach and inlet system and the overall health of the estuary grew dramatically in the two decades following the formation of the 1987 Chatham break. During this time, the observed thinning of portions of the barrier beach and periodic small-scale over-wash events sparked speculation about the fragility of the barrier beach and the possibility and implications of changes in the inlet configuration. In 2006 the Alliance hosted the *Pleasant Bay Symposium: Managing a Dynamic System*, where regional specialists explained the dynamics of the inlet and beach system and its influence on resource conditions throughout the Bay. The MEP Technical Report for Pleasant Bay released that same year underscored the importance of the inlet and its influence on tidal flushing as it relates to measuring and addressing nitrogen overloading from watershed land uses.

Almost a year to the day following the symposium, an extended storm system settled off the coast of the Northeast, delivering storm surges fueled by astronomically high tides. The so-called *Patriot's Day Storm* caused an over-wash in a narrow area of the barrier beach across from Minister's Point in North Chatham, approximately 1.8 miles north of the existing Chatham Inlet. Initially it was felt that the new breach would fill in with the southerly littoral drift of sediment. However, it quickly became apparent that the new inlet was, in fact, widening and deepening[1]. Presently both the 1987 and 2007 inlets allow tidal flow in and out of the Pleasant Bay system.

Over the past six years several research efforts have been undertaken to monitor the barrier beach and inlet configuration and assess its system-wide effects. Some of these research efforts have been compiled in the *Coastal Resource Guide for Pleasant Bay and Chatham Harbor* (Alliance et al, 2011). The guide draws from recent technical studies sponsored by the Alliance, as well as existing regional and state resources, to describe trends in barrier beach

[1] Chatham Breach closure briefing document, Chatham Coastal Resources Department, June 11, 2007

migration, tidal dynamics, flushing, water quality, and related processes and resources.

One of the studies highlighted in the Guide assesses the Nauset barrier beach and inlet formation and estimates its future configuration. This study (Giese, 2009) builds on earlier work (Giese, 1978) and analyzes current aerial photography and more than 150 years of historical data to assess the likely future movement of the outer beach and inlet. The data show that the second inlet formation in 2007 was a continuation of a 150-year cycle that occurs in two distinct phases. Phase 1 is an inlet formation stage in which a new breaching event launches a period of multiple inlets and changes in tides and tidal channels. The system is currently in Phase 1, which started with the formation of the 1987 inlet east of Chatham Light. Phase 2 is an inlet migration phase, in which a single stable inlet migrates southward. The inlet formed in 2007 is expected to become the single dominant inlet that migrates southward during this phase. The study estimates that this single inlet configuration could occur within the next 50 years.[2]

In the years following the 2007 inlet, questions arose as to the extent of increased flushing and improvements to water quality. A hydrodynamic study undertaken right after the 2007 inlet (ACRE, 2008) showed an increase in tidal flow throughout the system, consistent with many anecdotal reports of "higher high tides and lower low tides." This was supported by analysis of tide data (Giese, 2012), which showed that the measured difference between high and low tides, known as tidal range, was expanding. Tidal range is a key indicator of changes in the volume of water flowing in and out with the tides. If tidal range is expanding, there's a good chance that the volume of water exchanged with the tides is growing also. Nutrient modeling of updated flushing (SMAST 2008) showed a reduction in nutrient concentrations in well-flushed areas of the system such as Little and Big Pleasant Bay, but little improvement in the terminal ponds. Overall, changes in water quality were insufficient to meet nitrogen thresholds used to determine Total Maximum Daily Loads for nitrogen.

As the 2007 inlet became more established, many wondered if water quality would continue to improve. A recent analysis of tide data (Giese, 2012) demonstrates that the flow of water in and out of Pleasant Bay reached a peak in early 2010 and has declined since that time. This is due to a confluence of local and regional factors, according to the study. Localized shoaling is restricting out-flowing water during low tides, keeping low tides higher. On the other end of the tidal cycle, a downward trend in regional mean sea level is having a downward influence on high tides in Pleasant Bay and elsewhere. As a result, tidal range is now less than at any time since soon after the formation of the second inlet in 2007, and mean high water is lower than it has been since 2009. The reduction in tide range means that the volume of water flowing in and out of Pleasant Bay has decreased since 2010, with implications for water quality. Based on these

[2] Coastal Resource Guide for Pleasant Bay and Chatham Harbor

findings, increased flushing cannot be relied on as a sufficient strategy for addressing nutrient loading in Pleasant Bay.

In the coming five years the Alliance will focus on deepening our understanding of the management implications of on-going developments with the barrier beach and inlet configuration, and using that information to support system-wide management. As described in more detail in the remainder of this chapter, on-going resource management activities fall into three areas:

- Sediment management;
- Permitting guidelines and best management practices for coastal structures; and
- On-going data collection and research.

7.1 Resource Management Issue: Sediment Management

Sediment management in Pleasant Bay faces the dual challenges of increased sediment in some areas, and reductions in sediment in other areas. Dynamic shoaling in the areas close to the 2007 inlet poses a potential threat to traditional navigation access. A loss of sediment along some portions of shoreline threatens public access and potential loss of private property. Currently, sediment nourishment is underutilized as a management strategy for mitigating the effects of shoreline armoring as well as fortifying coastal landforms facing erosion threats.

7.1.1 Dynamic Shoaling

A large percentage of the Pleasant Bay system is characterized by shallow, sandy shoals and meandering channels. The areas of greatest shoal movement are generally in the vicinity of tidal inlets and channels with high tidal currents.

Areas adjacent to the two tidal inlets are particularly prone to migrating shoal patterns given the potential for the introduction of sediment from the barrier beach, strong tidal currents and high wave energy. The 2008 Resource Management Plan acknowledged that the effects of increased shoaling in the vicinity of the 2007 inlet could potentially impede traditional navigation access in the future. The 2008 update charged the Alliance with conducting a “study of the potential need for, impacts from, and feasibility of improvement dredging in areas where shoaling is limiting access in areas that traditionally have served as important public navigable waterways.” Following two years of study and discussions with state officials, the Alliance released a report entitled *Assessment of Need, Impacts and Regulatory Feasibility Associated with Limited Improvement Dredging in the ACEC* (2012). The assessment focused on a zone in the vicinity of the 2007 inlet, where shoaling activity is especially dynamic.

Because no part of that area had previously been permitted for dredging, future dredging would have been considered improvement dredging and therefore prohibited under state law within the ACEC. The entire proposed zone in question is within Chatham.

The assessment recommended an amendment to the Resource Management Plan to make it possible for the Town of Chatham to seek state and local permits for improvement dredging within the Pleasant Bay Area of Critical Environmental Concern (ACEC) under the following conditions:

- Proposed improvement dredging is within the zone specified by the article;
- Proposed improvement dredging is sponsored by a municipality;
- Proposed dredging is intended to maintain or restore navigation access which has been impeded by natural sediment movement; and
- The extent of proposed dredging is the minimum needed to maintain historic access.

The amendment was adopted in 2012 Town Meetings in Orleans, Chatham, Harwich and Brewster, and will be submitted to the state for approval. Complementary changes to state regulations were under development at the time of this 2013 plan update.

7.1.2 Shoreline Erosion

While shoaling is the primary sediment challenge in the eastern part of the system, many sections of the mainland shoreline are experiencing diminished sediment supply. In part, this is believed to be the result of increased coastal armoring of the mainland shoreline. Under natural circumstances winds, currents and tides hit a coastal bank and, depending on bank profile and vegetation, erode the bank's sediments. Eroded sediments are transported by winds and currents to the beach at the base of the bank, to elsewhere along the adjacent shoreline, or back out to sea. This natural action ensures that beaches are replenished with sand—which is continually redistributed by tides and storms—and nutrients are added to intertidal and fringe marsh. Without the erosion of coastal banks providing the primary source of sand, nearby beaches, dunes and barrier beaches would rapidly disappear. This in turn would jeopardize landward salt marshes, tidal flats and the extensive plant and animal life they support. Loss of salt marsh also makes upland areas more vulnerable to storm damage.

Coastal armoring prevents erosion of sediments from coastal banks for these natural purposes, and deflects wave energy in ways that negatively affect down-drift properties and infrastructure. By preventing erosion, hard structures diminish the supply of sediments available for natural beach nourishment. They also increase turbulence associated with breaking waves that can cause end-scour and erosion of down-drift properties. These combined impacts contribute to lowering the profile of the fronting beach. Within Pleasant Bay there is

indication of loss of beach and fringe marsh due to the presence of erosion control structures.

7.1.3 Beach Nourishment

Regular beach nourishment frequently is a mitigation requirement for the licensing of hard structures. However, efforts to replicate the benefits of natural sediment nourishment by placing material in front of a structure do not always generate desired results. In practice, beach nourishment is often unfeasible, neglected, or poorly executed, resulting in expenses for owners without the intended mitigation effects. The inevitable movement of sediment deposited as part of nourishment efforts may end up covering resource areas or causing unwanted shoaling in navigation channels. Either outcome results in lost resources or added public or private expense.

Under appropriate circumstances, sediment nourishment can be a pro-active stabilization strategy as well as an effective mitigation measure. As a pro-active measure, nourishment can help to stabilize a coastal landform such as a bank or barrier spit, or help to maintain a beachfront. Under proper conditions, nourishment can help to forestall or avoid installation of a hard structure or soft application that may yield unintended consequences.

7.2 Recommendations: Sediment Management

Shoaling from an influx of sediment in the eastern portion of the system, and erosion from the loss of sediment on the western shore present distinct management challenges. However, both are best addressed on a system-wide basis. Historically, dredging, dredged material disposal and beach nourishment are managed on a case-by-case basis, within the town of jurisdiction. A regional or system-wide approach to sediment management could help to ensure that:

- Permitting decisions reflect the larger role a site plays in the distribution of sediments in the system;
- Sediment losses from existing structures are evaluated and addressed;
- All nourishment efforts follow best management practices;
- Nourishment from dredged materials or other source is applied to priority areas where material is needed to protect landforms, habitat or public access; and
- Regulatory, jurisdictional and logistical considerations are carefully weighed in light of resource impacts associated with dredging or nourishment.

7.2.1 *Develop a Bay-wide Sediment Management Plan*. The plan would provide a comprehensive assessment of sediment dynamics in the Pleasant Bay system, including future trends, and would be intended to guide local policies and projects for dredging, disposal of dredged material, and review and permitting of erosion control structures and beach nourishment projects. The plan would recognize

the unique sediment management challenges of an estuarine system, which often include shallow depths, limited access, narrow beach widths and awkward shoreline angles for pumping dredged material. Elements of the plan would include, but not be limited to:

- Identifying the sediment characteristics of shoreline segments based on:
  - Sediment type;
  - Coastal landform;
  - Presence or absence of structures or non-structural management solutions;
  - Direction of sediment transport;
  - Littoral cell (if applicable); and
  - Fetch, current, and wave activity.
- Calculating the sediment budget for areas where coastal armoring has constrained erosion to determine the amount of foregone sediment nourishment over the life of the structure(s);
- Developing management or performance criteria for structures or alternative solutions for each area, based on characteristics;
- Identifying and prioritizing areas for accepting dredged material for purposes of shoreline stabilization, habitat restoration and protection of public access, consistent with Chapter 91 regulations;
- Identifying priority areas for proactive beach nourishment;
- Identifying strategies for disposing of fine grained or other material not compatible for beach nourishment;
- Providing a basis for permitting dredging and material disposal on a system wide or intermunicipal basis.

7.2.2 *The Alliance should work with local Conservation Commissions to develop and promote adherence to best management practices for beach nourishment projects.* The best management practices would be based on MassDEP's Guide to Best Management Practices for Beach Nourishment Projects in Massachusetts, but would be tailored to specific conditions in Pleasant Bay.

7.3 Environmental Impacts and Regulatory Guidance for Docks, Piers and Erosion Control Structures

The 1998 plan documented the direct and indirect environmental impacts of structures on the Bay's resources. The harmful effects of docks and piers cited in the plan include blocking wind and tidal flow, shading of vegetation, chemical leaching from materials, and impacts from construction and removal. As noted above, impacts from erosion control structures stemmed from the concern that hard structures (i.e., revetments, bulkheads, gabions) interfere with natural erosion and re-nourishment processes in the Bay. The need for clear guidelines to assist towns with reviewing applications for marsh walkways is also recommended.

The priority status given to the regulation of docks and piers in the 1998 plan was based on the fact that a Categorical Restriction on the issuance of new Chapter 91 licenses for private piers had been put into effect within the ACEC until such time as guidelines for permitting new structures were put into place. The 1998 plan provided a detailed resource assessment of the Bay's shoreline area that was used to identify areas where new piers would continue to be prohibited, and areas where piers could be permitted provided they met certain performance criteria and design standards. The plan also called for the Categorical Restriction to be extended until such time as the towns adopted new or revised policies and regulations consistent with the framework outlined in the plan. Figure 18 shows where existing docks and piers are located in Pleasant Bay as of 2007.

The framework for permitting new docks and piers was subsequently developed into a comprehensive set of permitting guidelines (1999). Local Conservation Commissions and Planning Boards relied upon the guidelines to develop specific regulatory or bylaw changes necessary to bring local regulations into compliance with the resource management plan. The guidelines allowed the towns to achieve consistency in their treatment of docks and piers while working within the existing structure of local regulations. Although the guidelines were developed for Pleasant Bay, each town opted to apply many of the performance standards town-wide, resulting in a significant increase in the protection of coastal resources beyond the ACEC boundary. The Guidelines were approved by the Secretary of the Executive Office of Environmental Affairs, and are now relied upon in determinations of Chapter 91 license applications within the ACEC.

The Alliance undertook a similar approach in developing *Guidelines for Private Walkways and Stairways in Fresh and Marine Resource Areas In Pleasant Bay* (2002), and *Guidelines for Permitting Shoreline Structures on Freshwater Lakes and Ponds in the Pleasant Bay Area of Critical Environmental Concern* (2012).

Some areas of the Bay and types of structures are not specifically addressed in any of the guidelines noted above. These include:

- Erosion control structures;
- Docks or piers along the shoreline of the Bay Islands and Muddy Creek;
- Other types of structures that could be placed along any shoreline areas including, but not limited to, anchored floats, outhauls, and ramps.

7.3.1 Resource Management Issue: Erosion Control Structures

Some of the town landings along Chatham's eastern facing shoreline such as Strong Island, Scatteree, and Cotchpinicut landings have experienced heightened erosion due to their proximity to the 2007 inlet. Not only has this

resulted in the need for more frequent nourishment efforts but in the case of Cotchpinicut and Scatteree landing, the actual footprint of the landings have been reduced due to shoreline retreat. Jackknife Beach in Chatham has been eroding and the parking lot experiences more frequent flooding. This is due to a combination of factors including the increase in water elevations and storm surge levels due to the second inlet formation as well a general reduction of updrift sediment supply resulting from existing erosion control structures along the abutting private golf course.

When the 1998 Resource Management Plan was written, approximately 22,627 feet of Pleasant Bay's shoreline was protected by erosion control structures. There were 103 revetments, 25 bulkheads, and only five soft applications in the study area. As can be seen in Table 5, there has been some change in these numbers.

Table 5: Erosion Control Structures on Pleasant Bay

	Orleans	Brewster	Chatham	Harwich	2007 Total	1998 Total
Bulkheads	10	--	14	3	27	25
Revetments, Gabions	25	1	64	15	105	103
Soft Applications	8	--	20	--	28	5
Total Number	43	1	98	23	165	133

As noted above, hard structures diminish natural erosion and nourishment processes, resulting in the loss of beach height and vitality, and vegetated marsh. In addition, use of heavy equipment in the construction of structures or for gathering nourishment sand from down-drift areas can crush near-shore shellfish and vegetation. While use of hard structures may be called for in certain cases, soft applications are preferred where they can be effective with fewer negative impacts on surrounding resources. Figure 19 shows the distribution of hard and soft erosion control structures in Pleasant Bay.

The southern portion of shoreline around "Big" Pleasant Bay is experiencing a loss of sand and a resulting change to a stony shoreline. This is occurring because the erosion of the protected bluffs no longer provides fresh sediment. This area includes Jackknife Harbor in Chatham, Bay Road Beach in Harwich, and the Route 28 beach area and town landing in Orleans. These three locations constitute the only public beachfront on the Bay, as well as a number of private properties. Protection against the loss of these beach areas is warranted. By comparison, the southeast shore, where there are few erosion control structures, remains sandy or covered with beach grass.

Revetments, sea walls and other hard structures are also notorious for impeding lateral access along the shoreline. This effect is exacerbated as beaches at the base of the structure are washed away and not effectively re-

nourished. Structures seeking a Chapter 91 license are supposed to provide access for fishing, fowling and navigating by doing such things as installing signs stating that persons with legal public access may traverse the structure. Stairs and platform walkways also may be required to provide safe passage for fishers, fowlers, and navigators. Some erosion control structures on the Bay were built before the Chapter 91 public access requirements were in effect, and are not designed to allow for safe passage. Also, it is believed that some newly licensed structures are not in compliance with licensing requirements for public access. Structures built above mean high water are not held to such requirements, even though over time those structures may end up below mean high water due to erosion or sea level rise

The observed cumulative effects of hard structures on natural resources and public access in Pleasant Bay are significant. As a result, there is continuing desire that hard structures be limited in number and size, and that soft alternatives be utilized whenever they can be shown to provide ample protection. Soft applications are already preferred by state and local permitting agencies because they provide substantial protection with minimum interruptions to beach nourishment and natural habitats. While soft applications may require frequent maintenance to remain effective, they may be less costly than hard structures in the long run.

7.3.2 Recommendations: Inventory of Coastal Structures and Management Applications

7.3.2.1 *Develop a detailed inventory of coastal structures in Pleasant Bay.* The inventory should generate information sufficient for GIS mapping of structures and should encompass:

- All types of shoreline structures (docks, piers, walkways, floats, boathouses, coastal engineered structures);
- A classification system for erosion control structures;
- GIS coordinates for the entire length and width of the structure and, if possible, elevation;
- Permitting status and regulatory conditions of permitting;
- Dated photographs; and
- Field verification of information.

7.3.2.2 *Develop a detailed inventory of non-structural coastal management solutions*. The inventory would encompass soft applications and significant nourishment projects that are not considered structures.

7.3.3 Recommendations: Regulatory Guidance for Erosion Control Structures

7.3.3.1 *Develop Performance Standards and Design Criteria for Erosion Control Structures*. Performance standards and design criteria should be developed for

erosion control structures. Local and state permitting authorities would use the performance standards to assess situations where the use of hard structures is the only feasible alternative for erosion control. In such cases, the design criteria would be used to minimize negative environmental impacts from such structures. The design criteria for hard structures should address:

- Designing the height of the structure to allow sediment release during extreme storm events;
- Requiring “rough face” surfaces with the shallowest possible slope to reduce wave energy;
- Requiring design features to reduce “end effect” erosion without resulting in a footprint that encroaches on resource areas;
- Constructing hard structures as far landward of mean high water as possible;
- Requiring construction to be staged from the landward side of the structure, where possible, to minimize construction impacts on existing beach front, fringe marsh, and shellfish resources;
- Requiring vegetative covering and beach nourishment, either immediately following construction or when conditions allow;
- Requiring structures to be constructed with stairs, platform walkways, or other acceptable design, which would allow safe public access. Future erosion of beach-front should be considered relative to preserving public access and addressed in the structure design;
- Requiring compliance with beach re-nourishment guidelines (see 7.2.2);
- Comparable design criteria would also be developed for soft applications.

7.3.3.2 *Treatment of Erosion Control Structures Subject to Categorical Restriction*. Erosion control structures located within the boundaries of the ACEC below mean high water may be subject to the existing Categorical Restriction on new Chapter 91 licenses issued by MassDEP (310 CMR 9.32 (1)(e).) In such cases, state waterways regulations also allow for granting a license for purposes of shoreline stabilization, provided that reasonable measures are taken to avoid, minimize, and mitigate any encroachment in a waterway (310 CMR 9.3.2 (2).) Until such time as *Performance Standards and Design Criteria for Erosion Control Structures* as outlined in 7.3.3.1 above are adopted by the Alliance towns and the state, it is recommended that DEP apply regulatory discretion provided for in 310 CMR 9.3.2 (2) in its review of applications for Chapter 91 licenses for erosion control structures in the ACEC, and that in its review DEP give due consideration to the issues enumerated in 7.3.3.1 above and 7.3.3.3 below. Once guidelines and performance standards are completed in accordance with 7.3.3.1, adopted into regulation by the respective towns and approved by the state, they will replace the Categorical Restriction and provide guidance to DEP in issuing Chapter 91 licenses for such structures. Conservation Commissions are encouraged to adopt and apply the same performance standards and design criteria for erosion control structures that do not require a Chapter 91 license.

7.3.3.3 *Encourage Alternatives to Hard Structures.* Local and state permitting agencies should be urged to ensure that alternative measures to hard structures are utilized wherever possible to mitigate the effects of coastal bank loss. Areas of special concern include the southern shore of “Big” Pleasant Bay. These areas, which include public beaches and other access points, are experiencing a transition from sandy to stony beaches and loss of vegetation due to erosion and lack of sediment input. Use of hard structures in these areas could further decrease the sediment supply. It is important to note that some techniques that are considered soft applications are becoming increasingly fortified in their application. One such example is the practice of wrapping fiber roles in wire and anchoring them. Fortified “soft” applications function similarly to traditional hard structures and may generate similar impacts. These impacts should be carefully monitored, and mitigation methods outlined above under 7.3.3.1 should be applied as appropriate.

The selection of erosion control measures should be made with an understanding of all reasonable alternatives including the landward relocation of the structure where possible, and taking into account the entire profile of the resource area. For example, fortification or restoration of fringe marsh could provide significant storm damage prevention and minimize the need for extensive fortification. The following is a partial list of alternatives to hard structures that should be considered:

- Bank restoration;
- Marsh restoration;
- Relocation of buildings away from the eroding edge;
- Designing the structure appropriate to the rate and cause of erosion;
- Re-contouring of existing bank elevations;
- Vegetative plantings such as dune grass and other types of compatible vegetation;
- Proactive and maintenance beach nourishment;
- Soft structures such as fiber rolls.

7.3.3.4 *Study Building Relocation for Erosion Management*. A cost benefit analysis of building relocation as an alternative to installing erosion control structures should be undertaken. The study should consider the financial and resource costs and benefits of building relocation in comparison with other alternatives, and should also look at the other regulatory issues that would be associated with relocating structures, such as zoning, health and conservation requirements.

7.3.4 Resource Management Issue: Existing Unlicensed Docks

Since the Pleasant Bay dock and pier guidelines were adopted into regulation by the towns and accepted by the state, some permit applications have arisen for licensing of pre-existing but previously unlicensed structures. In

these cases, the Alliance has been asked to provide comment on the extent to which the structures described in the license applications adhere to the approved dock and pier guidelines. The guidelines state that *"[n]ew or revised regulations would not apply to existing licensed structures or to routine maintenance of such structures*." Existing licensed structures are not required to be consistent with the guidelines unless they propose a modification other than routine maintenance. The guidelines do not specify similar treatment for previously existing unlicensed structures, nor was it ever the intent to do so.

7.3.5 Regulatory Guidance for Existing Unlicensed Structures and New Licenses

7.3.5.1 *The following parameters will continue to be used in assessing consistency with guidelines for previously existing unlicensed structures*:

- Any structure that does not hold a valid Order of Conditions and Chapter 91 license is considered an unlicensed structure.
- Any structure with an amnesty license is considered a licensed structure. Pending amnesty license applications do not constitute a license.
- Previously unlicensed structures, even if they are pre-existing, are considered new for the purposes of assessing consistency and must conform to the dock and pier guidelines.
- Pre-existing unlicensed structures seeking licenses are subject to the same dock and pier guidelines as newly built structures seeking licenses.

7.3.5.2 *From time to time the Alliance is asked to assess consistency with guidelines for new licenses in areas that are not designated areas of prohibition for new docks*. Such licenses may be for pre-existing or new structures. In some instances, the proposed structures meet some but not all of the performance standards and design guidelines. In assessing consistency, the Alliance may consider minor variances from performance criteria and design standards consistent with the guidelines if 1) the new structure will reduce other stresses on resources in the Pleasant Bay system, 2) there is a clear, long-term community or public benefit (such as a shared structure or public use), 3) there are compelling site conditions that preclude a more compliant design alternative. This recommendation does not apply to structures in areas of prohibition.

7.3.6 Resource Management Issue: Docks on Bay Islands and Backside

The Pleasant Bay study area contains eight small islands that constitute 13 miles of shoreline and the bulk of undeveloped open space in the ACEC.[3] In Orleans, Pochet, Little Pochet, Hog, and Sampson's Islands are owned by a private conservation trust and, with the exception of fifty acres on Pochet Island reserved for existing homes, are subject to a conservation restriction. Sipson's Island is privately owned and contains some residences. Little Sipson's is owned

[3] Pleasant Bay RMP 1998, p.60.

by the Orleans Conservation Trust. Strong Island in Chatham is owned by the Town of Chatham and the Chatham Conservation Foundation, with a long term lease on three acres for a private residence. Tern Island is owned by the Massachusetts Audubon Society.

When the resource assessment of shoreline areas was developed for the 1998 resource management plan, it was believed that shoreline structures on bay islands were precluded by the islands' respective conservation status. Similarly, the backside of the barrier beach was not included in the assessment because it was within the boundary of the Cape Cod National Seashore. The extent of private interests in these areas was not fully recognized. As a result, the "Resource Assessment for Dock and Pier Impacts in Pleasant Bay" developed for the *Pleasant Bay Resource Management Plan* treated a combination of North Beach to the Pochet Bridge; and Strong, Little Sipson's, Sipson's, Sampson's and Hog Islands as a single area for the purposes of the assessment. The "Guidelines for Permitting Docks and Piers in Pleasant Bay", which is based on the assessment, did not make clear reference to these areas individually. In light of this, the Alliance's coastal processes work group considered whether further impact assessment of these areas was warranted, and whether the guidelines should be amplified or new guidelines should be developed and recommended to the towns to guide the review of permits for structures in these areas. With no further action by the Alliance, these areas would continue to be regulated by the existing conservation regulations and/or zoning bylaws applicable in each town, which reflect the Alliance's guidelines.

The work group concluded that the shoreline areas of the Bay islands and "backside" have a unique character and exemplary habitat value because they provide large, contiguous areas of open space, proximity to tidal flats which serve as feeding areas for migratory birds, relative isolation from Bay's mainland shoreline as well as significant scenic and aesthetic value. As such, these shoreline areas require application of the highest standards of protection.

7.3.7 Recommendation: Regulatory Guidance for Docks on Bay Islands and Backside

7.3.7.1 *Limit structures on Bay islands and Nauset Beach*. The shoreline areas of the Bay islands and backside of Nauset Beach are not suited to placement of new structures due to their unique habitat value. Structures in these areas should only be considered where they are necessary to provide safe and reasonable access, and only when it has been demonstrated that all alternative forms of access are impractical. In such cases where a structure is deemed necessary to provide reasonable access, it should be the minimal size necessary and must meet all applicable performance standards and design criteria as defined in the Alliance dock and pier guidelines and local and state regulations. Multiple structures on a single island or otherwise within 1,000 feet of another

structure are strongly discouraged, and steps to promote sharing of structures among multiple user groups should be a condition of approval.

7.3.8 Resource Management Issue: Categorical Restriction on Docks on Muddy Creek

Currently the Categorical Restriction on Chapter 91 licenses for new private structures remains in effect for Muddy Creek. Muddy Creek is not conducive to boating other than kayaking or canoeing, and there is no visible demand for shoreline structures. Route 28 blocks access to larger Pleasant Bay, and at this time there is no public access for boat launching. Steep slopes on either side of the Creek limit access by nearby private property owners.

The Towns of Chatham and Harwich are seeking to replace the Route 28 culverts with a single span bridge. A study of resource impacts associated with a bridge (Fuss & O'Neill, 2012) documented significant resource restoration and water quality benefits. In addition, the bridge would allow access into Muddy Creek for kayaks and other small non-motorized vessels. Muddy Creek is not conducive to motorized vessels. The Creek is very narrow and shallow, and prop dredging could further diminish water quality by re-suspending sediments and nutrients in the water column. According to the Cape Cod Commission's map of Significant Natural Resource Areas (Resource Management Plan, 2009), Muddy Creek and surrounding land area is within the Priority and Estimated Habitats mapped by the Massachusetts Natural Heritage and Endangered Species Program. Portions of the Muddy Creek watershed are within Identified Wellhead Protection Areas and Potential Public Water Supply Areas. Public opinion expressed during the review of the bridge concept conveyed a desire to retain the character of Muddy Creek as undisturbed habitat to the extent feasible, and this objective is not compatible with the noise and waking associated with motorized vessels. The 2013 resource management plan update recommends that Muddy Creek be added to the list of Areas of Critical Marine Habitat. In Areas of Critical Marine Habitat, the addition of new private docks is prohibited.

7.3.9 Recommendation: Regulatory Guidance for Docks in Muddy Creek

7.3.9.1 *Continue the Categorical Restriction on licensing of new private docks and piers in Muddy Creek.* It is recommended that the Categorical Restriction on new Chapter 91 licenses for private docks and piers in Muddy Creek continue to remain in effect. Muddy Creek is a resource sensitive area based on several of the criteria used to evaluate the appropriateness of shoreline areas for new docks. Features of Muddy Creek include: shallow water depth, presence of extensive fringing salt marsh, and physical features such as narrowness of the water body.

7.4 Resource Management Issue: Other Coastal Structures

Local Conservation Commissions are seeing an increased number of applications for other types of coastal structures, such as outhauls, anchored floats, boat ramps, boathouses, decks and racks. Many of these structures are subject to the Categorical Restriction on new Chapter 91 licenses until such time as local regulations are brought into compliance with an approved resource management plan. These types of structures are not addressed in any of the guidelines previously developed by the Alliance and adopted by the towns or the state. The structures themselves, as well as the use of the structures, may have direct or secondary impacts on resources in the area, and may interfere with other waterways users.

7.4.1 Recommendation: Regulating Other Coastal Structures

7.4.4.1 *The Alliance should develop permitting guidelines for ancillary coastal structures not addressed by any existing permitting guidelines.* These types of structures include but are not limited to: outhauls, anchored floats, boat ramps, boathouses, decks and racks. The guidelines should consider direct and secondary impacts from the structures and use of them.

7.5 Management Issue: Study Sea Level Rise and Coastal Processes

Recent studies of Pleasant Bay's tidal dynamics and barrier beach migration patterns underscore that this is a system undergoing constant change, with management implications for water quality, navigation, and overall resource health. Continued monitoring of tidal data, beach migration, and shoreline/marshline change are needed to assist resource managers in anticipating and effectively responding to changes throughout the system that could affect public health and safety, as well as natural resource conditions.

In reviewing potential management responses to the new inlet formation and current dynamics of the barrier beach system, the need for additional information has become more apparent. The Alliance has worked with a number of research partners to study trends and impacts associated with the new breach conditions and other coastal dynamics, and this collaboration should continue.

An emerging issue where more information is needed is the potential for impacts associated with Sea Level Rise (SLR). SLR will continue to be a factor in shoreline change caused by flooding and storm surges as well as coastal erosion. The effects of SLR can be magnified by human actions such as coastal armoring. The Intergovernmental Panel on Climate Change reported in 2007 that SLR could range from 7 to 23 inches by 2100. According to the U.S. Climate Change Science Program, recent reports estimate SLR at as much as 3.28 feet by 2100, due to accelerated ice flow and melting. A recent study by the US Geological Survey found that sea level was rising faster along the Atlantic Coast

of North American than anywhere on the globe. This degree of potential change in sea level, coupled with increased potential for storm surge, would be expected to have significant effects such as loss of coastal habitats and resources, increased coastal erosion, loss of recreational resources such as beaches and marshes, loss of public and private property and structures, salt-water intrusion into wells and septic systems, elevated storm surge levels, and more frequent coastal inundation.[4]

In addition to understanding the extent of possible impacts, it is timely to begin identifying and evaluating possible strategies to address impacts. Some strategies may take years to fully implement, and should be initiated prior to anticipated impacts. One such strategy involves identification of opportunities to acquire property or conservation easements to accommodate inland migration of salt marsh and other forms of coastal wetlands and landforms.

7.6 Recommendations: Study SLR and Coastal Processes

7.6.1 *Participate in developing and implementing a comprehensive approach to monitoring the barrier beach and inlet system.*

The comprehensive monitoring approach should encompasses:
- Sediment transport and erosion/deposition;
- Protection of shoreline resources, properties and public access points;
- Hydrodynamics of the two inlet system;
- Assessment of water quality;
- Barrier beach access;
- Barrier beach habitat and impacts to estuarine habitat from change in the barrier beach configuration; and
- Navigation.

7.6.2 *Assess the full effects of SLR in Pleasant Bay and Chatham Harbor, and Evaluate Management Strategies.* A detailed assessment of the potential effects of SLR is needed. The assessment should consider the range of SLR predictions. As part of the assessment or as a subsequent phase or study, an evaluation of the appropriateness and effectiveness of strategies for preparing for the effects of SLR is needed. This type of analysis would provide important information to assist local and regional resource managers. Possible strategies for further evaluation include, but should not be limited to:

- Acquiring coastal property to protect access, reduce property and infrastructure damage and allow inland migration of coastal resources;
- Relocating vulnerable infrastructure;
- Removing unnecessary, dangerous or damaging coastal armoring;

[4] Theiler, Rob. *Planning for Sea Level Rise and Shoreline Change at the Local Level.* U.S. Geological Survey. April 2009.

- Developing improved regulations to protect coastal systems and beaches;
- Encouraging landowners to obtain conservation easements for unarmored bluffs that provide sediment to down drift beaches.[5]

7.6.3 *Continue Support for Tide Gage Monitoring.* In 2007 the Alliance began working with Dr. Graham Giese to expand the collection, analysis and reporting of tide gage data in Pleasant Bay. Currently tide gages are deployed at the Fish Pier (by NOAA) and Meetinghouse Pond (by Cape Cod National Seashore.) This collaboration in support of tide data monitoring and analysis should continue. Additional tide gage monitoring locations should be considered if indicated by the data analysis. The Alliance will work with other research partners to support the continuation of the NOAA tide gage at the Chatham Fish Pier.

7.6.4 *Continue to Monitor Shoreline and Marshline Change.* Shoreline change maps generated by Massachusetts Coastal Zone Management did not include information on erosion rates for the shoreline of Pleasant Bay. Information on historic erosion rates is necessary for evaluating coastal wetland resources in terms of their value for storm protection, and sediment supply. A primary reason for monitoring erosion rates is to determine or document the need for a shoreline structure.

The Alliance sponsored a study of shoreline change based on maps and aerial photography from 1868 to 2005. The study found that, although there was little change in the shoreline of Pleasant Bay measured from the High Water Line over the 137 year period, there were areas of both marsh growth and depletion during this same time period.

7.6.5 *Continue to Build an Archive of Aerial Imager*y**.** As part of the shoreline/marshline change study, aerial photography dating back to 1938 was compiled. The imagery was identified and digitally archived for historical reference. Current and historical aerial photography provide an indispensable resource for monitoring shoreline dynamics, changes in aquatic vegetation and shoaling patterns.

Included in the archive are the aerial images generated from the comprehensive aerial flyovers of Pleasant Bay in 2000, 2005, 2009 and 2011. These flyovers should be continued every five years, or more frequently if circumstances warrant. The high-resolution digital aerial images provide an invaluable tool for resource managers involved with wetland protection, erosion management, and navigation.

[5] Ibid

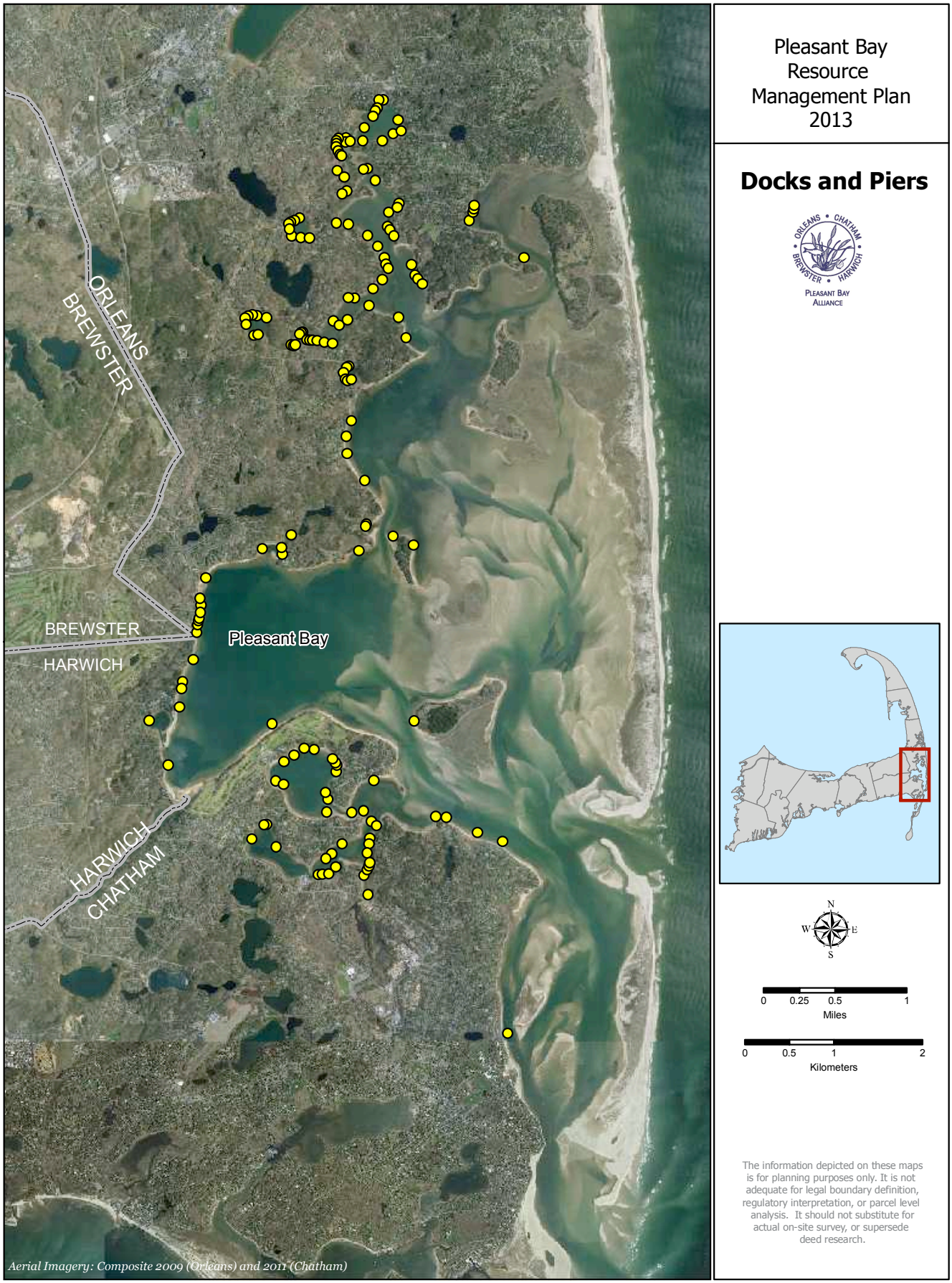


Figure 18 Docks and Piers

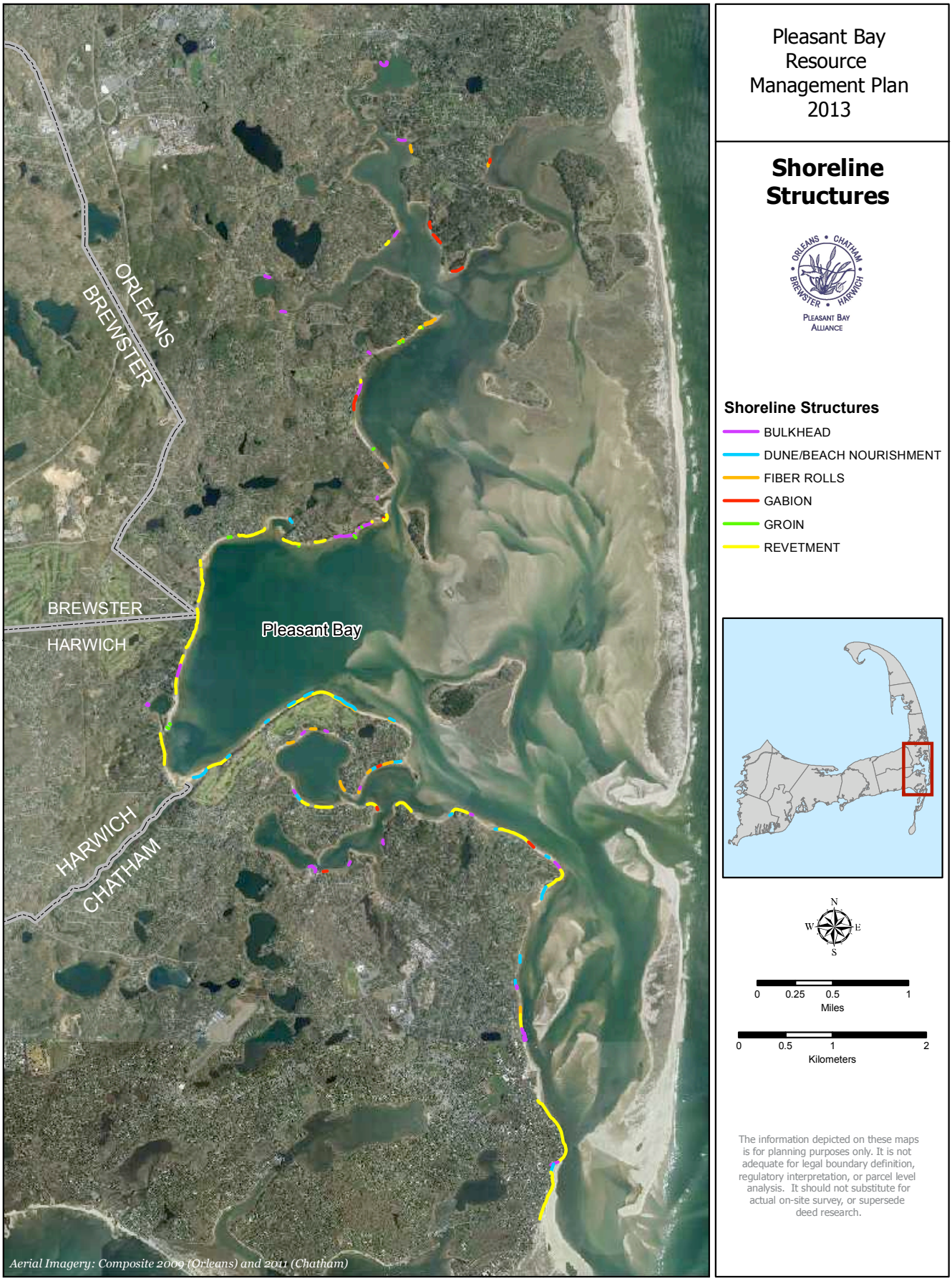


Figure 19 Shoreline Structures

Chapter 8
Waterways Safety and Navigation

8.0 Overview

Recreational and commercial boating continues to be one of the most popular activities in Pleasant Bay. Since 1998 when the first management plan was adopted, local harbormasters have noted an increase in the intensity of boating activity in the Bay. Over this same period, awareness of environmental impacts associated wtih moorings, boating and boat maintenance also has grown. As a result of new awareness, many older two-stroke outboard engines have been relplaced by cleaner four-stroke engines, boat outhaul activities have been relocated away from shoreline areas, and expanded use of conservation moorings has been under study.

Despite these gains, there continue to be a number of management issues associated with boating activity that require ongoing attention:

- Environmental impacts from motorized vessels continue, including hydrocarbon emisssions, prop dredging, increased turbidity, and erosion from waking;
- With a growing number and diversity of vessels on the water, periodic congestion and use conflicts continue to occur;
- There is continued strong demand for moorings which puts stress on town landings;
- Traditional mooring tackle causes bottom scour;
- Recent banner seasons for striped bass have increased congestion at town landings; and
- Dynamic shoaling is some areas has heightened interest in dredging to maintain navigation access.

A key objective of the resource management plan is to balance safe boating activity with natural resource protection. One of the ways this has been accomplished is through the harbormasters' coordinated bay-wide patrol. The coordinated bay-wide patrol was an outgrowth of the 1998 resource management plan, and is still in effect today. Features include:

- Each town increased patrol staff time to the Bay;
- Patrol schedules are coordinated to ensure adequate patrol coverage at all times;
- Patrol staff are cross deputized to facilitate responses regardless of town boundaries; and
- Radio and telecommunications have been improved to facilitate direct communication between the different town patrols in the Bay to report situations and request support.

The Alliance will continue to support coordinated management of the Bay's waterways, and address emerging concerns described below.

8.1 Resource Management Issue: Safety and Navigation

Back in 1998, strong public concern about the environmental and safety impacts of personal watercraft (PWC) prompted the Alliance to work with the towns, the Cape Cod National Seashore and the Massachusetts Environmental Police to adopt and implement a bay-wide ban on PWC operation in Pleasant Bay. Many PWC operators were perceived as viloating the "Rules of the Road," and the elimination of PWC is perceived as having reduced potential conflicts among vessels. However, it is acknowledged that an unseasoned boater can still create a lot of chaos. Too often problems occur because boaters fail to exercise common sense and common courtesy. Lapses in boating safety and etiquette become increasingly dangerous as boating activity increases. Harbormasters and other boaters have noted:

- Boating activity has intensified during the boating season, especially on the weekends. It is believed that there are more boats on the water during these times, and many of these boats are larger and more powerful than a decade ago. This increases the potential for boating conflicts, and heightens potential environmental effects from waking and mooring.
- The boating season has become longer. Whereas the season used to last from Memorial Day to Labor Day, it now extends well into October. This increased boating activity extends the need for harbor patrols.
- Public education is needed to re-enforce the existing regulation that "no wake speed" is required within 150 feet of a mooring field or swimming area or the shore, and that "headway speed" is required within 150 ft to 300 ft of a swimming area.
- There is a noticeable increase in kayaking on the Bay, with added confusion regarding powerboats and sailboats. Kite sailing and tubing are also more prevalent, increasing the potential for conflicts with other vessels.

The following recommendations are provided in response to these concerns.

8.2 Recommendations: Safety and Navigation

8.2.1 *Continue the coordinated bay-wide patrol.* The Towns of Orleans, Chatham and Harwich should continue to coordinate harbor patrols and should fund additional patrol personnel hours if harbormasters find an increase necessary to maintain adequate patrol coverage.

8.2.2 Deploy navigational aids and designate speed controls as needed. Navigational aids and speed controls should be used, as needed, in congested areas or where necessary to protect resources or guard against excessive speeds. Figure 20 shows Existing No Wake Zones in Pleasant Bay. Areas that

have been identified as having the potential need for additional aids or speed controls and should be carefully monitored.

8.2.3 *Evaluate opportunities for potential changes in waterways regulation or policies to promote safe and appropriate use of recreational equipment and activities*:

- Kayaks, canoes, kite-boards, towed tubes, water skis, and swimmers should be prohibited from operating in marked navigational channels unless crossing at a safe location;
- Marker buoys should be placed to delineate swimming public swimming areas; and
- Relocation of lobster pots should be undertaken by appropriate town officials as necessary if pots are located in areas where channels are narrow.

8.2.4 *Evaluate Restrictions on Motorized Vessels.* Muddy Creek is a narrow and shallow water body. The channel leading into Muddy Creek on the Bayside is a winding channel adjacent to a public landing and swimming areas and salt marsh. These features, coupled with its habitat values and lack of land based public access suggest that it is not an appropriate setting for motorized vessel traffic. The Alliance will work with the Harbormasters and Waterways Committees of Harwich and Chatham to evaluate policies or regulations to limit vessel access in Muddy Creek to non-motorized vessels (see recommendation 4.4.3).

8.2.5 Undertake or *support boater education efforts.* Public education efforts targeted to local and transient boaters should be undertaken to reinforce the recommendations of the resource management plan. The efforts should encompass informational brochures, signs at public landings, seminars, media, advertising, and public forums, and should address:

- Waterways regulations, and penalties for non-compliance;
- Environmental benefits of newer two- and four-stroke engines in terms of fuel efficiency and lower emissions;
- Operating and maintenance procedures designed to reduce impacts on natural resources;
- Unregulated boating protocols;
- Procedures concerning aquaculture grant areas;
- Appropriate use of town landings; and
- Resource sensitive areas.

8.3 Resource Management Issue: Town Landings and Other Access Points

Because so little of Pleasant Bay's shoreline is publicly owned, the number and variety of public access points are vitally important. Recent trends suggest that demand for access to the shoreline for boating, beach activities, shoreline walking, and other uses is on the rise. As demand for access continues to grow, additional stresses will be placed on the limited number of

existing access points. This trend has heightened concerns about whether existing access points are adequate to accommodate current and future demand while preserving fragile resources.

The seasonal stress on public landings has been heightened in the last few years by the robust striped bass fishery. Town landings at Ryder's Cove, Round Cove and at River Road experienced serious overcrowding. In response, Harwich and Chatham have taken measures to manage overcrowding. In 2011, Chatham adopted new regulations to limit ramp access during the heavy boating season. The system, which is in effect from July 6th through September 30th, issues a maximum of 40 ramp permits per day for visitors, with no limit on access for vehicles displaying a Chatham resident sticker, commercial boat haulers, marine contractors or government agencies. The system has helped to moderate overcrowding and damage to Ryder's Cove landing, but also had the effect of diverting demand for ramp access to Round Cove and River Road landings, respectively. In 2012 Harwich adopted a year round regulation that limits ramp use to vehicles with a resident sticker or anyone with a current mooring permit. There is no plan to limit access at River Road landing in Orleans. However, a public safety bylaw prohibits parking on streets near the landing, and calls for towing of viloating cars, trucks and boat trailers. Fines may increase if needed to deter illegal parking.

Most public access points on the Bay do not provide facilities or services for public support such as public transportation, restrooms, or outdoor furniture. Signs and historic markers pointing out the Bay's maritime history, or examples of natural phenomena such as barrier beach evolution, and biology, are extremely limited.

There are thirty open public access points located along the Bay, of which twenty-six are town landings (See Table 8, Chapter 9.) Of these, nine have boat ramps, and an additional four are suitable for small boat launching. The observed increase in boating activity in the Bay is coupled with more intensive use of boat ramps. When the Resource Management Plan was developed in 1998, River Road, Ryder's Cove and Round Cove were the most heavily used boat ramps. While that is still true today, use of other boat ramps and launch areas on the Bay has intensified, notably at Quanset Pond, Meetinghouse Pond, and Paw Wah Pond. One result of heavy use at town landings is an increased number of dinghies left on shore. The storage and dragging of the dinghies can cause damage to shoreline vegetation. Some dinghies are left abandoned, where they can cause a blight or saftey issue. Where most landings are very limited in size, placement of dinghies frequently encroaches on neighboring property.

8.4 Recommendations: Town Landings and other Access Points

8.4.*1 Promote a high level of public maintenance and investment at all town landings and public access points, especially the heavily used boat ramps at River Road, Round Cove and Ryder's Cove*. Town landings and ramps provide critical access to Pleasant Bay waterways and support a wide variety of recreational and commercial activities. Heavy use of landings and ramps may require more frequent investments in maintenance and improvements. Adequate signage should be provided to mark the limit of the landings and other relevant regulations and policies.

8.4.2 *Monitor the effects of new landing ramp access regulations.* The effect of access restrictions should be monitored over several seasons to ensure they are effective in addressing periodic overcrowding at Ryder's Cove and Round Cove and do not lead to unintended consequences. Monitoring efforts should encompass changes in usage at other Pleasant Bay landings and access points. As necessary, work with the Harbormasters and waterways committees to develop and recommend modifications.

8.4.3 *Promote steps to reduce impacts of dinghy storage at town landings. The following measures are recommended to minimize impacts from dinghy storage*:

- Towns are encouraged to provide one or more courtesy dinghies at town landings where there are mooring fields with heavy access demands, to cut down on the need for storage at the landing.
- Towns should establish policies or regulations concerning dinghy storage to require: all dinghies have their owner's phone numbers posted on them; and all dinghies be removed by November 15th.
- In locations where dinghies are causing excessive erosion, damage to vegetation or encroachment on private property, other efforts to limit dinghy storage should be considered. Towns should encourage boaters to bring dinghies back and forth rather than leaving them at the landing or, alternatively, issuing permits for dinghy storage. Brewster is finding positive results with dinghy racks that can be used with a $25 annual permit, and Orleans issues a permit for boats greater than nine feet in length.

8.4.4 *Monitor commercial activity occurring at town landings.* Unless special permission is granted, commercial activity at town landings is limited to transactions for the sale of shellfish or finfish. However, there is increasing interest in using landings for kayak or seal tours, small tackle fishing or other commercial tours or launches. While these activities are not currently observed as causing undue pressure, they should be monitored and, if warranted, steps to manage or regulate such activities should be considered.One approach to the regulation of commercial activities at landings is Chatham's Policy for Town Landings and Water Dependent Properties. The policy establishes a special permit process to manage private activities at town landings.

8.5 Resource Management Issue: Dredging and Material Disposal

From time to time, dredging of navigation channels is proposed or undertaken to preserve channel depths for continuous navigation access at all or nearly all tide levels. Due to the potential for ecological impacts, dredging and material disposal are highly regulated activities. State regulations differentiate between maintenance dredging, which is dredging of an area for which permits previously had been issued, and improvement dredging, which is dredging of an area for which permits previously were not issued and may not have been sought after.

Maintenance dredging is allowed within ACECs. The plan recommends that maintenance dredging be allowed to continue provided that all local, state, regional and federal permitting requirements are met, and the dredging project is consistent with the plan. Figure 21 shows locations of maintenance dredging and material disposal in Pleasant Bay. Since the plan was adopted in 1998, maintenance dredging within the ACEC has occurred only at the Round Cove entrance channel and Ryder's cove bulkhead. Dredged material from Round Cove was used to re-nourish the Bay Road Beach and Round Cove Barrier Beach in Harwich. Within the Pleasant Bay study area since 1998 dredging has occurred in Chatham Harbor to allow access to Aunt Lydia's Cove. Some dredged material from those projects has been used for beach and shoreline stabilization within the ACEC.

Under state law, improvement dredging is prohibited in an ACEC. The 2008 plan charged the Alliance with conducting a "study of the potential need for, impacts from, and feasibility of improvement dredging in areas where shoaling is limiting access in areas that traditionally have served as important public navigable waterways." The Alliance undertook more than two years of study of these issues, and released a report entitled *Assessment of Need, Impacts and Regulatory Feasibility Associated with Limited Improvement Dredging in the ACEC* . The assessment focused on the vicinity of the 2007 inlet, where dynamic shoaling could potentially impede traditional navigation in the future. Because no part of that area had previously been permitted for dredging, future dredging would have been considered improvement dredging and therefore prohibited under state law. As a result of the report, and extensive dicsussions with state officials, the Alliance proposed an amendment to the Resource Management Plan to make it possible for the Town of Chatham to seek permits for improvement dredging under the designated circumstances. The amendment was adopted by Town Meetings in all four Alliance Towns in 2012, and is inserted below as recommendation 8.6.3.

The state's Waterways (Chapter 91) Regulations prohibit the disposal of dredged materials within an ACEC, except for the purposes of beach

nourishment; or stabilization with proper vegetative cover; or the enhancement of fishery or wildlife resources. (310 CMR 9.40 (1)(b)). Any proposals to dispose of materials from dredging projects within the study area should be required to demonstrate consistency with the Resource Management Plan, and to meet all local, state and federal environmental permitting requirements.

Currently, material from dredging is disposed of within the town undertaking the dredging. Greater system-wide benefits could be achieved by locating the material where it could provide the maximum benefit for beach nourishment; or stabilization with proper vegetative cover; or the enhancement of fishery or wildlife resources, regardless of town boundary.

8.6 Recommendations: Dredging and Material Disposal

8.6.1 *Continue maintenance dredging as needed*. Maintenance dredging should be allowed to continue provided it meets all applicable permitting requirements and is consistent with the resource management plan and updates.

8.6.2 Continue to *evaluate need for and implications of dredging.* The Alliance will continue study of the potential need for, impacts from, and feasibility of improvement and/or maintenance dredging in areas where shoaling is limiting access in areas that traditionally have served as important public navigable waterways.

Note: The following recommendation 8.6.3 is inserted as voted at 2012 Annual Town Meetings. Renumbering of figures and tables is provided for consisitency with the 21013 Plan Update.

8.6.3 *Limited Improvement Dredging to Maintain or Restore Historical Navigable Access.* Under the following conditions within the area identified in Figure 4 [herein Figure 22] as the Zone of Potential Future Dredging in the Pleasant Bay ACEC, the resource management plan indicates that a municipality may seek local, regional and state authorization to undertake improvement dredging:

> 1. The proposed dredging is intended to maintain or restore historical navigable access for the public and is of the minimum scale necessary to maintain that access. Historical navigable access refers to the location of navigation channels and water depth at mean low water necessary to accommodate vessel drafts characteristic of the majority of vessels traditionally moored in Pleasant Bay and its subembayments. For contextual reference, historical channel depths are provided in Table 1 [herein Table 6], and the sizes of moored vessel are provided in Table 2 [herein Table 7]. Figures A, B and C show channel width at a depth of four feet or greater.

2. Shoaling and changes in tidal regime have altered traditional channels such that historical navigable access between Pleasant Bay and Chatham Harbor, between either water body and the Atlantic Ocean, or through the entrance to Bassing Harbor, is severely impeded. Severely impeded access would, for example, preclude access by the commercial fleet for safe haven of vessels, or preclude safe and reasonable access by recreational boaters.

3. Through the permitting process, the municipality has undertaken an evaluation of alternatives to improvement dredging which demonstrates that the proposed improvement dredging is the preferred feasible alternative to restore historical navigable access with regard to avoiding and minimizing impacts to natural resources.

4. A feasible plan is proposed to place the dredged material within the Pleasant Bay system in a manner that is beneficial to resources protected under local and state wetlands protection regulations.

5. Through the permitting process the municipality has undertaken an evaluation of resource impacts resulting from proposed improvement dredging and placement of dredged material, and is able to demonstrate avoidance and minimization of resource impacts and adequate mitigation for any unavoidable impacts. Resource impacts of concern include those affecting shellfish populations and habitat, finfish populations and habitat and other resources and values protected under state and local wetlands protection regulations.

The proposed project would be subject to all applicable local, regional and state regulations. During regulatory proceedings the Alliance would provide public comments based an assessment of information and materials provided with regard to items 1 through 5 above and to further describe the proposed improvement dredging project.

Recommendation 8.6.3 is not a recommendation or proposal for dredging, but an acknowledgement that under dynamic conditions, the Town of Chatham may need to dredge some portion of the designated area in the future in order to maintain traditional access. Such a proposal would still undergo extensive local, state and even county permitting reviews. The recommendation removes a hurdle that allows the Town to seek permits for improvement dredging if needed within the designated portion of the ACEC, pending all customary environmental reviews associated with the permitting process.

Table 6. Limiting Depths

Channel Location	1955-6 Limiting Depth at MLW	Depth of Maintenance Dredge as Permitted (Year)	2008 Approx. Limiting Depth (MLW)
Bassing Harbor	3’	NA	3’
Ryders Cove	5’	NA	not surveyed
Crows Pond	1’	NA	3’
Round Cove	1’	unknown	4’
Quanset Pond	1’	3’ (1959*)	1.5’
The Narrows (cove)	1’	unknown	not surveyed
The Narrows (channel)	3’	6’ (1959 & 1975*)	4.5’
Paw Wah Pond	.5’	3’ (1959*)	1’
Areys Pond	1’	3’ (1959*)	1.5’
KescayoGansett Pond	1’	3’ (1959*)	1’
Meetinghouse Pond	3’	unknown	6’
East & West of Strong Island/Minister’s Pt to Pleasant Bay, Chatham	4’	NA	4.5’

*Depth as shown on plan. Actual depths, if different from plan, are not recorded. Sources: 1955-6 data from National Oceanic and Atmospheric Administration/National Ocean Service; 2008 data from *Pleasant Bay Hydrographic Surveys* (Coastal Engineering Company).

Table 7. Moored Vessels in Pleasant Bay by Size, 2007

Boat Size in Feet	<16	16-25	>25-40	>40	Total Moorings (% Increase since 1996)
Orleans	234	549	37	0	820 (29%)
Chatham	184	604	52	0	840 (36%)
Harwich	29	123	7	1	160 (20%)
Bay Total (% Total Moorings)	447 (25%)	1,276 (70%)	96 (5%)	1 (0%)	1,820

Source: Harbormasters of Orleans, Chatham, Harwich, 2007

8.7 Management Issue: Pleasant Bay No Discharge Area

Designation of Pleasant Bay as a No Discharge Area was a recommendation of the 1998 resource management plan and subsequent updates. In 2010, the Pleasant Bay Alliance applied to US EPA and Massachusetts Coastal Zone Management (MCZM) to designate Pleasant Bay as a No Discharge Area. The Alliance submitted the application after gathering support from Boards of Selectmen and waterways committees in the four towns. The designation, which was put into effect in July 2010, makes it illegal to discharge treated or untreated boat sewage in Pleasant Bay. Pump out facilities are available to the boating public free of charge at Ryder's Cove, Round Cove and Meetinghouse Pond. To ensure public awareness of the designation, the Alliance co-sponsored publication of a boaters guide, which was mailed to all mooring permit holders and was widely distributed through marine businesses and harbormasters offices.

8.8 Recommendations: Pleasant Bay No Discharge Area

8.8.1 *Provide on-going public education*. Continue to work with harbormasters, waterways committees and local organiztions to produce and diseminate public education about the No Discharge Area, its purpose and its requirements.

8.8.2 *Monitor pump-out capacity*. Continue to work with harbormasters, waterways committees and local marinas and boat yards to monitor pump-out activity and evaluate if existing pump-out facilities have adequate capacity to meet current and anticipated needs. If additional capacity is needed, the Allance will work with all parties to design an adequate facilities solution and, as needed, seek grant funding for its purchase, installation and maintenance.

8.9 Resource Management Issue: Environmental Impacts from Boating

The 1998 plan and 2003 update cite numerous direct and secondary environmental impacts from boating, and motorized vessels in particular. These impacts include bank erosion, turbidity, loss of vegetation, and affects on water quality from hydrocarbon emissions and marine sanitary waste. The documents also point out that dredging to create or maintain navigational channels can destroy shellfish and vegetation, and that traditional moorings and tackle can scour bottom vegetation.

As noted above, there has been an observed increase in the intensity of boating activity in the Bay. All other things being equal, the negative environmental impacts of boating would be expected to increase as the number and size of vessels increases. However, some trends may help to offset the negative effects of that increase. It is widely held that a number of older more

heavily polluting two-stroke engines are being phased out and replaced with newer and cleaner two- and four-stroke engines, which are quieter and more fuel-efficient. Also, there is growing interest in exploring alternative mooring technologies that minimize or eliminate bottom scouring. While these emerging trends are promising, it is unlikely that the negative environmental impacts of boating can be eliminated. Over the coming years the Alliance will work with the harbormasters and related boating groups to promote the following measures aimed at managing and further reducing the environmental impacts of boating.

8.10 Recommendations: Environmental Impacts from Boating

8.10.1 *Develop and distribute a pamphlet on best management practices for boat maintenance geared to individual boat owners*. Desirable practices include:

- Only products scientifically proven to be environmentally benign, should be used for hull painting;
- A drop cloth, vacuum sander or other form of recovery system should be in place for hull scraping, and all dust and scraps generated should be disposed of in accordance with all applicable laws;
- Only biodegradable, non-toxic boat cleaners should be used. To avoid spills, use of any chemical products should be restricted while a vessel is on the water;
- Boat chemicals, and cleaning materials should be disposed of in accordance with all applicable laws;
- Steam cleaning methods should be used to clean outboard motors, and use of toxic chemical cleaners should be avoided;
- Premium oil should be used in outboards. All used motor oil from oil changes should be disposed of in accordance with all applicable laws;
- Propylene glycol mixtures should be used for anti-freeze rather than ethylene glycol mixtures. All used anti-freeze from changes should be disposed of in accordance with all applicable laws;
- A funnel should be used when filling an outboard motor with gas or oil;
- A bilge “pillow” should be used to absorb oil from bilge water before it is pumped overboard.

8.10.2 *Continue to promote adherence to the MCZM Marina Best Management Practices, including relocation of certain activities to inland areas where they can be contained*. Continue to support on-going efforts by private boat yards as they adopt measures to lessen impacts of outhaul and maintenance activities. Measures may include use of new technologies or relocating activities away from the shorefront.

8.10.3 *Address the need for environmentally safe haul out facilities for commercial vessels*. The need for additional haul out facilities for commercial vessels has been identified. Chatham and Harwich recently obtained grant funding for a shared self-contained power washing system for use by commercial

vessels. Other potential options for meeting this need should be developed and evaluated.

8.10.4 *Support or sponsor further research to characterize and quantify the impacts of boating on water quality, habitats, and other aspects of the marine environment in Pleasant Bay.* This research should assess:

- Extent of loss of vegetation;
- Extent of bank erosion;
- Loss of habitat due to noise or loss of vegetation;
- Impacts of chemical leaching from anti-fouling paints, and from treated lumber used for shoreline structures; and
- Impacts from moorings on bottom vegetation and shellfish.

The research would be available to the towns to use as a basis for reformulating guidelines or regulations to minimize any negative impacts of boating on the natural resources of the Bay.

8.11 Resource Management Issue: Mooring Management

Since the adoption of the Plan Harbormasters in the Alliance towns have maintained an upper limit on the number of mooring permits at all existing town mooring fields in Pleasant Bay. However, Table 8 shows there has been an increase in recorded permits in some areas. The increase is due in part to enhanced record keeping capabilities within the towns, as well as fuller utilization of moorings by boat yards and, to a lesser extent, an increase in mooring permits to waterfront homeowners (Orleans' policy only.) Table 7 shows that the vast majority of boats moored in the Bay are between 16 and 25 feet, with only 5% greater than 25 feet. Figure 23 shows Existing Mooring Areas in the Bay. A mooring free area continues to be in effect within Big Pleasant Bay, as outlined in the 1998 plan.

Table 8. Moorings in Pleasant Bay, 1996, 2001, 2007

Town	1996	2001	2007
Orleans	634	740	820
Chatham	616	960*	840
Harwich	133	165	160
Total	1,383	1,865	1,820

*Additional 78 permits are issued with no current boat
Source: Harbormasters of Orleans, Chatham, Harwich

Use of alternate mooring technologies such as helical screws that have the potential to reduce scouring are used on a very limited basis in the Bay. This is primarily because of the increased costs associated with this type of mooring technology. A recent study of alternative technologies (Urban Harbors Institute, draft 2012), referred to as conservation moorings, demonstrates that the

alternative technologies are as secure as traditional mooring systems, and result in significantly less bottom scour. Harbormasters have experimented with conservation moorings on a limited basis in Pleasant Bay. More widespread future use of conservation moorings is being evaluated.

8.12 Recommendations: Mooring Management

8.12.1 *Maintain mooring intensity at public mooring fields at current levels.* Harbormasters are urged to continue to limit the number of mooring permits at current levels in order to prevent overcrowding of the waterways and at town landings, and to minimize other boating impacts on resources.

8.12.2 *Promote selected use of alternative mooring technologies*. Use of alternative mooring technologies that limit scouring are encouraged, but not as a means of increasing mooring capacity in the Bay. The Alliance encourages local Harbormasters to explore the potential of one or more demonstration projects to test the long-term benefits of alternative technologies or mooring techniques.

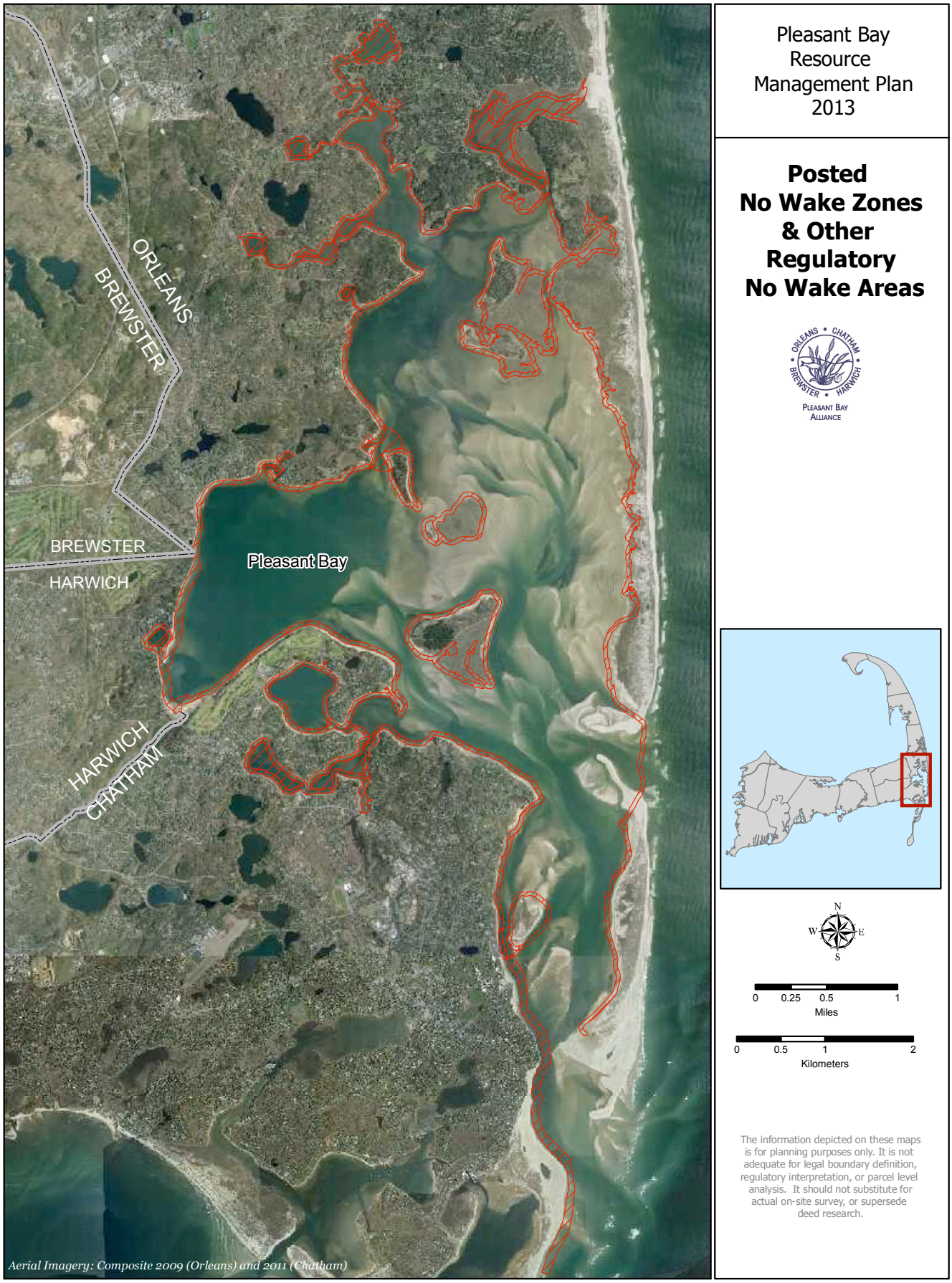


Figure 20 Posted No Wake Zones and Other Regulatory No Wake Areas

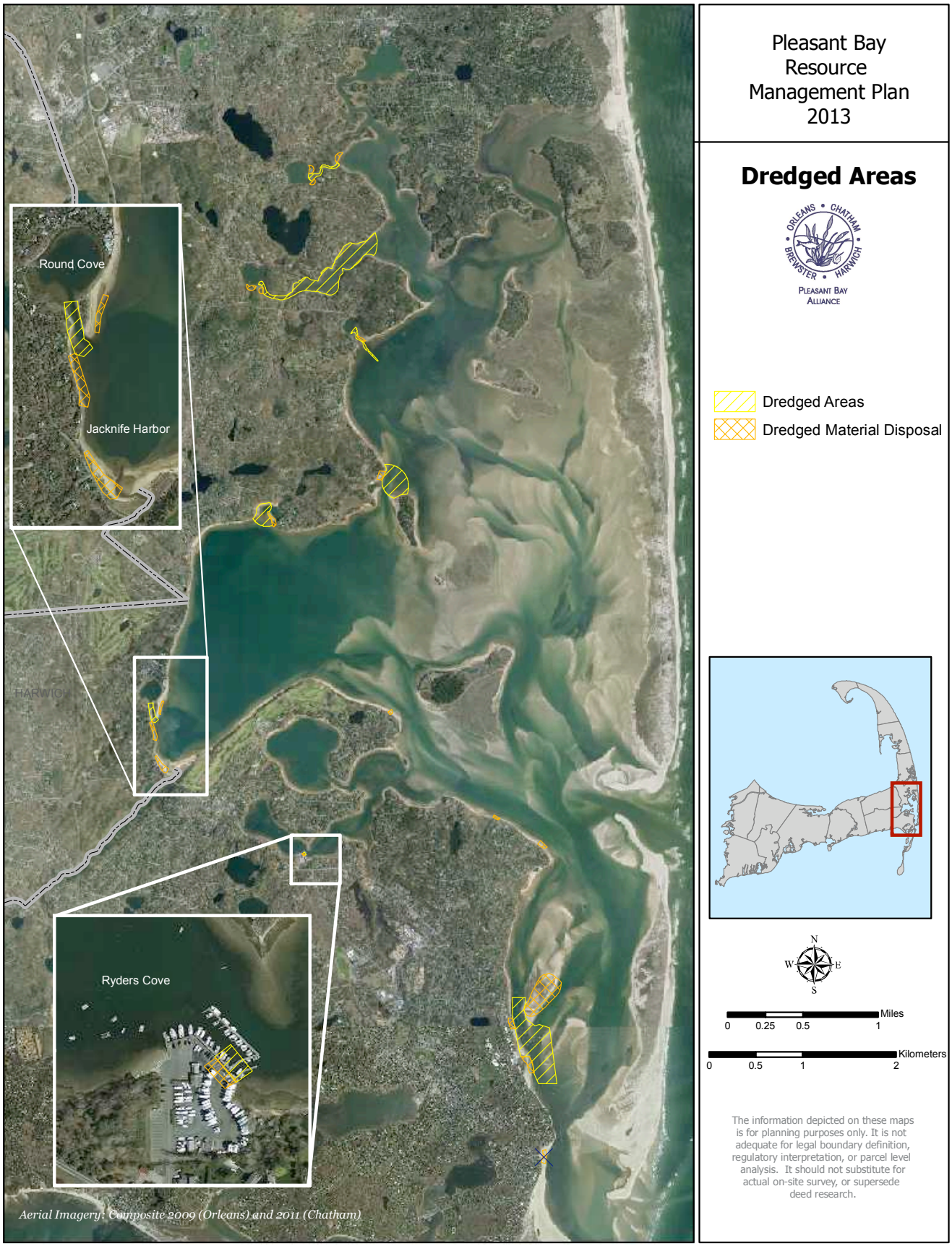


Figure 21 Dredged Areas

Zone of Potential Future Dredging

Figure 4

ZONE OF POTENTIAL FUTURE DREDGING

HISTORICAL MARKED NAVIGATION CHANNELS (NO DREDGE PERMIT EXISTS)

AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC)

Data Sources:
Dredge Permit Areas: Pleasant Bay Coastal Processes Workgroup
ACEC: MassGIS
Aerial Photo Composite: 2005 and 2010
Location of permitted dredging channels are approximate and are shown for general reference purposes only.

Figure 22 Zone of Potential Future Dredging

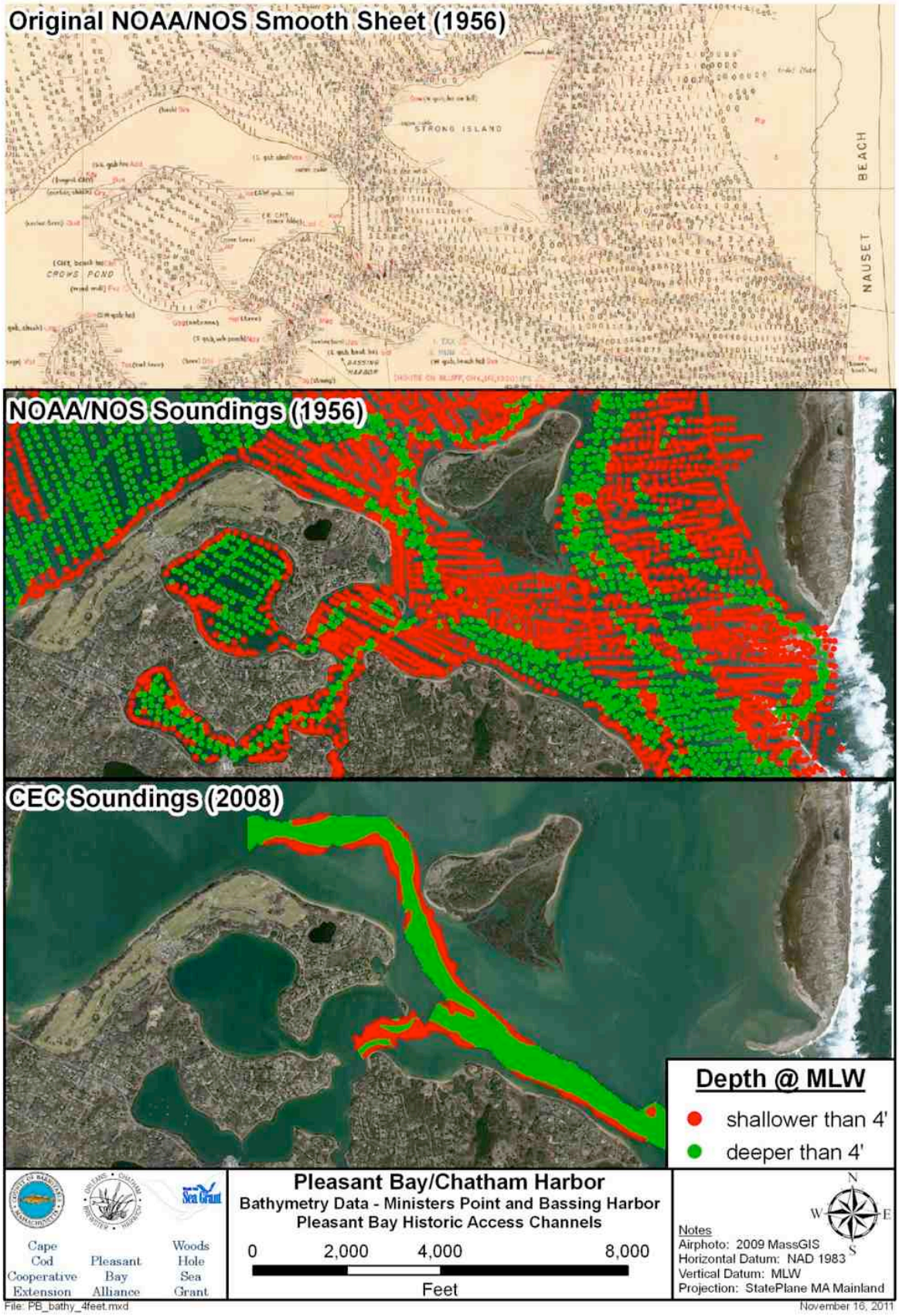


Figure A. Bathymetric Data – Ministers Point and Bassing Harbor

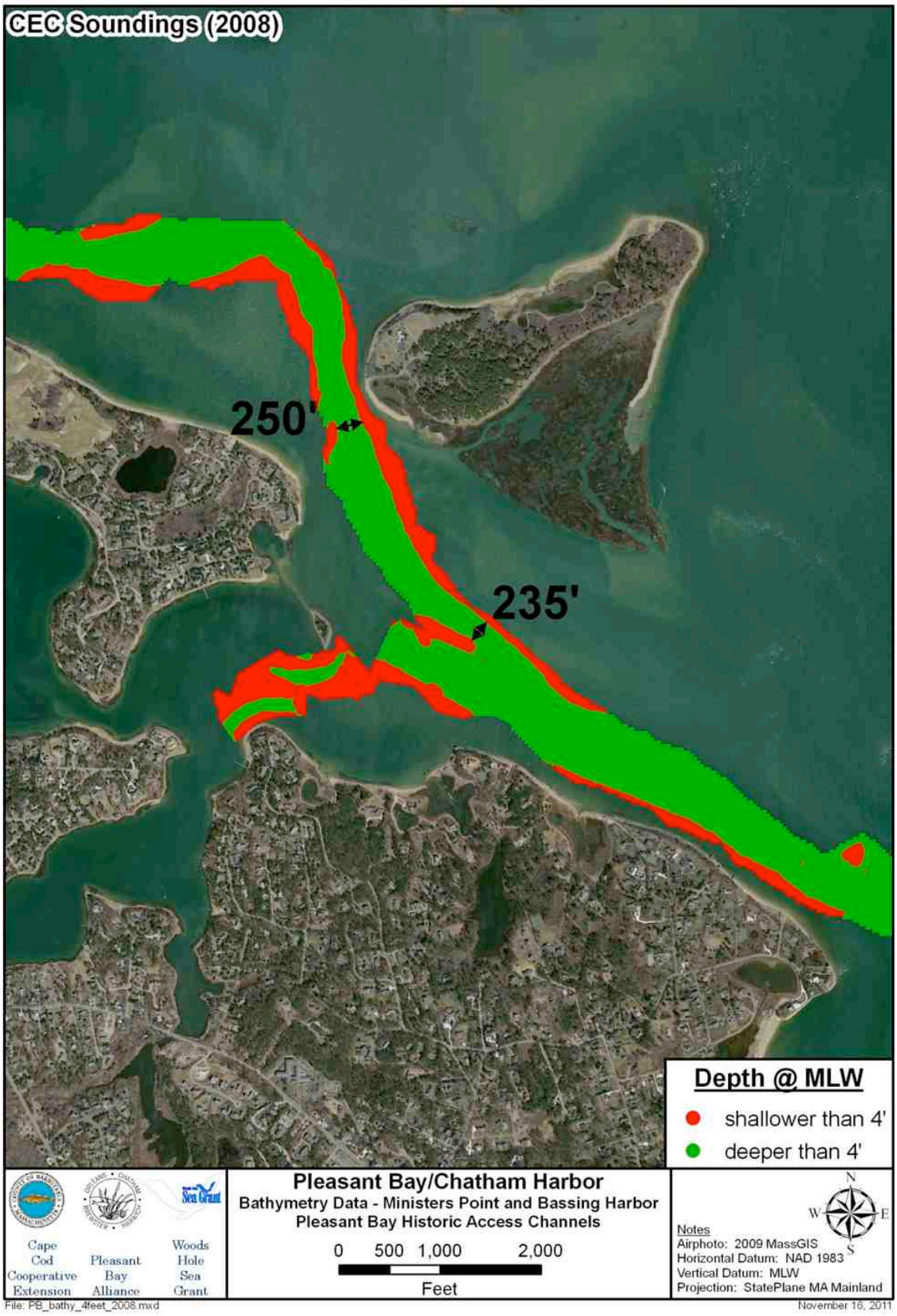


Figure B. Bathymetric Data – Ministers Point and Bassing Harbor

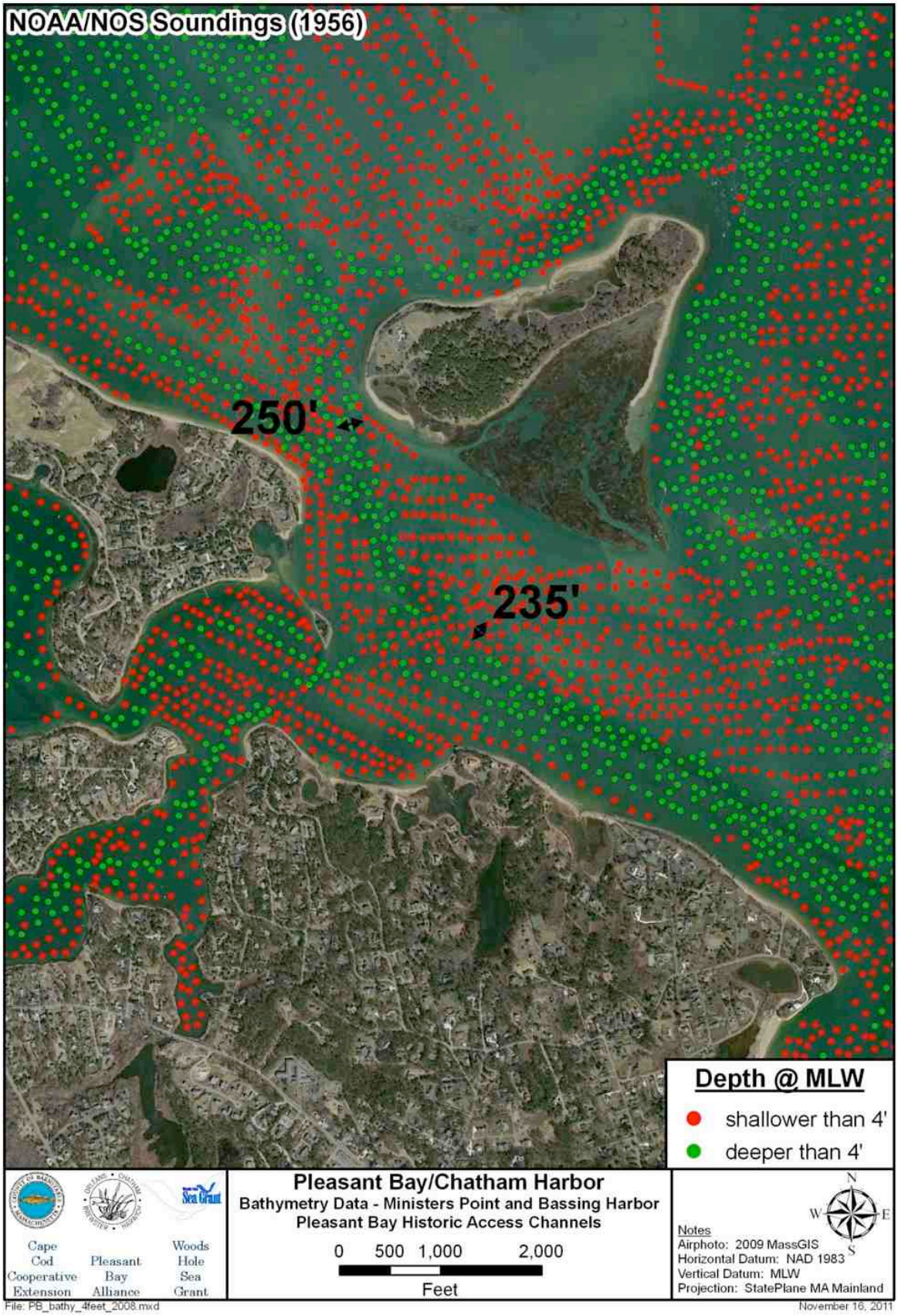


Figure C. Bathymetric Data – Ministers Point and Bassing Harbor

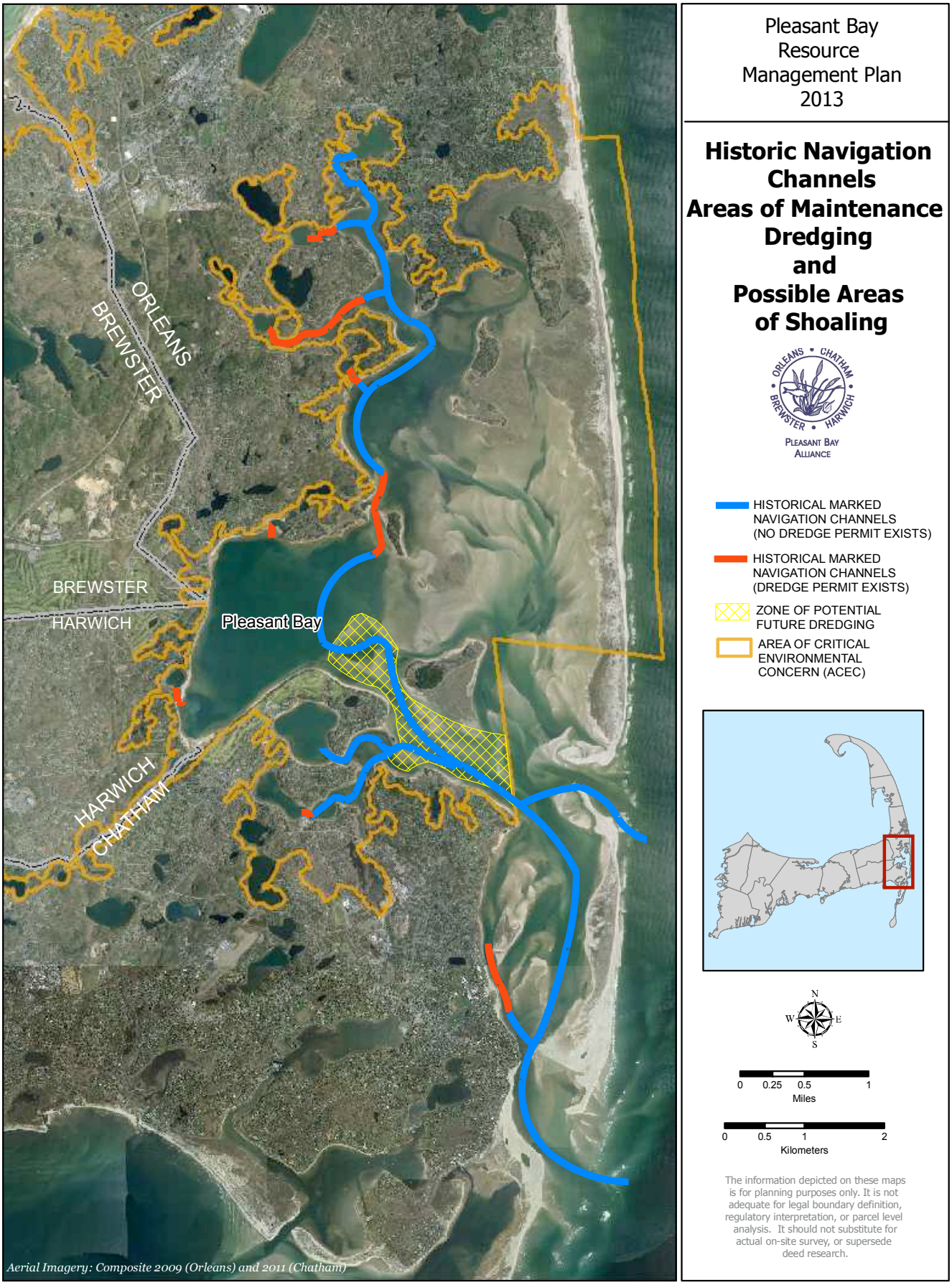


Figure 23 Historic Navigation Channels Areas of Maintenance and Possible Areas of Shoaling

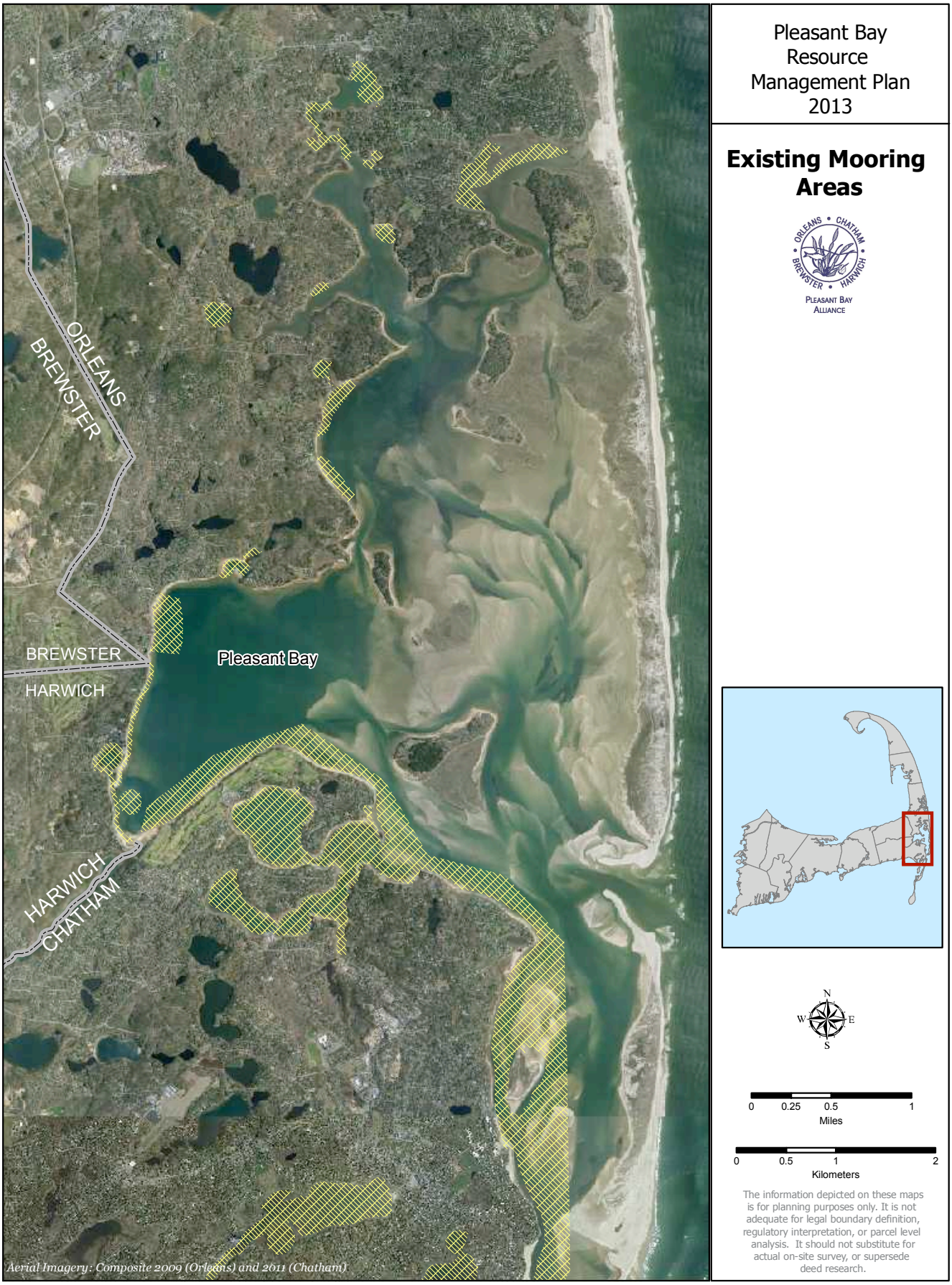


Figure 24 Existing Mooring Fields

Chapter 9:
Public Access and Historic Resources

9.0 Overview

Perhaps the single most obvious and widely cherished characteristic of Pleasant Bay is its beauty. To say that Pleasant Bay has a unique sense of place tells only part of the story. Each embayment, river, pond, marsh, beach and island of Pleasant Bay has a distinct character and natural beauty.

The abundant resources and scenic attractiveness of Pleasant Bay are important economic and environmental assets to the surrounding towns. People use and enjoy the Bay in many diverse ways, including boating, fishing, shellfishing, bird watching, swimming, and simply enjoying the view. The fact that many of these activities build a sense of appreciation and stewardship of the Bay is evidenced by the fact that many volunteers who collect water quality samples are avid boaters, fishermen, or birders who want to do what they can to protect and preserve the beauty and uniqueness of Pleasant Bay.

All of this suggests that managing the Bay's resources should encompass strategies to ensure that the many ways people enjoy the Bay are preserved in harmony with resource protection. It is easy to imagine the impacts of loving a place too much, but continued access to and enjoyment of the Bay is critical to support public stewardship and proactive, coordinated management of its resources.

The analysis and recommendations found in the 1998 plan and subsequent updates sought to promote:

- Reasonable public access to and along the shore;
- Protection of the sights and sounds of the Bay; and
- Appreciation for the Bay's historic and archaeological resources.

These three themes are carried forward in the workplan of the Alliance in the coming five years.

9.1 Management Issue: Public Access to and Along the Shore

Given the predominantly residential nature of surrounding land uses, the Pleasant Bay shoreline is largely privately owned. Public access to shore and water is concentrated at the 30 town-owned landings, beaches and conservation areas along the shoreline (see Table 9 and Figure 25). As noted in Chapter 8, use of public landings is on the rise, particularly for those landings that offer access for transient boaters. Landings are typically small, narrow properties with limited parking. There are three public access points that also serve as bathing beaches. Each of these three areas have limited parking and no facilities or on

duty lifeguard. One of these, Route 28 in Orleans, is a town landing. Jackknife was a landing and is now considered a rural beach, although it does support dry sailing and a mooring field.

Table 9. Town Landings and Other Public Access Points

Number/Town	Name	Parking	Ramp	Launch	Beach^
1-Orleans	Meetinghouse Pond	30	Yes	Yes	Yes
2-Orleans	River Road	25	Yes	Yes	No
3-Orleans	Kent's Point*	10	No	No	No
4-Orleans	Kescayogansett Pond	8	Yes	Yes	No
5-Orleans	Kescayogansett Pond	3	No	No	No
6-Orleans	Pochet-Sparrowhawk	8	No	Yes	No
7-Orleans	Pochet-Gilman	3	No	No	No
8-Orleans	Pochet-Barley Neck	8	No	No	No
9-Orleans	Arey's Pond	2	No	No	No
10-Orleans	Namequoit Road	4	No	No	No
11-Orleans	Portanimicut	18	Yes	Yes	Yes
12-Orleans	Quanset Pond	12	Yes	Yes	No
13-Orleans	Route 28	30	Yes	Yes	Yes
14-Orleans	Briar Springs Road	0	No	No	No
15-Harwich	Bay Road Beach*	12	No	No	Yes
16-Harwich	Round Cove	15	Yes	Yes	No
17-Chatham	Jackknife Harbor	20	No	Yes	Yes
18-Chatham	Crows Pond	10	Yes	Yes	No
19-Chatham	Ryder's Cove	20	Yes	Yes	No
20-Chatham	Strong Island	20	No	No	Yes
21-Chatham	Cotchpinicut	4	No	Yes	Yes
22-Chatham	Scatteree	10	No	No	Yes
23-Chatham	Andrew Hardings Lane	Closed	No	No	Yes
24-Chatham	Cow Yard	4	No	Yes	No
25-Chatham	Holway Street	Closed	No	No	No
26-Chatham	Claflin landing	Closed	No	No	Yes
27-Chatham	Water Street	Closed	No	No	No
28-Chatham	Fish Pier*	53	No	No	No
29-Chatham	Lighthouse*	57	No	No	Yes
30-Chatham	Bearses Lane	0	No	No	Yes
31-Chatham	Mistover Lane	Closed	No	No	No

*Alternative public access point; not a town landing
^Connotes small beach area; not a guarded beach

A major impediment to public access to and along the Bay's inner shoreline is the low proportion of publicly-owned shoreline property. This observation, which appeared in the plan, was confirmed by the Alliance's *Shoreline Access Inventory Project*. The project showed that of more than 3,000 acres of parcels located on the shoreline of the Bay, only 13% are owned by the towns. Of the 65.7 total miles of the Bay's shoreline, 10.36 miles, or roughly 16 %, belong to the towns, and only 3.4 miles is accessible by car. An additional 600 linear feet of shoreline became publicly accessible through the terms of a

recently purchased conservation restriction on the 9-acre Eelman's Point property located on the Narrows in South Orleans.

The Alliance's efforts to sustain public access to and along the shoreline focuses on:

- Support for maintenance of existing landings, beach areas and other public access points, including efforts to prevent erosion;
- Support for land purchases and conservation restrictions that limit development and provide or protect access; and
- Efforts to protect public access through provisions in local and state permits for shoreline structures.

Table 10. Shorefront Parcels on Pleasant Bay (By Ownership)

OWNERSHIP	ACRES (%)
Municipal	384.46 (13)
Federal – CCNS	910.33 (30)
Private Conservation Trust	505.90 (17)
Private – Undeveloped	275.53 (9)
Private – Developed	945.55 (31)
TOTAL	3030.77 (100)

Source: Shoreline Access Inventory Project, 1999, Pleasant Bay Alliance

9.2 Recommendations: Protect Public Access to and Along the Shore

9.2.1 *Promote enhanced access to and along the shoreline*:

- Requirements for human lateral passage should be incorporated in permitting guidelines to be developed by the Alliance for new or rebuilt shoreline protection structures, and these should be relied upon by local and state permitting authorities. Local and state permits for such structures should require mitigation for the loss of lateral passage at any stage of the tide and at any future date. These might include, but are not limited to, beach replenishment and the construction of flat walking surfaces in the wall. The discussion of how lateral access will be accommodated should be addressed in the design stage and be presented with plans filed for conservation commission review.
- Instances where the public access provisions of state Waterways Regulations (Chapter 91) are not being enforced should be brought to the attention of the MassDEP, which administers and enforces Chapter 91 regulations.
- Pre-existing erosion control structures, which, due to loss of slope on the fronting beach, now sit on state tidelands (i.e., are wet at high tides) are subject to Chapter 91 regulations. The MassDEP should incorporate special conditions to mitigate loss of shoreline lateral passage in any Chapter 91 licenses issued. These should include, but not be limited to, deed restrictions requiring signage stating that the public has the right to traverse over and to fish from protective shoreline structures, in accordance with the Colonial Ordinance.

9.2.2 *Undertake actions to reduce existing shoreline obstructions, and to prevent future obstructions*:

- Encourage MassDEP and the Massachusetts Attorney General to include "through-walking" in addition to "fishing, fowling (now interpreted to include bird-watching), and navigating" as a permissible activity over the passage provided.
- Initiate discussions with owners of existing structures that impede public passage to encourage voluntary measures to facilitate public passage. Impeded areas identified in the shoreline accessibility survey conducted by the Public Access Work Group provide a starting point for pursuing voluntary improvements.
- Research existing permits for requirements regarding public passage and enforcing such requirements where they are not being met.

9.2.3 *Support efforts to establish additional access points for low impact uses such as scenic viewing, walking, beach activities, and use of small, non-motorized vessels.*

9.2.4 *Develop a comprehensive public information program concerning public access points, support facilities and services, use guidelines, and public access rules and responsibilities*. Elements of the program should include:

- *User Guidelines and Information*. Information on the use and availability of access points would include: a map and list of public access areas; facilities and services provided at each access point such as walking trails, picnic areas, and parking; transportation options; and appropriate uses and activities. Such information should be provided through signs, brochures and displays, and should be distributed through chambers of commerce, retail outlets, public libraries, realtors' offices, and hotels/inns.

- *Interpretative Education Program*. An interpretative educational program would be designed to address the area's Native American history, history of settlement, maritime history, natural development, ecology and natural resources. The educational program should include information on programs and policies which are in place to protect the Bay's resources. Interpretative services from the National Park Service should be requested to participate in the development of public education displays and materials.

- *Public Access Rights and Responsibilities in the Intertidal Zone*. Realtors, chambers of commerce and other outlets would be requested to participate in efforts to communicate the public's rights of passage to prospective shoreline property owners. The public would be advised of property owners' rights, and that littering, unleashed pets, loitering, and other abuses of public access rights would not be tolerated. Information about liability laws would be provided to private property owners and the public.

9.5 Management Issue: Preserving Visual Access and Moderate Noise Levels on the Bay

The scenic qualities of the Bay and the surrounding area, as well as its sense of tranquility, are both important resources that need protection. Maintaining the unique sights and sounds that contribute to the character and natural resources of the Bay is a significant challenge in light of the constant changes in land development, and use of the Bay's shoreline and waterways.

9.5.1 Erosion of Public Views

The ability to glimpse the waters of the Bay from public ways has been incrementally reduced by private development and fencing and the growth of vegetation on both private and public properties. Even the spectacular views along Route 28 are limited to short stretches and in some areas, such as Ryder's Cove, are obscured by overgrown vegetation. The public's ability to see the Bay and enjoy its resources and panorama has been drastically eroded from early years of this century when the vast majority of the land bordering the Bay as well as its shoreline was undeveloped, supported low vegetation, and was freely open for public use. Significant public views are depicted on Figure 26.

The meandering, rural qualities of the portions of Route 28 must also be counted as a scenic asset of the Bay. Improvements to this roadway in the future must be designed carefully to preserve its character as well as the opportunities it provides for public viewing and access to the Bay.

9.5.2 Moderating Noise Levels on the Bay

As with visual access, the tranquility of the Bay is also threatened by encroaching land uses, and increased use of the shoreline and waterways. Noise emanates from motorized vessels operating at high speeds. These noises are a nuisance to shoreline property owners and other Bay users. Over the past few years, there have been an increased number of fireworks displays that result in a short period of intense noise. Short term or persistent intense noise levels from these and other sources can disturb habitat areas, and disrupt the balance of wildlife in the region.

9.6 Recommendations: Preserve Visual Access and Moderate Noise Levels on the Bay

9.6.1 *Protect existing views of the Bay and encourage the opening of new vistas.* The following actions should be undertaken to protect and enhance public views of the Bay:

- Coordinating with the towns' conservation commissions, and public works

departments to develop guidelines for maintaining vegetation on public lands along the shoreline so that invasive species and rampant vegetative growth do not block scenic vistas. Guidelines will need to be compliant with state and local wetlands regulations.

- Identifying incentives to encourage private property owners to manage vegetation so as to allow views from public roadways.

- Coordinating with the towns' planning boards to include in development reviews consideration how developments alter water views from public ways, and to encourage owners and developers to modify site plans to enhance and protect views.

- Coordinating with the state Highway Department to ensure that improvements to Route 28 maintain the road's scenic qualities and to maintain and enhance its public access areas. Future improvements to Route 28 should include provisions to allow parking for overlook-type sight seeing. Use of opaque barriers in scenic areas should be strongly discouraged.

9.6.2 *Explore ways to moderate noise on the Bay.* The following recommended actions are intended to help moderate noise levels on the Bay:

- Permits for all fireworks displays proposed within the study area should be reviewed by the applicable local Conservation Commissions, Natural Resource Departments and Harbormasters to ensure adequate protection is provided for natural resources and habitats.

- Speed controls should be enforced and transition to use of newer and quieter outboard motors encouraged as means of minimizing noise impacts.

- Commercial operations located on the shoreline should adopt noise mitigation measures such as restricting hours of noise generating operations, and installing sound proofing technologies.

9.7 Management Issue: Appreciation for the Bay's Historic and Archaeological Resources

At the Pleasant Bay Symposium in 2006, archaeologist Fred Dunford remarked that many of the management challenges that face us today—managing access to the water, providing ways for people to continue to make a living off the bay, and managing how land is used around the bay—may have changed in some respects but are essentially the same challenges that faced earlier inhabitants. Learning how to live in harmony with the Bay is a challenge of generations.

The 1998 plan contains a description of some of the cultural and historical resources found within the study area. However, it stops short of providing specific measures aimed at protecting those resources. In its review of the plan in 1999, the Massachusetts Historical Commission noted that while many of the plan's recommendations to protect natural resources would also help to protect archaeological resources, establishing the protection of fragile historical resources as an explicit goal would strengthen the plan.

A report commissioned by the Friends of Pleasant Bay, Inc. in 1987 provides an important context for developing management actions protect historic resources. Approximately 10 % of all pre-historic and historic archaeological sites recorded for Barnstable County fall with in the greater Pleasant Bay study area, what may prove to be the highest site density for any single locale on Cape Cod.[1] These resources may provide key insights into the political, religious, cultural, economic and adaptive processes of the Cape's indigenous peoples.[2]

In an effort to foster a deeper appreciation for and awareness of Wampanoag heritage and the history of Wampanoag settlement in the area, the Chatham Wampanoag Committee published a guide to the Chatham Monomoyick Trail. The guide provides information on key sites related to the Native American history in Chatham. A companion guide for Harwich is under discussion.

9.8 Recommendations: Promote Appreciation for the Bay's Historic and Archaeological Resources

9.8.1 *The Alliance should work with local historians, archaeologists and historical commissions to develop an inventory of sites and resources of historic, archaeological and cultural interest within the study area. The effort should include appropriate recommendations to protect and interpret these important community resources.*

9.8.2 *Support development of efforts such as the guide to the Chatham Monomoyick Trail, which enhance understanding and appreciation of Native American settlement in the Pleasant Bay region*.

[1] Frederick J. Dunford, An Archaeological Reconnaissance Survey of Pleasant Bay, Massachusetts, 1987, p 21
[2] Dunford p.48

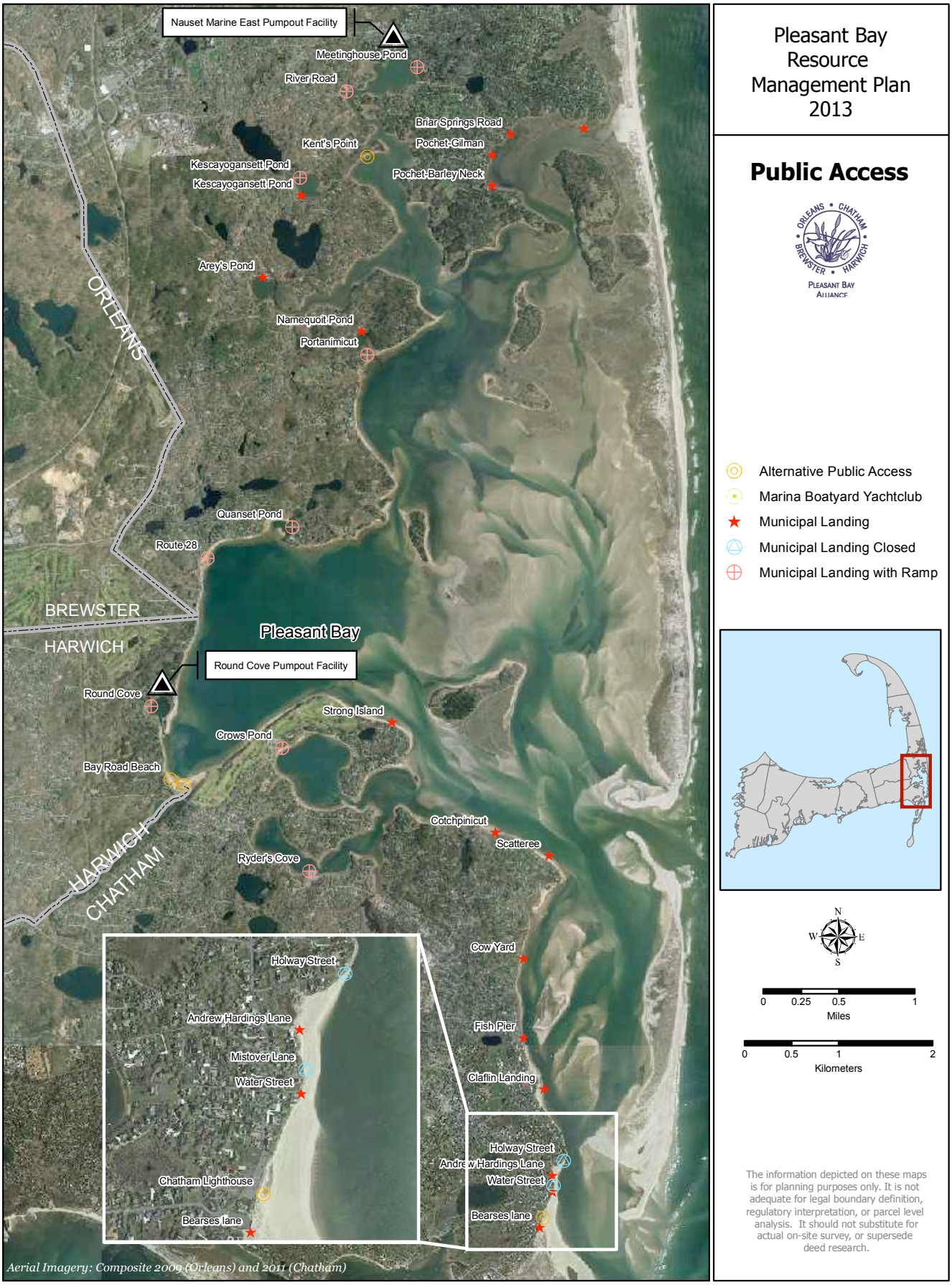


Figure 25 Public Access

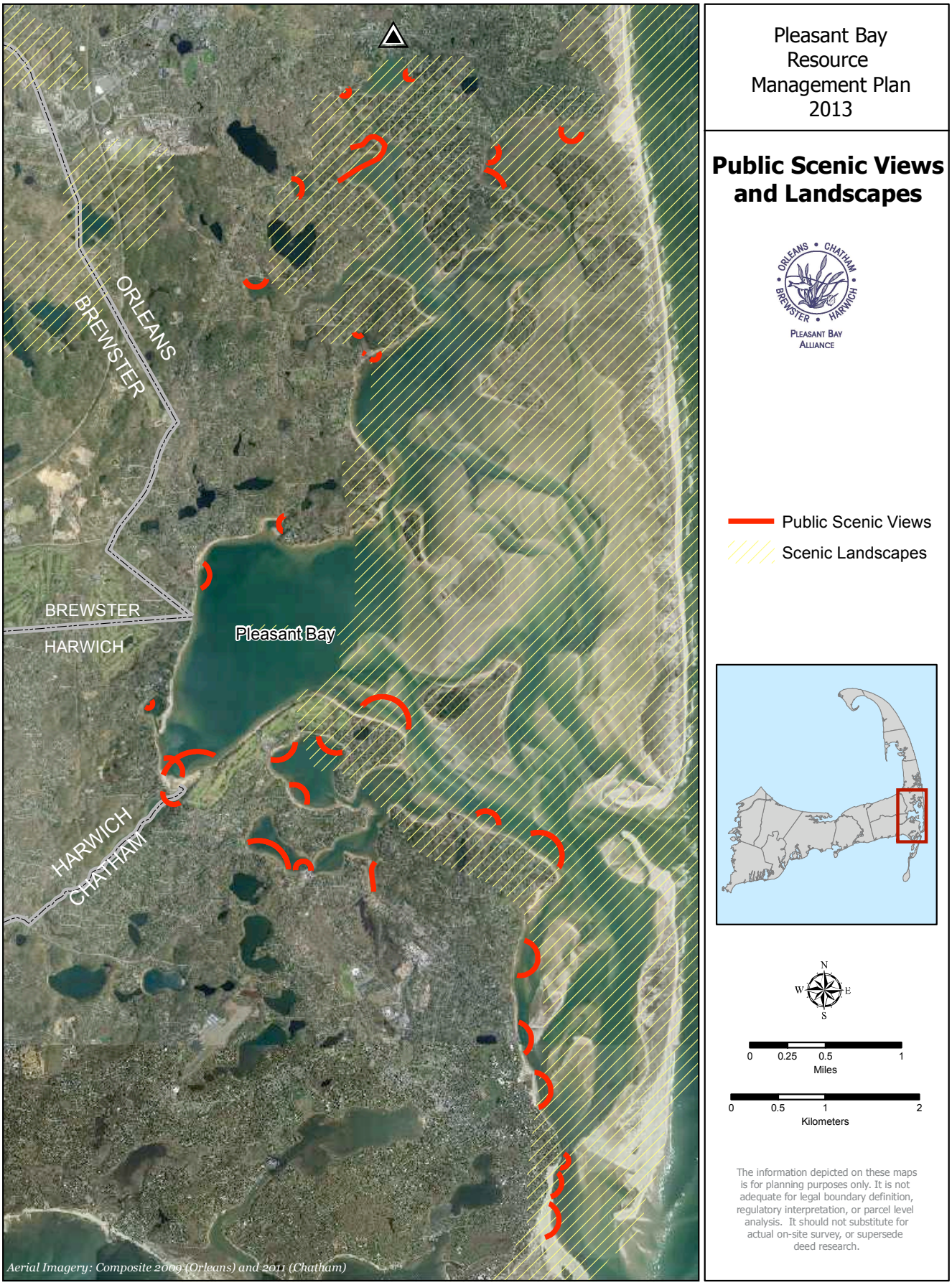


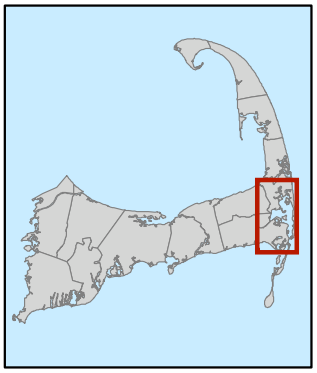
Figure 26 Public Scenic Views and Landscapes

Pleasant Bay Resource Management Plan 2013

Historic Sites

Pleasant Bay Alliance

1. Indian Meeting House Site
2. Old Coast Guard Station
3. Entrance 1619-1626
4. Remains of Sparrow Hawk
5. Early Meeting House
6. Old South Orleans Post office
7. Captain Kendrick House
8. First Boys Camp
9. First Girls Camp
10. First Drummer Cottage 1887
11. Tar Kilns Baker 1665
12. Tar Kiln Creek
13. Uncle Kiah's Spring
14. Warren Jensen Nickerson House
15. Elnathan Eldredge Mill
16. Indian Praying Stone
17. The Wading Place
18. William Nickerson House
19. William Nickerson Burial Monument
20. Great Point
21. Hotel Chatham
22. Jesse's Folly
23. Pull and Be Damned
24. Old Harbor Late 1900's
25. Old Harbor Coast Guard Station
26. Chatham Light
27. Old Village 1800's - Present
28. Chatham Bars Inn 1913
29. First Chatham Church
30. Marconi - RCA Wireless Receiving Station



N
W E
S

0 0.25 0.5 1
Miles

0 0.5 1 2
Kilometers

The information depicted on these maps is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis. It should not substitute for actual on-site survey, or supersede deed research.

Figure 27 Historic Sites

SECTION III. IMPLEMENTATION

Chapter 10.
Implementation

10.0 Overview

When the initial resource management plan was developed in 1998 considerable attention was paid to how the plan would be implemented and monitored over time. Consensus quickly grew around three organizational principles:

1. A specific, multi-town entity was needed to ensure that the plan's many recommendations would be implemented and that progress would be monitored;
2. The implementing structure would need to augment, and not duplicate, existing local and regional resources and activities; and
3. Regulatory authority and decision-making would remain within the member towns, but would be guided by the entity in matters regarding Pleasant Bay.

Accordingly, the resource management plan called for the formation of a four-town Alliance to implement the plan and to have overall responsibility and accountability for on-going stewardship of the Bay. The Alliance would develop policy recommendations, undertake scientific research, and promote public education and awareness. The make-up of the Alliance would include:

- A Steering Committee to govern the Alliance;
- A Technical Resource Committee to assist the Steering Committee;
- A Coordinator to manage day-to-day activities; and
- On-going community involvement through project issue specific work groups.

More than a decade later the Alliance is respected for its leadership and advocacy in the protection of the natural resource and public enjoyment of Pleasant Bay. In 2003, the state EOEA referred to the Alliance as "a model of coordinated municipal and regional planning and management of sensitive resources that other ACECs and communities across the Commonwealth can use as an example." In the five years ahead the Alliance will continue to build on this record of accomplishment, and strengthen its effectiveness in promoting the goals and objectives of the resource management plan.

10.1 Local Adoption and Authorization

In 1998, Town Meetings in Orleans, Chatham, and Harwich adopted the Pleasant Bay Resource Management Plan and authorized their respective Boards of Selectmen to enter into a Memorandum of Agreement (MoA) with the other communities to form the Pleasant Bay Resource Management Alliance to implement the plan. In 2003 the Town Meetings adopted the first five-year

update and authorized their respective Boards to renew the five-year MoA. In 2007, Town Meeting in Brewster voted to adopt the plan and 2003 update, and to authorize the Board of Selectmen to sign the MoA. In 2008, Town Meetings in all four towns adopted the 2008 Plan Update and authorized Selectmen to extend the Memorandum of Agreement for another five years.

The MoA sets forth the purposes of the Alliance, and its organizational structures and reporting and accounting responsibilities. The purpose of the Alliance is to implement the recommendations of the approved plan and subsequent updates, and to oversee the process of revising the plan upon the five-year anniversary of its approval. The renewal provision was incorporated to enable the towns to reassess the need and effectiveness of the Alliance, and to renew their commitment to its purposes. The current MoA expires in December 2013.

10.2 Alliance Governance and Administration

The organizational structure of the Alliance builds upon the high degree of public involvement and intergovernmental cooperation initiated with the development of the resource management plan and updates.

A Steering Committee is the policy setting body for the Alliance and has overall accountability and responsibility for coordinating implementation activities, including the authority to contract for services. As outlined in the memorandum of agreement, the Steering Committee consists of one representative and one alternate appointed by the Board of Selectmen in each Alliance town.[1] Each Board of Selectmen has also appointed from among its members a liaison to meet with the Steering Committee from time to time. The Steering Committee meets monthly and as a municipally sponsored committee is subject to Massachusetts open meeting laws.

A Technical Resource Committee (TRC) consisting of four resource management professionals from each town provides technical assistance to the Steering Committee. TRC members are appointed by their respective Board of Selectmen and consist of harbormasters, coastal resource managers, conservation agents, planners, and water quality scientists with professional responsibility for managing the Bays resources. To facilitate cooperation among other agencies involved in managing the Bay's resources, the TRC invites as ex officio members representatives from the Cape Cod Commission, Cape Cod National Seashore, and Massachusetts Coastal Zone Management. The TRC meets as needed and all meetings are open to the public.

[1] The original MoA was amended twice. In 2001, the MOA was amended to authorizing each Board to appoint one alternate member to the Steering Committee. This was to enable the Committee to act with a full complement of voting members despite individuals' travel plans and other scheduling conflicts. In 2007 the MoA was amended to include Brewster as a participating member in the Alliance.

A professional coordinator for the Alliance is responsible for developing and managing implementation projects, coordinating activities with local and state officials, grant writing, media management, and public outreach and involvement.

Pursuant to the intermunicipal agreement, the Director of Finance for the Town of Chatham acts as fiscal agent for the Alliance. The Town of Chatham manages a separate account for the Alliance for the receipt and disbursement of funds associated with the Alliance's implementation activities.

10.3 Project Management and Work Groups

The Coordinator works closely with the Steering Committee and TRC to manage individual projects. Work Groups have been formed for specific implementation projects as a way to increase technical expertise and provide a forum for substantive community involvement. In addition to TRC and Steering Committee members, work groups involve researchers from the National Park Service/Cape Cod National Seashore, Provincetown Center for Coastal Studies, Woods Hole Oceanographic Institute Sea Grant Program, Cape Cod Cooperative Extension Service, and Cape Cod Commission, as well as local officials, members of local boards and commissions, interested citizens, and representatives of conservation organizations and state environmental agencies.

Membership in work groups may change depending on the focus of the group at a given time. The following is a list of work groups that have completed or are now working on Alliance projects:

Water Quality Monitoring Work Group,
Coastal Work Group,
Fisheries and Biodiversity Work Group,
Navigation and Public Access Work Group,
Wetlands Work Group, and
Watershed Work Group.

10.4 Budgeting and Grantwriting

The Steering Committee, TRC and Coordinator developed a program budget and work plan for each fiscal year which identifies priority implementation projects and activities. Each action item or project in the work plan relates to a recommendation of the RMP. Funding for Alliance activities comes from annual appropriations from the towns and a combination of public and private grants.

Municipal funds cover the cost of the Alliance's administration and laboratory expenses for the water quality monitoring program. Grants are obtained for special projects. Since its inception, the Alliance has been

successful in obtaining $186,000 in grants from non-town sources. In addition, the Alliance has received technical assistance and analysis from the Cape Cod Commission, Woods Hole Sea Grant Program, Provincetown Center for Coastal Studies, Cape Cod Cooperative Extension Service, MA Division of Ecological Restoration, Massachusetts Department of Environmental Protection, and Cape Cod National Seashore. The Alliance greatly appreciates the financial and technical support of the following agencies, foundations and organizations:

Executive Office of Energy and Environmental Affairs,
Friends of Pleasant Bay, Inc.,
Cape Cod Commission,
Cape Cod National Seashore,
Cape Cod Water Protection Collaborative,
WHOI/ Sea Grant Program,
Provincetown Center for Coastal Studies, and
Cape Cod Cooperative Extension Service.

10.5 Public Outreach and Education

Public outreach and education was integral to the development and approval of the original resource management plan, and continues to be through the plan's implementation. Over the past five years the Alliance has undertaken the following implementation activities:

- Forums and Workshops. The Alliance convenes symposia and issue specific work shops regarding key issues encompassed in the Resource Management Plan.

- Outreach and Involvement of Local and Regional Organizations. The Alliance coordinator and other members of the Steering and Technical Resource Committees frequently make presentations to local and regional organizations explaining the Alliance's programs and activities.

- Media Outreach. The Alliance issues media releases on the occasion of noteworthy events, such as receipt of grants, and the launching or completion of studies or projects. Media outlets that frequently carry news about the Alliance and its activities include: the *Cape Cod Times*, *Cape Codder*, *Harwich Oracle*, *Cape Cod Chronicle*, and local radio stations.

- Website. The Alliance established www.pleasantbay.org, through which visitors can:
    - View a description of the Alliance and its programs and activities;
    - Download the resource management plan and other documents and reports prepared by the Alliance;
    - View media releases; and
    - View the schedule of upcoming meetings.

- Annual Reports. The Alliance submits an annual report to the Town Clerk of each community for inclusion in the annual Town Reports

10.6 Implementation Recommendations

10.6.1 *Adopt the Plan Update and Renew the MoA*. It is recommended that Town Meeting in each of the four Towns adopt the Resource Management Plan 2013 Update and authorize their respective Board of Selectmen to renew the five-year memorandum of agreement forming the Alliance.

10.6.2 *Review and modify Organizational Structure as Needed*.

10.6.3 *Continue to seek non-town sources of funding for its studies and programs*.

10.6.4 *Continue public outreach and education activities*. Outreach activities should include:

- The Alliance is proposing to sponsor issue forums and symposia focused on specific topics relevant to the resource management plan. The forums and symposia would provide opportunities to review issues in-depth, and invite outside experts.

- The Alliance will continue to issue publications reporting on research and project findings. The Alliance routinely makes its publications available through direct distribution, public presentations, and by making copies available for review at town halls, libraries and electronically on the Alliance's website

- Continue to promote public information and education on issues and initiatives through enhancements to the Pleasant Bay Alliance website, www.pleasantbay.org.

Chapter 3. Biodiversity and Habitat Protection

3.2 Recommendations to Address Water Quality and MEP Modeling

3.2.1 Continue the Citizens' Water Quality Monitoring Program in concert with the TMDL monitoring and compliance protocols being developed byMassDEP, MEP, and the Alliance.

3.2.2 Update statistical analysis of water quality data every five years.

3.2.3 Update MEP water quality model as needed to reflect changing conditions.

3.2.4 Continue to develop and disseminate periodic water quality reports for public information.

3.2.5 Address needs for eelgrass and benthic monitoring and reporting, in concert with the TMDL monitoring and compliance protocols being developed by MassDEP, MEP, and the Alliance.

3.2.6 Support ongoing monitoring of water quality conditions in freshwater ponds in the ACEC and in the Pleasant Bay watershed.

3.2.7 Track bacterial and other water quality issues. Continue to build awareness of bacterial water quality trends and measures to address problem areas.

3.2.8 Support the Geographic Response Plan (GRP) for oil spill preparedness with MassDEP and related agencies.

3.4 Recommendations to Address Shoreline/Salt Marsh Monitoring

3.4.1 Develop a plan to resume monitoring of the Jackknife and Sparrowhawk salt marsh sites; coordinate monitoring and data with Cape Cod National Seashore.

3.4.2 Continue aerial flyovers of the entire Pleasant Bay system every five years, or more frequently as needed.

3.6 Recommendations for Managing Ecological Diversity

3.6.1 Promote compliance with the Massachusetts Natural Heritage and Endangered Species Program (NHESP).

3.6.2 Develop best management practices to control or eradicate freshwater and marine invasive species in the ACEC.

3.6.3 Develop best management practices for site clearance or alteration.

3.6.4 Develop a citizen's guide (or series of guides) to the ecology of Pleasant Bay.

3.6.5 Support ongoing research aimed at understanding population dynamics and trends associated with seals, sharks, horseshoe crabs, piping plovers, least terns, diamond-back terrapin, razor clams, cormorants and the relationship between mussles and eiders.

3.6.5 Promote open space and habitat protection through support for a range of measures aimed at accomplishing protection of meaningful open space and particularly areas identified as priorities by local towns, land trusts or the Cape Cod Commission.

3.8 Recommendations: Areas of Critical Marine Habitat

3.8.1 Continue to provide guidance with respect to activities within ACMH to ensure that these sensitive habitat areas continue to be protected from adverse impacts.

3.8.2 Add Muddy Creek in its entirety as Area of Critical Marine Habitat 4.

3.8.3 Provide guidance with respect to activities within ACMH 4, to ensure that these sensitive habitat areas continue to be protected from adverse impacts.

3.8.4 Continue research and monitoring efforts designed to deepen knowledge about habitats provided wthin ACMH.

Chapter 4. Wetlands Protection

4.2 Recommendations to Strengthen Wetlands Regulations and Compliance

4.2.1 Strengthen local wetlands protection regulations and review procedures. The Alliance will continue to review existing wetlands protection regulations in the Alliance communities, and where advisable, work with the conservation agents and commissions to strengthen regulations.

4.4 Recommendations: Muddy Creek Restoration

4.4.1 Support and provide comment on the Muddy Creek Restoration Bridge Project being undertaken by the Towns of Harwich and Chatham.

4.4.2 Continue the Categorical Restriction on licensing of new private docks and piers in Muddy Creek.

4.4.3 Evaluate restrictions on motorized vessels in Muddy Creek.

4.6 Recommendations: Impacts on Wetlands Resulting from Sea Level Rise

4.6.1 Conduct an assessment of impacts to wetlands, public access points and other coastal resources and infrastructure resulting from potential changes in relative sea level.

4.6.2 Based on the assessment outlined in 4.6.1, develop management strategies to prepare for the anticipated effects of changes in relative sea level.

4.8 Recommendation: Tidal Restriction at Frost Fish Creek.

4.8.1 Support efforts by the Town of Chatham and Massachusetts Highway Department to evaluate design alternatives to increase flushing and improve water quality, habitat and other natural resources in Frost Fish Creek.

4.10 Recommendations: Protect Freshwater Ponds in the ACEC

4.10.1 Adopt and implement Freshwater Dock Guidelines.

4.10.2 Evaluate and implement lake and pond management alternatives.

4.10.4 Evaluate the need to update the 2004 Horsley Witten pond shore survey.

Chapter 5. Watershed Planning

5.5 Recommendations to address Nutrient Management

5.5.1 Continue to support comprehensive wastewater management planning.

5.5.2 Continue to promote watershed-based collaboration to achieve TMDLs: Coordinate planning for nutrient management plans; explore model scenarios; provide ongoing monitoring and reporting; explore strategies to equitably allocate cost and responsibility; act as communication link on key implementation issues.

5.5.3. Continue to support regional solutions to achieving TMDLs in the Pleasant Bay watershed

5.5.4 Continue to build and support public awareness of the need for nitrogen management strategies and adherence to the TMDLs.

5.5.5 Periodically update system-wide models of hydrodynamics and water quality.

5.5.6 Monitor, evaluate and, as appropriate, implement non-structural nutrient management strategies and technologies.

5.7 Recommendations: Fertilizer Management

5.7.1 Work with each town to adopt and implement the municipal turf management policy.

5.7.2 Promote public awareness of the impacts of fertilizer use, and provide information on alternative best management practices for turf management and landscaping.

5.7.3 Work with golf course managers to evaluate and implement strategies to identify a workable and meaningful nitrogen load reduction target, and a timeframe for achieving the target. In initial discussions the range of 5-10% has been discussed.

5.7.4 Promote other recommended measures to control nutrients from fertilizer use, as outlined in the fertilizer management plan: a bylaw to limit the size of lawns in future subdivisions in the watershed; and enforcement of existing regulations to protect or restore natural buffers along wetlands and water bodies.

5.9 Recommendations: Stormwater Management

5.9.1 Encourage the Alliance towns to complete and implement Phase II stormwater management plans as required by the EPA and MassDEP.

5.9.2 Promote adherence to MassDEP's Stormwater management policy and best management practices for protection of wetlands and water quality.

5.9.3 Promote a comprehensive approach to controlling nutrient loading from stormwater in the Pleasant Bay watershed.

5.9.4 Evaluate the benefits of adopting a stormwater management bylaw.

5.9.5 Encourage towns to fund implementation and maintenance of stormwater management infrastructure.

5.11 Recommendations to Address Bacterial Contamination

5.11.1 Continue to monitor bacteria levels at all previously tested locations if they are frequently used for public swimming.

5.11.2 Monitor trends in bacterial monitoring data. If any areas are found to experience sustained high levels of bacterial contamination, the Alliance will encourage efforts to identify sources of bacteria.

5.11.3 Support mutt mitt dispensers and public education regarding pet waste.

Chapter 6. Fisheries Management

6.3 Recommendations to Enhance Shellfish Management and Propagation

6.3.1 Evaluate the potential for enhancing the wild quahog fishery through measures such as establishing a spawning sanctuary; rotating heavily used shellfishing areas for closure, to allow time for stocks to replenish; or establishing one or more private aquaculture grants for the purpose of generating quahog larvae.

6.3.2 Continue to support the towns' efforts to increase the effectiveness of propagation, and strengthen enforcement of shellfishing regulations.

6.3.3 Pursue the re-establishment of a series of buoys to demarcate town boundaries, particularly at Strong Island, North Beach and Big Bay.

6.3.4 Monitor research on nutrient harvesting to understand the effectiveness of shellfish in removing pollutants, as well as other ecological benefits they provide. Pilot projects for nutrient harvesting using shellfish in Pleasant Bay should be explored.

6.3.5 Continue to support studies, such as the mussel project underway by Mass Audubon and the Town of Chatham, to address species interactions based on a thorough examination of the causes and consequences of species populations and behaviors.

6.5 Recommendations to Address Disease, Pest and Invasive Species

6.5.1 Develop management responses to invasive species and diseases.

6.7 Recommendation to Monitor Fisheries Habitat

6.7.1 Conduct research on the status of Pleasant Bay's fisheries habitat. Work with the Division of Marine Fisheries, Barnstable County and regional scientific institutions to determine the best approach to long term monitoring of the Bay's finfish and shellfish habitat.

6.7.2 Investigate, monitor and improve anadramous and catadramous fish passage, particularly active runs between Lonnie's Pond and Pilgrim Lake, Ryder's Cove and Stillwater Pond, and Muddy Creek and Ministers and Mill Ponds.

6.7.3 Work with ecologists and scientists from the Cape Cod National Seashore to develop a GIS mapping project of intertidal areas categorized by tidal regime, sediment type, and vegetative cover.

6.9 Recommendation to Manage Private Aquaculture

6.9.1 Encourage adherence to aquaculture best management practices developed by the Massachusetts Division of Fisheries.

6.9.2 Develop guidelines for evaluating proposals for expanded or new aquaculture grants within Areas of Critical Marine Habitat. (see recommendations 3.8.1-3.8.4.)

Chapter 7. Coastal Processes and Coastal Structures

7.2 Recommendations: Sediment Management

7.2.1 Develop a Bay-wide sediment management plan to provide a comprehensive assessment of sediment dynamics in the Pleasant Bay system, including future trends, and would be intended to guide local policies and projects for dredging, disposal of dredged material, and review and permitting of erosion control structures and beach nourishment projects.

7.2.2 Work with local Conservation Commissions to develop and promote adherence to best management practices for beach nourishment projects. The best management practices would be based on MassDEP's guide to best management practices for beach nourishment projects in Massachusetts.

7.3.2 Recommendations: Inventory of Coastal Structures and Management Applications

7.3.2.1 Develop an updated, detailed inventory of coastal structures in Pleasant Bay. The inventory should generate information sufficient for GIS mapping of structures.

7.3.2.2 Develop a detailed inventory of non-structural coastal management solutions. The inventory would encompass soft applications and significant nourishment projects that are not considered structures.

7.3.3 Recommendations: Regulatory Guidance for Erosion Control Structures

7.3.3.1 Develop performance standards and design criteria for erosion control structures. Local and state permitting authorities would use the performance standards to assess situations where the use of hard structures is the only feasible alternative for erosion control.

7.3.3.2 Until such time as performance standards and design criteria for erosion control structures as outlined in 7.3.3.1 above are adopted by the Alliance towns and the state, it is recommended that DEP apply regulatory discretion provided for in 310 CMR 9.3.2 (2) in its review of applications for Chapter 91 licenses for erosion control structures in the ACEC, and that in its review DEP give due consideration to the issues enumerated in 7.3.3.1 above and 7.3.3.3 below. Once guidelines and performance standards are completed in accordance with 7.3.3.1, adopted into regulation by the respective towns and approved by the state, they will replace the categorical restriction and provide guidance to DEP in issuing Chapter 91 licenses for such structures.

7.3.3.3 Encourage local and state permitting agencies to ensure that alternative measures to hard structures are utilized wherever possible to mitigate the effects of coastal bank loss. Areas of special concern include the southern shore of “Big” Pleasant Bay.

7.3.3.4 Study building relocation for erosion management. A cost benefit analysis of building relocation as an alternative to installing erosion controls structures should be undertaken. The study should consider the financial and resource costs and benefits of building relocation in comparison with other alternatives, and should also look at the other regulatory issues that would associated with relocating structures, such as zoning, health and conservation requirements.

7.3.5 Regulatory Guidance for Existing Unlicensed Structures and New Licenses

7.3.5.1 Consider previously existing unlicensed structures as new for the purposes of assessing consistency with the approved Guidelines and Performance Standards for Permitting Docks and Piers in Pleasant Bay.

7.3.5.2 In assessing consistency with the approved Guidelines and Performance Standards for Permitting Docks and Piers in Pleasant Bay, the Alliance may consider minor variances from performance criteria and design standards if the structure reduces other stresses on resources in the system, there is a clear public benefit, or there are compelling site conditions.

7.3.7 Recommendation: Regulatory Guidance for Docks on Bay Islands and Backside

7.3.7.1 Limit structures on Bay islands and Nauset Beach. Structures in these areas should only be considered where they are necessary to provide safe and reasonable access, and only when it has been demonstrated that all alternative forms of access are impractical.

7.3.9 Recommendation: Regulatory Guidance for Docks in Muddy Creek

7.3.9.1 Continue the Categorical Restriction on licensing of new private docks and piers in Muddy Creek.

7.4.1 Recommendation: Regulating Other Coastal Structures

7.4.4.1 The Alliance should develop permitting guidelines for ancillary coastal structures not addressed by any existing permitting guidelines. These types of structures include but are not limited to: outhauls, anchored floats, boat ramps, boathouses, decks and racks.

7.6 Recommendations: Study SLR and Coastal Processes

7.6.1 Participate in developing and implementing a comprehensive approach to monitoring the barrier beach and inlet system. Monitoring should encompasses: sediment transport and erosion/deposition; protection of shoreline resources, properties and public access points; and hydrodynamics of the two inlet system.

7.6.2 Assess the full effects of SLR in Pleasant Bay and Chatham Harbor, and evaluate management strategies.

7.6.3 Continue support for tide gage monitoring at Meetinghouse Pond and Chatham Fish Pier. Additional tide gage monitoring locations should be considered if indicated by the tide data analysis.

7.6.4 Continue to monitor shoreline and marshline change. Information on historic erosion rates is necessary for evaluating coastal wetlands resources in terms of their value for storm protection, and sediment supply.

7.6.5 Continue to build an archive of aerial imagery, incuding aerial flyovers of the entire Pleasant Bay system every five years or as needed.

Chapter 8. Waterways Safety and Navigation

8.2 Recommendations: Safety and Navigation

8.2.1 Continue the coordinated bay-wide patrol with harbormasters of Orleans, Chatham and Harwich.

8.2.2 Support deployment of navigational aids and speed controls as needed to enhance navigation safety.

8.2.3 Evaluate opportunities for potential changes in waterways regulation or policies to promote safe and appropriate use of recreational equipment and activities.

8.2.4 Evaluate restrictions on motorized vessels in Muddy Creek.

8.2.5 Undertake or support public education efforts to reinforce waterways regulations and environmentally friendly boating practices.

8.4 Recommendations: Town Landings and other Access Points

8.4.1 Promote a high level of public maintenance and investment at all town landings and public access points, especially the heavily used boat ramps at River Road, Round Cove and Ryder's Cove.

8.4.2 Monitor the effects of new landing ramp access regulations. The effect of access restrictions should be monitored over several seasons to ensure they are effective in addressing periodic overcrowding at Ryder's Cove and Round Cove and do not lead to unintended consequences.

8.4.2 Promote steps to reduce impacts of dinghy storage at town landings.

8.4.3 Monitor commercial activity occurring at town landings. While these activities are not currently observed as causing undue pressure, they should be monitored and, if warranted, steps to regulate such activities should be considered.

8.6 Recommendations: Dredging and Material Disposal

8.6.1 Continue maintenance dredging as needed, provided it meets all applicable permitting requirements and is consistent with the resource management plan and updates.

8.6.2 Continue study of the potential need for, impacts from, and feasibility of improvement and/or maintenance dredging in areas where shoaling is limiting access in areas that traditionally have served as important public navigable waterways.

8.6.3 Conditions under which permits may be sought for limited improvement dredging to maintain or restore historical navigable access.

8.8 Recommendations: Pleasant Bay No Discharge Area

8.8.1 Provide on-going public education. Continue to work with harbormasters, waterways committees and local organiztions to produce and diseminate public education about the No Discharge Area, its purpose and its requirements.

8.8.2 Continue to work with harbormasters, waterways committees and local marinas and boat yards to monitor pump-out activity and evaluate if existing pum-out facilities have adequate capacity to meet needs.

8.10 Recommendations: Environmental Impacts from Boating

8.10.1 Develop and distribute a pamphlet on best management practices for boat maintenance geared to individual boat owners.

8.10.2 Continue to promote adherence to the MCZM marina best management practices, including relocation of certain activities to inland areas where they can be contained. Continue to support on-going efforts by private boat yards as they adopt measures to lessen impacts of outhaul and maintenance activities.

8.10.3 Address the need for environmentally safe haul out facilities for commercial vessels. Chatham and Harwich recently obtained grant funding for a shared self-contained power washing system for use by commercial vessels. Other potential options for meeting this need should be evaluated.

8.10.4 Monitor or sponsor further research to characterize and quantify the impacts of boating on water quality, habitats, and other aspects of the marine environment in Pleasant Bay.

8.12 Recommendations: Mooring Management

8.12.1 Maintain mooring intensity at public mooring fields at current levels.

8.12.2 Promote selected use of alternative mooring technologies that limit scouring and other environmental impacts, but not as a means of increasing mooring capacity in the Bay.

Chapter 9. Public Access and Historic Resources

9.2 Recommendations: Protect Public Access to and Along the Shore

9.2.1 Promote enhanced access to and along the Pleasant Bay system shoreline.

9.2.2 Undertake actions to reduce existing shoreline obstructions, and to prevent future obstructions.

9.2.3 Support efforts to establish additional access points for low impact uses such as scenic viewing, walking, beach activities, and use of small, non-motorized vessels.

9.2.4 Develop a comprehensive public information program concerning public

access points, support facilities and services, use guidelines, and public access rules and responsibilities.

9.6 Recommendations: Preserve Visual Access and Moderate Noise Levels on the Bay

9.6.1 Protect existing views of the Bay and encourage the opening of new vistas.

9.6.2 Explore ways to moderate noise on the Bay.

9.8 Recommendations: Promote Appreciation for the Bay's Historic and Archaeological Resources

9.8.1 Work with local historians, archaeologists and historical commissions to develop an inventory of sites and resources of historic, archaeological and cultural interest within the study area. The effort should include appropriate recommendations to protect and interpret these important community resources.

9.8.2 Support development of efforts such as the guide to the Chatham Monomoyick Trail, which enhance understanding and appreciation of Native American settlement in the Pleasant Bay region.

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MEMORANDUM OF AGREEMENT
Between the Towns of Orleans, Chatham, Harwich and Brewster
TO ESTABLISH THE PLEASANT BAY RESOURCE MANAGEMENT ALLIANCE

Article I. Recitals

WHEREAS, the estuary known as Pleasant Bay and its watershed lies within the municipal boundaries of Orleans, Chatham, Harwich and Brewster, and

WHEREAS, in 1995 the four towns entered into an agreement to develop a resource management plan ("plan") to protect the vast natural resources of the Bay, and

WHEREAS, the agreement established as a goal of the plan to have the towns adopt uniform polices and regulations for the management of the Bay, and

WHEREAS, the plan developed in accordance with the agreement provides management recommendations concerning the towns' policies and regulations relative to water quality, wetlands, wildlife, fisheries, boating, shorelines structures, and public access, and

WHEREAS, the Towns of Harwich, Orleans, Chatham and Brewster have approved the plan and subsequent five-year plan updates (herein collectively referred to as "the plan");

NOW THEREFORE, the undersigned towns, in consideration of the mutual covenants contained herein, hereby agree as follows:

Article II. Policy and Purpose

1. This agreement forms the Pleasant Bay Resource Management Alliance ("Alliance"). Through participation in the Alliance the undersigned towns agree to implement the plan recommendations, acting by and through their designated officers, employees or agents. The towns also agree to seek funding through Town Meeting for implementation of the plan in accordance with the terms of this agreement.
2. Each town participating in the Alliance shall retain authority over the resources and activities within its jurisdiction. The Alliance shall coordinate, and not duplicate or compete with, the functions of existing regulatory and planning organizations in each of the undersigned towns as they pertain to the Pleasant Bay Resource Management Plan.

Article III: Steering Committee

1. A Steering Committee shall be created, with one member appointed by the Board of Selectmen of each undersigned town.
2. The Board of Selectmen of each undersigned town may appoint an alternate Steering Committee member to vote in place of the appointed member when the appointed member is absent.

3. The members of the Steering Committee shall serve at the pleasure of the Board of Selectmen of the Town by whom they were appointed.
4. Provided there is a quorum of three-quarters of the members or designated alternates present, the Steering Committee shall act by majority vote.
5. The Steering Committee shall elect a Chairman, Vice-Chairman, and Treasurer annually.
6. During any fiscal year for which a Town Meeting in one or more of the undersigned towns fails to appropriate funds in accordance with the provisions of Article VI of this agreement, the Steering Committee member and alternate from such town shall serve as an ex officio member and alternate and shall not vote.
7. The Steering Committee shall be authorized to expend funds, subject to the conditions contained herein, from the Pleasant Bay Resource Management Alliance Account as described in Article V of this agreement. The Steering Committee shall have no authority to contract for services or expend funds in excess of the amount available in said account. All contracts shall be in writing and no contract shall be entered into without a certification of the Town of Chatham Finance Department in accordance with Article V of this agreement.
8. The Steering Committee shall have overall responsibility and accountability for coordinating with officers, employees or agents of the undersigned towns to implement the plan.

Article IV: Technical Resource Committee

1. A Technical Resource Committee shall be created, with four members from each of the undersigned towns. The Committee members may include the harbormaster, shellfish constable, conservation agent, health agent, town planner, or their equivalent as determined by the town's Board of Selectmen, of each undersigned town.
2. The members of the Technical Resource Committee representing each town shall be appointed by their respective Board of Selectmen.
3. The Technical Resource Committee shall provide technical assistance, advice, and recommendations to the Steering Committee in the implementation of the plan.

Article V: Alliance Account

1. An account shall be established under the jurisdiction of the Town of Chatham Finance Department to be known as the Pleasant Bay Resource Management Alliance Account ("Alliance Account").
2. The Alliance Account shall be the depository for all non-municipal funds and municipal appropriations made for the implementation of the plan.
3. Expenditures from the Alliance Account shall be authorized by a majority vote of the Steering Committee as provided herein. Any expenditure so authorized shall be subject to the customary and ordinary requirements for the expenditure of funds in the Town of Chatham.
4. The Steering Committee is authorized to release funds from the Alliance Account for consultant services, or other goods and services related to the Pleasant Bay Resource Management Plan's implementation.

Article VI: Budgeting and Reporting

1. The Steering Committee shall prepare a proposed annual budget and operating plan for the coming fiscal year.
2. The proposed annual budget and operating plan shall be presented to the Boards of Selectmen of the undersigned towns per each town annual budget schedule.
3. The proposed annual budget shall indicate the amount of funds requested from the Towns of Orleans, Chatham, Harwich and Brewster for the coming fiscal year, as well as the amount and source of all non-municipal funds. The total amount of funds requested from the Towns of Orleans, Chatham, Harwich and Brewster, shall be apportioned as follows: thirty-five (35) percent to Orleans, thirty-five (35) percent to Chatham, eighteen (18) percent to Harwich, and twelve (12) percent to Brewster. In accordance with current practice, all participating towns shall include their share of funds as a line item in their annual town budget.
4. The proposed annual budget shall present the expenditures planned for the coming year.
5. At the end of each fiscal year the Steering Committee shall submit a financial statement and a report of activities to the Boards of Selectmen of the undersigned towns to be publicized in annual town reports.
6. Funds in the Alliance Account not expended by the end of the current fiscal year shall remain in said account and applied toward approved expenditures related to the implementation of the Pleasant Bay Resource Management Plan in the following fiscal year.

Article VII: Renewal and Termination

1. The approved plan shall be reviewed and updated as necessary every five years. Any proposed amendments to the approved plan shall be submitted to the Board of Selectmen in each of the undersigned towns for review and may be submitted to Town Meetings in the undersigned towns for approval.
2. This agreement shall expire December 31, 2018 unless prior to that date the undersigned towns take action either to extend or terminate the agreement.
3. Upon termination of the Alliance, the assets remaining in the Alliance Account after all outstanding obligations have been paid shall be returned to the source of funds. If the source of funds is not discernible, then remaining funds shall be distributed among the undersigned towns in accordance with Article IV. Section 3 of this agreement.
4. This agreement shall be subject to the applicable provisions of General Laws, Chapter 40, Section 4A governing contracts between municipalities except such provisions of Chapter 40, Section 4A requiring Town Meeting approval in which case each town's process shall be governed by applicable provisions of that town's Home Rule Charter.

Executed this day of , 2013 by

_____	_____
Chatham Board of Selectmen	Harwich Board of Selectmen
_____	_____
Orleans Board of Selectmen	Brewster Board of Selectmen