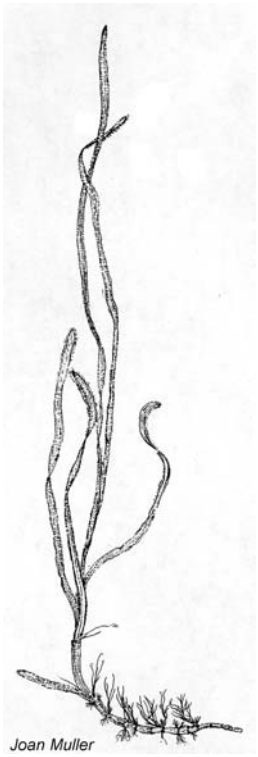
Waquoit Bay National Estuarine Research Reserve
Management Plan
2006-2011

Supporting Coastal Communities through Science



August, 2006

This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and the provisions of the Massachusetts Coastal Zone Management, October 17, 2005.

Cover photograph: Looking southwest from above South Cape Beach at Sage Lot Pond, Waquoit Bay and Dead Neck.

Acknowledgements

This management plan was produced by Elizabeth Fuller Valentine, Management Plan Coordinator, and staff members of the Waquoit Bay National Estuarine Research Reserve:

- Brendan Annett, Stewardship Coordinator and Acting Manager
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- Laurie Tompkins, Events Coordinator
- Christopher Weidman, Research Coordinator

Citizens and public officials attended a public meeting in December 2004 to help focus the Reserve's priorities for the next five years. Meeting participants included Rick York; Mashpee Shellfish Constable; Steve Tucker, Cape Cod Commission; and WBNERR volunteers George Harrison and Don Root. The following individuals contributed additional insight during meetings or interviews with the Management Plan Coordinator or provided written comments.

- Megan Amsler, Cape and Islands Self Reliance
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- **Massachusetts Office of Coastal Zone Management:** Susan Snow-Cotter, Truman Henson and Katie Lund.

- **National Oceanic and Atmospheric Administration:** Doris Grimm and Erica Sieden.

A second public meeting was held May 3, 2006 to solicit comments on the final draft of this management plan. Attendees included three local citizens: Frank and Betsy Lord and Ken Burnes.

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List of Acronyms

BUMP	Boston University Marine Program
CBSM	Community-based Social Marketing
CDMO	Centralized Data Management Office
CDM	Coastal Decision-Makers
COOPS	Center for Operational Oceanographic Products and Services
CPWB	Citizens for the Protection of Waquoit Bay
CTP	Coastal Training Program
DCR	Department of Conservation and Recreation
DEM	Department of Environmental Management
DEP	Department of Environmental Protection
DON	Dissolved Organic Nitrogen
EEOS	Environmental, Earth and Ocean Sciences Department (at U-Mass Boston)
GIS	Geographic Information Systems
IOOS	Integrated Ocean Observing System
MBL	Marine Biological Laboratory
MEPA	Massachusetts Environmental Policy Act
MCZM	Massachusetts Coastal Zone Management
MNWR	Mashpee National Wildlife Refuge
MOU	Memorandum of Understanding
NBDS	National Buoy Data Center
NEP	National Estuary Program
NERRS	National Estuarine Research Reserve System
NHESP	Natural Heritage and Endangered Species Program (Massachusetts)
NO_2	Nitrite
NO_3	Nitrate
NH_3	Ammonia
NH_4	Ammonium
NOAA	National Oceanic and Atmospheric Administration
PAR	Photosynthetically Active Radiation
PO_4	Orthophosphate
RSP	Restoration Science Program
SAV	Submerged Aquatic Vegetation
SWMP	System-wide Monitoring Program
UMASS	University of Massachusetts
USGS	United States Geological Survey
WBNERR	Waquoit Bay National Estuarine Research Reserve
WHOI	Woods Hole Oceanographic Institution

Executive Summary

Overview

Waquoit Bay National Estuarine Research Reserve Management Plan 2006-2011 is the third management plan for the Waquoit Bay National Estuarine Research Reserve (WBNERR). It describes the history, assets, programs, and administrative structures of WBNERR. It also defines and lays out the strategy for meeting the Reserve's mission over the next five years. The plan provides an update to the *Waquoit Bay National Estuarine Research Reserve Management Plan, September 2000*.

The Reserve's mission and vision are defined below.

> **Mission:** To improve the stewardship of the region's estuarine and coastal watershed ecosystems.
>
> **Vision**: To be recognized as a vital regional resource for expertise on sustainable coastal management provided through integrated programs of coastal ecosystem research and monitoring; management and stewardship; and education and training aimed at coastal communities, organizations, and individuals.

The Reserve's goals are to:

1. Improve the understanding of coastal ecosystems and the human influences on them.

2. Improve environmental literacy in our communities to enable environmentally-sustainable decision-making.

3. Demonstrate sustainable stewardship of the land and water ecosystems within the Reserve to serve as a model for community stewardship in the region.

4. Foster dialogue and development of coastal ecosystem management solutions through sustained community engagement.

5. Improve the operations, infrastructure and stature of the Reserve.

Figure 1 (beginning on page 4) depicts the goals and provides a summary of related objectives and key activities. These elements are described in detail in their respective chapters.

The Waquoit Bay National Estuarine Research Reserve supports coastal communities through science. It is a center of excellence with regard to estuarine science: science that is conducted by in-house researchers, in collaboration with scientists from world-renowned laboratories, and by independent researchers who are attracted by the infrastructure and information that the Reserve provides to support and guide their work.

Currently, the Reserve's Research Priority Areas are:

- Water quality / eutrophication / watershed land-use
- Climate change / sea level rise / shoreline change
- Assessment of ecosystem response to natural variability and human impacts

Reserve staff draws upon the scientific work conducted at WBNERR and elsewhere to promote better and more informed coastal management. The Reserve's Training and Education programs specifically guide individuals in their professional and personal roles toward environmentally-sustainable decisions. The Training and Education programs include the Coastal Training, Teacher Training, K-12 and Community Education programs.

WBNERR's Stewardship Program employs adaptive management techniques to protect the land and water resources of the Waquoit Bay watershed. Natural resources management on the Reserve is guided by the results of research conducted at the Reserve and elsewhere and is shared throughout the region through education and training. Furthermore, the Reserve serves as a model of resource management practices for similar coastal lands in the region.

In order to fulfill the Reserve's mission—to improve the stewardship of the region's estuarine and coastal watershed ecosystems—the efforts of WBNERR staff are directed toward motivating local communities to increasingly take responsibility for the development of solutions to coastal ecosystem management issues. WBNERR fosters community action by remaining engaged with coastal management agencies, leveraging training and education activities, making direct assistance available to communities and organizations, and serving on community boards.

The Waquoit Bay NERR is one of 27 sites that comprise the National Estuarine Research Reserve System (NERRS), a Federal state partnership of protected research and education sites administered by the National Oceanic and Atmospheric Administration (NOAA) and state partners. In this case, the partner is the Massachusetts Department of Conservation and Recreation (DCR). The National Estuarine Research Reserve System was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. Reserves are required by Federal regulation, 15 C.F.R. Part 921.13, to have a NOAA-

approved management plan that is updated every five years. The plans must describe reserve goals and objectives, management issues, and strategies for addressing them.

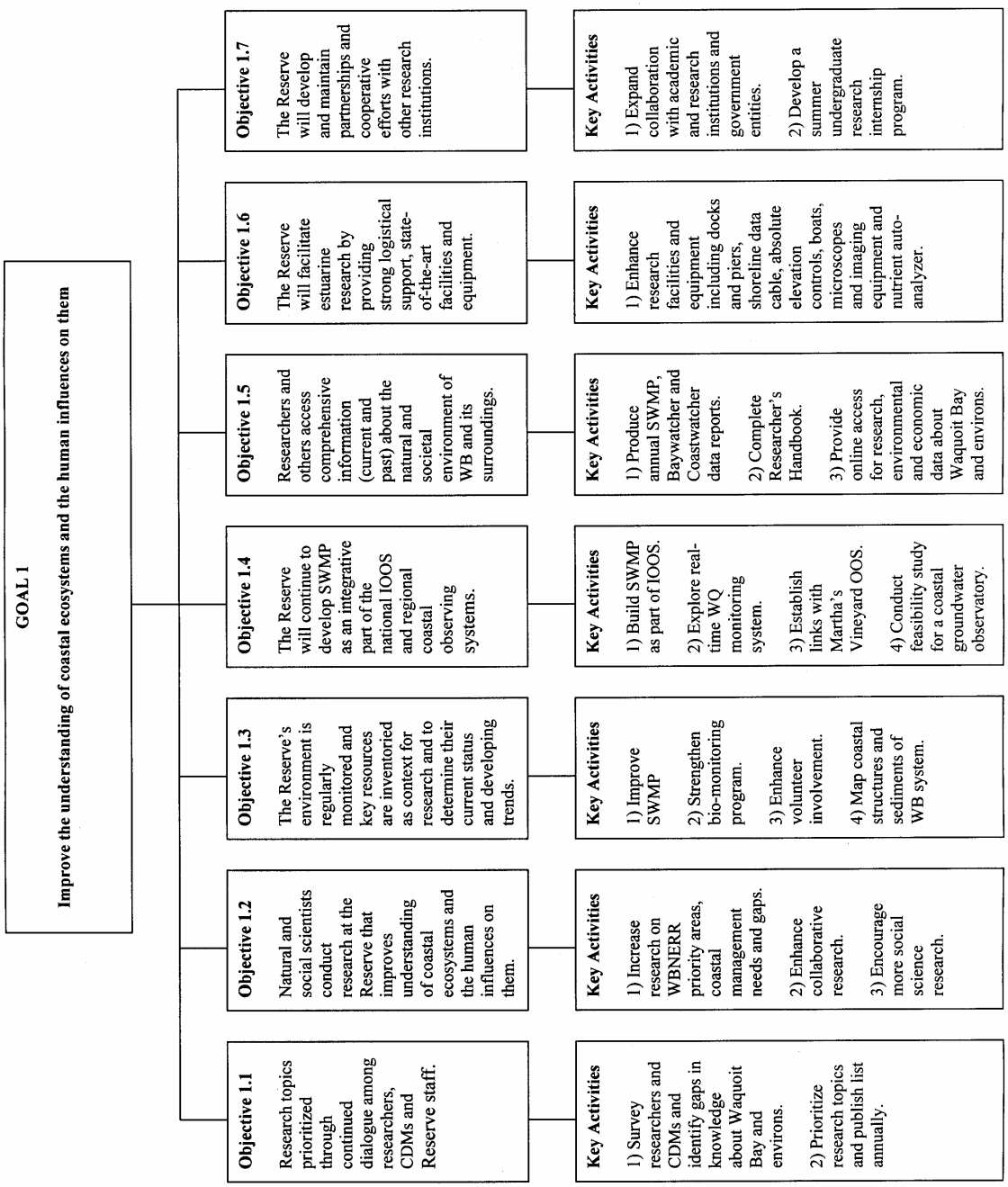
NOAA's stated purposes for management plans are to:

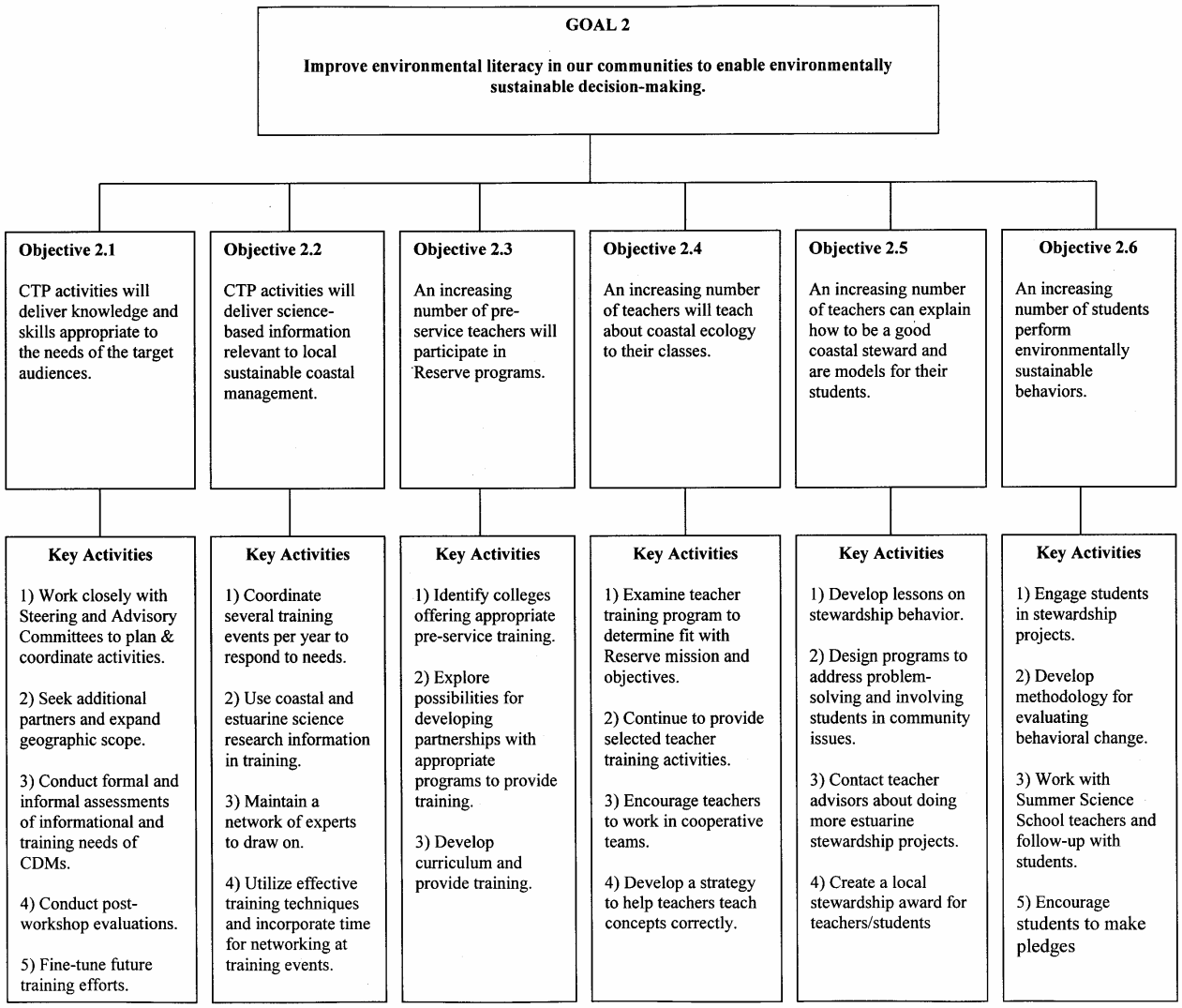
- Provide a vision and framework to guide reserve activities during the next five years.
- Enable the reserves and NOAA to track progress and realize opportunities for growth.
- Present reserve goals, objectives, and strategies for meeting the goals to constituents.
- Guide program evaluation under Section 312 of the CZMA.
- Enable the reserves to acquire facilities construction and land acquisition funds.

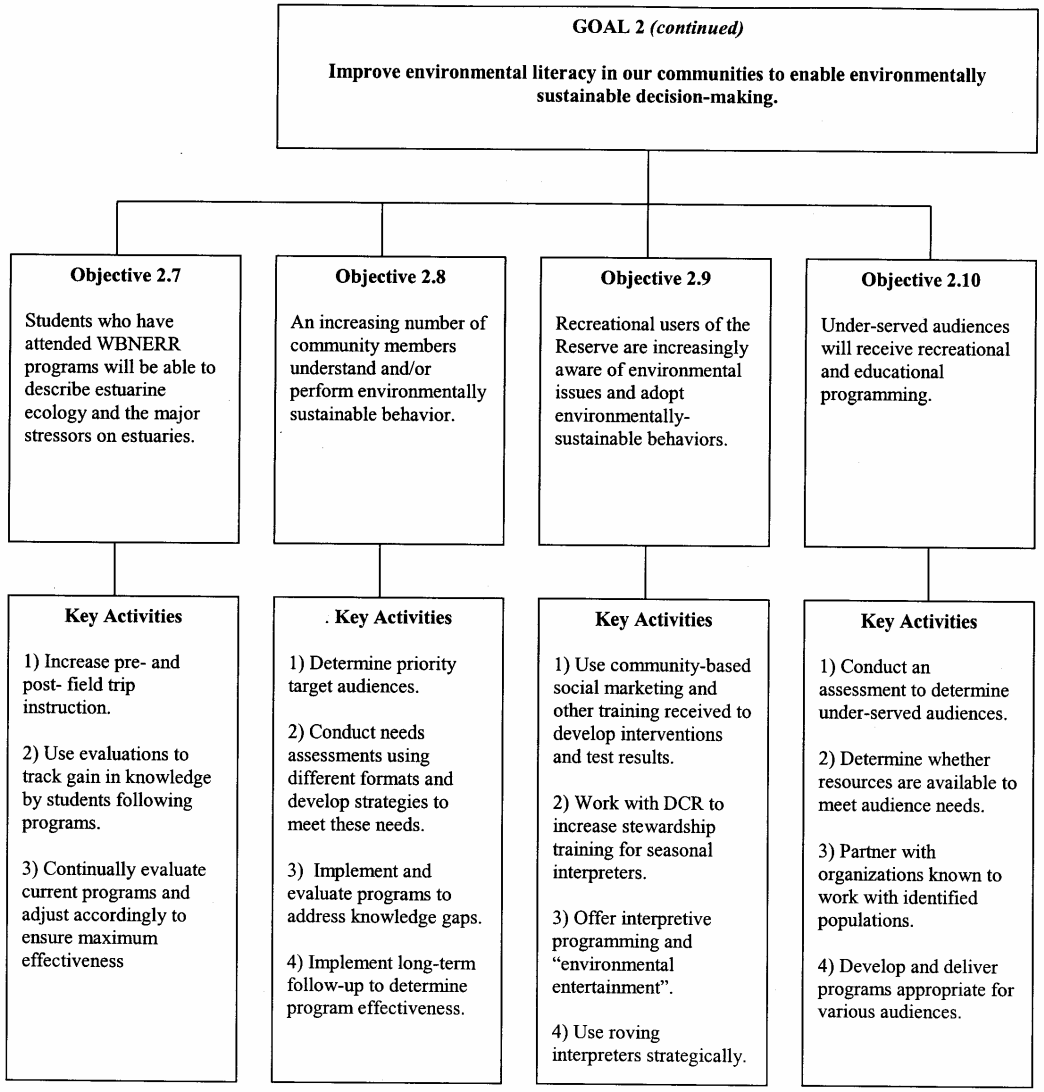
In addition, the Reserve's state partner, DCR, pursuant to M.G.L. Chapter 21, Section 2F, is required to prepare management plans for all reservations, forests and parks under the management of the Department. These plans must include guidelines for operations and land stewardship, shall provide for the protection of natural and cultural resources, and ensure consistency between recreation, resource protection, and sustainable forest management. The Commissioner shall seek and consider public input in the development of management plans, and shall make draft plans available for a public review and comment period through notice in the [Massachusetts] Environmental Monitor. Management plans must be submitted to the DCR Stewardship Council for the Council's adoption. DCR's resource management planning process includes the use of Land Stewardship Zoning Guidelines as a framework for the management of land and resources. The guidelines are incorporated into this management plan.

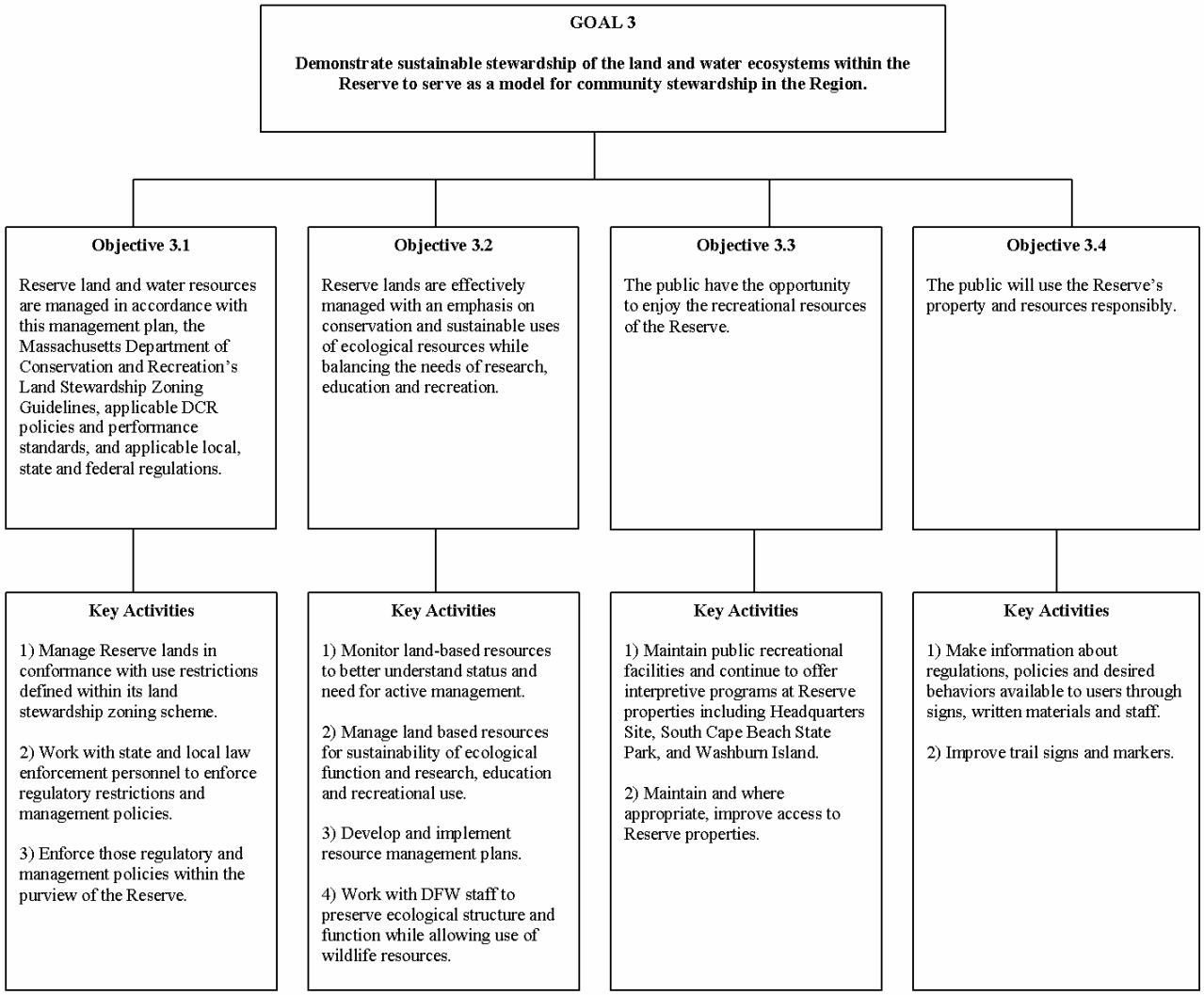
This plan addresses the management planning needs of both partners.

Figure 1: Summary of WBNERR Goals, Objectives and Key Activities.




GOAL 2
Improve environmental literacy in our communities to enable environmentally sustainable decision-making.
Objective 2.1
CTP activities will deliver knowledge and skills appropriate to the needs of the target audiences.
Key Activities
1) Work closely with Steering and Advisory Committees to plan & coordinate activities.
2) Seek additional partners and expand geographic scope.
3) Conduct formal and informal assessments of informational and training needs of CDMs.
4) Conduct post-workshop evaluations.
5) Fine-tune future training efforts.
Objective 2.2
CTP activities will deliver science-based information relevant to local sustainable coastal management.
Key Activities
1) Coordinate several training events per year to respond to needs.
2) Use coastal and estuarine science research information in training.
3) Maintain a network of experts to draw on.
4) Utilize effective training techniques and incorporate time for networking at training events.
Objective 2.3
An increasing number of pre-service teachers will participate in Reserve programs.
Key Activities
1) Identify colleges offering appropriate pre-service training.
2) Explore possibilities for developing partnerships with appropriate programs to provide training.
3) Develop curriculum and provide training.
Objective 2.4
An increasing number of teachers will teach about coastal ecology to their classes.
Key Activities
1) Examine teacher training program to determine fit with Reserve mission and objectives.
2) Continue to provide selected teacher training activities.
3) Encourage teachers to work in cooperative teams.
4) Develop a strategy to help teachers teach concepts correctly.
Objective 2.5
An increasing number of teachers can explain how to be a good coastal steward and are models for their students.
Key Activities
1) Develop lessons on stewardship behavior.
2) Design programs to address problem-solving and involving students in community issues.
3) Contact teacher advisors about doing more estuarine stewardship projects.
4) Create a local stewardship award for teachers/students
Objective 2.6
An increasing number of students perform environmentally sustainable behaviors.
Key Activities
1) Engage students in stewardship projects.
2) Develop methodology for evaluating behavioral change.
3) Work with Summer Science School teachers and follow-up with students.
5) Encourage students to make pledges

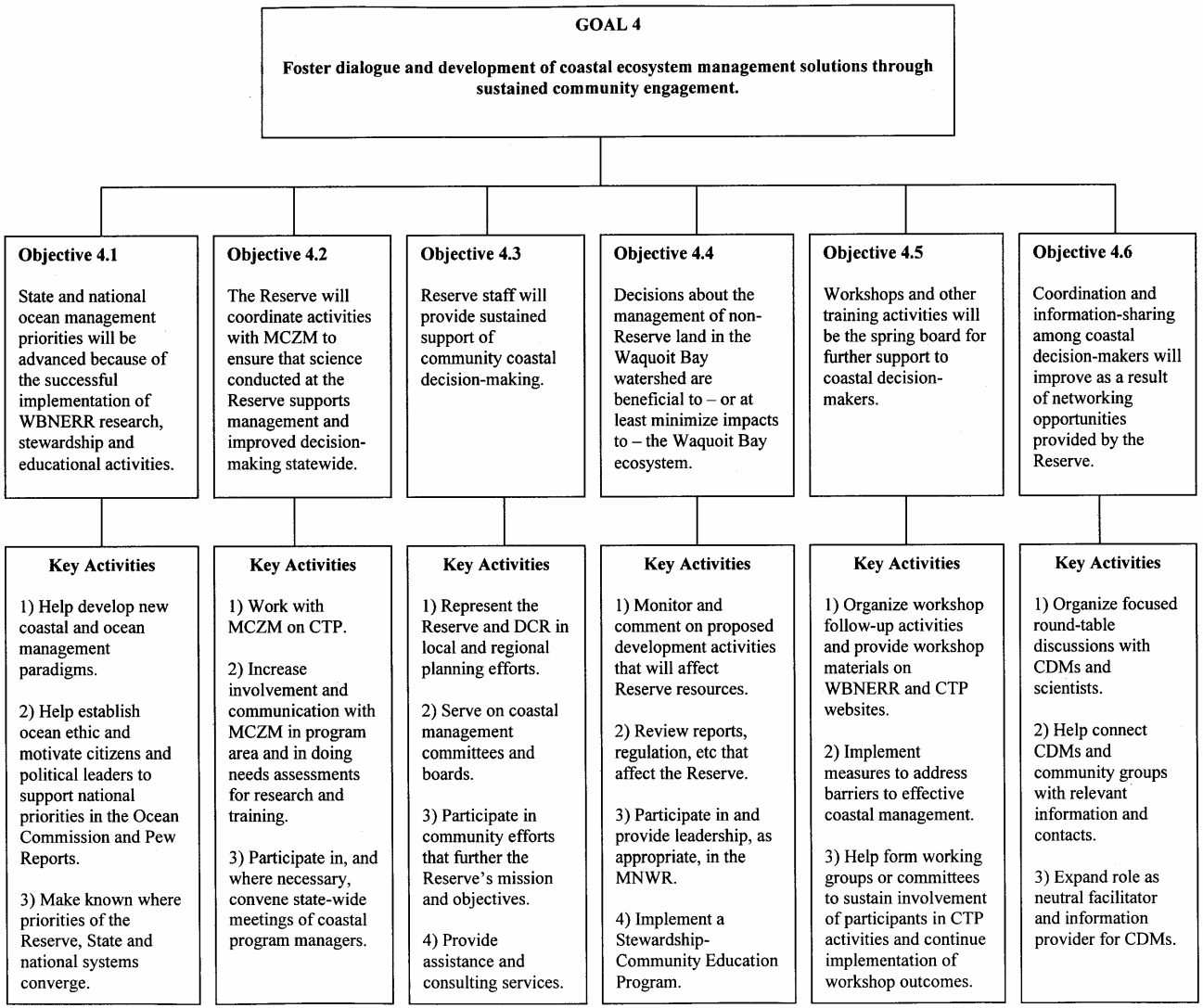

GOAL 2 (continued)
Improve environmental literacy in our communities to enable environmentally sustainable decision-making.
Objective 2.7
Students who have attended WBNERR programs will be able to describe estuarine ecology and the major stressors on estuaries.
Objective 2.8
An increasing number of community members understand and/or perform environmentally sustainable behavior.
Objective 2.9
Recreational users of the Reserve are increasingly aware of environmental issues and adopt environmentally-sustainable behaviors.
Objective 2.10
Under-served audiences will receive recreational and educational programming.
Key Activities
1) Increase pre- and post- field trip instruction.
2) Use evaluations to track gain in knowledge by students following programs.
3) Continually evaluate current programs and adjust accordingly to ensure maximum effectiveness
. Key Activities
1) Determine priority target audiences.
2) Conduct needs assessments using different formats and develop strategies to meet these needs.
3) Implement and evaluate programs to address knowledge gaps.
4) Implement long-term follow-up to determine program effectiveness.
Key Activities
1) Use community-based social marketing and other training received to develop interventions and test results.
2) Work with DCR to increase stewardship training for seasonal interpreters.
3) Offer interpretive programming and "environmental entertainment".
4) Use roving interpreters strategically.
Key Activities
1) Conduct an assessment to determine under-served audiences.
2) Determine whether resources are available to meet audience needs.
3) Partner with organizations known to work with identified populations.
4) Develop and deliver programs appropriate for various audiences.

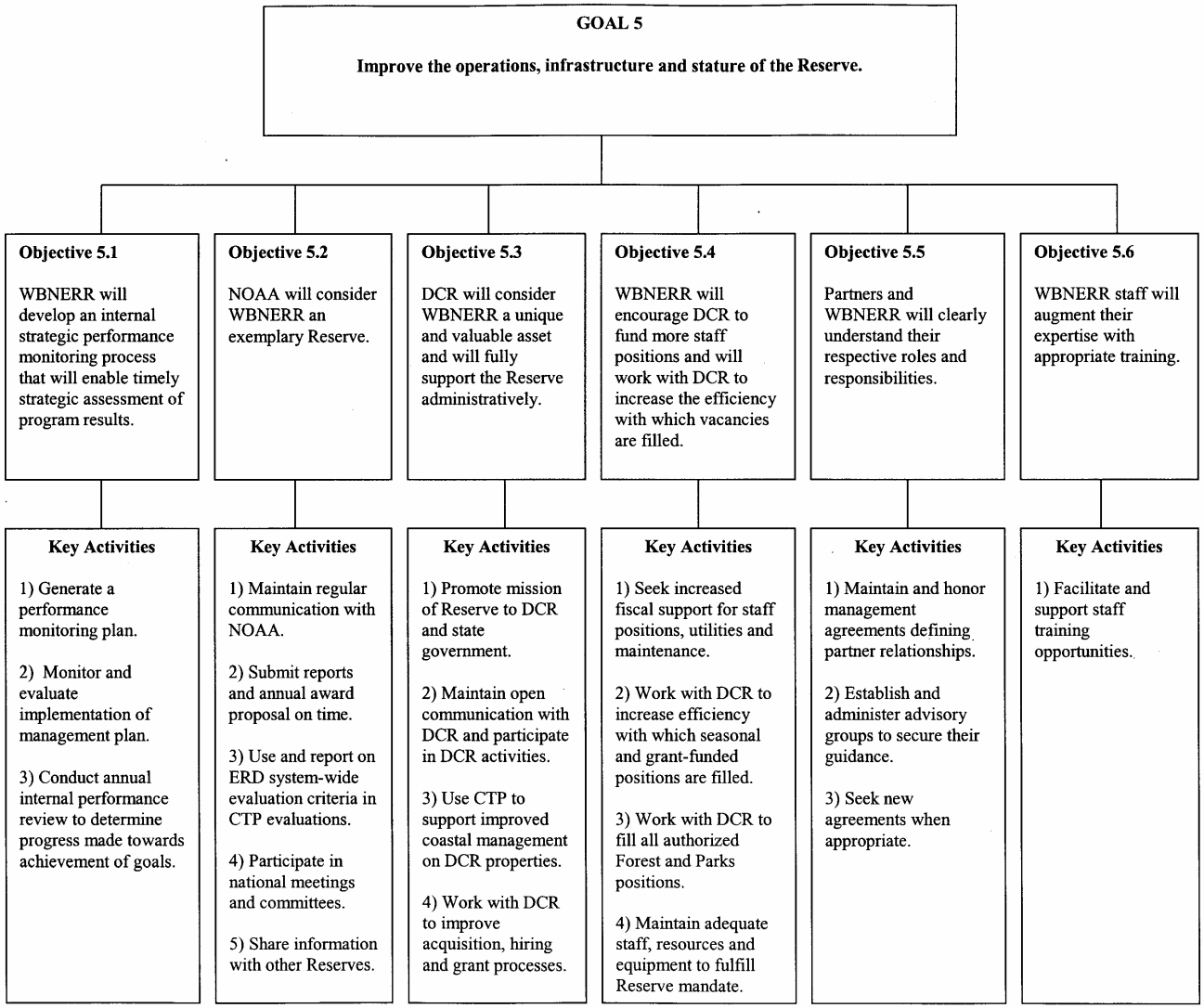

GOAL 3
Demonstrate sustainable stewardship of the land and water ecosystems within the Reserve to serve as a model for community stewardship in the Region.
Objective 3.1
Reserve land and water resources are managed in accordance with this management plan, the Massachusetts Department of Conservation and Recreation's Land Stewardship Zoning Guidelines, applicable DCR policies and performance standards, and applicable local, state and federal regulations.
Objective 3.2
Reserve lands are effectively managed with an emphasis on conservation and sustainable uses of ecological resources while balancing the needs of research, education and recreation.
Objective 3.3
The public have the opportunity to enjoy the recreational resources of the Reserve.
Objective 3.4
The public will use the Reserve's property and resources responsibly.
Key Activities
1) Manage Reserve lands in conformance with use restrictions defined within its land stewardship zoning scheme.
2) Work with state and local law enforcement personnel to enforce regulatory restrictions and management policies.
3) Enforce those regulatory and management policies within the purview of the Reserve.
Key Activities
1) Monitor land-based resources to better understand status and need for active management.
2) Manage land based resources for sustainability of ecological function and research, education and recreational use.
3) Develop and implement resource management plans.
4) Work with DFW staff to preserve ecological structure and function while allowing use of wildlife resources.
Key Activities
1) Maintain public recreational facilities and continue to offer interpretive programs at Reserve properties including Headquarters Site, South Cape Beach State Park, and Washburn Island.
2) Maintain and where appropriate, improve access to Reserve properties.
Key Activities
1) Make information about regulations, policies and desired behaviors available to users through signs, written materials and staff.
2) Improve trail signs and markers.

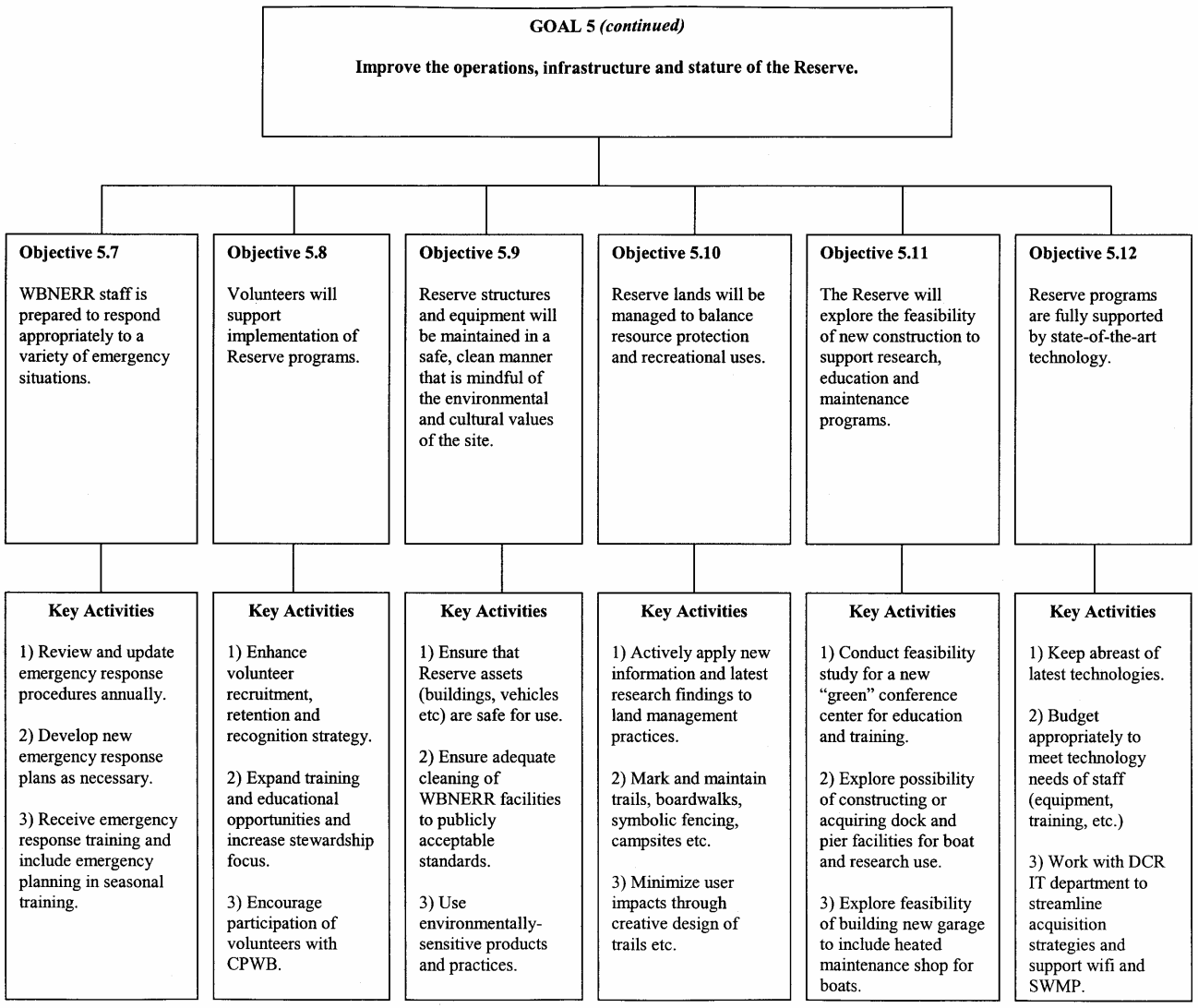
GOAL 3 *(continued)*

Demonstrate sustainable stewardship of the land and water ecosystems within the Reserve to serve as a model for community stewardship in the Region.

Objective 3.5	Objective 3.6	Objective 3.7	Objective 3.8
Ecological function is restored to humanly-altered natural habitats within the watershed.	DCR will acquire real estate rights to key parcels in the Waquoit Bay watershed area to expand the Reserve.	Reserve waters and wetlands are effectively managed with a prioritization on ecological needs while balancing the needs of research, education, recreation and sustainable use of natural resources.	Reserve resource management practices are used as a demonstration and teaching resource for similar coastal habitats in the Region.
Key Activities	**Key Activities**	**Key Activities**	**Key Activities**
1) Create a WBNERR Restoration Science Program consistent with NERRS-supported national Restoration Science Program. 2) Continue work on restoration projects: eelgrass and benthic communities, Quashnet River, South Cape Beach Saltmarsh, Coastal Sandplain, Abigail Brook, Sand Dunes and Threatened Birds.	1) Work with Mashpee National Wildlife Refuge (MNWR) partners to prioritize land for acquisition. 2) Seek funds for land acquisition. 3) Work closely with DCR on land acquisition process.	1) Continue to inventory significant resources and monitor changes. 2) Work with town and state officials to improve management of aquatic resources.	1) Incorporate examples of resource management practices into training and education programs. 2) Include descriptions of resource management activities in publications and on the Reserve's website. 3) Provide signage to explain resource management activities being implemented.

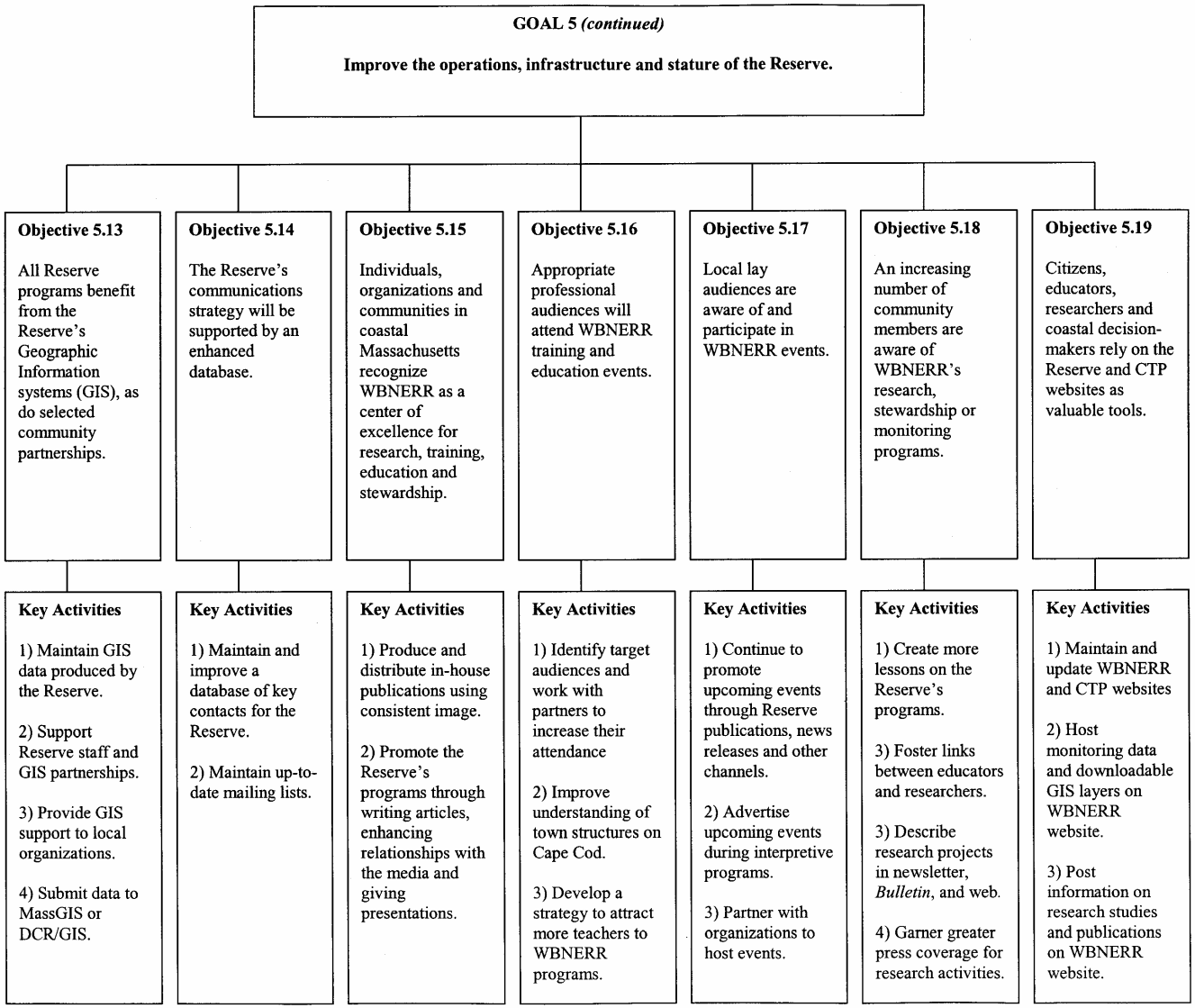

GOAL 4
Foster dialogue and development of coastal ecosystem management solutions through sustained community engagement.
Objective 4.1
State and national ocean management priorities will be advanced because of the successful implementation of WBNERR research, stewardship and educational activities.
Objective 4.2
The Reserve will coordinate activities with MCZM to ensure that science conducted at the Reserve supports management and improved decision-making statewide.
Objective 4.3
Reserve staff will provide sustained support of community coastal decision-making.
Objective 4.4
Decisions about the management of non-Reserve land in the Waquoit Bay watershed are beneficial to – or at least minimize impacts to – the Waquoit Bay ecosystem.
Objective 4.5
Workshops and other training activities will be the spring board for further support to coastal decision-makers.
Objective 4.6
Coordination and information-sharing among coastal decision-makers will improve as a result of networking opportunities provided by the Reserve.
Key Activities
1) Help develop new coastal and ocean management paradigms.
2) Help establish ocean ethic and motivate citizens and political leaders to support national priorities in the Ocean Commission and Pew Reports.
3) Make known where priorities of the Reserve, State and national systems converge.
Key Activities
1) Work with MCZM on CTP.
2) Increase involvement and communication with MCZM in program area and in doing needs assessments for research and training.
3) Participate in, and where necessary, convene state-wide meetings of coastal program managers.
Key Activities
1) Represent the Reserve and DCR in local and regional planning efforts.
2) Serve on coastal management committees and boards.
3) Participate in community efforts that further the Reserve's mission and objectives.
4) Provide assistance and consulting services.
Key Activities
1) Monitor and comment on proposed development activities that will affect Reserve resources.
2) Review reports, regulation, etc that affect the Reserve.
3) Participate in and provide leadership, as appropriate, in the MNWR.
4) Implement a Stewardship-Community Education Program.
Key Activities
1) Organize workshop follow-up activities and provide workshop materials on WBNERR and CTP websites.
2) Implement measures to address barriers to effective coastal management.
3) Help form working groups or committees to sustain involvement of participants in CTP activities and continue implementation of workshop outcomes.
Key Activities
1) Organize focused round-table discussions with CDMs and scientists.
2) Help connect CDMs and community groups with relevant information and contacts.
3) Expand role as neutral facilitator and information provider for CDMs.


GOAL 5
Improve the operations, infrastructure and stature of the Reserve.
Objective 5.1
WBNERR will develop an internal strategic performance monitoring process that will enable timely strategic assessment of program results.
Key Activities
1) Generate a performance monitoring plan.
2) Monitor and evaluate implementation of management plan.
3) Conduct annual internal performance review to determine progress made towards achievement of goals.
Objective 5.2
NOAA will consider WBNERR an exemplary Reserve.
Key Activities
1) Maintain regular communication with NOAA.
2) Submit reports and annual award proposal on time.
3) Use and report on ERD system-wide evaluation criteria in CTP evaluations.
4) Participate in national meetings and committees.
5) Share information with other Reserves.
Objective 5.3
DCR will consider WBNERR a unique and valuable asset and will fully support the Reserve administratively.
Key Activities
1) Promote mission of Reserve to DCR and state government.
2) Maintain open communication with DCR and participate in DCR activities.
3) Use CTP to support improved coastal management on DCR properties.
4) Work with DCR to improve acquisition, hiring and grant processes.
Objective 5.4
WBNERR will encourage DCR to fund more staff positions and will work with DCR to increase the efficiency with which vacancies are filled.
Key Activities
1) Seek increased fiscal support for staff positions, utilities and maintenance.
2) Work with DCR to increase efficiency with which seasonal and grant-funded positions are filled.
3) Work with DCR to fill all authorized Forest and Parks positions.
4) Maintain adequate staff, resources and equipment to fulfill Reserve mandate.
Objective 5.5
Partners and WBNERR will clearly understand their respective roles and responsibilities.
Key Activities
1) Maintain and honor management agreements defining partner relationships.
2) Establish and administer advisory groups to secure their guidance.
3) Seek new agreements when appropriate.
Objective 5.6
WBNERR staff will augment their expertise with appropriate training.
Key Activities
1) Facilitate and support staff training opportunities.


GOAL 5 (continued)
Improve the operations, infrastructure and stature of the Reserve.
Objective 5.7
WBNERR staff is prepared to respond appropriately to a variety of emergency situations.
Objective 5.8
Volunteers will support implementation of Reserve programs.
Objective 5.9
Reserve structures and equipment will be maintained in a safe, clean manner that is mindful of the environmental and cultural values of the site.
Objective 5.10
Reserve lands will be managed to balance resource protection and recreational uses.
Objective 5.11
The Reserve will explore the feasibility of new construction to support research, education and maintenance programs.
Objective 5.12
Reserve programs are fully supported by state-of-the-art technology.
Key Activities
1) Review and update emergency response procedures annually.
2) Develop new emergency response plans as necessary.
3) Receive emergency response training and include emergency planning in seasonal training.
Key Activities
1) Enhance volunteer recruitment, retention and recognition strategy.
2) Expand training and educational opportunities and increase stewardship focus.
3) Encourage participation of volunteers with CPWB.
Key Activities
1) Ensure that Reserve assets (buildings, vehicles etc) are safe for use.
2) Ensure adequate cleaning of WBNERR facilities to publicly acceptable standards.
3) Use environmentally-sensitive products and practices.
Key Activities
1) Actively apply new information and latest research findings to land management practices.
2) Mark and maintain trails, boardwalks, symbolic fencing, campsites etc.
3) Minimize user impacts through creative design of trails etc.
Key Activities
1) Conduct feasibility study for a new "green" conference center for education and training.
2) Explore possibility of constructing or acquiring dock and pier facilities for boat and research use.
3) Explore feasibility of building new garage to include heated maintenance shop for boats.
Key Activities
1) Keep abreast of latest technologies.
2) Budget appropriately to meet technology needs of staff (equipment, training, etc.)
3) Work with DCR IT department to streamline acquisition strategies and support wifi and SWMP.

GOAL 5 ***(continued)***

Improve the operations, infrastructure and stature of the Reserve.



Accomplishments

There have been significant accomplishments during the past five years. These include:

- Acquisition of several parcels of land and an associated boundary change that will be formalized with this management plan.
- Evolution of the Research Translator position into the Coastal Training Coordinator position.
- Formal creation of the Massachusetts Coastal Training Program.
- Expansion of the number of staff positions to include the stewardship coordinator, technology coordinator, events coordinator, volunteer and interpretive coordinator, and assistant research coordinator positions.
- Initiation of a biomonitoring program.
- Graduate credit courses for teachers.
- Increased work with communities to implement solutions to coastal management challenges.
- Expanded collaborations.

NOAA Final Evaluation Findings

This plan includes objectives that address recommendations made by the NOAA evaluation team as a result of the most recent Section 312 (of the CZMA) Evaluation of the Commonwealth's management of the Reserve. The report issued by NOAA in November 2004 offers seven recommendations that are intended to increase the ability of the Reserve to fulfill its obligations as part of the NERRS (see Appendix K). Five of these recommendations are specific to the relationship between WBNERR and DCR and address Reserve placement within the agency, hiring and procurement processes, the need to fill all authorized positions, and additional financial support from the State.

Plan Highlights

The objectives in this plan represent a maturation of many of the Reserve's ongoing programs and the introduction of a few new initiatives. Some of the highlights are listed below.

New and recent activities documented with this plan:

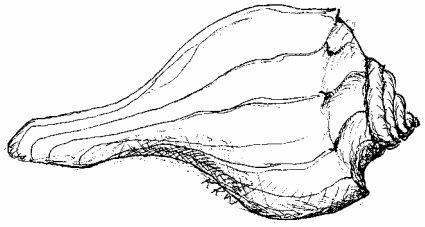
- With this management plan, new properties purchased over the past five years are being formally added to the Waquoit Bay NERR. These parcels include the two Childs River parcels, the Abigail Brook land, the Phinney property, and the recently donated NStar land. Protection of these properties prevents their future development and, thus, eliminates potential new sources of nitrogen in the Waquoit Bay estuarine ecosystem. Inclusion of these properties within the Reserve boundary adds underrepresented habitats typical of the biogeographic province, including various migratory fish runs, coastal forested uplands and

freshwater wetlands. These properties also provide previously non-existing access and further opportunities for the Reserve's research and education programs.

- Development of the System-wide Monitoring Program (SWMP) as an integrative part of the national Integrated Ocean Observing System (IOOS) and regional ocean observing systems.
- Reemphasis on collecting and providing comprehensive information about the Waquoit Bay system to be made available to scientists and to be translated to coastal decision-makers dealing with coastal management issues in similar embayments in the region.
- A more strategic approach to evaluating the effectiveness of the Reserve's programs.
- Increased activities that provide sustained support of community coastal-decision making.
- Increased collaborative efforts to affect better coastal management.
- Increased use of the lessons learned in the Reserve's resource management and restoration practices in training programs.
- Continued and increased coordination with partners, in particular, other coastal management organizations.

New initiatives to be pursued during the term of this management plan:

- Increased state funding for staff positions and/or greater state support for Reserve activities through increased efficiencies.
- New facilities including a coastal training center seating 125 people, a dock for researchers, and a garage large enough for indoor boat and vehicle maintenance during the winter months.
- Application of community-based social-marketing (social science) in the Reserve's activities supporting sustainable coastal communities through science.
- More emphasis on invasive species management and the development of specific resource plans.
- Expansion of the biomonitoring program.
- Development of an integrated restoration science program.
- An increase in the geographic scope of the Reserve's services.
- Training of pre-service teachers.
- More in-depth, longer-term, effective programming for the public, coastal decision-makers and teachers.
- Greater emphasis on increasing public awareness of the research, monitoring, and stewardship activities of the Reserve.



Chapter 1: Introduction

Purpose and Scope of Plan

Waquoit Bay National Estuarine Research Reserve Management Plan 2006-2011 is the third management plan for the Waquoit Bay National Estuarine Research Reserve (WBNERR). It describes the history, assets, programs, and administrative structures of WBNERR. It also defines and lays out the strategy for meeting the Reserve's mission, vision and goals over the next five years.

Mission: To improve the stewardship of the region's estuarine and coastal watershed ecosystems.

Vision: To be recognized as a vital regional resource for expertise on sustainable coastal management provided through integrated programs of coastal ecosystem research and monitoring; management and stewardship; and education and training aimed at coastal communities, organizations, and individuals.

Goals:

1. Improve the understanding of coastal ecosystems and the human influences on them.

2. Improve environmental literacy in our communities to enable environmentally-sustainable decision-making.

3. Demonstrate sustainable stewardship of the land and water ecosystems within the Reserve to serve as a model for community stewardship in the region.

4. Foster dialogue and development of coastal ecosystem management solutions through sustained community engagement.

5. Improve the operations, infrastructure and stature of the Reserve.

The Management Plan is organized by goals rather than strictly by program area. This being said, the first three goals primarily address the Reserve's program areas of research and monitoring, training and education, and stewardship, respectively. The interconnectedness of the program areas is most especially demonstrated in Chapter 5 which addresses Goal 4 and in the objectives and action items that are listed within each chapter. All of the programs address the themes of water quality/eutrophication, climate change/renewable energy, and coastal ecosystem management.

In addition to goals and theme areas, the Reserve is guided by a series of principles. These overarching guiding principles describe how the Reserve conducts business. They are:

- WBNERR staff from all program and administrative areas collaborates to advance the Reserve's goals and objectives and, thereby, improve stewardship of the region's estuarine and coastal watershed ecosystems.

- Reserve activities and programs are targeted to lead to real behavioral change in support of better coastal stewardship.

- The Reserve guides people toward environmental literacy by presenting information systematically and strategically, and by providing opportunities for people to become engaged in problem solving on environmental issues, over an extended time.

- The Reserve works in partnership with others at the local, state, and Federal level.

- Reserve programs capitalize on the physical setting of the Reserve to inspire questions, learning, and conscious decision-making.

- The management and programs of the Reserve demonstrate good environmental practices and behaviors.

- The Reserve protects natural resources within its designated lands and waters from degradation.

- The Reserve facilitates innovative inquiry of natural and social systems affecting the coast.

- WBNERR staff conducts regular, critical self-evaluations of programs to continually improve the Reserve's scientific, stewardship and educational offerings.

- WBNERR staff conducts their work with integrity, respect, openness, and excellence.

Public Process for Developing the Plan

The *Waquoit Bay National Estuarine Research Reserve Management Plan, 2006-2011* was developed with input from core constituents and partners. About a dozen citizens attended a public meeting on December 8, 2004 to offer their advice about where the Waquoit Bay Research Reserve's efforts should be focused over the next five years. Participants were invited to address three broad questions:

- Which of the Reserve's programs are most beneficial?
- Which could be improved? and,
- Are there unmet needs the Reserve can address?

WBNERR staff also met individually with representatives of the scientific, education, and coastal management communities (refer to Acknowledgements) to solicit their insight and recommendations for future management of the Reserve. The WBNERR interviewer prepared notes following each meeting and shared these with other staff members, as appropriate, for their consideration and potential inclusion in the Management Plan.

A full draft of the *Management Plan* was circulated in the summer of 2005 to key partners within state and Federal government. Once recommendations generated by this first review were incorporated and partner agencies were comfortable with the content of the plan, a 30-day public comment period was initiated by publishing a notice in the MEPA Environmental Monitor on April 10, 2006. A public meeting was held May 3, 2006. A summary of all comments received during the MEPA review and actions taken to address them is included in Appendix A.

The Massachusetts Office of Coastal Zone Management (MCZM) also reviewed the management plan for federal consistency. They found that the plan is consistent with the MCZM enforceable program policies (Appendix B).

Reserve Management Structure

The Reserve is a component of the National Estuarine Research Reserve System (NERRS), a Federal-state partnership of protected research sites administered by the National Oceanic and Atmospheric Administration's (NOAA's) Estuarine Reserve Division (ERD) within the Office of Coastal Resources Management (OCRM). The state partner is the Massachusetts Department of Conservation and Recreation (DCR). The strategy laid out in this management plan for Waquoit Bay NERR supports and/or complements the Federal NERRS priorities and satisfies DCR's management planning requirements.

The Reserve manager and staff are DCR employees. They strive to align the Reserve's activities with both NOAA and DCR priorities while remaining true to their mission to improve stewardship of the region's estuarine and coastal watershed ecosystems. The complexity of this three-way relationship is expanded upon in Chapter 6.

Introduction to the National Estuarine Research Reserve System

The National Estuarine Reserve System was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. The CZM Program is dedicated to comprehensive, sustainable management of the nation's coasts.

The reserve system is a network of protected areas established to promote informed management of the Nation's estuaries and coastal habitats. The reserve system currently consists of 26 reserves in 21 states and territories, protecting over one million acres of estuarine lands and waters.

Mission

As stated in the NERRS regulations, 15 C.F.R. Part 921.1(a), the National Estuarine Research Reserve System mission is:

> *the establishment and management, through Federal-state cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.*

Goals

Federal regulations, 15 C.F.R. Part 921.1(b), provide five specific goals for the reserve system:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the System;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

National Estuarine Research Reserve System Strategic Goals 2003 – 2008

The reserve system began a strategic planning process in 1994 in an effort to help NOAA achieve its environmental stewardship mission to "sustain healthy coasts." In conjunction with the strategic planning process, ERD and reserve staff has conducted a multi-year action planning process on an annual basis since 1996. The resulting three-year action plan provides an overall vision and direction for the reserve system.

Reserve System Strategic Plan Goals (revised 2002):

1. Improve coastal decision-making by generating and transferring knowledge about coastal ecosystems.
2. Enhance and expand the National Estuarine Research Reserve System.
3. Increase awareness, use, and support of the reserve system and its estuarine science, education, and stewardship programs.

Biogeographic Regions

NOAA has identified eleven distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the reserve system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2004, the reserve system includes twenty-seven reserves and one reserve in the process of designation. (Figure 2). The reserves are listed below with their designation date.

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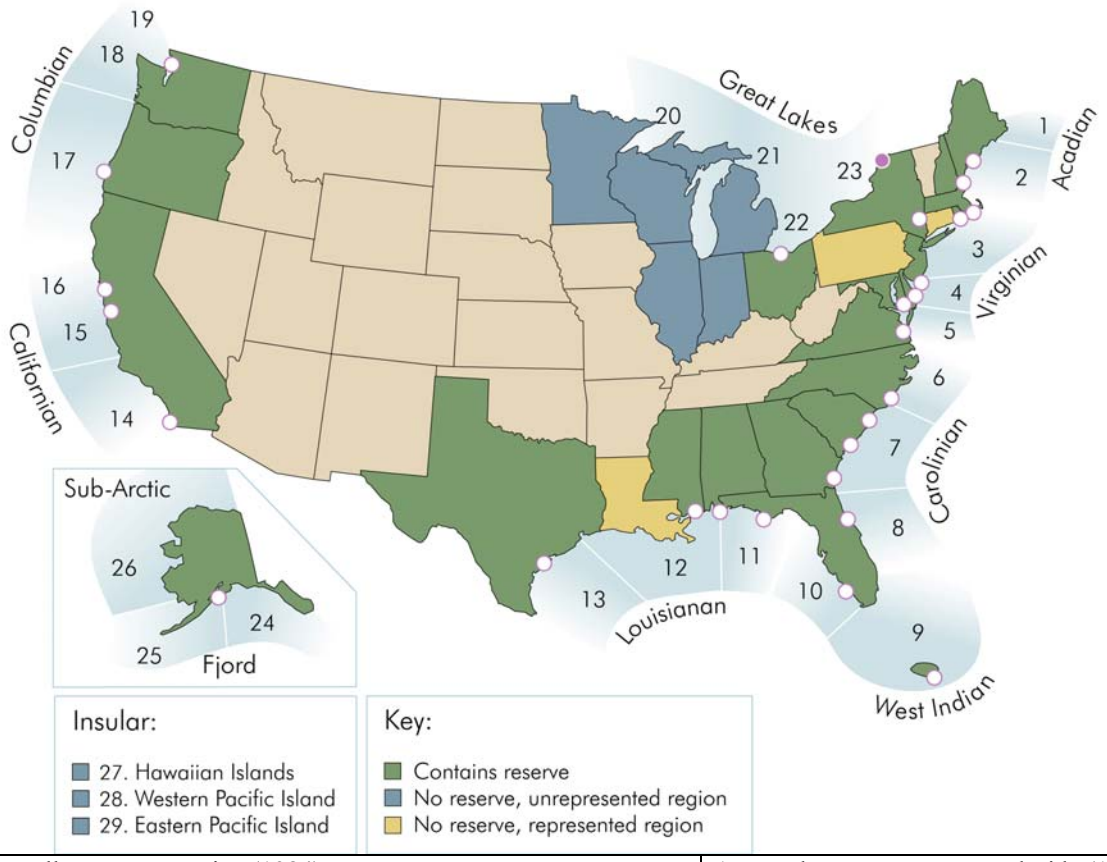
Figure 2: National Estuarine Research Reserve System.



1. Wells Reserve, Maine (1984)	15. Rookery Bay Reserve, Florida (1978)
2. Great Bay Reserve, New Hampshire (1989)	16. Apalachicola Reserve, Florida (1979)
3. Waquoit Bay Reserve, Massachusetts (1988)	17. Weeks Bay Reserve, Alabama (1986)
4. Narragansett Bay Reserve, Rhode Island (1980)	18. Grand Bay Reserve, Mississippi (1999)
5. Hudson River Reserve, New York (1982)	19. Mission-Aransas Reserve, Texas
6. Jacques Cousteau Reserve, New Jersey (1998)	20. Tijuana River Reserve, California (1982)
7. Delaware Reserve (1993)	21. Elkhorn Slough Reserve, California (1979)
8. Chesapeake Bay Reserve, Maryland (1985,1990)	22. San Francisco Bay, California (2003)
9. Chesapeake Bay Reserve, Virginia (1991)	23. South Slough Reserve, Oregon (1974)
10. North Carolina Reserve (1985,1991)	24. Padilla Bay Reserve, Washington (1980)
11. North Inlet-Winyah Bay Reserve, South Carolina (1992)	25. Old Woman Creek, Ohio (1980)
12. ACE Basin Reserve, South Carolina (1992)	26. Proposed Reserve—St. Lawrence River
13. Sapelo Island, Georgia (1976)	27. Kachemak Bay Reserve, Alaska (1999)
14. Guana Tolomato Matanzas Reserve, Florida (1999)	28. Jobos Bay Reserve, Puerto Rico (1981)

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Reserve Designation and Operation

Under Federal law (16 U.S.C. Section 1461), a state can nominate an estuarine ecosystem for Research Reserve status so long as the site meets the following conditions:

1. The area is representative of its biogeographic region, is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
2. The law of the coastal State provides long-term protection for the proposed Reserve's resources to ensure a stable environment for research;
3. Designation of the site as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and
4. The coastal State has complied with the requirements of any regulations issued by the Secretary [of Commerce].

Reserve boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

If the proposed site is accepted into the reserve system, it is eligible for NOAA financial assistance on a cost-share basis with the state. The state exercises administrative and management control, consistent with its obligations to NOAA, as outlined in a memorandum of understanding. A reserve may apply to NOAA's ERD for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

National Estuarine Research Reserve System Administrative Framework

The Estuarine Reserves Division of the Office of Ocean and Coastal Resource Management (OCRM) administers the reserve system. The Division establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates reserves for compliance with Federal requirements and with the individual reserve's Federally-approved management plan.

The Estuarine Reserves Division currently provides support for three system-wide programs: the System-Wide Monitoring Program, the Graduate Research Fellowship Program, and the Coastal Training Program. They also provide support for reserve initiatives on restoration science, invasive species, K-12 education, and reserve specific research, monitoring, education and resource stewardship initiatives and programs.

Massachusetts Department of Conservation and Recreation

When Waquoit Bay was formally designated as a National Estuarine Research Reserve in 1988, its state partner was the Department of Environmental Management (DEM). In July of 2003, DEM was merged with the Metropolitan District Commission to form the Department of Conservation and Recreation (see Mass General Law c21§1). The new agency serves to realize operational efficiencies, regain Massachusetts' position at the forefront of the Conservation Movement and also to build upon both agencies' strengths and commitment to creating a world-class parks and recreation system.

The mission of the Department of Conservation and Recreation is to protect, promote, and enhance the natural, cultural and recreational resources of the Commonwealth for the well being of all. In terms of values, DCR staff believes deeply in, and is committed to, the public trust and responsible stewardship, as well as fairness and inclusiveness. Staff also commits to do their work with integrity, respect, openness, and excellence.

DCR manages many facilities that annually attract hundreds of thousands of people from around the globe, including Pilgrim Memorial State Park, the home of Plymouth Rock; Walden Pond State Reservation, Henry David Thoreau's chosen place for peaceful contemplation; the Emerald Necklace of urban parks designed by Frederick Law Olmsted; and the Charles River Esplanade, host site for the Boston Pops' Fourth of July concert and fireworks festivities. In total, more than 35 million people visit Massachusetts' state and urban parks each year.

DCR promotes smart growth in the Commonwealth and helps private landowners and municipalities to protect land and resources through technical assistance, grants programs, and other resource protection services.

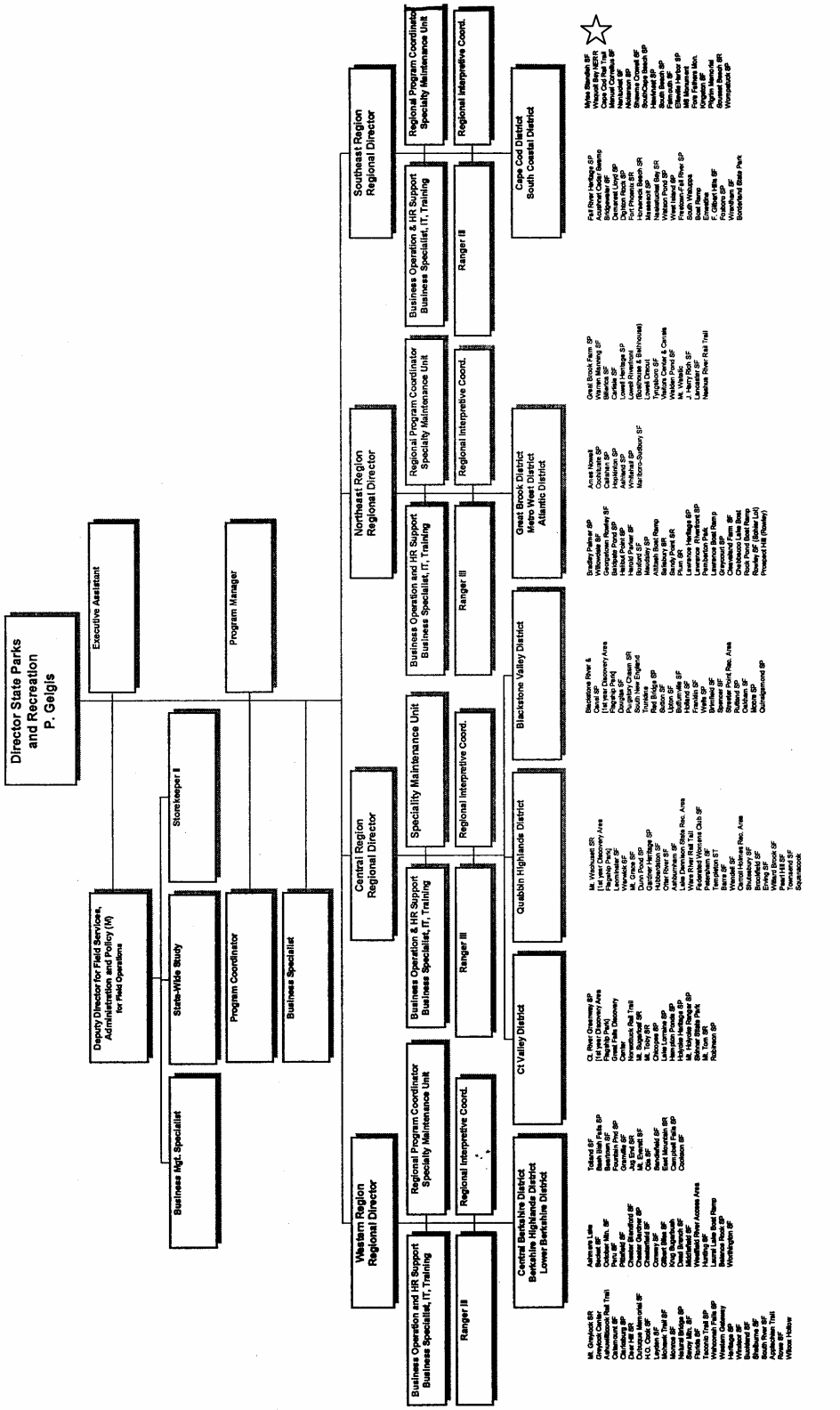
DCR staff also provides environmental education programs and oversight for state-designated Areas of Critical Environmental Concern. DCR's stewardship of Massachusetts' natural and historical resources provides significant benefits to the Commonwealth, its citizens, and visitors: healthy, productive forests; clean drinking water; flood control; scenic beauty; historic preservation; healthy ecosystems; wildlife habitat protection; and coastal access, as well as improved public safety and public health.

The agency is divided into three resource divisions: the Division of Urban Parks and Recreation, the Division of Water Supply and Protection, and the Division of State Parks and Recreation (DSPR), of which the Waquoit Bay Reserve is a part (Figure 3). The DSPR is dedicated to improving the quality of life in the Commonwealth of Massachusetts by conserving our natural and cultural resources through professional stewardship, and connecting people to these resources through recreation and education, and cooperating and partnering with others who share our common purpose. The DSPR is the steward of nearly 300,000 acres of the state's forests, beaches, mountains, ponds, riverbanks, trails, and parks outside of the urban park area. The DSPR also manages 20 outdoor swimming pools and owns 18 skating rinks which are managed through leasing

agreements with outside vendors. The DSPR protects land and resources on privately and municipally held land through technical assistance, grant programs, planning programs, policy development, and other resource protection services.

Pursuant to M.G.L. Chapter 21, Section 2F, DCR is required to prepare management plans for all reservations, forests and parks under its management. These plans must include guidelines for operations and land stewardship, shall provide for the protection of natural and cultural resources, and ensure consistency between recreation, resource protection, and sustainable forest management. The Commissioner of DCR shall seek and consider public input in the development of management plans, and shall make draft plans available for a public review and comment period through notice in the Environmental Monitor. Management plans must be submitted to the DCR Stewardship Council for the Council's adoption.

Figure 3: DCR Division of State Parks and Recreation Organizational Chart.



History of Waquoit Bay Reserve

In response to growing recognition of the importance of estuaries and the changes to them resulting from coastal development, Massachusetts established an estuarine research program in 1963. Results of the study were published in 1975 and the data were subsequently utilized to calculate indices comparing species diversity with environmental quality for selected estuaries within the state.

Between 1974 and 1978, the Commonwealth of Massachusetts investigated the feasibility of applying to the National Estuarine Sanctuary Program (the former name of the National Estuarine Research Reserve System) and considered several possible sites for sanctuary status. At that time the North–South River complex and Waquoit Bay were selected as sites most likely to meet the requirements of the Federal program and benefit from the research and education programs and protection that the designation would provide.

In 1979, the Commonwealth designated Waquoit Bay as an Area of Critical Environmental Concern (ACEC) in accordance with Massachusetts General Laws Chapter 21A Section 2(7). See Chapter 4 for more information about the ACEC program and a map of the Waquoit Bay ACEC (Figure 15). This designation followed an extensive public participation process during which major management issues for the area were addressed and interest in establishing National Estuarine Sanctuary status was expressed.

Based on the results of the earlier research program and review of alternative sites, Massachusetts recommended Waquoit Bay for designation as a National Estuarine Sanctuary in July 1981. The area proposed included the land and water areas commonly known as Waquoit Bay, Washburn Island, South Cape Beach, the Sargent Estate, Sage Lot Pond, Flat Pond, Hamblin Pond, Jehu Pond and the major salt marshes immediately adjacent to those areas.

In 1981, the Commonwealth applied for and was awarded a Federal “pre-acquisition” grant for further evaluation of the site, collection of information necessary for the preparation of a management plan and a draft environmental impact statement, and preliminary acquisition activities.

In December 1982, the Commonwealth acquired South Cape Beach and in June 1983, the Commonwealth acquired Washburn Island. Based on this commitment to protect significant components of the Waquoit Bay ecosystem, the Commonwealth successfully applied for additional Federal assistance to develop Waquoit Bay as a National Estuarine Sanctuary. The NOAA funding was used to acquire, in November of 1987, the 21-acres of wetlands, waters, and uplands of the Sargent Estate at the head of the Bay to serve as the Reserve Visitor Center and Headquarters. The NOAA funding was also used for construction of necessary support facilities and equipment for Reserve research and education. Formal designation of the Waquoit Bay National Estuarine Research Reserve took place in June 1988.

Boundaries

The Reserve continues to pursue strategic land acquisitions that may expand the Reserve boundary in the future. With the addition of 95 acres of new acquired lands, the Reserve now has a total area of 2,780 acres. This includes 1,286 acres of lands owned by the Commonwealth of Massachusetts, 1,359 acres of waters held in trust by the Commonwealth, as well as 135 acres of privately owned salt marshes or "major marsh areas" (described in the original designation, the 1989 Management Plan and the 2000 Management Plan) which are private in-holdings within the Reserve boundary in which resources are protected by the laws and regulations described under objective 3.1 beginning on page 83. Lands protected within the Reserve are distributed among eight distinct areas (refer to Figure 4):

- Headquarters, 21 acres of land
- Childs River, 19 acres of land
- Washburn Island, 286 acres of land
- Phinney Property, 10 acres of land
- Quashnet Woods (which includes the new 31 acre NStar property), 426 acres of land
- North Quashnet, 27 acres of land
- Abigail Brook, 35 acres of land
- South Cape Beach State Park, 462 acres of land

With the formal acceptance of the July 2000 Management Plan, two parcels of land were added to the boundary of the Waquoit Bay NERR: the Quashnet River Area and the Great Flat Pond parcel. The Quashnet River land was—and remains—the property of the Commonwealth of Massachusetts and is jointly managed by two state agencies: the Department of Fisheries and Wildlife and the Department of Conservation and Recreation. The Great Flat Pond land was purchased by the Commonwealth from a private entrepreneur and, thus, saved from development. Both parcels are also within the Mashpee National Wildlife Refuge (MNWR). The Refuge was established in 1995 to assure long-term protection of the unique and highly productive natural resources associated with the Waquoit Bay watershed. The MNWR boundary wraps around and overlaps the Reserve in several places. WBNERR is a member of the eight-party MNWR Conservation Partnership. Together, they have protected over 1,400 additional acres in the Waquoit Bay watershed since 1995.

With this management plan, new properties purchased over the past five years are being formally added to the Waquoit Bay NERR. Most of these additional lands have been added as a result of WBNERR's involvement with the Mashpee National Wildlife Refuge (MNWR) Conservation Partnership.

The Reserve added 19 acres in the Childs River in 2002 and in 2003 acquired the Abigail Brook property, a 35-acre parcel of important estuarine habitat. The Reserve purchased

10 acres called the Phinney property in 2004. In spring 2005, a 31 acre parcel, known as the NStar parcel, was added to the Quashnet River Area.

The addition of these lands to the Reserve's boundary is consistent with the goals of the Reserve System. Specifically, the expansion increases the amount of protected land within the rapidly developing Waquoit Bay watershed (Figure 5). These lands represent a stable environment for research and stewardship. They also provide additional opportunities for education, training and interpretive programs leading to enhanced public understanding of estuarine areas and coastal management issues. Furthermore, by protecting these lands from development, the Reserve has reduced potential nitrogen loading to the Waquoit Bay estuarine system. Refer to Objective 3.6 for further discussion of the WBNERR boundary expansion.

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Figure 4: WBNERR Boundaries.

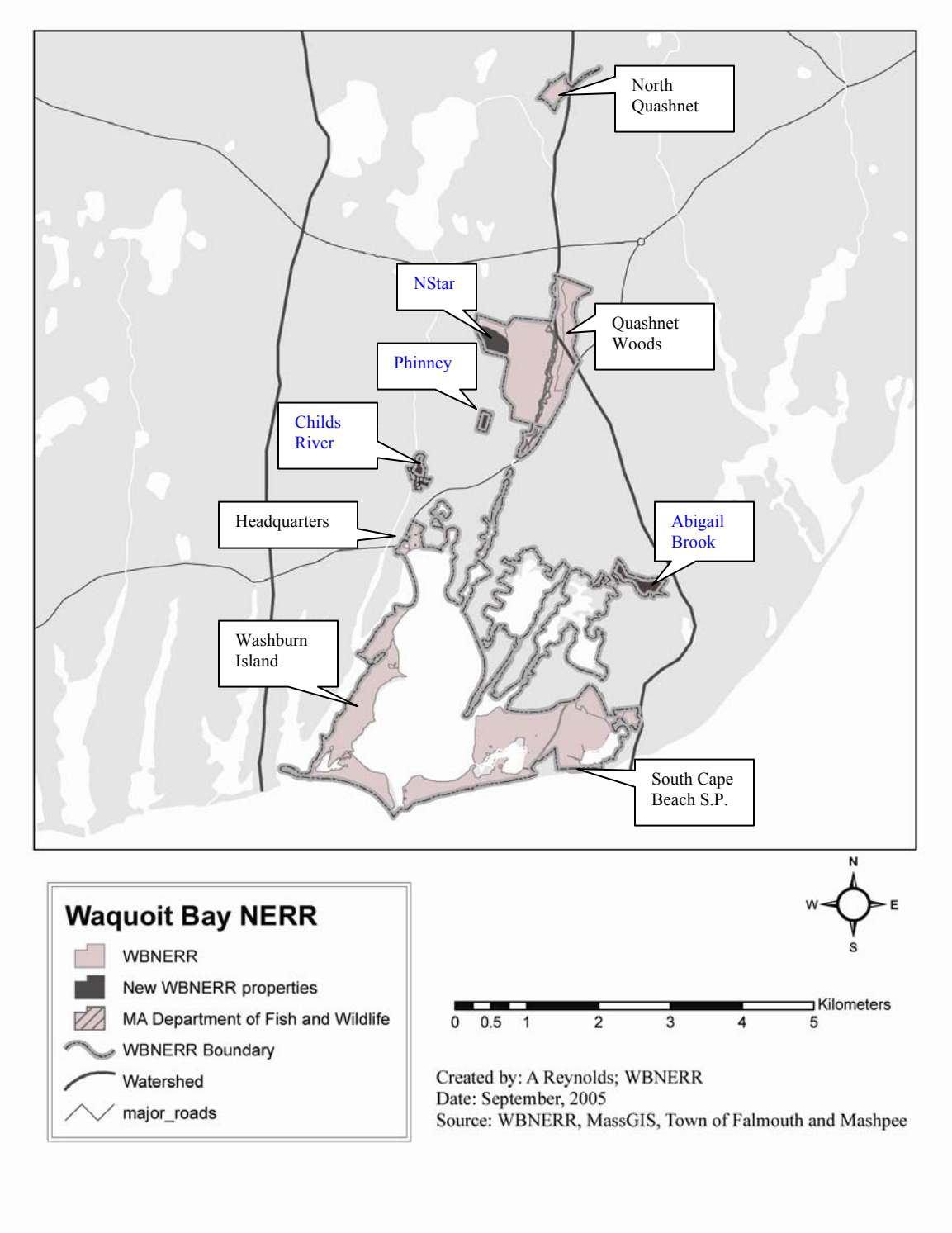
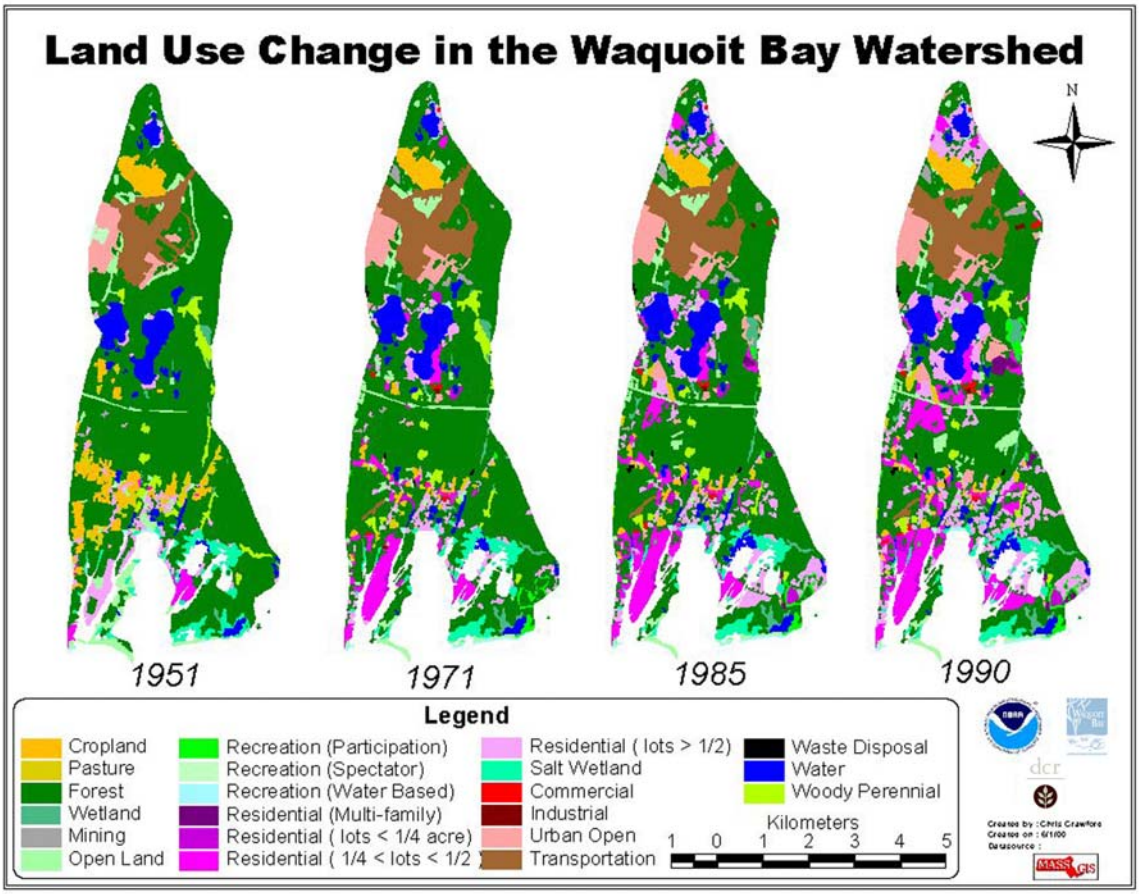


Figure 5: Land Use Change in the Waquoit Bay Watershed.



Assets of Waquoit Bay National Estuarine Research Reserve

Natural Resources

The Waquoit Bay Reserve on Cape Cod Massachusetts is composed of open waters, salt and fresh marshes, barrier beaches, sand dunes, rivers, mixed pine and oak forests, and sandplain grasslands. The more than 2,700 acres of aquatic and terrestrial habitat in the Reserve are representative of the New England portion of the Virginian biogeographic province. The Reserve's natural features are fully described in *The Ecology of the Waquoit Bay National Estuarine Research Reserve*, edited by Margaret A. Geist and published in 1996. Portions are excerpted below.

Waquoit Bay, with an area of approximately 825 acres, is the dominant feature of the Reserve. With a maximum depth of 8.9 feet and mean depth of 2.6 feet, the shallow bay is warmer in the summer and colder in the winter than neighboring Vineyard Sound. Salinity ranges from 0 parts per thousand (ppt) in the upper reaches of rivers to about 32 ppt in the open Bay. Eelgrass, *Zostera marina,* covered extensive areas of the Waquoit

Bay estuarine complex until recent decades when disease and eutrophication caused rapid declines in abundance and distribution.

The Bay is home to resident finfish populations, serves as a nursery area for other species of finfish, and supports a cadre of diadromous fish. Invertebrates are also well represented by species such as quahogs, *Mercenaria mercenaria,* soft-shell clams, *Mya arenaria,* and blue crab, *Callinectes sapidus.* Other species of the open water include sea ducks in winter, ospreys, *Pandion haliaretus,* each spring and summer, and harbor seals, *Phoca vitulina.*

Approximately 300 acres of salt marsh are located within the Reserve, mainly around Hamblin, Jehu, and Sage Lot ponds, at the head of Great River, along the shores of Washburn Island, at the head of Waquoit Bay and Eel Pond, and at the mouth of the Childs and Moonakis rivers.

Estuarine channels and tidal creek habitats link the open bay environment to the smaller, more tidally restricted salt ponds and their associated salt marshes. The estuarine channels and tidal creek beds within the Reserve are primarily sandy mud with a layer of macroalgae growing over the bottom. They are home to ribbed mussels, *Geukensis demissa,* blue crabs, *Callinectes sapidus,* and lady crabs, *Ovalipes ocellatus.*

About 2.5 miles of beach and sand dunes extend along the southern shore of Washburn Island and South Cape Beach. A portion of the barrier beach at South Cape Beach State Park is used for public recreation. The balance is undeveloped and supports a diverse community of species. On the limited-access Washburn Island, beach plants grow in profusion.

The fresh water wetlands of the Waquoit Bay watershed are rich in plant and animal species. At South Cape Beach, freshwater marsh species include the common cattail, *Typha latifolia,* and reed grass, *Phragmites australis,* as well as twig rush, *Cladium marascoides,* and water lily, *Nymphaea odorata.* Patches of bogs have such species as sheep laurel, *Kalmia augstifolia*, sweet gale, *Myrica gale,* and *Sphagnum* sp. Many waterfowl are solely dependent upon wetlands for their breeding, feeding and migratory needs. Ospreys forage for fish in freshwater areas. Many upland wildlife species, including game and song birds, opossum, raccoons and white-tailed deer, are seasonally dependent on wetlands.

Coastal plain streams provide important sources of water for upland species and are prime habitat for fish, turtles, ducks and geese. The Quashent River is an important habitat for alewife, *Alosa pseudoharengus,* blueback herring, *A. aestivalis,* and American eel, *Anguilla rostrata,* and holds one of the last remaining sea-run brook trout, *Salvetinus fontinalis,* populations in the United States.

In addition to aquatic resources, the Reserve encompasses 1,286 acres of upland, including notable pine barrens and sandplain grasslands. Pitch pine/scrub oak, *Pinus rigida/ Quercus illicifolia,* barrens occur on dry, acidic, nutrient poor, well drained soils

in the Waquoit Bay watershed and other coastal outwash plains. Examples of pitch pine/scrub oak barrens are found throughout the Reserve. Typically, a dense understory of scrub oaks and huckleberry, *Gaylussacia baccata,* grows beneath the pitch pines and excludes other plants. Often patches of lowbush blueberry, *Vaccinium augustifolium,* bearberry, *Arctostaphylos uva-ursi,* sweetfern, *Comptonia peregrine,* or lichen grow in the open spaces between oaks. This pine barrens community has adapted to occasional fires for its maintenance as nutrients, generally scarce in the poor soils, become more available in the ashes of a fire.

Sandplain grasslands are open, treeless grasslands on dry, sandy soils. These grasslands are found in areas of glacial deposits in southeastern Massachusetts, including Cape Cod and the Islands, and a few places in Connecticut. Prairie grasses are the dominant species of these grasslands. Bird's foot violet, *Viola pedata*, which grows extensively on the Sargent Estate within the Waquoit Bay Reserve, is an indicator of sandplain grasslands. A large population of New England blazing star, *Liatris scariosa* var. *novae-angliae,* inhabits Washburn Island. This species is listed as a Species of Special Concern in Massachusetts. The federally endangered sandplain gerardia, *Agalinis acuta,* is also found within the Reserve.

Archeological, Historical, and Cultural Resources

Five prehistoric sites have been identified on WBNERR land in Falmouth and many more are known on adjacent lands. In the vicinity of the Reserve, sites which range in age from possibly as early as the Paleo Indian Period (12,000 to 9,000 BP) to the Contact Period (450 BP) may be expected to have survived on undeveloped land. When considered in the context of 12,000 years of human habitation, all of WBNERR must be considered archaeologically sensitive for prehistoric resources.

Artifacts collected on Washburn Island indicate that the island was recurrently occupied over a period of as much as 5,500 years. Artifacts inventoried from the Island (site 19-BN-575) indicate Native American activity from Late Archaic (ca. 6,000 – 3,000 years ago), Early and Middle Woodland (3,000 - 1,100 years ago), and Late Woodland (1,100 – 400 years ago) times. The range of implements and edge tools suggests that Washburn Island served as a habitation site as opposed to some type of special purpose site, *e.g.,* kill or butchering. The sites also may have served in part as lithic workshops, as they have yielded quantities of lithic flaking debris, cores and preforms, indicating stone tool manufacturing. The remains of a 30-year old Native American from an unknown temporal period were also found on Washburn Island.

There are vestiges of more recent history on Reserve land as well. Cellar holes and building rubble mark the location of two of three 19th century farmsteads on Washburn Island. A brick foundation is all that remains of an elaborate estate that was built in 1900 by the son of the founder of the Bryant & Sturges shipping firm, which is credited with opening up the Pacific Northwest to trade. The estate was destroyed by fire in 1926. Some concrete exposed at the dune's edge at the far southern end of the island has been identified as the site of a garage belonging to a family that had their beach cottage moved

from the Island to Central Avenue in Falmouth in 1942, before the army took possession of the island.

Between 1942 and 1945 the island served as the Camp Edward's Engineer Amphibian Command. In this capacity the island became one of the Army's principle amphibious training grounds. Washburn Island has been referred to as "the cradle of our European invasion" (Enterprise 1953), as the men who trained on its shores went on to spearhead the assaults at Normandy, France; Oran, Algeria; and Salerno, Italy. Toward the end of the war the base was used as an "R & R" center for convalescing soldiers from nearby Camp Edwards. Many deteriorating concrete foundations and slabs located toward the northern and central portion of the island are associated with this military use. The asphalt roads and the bridge abutments on the northwest shore of the island are also military features.

On the mainland, at the head of Waquoit Bay, is the Reserve's headquarters site, sometimes referred to as the Sargent Estate. The main house was built between 1880-1890 by Ignatious Sargent in the Shingle Style of late Victorian construction and used as a summer "cottage" for family vacations until it was damaged in a hurricane in 1938. The mansion features sixteen rooms with ornate fireplaces and mantels and exotic woods on the first two floors. It included one of the first central vacuum systems. Following the 1938 hurricane, the building was boarded up for almost fifty years until it was acquired by the Commonwealth of Massachusetts in 1987 for use by the Reserve. The estate also includes a carriage house, gate house, boat house, and chicken coop. All of these buildings, except for the chicken coop, have been adapted for new uses by the Reserve.

The Reserve's headquarters are located within the Waquoit National Historic District. The Historic District was established in 2004 in recognition of the area's significance as an isolated Falmouth Village that reached the high point of its development in the 1850s with industrial, marine, agricultural, and summer tourism components.

Facilities

Headquarters Site

Visitor Center/Main House

The Visitor Center/Main House is the principal point of contact for visitors to the Reserve and provides office and meeting space for the staff of the Reserve. The first floor is handicapped-accessible and contains a large meeting room and three smaller rooms. Of the smaller rooms, two make up the Exhibit Center and the third is a storage room. The first floor also has two handicapped-accessible toilets. The second floor consists of offices, a small kitchen/lunchroom, and a bathroom for the staff of the Reserve. The cellar and attic are used for storage.

Carriage House

The Carriage House consists of 13 rooms; three are used for research, one is a shower room for researchers, one large room is set up as a classroom/laboratory. Two rooms are handicapped-accessible toilets. There is a furnace room, a two-bay storage area, a two-bay shop area, an office, an employee toilet, and a break room used by maintenance staff. The building sits on a concrete slab and has attic storage space.

Gate House

The Gate House is used primarily as a dormitory for visiting students, scientists, and others. It consists of two floors with a small cellar and small attic. The first floor is fully handicapped-accessible and has one bedroom, toilet, full bath, kitchen, and a sitting room. There are two bedrooms and a full bath on the second floor. Bunk beds on the first and second floors provide sleeping accommodations for 12 people.

Boat House

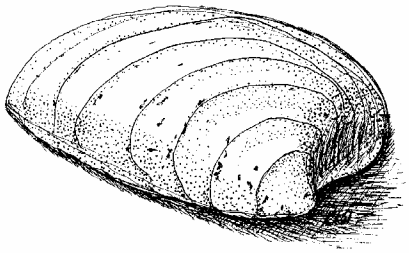
The Boat House consists of one floor of living area and a cellar. The main floor has four rooms: one large space used as a library and meeting room, one room used for office space, a small kitchen, and a bathroom. The cellar is used for boat and research equipment storage.

South Cape Beach State Park

The 462 acres which make up South Cape Beach State Park are located between Waquoit Bay and Vineyard Sound, to the east of the entrance to the Bay. When the Commonwealth of Massachusetts acquired the property in 1982 it included a small cottage (since removed), a mile of gravel roads, and two small gravel-based parking lots with a total capacity of 110 cars. There are now several new facilities that were modified or constructed by the State within the intensive use recreational area of the Park. These include a beachfront area, boardwalks to the beach, a contact station, two composting toilets, and a 200-car parking area. Trails used in education programs and by visitors traverse some areas of the Park.

Washburn Island

The Commonwealth acquired the 286 acres that comprise Washburn Island in 1983. At that time there were no structures on the island. Today, the island has several unimproved areas for camping supported by two composting toilets. There are also trails on the island for nature viewing and exploration. Most of the present vegetation on the site dates from after World War II.



Chapter 2: Understanding Coastal Ecosystems

Goal 1: Improve the understanding of coastal ecosystems and the human influences on them.

Overview

Goal 1 expresses the Reserve's important role in fostering research on coastal ecosystems and the human impacts on them. The Reserve fulfils this role by providing a dedicated, stable natural ecosystem representative of the biogeographic region as a platform for scientific investigation, providing scientists with infrastructure and information that supports and guides their work, and communicating the results to coastal communities to aid their decision-making.

For infrastructure, the Reserve provides researchers with an estuarine base of operations, facilities, and a range of logistical support. For information, the Reserve maintains an intensive research and monitoring program and research archive aimed at providing scientists with a rich set of current and past environmental and societal data to create a broad and detailed context for their studies. The Reserve also obtains and communicates information regarding the important coastal resource management issues in the region to help focus research on community needs. Research results provide feedback to adaptive resource management activities at the Reserve and are incorporated into the Reserve's training and education programs.

Currently, the Reserve's Research Priority Areas are:

- Water quality / eutrophication / watershed land-use
- Climate change / sea level rise / shoreline change
- Assessment of ecosystem response to natural variability and human impacts

These Research Priority Areas are continually refined through dialog between DCR, WBNERR and CZM staff; researchers; and coastal decision-makers, and with consideration for the NERRS Research Goals, Research Priorities and Focus Areas (Figure 6).

Each year, a working group consisting of technical staff from WBNERR, DCR, and CZM (and possibly selected individuals from other EOEA agencies) will develop the annual WBNERR research priorities. These priorities, driven primarily by NOAA guidance and statewide coastal management needs, will guide research activities supported by the reserve.

Figure 6: Summary of Statements Guiding WBNERR and NERRS Research and Monitoring.

Waquoit Bay NERR Priority Research Areas

- Water quality / eutrophication / watershed land-use
- Climate change / sea level rise / shoreline change
- Assessment of ecosystem response to natural variability and human impacts

Reserve System Research Goals

Research at Waquoit Bay Reserve is designed to fulfill the Reserve System goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, state, public and private use of one or more reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

Reserve System Research Funding Priorities

Federal regulations, 15 C.F.R. Part 921.50 (a), specify the purposes for which research funds are to be used:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem,
- Provide information needed by reserve managers and coastal ecosystem policy-makers, and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

The reserve system is focusing on the following **research areas** to support the priorities above:

- Eutrophication, effects of non-point source pollution and/or nutrient dynamics;
- Habitat conservation and/or restoration;
- Biodiversity and/or the effects of invasive species;
- Mechanisms for sustaining resources within estuarine ecosystems; or
- Economic, sociological, and/or anthropological research applicable to estuarine ecosystem management.

Research is conducted internally by Reserve scientific staff, externally by visiting scientists from other institutions and agencies, and in collaborations or partnerships between the Reserve and other scientists, institutions and agencies. Internal research and monitoring have the primary mission of maintaining the Reserve as a natural laboratory by obtaining and providing critical environmental and societal information on the Waquoit Bay estuarine system and adjacent marine and terrestrial systems that influence it. External research by visiting scientists addresses the broad range of natural and social science problems from basic research on the biology and physical environment of

estuaries to applied research addressing specific coastal management problems. Collaborative research, carried out by the Reserve in partnership with outside entities, is focused on filling information gaps identified by the Reserve or addresses pressing local and regional coastal management issues.

Research partnerships, in particular, provide the Reserve with significant leverage in focusing research on critical areas and concerns. Linkages and cooperative efforts with universities and other institutions, both governmental and non-governmental, help to highlight the Reserve as a convenient and effective site for coastal research along with increasing the awareness of coastal resource management needs within the research community.

Research at the Reserve is also driven by the National Estuarine Research Reserve System's Research and Monitoring Plan.

Research and Monitoring Plan [§921.50]

The reserve system provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries.

There are two reserve system efforts to fund research on the previously described areas. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research in the reserves. The fellowship provides graduate students with funding for 1-3 years to conduct their research, as well as an opportunity to assist with the research and monitoring program at a reserve. Projects must address coastal management issues identified as having regional or national significance; relate them to the reserve system research focus areas; and be conducted at least partially within one or more designated reserve sites.

Students work with the research coordinator or manager at the host reserve to develop a plan to participate in the reserve's research and/or monitoring program. Students are asked to provide up to 15 hours per week of research and/or monitoring assistance to the reserve; this training may take place throughout the school year or may be concentrated during a specific season.

Secondly, research is funded through the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), a partnership between NOAA and the University of New Hampshire (UNH). CICEET uses the capabilities of UNH, the private sector,

academic and public research institutions throughout the U.S., as well as the 26 reserves in the reserve system, to develop and apply new environmental technologies and techniques.

System-Wide Monitoring Program

It is the policy of Waquoit Bay Reserve to implement each phase of the System-Wide Monitoring Plan (SWMP) initiated by ERD in 1989, and as outlined in the reserve system regulations and strategic plan:

- Phase I: Environmental Characterization, including studies necessary for inventory and comprehensive site descriptions;

- Phase II: Site Profile, to include a synthesis of data and information; and

- Phase III: Implementation of the System-wide Monitoring Program.

The System-wide Monitoring Program provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national references sites. The program currently has three main components and the first is in operation.

1. **Abiotic Variables:** The monitoring program currently measures pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Each reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.

2. **Biotic Variables:** The reserve system will incorporate monitoring of organisms and habitats into the monitoring program as funds become available. The first aspect likely to be incorporated will quantify vegetation (e.g., marsh vegetation, submerged aquatic vegetation) patterns and their change over space and time. Other aspects that could be incorporated include monitoring infaunal benthic, nekton and plankton communities.

3. **Landuse, Habitat Mapping and Change:** This component will be developed to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element will be to examine the links between watershed land use activities and coastal habitat quality.

These data are compiled electronically at a central data management "hub", the Centralized Data Management Office (CDMO) at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. They provide additional quality control for data and metadata and they compile and disseminate the data and summary statistics via the Web (http://cdmo.baruch.sc.edu) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

Monitoring at WBNERR

Environmental monitoring is one of the Reserve's major activities to which it devotes significant resources of equipment, supplies and personnel time. Because of the Reserve's committed presence to a specific piece of water and land, it is positioned to carry out intensive monitoring critical to detecting environmental variability and long-term trends that would otherwise be difficult to accomplish within the short-term, hypothesis-driven venue typical of most research efforts. Monitoring at the Reserve currently consists of the following five programs (refer to Figure 7 for monitoring sites).

1. **System-wide Monitoring Program**
   The SWMP now serves as the "hard-wiring" framework for the Reserve's natural laboratory, supplying real-time and archived meteorological and water quality information to Reserve staff, visiting researchers, and surrounding communities. The SWMP currently has three main components:

   a. Abiotic Variables
      i. *Water Quality*: continuous ½ hourly measurements at four long-term monitoring stations (Figure 7). The parameters measured using YSI 6600 data loggers are water temperature, conductivity, salinity, dissolved oxygen, water level, pH, turbidity, and fluorescence.
      ii. *Meteorology*: continuous 15 minute measurements at one station. The parameters measured are air temperature, relative humidity, barometric pressure, wind speed and direction, precipitation, and photo-synthetically active radiation (PAR).
      iii. *Nutrients*. Monthly collections are made at four long-term monitoring stations, and one diel set at one of these stations. The parameters measured are dissolved nitrogen (NO2, NO3, NH3, DON), dissolved phosphorus (PO4), and Chlorophyll.
   b. Biotic Variables: The Waquoit Bay Reserve has begun monitoring biotic variables through periodic surveys, using aerial imagery and GIS mapping, of the Reserve's salt marsh and wetland vegetative communities, submerged aquatic vegetation (SAV), and macroalgae to detect change over time. Initiated in 2004, the Research Coordinator expects to repeat the surveys at 2-5 year intervals.

c. Landuse, Habitat Mapping and Change: As mentioned above, the Waquoit Bay Reserve has begun some mapping of coastal habitat for the biomonitoring project. This activity overlaps with the habitat mapping and change component.

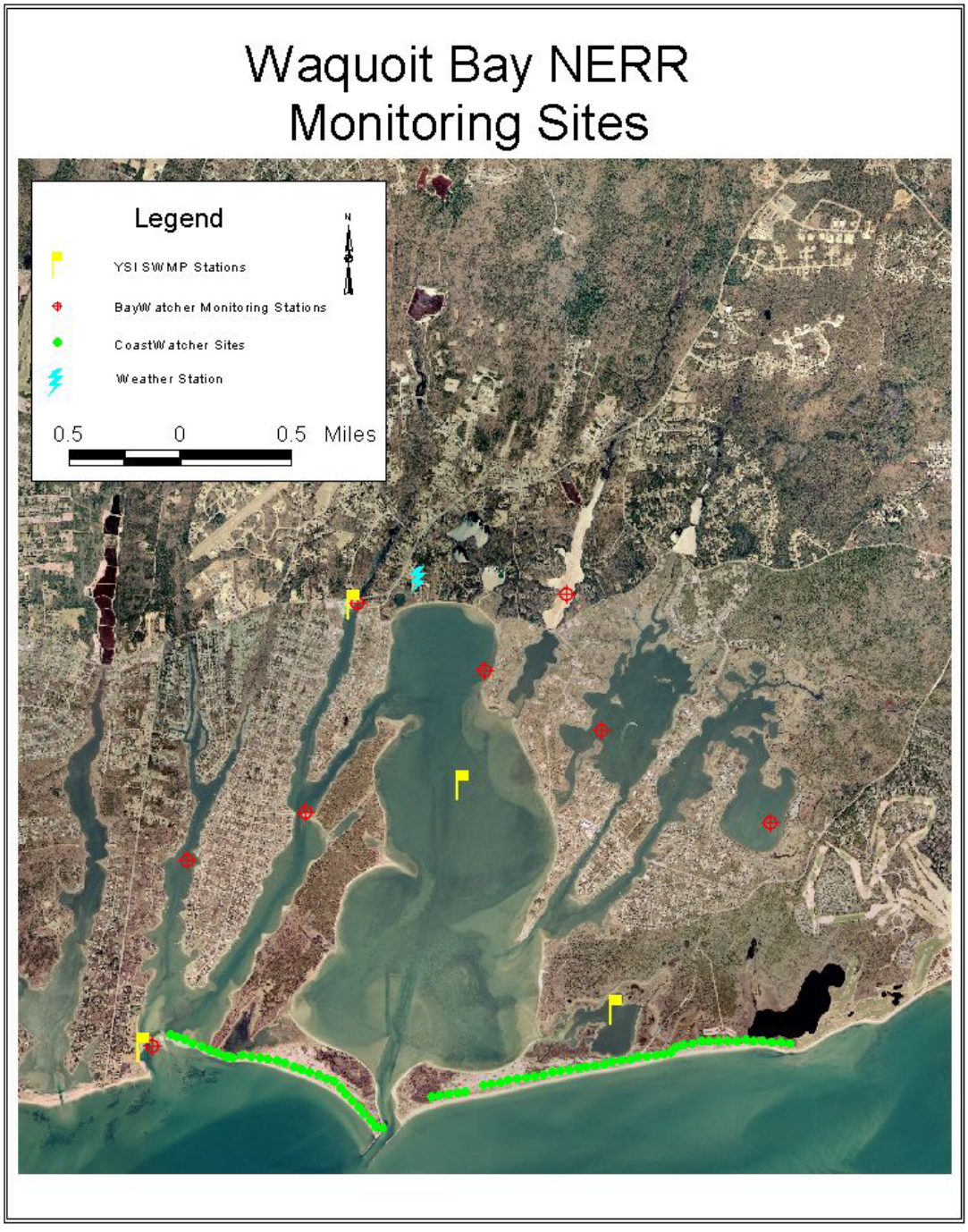
2. **BayWatchers** – BayWatchers is a volunteer Citizen Water Quality Monitoring group based in Waquoit Bay and begun in 1993. Each of the 8 sites throughout the Reserve is measured for dissolved oxygen, salinity, temperature (air and water), water clarity (secchi depth), chlorophyll and nutrients. All sites are monitored once a month in the winter and twice a month in the summer.

3. **CoastWatchers** – CoastWatchers is another group staffed by volunteers. They measure shoreline change on the 3 miles of Waquoit Bay NERR's Vineyard Sound-facing coastline. Since October 2000, linear and profile measurements have been taken of South Cape Beach and Washburn Island every 2 months from October through April.

4. **Threatened/Endangered Species** – Threatened and endangered species are present throughout the Reserve. Every spring, Piping Plovers (*Charadrius melodus*) appear on the beaches of Washburn Island, South Cape Beach, and neighboring New Seabury. The Reserve's seasonal Shorebird Manager and trained volunteers monitor the beaches and erect symbolic fencing to protect the Plovers. Other monitored species include the Roseate Tern, Least Tern, Common Tern, Willets, and American Oyster Catchers. Monitoring programs are also in place for rare, endangered or state listed plants, including Northern Blazing Star (*Liatris borealis*) and Sandplain Gerardia (*Agalinus acuta*).

5. **Stewardship Monitoring** – WBNERR's Stewardship Program conducts additional monitoring programs to inventory, evaluate the status of, and track changes in the valuable natural resources within the Waquoit Bay watershed. Examples include long-term resource monitoring programs of amphibians, aquatic insects, stream fish, vernal pool habitats, and visitor use impacts to natural vegetation.

Figure 7: Waquoit Bay NERR Monitoring Sites.



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WBNERR Research and Monitoring Objectives

Objective 1.1: Research topics are prioritized through continued dialogue among researchers, coastal decision-makers and Reserve staff.
WBNERR staff will:

a. Review and/or conduct formal and informal surveys and interviews of researchers and coastal decision-makers.
b. Identify gaps in knowledge about Waquoit Bay's environment and ecosystem.
c. Publish a prioritized list of research topics and critical coastal resource management concerns annually.

The Research Coordinator is keenly aware of NERRS research goals, priorities, and focus areas. Using this knowledge, the Reserve identifies, refines and prioritizes research topics and critical coastal resource management concerns through literature reviews and regular dialogue among researchers, resource managers (including DCR and Massachusetts Coastal Zone Management staff), and representatives of coastal communities. The CTP Coordinator, working with other Reserve staff, organizes meetings, workshops and other events for this purpose. Less formal discussions also occur on a regular basis, allowing research priorities to evolve in an organic and often rapidly changing manner. This combination of critical thought and flexibility to respond to emerging issues allows the Reserve to catalog research needs on an ongoing basis. The Reserve's current Priority Research Areas were identified through this process (Figure 6).

Similarly, a list of currently recognized management needs for the region has been developed. A partial list of these needs follows.

- Improved assessment of contaminant-loading to local estuaries and strategies for reducing this input and mitigating its effects.
- Improved nitrogen-loading and eutrophication models, in particular, including assessing the impacts of re-development in any consideration of build-out and land-use scenarios for Cape Cod.
- Effective community strategies for reducing coastal nitrogen-loading and reversing eutrophication and associated habitat loss.
- Assessing the short and long-term impacts of climate change and sea level rise on the regional coastal environment and developing strategies to mitigate negative effects.
- Assessing near- and long-term shoreline change in the region and developing strategies to mitigate negative effects.
- Identifying natural variability and its causes in estuarine ecosystems and developing strategies that sustain healthy ecosystems while mitigating negative costs to communities.
- Identifying changes in estuarine ecosystems caused by human activities and developing strategies that change these activities to reduce or eliminate any negative impacts.

- Identify harmful invasive species and develop strategies to eliminate them or reduce their negative impact on estuarine ecosystems.

As noted above, a key aspect of the Reserve's research program is the provision of a rich set of environmental and societal data regarding Waquoit Bay and its watershed. These data establish a broad and detailed context for scientific studies. Knowledge of the Bay is, nonetheless, incomplete. Identifying gaps in knowledge about Waquoit Bay and its related systems is one of the Research Coordinator's primary functions. For example, it is the Research Coordinator's responsibility to maintain the research archive and to be knowledgeable about what research has been conducted in Waquoit Bay. Gaps in knowledge are often identified suddenly when a researcher or coastal manager tries to answer some question. These gaps serve as foci for future research. The Reserve's responsiveness to filling these gaps, once identified, is a key ingredient to the Reserve's success. A partial list of the currently recognized gaps is included here.

- Sub-surface geology and geological history of Waquoit Bay system including sea level rise.
- Current bottom sediment characterization and distribution of Waquoit Bay.
- Sedimentation (composition and rate) history in Waquoit Bay.
- Detailed land-cover and land-use history in Waquoit Bay watershed prior to 1950.
- Sub-tidal habitat changes in Waquoit Bay prior to 1950.
- Water quality / eutrophication history in Waquoit Bay prior to 1990.
- Estuarine faunal and floral population changes in Waquoit Bay and its watershed, including invasive species.
- Microbial ecosystems of the subterranean estuarine environment, in particular at the fresh groundwater / salt estuarine water interface zone.
- Variation of conditions in the fresh groundwater / salt estuarine water interface zone.
- Hydrodynamic model(s) for Waquoit Bay and Vineyard Sound, including combined stratification, wind and tides.
- Wave-environment and characterization within Waquoit Bay and adjacent Vineyard Sound.
- Sediment transport along Reserve's Vineyard Sound shoreline.
- Variations in groundwater levels in Waquoit Bay watershed and inflow rates to Waquoit Bay system.
- Variations in surface fresh water flow from all major creeks and rivers to Waquoit Bay.
- Detailed climate history of Waquoit Bay including impacting-storm history prior to 2002.
- Map and history of human alterations to Waquoit Bay shoreline: docks, seawalls, revetments, groins, marinas, etc.

Based on 1) knowledge of current literature and conversations with researchers and coastal decision-makers and 2) the Research Coordinator's current knowledge of gaps, a prioritized list of research topics will be published annually.

Objective 1.2: Natural and social scientists conduct research at the Reserve that improves the understanding of coastal ecosystems and the human influences on them.

WBNERR staff will:

a. Conduct internal and collaborative research within the Reserve focused primarily on the Research Priority Areas, regional and local coastal management needs, and gaps in knowledge of the Waquoit Bay system.
b. Work with CICEET, GRF, and other NOAA and NERRS programs to support research projects at the Reserve site, as well as more generally within NERRS, that address the Research Priority Areas, regional coastal management needs, and gaps.
c. Develop a strategy to encourage external researchers to conduct research on WBNERR's priority topics.
d. Encourage more social science (SS) research on societal attitudes and actions that may impact estuaries.

Research at the Reserve is conducted by three categories of scientists: internal, collaborative, and external. Internal and collaborative research is directed at Priority Areas, critical coastal management needs, and gaps. Collaborative research is that conducted with CICEET funding, by Graduate Research Fellows, and all other research that is jointly conducted by Reserve staff and outside parties. External researchers are those with no direct affiliation with the Reserve. The Reserve encourages external scientists to conduct studies at the Reserve by making them aware of research needs, support (*i.e.,* information and infrastructure), and funding opportunities available through NOAA and NERRS mechanisms. The Research Coordinator will work with the CTP Coordinator to develop a strategy to attract more external researchers. A list of current research is included in Appendix C.

In addition to the Reserve's strong support for natural science research on estuaries, the Reserve is encouraging more social science research on societal attitudes and actions that may impact estuaries. Toward this end, WBNERR is investigating the development of partnerships with social science departments at universities and institutions and the establishment of annual and/or seasonal social science internships (see Objective 1.7.c).

Objective 1.3: The Reserve's environment is regularly monitored and key resources are inventoried as context for research and to determine their current status and developing trends.

WBNERR staff will:

a. Continue to implement and, as resources allow, improve SWMP in coordination with NERRS.
b. Add an additional meteorological station over water in the bay or near its barrier beach areas, resources permitting.
c. Expand the number of permanent long-term SWMP water quality stations, as resources allow.
d. Transition the initial bio-monitoring program into a permanent program to include SAV, macro-algae, salt marsh vegetation, and invasive and rare species.
e. Continue to enlist and train volunteers to participate in ongoing monitoring programs: BayWatchers, CoastWatchers and Endangered Species.
f. Continue to map the coastal structures of the Waquoit Bay system, including such structures as docks, piers, seawalls, groins and revetments.
g. Continue to map the bottom sediment composition and distribution of the Waquoit Bay system.
h. Seek to obtain high-resolution bathymetry of the Waquoit Bay system and Reserve topography using LIDAR or other high-resolution remote-sensing technology.

The Waquoit Bay Research Reserve is committed to the collection of information about the Reserve's environment and key resources. The Reserve fully participates in the SWMP by collecting and transmitting data on abiotic and biotic variables and land use, and by mapping habitat and changes in habitat in accordance with established protocols. As resources allow, the Reserve will improve SWMP at the site level by:

- Achieving less temporal gaps in the data stream,
- Increasing data quality,
- Adding parameters, where appropriate, such as Chlorophyll, Dissolved Silica and Total Suspended Solids and hydrodynamic parameters such as waves and currents,
- Developing a high-frequency, automated measurement capacity where appropriate, and
- Developing a real-time, telemetered capability where appropriate

The Reserve will pursue further improvements to the SWMP at the site. For instance, the installation of an additional meteorological station over water in the bay or near its barrier beach areas would better reflect estuarine meteorological conditions. The Reserve will also endeavor to establish a permanent bio-monitoring program to include SAV, macro-algae, salt marsh vegetation, and invasive and rare species. Additionally, the Reserve will seek to expand the number of permanent long-term SWMP water quality stations at one or more of the following locations:

- Vineyard Sound (marine source to estuary)
- Quashnet or Moonakis River (main surface fresh sources to estuary)
- North Basin near the Boathouse (proximate to many research experiments)
- Groundwater well near Mansion (monitor groundwater conditions and levels)

The Reserve will improve monitoring of the Reserve and its environs beyond the context of the SWMP, as well. For instance, the Reserve will continue to enlist and train volunteers to participate in ongoing monitoring of water quality, shoreline change, and threatened/endangered species. Efforts to map coastal structures and the bottom sediment composition and distribution of the Waquoit Bay system will, likewise, continue. As will efforts to obtain high-resolution bathymetry of the Waquoit Bay system.

Objective 1.4: **The Reserve will continue to develop SWMP as an integrative part of the national IOOS and regional coastal observing systems.**
WBNERR staff will:

a. Continue to coordinate with NERRS to build its SWMP infrastructure and technology to be a fully functioning part of IOOS.
b. Continue to work with other regional entities, including regional IOOS associations, to participate in the development of IOOS.
c. Work with several Cape towns and other regional entities to explore the development of a real-time water quality monitoring system for Cape Cod and southeastern Massachusetts.
d. Establish a working relationship with the Martha's Vineyard Ocean Observing System including, where appropriate, data exchange and exploration and inclusion of data in education programs.
e. Assess, in collaboration with others (WHOI and USGS), the feasibility of establishing a coastal groundwater observatory at the Reserve and, based on those assessments, develop plans and implement recommendations.

The coastal component of the Integrated Ocean Observing System (IOOS) is envisioned as a national network of data acquisition and dissemination sites that will provide comprehensive and timely information about the status, condition, and future of the nation's estuaries and coastal ocean waters. The Federal coastal IOOS will consist of regional observing systems that represent a collaboration of state and Federal agencies, academia, private industry, and non-governmental organizations. In 2004, the NERR SWMP was identified as an integral part of the coastal "backbone" of IOOS and, as such, a key design element of the coastal observing system. Over the term of this Management Plan (next 5 years), the integration of SWMP with IOOS is expected to be a major influence on the implementation, development and further expansion of SWMP within NERRS. This will likely entail significant changes in SWMP at the Reserve level including data collection, instrumentation, data quality control, and data accessibility.

The Reserve will explore the establishment of linkages with regional organizations to create a Cape and Islands/Southeastern Massachusetts real-time water quality monitoring

network as part of IOOS development. In addition, the Reserve will coordinate with other intensive research and monitoring marine observatories in the area—the closest being the Martha's Vineyard Ocean Observatory operated by the Woods Hole Oceanographic Institution—to expand the types of environments available for coastal researchers. Similarly, many researchers using the Waquoit Bay Reserve have long focused on the problem of eutrophication and the delivery of nutrient laden groundwater to the estuary. Within the next five years, the Research Coordinator will explore the option of creating a coastal groundwater observatory, possibly in partnership with USGS and WHOI.

Objective 1.5: Researchers and others will be able to access comprehensive information about the natural and societal environment of Waquoit Bay, its surrounding watershed and communities, both current and past.
WBNERR staff will:

a. Continue to summarize and characterize SWMP abiotic data in an annual report that will also be available on the Reserve's web site.
b. Continue to summarize *Baywatcher* and *Coastwatcher* data in an annual report that will also be available on the web site.
c. Continue to up-date the Reserve's research bibliography annually.
d. Make real-time SWMP data available on the web.
e. Complete the Waquoit Bay Researchers' Handbook, a compendium and summarization of environmental information about Waquoit Bay.
f. Continue to post downloadable GIS products (*i.e.,* maps of Waquoit Bay and environs) on the Reserve's web site.
g. Make societal information—such as NOAA's Census and Bureau of Economic Analysis Data—for the region surrounding the Reserve available on the web.
h. Create links from the Reserve web site to other data relevant to Waquoit Bay research.

The Reserve packages information so that it is readily available to researchers. Making the data sets listed above accessible is part of the Reserve's commitment to providing a comprehensive research platform.

Objective 1.6: The Reserve will facilitate estuarine research by providing strong logistical support, state-of-the-art facilities and equipment.
WBNERR staff will:

a. Review and assess its needs for research infrastructure, including improvements to buildings and laboratory spaces.
b. Proceed with plans and recommended actions, based upon the assessment of need (1.6.a) and as funds allow, to insure adequate state-of-the-art research facilities.
c. Develop a feasibility study for construction or acquisition of dock and pier facilities for boat and research use. (same as 5.11.b)
d. Assess the feasibility of installing a data cable along the Boathouse shoreline.
e. Assess the feasibility of installing absolute elevation controls at several key points throughout the Reserve.
f. Regularly assess its research boat needs, including onboard equipment.
g. Seek to acquire and install a microscope and associated imaging equipment and software.
h. Periodically reassess the need for in-house nutrient analysis and may obtain related equipment, such as a nutrient auto-analyzer for the laboratory.

The Reserve offers physical structures and equipment as yet another facet of its comprehensive research platform. Existing facilities include the laboratory in the Carriage House and space on the first floor of the Boat House for equipment storage. The Reserve also maintains several boats for research and monitoring use. The Research Coordinator can employ the boats in support of internal, collaborative and external research and monitoring. Because of DCR regulations, however, the motorized boats must be operated by trained Reserve staff.

The laboratory currently includes cold and dry storage for samples, sorting tables and workbenches, and wet lab facilities including a fume hood, water filtration equipment, micro-balance, sinks and tight tank for handling toxic substances, distilled water, and flourometer and spectrophotometer.

During the period of this Management Plan, the Reserve will seek to improve its physical infrastructure. State-of-the-art lab facilities will accommodate and enhance good science. A dock will be a platform for scientific experiments and will allow for easier access to vessels and is recommended in the 2004 *Final 312 Evaluation Report* issued by NOAA (refer also to Objective 5.11, *Construction Plan)*. The installation of a data cable will allow researchers to connect equipment that provides real-time access to their experimental data. The installation of absolute elevation controls will enable better monitoring of the environment in reference to local sea level and sea level rise.

Similarly, the Reserve will seek to identify and acquire the most appropriate and beneficial equipment needed to support research at the Reserve. For instance, equipment for the research vessels may include an improved GPS/sounder with data storage capacity, an underwater video system, and an onboard vibra-coring system. The acquisition of a microscope and associated imaging equipment and software will improve

the Reserve's capacity for monitoring planktonic and benthic micro-organisms and identifying environmental signals in microscopic growth structures of marine organisms. A nutrient auto-analyzer will permit the Reserve to conduct in-house nutrient analysis should the Research Coordinator determine that it would be beneficial to do so.

Objective 1.7: The Reserve will develop and maintain partnerships and cooperative efforts with other research institutions.
WBNERR staff will:

a. Maintain, explore and develop collaborative efforts with academic and research institutions including the University of Massachusetts, Boston College, Boston University, Marine Biological Laboratory, Woods Hole Oceanographic Institution, Cape Cod Community College, and other academic and research institutions as appropriate.
b. Maintain, explore and develop collaborative efforts with governmental entities engaged in coastal science including the Massachusetts Office of Coastal Zone Management, Massachusetts Division of Marine Fisheries, U.S. Geological Survey, and the Buzzards Bay National Estuary Program.
c. Explore the development of a summer undergraduate research internship program.

The Waquoit Bay Research Reserve maintains mutually beneficial relationships with numerous academic and private research institutions, as well as with government agencies engaged in coastal science. In exploring and carrying out all research partnerships and collaborative efforts, the Reserve promotes its capacity to provide expertise on effective education and outreach for research. The Reserve's relationships with other institutions are summarized below.

- **University of Massachusetts-Boston:** The Reserve will maintain its relationship and Memorandum of Understanding (MOU) with the Environmental, Earth and Ocean Sciences (EEOS) Department and the Urban Harbors Institute, seek opportunities to cooperate on research and education when and where appropriate, and investigate the possible establishment of a field site for the EEOS at the Reserve.
- **U-Mass System:** The Reserve will explore partnerships and collaborative efforts with other University of Massachusetts campuses and colleges including UMASS-Dartmouth, UMASS-Amherst, Bridgewater State College and Massachusetts Maritime Academy.
- **Boston College:** The Reserve will continue to provide logistical support to graduate and undergraduate researchers from the Geology and Geophysics Department at Boston College and explore possible collaborative research.
- **Boston University:** The Reserve will maintain cooperative links with the Boston University Marine Program (BUMP) that operates through the Marine Biological Laboratory.

- **Marine Biological Laboratory (MBL):** The Reserve will continue to 1) act as a host site for undergraduate, graduate, and post-doctoral research and education experience; 2) act as a field site for The Ecosystem Center's Semester in Environmental Science (SES), an undergraduate education and research program; 3) host other researchers; and 4) explore closer ties to the MBL/WHOI library system.
- **Woods Hole Oceanographic Institution (WHOI):** The Reserve will continue to encourage researchers to use the Reserve site, explore collaborative projects with the Coastal Ocean Institute, continue to work closely with WHOI Sea Grant on research projects located in Waquoit Bay, and help prioritize research needs for both Sea Grant and the Reserve.
- **Massachusetts Office of Coastal Zone Management:** The Reserve will continue to work with the MCZM program on several projects such as wetlands assessments and to provide logistics for other assessment projects.
- **Massachusetts Division of Marine Fisheries:** The Reserve will provide staff support to the annual winter flounder survey on the south shore of Cape Cod to maintain and enhance the 30 year data set.
- **U.S. Geological Survey (USGS):** The Reserve will continue to provide a site for groundwater and coastal research. USGS will provide the Reserve with logistical support, technical assistance, and equipment, especially stream gauges and groundwater wells needed for the IOOS network.
- **Buzzards Bay National Estuary Program:** The Reserve will explore the possibility of the NEP being an IOOS partner in a regional network.

As part of partnerships with other institutions, the Reserve will also explore creating undergraduate research opportunities. In particular, the Reserve will investigate the development of a summer undergraduate internship program to support researchers (internal and external) by pairing interns with physical and social scientists and offering housing and a stipend.

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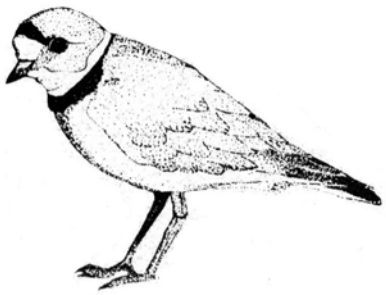

Joan Muller

Chapter 3: Improving Environmental Literacy

Goal 2: Improve environmental literacy in our communities to enable environmentally-sustainable decision-making.

Overview

This chapter describes a maturation of philosophy with regard to the most effective educational techniques to apply to the development and implementation of solutions to coastal management issues. The Reserve has assumed for years that providing information through courses, workshops, materials, and presentations—in other words, educating people—would result in changed behavior and lead to better coastal management. However, discussions over the past year, fueled by inquiry into the best approaches for fostering environmental literacy and sustainable behavior, have caused Reserve staff to question the long-standing belief that if you provide information to people, they will do the "right" thing. Research suggests (McKenzie-Mohr and Smith, 1999) that information alone does not change behavior or even lead to environmental literacy. Rather, programs that actively engage people in explorations and problem solving over time (*i.e.,* a day, several sessions) develop participants' sense of personal investment in the issue. Because of these findings, the Reserve will focus more resources on longer, more involved programs that systematically present environmental literacy concepts and involve people in hands-on problem solving activities, preferably out in the field.

In order to provide education and training programs that inform learners and promote changes toward sustainable behaviors, Reserve staff members design classes, courses, workshops, and materials that engage learners over time and include in-depth information and activities. Research about the "spaced learning effect" supports the practice of providing multiple opportunities to study and learn new material, as well as the value of having interactive lessons. Dempster (1991) reports, "With total study time equated, two or more opportunities to study the same material are much more effective than a single opportunity." One way the Reserve is incorporating this approach is to offer teacher

training courses, rather than just one-day sessions. In these courses, instructors introduce concepts and skills in one session and then review and reinforce them in subsequent sessions.

While all WBNERR programs promote environmental literacy, it is the Training and Education programs that specifically guide individuals in their professional and personal roles toward environmentally-sustainable decisions. These decisions will, in turn, translate into environmentally-sustainable behavior at both the individual and community levels. The Training and Education programs include the Coastal Training, Teacher Training, K-12, and Community Education Programs. All Training and Education activities support the NERRS Education Mission and Goals and NERRS Education Objectives (see Figure 8).

The Reserve's education and training programs utilize the benefits of the protected natural habitats within the Reserve and transfer knowledge of coastal ecosystem processes developed by research results from here and elsewhere to various audiences. Resource management issues are incorporated into the activities.

Figure 8: Summary of Statements Guiding WBNERR and NERRS Training and Education.

Waquoit Bay NERR: Training and Education Mission Statements

- CTP: The CTP fosters sound science-based coastal decision-making in Massachusetts by 1) providing up-to-date scientific information and skill building opportunities that are directly responsive to the needs of the coastal management community and 2) contributing to the development of networks of decision-makers and researchers.
- K-12 and Professional Teacher Development: Programs for students and teachers increase learners' knowledge of coastal ecology and the impacts of human actions on coastal areas to promote ecologically sustainable behaviors.
- Community Education: The Community Education Program fosters behavioral change that leads to resource conservation and advances the mission of the Reserve.

Reserve System Education Mission and Goals

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education policy at Waquoit Bay Reserve is designed to fulfill the reserve system goals as defined in the regulations (15 C.F.R Part 921(b). Education goals include:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas.

Reserve System Education Objectives

Education-related objectives in the Reserve System Strategic Plan (FY 03-08) include:

- Enhance the transfer of knowledge, information and skills to coastal decision makers for improved coastal stewardship.
- Provide education programs for students, teachers and the public to increase literacy about estuarine systems.

Education Plan [§921.13(a)(4)]

The reserve system provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation in the reserves incorporates a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues and incorporate science-based content. Reserve staff members work with local communities and regional groups to address coastal resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education programs, the reserves help communities develop strategies to deal successfully with these coastal resource issues.

Formal and non-formal education and training programs in the NERRS target K-12 students, teachers, university and college students and faculty, as well as coastal decision-maker audiences such as environmental groups, professionals involved in coastal resource management, municipal and county zoning boards, planners, elected officials, landscapers, eco-tour operators and professional associations.

K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity. Reserve education activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. Education and training programs, interpretive exhibits and community outreach programs integrate elements of NERRS science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

Reserve System Coastal Training Program

The Coastal Training Program (CTP) provides up-to-date scientific information and skill-building opportunities to coastal decision-makers who are responsible for making decisions that affect coastal resources. Through this program, National Estuarine Research Reserves can ensure that coastal decision-makers have the knowledge and tools they need to address critical resource management issues of concern to local communities.

Coastal Training Programs offered by reserves relate to coastal habitat conservation and restoration, biodiversity, water quality and sustainable resource management and integrate reserve-based research, monitoring and stewardship activities. Programs target a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profits, business and applied scientific groups. These training programs provide opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems. Additionally, the CTP provides a critical feedback loop to ensure that professional audiences inform local and regional science and research

agendas. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a reserve-based field activity.

Partnerships are important to the success of the program. Reserves work closely with State Coastal Programs, Sea Grant College extension and education staff, and a host of local partners in determining key coastal resource issues to address, as well as the identification of target audiences. Partnerships with local agencies and organizations are critical in the exchange and sharing of expertise and resources to deliver relevant and accessible training programs that meet the needs of specific groups.

The Coastal Training Program requires a systematic program development process, involving periodic review of the reserve niche in the training provider market, audience assessments, development of a three to five year program strategy, a marketing plan and the establishment of an advisory group for guidance, program review and perspective in program development. The Coastal Training Program implements a performance monitoring system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning, and enhanced networking with peers and experts to inform programs.

The Massachusetts Coastal Training Program

The reserve system Coastal Training Program is manifested at the Waquoit Bay NERR as the Massachusetts CTP. Its mission is to foster sound science-based coastal decision-making. CTP accomplishes this mission by serving as a link between research, policy, community support, and education. As an active member of the coastal management community, the CTP Coordinator stays abreast of current scientific research and policy issues and is engaged with State and community boards and commissions. The CTP Coordinator incorporates the most current and effective educational techniques into CTP programs and materials. The approach is consistent with constructivist learning theory that is applied to the Reserve's K-12 programs. Activities include targeted training and education at the state and local level that is directly responsive to the needs of the coastal management community and that provides the best available information, including cutting-edge research. The CTP program is also available for one-on-one consultancies and provides information through its web site (www.coastaltraining.org) and written materials.

The CTP has been very successful in providing scientific data, practical training, and outreach materials on such varied topics as wastewater management, coastal landscaping using native plants, the management of docks and piers, salt marsh restoration, atmospheric nitrogen deposition, nutrient loading and eutrophication, renewable energy use, and local initiatives to respond to global climate change. Positive impacts of CTP workshops and training include aiding towns to both complete energy audits of municipal energy use and to create Climate Action Plans; helping to establish new collaborations

between organizations on Cape Cod; and educating town managers and planners on wastewater treatment management strategies.

Objective 2.1: CTP activities will deliver knowledge and skills appropriate to the needs of the target audiences.
WBNERR staff will:

a. Continue to work closely with the Steering Committee to plan and coordinate training activities of the three organizations.
b. Maintain and use a CTP Advisory Committee.
c. Seek appropriate partners for specific training activities and to expand the geographic scope of its activities.
d. Maintain ongoing informal and formal assessments of the informational and training needs of the Commonwealth's coastal decision-makers.
e. Provide post-workshop evaluations to all participants.
f. Analyze evaluations and workshop discussions to assess the success of the workshop and to fine-tune future training efforts.

The Coastal Training Program works in partnership with a Steering Committee, Advisory Committee and selected partners to plan, coordinate and implement training programs. Training programs are continually improved and expanded through the combined experience and expertise of the partners.

The Massachusetts CTP is directed by the WBNERR-based CTP Coordinator in association with Steering Committee members from the Massachusetts Coastal Zone Management Program and the Woods Hole Oceanographic Institution's Sea Grant Program. These three institutions offer workshops and other training alone and in partnership with each other and several other private, public and non-profit organizations.

Assisting the CTP Steering Committee is the CTP Advisory Group, currently consisting of nine local coastal leaders in science, management, advocacy, and education. Advisory Group members serve two-year terms. The Advisory Group, which meets with the Steering Committee a few times a year, helps devise future workplans and set CTP priorities; identifies education and training needs in the Commonwealth; finds effective ways to publicize and promote coastal training opportunities; and collaborates on future CTP activities.

To strengthen the breadth and depth of CTP offerings throughout the Commonwealth, the CTP continually seeks to develop new strategic partnerships. The CTP works with partners to develop training courses and to expand the geographic reach of its training programs through partners' existing networks of coastal decision-makers. The intended geographic scope of the CTP includes the North Shore, Greater Boston, the South Shore, Buzzards Bay, Cape Cod, and the Islands. In reality, most of the training events have been held on Cape Cod. The CTP wants more people and organizations from outside of the Reserve's local geographic area to be aware of and participate in training events.

Within the local area, CTP wants to attract more participants from municipal boards that are charged with coastal management responsibilities.

The CTP uses assessments and evaluations to improve its ability to meet audience needs. Identifying the coastal management community's priority training needs is one of the CTP Coordinator's primary responsibilities. Toward this end, the CTP Coordinator is continually involved in informal needs assessments. The CTP Coordinator maintains open and regular dialog with the Steering and Advisory Committees and other key partners in the fields of coastal management, science, education, and advocacy. Furthermore, the CTP Coordinator is an active member of the coastal management community. As such, the Coordinator is aware of the pressing needs currently facing coastal decision-makers. Additionally, the CTP Coordinator works with Research and Stewardship staff and other contacts within the scientific community to stay abreast of emerging science and technology. The CTP is responsible for drawing the attention of coastal decision-makers to these emerging issues and their implications for resource management. For example, some CTP programs are built around restoration activities at the Reserve.

The CTP also undertakes formal needs assessments to help the program provide current and targeted information to coastal decision-makers. For example, the Steering Committee completed a market analysis to inventory coastal training providers and has conducted three separate formal audience assessments to determine the needs of particular groups of coastal decision-makers, *i.e.,* local government officials, non-profit organizations, and shellfish aquaculturists. Future needs assessments targeting different types of decision-makers will be performed.

Information gathered through both the informal and formal needs assessments is used to shape CTP activities. Following a workshop or event, Reserve staff evaluates the success with which the program satisfied audience needs. The program evaluations help the CTP to provide better training programs in the future and to identify new training topics. All workshop participants are asked to complete an evaluation form that incorporates the ERD system-wide evaluation criteria at the conclusion of each workshop. WBNERR staff also make note of significant discussion points raised during workshops. Later, WBNERR staff will consider workshop discussions and analyze all evaluations to learn which aspects of the workshop were most appreciated, which could be enhanced, and what other topics or formats should be considered.

Objective 2.2: CTP activities will deliver science-based information relevant to local sustainable coastal management.
WBNERR staff will:

a. Coordinate several training events per year that will address training needs that are identified through needs assessments and/or are related to emerging resource management issues.
b. Include coastal and estuarine scientific research or research information in training programs.
c. Utilize the most effective training techniques to deliver information to the resource management, scientific, and governmental communities.
d. Maintain a network of experts in relevant fields to draw upon as workshop presenters.
e. Incorporate time for networking and discussion of barriers to effective coastal management into training events.

Coastal Training Programs are designed so that participating coastal decision-makers will gain the knowledge, tools and resources they need to make sustainable coastal management decisions. CTP workshops address the following topics:

- Training needs identified through informal needs assessments,
- Training needs prioritized in the formal CTP needs assessments (*i.e.,* wastewater/nitrogen loading, community training and outreach, and shoreline development planning and impacts), and
- Emerging issues identified through research at the Reserve and elsewhere that have not yet been widely recognized as having a bearing on local coastal management decisions.

In the course of addressing these topics, the CTP will accurately communicate coastal and estuarine scientific information, as well as coastal management research results, project results, new ideas, practical tools, and solutions to coastal management problems. Particular effort will be directed toward transferring resource management tools to all coastal Areas of Critical Environmental Concern (ACEC) communities.

The design of individual workshops is based on knowledge of educational techniques that effectively engage adult audiences. The CTP works in partnership with the Reserve's Education, Research, and Stewardship staff to continually improve the delivery of programs. The CTP also draws upon a network of experts in relevant fields as workshop presenters. The participation of recognized experts further enhances the value of CTP workshops and other events.

The fact that training programs bring coastal decision-makers together in the same room for a few hours is an important aspect of the CTP. Individuals have the opportunity to meet and share ideas with other people who are grappling with similar issues. This interaction may breed new partnerships or other opportunities to solve coastal problems. When appropriate, participants are also encouraged to discuss barriers they have

encountered in their efforts to implement effective coastal management techniques and policies. Removal of these obstacles may then become the subject of future WBNERR efforts.

Teacher Training and K-12

The Reserve offers teacher training courses, in-service teacher training, classroom programs, and field work with students at the Reserve and other coastal locations. The purpose of each program is, essentially, to help adults and children learn the scientific concepts necessary to be able to make informed decisions about the coastal environment. Learning science is an active process; something students do, not something that is done to them. In learning science, students describe objects and events, ask questions, acquire knowledge, construct explanations of natural phenomena, test those explanations in many different ways, and communicate their ideas to others.

The primary intent of Waquoit Bay Reserve education programs is to increase the learner's understanding of estuarine systems, factors that influence them, and the learners' role as coastal stewards. A secondary purpose is to promote scientific literacy. Scientific literacy includes knowledge and understanding of scientific subject matter, as well as understanding the nature of science, the process of science, and the role of science in society and personal life. Learners should develop an understanding of what science is, what science is not, what science can and cannot do, and how science contributes to better management of resources.

Reserve programs incorporate an inquiry or constructivist approach. For scientists, inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students and other learners in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. Inquiry is a multifaceted activity that involves:

- making observations,
- posing questions,
- examining books and other sources of information to see what is already known,
- planning investigations,
- reviewing what is already known in light of experimental evidence,
- using tools to gather, analyze, and interpret data,
- proposing answers, explanations, and predictions, and
- communicating results.

Reserve programs incorporate as many of these components as possible, including multiple visits by students and learning themes with projects that students complete over time. Waquoit Bay Research Reserve education programs also adhere to *Massachusetts Frameworks for Science Education* and link programs and lessons to key academic concepts identified by the State. Reserve staff strives to involve students and other learners in inquiry-oriented investigations where they interact with their teachers and

peers. Learners establish connections between their current knowledge of science and the scientific knowledge found in many sources; they apply science content to new questions; they engage in problem solving, planning, decision making, and group discussions; and they experience assessments that are consistent with an active approach to learning.

Research on cognition has supported the development of current conceptions of science learning. There is a considerable body of cognitive research (Lapointe et al. 1992) which has provided evidence that learners are not passive recipients of codified knowledge but rather active participants. As a result, national science education initiatives now emphasize the following:

- Instruction through presentation of real-world problems and applications rather than abstract knowledge; and
- Opportunities for students to investigate natural phenomena, often involving data.

Waquoit Bay Reserve education programs incorporate learning using real problems and interacting with natural phenomena, including regular comparisons between Waquoit Bay and learners' home ecosystems. For example, Reserve staff use topographic maps to introduce coastal habitats or to demonstrate the proper siting for a wind turbine, and train the learners to use topographic maps of their own areas. Staff are also increasing the use of data from the System-Wide Monitoring Program with both math and science classes. The time and preparation required for in-depth and ongoing programs for K-12 students and teachers has reduced the number of programs offered at Waquoit Bay Reserve. The effectiveness of each program, however, has increased.

For K-12 and teacher training, WBNERR's focal topics are geology and coastal processes, eutrophication of coastal waters, climate change, and renewable energy. These topics are very similar to the Reserve's Priority Research Areas (refer to Figure 6). For each focal topic, Waquoit Bay Reserve education staff schedule a variety of programs, classes, and presentations in order to reach teachers, students, and community members. Reserve staff strive to provide opportunities for learners to choose introductory, intermediate, or advanced sessions on selected topic, as well as offering an opportunity for ongoing partnerships and projects. While teachers are a major target audience for WBNERR programs, the Reserve also works with many classes of students from elementary through undergraduate level and offers a variety of ways community members can learn about coastal topics.

Technology education, including collecting, analyzing, and interpreting data, is an important aspect of WBNERR education programs. It is a link with the NERRS System-Wide Monitoring Program, a connection with the International Ocean Observing System (IOOS), an integral part of renewable energy education, and a content area that teachers in Massachusetts are required to present.

Objective 2.3: An increasing number of pre-service teachers will participate in Reserve programs.
WBNERR staff will:

a. Identify colleges currently offering appropriate pre-service training.
b. Explore possibilities for partnering with appropriate programs to provide training.
c. Develop curriculum and provide training.

The Reserve will pursue a strategy of working to incorporate environmental issues into teacher training programs at the pre-service level (*i.e.,* while teachers are still pursuing their teaching degrees). Toward this end, WBNERR will identify Massachusetts colleges and universities that offer teacher preparation in the biological, physical and social sciences and will cultivate relationships with these institutions. WBNERR will then work with selected colleges and universities to develop pre-service curricula related to WBNERR's priority issues and to provide training on the same.

Objective 2.4: An increasing number of teachers will teach about coastal ecology to their classes.
WBNERR staff will:

a. Examine current teacher training programs to see how they fit into the Reserve mission and objectives.
b. Continue to provide selected teacher training offerings.
c. Encourage teachers to work in cooperative teams.
d. Develop a strategy to make sure teachers are teaching concepts correctly.

WBNERR currently offers a variety of teacher training opportunities, including graduate credit courses. The programs highlight topics such as renewable energy, climate change, coastal processes, eutrophication, and estuarine ecology. Reserve staff will strategically assess which of these are most appropriate to the Reserve's mission and whether there is a need to develop new courses. A selected program of teacher training opportunities will then be offered. The training will encourage teachers to work in cooperative teams. Reserve staff will also develop a strategy to make sure teachers are teaching concepts correctly.

Objective 2.5: An increasing number of teachers can explain how to be a good coastal steward and are models for their students.
WBNERR staff will:

a. Develop more lessons based on stewardship behaviors.
b. Design WBNERR programs to provide opportunities for real-world problem solving to enable teachers to involve students in community issues.
c. Contact teacher advisors about undertaking more estuarine stewardship projects with their clubs.
d. Create a local stewardship award for teachers and students.

Beyond teaching about coastal ecology, WBNERR wants teachers to understand and model good stewardship behavior. Toward this end, lessons for both the summer teacher training programs and in-service training will include an emphasis on stewardship behavior. Lessons will be built around local issues to make them more relevant and useful to teachers engaging students in real-world problem solving. Additionally, the Reserve will contact teacher advisors about undertaking more estuarine stewardship projects with their ecology clubs and will create a local stewardship award for teachers and students.

Objective 2.6: An increasing number of students perform environmentally sustainable behaviors.
WBNERR staff will:

a. Engage some students in stewardship projects while they are visiting the Reserve.
b. Assess which programs can expect behavioral changes.
c. Develop a methodology for evaluating behavioral change.
d. Work with the Summer Science School teachers to incorporate activities designed to lead to sustainable behavior into their lesson plans.
e. Conduct follow-up with summer school students to evaluate the effectiveness of efforts to promote sustainable behavior.
f. Ask students participating in Reserve educational programs to make a pledge to adopt environmentally sustainable behaviors.

The ultimate evidence that stewardship-oriented teacher training is working will be the adoption of environmentally-sustainable behaviors by students. To help students establish environmentally-sustainable behaviors, the Reserve will engage students in stewardship projects while visiting the Reserve. Potential projects include habitat restoration, invasive species removal, endangered species monitoring and access management.

Furthermore, Reserve staff will work with the Summer Science School teachers to incorporate activities designed to lead to sustainable behavior into their lesson plans. Reserve staff will then follow up with students before the next summer to learn whether or not behaviors have been maintained.

Students participating in WBNERR educational programs will be asked to make a written pledge that they will adopt specific environmentally sustainable behaviors. By eliciting this sort of commitment, WBNERR staff will further encourage students to incorporate the lessons they learn at the Reserve into their lives.

Objective 2.7: Students who have attended WBNERR programs will be able to describe basic estuarine ecology and the major stressors on estuaries.
WBNERR staff will:

a. Increase the pre- and post- field trip instruction.
b. Increase implementation of evaluations to track students' gains in knowledge following programs.
c. Examine how well current programs meet this objective and may adjust numbers and types of programs in order to deliver the most effective programs possible.

Students who have participated in WBNERR programs should be able to describe basic estuarine ecology and the major pressures on estuaries. In order to evaluate the effectiveness of WBNERR offerings in achieving this objective, students in selected programs will be given pre- and post-tests to assess changes in knowledge. If evaluations show that desired levels of knowledge are not attained, programs will be refined to better communicate key concepts. As a result of the evaluations, Reserve staff could potentially deliver fewer, but more effective, programs.

Community Education

The goal of the Community Education Program is to foster behavioral change that leads to resource conservation and advances the mission of the Reserve. Community Education focuses on audiences whose personal choices directly impact the integrity of our estuaries and their associated watersheds. Activities include events, like the Watershed Block Party, that are intended to raise awareness of environmental issues and values, as well as in-depth courses for community members such as *Cape-Friendly Landscaping* and *Green Home and Business: Focus on Energy* (a course on energy efficiency and renewable energy). Target audiences include, but are not limited to, watershed residents and recreational users of the Reserve. Over the course of the next five years, staff will explore options for expanding programs to underserved audiences.

During the past year, Reserve staff have attended and sponsored several training events on how to use a more targeted, results oriented, research-based approach to community education. During the next five years, staff will place an emphasis on putting this training into action by doing a more complete planning and follow-up process for each program. For example, Reserve staff intend to increase the use of community-based social marketing (CBSM) techniques such as those described by McKenzie-Mohr and Smith in *Fostering Sustainable Behavior* (1999). CBSM encourages behavior change through programs that 1) identify barriers, 2) apply the tools of behavior change: commitment, prompts, norms, communication, and incentives, and 3) remove external barriers. In all

community education programs, Reserve staff will strive to provide research-based information about impacts of human activities on coastal systems and suggestions for less harmful alternative behaviors.

Objective 2.8: An increasing number of community members understand and/or perform environmentally sustainable behavior.
WBNERR staff will:

a. Determine priority target audiences.
b. Describe the current state of environmental knowledge of target audiences and identify gaps and needs through needs assessment (survey, interview, focus group).
c. Develop strategies to meet the needs of different audiences.
d. Implement programs to fill gaps in knowledge.
e. Evaluate programs to guide further actions.
f. Implement long-term follow up to determine effectiveness of programs.
g. Use more community-based social marketing tools.

WBNERR promotes the adoption of environmentally-sustainable behavior related to energy consumption, landscaping, and construction, among other topics. The Reserve will increasingly draw upon community-based social marketing to effect positive changes in people's behavior by instituting specifically targeted projects. Over the course of the next five years, Reserve staff will identify specific community-based social marketing projects. They will define and promote a set of desired behaviors, track over time, and look for responses in the environment (refer to Objective 4.4).

Objective 2.9: Recreational users of the Reserve are increasingly aware of environmental issues and adopt environmentally-sustainable behaviors.
WBNERR staff will:

a. Use community-based social marketing, training from visitor use workshop and/or Project Design and Evaluation techniques to develop interventions and test results.
b. Work with DCR to provide more emphasis on stewardship when training seasonal interpreters.
c. Work with other staff to refine the definition of target audiences and behaviors that need to be changed.
d. Continue to offer interpretive programming, along with “environmental entertainment."
e. Continue to require seasonal interpreters at the Reserve to incorporate local coastal management issues and information about environmentally-sustainable behavior into their programs.
f. Be more strategic about deploying roving interpreters.

The WBNERR Education Coordinator is responsible for training seasonal interpretive workers at the Reserve and is often involved in the training of seasonal staff at other DCR facilities, especially coastal parks. The seasonal interpretive staff training addresses interpretive techniques and provides opportunities to interface with researchers studying issues, such as coastal change and Cape Cod geology, estuarine ecology, and eutrophication. During the next five years, the Reserve will place an even greater emphasis on stewardship and will develop community-based social marketing (CBSM) approaches. Seasonal interpretive staff will be trained in CBSM, will observe results, collect data, and provide feedback to year-round staff who, in turn, will adaptively adjust programs.

Education staff will work with other Reserve staff members to refine the definition of target audiences and behaviors that need to be changed. For example, staff may identify trail bike impacts or the destruction of piping plover nests. Once education staff are made aware of these types of incidents, they can begin developing programs targeting specific audiences and behaviors that need to be changed.

The Reserve offers a variety of interpretive programs that presently include the Junior Ranger program, Creature Feature, and Saturday Open House, among other events. The Junior Ranger program is part of a statewide summer program for children aged eight to twelve years old. For Creature Feature, a table is set up at South Cape Beach to catch people coming to the beach who would not ordinarily come to the Reserve's headquarters. The Open House was instituted to bring families into the Reserve headquarters to learn about WBNERR's research, stewardship and educational activities. Stewardship elements are incorporated into all programs, as are local coastal management issues.

The Reserve's seasonal interpreters are sent to areas where there are the most visitors and, not surprisingly, the most problems. The interpreters employ roving interpretation techniques to deliver stewardship messages.

In addition to the Reserve's education and stewardship-oriented interpretive programs, WBNERR offers a variety of other events that are more appropriately classified as entertainment with an environmental flair. *Evenings on the Bluff* are one example. The programs, sponsored by CPWB, feature professional entertainers who typically use song, storytelling, and/or comedy to convey information about the environment, wildlife, and the role of people as stewards of the natural world. Generally, one program each season is presented by members of the Wampanoag tribe and may include traditional song and dance, as well as a discussion of their historic and modern relationship to the estuary.

Objective 2.10: Under-served audiences will receive recreational and educational programming.
WBNERR staff will:

a. Conduct an assessment to determine which audiences are being under-served.
b. Determine whether resources are available to meet audience needs.
c. Partner with organizations that have a record of working with the identified populations.
d. Develop and deliver programs appropriate for various audiences.

Some people within the Waquoit Bay region do not have equal access to the Reserve's programs due to language barriers. These populations include the large Brazilian immigrant community and the deaf community. For other groups there may be other barriers. During the next five years, staff will focus more attention on outreach to these groups when doing so is compatible with the Reserve's mission.

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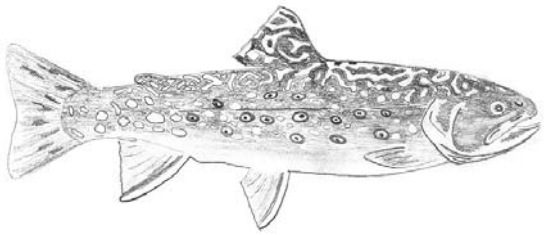


Chapter 4: Demonstrating Sustainable Stewardship

Goal 3: Demonstrate sustainable stewardship of the land and water ecosystems within the Reserve to serve as a model for community stewardship in the region.

Overview

This chapter describes WBNERR's activities to protect the land and water resources of the Waquoit Bay watershed through land stewardship zoning, regulatory mechanisms, land management techniques, the management of public access, restoration activities, efforts to acquire and protect additional lands, and strategies to exert influence over the management of waterbodies. Adaptive natural resource management on the Reserve is guided by results of research conducted at the Reserve and elsewhere and is shared throughout the region through education and training. This chapter also describes the Reserve's role as a model of resource management practices for similar coastal lands in the region. These practices are represented by Objectives 3.1 through 3.8, Together, they form the Reserve's **Resource Protection Plan** and generally fall under the purview of the Stewardship Program**.**

Policies, Regulations, and Enforcement Mechanisms

Objective 3.1: Reserve land and water resources are managed in accordance with this management plan, the Massachusetts Department of Conservation and Recreation's Land Stewardship Zoning Guidelines, applicable DCR policies and performance standards, and applicable local, state and Federal regulations.
WBNERR staff will:

a. Manage Reserve lands in conformance with the use restrictions defined within the Land Stewardship Zoning Guidelines.
b. Remain cognizant of regulatory restrictions and management policies and enforce those for which the Reserve has authority to do so and will work with state and local law enforcement personnel to enforce others.

Land Stewardship Zoning

WBNERR utilizes DCR's Land Stewardship Zoning Guidelines to consistently direct land management policy on Reserve lands. The three zone designations guide the level of activity allowed in various areas of the Reserve and assist Reserve staff with balancing research, education and recreation activities with resource protection by restricting inappropriate activities and directing higher impact activities away from more sensitive areas. Structures and activities associated with research, education, stewardship, facilities management and recreation are limited based on zone. Zone 1 designated areas are comparable to the NOAA NERRS "core area" designation. Zone 2 and Zone 3 areas combined are comparable to the NOAA NERRS "buffer area" designation.

DCR defines the three zones as follows.

> **Zone 1** is the most restrictive zone**.** This zone includes unique, exemplary and highly sensitive resources and landscapes that require special management approaches and practices to protect and preserve the special features and values identified in the specific Resource Management Plan. Examples of these resources include rare species habitat identified by the Natural Heritage and Endangered Species Program as being highly sensitive to human activities, fragile archaeological or cultural sites, and unique or exemplary natural communities. Management objectives emphasize protecting these areas from potentially adverse disturbances and impacts. Research and education activities are permitted in Zone 1 but with careful supervision from Reserve staff to ensure protection of sensitive resources. The Reserve includes 459 acres designated Zone 1, or "core area".
>
> **Zone 2** includes areas containing typical yet important natural and cultural resources on which common forestry practices and dispersed recreational activities[1] can be practiced at sustainable levels that do not degrade these resources and that hold potential for improving their ecological health, productivity and/or protection through active management. Examples include terrestrial and aquatic ecosystems characterized by a diversity of wildlife and plant habitats, rare species habitat that is compatible with sustainable forestry and dispersed recreation, agricultural resources, and resilient cultural sites and landscapes. Zone 2 areas may be actively managed provided that the management activities are consistent with the approved Resource Management Plan for the property. The Reserve includes 803 acres designated Zone 2.
>
> **Zone 3** includes constructed or developed administrative, maintenance and recreation sites, structures and resilient landscapes which accommodate concentrated use by recreational visitors and require intensive maintenance by DCR staff. Examples include areas developed and deemed appropriate for park headquarters and maintenance areas, parking lots, swimming pools and skating rinks, paved bikeways, swimming beaches, campgrounds, playgrounds and athletic fields,

[1] WBNERR considers research and education to also be appropriate activities for Zone 2.

parkways, golf courses, picnic areas and pavilions, concessions, and areas assessed to be suitable for those uses. The Reserve includes 24 acres designated Zone 3, which combined with the 803 acres designated Zone 2 make up a "buffer area" of 827 acres.

Significant Feature Overlays supplement the three land stewardship zones to identify specific resource features. These significant features are generally identified through an inventory process or research and are formally designated. The purpose of these overlays is to provide more precise management guidance for identified resources and to recognize, maintain, protect or preserve unique and significant features, regardless of the zone in which they occur. Examples of significant feature overlays include Forest Reserves, areas subject to public drinking water regulations, or areas subject to historic preservation restrictions. The types of Significant Feature Overlays applied to the WBNERR lands include Protected Species Habitat Areas (which are based on the Massachusetts Natural Heritage and Endangered Species Program Priority Habitat maps) and Cultural Resource Areas (for historic and archaelogical values).

The Protected Species Habitat Area Significant Feature Overlays apply to several different Reserve properties for protection of habitat of a variety of protected rare plant and animal species. Protected Species Habitat Overlays are designated at the Headquarters Area, Quashnet River Area, Abigail Brook Area, South Cape Beach Area, and Washburn Island. Management activities within these overlay areas are done with consultation from staff of the Massachusetts Natural Heritage and Endangered Species Program (NHESP). A Protected Species Habitat Overlay is located at the Headquarters Area because of the presence of the federally endangered plant *Agalinis Acuta*. Public access is limited from this area year round, a specific mowing regime (mowing only in December and June) is applied, and annual monitoring is performed. South Cape Beach and Washburn Island contain Protected Species Habitat Overlays for federally and state listed nesting shorebirds. Public access is limited from these locations with symbolic fencing and signage during the nesting season. Pets are restricted from the vicinity between April and September. Reserve staff and volunteers monitor nesting activity daily, educate visitors and recreational users and when appropriate set up predator exclosure devices to protect nest sites. Protected Species Habitat Overlays at the Abigail Brook Area and the Quashnet River Area are designated for an assemblage of moths and butterflies that are rare within Massachusetts. These species are dependent on early successional habitat in coastal pine barren and pine-oak woodland habitats. Management activities for these locations, such as selective cutting and prescribed burning, are being evaluated with input from NHESP.

The Cultural Resource Area Significant Feature Overlays apply to the entirety of the Headquarters Area, Childs River Area, and Washburn Island. This designation exists on Washburn Island because of documented prehistoric Native American sites and the historic remains on the island (including World War II era military remains). The designation exists at the Headquarters and Childs River Areas because of documented prehistoric Native American sites and the National Historic Register landmarks associated with the Sargent Estate (now the headquarters facilities) and the Waquoit

Village National Historic District. Any proposed major projects and development activities will be reviewed by a DCR cultural resource expert.

The area of the Reserve that has been designated as the Waquoit Bay Area of Critical Environmental Concern (ACEC) should also be considered a Significant Feature Overlay. This overlay is not shown as such on the series of Figures 9-14 showing Land Stewardship Zoning. However, the boundary of the ACEC is shown on Figure 15, and the specific ACEC regulatory performance standards and requirements are described on pages 84 through 89.

General management guidelines for each of the three management zones are included in the Land Stewardship Zoning Guidelines (see Appendix D). WBNERR staff participated in the development of the guidelines and will manage Reserve lands accordingly. A brief description of how Land Stewardship Zoning is applied to Reserve lands and waters follows.

Headquarters and Childs River Areas

The Headquarters Area (Figure 9) includes all of the Reserve's buildings, including the visitor center, office, laboratory, classroom, meeting and maintenance space, as well as associated parking lots and boat and equipment storage areas. Because of the structures and facilities necessary to accommodate concentrated use by Reserve staff, these developed areas are classified Zone 3. The wooded area north and east of the carriage house is also listed as Zone 3 because it is a potential location for construction of the new Coastal Training Center building. This area is a relatively resilient landscape immediately adjacent to the concentrated intensive use area of the other facilities, but a thorough ecological and archaeological site assessment must be conducted prior to work activities for such development. The land immediately adjacent to the entrance road at the Headquarters property is managed for its rare coastal sandplain vegetation community and is, therefore, classified as Zone 1. This area contains several rare species of note including the Federally endangered sandplain gerardia (*Agalinis acuta*). All wetlands (salt and fresh) on the entire Reserve, as delineated by Massachusetts Department of Environmental Protection maps, are classified as Zone 1 because of their demonstrated importance to the value of the Waquoit Bay estuarine ecosystem. This designation includes the salt marsh and salt pond located in the southwest corner of the Headquarters property. The remainder of the Headquarters property, composed of mixed pine/oak woodland, and the mixed pine/oak woodland on the nearby Childs River property are classified as Zone 2. Wetlands along the Childs River are classified as Zone 1. The entire extent of both these areas is covered by a Significant Feature Overlay for Cultural Resources. Both areas are included within the federally designated Waquoit Village National Historic Register District and there are important documented prehistoric archeological sites in the vicinity. A Significant Feature Overlay for Protected Species Habitat covers part of the Zone 1 area of the Headquarters property. The overlay is based on MA NHESP 2005 Priority Habitat Maps.

South Cape Beach Area

The state beach parking lot and the beach immediately in front (south) of the parking lot are classified as Zone 3 because they are necessary to accommodate intense, concentrated use (Figure 10). With the exception of this Zone 3 area, all beach, dune, barrier habitat and wetland (fresh and salt as delineated by Massachusetts Department of Environmental Protection maps) are classified as Zone 1 because of their value to protected species and demonstrated importance to the coastal and estuarine ecosystem. The Zone 1 area includes the extensive salt marshes around Sage Lot Pond, the extensive fresh marsh north of Flat Pond, and vernal pools. All other areas composed of mixed pine/oak woodland are classified as Zone 2. Paved access roads leading to both the state beach area and the town beach inholding fall within the Zone 2 area. Much of the South Cape Beach Area, including the land classified as Zone 3, is covered by a Significant Feature Overlay for Protected Species Habitat for shorebirds including piping plover (*Charadrius melodus*) and least tern (*Sterna antillarum*). This overlay is based on MA NHESP Priority Habitat maps.

Washburn Island

On Washburn Island (Figure 11), all beach, dune, barrier habitat and wetland (salt and fresh, including vernal pools, as delineated by Massachusetts Department of Environmental Protection maps) are classified as Zone 1 because of their value to protected species (including piping plover and least tern) and demonstrated importance to the coastal and estuarine ecosystem. All other lands, primarily composed of mixed pine/oak woodlands, are classified as Zone 2. This Zone 2 is subject to habitat management which includes activities such as selective thinning and prescribed burning. The Washburn Island camping area is located within this Zone 2 area. Despite its popularity and regular use during summer, the camping sites are limited in number, dispersed and primitive in nature. Portions of the southern part of the island are covered by a Significant Feature Overlay for Protected Species Habitat for shorebirds, including piping plover (*Charadrius melodus*) and least tern (*Sterna antillarum*). This overlay is based on MA NHESP Priority Habitat maps. The entirety of Washburn Island is covered by a Significant Feature Overlay for Cultural Resources due to its significant colonial and military history, as well as the presence of important prehistoric archaeological sites.

Quashnet River Area (including the 10 acre satellite "Phinney Property")

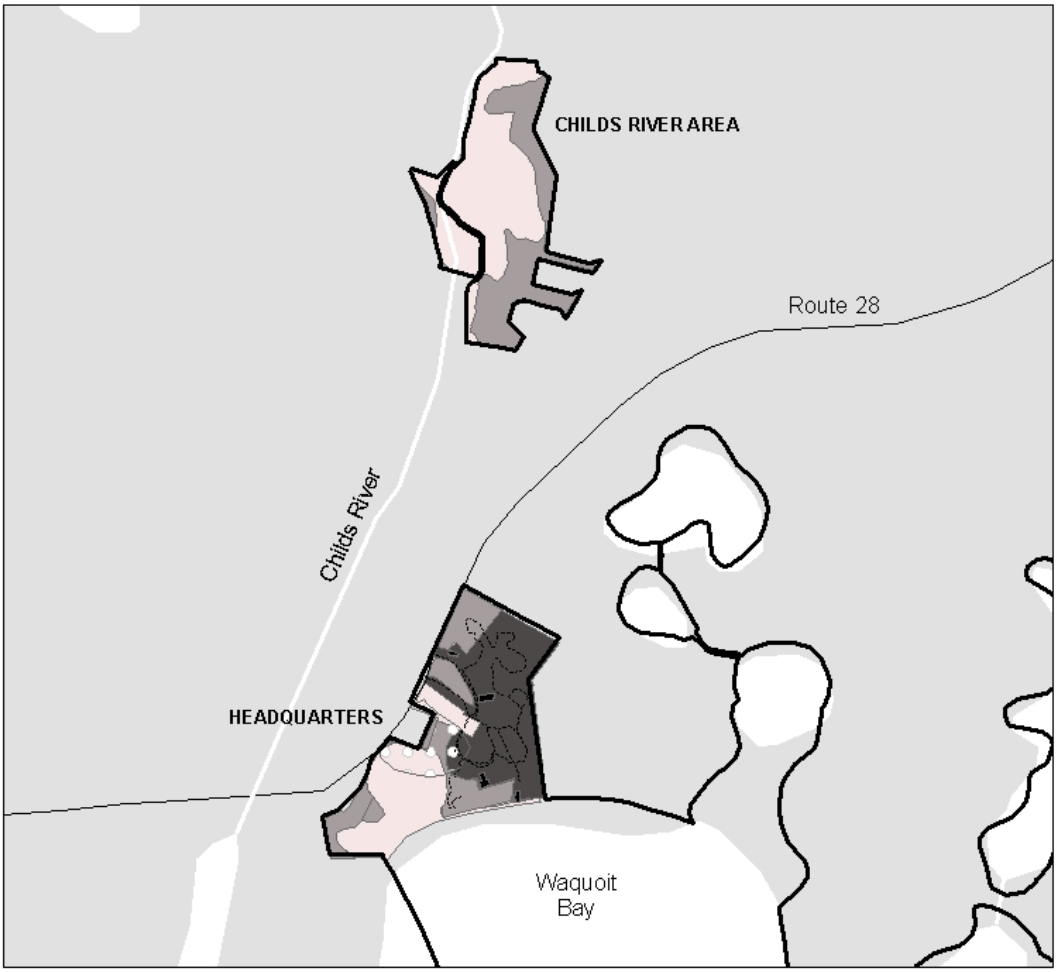
A 300 foot strip on either side of the Quashnet River (Figure 12) is classified as Zone 1 in recognition of the unique and valuable aquatic resources associated with the river. The Quashnet is home to one of the last remaining populations of native sea-run brook trout populations in the United States. It also contains runs of other important migratory fish including alewife and blueback herring and American eel. This stretch of river is the location of a long term habitat restoration project and all activities related to this effort are acceptable within the Zone 1 area (see "Current Restoration Projects," p. 99). Other wetlands and vernal pools dot this property and are classified as Zone 1. The remainder of the land, primarily composed of mixed pine/oak woodland is classified as Zone 2 and is subject to upland habitat management including selective thinning and prescribed fire. A small area in the northwest corner of this property is covered by a Significant Feature Overlay for Protected Species, based on MA NHESP maps. The southern boundary of

this property abuts the Waquoit Village National Historic Register District at the former site of an historic mill dam.

Abigail Brook Area
The entirety of the Abigail Brook property (Figure 13) is comprised of mixed pine/oak woodland and is classified as Zone 2. A small portion of the northern part of the property is covered by a Significant Feature Overlay for Protected Species, based on MA NHESP maps.

North Quashnet Area
The entirety of the North Quashnet property (Figure 14) is comprised of mixed pine/oak woodland and is classified as Zone 2. There are no Significant Feature Overlays covering this property.

Figure 9: Headquarters and Childs River Areas.



DCR Land Stewardship Zoning: Heaquarters and Childs River Areas

Stewardship Zones
- Zone 1
- Zone 2
- Zone 3

Significant Feature Overlays
- Protected Species Habitat (NHESP Priority Habitat 2005 on DCR owned lands)
- Cultural Resources (Cultural Resources overlay includes entire extent of the both properties)

- WBNERR Boundary
- Major Roads
- Trails
- Reserve Buildings

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Created by: A Reynolds; WBNERR
Date: September, 2005
Source: WBNERR, MassGIS, Towns of Falmouth and Mashpee

Kilometers
0 0.15 0.3

Figure 10: South Cape Beach Area.

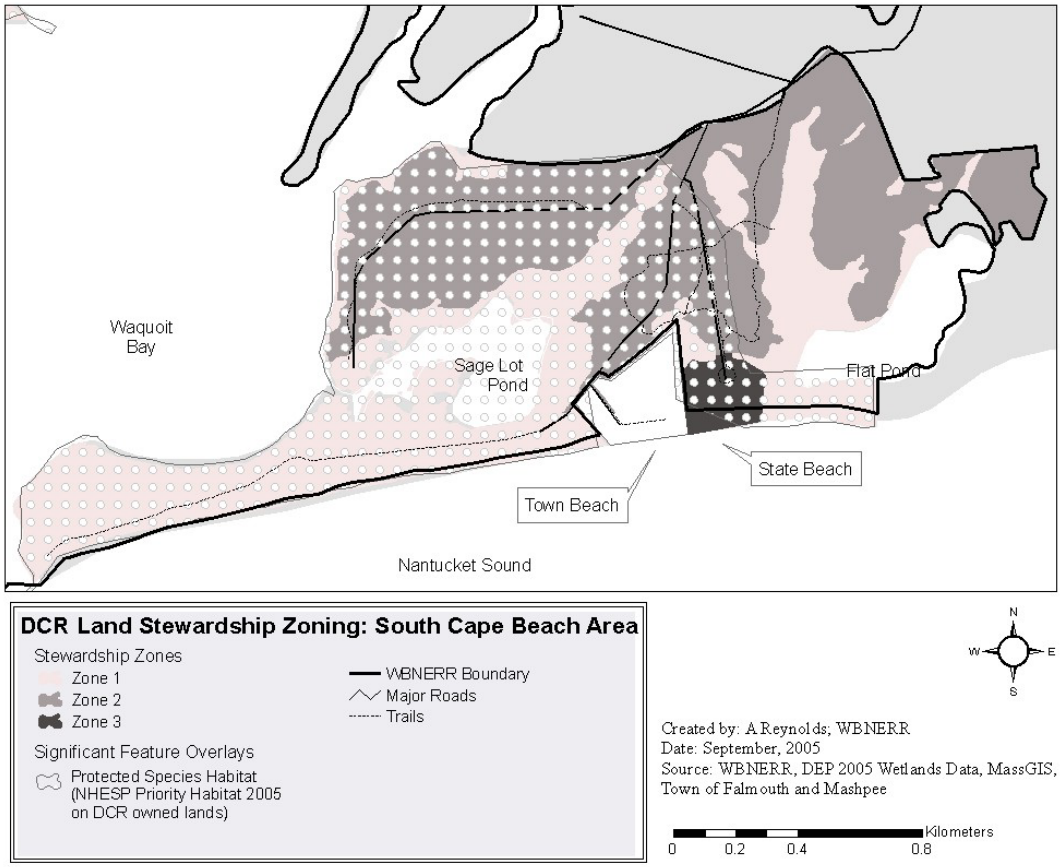


Figure 11: Washburn Island Area.

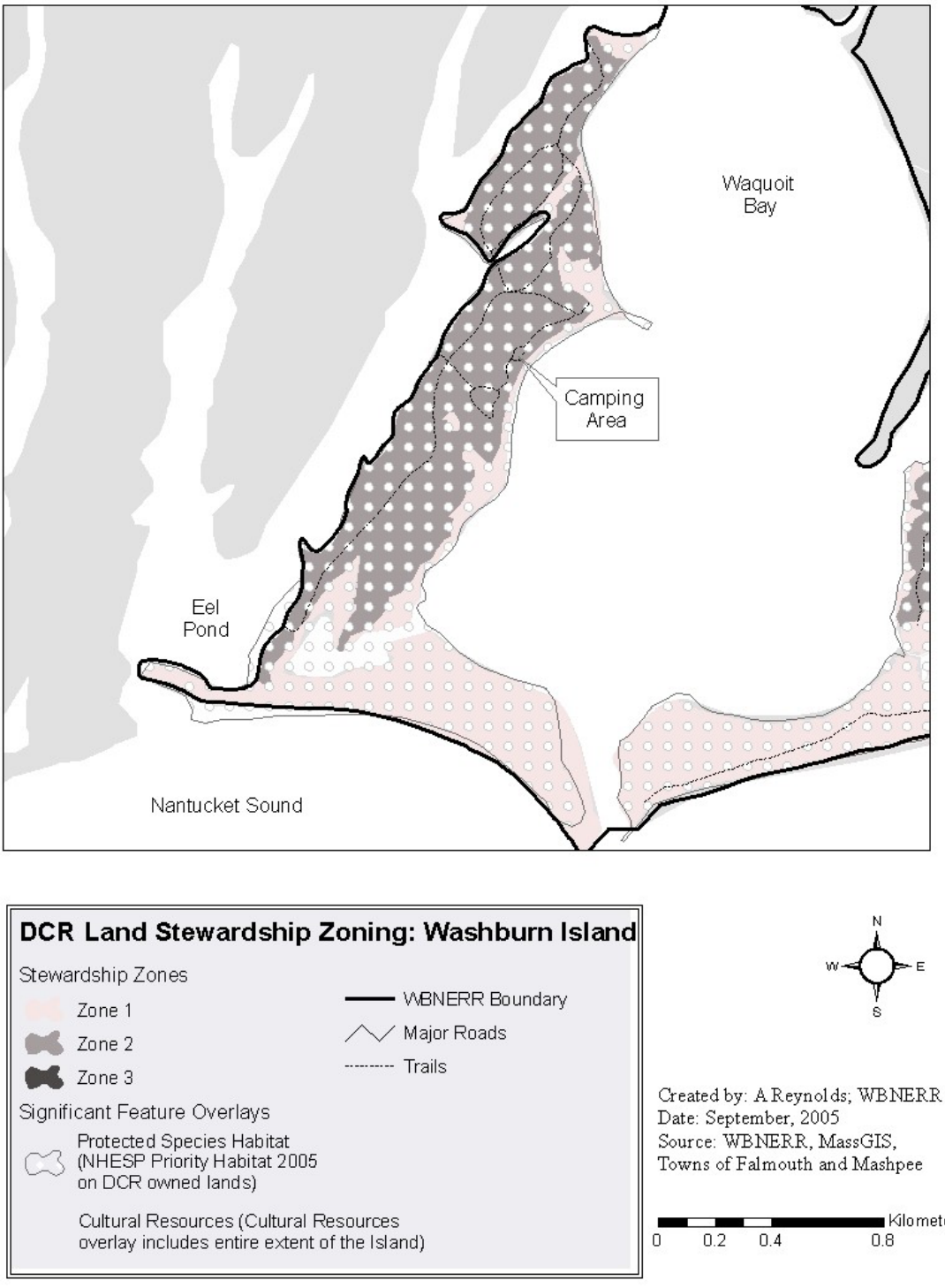


Figure 12: Quashnet River Area (including the satellite "Phinney Property").

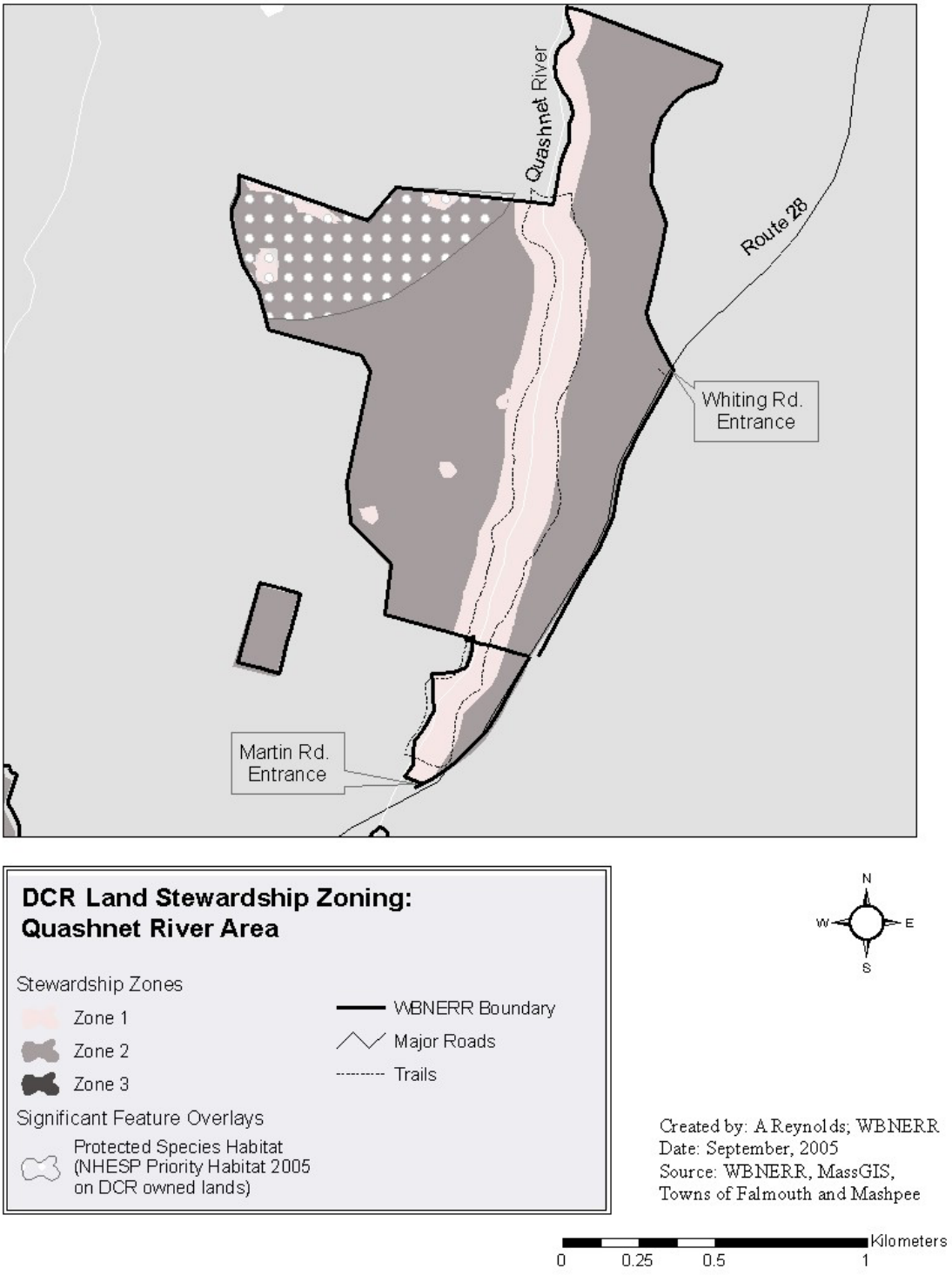


Figure 13: Abigail Brook Area.

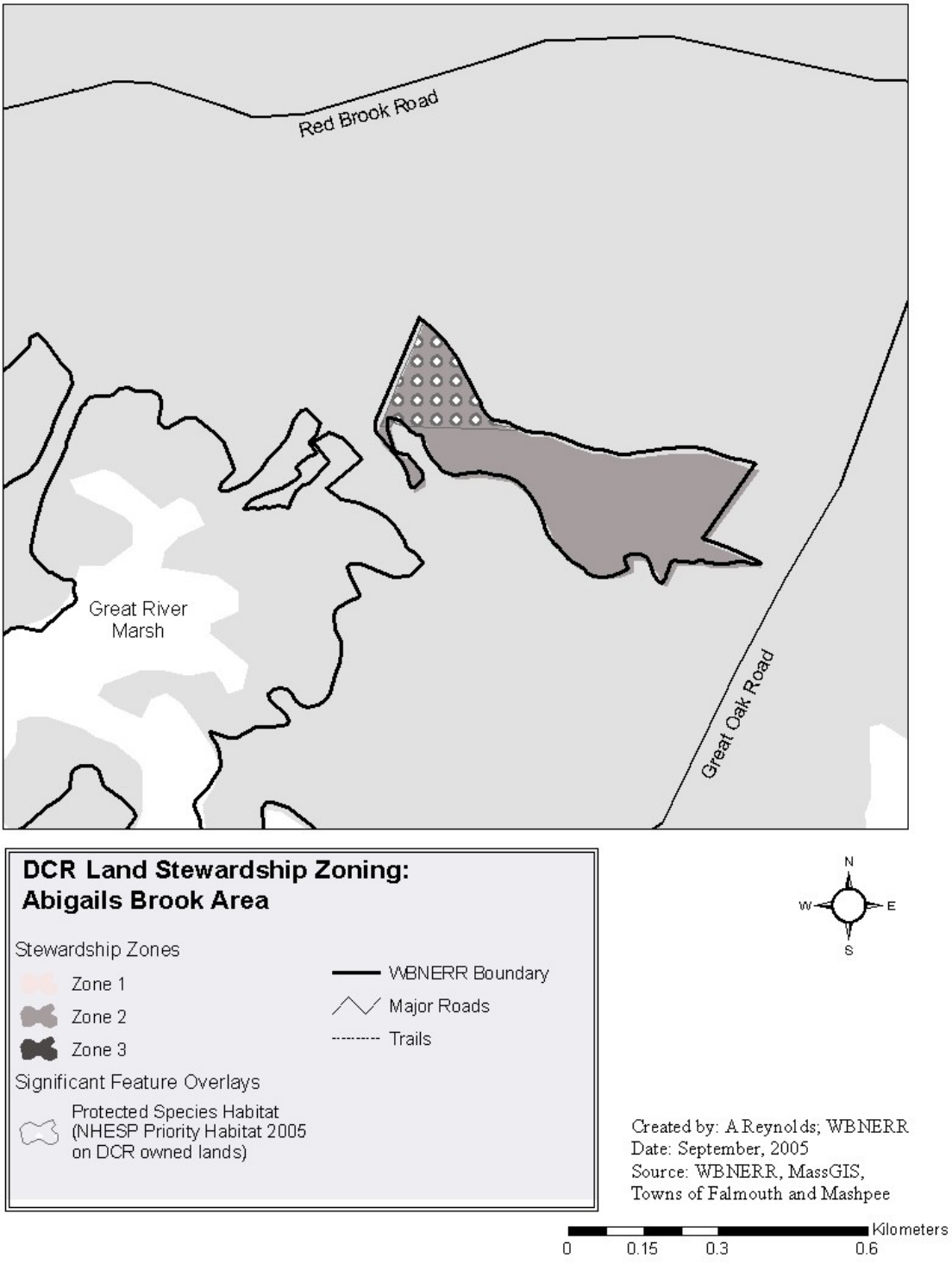
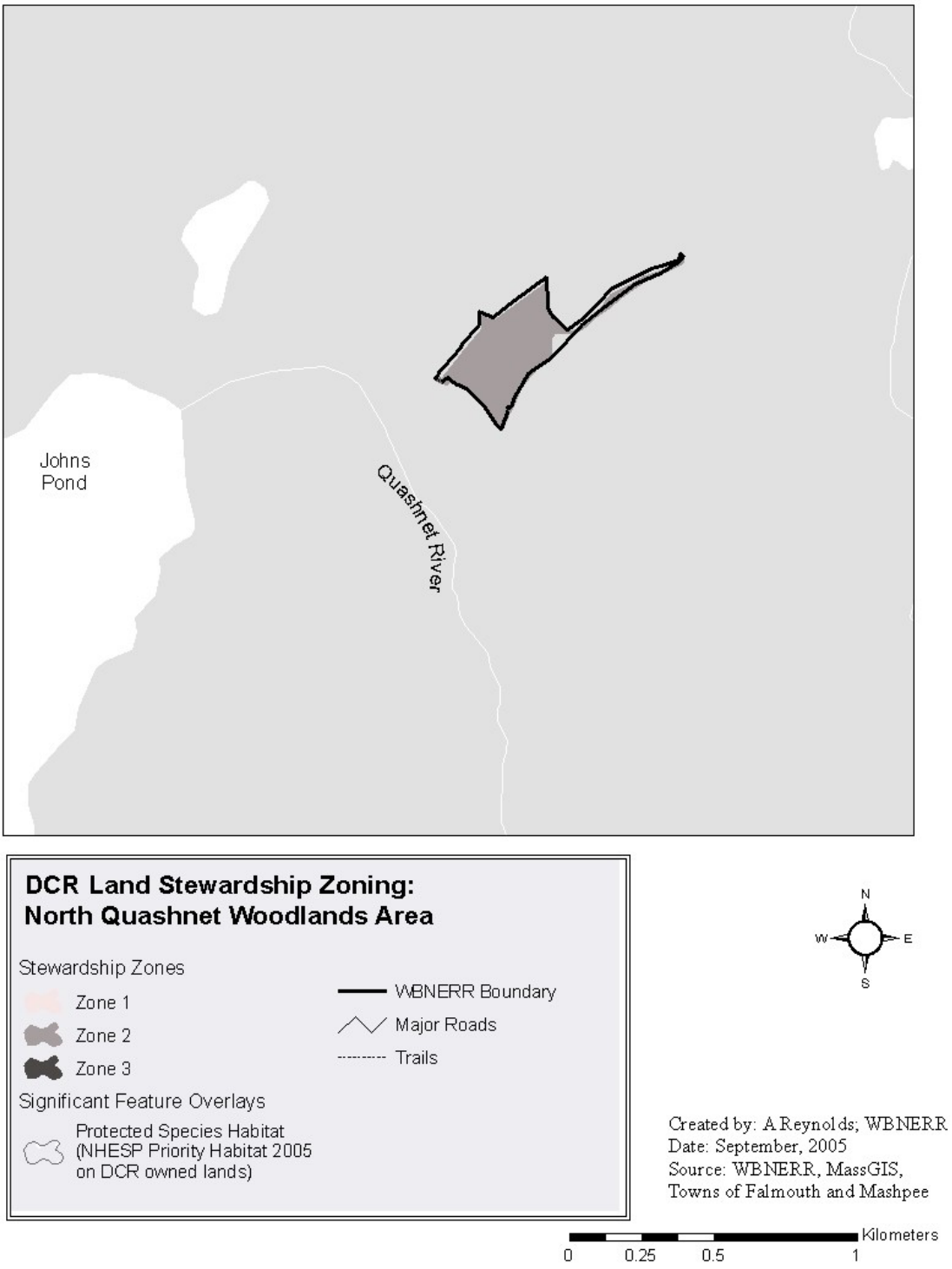


Figure 14: North Quashnet Woods Area.



Laws and Regulations

A variety of existing local, state, and Federal laws and regulations protect natural resources within the Reserve. These policies are summarized below. Reserve staff remain cognizant of regulatory restrictions and management policies and enforce those for which the Reserve has authority to do so and work with state and local law enforcement personnel to enforce others, especially those regarding the Waquoit Bay Area of Critical Environmental Concern (ACEC).

Areas of Critical Environmental Concern

Waquoit Bay and some surrounding uplands were designated as an Area of Critical Environmental Concern (ACEC) in 1979 (Fig. 15). ACECs are places in Massachusetts that receive special recognition because of the quality, uniqueness, and significance of their natural and cultural resources. The State Department of Conservation and Recreation (DCR) administers the ACEC Program and closely coordinates with the Massachusetts Office of Coastal Zone Management (MCZM) regarding coastal ACECs.

The Waquoit Bay ACEC has boundaries nearly identical to the Reserve, mainly differing in extent of tidal river protection. In relation to the Reserve boundary, the ACEC includes greater extents of the Childs and Quashnet Rivers; Red Brook; Jim, Little, Flat and Witch ponds; and of a few tributaries. However, the Reserve boundary includes Great and Little Rivers and the ACEC boundary does not. See Appendices E-G for the Waquoit Bay ACEC designation document, resource summary, and legal boundary description.

The purpose of the ACEC designation is to preserve, restore, and enhance the natural and cultural resources of the area. The goals of the designation are achieved through the application of stricter standards under existing state regulations, through priority attention from state agencies for technical assistance, grants, or other programmatic means, and through cooperative stewardship efforts from citizens to Federal agencies. A synopsis of regulations that apply stricter standards within ACECs follows. It is important to note that ACEC designation does not create new regulations, nor does it supersede local regulations or zoning. For further information concerning regulatory effects of ACEC designation, see www.mass.gov/dcr/stewardship/acec/regsum.htm for a quick summary or www.mass.gov/dcr/stewardship/acec/acecGuide.pdf for a complete guide.

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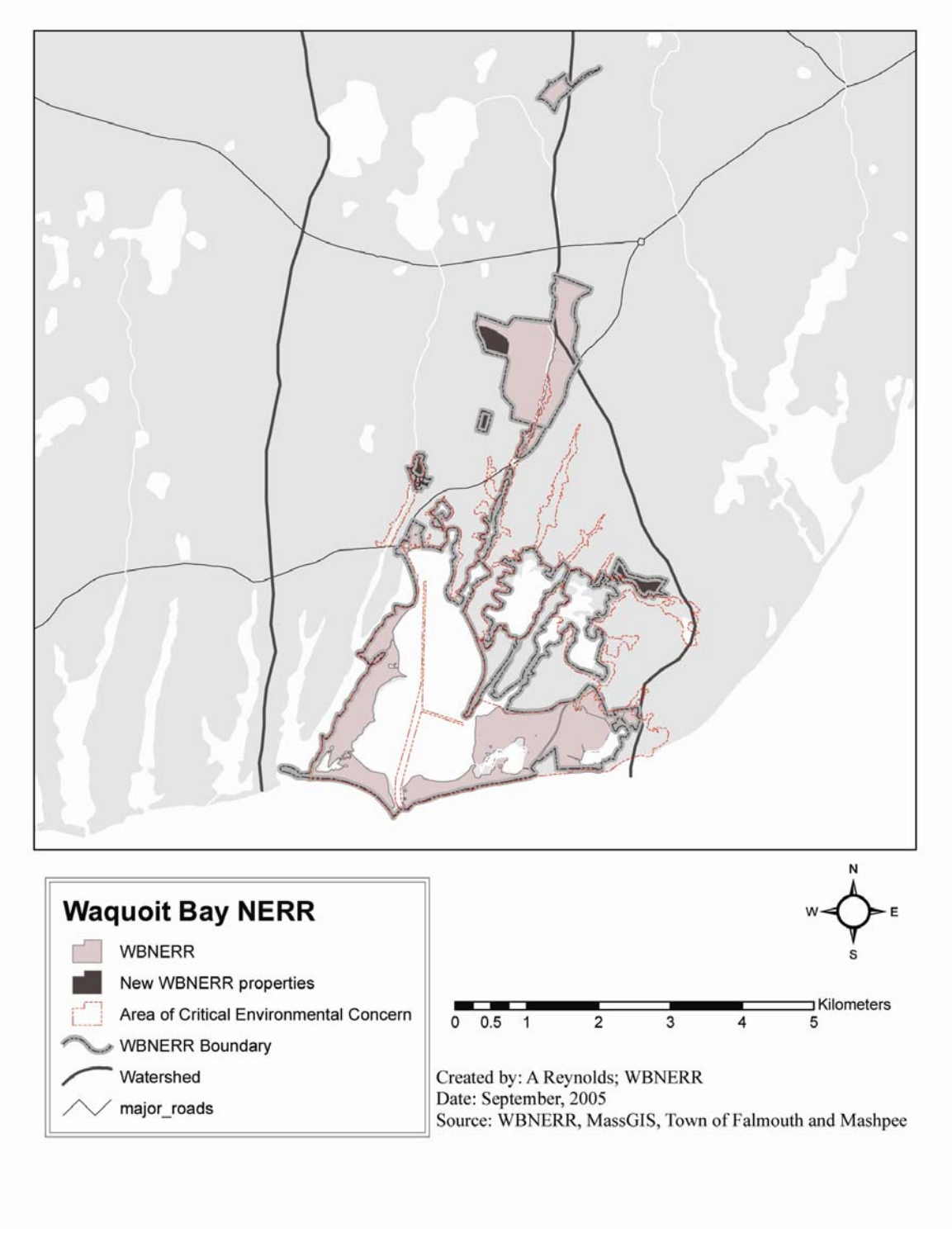
Figure 15: ACEC and WBNERR Boundaries.



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Regulations with Stricter Standards within ACECs

Massachusetts Environmental Policy Act (MGL c. 30, ss. 61-62H and 301 CMR 11.00)
MEPA ensures that proponents study alternatives to proposed actions and avoid, minimize, and mitigate environmental impacts of proposed actions. MEPA review is not a permitting process, but rather it is an information-gathering process that precedes final action by state permitting agencies. Projects located within ACECs subject to MEPA jurisdiction require closer scrutiny than projects located outside of ACECs (301 CMR 11.03(11)). That is, the review threshold of projects that require the filing of an Environmental Notification Form (ENF) is reduced for projects located within an ACEC.

Public Waterfront Act (MGL c. 91 and 310 CMR 9.00)
Commonly known as Chapter 91 and administered by the Department of Environmental Protection, this law protects the public's rights to access the waterfront for use and enjoyment of waterways of the Commonwealth, and codifies the Massachusetts version of the Public Trust Doctrine into statute. The Waterways regulations do not allow new fill in ACECs and place increased limits on new structures within ACECs (sections 9.32(1)(e) and 9.32(2)(d)). Proposed, new, privately owned structures for water-dependent use below the high-water mark, such as private docks or piers, are only eligible for a license provided that such structures are consistent with an ACEC resource management plan adopted by the municipality and approved by the Secretary of Environmental Affairs. Improvement (new) dredging is prohibited within an ACEC, except for the sole purpose of fisheries and wildlife enhancement. Maintenance dredging remains eligible for a permit. The disposal of dredged material is prohibited within an ACEC except for the purposes of beach nourishment, dune construction or stabilization with proper vegetative cover, or the enhancement of fisheries or wildlife resources (section 9.40(1)(b)).

Wetlands Protection Act (MGL c. 131, s. 40 and 310 CMR 10.00)
The Act is administered by local Conservation Commissions and DEP and ensures protection of wetland resources, including all coastal areas between Mean High Water and the limits of the Territorial Sea. The regulations require avoidance, minimization, and mitigation of impacts (including impacts to aquatic vegetation, flood control, and fisheries and wildlife habitat), and establish performance standards that define levels of impact that a project cannot exceed. For coastal resource areas within ACECs, the performance standard is "no adverse effect" on the interests of the Act, except for maintenance dredging for navigational purposes of "Land Under the Ocean" (sec. 10.24 (5) (b)). A higher performance standard also applies to the inland (freshwater) wetlands resource areas known as "Bordering Vegetated Wetland (BVW)." Within an ACEC, potential projects are prohibited that would result in the loss of up to 5,000 square feet or, in some cases, in the loss of up to 500 square feet of BVW (310 CMR 10.55(4)(c)). This standard for BVW applies to all ACECs. Work affecting BVW

may be permitted if it can be authorized under the "limited projects" section listed at 310 CMR 10.53(3).

Massachusetts Coastal Zone Management (MCZM) Program Regulations (310 CMR 21.00)
The MCZM regulations call for all appropriate EOEA agencies to preserve, restore and enhance complexes of coastal resources of regional or statewide significance through the ACEC Program. State and Federal coastal zone regulations stipulate that any Federal activity affecting the coastal zone must be consistent with MCZM's policies to the maximum extent practicable. As such, any project proposed in an ACEC that requires a Federal permit, is Federally funded or is a direct Federal action is subject to review by MCZM before the Federal activity can take place.

Solid Waste Facilities Site Assignment Regulations (310 CMR 16.00)
The Solid Waste Siting regulations prohibit the siting of new solid waste facilities within an ACEC (section 16.40(4)(d)). The regulations also prohibit the siting of such a facility located adjacent to an ACEC if such a siting "would fail to protect the outstanding resources of an ACEC."

State and Federal Endangered Species Act:

The state's Endangered Species Act (M.G.L. c. 131A and 321 CMR 8:00, 321 CMR 10:00) provides for listing endangered or threatened species or species of concern, and of their habitat. Once listed, the Act prohibits the taking, possession, transport, export, processing, sale or purchase of such species and any other species listed under the Federal Endangered Species Act. The Act prohibits any alteration of significant habitat of any protected species that may reduce the viability of the habitat. The Act is administered by NHESP within the Massachusetts Department of Fish and Game (DFG, formerly the Department of Fisheries, Wildlife and Environmental Law Enforcement). The NHESP publishes a map of estimated threatened and endangered species habitat, however, the resident species are not identified to prevent unauthorized takings. The Massachusetts program also coordinates with the Federal Endangered Species Act, administered by the U.S. Fish and Wildlife Service. The Federal Endangered Species Act of 1973 lists plants and animals as either Endangered or Threatened and designates areas of Critical Habitat for each listed species. The ESA prohibits the taking of a listed species, as well as any activity having a negative effect on a listed species or designated critical habitat. Furthermore, the ESA requires consultation with the U.S. Fish and Wildlife Service concerning proposed activities that may have an adverse effect on a listed species or critical habitat.

Ocean Sanctuaries Act

The Ocean Sanctuaries Act (MGL c. 132A, ss.12A-16F, 18 and 302 CMR 5.00) established five Ocean Sanctuaries in Massachusetts waters: the Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex Ocean Sanctuaries. The sanctuaries

include most state waters with the major exception of an area east of Boston Harbor. The Waquoit Bay Reserve is within the Cape and Islands Ocean Sanctuary. The landward boundary of the sanctuaries is the mean low water mark and the seaward boundary is the limit of state waters, generally three miles offshore.

The Department of Conservation and Recreation (DCR) administers the Ocean Sanctuaries Program. The Act prohibits activities that may significantly alter or endanger the ecology or appearance of the ocean, seabed, or subsoil of sanctuaries or the Cape Cod National Seashore. To accomplish this goal the Act prohibits (1) building structures on or under the seabed; (2) construction or operation of offshore or floating electrical generating stations; drilling or removal of sand, gravel (except for the purposes of beach nourishment), other minerals, gases, or oils; (3) dumping or discharge of commercial, municipal, domestic or industrial wastes; (4) commercial advertising; and (5) incineration of solid waste or refuse on vessels within sanctuary boundaries. These prohibitions may be waived if a finding of "public necessity and convenience" can be made for the proposed project or activity.

There is no separate Ocean Sanctuaries review process. Ocean Sanctuaries staff comment on MEPA filings and on DEP Chapter 91 license applications during the respective public comment periods. Proposals that are below MEPA thresholds are presumed to comply with the Ocean Sanctuaries Act. Likewise, a project that receives a Chapter 91 License is presumed to comply with the Ocean Sanctuaries Act.

Waquoit Bay No Discharge Zone

Waquoit Bay is a Federal No Discharge Zone, as designated by the US EPA. This designation prohibits discharge from any type of marine head to the waters of the Bay. Type I and Type II marine sanitation devices, designed to treat waste and discharge it overboard, cannot be discharged in the Bay. Any waste generated must be retained and either pumped out to a system that ultimately discharges to an approved land-based treatment system or taken out of the Bay for discharge. Type III marine sanitation devices include holding tanks, incinerating devices, and recirculating devices; none of these can legally discharge any material into the Bay. It is, of course, illegal to discharge raw sewage to the Territorial Sea or any inland waterbody.

Two pump-out facilities are available in waters connected to Waquoit Bay. Edwards Boatyard has a dock-based facility on the Childs River in Falmouth. The Town of Mashpee operates a boat-based pump-out. Boaters can contact the Mashpee Harbor Master on VHS Channel 9 on Sundays for free pumpouts in Waquoit and Popponesett Bays. It is available dockside at other times at the town dock on Little River. The pumpout boat is in the water until Columbus Day.

Waquoit National Historic District

The Waquoit National Historic District was listed in the National Register of Historic Places on February 26, 2004. The Reserve's Headquarters Site is located within the

Historic District which is roughly bounded by the Childs River, Carriage Shop Rd., Waquoit Hwy., Moonakis River, Moonakis Rd., Waquoit Bay, and Waquoit Landing. Listing in the National Register provides formal recognition of a property's significance and makes the property eligible for preservation restrictions and provides limited protection from federally funded, licensed or assisted projects. The district is significant as an isolated Falmouth Village that reached the high point of its development in the 1850s with industrial, marine, agricultural, and summer tourism components.

Because of the National Historic District designation, the historic Shingle Style main house and boat house and other existing outbuildings must continue to look as they do. The Cape Cod Commission, a regional planning body, will review proposals for substantial and detrimental alterations to, or demolition of, existing structures. New buildings on site are not subject to Cape Cod Commission Review. They are, however, subject to review by the Falmouth Historical Commission. Any new construction must be located in places that do not obstruct the existing views of the ca. 1900 estate and its buildings.

Other State Regulatory Requirements Specific to DCR-Owned Lands

Rules governing all Forests and Parks and the public's use of these lands are regulated by 304 CMR 12, an outline of which follows.

304 CMR 12.00: FORESTS AND PARKS RULES

Section

12.01: General Provisions
12.02: Definitions
12.03: Hours of Operations
12.04: Public Behavior, Disorderly Conduct and Removal of Persons
12.05: Enforcement
12.06: Alcoholic Beverages Prohibited
12.07: Audio or Noise Producing Devices
12.08: Animals on Division Properties
12.09: Seeing Eye and Medical Support Dogs Allowed
12.10: Dumping, Littering, and Garbage
12.11: Damage to Buildings, Signs and Other Property; Metal Detectors; Geological Features and Artifacts
12.12: Solicitation and Commercial Use
12.13: Fires, Lighted Smoking Materials, Embers
12.14: Smoking in Department Buildings Prohibited
12.15: Technical Climbing
12.16: Free Flight Devices
12.17: Special Use Permits
12.18: Hunting Fishing and Trapping
12.19: Target Shooting
12.20: Field Trials
12.21: Use of Non-Motorized Vehicles
12.22: Facilities Fees
12.23: Traffic Rules and Parking
12.24: Designated Campsites: General Rules

12.25: Designated Campsite or Cabin Visitors
12.26: Campsite Overflow Areas
12.27: Group Campsites, Safari Sites and Day Use Sites
12.28: Trail Use, General Provisions
12.29: Snow Vehicle and Off-Road Vehicle Operation
12.30: Trail Use, Bicycle Paths and Rail Trails
12.31: Use of Appalachian Trail
12.32: Use of Division Water Bodies including Beaches
12.33: Swimming Pools
12.34: Boating/Watercraft
12.35: Windsurfing
12.36: Board Surfing
12.37: Towing Behind Boats
12.38: Private Use of Division Waters

To summarize a few points relevant to the Reserve:

- No person shall bring a dog, cat or other animal into any State Forest, Park or Reservation except in areas and under conditions determined by the Director of the Division of Forests and Parks (304 CMR 12.08). For WBNERR, this means that dogs are allowed on leashes in most areas. However, they are not permitted on the public swimming beaches at South Cape Beach State Park or on Washburn Island.
- Littering is prohibited (304 CMR 12.10).
- A person shall not damage or remove any Department property real or personal (304 CMR 12.11).
- The Director of DCR may designate parks and forests, including WBNERR, where fires shall be limited to manufactured fuels only (304 CMR 12.13).
- No person shall launch or use any internal combustion powered watercraft of any nature or type on Division waters were it is posted as prohibited (as it is on all Reserve Ponds) (304 CMR 12.34).

Enforcement

Most permanent and seasonal staff are trained to educate visitors about relevant rules and regulations. They are not, however, trained in, nor authorized to carry out, law enforcement activities. Rather, they are expected to report unlawful behavior to the appropriate personnel or outside law enforcement officials.

The one WBNERR staff member with law enforcement authority is the current Forests and Parks Supervisor who has been trained as a DCR Park Ranger. Park rangers are responsible for enforcement of the Department's rules and regulations on DCR properties, searching for lost or missing persons, and assisting the Massachusetts Bureau of Forest Fire Control as needed. Park Rangers can invoke the non-criminal citation process as necessary. The citation process may involve issuing fines or tickets for various infractions of DCR rules.

The Forests and Parks Supervisor typically encounters incidents like illegal dumping, land encroachment, off-road vehicle use and illegal fire pits. Illegal dumping on Reserve property is a perennial problem. WBNERR staff will continue to identify illegal dumping during their routine patrols and, for both aesthetic and safety reasons, will collect the debris for proper disposal. An estimated eight to ten tons of refuse are removed annually. Staff on routine patrol may also encounter instances in which abutters to WBNERR property are using Reserve land for private or commercial use. When encroachment occurs, Reserve staff—generally the Stewardship Coordinator—contact the property owner and resolve the issue on a case-by-case basis. Staff also identify and report illegal all-terrain and off-road vehicle use and related damage. Approximately three to six illegal fire pits are found on Washburn Island each year. Fire pits are occasionally found in the Quashnet Woods and South Cape Beach areas, as well. Open fires are prohibited on Reserve property. Reserve staff dismantle and/or fill in the fire pits to discourage continued use.

Occasionally, an incident of a more serious nature occurs and restraint is used. Cooperation with police may result in an arrest at a DCR facility. The Reserve may call upon local police departments, Harbormasters, Natural Resource Officers, Massachusetts Environmental Police Officers and the U.S. Coast Guard for additional patrol, enforcement, and emergency response as necessary. All incidents must be reported to DCR through the formal incident reporting process.

Land Management

Objective 3.2: Reserve lands are effectively managed with an emphasis on conservation and sustainable uses of ecological resources while balancing the needs of research, education and recreation.
WBNERR staff will:

a. Monitor land based resources to gain a better understanding of their status and the need for active management.
b. Manage land based resources for sustainability of ecological function, research, education and recreational uses.
c. Develop and implement, in collaboration with appropriate partners, specific resource management plans, including:
    1. Washburn Island Fire Management Plan
    2. Road Access Management Plan
    3. Protected Species Plan
    4. Forest Management Plan
    5. Invasive Species Management Plan
d. Work with DFW staff to ensure that wildlife management activities prevent or minimize impacts to ecological structure and function while allowing sustainable uses of wildlife resources.

WBNERR will maintain existing monitoring programs and develop new ones to inventory, evaluate the status of, and track changes in the valuable natural resources

within the Waquoit Bay watershed. Examples include long-term resource monitoring programs of birds, amphibians, insects, vernal pool habitats, emergent wetland habitats, and visitor use impacts to natural vegetation.

The monitoring efforts summarized above support decision-making at the Reserve. The Reserve responds to information regarding degradation of resources by implementing activities that protect natural values. The Reserve can implement activities directly (*e.g.,* close areas to public access, remove nuisance vegetation) or work with outside organizations to ensure that non-Reserve activities with the potential to impact Reserve resources (*e.g.,* disposal of dredge material, maintenance of roads) are conducted in a way that is as sensitive as is reasonably possible. Monitoring information also supports decisions about what type of research is needed, where certain types of research can be conducted, what type of educational materials or programs would be beneficial, and which recreational uses will be allowed where. For instance, there is a popular kayak portage between Eel Pond and Tim's Pond at the southwest corner of Washburn Island that has been getting increasing use in recent years. This area will be monitored over time and structural controls may be necessary to protect wetland and SAV resources in this area if recreational use becomes more intense.

WBNERR staff will work with appropriate partners—including DCR, CZM, and the ACEC program—to develop and implement resource management plans for several key resources at the Reserve that warrant specific consideration. For instance, the existing Washburn Island Prescribed Fire Plan needs to be updated to include a greater emphasis on ecological restoration. Controlled burns are conducted on Washburn Island for three reasons: to maintain a fire-dependent sandplain community; to maintain low forest fuel and, thereby, prevent a catastrophic fire; and to serve as a training site for fire response crews in southeastern Massachusetts. All three functions will be included in the revised plan. Experimental burns conducted in association with monitoring will be paramount, however. The studies will attempt to determine how the state-listed plant *Liatris borealis*—and the whole island community—respond to different types of fire events, *i.e.,* sustained hot fires vs. periodic, less intense fires.

Another plan that needs to be developed concerns access along dirt roads within the Reserve. A Road Access Management Plan will be developed based on recommendations developed with the Mashpee National Wildlife Refuge Conservation Partnership. The plan will address:

- types of allowable roads, *i.e.,* width and surface,
- maintenance frequency of roads, *i.e.,* surface grading and trimming adjacent to roads, and
- management of traffic, *i.e.,* installation of gates (or not) and schedules for opening and closing gates.

The Reserve currently has an organized approach, rather than a definitive plan, for monitoring and managing protected species. For example, competing plants are mowed or burned in order to allow rare plants to flourish. Shorebirds are protected by closing

areas to human activities and by artificially protecting nests from natural predation. During the process of developing a Protected Species Plan, these activities—and others—will be critically examined and, as appropriate, be strategically selected for continued application.

Finally, due to the maturation of forest lands within the Reserve and increasing impacts from the spread of non-native plants, issues such as Forest Management and Invasive Species Management will soon need to be addressed Reserve-wide with specific plans. In recognition of these impending needs, the Reserve will identify internal financial and staffing resources and will seek support through external grants and/or partnerships with other organizations to develop and implement appropriate strategies.

Public Access Plan

Objective 3.3: The public have the opportunity to enjoy the recreational resources of the Reserve.
WBNERR staff will:

a. Maintain public recreation facilities and continue to offer interpretive programs at the Headquarters Site, South Cape Beach State Park, Washburn Island, and other Reserve properties.

Each year thousands of people visit the Waquoit Bay National Estuarine Research Reserve Headquarters Site, South Cape Beach State Park, Washburn Island, Quashnet Woods, other parcels of WBNERR property and/or the open waters of the Bay and its tributaries. Some come for the unstructured recreational benefits that the Reserve provides, including swimming, fishing and shellfishing, hiking, boating, and birding. Others come for more structured activities that are related to the Reserve's research and education programs. Activities are held or allowed at all components of the Reserve. Some rules and regulations are common to all components and are summarized under Objective 3.1. Other rules are specific to particular components and are described below in association with a summary of public access opportunities at each site.

Headquarters Site

The Reserve Headquarters Site is generally utilized as a "campus" with emphasis on research, education/outreach and administration. The Headquarters Site also provides access to a wide range of activities for the public. The Visitor Center, Boat House, and Carriage House host many structured educational and interpretive activities. Additionally, casual visitors can follow a short trail through the woods and around a scenic overlook of the Bay and coastal pond. A trail guide featuring the walking trails at the Headquarters Site, Washburn Island, and South Cape Beach State Park is available in the Visitors Center. Exhibits at the Visitor Center offer additional information to walk-in visitors.

Reserve policy concerning public access to the Headquarters Site includes the following guidelines:

- The Headquarters Site is limited to passive recreational activities that do not compromise the mission or objectives of the Reserve.
- Outside groups may use the Headquarters Site as long as their mission and objectives are consistent with the Reserve's or if the Reserve provides an educational program as an integral part of their program.
- Access to the beach through the Headquarters Site for recreational use is discouraged because of potential conflicts with research or education programs on the beach or in the water in front of the beach. As an attractive alternative, South Cape Beach State Park provides considerably more extensive beach facilities. Also, people with boats are welcome to use the beaches on Washburn Island.
- Limited access is provided to commercial and recreational shellfishers on a "straight to the resource" basis. That is, shellfishers are allowed to use some of the limited parking spaces at the Headquarters Site during regular operating hours as long as there are no large events going on and as long as they pass through to the shellfishing area without lingering on the Reserve's or abutters' beaches.
- Public access to the research laboratory is limited to tours guided by Reserve staff members or volunteers. This policy protects both visitors and the integrity of the research work being done.
- Access to the endangered species management area is limited to Reserve staff members, researchers and volunteers working with this program. This directive protects the fragile plants in this management area.

South Cape Beach State Park

The South Cape Beach area includes South Cape Beach State Park and a beach owned and operated by the Town of Mashpee. The town beach is not part of the Reserve. South Cape Beach State Park provides a wide range of ocean-side recreational opportunities including access to beaches and trails. Several types of interpretive activities take place here, including regularly scheduled interpretive walks. Refer to Objective 2.10 for a fuller description of interpretive programs. Various research projects are also conducted at South Cape Beach.

Parking, requiring a fee or appropriate permit during the summer, is available at the State beach parking lot or the Town of Mashpee parking lot.[2] At the old state parking area, there is a boardwalk with a bicycle rack but no parking facilities for automobiles. Bicyclists are encouraged to use this area. Many bicyclists, however, choose to use the State beach's main parking lot even though there is no bike rack. WBNERR will, therefore, budget funds for a new bike rack. For visitors with limited mobility, a specially designed "sand chair" (a wide-tire wheelchair) is available at the State beach. Arrangements must be made in advance at Headquarters.

[2] Seasonal passes to the State Beach are available at the contact station at South Cape Beach. Senior passes to the State Beach are available at the Visitor Center at the Headquarters Site of the Reserve and at the ticket booth at South Cape Beach.

The following policies and guidance balance the requirements of resource protection, research, and quality recreational experiences.

- Swimming, sunbathing, hiking and birdwatching are the primary recreational uses of the beach area.
- No motorized boating access is provided at South Cape Beach State Park. There is a state-funded boat ramp on Great River accessed from Great Oak Road.
- Access is allowed on a year-to-year basis for hunting in season. Access for hunting is reassessed annually by WBNERR and the South Cape Beach Advisory Committee.
- Off-road vehicles are prohibited.

Washburn Island

Washburn Island, while accessible only by water, is very popular with day users and campers. Most visitors come by private boat: they either anchor and wade ashore or beach their boats. The Reserve provides limited boat access during the summer for scheduled interpretive programs and, occasionally, for other programs when prior arrangements have been made.

During the summer, the Reserve offers regularly scheduled interpretive walks, roving interpretation for boaters, and special programs. There is a hiking trail running down the center of the Island. Three Island Managers live on the island in the summer and are responsible for managing camping on the island and providing interpretive tours. Washburn Island has eleven campsites: nine family sites and two group sites that are limited to 25 people each. There are two composting toilets on the island. Camping permits (requiring a small fee) are available through an on-line reservation service, ReserveAmerica.com or by calling 1-877-422-6762. A limited number of permits are also available at Reserve headquarters. Permits are available May through mid-October (Columbus Day). State regulations restrict the length of stay at a campsite to no more than fourteen consecutive days (304 CMR 12:24(5)(a)) between Memorial Day and Labor Day.

Quashnet Woods Property

Presently there is a 2.5 mile long trail running along the Quashnet River within this property. The trail is accessible through the Martin Road or the Whiting Road gates. An existing dirt road forms one side of the trail. The trail crosses over the river at a herring run and circles back as a path through the forest. The trail is not handicapped-accessible and parking at the trailhead is limited. Any overflow parking is forced onto the roadside. WBNERR has conducted a parking needs assessment for the property and is moving ahead with plans to install an interpretive kiosk, signage and a more formal parking area.

Childs River

While there are no official trails on the Childs River property, the public is permitted to hike and explore. Regulations guiding usage are posted on signs at the property's boundaries. The property will be evaluated for the feasibility of public trails.

Abigail Brook

The Abigail Brook property has an existing public trail that is maintained by volunteers. Regulations guiding usage are posted on signs at the property's boundaries.

Objective 3.4: The public will use the Reserve's property and resources responsibly.
WBNERR staff will:

a. Continue to make information about regulations, Reserve policies, and appropriate behaviors readily available to users through signs, written materials, and staff.
b. Improve trail signs and markers.

Applicable rules and regulations are posted throughout Reserve lands and described in literature available at Reserve facilities and from Reserve staff.

When appropriate, all WBNERR staff educate Reserve visitors about rules and regulations and appropriate behaviors and activities. In particular, the Island Managers and the Shorebird Manager are trained and are responsible for educating visitors to the heavily used Washburn Island and South Cape Beach areas of the Reserve, respectively.

Existing signage throughout the Reserve will be enhanced with more and better trail signs that depict the trails and, where appropriate, include additional information about such things as key ecological resources, actions individuals can take (or avoid) to protect natural resources, and the Reserve's mission to improve stewardship of the region's estuarine and coastal watershed ecosystems. Refer also to Objective 3.8.

Ecological Restoration Activities

Objective 3.5: Ecological function is restored to humanly altered natural habitats within the watershed.
WBNERR staff will:

a. Create a WBNERR Restoration Science Program that is consistent with the NERRS-supported national Restoration Science Program
b. Continue work on restoration projects:
    - Estuarine eelgrass and benthic communities
    - Quashnet River
    - South Cape Beach Saltmarsh
    - Coastal Sandplain
    - Abigail Brook
    - Sand Dunes
    - Threatened Birds

Restoration Science Program

The National Estuarine Research Reserve System is in the process of developing implementation strategies for a Restoration Science Program (RSP). The national RSP implementation plan is being developed by NOAA/ERD and the NERRS. The goal of the RSP is to improve the effectiveness of habitat restoration practices by advancing the science of restoration. Two key aspects of the proposed program are the establishment of Restoration Demonstration Projects and Restoration Reference Sites. Restoration Demonstration Projects will be designed specifically to address pressing restoration issues and information gaps in regional habitat restoration needs. The NERRS Coastal Training Program (CTP) will disseminate lessons learned from these projects. Restoration Reference Sites are areas of significant ecological integrity within the Reserve that will be monitored over the long-term. They will be available for use as comparison sites for regional restoration projects outside of the Reserve. Monitoring of the Restoration Reference Sites will be integrated with the NERRS System-wide Monitoring Program (SWMP).

Habitat restoration at WBNERR is intended to improve the ecological integrity and biogeographical representative character of the Reserve, provide additional habitat for threatened and endangered species, and address information gaps in the science of habitat restoration. The Reserve's proposed Restoration Science Program will establish the need for habitat restoration at the Reserve, identify restoration sites, and describe a restoration strategy complete with priorities and a timeline. In establishing the need for restoration at the Reserve, the Restoration Science Program will outline the habitat attributes and natural processes significantly altered by human activities. The plan will describe the direct and indirect effects of those alterations on the physical and ecological processes within the Reserve and the Waquoit Bay watershed and on human health and the local and regional economy. A significant aspect of the WBNERR Restoration Science Program will be the development of a method to prioritize areas needing restoration

through ongoing inventories and monitoring of change and consultation with outside experts. Preliminarily, the WBNERR Restoration Science Program will include the following elements:

- Detailed characterizations of discreet restoration project sites.
- A restoration project planning process that includes the use of advisory groups.
- Project goals and objectives for individual projects and groups of projects.
- A list of the most appropriate restoration science questions to address for each project site.
- Baseline and post construction monitoring plans.
- Funding strategies for project construction, monitoring, and construction of access and educational programs and trails.
- Criteria for site prioritization and timelines for project implementation.
- Educational opportunities (*e.g.,* K-12, interested public, and professional teacher development) associated with restoration projects and restoration outreach plans.

Restoration strategies will be developed to integrate multiple levels of Reserve staff and community participation, where appropriate. The role of volunteers and AmeriCorps crews will be outlined for each project and opportunities for educational activities, public outreach and interpretation will be included in project planning.

Current Restoration Projects

The Waquoit Bay watershed, like most coastal areas in the Northeast U.S., has a long history of human alteration. Even the lands and waters that are now protected within the Reserve and appear "natural" have been altered from their pre-colonial condition and may not be providing the full ecological functions that they once did (or could). Several projects have been implemented and/or are currently underway to restore ecological function to disturbed areas. It is expected that, during the term of this management plan, WBNERR habitat restoration activities will be organized into a NERRS-supported Restoration Science Program.

Estuarine Eelgrass and Benthic Communities

Eutrophication is the most significant issue affecting the Waquoit Bay ecosystem. Continually increasing nitrogen loads from wastewater, fertilizer and atmospheric sources have led to drastic shifts in estuarine habitats. Eel grass habitat, critical to fish and shellfish communities, was once plentiful. It is now completely missing from the main Bay and is disappearing from the few subembayments where it remains. In addition to eelgrass loss, eutrophication has led to a variety of other changes that affect benthic communities throughout the estuary by changing dissolved oxygen conditions and bottom substrate.

The solution to eutrophication is to reduce the amount of nutrients getting to the Bay from its watershed and airshed. Success will require changes at the local, regional and even national level. Despite the daunting scale of the task, WBNERR

is actively engaged in activities to restore the health of Waquoit Bay's eelgrass and benthic communities.

Scientific research conducted at the Reserve beginning in the late 1980s helped to define the problem of eutrophication. More recently, monitoring data collected at the Reserve has been used in linked watershed-embayment models that are being used by the Massachusetts Estuaries Project (MEP) to calculate Total Daily Maximum Loads (TMDLs) for nitrogen. TMDLs represent the maximum amount of nitrogen a waterbody can assimilate and still accommodate its designated use(s), *e.g.,* drinkable, swimmable. The models and TMDLs are tools used at the State and local level to direct decisions regarding nitrogen-load-reducing management activities. In addition to providing monitoring data, WBNERR staff have contributed to the Massachusetts Estuaries Project by serving on the advisory committee, reviewing and commenting on reports, and offering technical input to the nitrogen loading models. WBNERR also promotes nutrient reduction through programs that educate watershed residents about the source of the problem and potential solutions. Additionally, the Reserve and its partners actively pursue opportunities to protect open space and to maintain vegetative cover that helps to intercept nitrogen by taking land out of potential development. WBNERR will remain determinedly engaged in these activities for the duration of this management plan.

Quashnet River

The Quashnet River is the largest tributary stream of Waquoit Bay and an example of the coastal cold-water, low-gradient streams unique to glacial outwash plains of the region. Historically, it was famous for its anadromous fish runs of river herring and native sea-run brook trout. It also supports a catadromous run of American eels. A combination of human impacts—including dam construction, over fishing and intense agricultural practices—had degraded the physical habitat in the Quashnet River. For more than 30 years, Trout Unlimited and the MA DFW have worked to reclaim the Quashnet as a trout stream and, coincidentally, improve habitat for a diverse community of fish, invertebrates, birds and other native animals and plants. WBNERR has contributed to the restoration effort by planting and monitoring experimental plots for different types of revegetation, providing technical advice about revegetation and habitat structures, coordinating AmeriCorp group project days, and assisting with restoration monitoring. The Reserve intends to continue to work with Trout Unlimited and the DFW to improve the habitat to restore the intertwined river-bay ecosystem.

South Cape Beach Saltmarsh

Road construction significantly limited the flow of salt water onto the salt marsh behind the now largely abandoned roadway to the “old” state beach and at the Mashpee town beach road at the southeast corner of Waquoit Bay. The altered flow may have caused a loss of salt marsh cordgrass, *Spartina alterniflora,* and

salt marsh hay, *Spartina patens.* These desirable marsh grasses have been replaced by *Phragmites* sp. which is considered less desirable than the marsh grasses as wildlife habitat. *Phragmites* also produces less material for the detrital food chain and is thought by some to be a fire hazard because it dries at the end of the growing season. In addition, there is some evidence that panne areas in the healthy wetlands are increasing. The Reserve has worked with MA CZM and the Town of Mashpee to assess the problem and consider alternative restorative actions. The Reserve, in partnership with these organizations, is currently moving forward with final construction designs to implement actions that will restore tidal flow to the constricted marsh area. Specifically, two narrow culverts will be removed and replaced with one bridge and one larger culvert. An ongoing pre-project monitoring program will continue into the future to assess the success of the restoration activities.

Coastal Sandplain

The Reserve contains several small areas of remnant coastal sandplain grassland. This once common natural community is now rare because it has been replaced by coastal development or the wildfire disturbances that once maintained it are now arrested. The Reserve uses mechanical methods and prescribed fire to control natural succession and restore sandplain grassland habitat on Washburn Island and at the headquarters site. These activities promote the rare natural community and species that comprise it, including *Agalinis acuta* (sandplain gerardia) and *Liatris borealis* (New England blazing star). *Agalinis* is on the Federal endangered species list and *Liatris* is a state-listed plant of special concern.

Abigail Brook

Abigail Brook is a small, wetland-fringed tributary on the east side of Waquoit Bay. The *Cape Cod Atlas of Tidally Restricted Saltmarshes,* prepared by the Cape Cod Commission, describes the culvert under Great Hay Road as a tidal restriction. Replacement of this culvert with a larger structure will allow natural tidal flows to return to this altered wetland with positive effects on the plant and animal community. This project is currently being considered for future implementation by the Reserve with partner organizations: MA CZM Wetland Restoration Program, Natural Resources Conservation Service, and U.S. Fish and Wildlife Service.

Sand Dunes

Foot passage through the dune areas of South Cape Beach State Park has damaged the dune grasses and the dunes. Dune restoration will be accomplished through a combination of boardwalk construction, fencing, dune planting, signage, and outreach.

Threatened Shorebirds

There are two species of concern on Reserve property; the piping plover and the least tern. The Federal government lists the piping plover as a threatened species of shore bird. Piping plovers presently nest in limited numbers on South Cape Beach and the beach at the southern end of Washburn Island. Because their eggs are laid on the ground and are well camouflaged, they are often accidentally damaged or destroyed by human actions. Nests on the ground also make the eggs easily accessible to predators. The Reserve's Seasonal Shorebird Manager works in cooperation with the Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement (DFWELE) and the Massachusetts Audubon Society. The Reserve trains volunteers to 1) recognize signs of mating and nesting activity and 2) to erect predator exclusion fences to protect eggs and hatchlings. Volunteers inform beach-goers about risks to the birds' nests and chicks from dogs, flying kites, and other human activities on the beach. The seasonal shorebird manager tallies adult bird pairs and egg and fledgling numbers.

Least terns (*Sterna antillarum*), a state species of special concern, are present at South Cape Beach and have historically nested there. Roseate terns, common terns, willets, and American oyster catchers also feed at South Cape Beach and may nest there as well. Reserve staff monitor the activities of all five species.

Land Acquisition

Objective 3.6: DCR will acquire real estate rights to key parcels in the Waquoit Bay Watershed area to expand the Reserve.
WBNERR staff will:

a. Work with MNWR partners to prioritize land for acquisition.
b. Seek funds for land acquisition.
c. Work closely with DCR land acquisition staff on land acquisition process.

Research at WBNERR has shown that land use change, particularly residential development, in the Waquoit Bay watershed has resulted in drastic impacts to estuarine resources. A key component of WBNERR's efforts to protect the quality of the land and water ecosystems within the Reserve is the preservation of undeveloped land in and around the Waquoit Bay watershed. Land acquisition by the Reserve provides increased opportunities for research and education activities. Such protection of undeveloped land also provides many tangential benefits to coastal communities in the form of aesthetic values, controlled recreational access, limitations to increases in traffic, and protection of drinking water resources. Land acquisition activities are implemented in conjunction with the Reserve's participation in the Mashpee National Wildlife Refuge Conservation Partnership. The Reserve's strategy for land acquisition is detailed in Appendix H: Acquisition Plan.

Boundary Change

Lands purchased since the last management plan was prepared are incorporated into the Reserve boundary with this management plan. Over the past five years, the Reserve has gained title to the five properties described below.

- The two Childs River properties total 19 acres and straddle the Childs River (the second largest tributary to the Bay) just upstream of tidal influence. The property includes coastal pine/oak woodland habitat and unique coastal low gradient stream habitat important to multiple migratory fish species.
- The 35 acre Abigail Brook parcel is located immediately adjacent to the easternmost portion of the Reserve in the vicinity of Upper Great River. This property includes coastal upland pine/oak woodland and important riparian buffer to the adjacent Abigail Brook and its associated wetlands.
- The 10 acre Phinney parcel is located near the Quashnet River in the central portion of the Bay's watershed. The property includes pine oak woodland characteristic of coastal uplands in the area.
- The 31 acre NStar parcel is also located near the Quashnet River in the central portion of the Bay's watershed. It is immediately adjacent to the Reserve's Quashnet River Area property and includes a variety of coastal upland and wetland habitats, including some vernal pool and freshwater wetland habitats not previously represented in the Reserve.

The Reserve has also acquired a conservation easement on about seven acres of Town of Mashpee open space land which is not being incorporated into the Reserve boundary at this time.

All of the new lands are within the land acquisition boundary of the U.S. Fish and Wildlife Service's (USFWS) Mashpee National Wildlife Refuge. A Final Environmental Assessment of the MNWR (USFWS 1995) found "no significant impact" would result from the proposal to cooperatively preserve, protect, and manage lands within the towns of Mashpee and Falmouth. The proposal was developed by USFWS after extensive public input from citizens, elected officials, government agencies, and interested organizations.

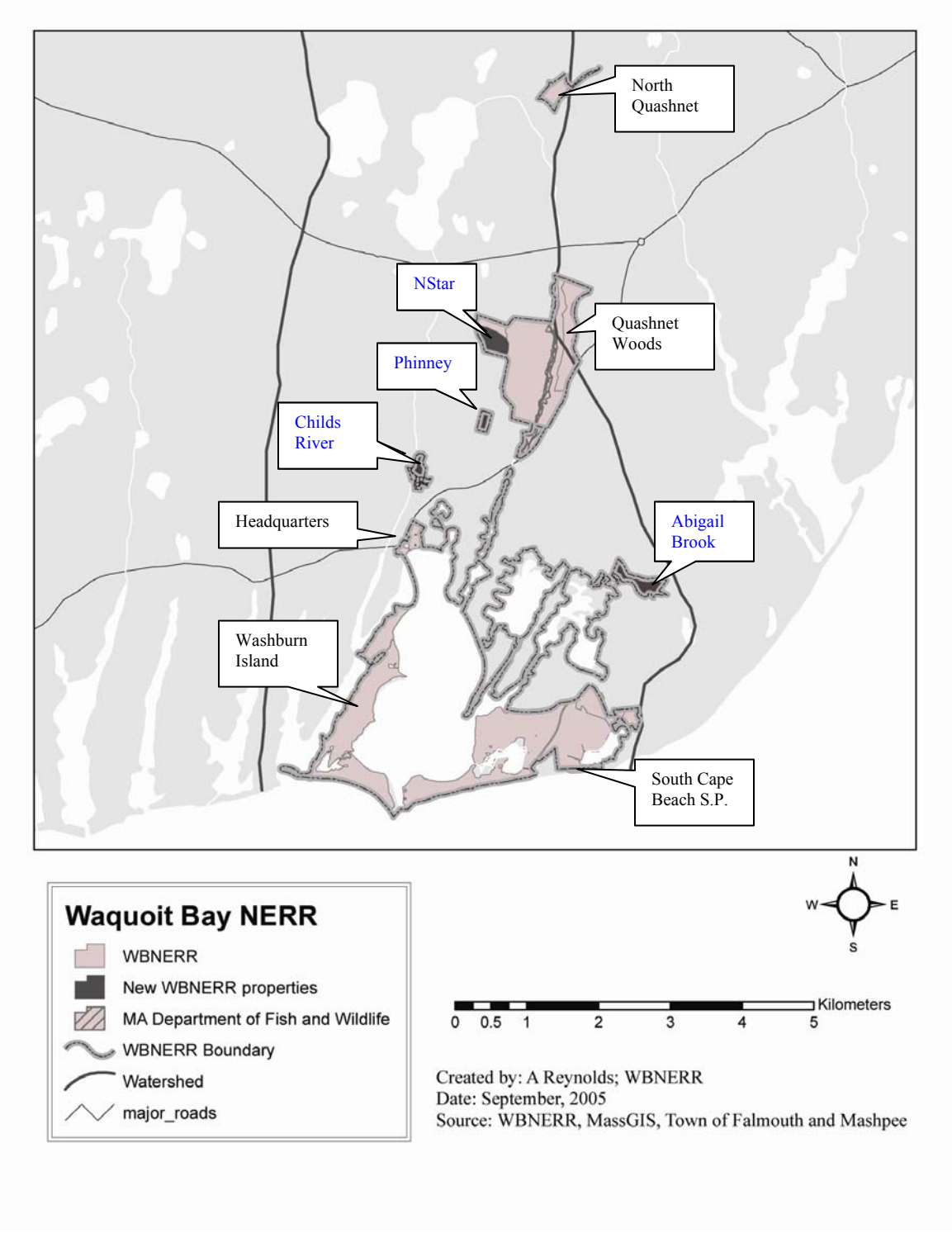
Protection of the five properties listed above prevents their future development and, thus, eliminates potential new sources of nitrogen in the Waquoit Bay estuarine ecosystem. Inclusion of these properties within the Reserve boundary adds underrepresented habitats typical of the biogeographic province, including various migratory fish runs, coastal forested uplands and freshwater wetlands. These properties also provide previously non-existing access and further opportunities for the Reserve's research and education programs.

All of these parcels have a history of rural agricultural land use. Cranberry operations existed at the Childs River and Abigail Brook parcels, while grazing was the likely historic land use at the other parcels. Agricultural operations at all sites have been

abandoned for at least 30 years and vegetation succession is occurring on all of the properties. With the inclusion of these properties into the NERR boundary, they are subject to all land and water resource management, signage and public information, law enforcement and other site control activities outlined in this Management Plan. Reserve led biological monitoring, including vegetation and rare species, has already begun in these areas. The habitats represented on these properties are currently being made available to research, education and stewardship demonstration activities. For example, an invasive species control project is currently underway at the Childs River property, vernal pool monitoring is occurring at the NStar property and restoration of tidal restrictions is in planning at the Abigail Brook property.

These most recent additions are identified in Figure 16. As new lands identified within the Stewardship Focus Area (refer to Appendix H) are acquired, they will also be incorporated into the Reserve boundary through a formal review and approval process.

Figure 16: WBNERR Boundaries**.**



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Marine and Freshwater Resources

Objective 3.7: Reserve waters and wetlands are effectively managed with a prioritization on ecological needs while balancing the needs of research, education, recreation, and sustainable use of natural resources.
WBNERR staff will:

a. Continue to inventory significant resources and monitor changes.
b. Continue to work with town and state officials to improve management of aquatic resources.

The Reserve includes approximately 1,359 acres of estuarine waters, several freshwater ponds, tributary streams, vernal pools and substantial groundwater resources beneath its lands. Freshwater resources in tributary streams, ponds and vernal pools support unique vegetation and animal communities including amphibian and anadromous fish populations. The open waters of the bay once supported one of the most diverse estuarine fish communities in the state (Curley *et al,* 1971). These waters are still significantly important to commercial and recreational shellfish and fin fish fisheries. The Bay waters also enhance the value of the surrounding real estate and provide valuable recreational activities, including swimming, boating, windsurfing and kiteboarding.

The watershed's fresh water resources, as well as Waquoit Bay itself, are impacted by eutrophication resulting from excessive nutrient loading. This problem seriously threatens water quality in the Bay and is expected to continue to worsen until alternatives to wastewater disposal can be implemented on a large scale in the watershed. Additionally, freshwater resources are threatened by toxic contamination moving through groundwater from the nearby Superfund site at the Massachusetts Military Reservation. In addition to threats to the quality of water resources, future population growth on Cape Cod threatens the quantity of freshwater resources. Groundwater withdrawal from the Waquoit Bay watershed's sole source aquifer could potentially lead to drops in water levels that could seriously impact habitats in streams, ponds and vernal pools.

WBNERR is committed to continuing existing monitoring programs and developing new ones to inventory, evaluate the status of, and track changes in the valuable aquatic, estuarine and marine resources in the Reserve and its vicinity. Examples of this include SWMP, the submerged and emergent vegetation monitoring project, vernal pool monitoring, aquatic insect monitoring and stream fish monitoring. Monitoring results will continue to inform management decisions at the Reserve.

The Reserve has no management authority over the open waters of the Bay or upstream freshwater resources. However, the Reserve influences water resource protection via research, education, stewardship demonstrations, and the translation of research for policy-makers. Since marine and freshwater resource problems and their solutions are complicated and go beyond the scale and jurisdiction of the Reserve, the Reserve cooperates with outside groups, including municipalities and other state and Federal agencies, to address them. The Reserve works to make science-based information

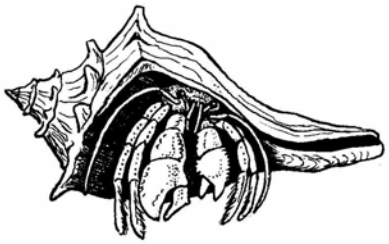
available to policy-makers and decision-makers through workshops and direct communication. WBNERR also comments on reports, proposed projects and proposed policy changes that could affect the Reserve's water resources. Additionally, Reserve staff participate on local and regional planning committees that make decisions that affect marine and freshwater resource management in the Reserve and the surrounding area.

Modeling Conservation Practices

Objective 3.8: Reserve resource management practices are used as a demonstration and teaching resource for similar coastal habitats in the region.
WBNERR staff will:

a. Incorporate examples of resource management practices into training and education programs.
b. Include descriptions of resource management activities on the Reserve's web site and in publications.
c. Provide signage that explains the type and purpose of resource management activities being implemented.

A primary function of Waquoit Bay NERR is to transfer information about sound resource management practices to other land managers. This objective is accomplished by incorporating examples of resource management practices into training and education programs. For instance, participants in the *Cape Friendly Landscaping* course learn from the Reserve's own landscaping practices. Descriptions of resource management activities at the Reserve are included on WBNERR's web site and in publications to further increase awareness of environmentally sustainable land and water management techniques. Additionally, signage at the Reserve helps to interpret management activities for Reserve visitors. For example, signs at boardwalks that cross sand dunes explain the fragile nature of these features and briefly describe their function in the coastal landscape.



Chapter 5: Sustaining Community Engagement

Goal 4: Foster dialogue and development of coastal ecosystem management solutions through sustained community engagement.

Activities in support of the preceding three goals—understanding coastal ecosystems, improving environmental literacy, and demonstrating sustainable stewardship—will ultimately be judged successful if they motivate local communities to increasingly take responsibility for the development of solutions to coastal ecosystem management issues. WBNERR's role in this context is to foster community action that is consistent with—and may even shape—state and Federal coastal management priorities. Toward this end, WBNERR remains engaged with coastal management agencies, leverages training and education activities, and makes direct assistance available to communities and organizations.

National Context for Local Action

Objective 4.1: State and national ocean management priorities will be advanced because of the successful implementation of WBNERR research, stewardship and educational activities.
WBNERR staff will:

a. Contribute to the development of new coastal and ocean management paradigms.
b. Help to establish an ocean ethic and motivate citizens and political leaders to support national priorities identified by the Pew Oceans Commission and the U.S. Commission on Ocean Policy.
c. Make known where the Reserve's priorities converge with those of State and national systems.

Research, stewardship and educational efforts undertaken by the Reserve foster the development of solutions to local coastal ecosystem management issues. The Reserve's influence, however, is not strictly local. WBNERR contributes to the understanding of coastal management issues and solutions at the regional and national levels. Thus, the

Reserve serves as an important link between local coastal management challenges and state and national priorities.

Much, if not all, of the Reserve's work is consistent with the principles and goals detailed in the reports of the Massachusetts Ocean Management Task Force, the Pew Oceans Commission, and the U.S. Commission on Ocean Policy. The scientific research conducted at WBNERR, along with the monitoring data collected by the Reserve, contributes to the body of knowledge on critical topics identified in the reports, including climate change, nutrient loading, shoreline change, and ecosystem responses. Stewardship activities protect and enhance valuable habitats and, likewise, contribute to the knowledge base of ecosystem function and management approaches. This type of sound, scientific information is needed to support the development of new coastal and ocean management paradigms.

WBNERR is improving environmental literacy through training and educational programs directed at coastal decision-makers, students and the broader community. Environmental literacy, in turn, is the foundation for a strong ocean ethic and the collective will to adopt environmentally sustainable behaviors and policies.

WBNERR will remain cognizant of areas where its priorities converge with State and national priorities. When appropriate—for instance, when applying for grant funding or reporting to NOAA—these areas of convergence will be documented to strengthen both the Reserve's and NERRS's position.

Massachusetts Ocean Management Task Force

The Governor-appointed Ocean Management Task Force was established in June 2003. The Task Force was asked to develop statewide ocean management principles to guide future ocean management in the Commonwealth. Such a task force was necessary because of increasing conflicts between traditional and emerging uses of ocean resources (*e.g.,* fishing and laying of fiber optic cable) and the absence of a legal framework to address the following questions:

> Which uses should be allowed in which areas? Who should decide? How do we ensure that individual and collective uses do not harm the environment? Do we have the right information to make these decisions? Do public agencies that are authorized to make these decisions have the right tools? Given that the ocean is a public trust resource, how should the Commonwealth effectively manage the "assets of the trust" it owns on behalf of the public to best protect and use them for the benefit of the citizens today and in the future? (MOMTF 2004*,* 5)

In response to this challenge, the Task Force developed six principles for ocean management and fifteen recommendations. The principles state that managing activities above, below and on the ocean surface should "embody an ethic of ocean stewardship that (1) protects the public trust; (2) values biodiversity; (3) respects the interdependence of ecosystems; (4) fosters sustainable uses; (5) makes use of the best available

information; and (6) encourages public participation in decision-making" (MOMTF 2004, 6). Of the fifteen recommendations, four relate to the work conducted at the Waquoit Bay Reserve:

- **Climate Change:** The Task Force recommends the collection of information about trends relating to climate change impacts in Massachusetts and supports policies that decrease reliance on energy resources that emit greenhouse gases.
- **Marine and Ocean Resource Trends:** The Task Force recommends that an advisory group evaluate and estimate baseline marine species population levels, habitat conditions, and contaminant levels to evaluate changes in ocean resources through time, identify emerging threats to ocean resources, and determine appropriate management goals.
- **Ocean Monitoring and Research:** The Task Force recommends the development of a comprehensive ocean resources monitoring and research plan. The monitoring and research plan should encompass living and non-living estuarine and marine resources; water and sediment quality; physical oceanographic, wind, and weather patterns; as well as studies of the economic and other uses of these resources.
- **Ocean Literacy and Stewardship:** The Task Force recommends a formal commitment to developing a new ocean literacy and stewardship ethic among all citizens of Massachusetts. The initiative should target a multigenerational audience, and include the private and public sectors, academic institutions, politicians, advocates, the media, and the general public.

Pew Oceans Commission

The Pew Ocean Commission is an independent body formed in June 2000 for the first national review of ocean policies in more than 30 years. The Pew Oceans Commission developed a plan of action to protect, maintain and restore ocean assets. The Pew Report's recommendations are divided into five sections: Ocean Governance for the 21st Century, Restoring America's Fisheries, Confronting Coastal Sprawl, Cleaning Coastal Waters, and Sustainable Marine Aquaculture.

The Pew Report, through analogy, defines the tools the nation needs to reverse the declining health of our ocean and coastal ecosystems: a compass, a chart and the wind in our sails. "That compass is a strong ocean ethic, the chart is a new legal framework, and the wind is our national will (POC 2003, 29).

U.S. Commission on Ocean Policy

The U.S. Commission on Ocean Policy was established pursuant to the Oceans Act of 2000. The sixteen Commission members were directed to establish findings and develop recommendations for a coordinated and comprehensive national ocean policy. An outline of the Commission's detailed report is included in Appendix I. The Commission also developed an overarching set of principles to guide national ocean policy. The themes of the principles are:

- Sustainability
- Stewardship
- Ocean-Land-Atmosphere Connections
- Ecosystem-based Management
- Multiple Use Management
- Preservation of Marine Biodiversity
- Best Available Science and Information
- Adaptive Management
- Understandable Laws and Clear Decisions
- Participatory Governance
- Timeliness
- Accountability
- International Responsibilities

Regional Involvement

Objective 4.2: The Reserve will coordinate activities with MCZM to ensure that science conducted at the Reserve supports management and improved decision-making statewide.
WBNERR staff will:

a. Continue to work with MCZM on the Coastal Training Program.
b. Encourage, participate in, and, if necessary, convene state-wide meetings of coastal program managers.
c. Increase involvement and communication with MCZM in appropriate program areas.
d. Work with MCZM to have high staff participation in needs assessments for research and training.

Both the MCZM and the NERRS program were established under the Federal Coastal Zone Management Act. The Reserve system is intended to provide technical support and education to coastal decision-makers and managers. As such, it is expected that both programs work closely together.

The Massachusetts Office of Coastal Zone Management (MCZM) is a part of the Executive Office of Environmental Affairs. MCZM's mission is to balance the impacts of human activity with the protection of coastal and marine resources. As a networked program, MCZM was specifically established to work with other state agencies, Federal agencies, local governments, academic institutions, nonprofit groups, and the general public to promote sound management of the Massachusetts coast.

Over the years, WBNERR and MCZM have worked together in varying degrees of intimacy. For instance, MCZM and WBNERR work together in an ad hoc manner on many projects (*e.g.,* staff from both entities participate in coastal pond monitoring activities). They work very closely on the Coastal Training Program and ecological restoration activities (see Objectives 2.1-2.3 and 3.5). In addition, the Reserve manager

meets a few times a year with the other managers of coastal programs in Massachusetts, including the MCZM program, the Stellwagen Bank Marine Sanctuary, the two Sea Grant Programs and the two National Estuary Programs. The meetings provide an opportunity for information sharing and collaboration. The Reserve manager will encourage these meetings and, when appropriate, convene them. Additionally, the MCZM Director will participate, in an advisory role, in quarterly WBNERR/DCR Administrative Committee meetings. The WBNERR manager will participate in monthly MCZM senior staff meetings as well as in MCZM bi-weekly staff meetings when appropriate. DCR, WBNERR and MCZM are currently assessing additional opportuntities to enhance formal mechanisms for involvement and communication between the programs, *e.g.,* the Waquoit Bay NERR Advisory and Administrative Committees (refer to Objective 5.5.b).

WBNERR will further enhance its relationship with MCZM by facilitating a high level of MCZM staff involvement in needs assessments for research and for training. Input from MCZM could lead, as it has in the past, to collaboration on research or monitoring projects. Additionally, WBNERR may be in a position to make recommendations to visiting researchers or graduate students on research projects relevant to MCZM needs.

Objective 4.3: Reserve staff will provide sustained support of community coastal decision making

WBNERR staff will:

a. Represent the Reserve and DCR in local and regional planning efforts.
b. Participate in community efforts that further the Reserve's mission and objectives.
c. Serve on committees and boards relevant to coastal management.
d. Facilitate the formation of committees and working groups by providing staffing, facilities, and leadership.
e. Respond to requests for assistance and provide one-to-one consulting services when possible and appropriate to the Reserve's mission.

Ultimately, local communities must take initiative and provide leadership for managing coastal resources. The Reserve provides encouragement and technical and administrative support to communities to facilitate their efforts. In some cases, Reserve staff directly participates on local or regional committees and boards that deal with coastal management issues. WBNERR staff participates in the Falmouth Coastal Resources Working Group, Falmouth Salt Ponds Management Committee, Falmouth Energy Committee, the Barnstable County Wastewater Implementation Committee, the Massachusetts Estuaries Project Advisory Committee and numerous other boards and committees.

Reserve staff has also provided the incentive and leadership that encourages people with common concerns to convene. For example, Reserve staff continues to support the Waters Around Us and the Seacoast Shores Association as they work with the town of Falmouth to address nitrogen loading from their community.

Staff also works with disparate interests from multiple communities on common causes, including those communities with ACECs. An example is the work on renewable energy education that targets homebuilders, vocational technical schools, college students and homeowners and brings together the Cape Cod Community College, the Cape Cod Economic Development program, Cape and Islands Self Reliance, and several others.

When it is appropriate to the Reserve's mission and assuming resources are available, the staff will respond to requests for support from towns and community groups. This support includes the identification and provision of project-specific, science-based information, training activities, and one-to-one consultation, especially if it is determined that such help will launch sustainable projects. The Reserve communicates the availability of this type of information and support to local towns and community groups (see objectives 5.15-19).

Objective 4.4: Decisions about the management of non-Reserve land in the Waquoit Bay watershed are beneficial to—or at least minimize impacts to—the Waquoit Bay ecosystem.
WBNERR staff will:

a. Monitor, research and comment on proposed developments and activities with potential to affect Reserve resources.
b. Review and comment on reports, regulations, by-laws, and policies that affect the Reserve.
c. Participate in and, where appropriate, provide leadership in the MNWR land conservation partnership.
d. Implement a Stewardship/Education program targeting those whose cooperation is needed for long-term protection of the Reserve's resources.

WBNERR resources are affected by activities on all watershed lands and adjacent waters, including areas not owned by the Reserve. Groundwater and rivers from portions of Falmouth, Mashpee and Sandwich interconnect throughout the watershed and eventually with the Bay. As such, all watershed residents and decision-makers have the ability to affect the quality of the Waquoit Bay ecosystem for better or worse. The Reserve works to direct these people toward behaviors and projects that make them "good" watershed stewards and minimize their impacts on the Reserve's resources.

Toward this end, Reserve staff track, investigate, and comment on proposed developments and activities that could potentially impact watershed resources and, therefore, Waquoit Bay. In addition staff review and comment on regulatory and policy initiatives and changes that affect the Reserve's, DCR's and NOAA's interests. The Reserve takes such public comments very seriously and insists that decision-makers seriously consider the Reserve's view point in light of the regional, state and national significance of the Waquoit Bay ecosystem.
The Mashpee National Wildlife Refuge conservation partnership, involving eight local, state, Federal, tribal, and non-profit agencies, was established in order to coordinate land

protection efforts within the Waquoit Bay watershed (see Objective 5.5). WBNERR staff chair partnership meetings and have been instrumental in leading the group's conservation and management planning efforts. The Reserve also provides meeting space and GIS mapping support. WBNERR staff will continue to be actively involved and will take a leadership role as necessary.

Activities of individuals at home, at work and while recreating can have significant impacts on the watershed. The WBNERR Stewardship Program is currently working with the Education Program to enhance outreach directly to watershed stakeholders to better inform their decision-making and lesson their impact on the resources managed by the Reserve. WBNERR is developing a community education initiative based on research and stewardship principles, including the Reserve's own stewardship practices. The initiative will incorporate principles of community-based social marketing and especially target watershed residents. Reserve staff will define and promote a set of desired behaviors, track over time, and look for responses in the environment (refer to Objective 2.9). The goal is to make residents and businesses good stewards of Waquoit Bay by helping them to understand that they and their activities are connected to the health of the natural environment.

Leverage Training and Education Activities

Objective 4.5: Workshops and other training activities will be the springboard for further support to coastal decision-makers.
WBNERR staff will:

a. Provide organized workshop follow-up, including the placement of workshop agendas, presentations, proceedings, reference material, and contact information for presenters on the WBNERR and CTP web sites.
b. Implement measures to address barriers to effective coastal management as identified under Objective 2.3.e.
c. CTP partners will look for ways to sustain the involvement of audience members through the formation of working groups or committees that would continue implementation of workshop outcomes.

As part of CTP's support to coastal decision-makers after they have participated in a training event—and to provide information to coastal decision-makers who were not able to attend—workshop materials, presentations, and reference materials are made available on the WBNERR web sites (www.waquoitbayreserve.org and www.coastaltraining.org). Overtime, the on-line "library" of information relating to WBNERR's priority topics will grow and remain readily available. Other materials to be posted include workshop agendas, proceedings, and contact information for presenters.

As described under Objective 2.3.e, workshop participants may be asked to identify obstacles to implementation of sustainable coastal management practices highlighted in the training. WBNERR can then use this information to guide its own research and to take an active role in barrier removal. For instance, professional landscapers who resisted

the use of native plants in landscaping (to reduce nitrogen loading) are obstacles to homeowner's use of these plants. The Reserve staff, therefore, targeted landscapers for training. This effort identified another obstacle: the lack of availability and knowledge of native plants by the nurseries. By working with the Falmouth Friendly Lawns Committee, the Reserve is involved in an assessment of nurseries and will work with them to increase the knowledge of their staff and make information on native plants available to their clients.

The Falmouth Friendly Lawn Committee is an example of the formation of an organized effort by a group of people interested in reducing nitrogen loading to the estuaries from residential fertilizer use. Reserve staff provided initial information and training and continues to serve on this town-appointed committee.

Objective 4.6: Coordination and information-sharing among coastal decision-makers will improve as a result of networking opportunities provided by the Reserve.
WBNERR staff will:

a. Bring coastal decision-makers and scientists together for focused round-table discussions on specific issues.
b. Act as referral service connecting coastal decision-makers and community groups with relevant information and contacts.
c. Expand its role as a neutral facilitator and information provider for decision-makers in coastal Massachusetts.

As noted in Objective 2.3.e, networking opportunities are incorporated into CTP training events. The CTP also fosters networking by coordinating roundtable discussions between decision-makers and scientists. The discussions address priority issues, including those that affect coastal ACECs. Participants bring the perspective of their profession and learn how individuals from other fields perceive and address the particular topic under discussion. This helps raise the awareness of the researchers about coastal management information needs and helps the coastal decision-makers understand the culture of science which has a different time-frame and need for accuracy. It provides a mechanism for these groups, both important contributors to coastal management, to question and learn from each other directly. Often the managers can learn information important to coastal management from the scientists prior to its publication in papers.

The CTP is a hub of information about sustainable coastal management and training. Likewise, the Education, Research and Stewardship programs are repositories of information related to their areas of expertise. As such, each program acts as a clearing house and referral service, connecting those in need of information with those who can provide it. The Reserve also acts as a matchmaker connecting groups with common goals. The Reserve staff has often found that they can provide an important service by simply bringing together communities who are working on similar issues for an informal discussion.

As an additional service to the coastal management community, WBNERR will expand its role as a neutral facilitator and information provider for decision-makers in coastal Massachusetts. Currently the Reserve's audience and geographic influence is primarily the Cape and Islands and southeastern Massachusetts. Through the CTP, the Teacher Training Program, and the Community Education Program, the Reserve will expand the area from which it draws participants and to which it offers its services.

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Chapter 6: Improving Operations, Infrastructure and Stature

Goal 5: Improve the operations, infrastructure and stature of the Reserve.

The administration of the Waquoit Bay National Estuarine Research Reserve supports and enables the implementation of the Reserve's principal functions: research and monitoring, education and training, and stewardship. The term "administration" is used here to include Reserve activities in response to agency mandates and in accordance with agency procedures. Administration includes support of employees and volunteers, maintenance of all Reserve assets, and the adoption and support of appropriate computer technologies. Administration also includes the Reserve's efforts to publicize its activities to a variety of audiences. This chapter is divided into sections to address these topics: Management Environment; Human Resources; Facilities, Grounds and Equipment; Construction Plan; Public Access Plan; Technology; and Communications Plan. Taken together, these sections form the Reserve's ***Administrative Plan***.

Management Environment

Self-Evaluation

Objective 5.1: WBNERR will develop an internal strategic performance monitoring process that will enable timely strategic assessment of program results.
WBNERR staff will:

a. Generate a performance monitoring plan.
b. Monitor and evaluate implementation of the management plan to ensure all guidelines and requirements are met.
c. Meet annually to review progress toward achieving goals, objectives and selected, measurable milestones in the management plan.

The operation of the Reserve will be guided by this document, *Waquoit Bay National Estuarine Research Reserve Management Plan 2006-2011.* To enable staff to strategically assess program results, a performance monitoring plan that details key

results and indicators to be measured under each goal and objective will be generated. Staff will monitor and evaluate implementation of the management plan to ensure that all requirements are met and all guidelines (*e.g.,* Land Stewardship Zoning Guidelines) are incorporated into management decisions. Furthermore, the staff will meet annually, during the winter, to review progress toward completing action items in support of achieving the objectives described in this management plan. This annual performance review will allow staff an opportunity to reflect upon what has worked well (or not so well) in the past and to incorporate that knowledge into future work plans. Many of the objectives and action items described in this management plan are not easily quantifiable, particularly those that deal with changing attitudes and behavior. As such, while progress toward the achievement of all objectives will be examined, only progress toward selected, measurable milestones will be documented initially (Figure 17). Performance monitoring will be an iterative process. Over time, partners will be invited to contribute their own observations and assessments of WBNERR's performance.

Figure 17: Selected Measurable Milestones.

Relevant Objective	Milestones
Understanding Coastal Ecosystems	
1.1	A list of prioritized research topics is published on the Reserve's web site.
1.1	Prioritized research topics are advertised through brochures to the research community.
1.3	Summarized water quality data from 8 Baywatcher sites is published annually on WBNERR web-site.
1.3	Shoreline change data is published annually on WBNERR web-site.
1.3	Final report for 2004-2006 SAV and salt marsh bio-mapping baseline study is submitted to NERRS by January 1, 2007.
1.3	Quality checked nutrient, meteorological and water quality data from long-term SWMP sites and weather stations is submitted annually to NERRS CDMO.
1.4	One SWMP water quality and meteorological station are each supplied with telemetry and data from these sites is available online by 2007.
1.5	Updated research and monitoring databases available online.
Improving Environmental Literacy	
2.1	Regular meetings of CTP Steering Committee and Advisory Committees are instituted
2.1	CTP activities that involve broad geographic coverage are convened annually.
2.2	Evaluations are developed according to the NERRS CTP Performance Monitoring Manual and conducted following all CTP events.
2.2	CTP performance reports are prepared and submitted to NOAA ERD every six months.
2.3	Coastal decision-makers increase their scientific understanding of WBNERR priority issues.
2.3	Coastal decision-makers improve their abilities to access science-based resources.
2.3	Coastal decision-makers gain increased skills related to technologies and/or best management practices
2.5	Increased number of teachers are trained.
2.5	Increased number of teacher workshops are offered.
2.5	Increased number of teachers are provided consulting services by Reserve staff.
2.7	Increased number of students pledge to adopt environmentally sustainable behaviors.
2.8	Increased number of students attend Reserve programs covering basic estuarine ecology.
Demonstrating Sustainable Stewardship	
3.1	Reserve boundaries are marked and visitor use signage is install at newly acquired properties.
3.2	Volunteers are trained to monitor nesting shorebirds on all Reserve beaches five days per week between the months of April and August.

3.2	Applications for state certification of two vernal pools is submitted.
3.2	Inventories of two priority invasive plants are completed.
3.3	Identification signage is installed at four pubic access locations.
3.4	Gates and barriers are installed to limit motor vehicle access to three roads within the Reserve boundary.
3.5	Two tidal restrictions are removed within the Reserve boundary.
3.7	Water quality monitoring data is provided to town and state programs engaged in water quality management.
3.8	Two CTP workshops on habitat restoration are offered annually.
Sustaining Community Engagement	
4.3	Increased WBNERR representation on key coastal management related committees and boards in the Region.
4.5	All CTP workshop materials will be posted on WBNERR and CTP websites.
4.5	Working groups will be established to continue work on key areas focused on in CTP workshops.
4.6	Several formal focus group discussions on coastal management issues will be convened annually with coastal decision-makers
Improving Operations, Infrastructure and Stature	
5.1	Annual performance review process is institutionalized within WBNERR.
5.1	WBNERR consistently participates in the NERRS Annual Meeting.
5.7	Emergency response plans are developed and tested for different hazards (e.g. hurricanes, storms etc).
5.8	Increased number of volunteers are participating in WBNERR programs.
5.14	WBNERR database of key contacts is improved.
5.15	WBNERR Newsletter is produced quarterly.
5.15	At least (2) *Science to Management Bulletins* are produced each year.
5.15	Brochure describing Education Department programs is developed.
5.15	Brochure outlining CTP activities is produced annually.
5.19	WBNERR web site is regularly updated and contains detailed information on each major program area.

WBNERR's ability to function efficiently is, in part, based upon internal management tools and routines. Appendix J contains a collection of forms that WBNERR staff use to track everything from reservations for special events, to moorings, to volunteer hours.

Agency Partners

National Oceanic and Atmospheric Administration

Objective 5.2: NOAA will consider WBNERR an exemplary reserve.
WBNERR staff will:

a. Maintain regular and open communication with NOAA.
b. Submit reports on time.
c. Submit annual award proposal on time.
d. Continue to incorporate and report the ERD system-wide evaluation criteria in its CTP evaluations.
e. Participate in national meetings, serve on system-wide committees, and provide leadership.
f. Make materials and program templates available to other reserves and respond to inquiries for assistance and information.
g. Represent the NERR System at national and regional workshops and conferences.
h. When appropriate, WBNERR will serve as a pilot test site for grant-related improvements and other initiatives.

Since its inception, the Waquoit Bay NERR has enjoyed excellent relations with its Federal partner, NOAA. This has been due, in large part, to a shared vision for both the Reserve and the NERR System. It is a mutually supportive relationship in which NOAA funds and guides the Reserve and the Reserve implements overall NERR System policies and guidelines (see Chapter 1) as set by the Estuarine Reserve Division (ERD) within the Office of Coastal Resource Management (OCRM). In support of this relationship, WBNERR maintains regular communication with ERD and OCRM and submits reports and annual award applications in a timely manner. WBNERR also works within the System to advance the NERRS mission and goals beyond the Reserve's boundaries. WBNERR staff participate in national meetings and system-wide committees, collaborate with other reserves on a variety of projects, and represent the NERR System at national and regional workshops and conferences. WBNERR will further advance the operation of the NERR System by making itself available as a beta test site for new initiatives, including improvements to grant administration.

Massachusetts Department of Conservation and Recreation

Objective 5.3: DCR will consider WBNERR a unique and valuable asset and will fully support the Reserve administratively.
WBNERR staff will:

a. Communicate and promote the unique role and mission of the Reserve to DCR and State government.
b. Promote the assessment of the Reserve's placement within the State government.
c. Maintain open and regular communication with DCR.
d. Respond to requests for information.
e. Participate in DCR activities.
f. Support improved coastal management on DCR properties by making research and stewardship information readily available through the Coastal Training Program and other mechanisms.
g. Work with DCR to establish a better system to acquire computer hardware and software and other research and communication equipment.
h. Work with DCR to expedite the processing of contracts and grants and hiring people.

The Reserve also operates within the administrative structure of its state partner: the Department of Conservation and Recreation (DCR). NOAA evaluates the Commonwealth's management of the Reserve every five years during a "312 Evaluation."

The name refers to Section 312 of the Coastal Zone Management Act. Reviews are conducted regularly by OCRM/NOAA to ensure that a state is complying with Federal NERRS goals, approved work plans, and Reserve-specific management plans. The reviews identify Reserve accomplishments and deficiencies. If deficiencies are found in a Reserve's operation, OCRM provides recommendations for improvement. In severe instances, OCRM may redirect Federal resources, withdraw financial assistance, or withdraw National Estuarine Research Reserve designation.

The latest 312 Report for Massachusetts was issued in November 2004 for the period February 1999 to August 2003. The evaluation addresses both the State's coastal zone management program, administered by the Massachusetts Executive Office of Environmental Affairs (EOEA), and the Waquoit Bay NERR administered by the Massachusetts Department of Conservation and Recreation. It offers eleven Program Suggestions to strengthen both programs (Appendix K). Five of the recommendations are specific to the relationship between WBNERR and DCR.

1. DCR and WBNERR should develop a plan to address issues that have been problematic in the past, specifically: Reserve placement within the agency, staffing, equipment and supply needs, communication and visibility, and overall support and recognition from parent agency. A plan should be submitted to NOAA within six months of receiving final findings.

2. DCR should modify the approval process to ensure timely acquisition of equipment and supplies, especially since such equipment and supplies requests have already been approved through the annual NOAA grants process. Within three months of receiving the final Findings, DCR should submit a strategy to NOAA for addressing this issue.
3. The DCR should consider funding other WBNERR positions or utilities and maintenance costs so that NOAA award funding could be used for programs and projects.
4. DCR should provide WBNERR with the necessary means to fill seasonal positions in an expedient manner so that the Reserve can take advantage of hiring the best and brightest summer interns.
5. WBNERR and DCR should agree on a staffing and hiring plan (based on needs identified in WBNERR's management plan) to address deficiencies in personnel needs. WBNERR and DCR Human Resources should explore opportunities to increase interaction between staff and increase effectiveness of communication.

This Management Plan is required to address these 312 recommendations. The unique nature of the Reserve explains, in part, why the Reserve's business has often "fallen through the cracks" as noted above (and highlighted in past 312 reports).

As a member of the NERRS, WBNERR is required to provide opportunities for long-term research and monitoring, education, training, interpretation, and stewardship. The Reserve is a living laboratory where research and monitoring increase understanding of estuarine ecosystems and where education and outreach disseminate the results of research to the public and policy-makers in support of informed coastal management. The expectations and requirements of the national system make Waquoit NERR unique within the DCR which focuses primarily on the provision of outdoor recreation and resource protection.

WBNERR is, nonetheless, considered a "park" by DCR with regard to its placement within the agency. The Waquoit Bay NERR is administered by Region 1 of the Division of State Parks and Recreation. This placement makes it difficult for DCR to adequately support WBNERR's mission which is much broader and more complex than that of a typical park. In order to investigate alternative arrangements that are more mutually supportive—and to address the first 312 Recommendation listed above—WBNERR staff will work with representatives of state entities to assess the most advantageous placement of the Reserve within DCR or another state agency. Discussions could involve DCR, the university system, and the Massachusetts Office of Coastal Zone Management.

To continue to address concerns raised by the 312 Evaluation, WBNERR will maintain open and regular communication with DCR, will respond promptly and thoroughly to requests for information and will participate in DCR activities as appropriate. WBNERR will seek out ways it can provide its services to DCR. For example, WBNERR will support the mission of DCR by identifying and promoting opportunities to improve coastal management on DCR properties. WBNERR's research program is undoubtedly a center of coastal expertise (refer to list of current research in Appendix C). The Reserve

hopes that DCR will take greater advantage of this in-house resource in the future. The Reserve will, therefore, explore and develop ways for the results of the science conducted at the Reserve and elsewhere to be incorporated into management decisions on DCR's coastal properties. Meetings, research summaries, contributions to daily reports, and monthly emails are all potential methods the Reserve will consider. Also, WBNERR Coastal Training Program activities provide DCR managers with an opportunity to learn from the coastal ecosystem research and environmental stewardship experience developed at the Reserve and elsewhere. The Reserve's CTP Coordinator will actively work with DCR's training program coordinator in Boston and at the regions to explore how CTP can provide training to DCR staff..

The Reserve's reliance on grant funding is a hindrance when it comes to working within a large bureaucratic structure. Grants have finite time periods during which staff needs to be hired, equipment needs to be purchased, and the project needs to be completed. As referenced in the second 312 Recommendation, there have been long-standing issues between DCR and the Reserve related to procurement and grant management. For instance, equipment and technology needs at the Reserve (*e.g.,* research equipment and computer equipment and software) are different from other DCR facilities. Because these purchases fall outside of routine operations for DCR, there are often delays in approvals and maintenance. As an example, an order for MIS computer equipment took over a year to fill and resulted in the delay of critical research activities. Also, grants that the Reserve receives from outside agencies often include activities that challenge established DCR procedures or straddle fiscal years, thus hampering the expeditious completion of the necessary paper work for the project.

To resolve these issues, Reserve staff will continue to work with DCR's procurement and contracts staff to insure that they submit the right forms to the right people in a timely manner. Reserve staff will follow up to make sure the paperwork was received, answer any questions, and clarify any points of confusion. Reserve staff will continue to educate the Boston staff regarding the unique nature of the Reserve, its requirement to participate in national programs that mandate specific equipment and positions, and the realities of grant requirements. The Department will be responsible for reviewing how it handles Reserve business to see if there are ways to facilitate procurement, contracts, etc. as recommended in the 312 evaluation.

Objective 5.4: WBNERR will encourage DCR to fund existing staff positions when resources are available and other more highly prioritized statewide DCR staffing needs have been met. And WBNERR will work with DCR to increase the efficiency with which vacancies are filled.

WBNERR staff will:

a. Seek increased state fiscal support for staff positions and/or utilities and maintenance, currently supported by NOAA funds, if resources become available.
b. Work with DCR to increase the efficiency of DCR in filling all staff positions, most especially seasonal staff positions and positions funded under limited term grant awards.
c. Work with DCR to ensure that all authorized Forest and Parks positions are filled.
d. Maintain adequate staff, resources, and equipment to fulfill obligations under SWMP and other NERRS mandates.

DCR currently maintains a prioritized list of critical statewide staffing needs and the agency is making strides to direct its limited appropriation to fill those diverse needs. WBNERR programs will benefit if staffing needs are considered on this DCR list. If the more highly prioritized statewide staffing needs are met, then DCR would consider funding existing staff positions at the Reserve, allowing more of the NOAA grant funds to be invested into Reserve education and research programs.

NOAA's Estuarine Reserves Division provides operating funds to WBNERR annually. The amount is determined each year through the appropriation process. DCR, as the state partner, is required to provide a 30 percent match. It is expected that the Federal funds will be used for program activities related to research, education, and stewardship. At WBNERR, 67 percent of Federal funds are allocated to personnel costs, leaving little for programs and activities. For instance, two core positions—the Coastal Training Program Coordinator and the Stewardship Coordinator—are entirely supported with Federal funds (although the CTP position, then known as the Research Translator, was state-supported until October 2002). Similarly, some of the three Island Manager positions have historically been funded through NOAA. The Island Managers fill a recognized Forest and Parks role similar to that of Boston Harbor Island Managers. As such, it can be argued that state seasonal employee funds should be used to support all three Washburn Island Manager positions. Fully funding the salaries and benefits of additional WBNERR employees would be one way of satisfying the 312 Program Suggestion, "The DCR should consider funding other WBNERR positions or utilities and maintenance costs so that NOAA award funding could be used for programs and projects."

Programs and projects would also benefit from a more efficient hiring process. Delays often arise from the fact that job descriptions for tasks required under Federal mandates (*e.g.,* research, stewardship, and science-to-management functions) often do not mesh with existing state-defined positions. Frequent delays related to lost paperwork and other administrative errors further complicate the hiring process. A four to six month delay between the time a job offer is extended and authorization to begin work is granted is not

atypical. Many job candidates simply cannot afford to wait for this inexplicably lengthy period and accept job offers from other employers. WBNERR must then begin the hiring process all over again. In addition, many positions are funded through grants with specific start and end dates. Hiring delays make it difficult to accomplish tasks required of the award, leave the Reserve and the Department open to criticism, and possibly jeopardize the funding.

Also, the state hiring process does not allow for the timely start of seasonal staff. To be most effective, the following seasonal positions should start on the dates listed.

- **Seasonal Shorebird Manager (1):** start mid-March to comply with a State Natural Heritage Program request.
- **Long-term Seasonal Laborer (1):** start April 15 and extend through October 15.
- **Interpretive Naturalist (1):** start April 15th and extend through October.
- **Island Managers (3):** start mid-May.
- **Summer Workers (4):** start two on the third Sunday in May; start two additional workers mid-June.
- **South Cape Beach State Park Life Guards (4):** start the second week of June.

Understaffing has also been a problem at the Reserve because several key positions are presently vacant and have been so for a period of years. For example, in recent years there have been no lifeguards assigned to the popular ocean beach at South Cape Beach State Park. The absence of trained life saving personnel is clearly a safety and liability issue. Also, there is an expectation among the public that when they pay for beach access (there is a $7/day parking fee) that there will be lifeguards monitoring the beach and adjacent waters. The year-round Facilities Repair and Long-Term Seasonal Laborer positions at the Reserve, likewise, need to be filled. These positions are especially needed in the spring to help get ready for the busy summer research, education, and recreation season (*e.g.,* prepare boats, moorings, trails, parking areas, signs, camp sites, etc.) and in the fall to prepare equipment and facilities for the winter. Similarly, it is imperative that the research program remain fully staffed. The Reserve is obligated by Federal regulation (15 C.F.R. Part 921.50) to collect standardized data on national estuarine environmental trends. In order to support this task and to assure the quality of the data, the Reserve must have adequate staff with appropriate expertise and the proper supplies and equipment.

WBNERR also desires a more efficient hiring process. State hiring processes are established through the Human Resources Division in the Executive Office of Administration and Finance. As such, the process for hiring new WBNERR employees is not fully controlled by DCR. Nonetheless, WBNERR is committed to working with DCR's Human Resources staff to enhance the hiring process. Specifically, WBNERR will work with DCR to implement aspects of the *Commonwealth of Massachusetts Human Resources Division Model Hiring Plan* and, thereby, reduce the time it takes to hire new employees. For instance, WBNERR staff will work with DCR to:

- Reduce the amount of time it takes to post a job.
- Ensure that complete application packages—with each applicant's cover letter, resume and references stapled or clipped together—are forwarded to WBNERR for review very soon after the close of the posting period.
- Complete interviews as soon as possible following the close of the posting period.
- Reduce the time it takes for selected candidates to be approved for hire.
- Support the agency's attempts to have seasonal staff positions filled in sufficient time to satisfy the start dates listed above.

Management Agreements

Objective 5.5: Partners and WBNERR will clearly understand their respective roles and responsibilities.
WBNERR staff will:

a. Maintain and honor management agreements defining partner relationships.
b. Establish and administer advisory groups in such a manner as to secure their guidance.
c. Seek new agreements when appropriate.

A number of Memoranda of Agreement (MOAs) or Memoranda of Understanding (MOUs) have been developed to clarify coordination between various entities regarding the acquisition and operation of the Waquoit Bay National Estuarine Research Reserve and its component parts. These are discussed briefly below and appear in the Appendices. Many of the agreements refer to the Department of Environmental Management (DEM). Since these agreements were written, DEM was merged with the Metropolitan District Commission to form the Department of Conservation and Recreation (DCR). DCR assumed responsibility for all contracts previously entered into by DEM. The descriptions below refer to the agency—either DEM or DCR—that is referenced in the actual agreement. It is DCR and, more specifically, WBNERR, that is responsible for meeting the terms of the agreements, however.

MOU between NOAA and Massachusetts Department of Conservation and Recreation (Appendix L)

This MOU states the provisions for the cooperative management of the Waquoit Bay National Estuarine Research Reserve in Massachusetts, between the Massachusetts Department of Conservation and Recreation and the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resources Management.

MOU between the Town of Mashpee and the Commonwealth of Massachusetts regarding South Cape Beach (Appendix M)

This MOU, dated June 29, 1981, describes the terms of the transfer of South Cape Beach to the Massachusetts Department of Environmental Management. The agreement outlines allowable uses on the property; describes criteria for

designing, siting, and maintaining facilities; and defines DEM's responsibility to prevent erosion and preserve critical habitat. Through the MOU, the Department agrees to "at all times continue to recognize a South Cape Beach State Park Advisory Committee" comprised of local representatives. The Department also agrees to reserve a 10-acre parcel off of Wills Work Road for the potential development of a boat launch/pier facility by the town of Mashpee. It is the Reserve's position that if and when there is a transfer of land, any usage would be limited to passive recreation. The infrastructure to support this passive recreation should be limited and should incorporate principles of Low Impact Development. In the event of a land transfer, DCR/WBNERR would continue to manage the access road to the 10-acre parcel, *i.e.,* Wills Work Road. Furthermore, WBNERR would encourage Mashpee to continue to consider the land as part of the Waquoit Bay Reserve.

MOU Concerning Cooperation and Coordination with Regard to the Mashpee National Wildlife Refuge (Appendix N)

In 1995, the U.S. Fish and Wildlife Service established the Mashpee National Wildlife Refuge (MNWR). The boundaries of the MNWR encompass pre-existing protection efforts by a variety of entities within the Waquoit Bay watershed. This MOU, therefore, provides a formal basis for cooperation and coordination between the U.S. Fish and Wildlife Service, the Massachusetts Division of Fisheries and Wildlife, the Massachusetts Department of Environmental Management/Waquoit Bay National Estuarine Research Reserve, the Town of Mashpee/Mashpee Conservation Commission, the Town of Falmouth/Falmouth Conservation Commission, the Falmouth Rod and Gun Club Inc., the Orenda Wildlife Land Trust, and the Mashpee Wampanoag Indian Tribal Council for matters pertaining to the Mashpee National Wildlife Refuge in Mashpee and Falmouth. Although the responsibilities of the parties involved in the Mashpee NWR management partnership are different, there are complimentary functions and areas of common interest that permit and benefit from cooperation, coordination, and joint endeavors.

Letter of Agreement between the Massachusetts Department of Fisheries and Wildlife (DFW) and the Massachusetts Department of Environmental Management (DEM) to add the Quashnet Woods Property to the Boundary of the Waquoit Bay NERR (Appendix O)

There is a parcel of land within the bounds of the Mashpee National Wildlife Refuge known as the Quashnet Woods Property. The land is jointly owned and managed by two state agencies: DFW and DEM. DFW has primary responsibility for the DFW-owned river banks. DEM's Waquoit Bay NERR has primary responsibility for the rest of the property. Through this agreement, the entire Quashnet Woods Property is added to the boundary of DEM's Waquoit Bay NERR. Under this agreement the property will continue to be managed in the

same manner subject to the provision that all activities must be in accordance with the Federal National Estuarine Research Reserve regulations.

Memorandum of Agreement between Massachusetts Department of Conservation and Recreation Waquoit Bay National Estuarine Research Reserve and Town of Mashpee Regarding South Cape Beach Salt Marsh Restoration Project (Appendix P)

This agreement sets the parameters for the South Cape Beach Salt Marsh Restoration Project. WBNERR agrees to continue its efforts to lead the team of partners to implement the project. The Town of Mashpee authorizes the WBNERR-led project team to implement this project, including replacement of the culvert under South Cape Beach road and deepening of the salt marsh channel, on property owned by the Town.

MOU between WBNERR and Citizens for the Protection of Waquoit Bay (Appendix Q)

The Reserve has established a Memorandum of Understanding with the Citizens for the Protection of Waquoit Bay (CPWB) for this group to function as a "friends group" for the Reserve. CPWB sponsors some programs, including the Summer Science Camp and Evenings on the Bluff, and raises money for others. The original agreement was signed in 1991 and calls for renewal every three years. It was renewed in 1994, 1998, 2001, and 2004.

Agreement of Cooperation and Exchange between the Massachusetts Department of Environmental Management (Waquoit Bay National Estuarine Research Reserve) and the University Of Massachusetts, Boston (Department of Environmental, Coastal and Ocean Sciences, and Urban Harbors Institute) (Appendix R)

By the terms of this agreement the Massachusetts Department of Environmental Management (DEM) and the University of Massachusetts, Boston (UMB) hereby agree to establish a framework for the development of cooperative initiatives based on the principle of equality and mutual benefit that will include staff/faculty and student exchanges, collaborative research activities, joint curriculum and course development, administration of funds, and special programs to address the research, education, and outreach needs of the National Estuarine Research Reserve System (NERRS) and the University of Massachusetts, Boston.

Interdepartmental Service Agreement between Executive Office of Environmental Affairs (DCR) and the University of Massachusetts, Boston (Appendix S)

Through the terms of this Interdepartmental Service Agreement, UMass Boston agrees to carry out basic nutrient analysis on approximately 20 water samples

collected every month (about 250 per year) at the Reserve. The water samples are mandated under the NERR System-wide Monitoring Program (SWMP). The SWMP-approved protocols require that these water samples by analyzed for ammonium, nitrate, nitrite and ortho-phosphate. The Reserve may request analysis of the following parameters, as well: total dissolved nitrogen, particulate nitrogen, and silica. This agreement is being renewed for a three-year period beginning July 1, 2005.

Agreement between Framingham State College, Division of Graduate and Continuing Education (DGCE), and Waquoit Bay National Estuarine Research Reserve (Appendix T)

This is an agreement between Framingham State College Division of Graduate and Continuing Education and Waquoit Bay National Estuarine Research Reserve to provide graduate credit for professional development courses offered by Waquoit Bay National Estuarine Research Reserve instructional staff.

Advisory Groups

Several advisory and administrative oversight groups provide input on matters of policy and operations.

Waquoit Bay NERR Advisory Committee

In the past, WBNERR worked with an Advisory Committee. The original committee was composed of individuals with an interest in the preservation of Waquoit Bay and its watershed. The committee was especially useful during the Reserve's initial, formative years. Over time, the needs of the Reserve changed to reflect its maturation. During this same period, the committee became less involved with Reserve activities. After a three-year period during which the Advisory Committee did not meet, the Reserve manager initiated a process to re-establish an Advisory Committee with a broader composition of members and new objectives. The Reserve Manager has submitted a list of nominees to the Commissioner for approval.

Waquoit Bay NERR Administrative Committee

The Commissioner of the then Department of Environmental Management established the Committee in 1995 in recognition of the fact that the role and interests of the Waquoit Bay NERR extend beyond traditional forests and parks activities. The Committee's role is to improve communications and coordination among those involved in the operation of the Reserve and its wide-ranging programs and to expedite financial and administrative matters. The group includes managers from numerous divisions within DCR including parks and resource protection and, on an as-needed basis, administrators and staff from management information services, Federal grant administration, human resources, and

engineering. Representatives from the Office of Coastal Zone Management, the Division of Marine Fisheries, and other agencies of the Executive Office of Environmental Affairs are also invited to discuss specific issues.

South Cape Beach Advisory Committee

The South Cape Beach Advisory Committee was established as part of the MOU between the Town of Mashpee and the Commonwealth (Appendix M) that established South Cape Beach State Park. Article 18 of the agreement establishes the South Cape Beach Advisory Committee with the following membership:

- 8 residents or representatives of the Town of Mashpee,
- 1 resident or representative of the Town of Sandwich,
- 1 resident or representative of the Town of Falmouth,
- 1 resident or representative of the Town of Barnstable,
- 1 non-voting representative of the Massachusetts Office of Coastal Zone Management,
- 1 non-voting representative of the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement,
- The sitting State Representative for the Mashpee area as a non-voting member, and
- The sitting State Senator for the Mashpee area as a non-voting member.

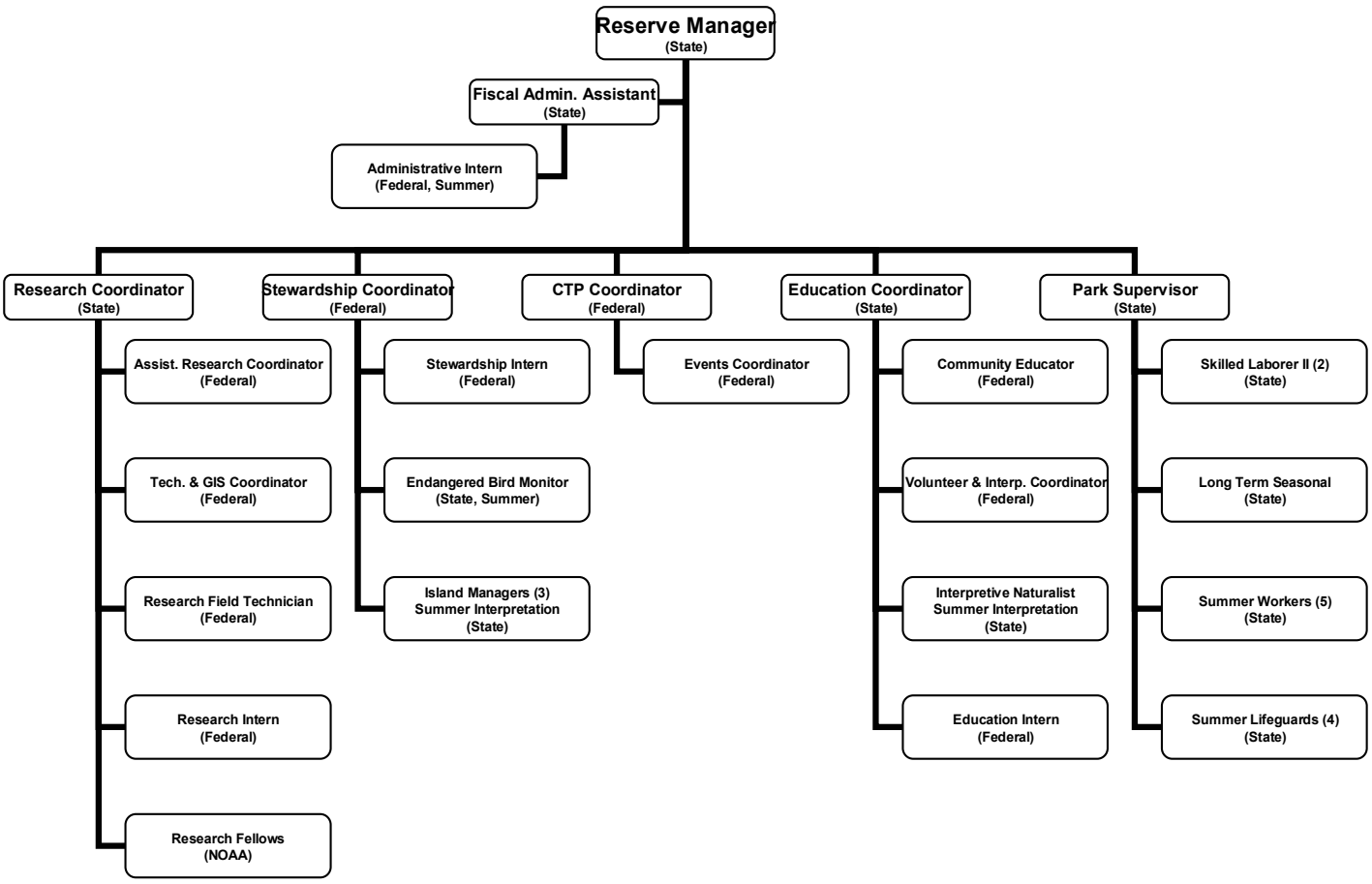
The South Cape Beach Advisory Committee is responsible for making recommendations to the DCR on park management and operations, rules and regulations, and design and plan review. The committee held a seat on the Reserve Advisory Committee as it was previously structured and will retain a seat if the Reserve Advisory Committee is reconstituted

Staffing

Reserve Staff Roles and Responsibilities

At WBNERR, in 2005, there are thirteen full-time, year-round staff positions and two job-sharing positions that are the equivalent of one full-time position. There are six additional categories of seasonal staff. The number and type of seasonal staff changes annually depending on available state funding and priorities. Refer to Figure 18: WBNERR Organizational Chart. The chart indicates which positions are Federally funded and which are state funded. Two science school directors are also part of the WBNERR team during the summer months. Since they are hired and paid by the Citizens for the Protection of Waquoit Bay, however, they are not considered WBNERR employees. Their salary is paid with funds collected through tuition fees.

Figure 18: Waquoit Bay NERR Organizational Chart with Position Funding Source (November 2005).



Year-Round Reserve Staff Job Descriptions

Reserve Manager

The Reserve Manager is the principal administrator of the Reserve and is responsible for ensuring that the policies in the Reserve management plan are followed and that Reserve programs successfully meet the mandates of the national and state programs responsible for the Reserve. The Reserve Manager has overall responsibility for all activities, lands, and facilities within the Reserve boundaries—including those at South Cape Beach Recreational Area and Washburn Island. The Reserve Manager has ultimate responsibility for the research, education and stewardship programs and is also the principal point of contact at the Reserve for DCR, NERRS and outside agencies.

Research Coordinator

The Research Coordinator is responsible for coordinating all Reserve research and monitoring efforts. This includes coordinating the use of Reserve resources and facilities by visiting researchers; developing funding sources for research; developing, implementing, and evaluating in-house research and monitoring efforts; supervising those working on in-house research and monitoring projects; and representing the Reserve on matters related to research and monitoring. The Research Coordinator also represents the research interests of the Reserve to the NERRS and implements NERRS research program objectives at the Waquoit Bay Reserve.

Assistant Research Coordinator

The Assistant Research Coordinator assists the Reserve's Research Coordinator by coordinating the technical aspects of the Reserve's System-Wide Monitoring Program (SWMP) and other ecological monitoring programs, including citizen volunteer programs. Responsibilities include carrying out all water quality, meteorological, and biological monitoring components of SWMP; maintaining all SWMP-related field and laboratory equipment; and performing laboratory analysis for SWMP. The Assistant Research Coordinator also supports research-related activities by providing field and laboratory support and maintaining research-related facilities and equipment. This position also provides technical support for, and participates in, educational activities related to Reserve research and monitoring.

Research Technician

The Research Technician works with the Research Coordinator to implement the Reserve's research and monitoring programs.

Coastal Training Program Coordinator

The Coastal Training Program (CTP) Coordinator directs, provides, and organizes training and other educational opportunities concerning coastal management issues and estuarine research for resource managers, local and state government officials, environmental planning organizations and other coastal decision-makers throughout coastal Massachusetts, and communicates coastal management research needs to members of the scientific community. In this role, the CTP Coordinator prepares and updates training strategy and program implementation documents; conducts and/or supervises needs assessments of regional coastal decision-makers to determine their scientific information and training needs; works to identify upcoming coastal and estuarine science and management issues that may yield opportunities for coastal decision-maker training; represents the Reserve regarding CTP issues in interactions with the NERRS system, including all other CTP programs, and NOAA's Estuarine Reserves Division (ERD); develops partnerships and coordinates with other training providers and users; and collaborates with the Reserve's education, research and stewardship staff to develop and evaluate the means to transfer scientific information to the resource management, scientific and governmental communities.

Education Coordinator

The Education Coordinator is the principal link between the research efforts of the Reserve and the general public and develops and carries out various types of programs for schools, volunteer groups, and the public-at-large. Particularly important is the development and implementation of Teacher Training Programs and Community Education Programs. The Education Coordinator is responsible for supervision of the Community Educator and Interpretive Services staff. The Education Coordinator also provides coastal expertise and represents the interpretive and educational interests of the Reserve to the DCR Bureau of Ranger Services. Furthermore, the incumbent represents the education program interests of the Reserve to the NERRS and implements NERRS education program objectives at the Waquoit Bay Reserve.

Community Educator

The Community Educator works in the schools and with others to train teachers how to reach curriculum objectives through lessons in coastal ecology and management. The Community Educator also works with school children and youth groups. Specifically, the Community Educator

- Conducts teacher training sessions on topics in coastal ecology and climate science;
- Recruits, trains, and supervises teachers and volunteers for education programs;
- Develops teaching materials based on research and monitoring from Waquoit Bay Reserve, the Reserve system, and other relevant research;
- Provides information, consulting services, and teaching materials about coastal ecology to teachers, researchers, and students;
- Serves on committees to carry out the mission of Waquoit Bay Reserve; and
- Provides field-based educational experiences for students, such as pond monitoring and beach profiling.

Stewardship Coordinator

The Stewardship Coordinator is responsible for leading long-term protection and management of the Reserve's natural resources. This includes natural resource inventory and management, habitat/ecosystem restoration, regional environmental planning, development and policy review and coordination with stewardship activities in the NOAA national reserve system. Stewardship activities involve aspects of research, monitoring, education, policy and traditional forest and parks management, thus, the Stewardship Coordinator works as part of a team with the Reserve's Manager, Research Coordinator, CTP Coordinator, Education Coordinator, Forest and Parks Supervisor and other agency resource management staff. Since the long-term health of the Reserve's resources are dependent on land use in the entire watershed, and since the Reserve has regulatory jurisdiction only on DCR owned land and not on the open water within the Reserve, the person in this position must work closely with local, state and Federal officials, as well as

with local land owners, to manage natural resources affected by activities outside of DCR lands.

Fiscal Administrative Assistant
The Fiscal Administrative Assistant is responsible for processing all financial materials, all grants and contracts (personnel and otherwise), all purchases and contributions for the state and Federal program partners. This staff person functions as office manager. The Administrative Assistant also schedules facilities and provides administrative support to all Reserve programs and the numerous projects within each program area.

Events Coordinator
The Events Coordinator is a part-time position that assists the CTP, Education, Stewardship and Research departments in the coordination of workshops, volunteer training, adult education opportunities, and other events. This position is responsible for program logistics, marketing and outreach, registration, and follow-up. This position also serves as a liaison with the Reserve's Friends Group: Citizens for the Protection of Waquoit Bay. The Events Coordinator and the Volunteer and Interpretive Coordinator positions are job sharing positions. As such, both positions are eligible for benefits.

Volunteer and Interpretive Coordinator
The Volunteer and Interpretive Coordinator is also a part-time position and is responsible for overseeing volunteer activities at the Reserve, including recruitment, training and supervision of Visitor Center Greeters. This position, in consultation with the Education Coordinator, oversees the interpretive program at the Reserve. This position also supports the Fiscal Administrative Assistant when needed.

Technology Coordinator
The Technology Coordinator provides Geographic Information System (GIS) coordination, web page management, library database management, and technical assistance for the Waquoit Bay Research Reserve. This position is responsible for maintenance of the Geographic Information System database for the Research, Education, Stewardship and Management programs. GIS projects include, but are not limited to, habitat mapping, endangered species monitoring, land acquisition strategies, and shoreline change. This position is responsible for the design and maintenance of two web pages for the Reserve: the primary Reserve web page (www.waquoitbayreserve.org) and the Coastal Training Program web page (www.coastaltraining.org). This position also creates, implements, and manages an image library database and works with the Reserve's Technology Committee to formulate short and long-term technology plans including technology purchases. Additionally, this position is responsible for all equipment with a computer chip.

Forests and Parks Supervisor
The Forests and Parks Supervisor has day-to-day responsibilities for the Reserve's facilities, lands, and equipment. The Supervisor also oversees the operation of South Cape Beach State Park and supervises summer workers. The Park Supervisor works with the Stewardship Coordinator and Reserve staff to apply research information to management of Reserve property. The Forests and Parks Supervisor is also responsible for enforcing DCR policies on WBNERR property.

Skilled Laborer
The Skilled Laborer assists the Park Supervisor in the completion of assigned tasks related to facilities, lands, equipment, and operations of the Reserve.

Facilities Repair
Working with the Forests and Parks Supervisor and the Skilled Laborer, the Facilities Repair person maintains the buildings, land and equipment and is able to perform basic plumbing and carpetry.

Seasonal Staff Job Descriptions

Endangered Species Monitor
The Endangered Species Monitor coordinates the endangered species program, including oversight of the volunteer Piping Plover Patrol. The Endangered Species Monitor also offers regularly scheduled interpretive programs at South Cape Beach.

Interpretive Naturalist
The Interpretive Naturalist offers regularly scheduled interpretive programs at Reserve Headquarters, South Cape Beach State Park, the Quashnet Woods Property, and off-site. The Interpretive naturalist also offers special programs to visiting groups, as well as at off-site locations.

Island Managers
Island Managers are responsible for managing camping on Washburn Island, including checking camping permits, patrolling the Island, and providing regularly scheduled interpretive tours.

Long-Term Seasonal Staff
This position assists the Forests and Parks Supervisor in maintaining buildings and grounds at the Reserve.

Summer Workers
The Summer Workers assist the Forest and Parks Supervisor in maintaining facilities and managing visitor usage of Reserve lands, including South Cape Beach State Park.

Life Guards

Life guards stationed at South Cape Beach are responsible for swimmer safety. One life guard is designated as a Head Life Guard and given supervisory authority over Life Guards and Summer Workers at South Cape Beach. The Head Life Guard is responsible for daily training and position rotation. The Head Life Guard also coordinates with Town of Mashpee life guards at the Town beach within South Cape Beach State Park. There have been no life guards assigned to South Cape Beach for the past three years.

Staff Training and Emergency Response

Objective 5.6 WBNERR staff will augment their expertise with appropriate training.

a. WBNERR management will facilitate and support staff training opportunities when possible and appropriate.

WBNERR staff are encouraged to pursue training that will assist them to better perform their jobs. Training may take the form of conferences, workshops, courses related to their job functions, and lectures. WBNERR also provides training to seasonal staff that covers the following topics:

- Interpretive techniques
- First aid/safety
- Wampanoag history and culture
- Coastal plants
- Salt marsh and estuarine ecology
- Groundwater and watersheds
- Cape Cod coastal geology
- Solutions to coastal environmental problems
- Publicity

Objective 5.7: WBNERR staff is prepared to respond appropriately to a variety of emergency situations.

WBNERR staff will:

a. Review existing emergency response procedures annually and update as necessary.
b. Develop Emergency Response Plans for incidents that occur on parcels for which a plan does not already exist.
c. Be trained in emergency response procedures.
d. Place copies of Emergency Response Plans in key locations.
e. Continue to include emergency planning in seasonal training.

Because of the wide range of activities undertaken by Reserve staff members, visiting researchers, educators, users of recreational facilities, and others on Reserve property or under its auspices, there is a strong need to develop and implement emergency response procedures. WBNERR has written emergency response protocols for lab accidents and incidents on Washburn Island. There are also standard operating procedures for emergency incidents that occur on any DCR property. These plans will be reviewed annually to ensure their continued relevance and accuracy (*e.g.,* phone numbers will be confirmed).

There is a need to develop an Emergency Response Plan specifically for incidents that occur on lands that are separate from the Headquarters Site, *e.g.,* Quashnet Woods. The Stewardship Coordinator is working with the MNWR conservation partnership and the towns of Falmouth and Mashpee to develop such a plan.

A portion of the seasonal staff's formal training at the start of each season is dedicated to emergency response procedures. New research staffers are introduced to safety protocols and equipment in the lab. Emergency response procedures will be reviewed with all existing staff members. New employees will be given copies of the protocols as part of their orientation. Additionally, copies of all emergency response plans will be inserted in brightly-colored binders and placed in key locations: administrative office, lab, maintenance shop, and boat house.

Volunteers

Objective 5.8: Volunteers will support implementation of Reserve programs.
WBNERR staff will:

a. Enhance volunteer retention and recruitment strategy.
b. Expand ongoing training and educational opportunities and increase the focus on stewardship.
c. Enhance volunteer recognition.
d. Encourage cross participation of volunteers with Citizens for the Protection of Waquoit Bay (*i.e.,* the Reserve's Friends Group).
e. Encourage a subset of volunteers to assume leadership roles in coordinating and taking ownership of projects.

Volunteers support many Reserve programs. They participate in water quality and shorebird monitoring programs and act as trail stewards and visitor greeters. Volunteers also help organize events, provide administrative support, and assist with maintenance activities. Because of the critical importance of volunteers to the successful implementation of Reserve programs, WBNERR is dedicated to attracting new, and retaining existing, volunteers. The Reserve actively recruits volunteers in the spring through press releases, articles in local publications, recruiting events, open houses and community education events.

WBNERR provides numerous training opportunities to ensure, to the greatest extent possible, that volunteers fully and accurately represent the Reserve to the public. Volunteers are, after all, the "face" of the Reserve to many visitors. Volunteers are also likely to share their enthusiasm for the Reserve (or lack there of) with their friends and family. They have the potential, therefore, to play another important role for the Reserve: that of a stewardship "advocate." With this in mind, a wide variety of training opportunities are available to volunteers. Training activities include informational sessions with staff, courses on some of the Reserve's priority issues, and workshops outlining WBNERR's research, educational programs, and stewardship activities.

The Reserve expresses its appreciation to volunteers through several events each year. The annual potluck dinner affords volunteers the opportunity to meet like-minded individuals within the community. There is also an annual recognition event or field trip where staff and volunteers gather to celebrate the commitment and dedication of the volunteers. The "Volunteer of the Year" award is presented during this educational and festive event.

Citizens for the Protection of Waquoit Bay (CPWB) is another volunteer group that supports the Reserve and its programs. Reserve volunteers are encouraged to join this "friends group" and to regularly participate in events organized by CPWB, including clean-up efforts and fund-raising.

To further enhance the support volunteers provide to the Reserve, staff will identify individuals to assume leadership roles. For instance, a volunteer leader may be assigned to organize the other CoastWatchers, thus relieving the Research Coordinator of this responsibility. Individuals who are inclined to accept this sort of responsibility will derive satisfaction from the knowledge that their time and effort is supporting the Reserve's mission in a substantial and meaningful way.

Facilities, Grounds and Equipment

Objective 5.9: Reserve structures and equipment will be maintained in a safe, clean manner that is mindful of the environmental and cultural values of the site.
WBNERR staff will:

a. Ensure, to the greatest extent possible, that all buildings, vehicles, vessels, and other equipment are safe for their designated uses.
b. Ensure that WBNERR facilities are cleaned to publicly acceptable standards.
c. Use environmentally-sensitive products and practices to the greatest extent possible/practical.
d. Design improvements or modifications to the Sargent Estate, including its buildings and grounds, in accordance with the *Secretary of the Interior's Standards and Guidelines for Historic Preservation Projects.*

The Reserve's Forest and Park Supervisor oversees the regular maintenance of all buildings, vehicles, vessels, and other non-research equipment. Through regular

maintenance, these assets are kept in good working order. Additionally, all facilities are kept clean. The care with which the Reserve maintains its assets prolongs the useful life of the structures and equipment. It also helps to convey to visitors that they have entered a special place: one that is valued and cared for. Toward this end, all maintenance activities are carried out in a professional manner.

The Reserve demonstrates environmentally-sustainable operations through its selection of products and adoption of best management practices. For instance, the Reserve has replaced many incandescent light bulbs with compact fluorescent bulbs and installed exterior solar-powered lighting at the Headquarters Site. Additionally, Energy Star-rated equipment is used when possible, as are environmentally-sensitive cleaning products, paints and other compounds. Staff also regulate their own behavior as part of the Reserve's effort to model good environmental stewardship. For example, the heat is turned down when buildings are not in use. Lights and computers are, likewise, turned off when not in use. Additional measures include reusing scrap paper, composting food scraps, and combining vehicle trips. The Reserve will continue—and, where possible, will expand—these measures into the future.

Because the Reserve's headquarters are within the Waquoit National Historic District, any modifications to the buildings or grounds will be conducted in accordance with accepted standards for historic preservation.

Objective 5.10: Reserve lands will be managed to balance resource protection and recreational uses.
WBNERR staff will:

a. Continue to actively apply new information and the latest research findings to land management practices.
b. Ensure that trails, roads, boardwalks, symbolic fencing and campsites are well marked and maintained.
c. Design trails so as to minimize user impacts.
d. Continue to protect cultural resources.

WBNERR staff must routinely balance the need for resource protection with the public's recreational use of Reserve property. The Stewardship Coordinator and Forests and Parks Supervisor work closely together to define and implement the most appropriate land management practices. For instance, mowing of and access to certain lawn areas at the Headquarters Site is restricted in order to allow an endangered plant species to flourish. Quite nearby, however, the public is invited to attend events, hike, and picnic.

To clearly identify areas where the public are and are not allowed, WBNERR staff will ensure that trails, roads, boardwalks, symbolic fencing and campsites are well marked and maintained.

New hiking trails are developed periodically. Staff are mindful of potential user impacts and design trails to minimize impacts to the greatest extent possible.

The cultural resources of WBNERR, including archaeological remains and significant historic buildings, are finite resources. They represent unique events in time and space that are part of our communal heritage. Typically, prehistoric sites resulted from short term, sporadic occupation. There is seldom much material left behind, and under the best of circumstances they are difficult to excavate and interpret properly. They are extremely fragile and easily damaged. Archaeological sites cannot be repaired or fixed; their loss is analogous to the extinction of a plant or animal—once they are gone, they are gone forever. In order to protect these resources, Reserve staff consider and minimize the potential effects of projects—both capital and everyday operations—on historic and archaeological resources. They report discoveries of artifacts, soil anomalies, and looting and observed soil erosion at known sites to DCR's Office of Cultural Resources. They also keep information about the specific locations of prehistoric sites strictly confidential.

Construction Plan

Objective 5.11: The Reserve will explore the feasibility of new construction to support research, education, and maintenance programs.
WBNERR staff will:

a. Pursue the feasibility of constructing a new 'green" conference center for education and training programs and to serve as a model of sustainable building practices.
b. Explore the possibility of constructing or acquiring dock and pier facilities for boat and research use. (same as 1.6.c)
c. Explore the feasibility of building a new garage to include a large, heated maintenance shop for boats.

Per the 312 Report (Appendix K), WBNERR has analyzed future facility needs. Based on this analysis, WBNERR will pursue three major construction projects over the term of this management plan: a conference center, a dock, and a maintenance shop. Phase I of each project will be a feasibility study complete with designs, permit identification, and cost estimates for construction. Phase II of each project will be to secure funding and Phase III will be construction. The need for both the conference center and dock is documented in the 312 Evaluation.

If funding is secured, the conference center, designed as a "green building," will be used to augment the Reserve's existing facilities. Currently WBNERR has two meeting spaces: the Boat House and the Main House. Both have limited capacity. Twenty-five people can be accommodated sitting around tables and a maximum of sixty people can be accommodated with stadium-style seating. There are several times a year when WBNERR events draw more than 60 people, however. It is anticipated that, with the success of the Massachusetts Coastal Training Program, the Reserve will increasingly be unable to accommodate everybody that wants to attend its training programs. WBNERR's

solution is to add a conference center that will include meeting space for at least 125 people, a kitchen, storage, plus some additional office space. Most importantly, it will be constructed according to "green building" principles. That is, it will incorporate environmentally-sustainable features such as bamboo flooring, solar heating, and energy efficient appliances. The building will also feature educational plaques throughout, in order to help visitors to the conference center learn about the green design elements.

A fixed or floating dock in front of the Boat House would serve as an access way to vessels and as a research platform. Currently, both in-house and visiting researchers have to maneuver a dinghy from the beach into the water, row out to their moored boats, attach the dinghy to the boat, and bring the boat and dinghy to the shore to pull the dinghy on the beach again. These steps are necessary before the researchers can start loading their equipment into the boats. A dock would be a much more efficient way to access the boats and load equipment so that researchers can get to their research sites more quickly. The dock could also serve as a research platform from which scientific instruments are suspended or are otherwise attached.

Gaining regulatory approval for such a dock may be difficult. As noted in Chapter 4, new private docks and piers are prohibited within an ACEC without an approved resource management plan (there is no such plan for the Waquoit Bay ACEC). The towns of Falmouth and Mashpee must take the lead in developing an ACEC resource management plan. If the towns decide to develop a plan, WBNERR staff will work with the towns to create a plan that is protective of the area’s critical resources and which also allows for a research dock.

Because the categorical restriction on new docks does not apply to public water-dependent structures, another option is to seek approval for a public dock, Realistically, however, public access is in conflict with protecting the integrity of ongoing research and would create problems related to parking and the provision of landside access (the only access to the waterfront area is down a steep and narrow staircase from the boat house). Other options include seeking a variance from the Massachusetts Department of Environmental Protection (the permitting agency) or obtaining a Section 10A permit for a floating dock.

The third construction project that WBNERR will pursue is an expanded maintenance shop that can accommodate the Reserve's larger vessels. Currently, there is no indoor space in which to scrape and paint hulls or maintain outboard motors (Reserve staff maintains four boats). Also, trucks are kept outside year-round making winter maintenance and the attachment and removal of plows difficult.

Technology

Objective 5.12: Reserve programs are fully supported with state-of-the-art technology.
WBNERR staff will:

a. Continue to keep up-to-date on the latest technologies necessary for all departments.
b. Continue to set aside a portion of the budget to meet the growing technology needs of staff for items such as computers, software, other equipment (*e.g.,* digital camera), and training.
c. Work with the DCR Information Technology department to continue modifying acquisition strategies to streamline technology purchases and support existing networks, wireless technology, and SWMP.
d. Provide the training necessary for utilizing these technologies.

Technology supports and, in many cases, enables the work of all Reserve staff. For example, all staff have access to networked computers for production and electronic communications. The System-wide Monitoring Program relies upon wireless transfer of data. In order to continue to fully support the Reserve's departments, the Technology Coordinator will continue to stay informed about the latest technologies appropriate for each department. Furthermore, if possible, WBNERR will budget the funds necessary to obtain new technologies and will work with the DCR Information Technology department to continue modifying acquisition strategies to streamline technology purchases (refer to Objective 5.2.c) and support WBNERR programs, including wireless network and SWMP. Once new technologies are obtained, WBNERR staff will provide training (or will arrange for training by a third party) to insure that the new equipment is used appropriately and to its full capacity.

Objective 5.13: All Reserve programs benefit from the Reserve's Geographic Information Systems (GIS), as do selected community partnerships.
GIS staff will:

a. Accurately maintain GIS data produced by the Reserve.
b. Support Reserve programs directly or by coordinating outside expertise.
c. Support GIS partnerships by coordinating periodic Upper Cape GIS meetings.
d. Provide GIS support to local organizations that complement the Reserve's mission, when possible and appropriate.
e. Submit data to MassGIS or DCR/GIS for availability to ACEC resource management and project review.

The Technology Coordinator is responsible for accurately maintaining GIS data produced by the Reserve. Data is in a variety of formats and is documented according to Federal Content Standards for Digital Geospatial Metadata. The data—collected through geographic positioning systems (GPS), remote sensing and collaboration—is used in-

house and by local towns and State agencies. In addition to maintaining data, the Technology Coordinator assists staff from all departments to use the data by producing maps that are used for planning purposes, in education programs, and in publications. When necessary, the Technology Coordinator will draw upon the expertise of outside GIS specialists in support of Reserve activities. Reserve staff also support local GIS users by coordinating periodic Upper Cape GIS meetings that promote discussion, data exchange, and problem solving between town governments and other organizations, such as USGS. The Technology Coordinator also provides GIS support to local organizations that complement the Reserve's mission. For example, the Technology Coordinator produced maps in support of the Falmouth Coastal Resources Working Group, a body formed by Town Selectmen in response to growing concern about beach erosion and shoreline maintenance costs.

Objective 5.14: The Reserve's communications strategy will be supported by an enhanced database.
WBNERR staff will:

a. Maintain and improve a database that allows staff to contact appropriate people and to accurately track individual involvement with the Reserve.
b. Update existing mailing lists, including town officials and board members, on an ongoing basis.

The Reserve has an existing database that is used to track volunteers, to identify CTP and educational program participants, and to generate mailing lists. The database can be made more useful to the CTP by coding each entry when invitations or materials are mailed from WBNERR and when individuals participate in a WBNERR training event or workshop. Over time, this sort of tracking will produce an individual profile that highlights which of the Reserve's offerings are most attractive to people in certain positions. This information will help CTP to plan for future events. For example, the CTP will be able to design workshops for selected audiences with a common set of past training experiences. Contact information in the database is updated on an ongoing basis.

Communications Plan

Objective 5.15: Individuals, organizations and communities in coastal Massachusetts recognize WBNERR as a center of excellence for research, training, education, and stewardship.
WBNERR staff will:

a. Continue to produce and distribute publications including the newsletter, *Science to Management Bulletins*, and brochures.
b. Ensure that all publications are professionally produced with a consistent look and feel.
c. Continue to write articles for magazines and e-newsletters.
d. Continue to make presentations to organizations and at workshops and conferences regarding Reserve programs.
e. Further promote the availability of Reserve staff to speak to civic groups and other organizations.
f. Enhance relationships with local media outlets: newspapers, radio and television.

WBNERR's communication plan supports and advances work in all program areas. Through effective communications, WBNERR enhances the visibility and reputation of its core programs, attracts participants to Reserve events, and provides information about specific services available to key audiences. Comunication efforts help define the relevance of WBNERR for scientists, coastal decision-makers, educators, the general public, and DCR. All communication pieces—newsletters, press releases, presentations, etc.—emphasize the Reserve's leadership role in addressing current estuarine and coastal management issues through science and monitoring, training and education, and stewardship.

A significant component of the Reserve's communication plan relies upon the written word in the form of publications, such as the newsletter, *Science to Policy Bulletins*, submissions to magazines and newsletters, and brochures. The newsletter is printed three times a year and is directed toward a general audience. It features articles describing the Reserve's activities and the relationship of these activities to coastal management issues. WBNERR events, programs and training opportunities are also announced in the newsletter. Each *Science to Policy Bulletin* explores a current subject of concern in depth. The *Bulletin* is written in an accessible style and is intended for coastal management professionals, as well as interested lay people. News about Reserve activities is further spread through staff contributions to a variety of magazines and e-newsletters that reach audiences ranging from local church groups to coastal managers nationally.

Coastal decision-makers, researchers, and teachers must be aware of the Reserve's services and programs in order to take advantage of them. Toward this end, WBNERR has a brochure that summarizes the Reserve's activities and facilities and includes a map depicting the Reserve's land holdings and hiking trails. The Reserve also has an information packet that describes the Coastal Training Program. It contains a brochure and other materials that summarize how the CTP provides up-to-date scientific

information and skill building opportunities to coastal decision-makers. The Reserve will continue to produce and distribute these materials and will strive to deliver the CTP brochure to all new town officials and board members on Cape Cod with coastal management responsibilities (refer to Objective 5.16.b).

WBNERR will develop new materials targeting other key audiences. For instance, in order to attract more scientists to the Reserve (refer to Objective 1.2.c) a brochure will be developed that highlights current research needs and the types of support available through the Reserve.

A brochure directed toward educators will also be developed. The Education brochure will describe programs and resources available to teachers and students. Furthermore, since Massachusetts teachers are expected to cover State-defined "frameworks" (*e.g.,* the biological framework) in their teaching, the brochure will highlight connections between WBNERR's offerings and the State frameworks. The brochure will be distributed to science department heads at all Cape schools, to all teachers in the Reserve's database and to other key educators and administrators.

To help support WBNERR's image as a credible source of information on a variety of coastal management issues, Reserve staff will develop all publications with a consistent look and tone. Whenever possible, publications will be professionally produced.

WBNERR conveys its messages through direct interaction with people as well. WBNERR staff make presentations on a regular basis to professional and lay audiences. For example, the Reserve Manager recently addressed the Martha's Vineyard Water Alliance about the Reserve's activities vis a vis nitrogen loading. Non-professional audiences are also very important to the realization of the Reserve's goal of promoting environmental literacy. Toward this end, Reserve staff are available to speak to civic groups and other parties about WBNERR's priority issues. Information about the availability of Reserve staff for speaking engagements is generally spread through informal, word-of-mouth mechanisms.

WBNERR presently enjoys good coverage in the local press as a result of media releases issued by the Reserve and general media coverage. To garner further or more in-depth coverage of WBNERR activities and events, the Reserve will host an annual press day to introduce reporters to the Reserve's current research, discuss coastal management implications and solutions, highlight stewardship activities, and identify resources available through the Reserve. A press day will also serve to increase awareness of the Reserve's priority issues: water quality/eutrophication, climate change/renewable energy, and coastal ecosystem management.

Objective 5.16: Appropriate professional audiences will attend WBNERR training and education events.
WBNERR staff will:

a. Identify appropriate audiences for each event.
b. Improve their understanding of town structures on Cape Cod and the Islands with respect to coastal management responsibilities.
c. Develop a strategy to attract more teachers to WBNERR programs.
d. Contact superintendents and/or science coordinators and engage them in discussions about in-service program opportunities.
e. Partner with organizations representing target audiences as a way to increase attendance.

WBNERR staff gives careful attention to the identification of appropriate audiences when they are planning training and education events, particularly when a new subject is the focus of the event (*e.g.,* the health implications of climate change). Information about who should be invited to events is gathered through networking and by contacting professional organizations. Announcements are then targeted toward appropriate professional audiences. For instance, educators receive mailings about teacher training opportunities and home builders are invited to energy efficiency workshops. Contact information for a variety of audiences is maintained within the Reserve's database (refer to Objective 5.14). This information is used to target direct mailings and is updated on an ongoing basis.

Reaching out to members of volunteer boards and commissions, such as local conservation commissions, is a more challenging issue. Membership changes regularly, members typically have other jobs and responsibilities during the day, and the most direct communication channels are not always apparent. Despite the inherent difficulty in reaching this audience, it is imperative that the Coastal Training Program do so. Conservation commissions, waterways committees, and other similar entities are charged with making decisions that, directly or indirectly, impact the health of the Commonwealth's coasts. Furthermore, members of volunteer boards are not necessarily environmentally-literate. The number and variety of boards is likely to be different from town to town and, also, the responsibilities of particular departments (*e.g.,* Health) are likely to vary, as well. WBNERR will, therefore, identify relevant town departments, commissions and committees on Cape Cod, their responsibilities, and their membership. A mailing list of town officials and board members is incorporated within the Reserve's database and will be updated regularly so that CTP events can be strategically promoted.

Teachers are another key audience with whom the Reserve wants to enhance relations. The Reserve offers many well-attended teacher training programs throughout the year. To further increase participation, WBNERR staff will identify barriers to teacher participation in Reserve programs and develop strategies to overcome them. Staff will also contact superintendents and/or science coordinators and engage them in discussions about in-service program opportunities.

To further increase participation in WBNERR events, Reserve staff will continue partnerships with organizations representing target audiences, *e.g.,* Cape and Islands Board of Realtors, and will strive to form new relationships.

Objective 5.17: Local lay audiences are aware of and participate in WBNERR events.
WBNERR staff will:

a. Continue to promote upcoming events, workshops and training through the Reserve's own publications, news releases, and other channels.
b. Advertise upcoming public events during interpretive programs.
c. Partner with selected organizations to host events.

In addition to programs directed toward key professional audiences, the Reserve delivers numerous education and interpretive programs to the general public. Events include workshops on Cape-friendly landscaping, Evenings on the Bluff, and interpretive walks. These types of events are advertised through the newsletter, web site, news releases, and other mechanisms. Seasonal staff promote upcoming events during their interpretive walks. Events are also promoted by partner organizations such as Citizens for the Protection of Waquoit Bay.

Objective 5.18: An increasing number of community members are aware of WBNERR's research, stewardship or monitoring programs.
WBNERR staff will:

a. Create more lessons and activities based on the Reserve's research, monitoring and stewardship programs.
b. Actively foster links and partnerships between educators and researchers.
c. Ensure that individual research projects are described in the newsletter, on the web site, and in the *Science to Policy Bulletin*.
d. Garner greater press coverage of research activities.
e. Work with outside researchers to ensure that they credit the Reserve and NOAA when giving presentations or submitting journal articles.

Many people, while familiar with some aspect of WBNERR, are unaware of the full breadth of activities conducted at and supported by the Reserve. For example, teachers are likely to know about educational offerings but may be unfamiliar with the Reserve's research and stewardship activities. By making teachers—and all audiences—more aware of the comprehensive nature of its commitment to estuarine health, WBNERR will gain credibility and stature among community members. Toward this end, lesson plans based on the Reserve's research, monitoring, and stewardship programs will be developed and made available on the Reserve's web site. Additionally, the Reserve actively fosters links and partnerships between educators and researchers in order to involve students at the elementary, secondary, and collegiate levels in science, whether it be in the field or in the

classroom. Through this technique, the results of research and monitoring at the Reserve are made readily available to students and teachers.

Descriptions of research projects conducted at the Reserve are included in the newsletter and on the web site. As part of the effort to increase awareness of WBNERR's research activities, Reserve staff may produce an annual "research summary" issue of the *Science to Policy Bulletin* that features one season's research and its implications for management. Reserve staff will also prepare press releases and draw upon relationships with members of the media to expand press coverage of WBNERR's research activities (see objective 5.15.f). They will also work with researchers that use WBNERR as a study site to insure that the Reserve and NOAA are properly credited in publications and presentations.

Objective 5.19: Citizens, educators, researchers, and coastal decision-makers rely on the Reserve and CTP web sites as valuable tools.
WBNERR staff will:

a. Ensure that the WBNERR web site consistently provides dynamic information to the public about the Reserve's purpose, core programs, and events.
b. Maintain current information about educational resources and programs on the WBNERR web site.
c. Continue to host monitoring data and downloadable GIS layers on the WBNERR web site.
d. Update and maintain other information about research studies and publications.
e. Improve the placement of CTP information on the WBNERR web site and enhance the CTP web site.

The Waquoit Bay NERR hosts two web sites: www.waquoitbayreserve.org is the Reserve's primary web site and www.coastaltraining.org is the Coastal Training Program's web site. The primary WBNERR site hosts general information about the Reserve, lists news and publications, provides camping information, and includes additional content areas for education, monitoring, GIS, research, and workshops and events.

The Education content area contains a wealth of information including descriptions of teacher training programs, lesson plans, resources for teachers, and the Massachusetts Curriculum Frameworks. Reserve education and technology staff will continue to work together to maintain this area of the web site.

Monitoring data and downloadable GIS maps of Waquoit Bay and the vicinity will also be maintained on the web site as aids to both researchers and educators. To improve the level of support to researchers, the Research content area will be updated to include titles

and abstracts of current research projects and publications and will incorporate the additional data described in Objective 1.5.

Reserve staff will make information about the Coastal Training Program on the WBNERR site more readily apparent. Presently, there is no general description of the CTP on the WBNERR site; just a link to the CTP web site. And, on the CTP web site, there is no link to information about past workshops. This information is hosted on the WBNERR site. This confusing situation will be rectified by adding a statement about the CTP within the "Workshops and Events" content area and by adding links to information about past workshops to the CTP web site. As part of planning and implementing future workshops, WBNERR staff will arrange for workshop materials—including agendas, presentations, reference material, and contact information for presenters—to be added to the CTP web site (refer to Objective 4.5.a).

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