Great Bay National Estuarine Research Reserve

Management Plan

2006-2010

Submitted by: NH Fish and Game Department
225 Main Street
Durham, NH 03824

Great Bay National Estuarine Research Reserve

Management Plan 2006-2010

The Great Bay National Estuarine Research Reserve is part of the National Estuarine Research Reserve System (NERRS), established by Section 315 of the Coastal Zone Management Act, as amended. Additional information about the system can be obtained from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration, US Department of Commerce, 1305 East West Highway – N/ORM5, Silver Spring, MD 20910.

Copies of this publication are available from the Great Bay National Estuarine Research Reserve, NH Fish and Game Department, 225 Main Street, Durham, NH 03824.

Acknowledgments

Written by: Dea Brickner-Wood and Peter Wellenberger
Edited by: Kathy Mills
Maps by: Rachel Stevens
Contributors: Beth Kane, John Nelson, Brian Smith and Bruce Smith

Funding for preparation of the draft Great Bay Management Plan provided by The Cheney Companies, Newmarket, NH.

Great Bay National Estuarine Research Reserve
Management Plan Executive Summary

The Great Bay estuary is one of the most recessed estuaries along the eastern seaboard. Located in the Gulf of Maine watershed, this drowned river valley extends 15 miles inland from the Atlantic coast creating a complex mosaic of freshwater wetlands. The Great Bay estuary has elicited such diverse and descriptive phrases as New Hampshire's hidden treasure and the "Crown Jewel" of the seacoast. These descriptions just begin to paint a picture of a resource that has captured the hearts, minds and imagination of its inhabitants for hundreds of years.

The estuary is also located in a geographic area that has experienced intense development pressure since the 1970's. The two seacoast counties, Rockingham and Strafford, have added over 180,000 new residents from 1970 to 2000 (US Census figures 2000). This development pressure has continued to escalate as we enter the new century.

In 1989, Great Bay was designated as a National Estuarine Research Reserve (NERR) site, making it the 18th estuary in the United States to join the system. As a federal/state partnership, Reserves are committed to the long-term research, education and stewardship of valuable estuarine resources. The Great Bay Research Reserve operates under the auspices of the National Oceanic and Atmospheric Administration (NOAA) within the authority of the Coastal Zone Management Act (CZMA). The New Hampshire Fish and Game Department has served as the lead state agency since 1989. It is within this management framework that the Reserve operates and sets the stage for how the Management Plan was developed.

Since the Great Bay Reserve's inception, a dynamic partnership approach has emerged in both resource management and protection of the Great Bay region that includes residents and individual volunteers, communities, state and federal agencies, nonprofit conservation organizations, businesses, and educational institutions. This collaborative effort has made tremendous strides in furthering the scientific understanding of the estuarine system, providing educational and outreach opportunities, and demonstrating the importance of providing for the estuary's protection and stewardship, now and in the future.

The Management Plan

In this context of both a richly diverse ecosystem and organizational partnership, the Great Bay NERR Management Plan was developed to serve as a dynamic, action-oriented document. The Reserve's mission is *to promote informed management of the Great Bay estuary and estuarine habitats through linked programs of stewardship, public education, and scientific understanding.* The Management Plan seeks to achieve this vision and includes the following:

- Provides a description and summary of the Great Bay's natural and cultural history.
- Highlights the accomplishments of the Reserve since its inception in 1989.
- Identifies the current management issues facing the Reserve.
- Establishes the Reserve's goals, objectives and action items for the next 5 years.
- Provides a framework for the design, implementation and evaluation of the actions and progress of the Reserve's programs and Management Plan goals.

- Serves as an internal management tool to assist Reserve staff in their planning activities.
- Serves as an external educational tool to inform the public of both the Great Bay Reserve and the Reserve Systems' mission and programs.
- Serves as a tool to help guide the Coastal Zone Management Act Section 312 evaluation of the Reserve.

The Management Plan is organized into nine information chapters. The mission statements for the nine elements are as follows:

1. **Administration**: Provide administrative leadership and resources necessary to fulfill the Reserve's mission as established in state and federal law, administrative rules and inter-agency agreements.

2. **Research and Monitoring:** Improve the health of the Great Bay estuary and the watershed by conducting research and monitoring activities and providing information that promotes informed resource management.

3. **Resource Protection**: Provide for the long-term conservation and protection of the biodiversity of the Great Bay estuary and associated habitats.

4. **Stewardship**: Maintain the ecological integrity of the Great Bay region by using a comprehensive stewardship approach to education, land acquisition, and research and monitoring.

5. **Facilities and Construction:** Enhance the mission of the Reserve and its associated research, education, and stewardship programs through the maintenance and development of facilities necessary to support these efforts.

6. **Education, Outreach and Interpretation:** Design and implement a comprehensive program of education and interpretation based on solid scientific principles that strengthen understanding, appreciation and stewardship of estuaries, coastal habitats, and associated wetlands throughout the Great Bay watershed.

7. **Public Involvement and Volunteerism**: Continue hosting and participating in activities that encourage residents within the Great Bay watershed to understand and support the Reserve's mission.

8. **Public Access**: Provide appropriate public access to the Reserve's protected lands and waters, while protecting the inherent natural resource values of these lands and waters.

9. **Boundary and Land Acquisition Plan**: Protect the critical estuarine resources and associated uplands of the Great Bay estuary while working in partnership with other agencies and organizations to provide for the long-term conservation of properties within the proposed 2005 Reserve boundary.

The Great Bay NERR Management Plan is both an ambitious and practical document that hopes to build on past successes, prioritizes the critical issues facing the estuary and develops strategies to address them. In collaboration with dedicated volunteers and partnering entities, we will work together to make the vision of this plan a reality.

TABLE OF CONTENTS

FIGURES

Chapter I
Overview

A. The National Estuarine Research Reserve System

1. Introduction

The National Estuarine Research Reserve System (NERRS) was created by the Coastal Zone Management Act of 1972 (CZMA), as amended, 16 U.S.C. sec. 1451-1465, to augment the federal Coastal Zone Management Program. The program is dedicated to the comprehensive, sustainable management of the nation's coasts.

The NERRS is a network of protected and managed areas established to promote informed management of the nation's estuaries and coastal habitats. The System currently consists of 27 Reserves in 22 states and territories, protecting over one million acres of estuarine waters and associated lands.

2. Mission and Goals of NERRS

Mission

As stated in the regulations, 15 C.F.R. Part 921 at sec. 921.1(a), the NERRS 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***. NERRS sites are established to provide opportunities for long-term research and monitoring, education and interpretation, and stewardship.

Goals

Federal regulations, at 15 C.F.R. Part 921 at sec. 921.1(b), provide five specific System-wide goals:

Goal 1:
Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;

Goal 2:
Address coastal management issues identified as significant through coordinated estuarine research within the System;

Goal 3:
Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;

Goal 4:
Promote federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and

Goal 5:
Conduct and coordinate estuarine research with the System, gathering and making available information necessary for improved understanding and management of the estuarine areas.

3. Biogeographic Regions

The National Oceanic and Atmospheric Administration (NOAA) has identified eleven distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (see 15 C.F.R. sec. 921, Appendix I and II for NERRS biogeographical and typological classification scheme). When complete, the System will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. Each reserve is responsible for conducting research and providing educational and interpretive services that are applicable to its region. The NERRS currently includes twenty-seven reserves, with three more in development as shown in **Figure 1.1**.

4. Reserve Designation and Operation

Under federal law (16 U.S.C. sec. 1461), an estuarine area nominated by a state for reserve status may be designated by the Secretary of Commerce if 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.

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 NERRS, 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 (see Appendix E). A Reserve may apply to NOAA's Estuarine Reserves Division (ERD) for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

5. NERRS Administrative Framework

NOAA's ERD administers the overall Reserve System on the federal level. ERD establishes standards for designating and operating the sites, provides support for Reserve operations, undertakes projects that benefit the entire System, and integrates information from individual reserves to support decision-making at the national level. As required by federal regulation, 15 C.F.R. sec. 921.40, ERD periodically evaluates Research Reserves' operations for compliance with federal requirements and with the individual Reserve's federally approved management plan.

ERD provides federal funds to help support operations, research and monitoring, education and coastal training, and stewardship on an annual basis as approved by Congress. Sites also can apply

Figure 1.1 NERRS Map with Biogeographic Regions

for funds to support development projects, facility construction, and land acquisition as they become available through the federal budget process.

Each Reserve is a "living laboratory" managed on a daily basis by a state agency or university. This is accomplished in partnership with local community members who often participate through friends groups, volunteer programs, and advisory groups. Reserve staff work to engage communities in characterizing and addressing local natural resource management issues. In addition, because Reserves are designated to represent large biogeographic regions, they also serve as important sources of information to coastal states with similar estuarine ecosystems.

6. System-Wide Programs - NERRS and the Great Bay National Estuarine Research Reserve (GBNERR)

NERRS 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 initiated 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. As part of the process, the Reserve System developed a vision: "Healthy estuaries and watersheds where coastal communities and ecosystems thrive"; and mission: "To practice and promote coastal and estuarine stewardship through innovative research and education using a system of protected areas" (NERRS 2006a).

National Estuarine Research Reserve System 2005-2010 Strategic Plan Goals

Goal 1: Strengthen the protection and management of representative estuarine ecosystems to advance conservation research and education;

Goal 2: Increase the use of Reserve science and sites to address priority coastal management issues; and

Goal 3: Enhance people's ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

Each year, the action plan is evaluated and revised to reflect changes in the program and to guide future initiatives. Proposed changes are then reviewed at the annual fall meeting. In conjunction with these Action Plan Goals, the NERRS has developed system-wide programs to address the above goals. The GBNERR is currently involved in all three system-wide programs:

- System-Wide Monitoring Program
- Graduate Research Fellowship Program
- Coastal Training Program

The Reserve System is also closely associated with the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). CICEET was established in 1997 as a national center for the development and application of innovative environmental technologies for monitoring, management, and prevention of contamination in estuaries and coastal waters. CICEET is a unique partnership between the University of New Hampshire and NOAA, and promotes the collaboration among academia, government and the private sector. Great Bay serves as the host Reserve for CICEET.

Although Reserve staff participates in state-supported and externally supported programs and projects, the partnership with NOAA is vitally important to ensuring our nation's ability to make informed decisions about how to use and manage estuarine and coastal resources. In order to accomplish this mission, each Reserve relies upon NOAA and ERD for adequate funding to support operations, land acquisition and facility construction, and for participation in system-wide programs.

B. Purpose and Scope of the GBNERR Plan

1. State Partnership Role and Designation

Since the early 1940's, the State has been concerned about the planning and management of the Great Bay area. In 1941, the New Hampshire Legislature adopted a "Joint Resolution to Make a Long Range Plan for the Development of Great Bay." It charged the Office of State Planning (then called the State Planning and Development Commission) with the task of developing what became the Great Bay Plan (NH State Planning and Development Commission 1945). It referred to the estuary as *the greatest undeveloped recreational resource in all of the New England*. This ambitious plan included eight major components including creating better access, pollution control, improved fisheries, and preventing erosion of the land. Its most notable recommendation was to create a series of dams to increase recreational opportunities. While the dams were never funded, many of these ideas have since been implemented.

In the 1960's, there was renewed interest in a development plan for the Great Bay. Once again, Legislature proposed increasing access and explored the feasibility of inland waterway from Lake Winnipesaukee to Great Bay (NH Office of State Planning 1989). As in the 1940's, the focus of these efforts was on the recreational potential of the estuary.

The 1970's brought about another chapter in the State's planning efforts, this time with an emphasis on resource management. A proposal by Aristotle Onassis to build a large oil refinery in the Great Bay region led local residents to explore ways to protect the estuary. With the advent of the New Hampshire Coastal Zone Program, the State began the process of developing a plan to manage the entire estuarine system.

The State began exploring the possibility of including Great Bay as a part of the Reserve System in 1982. The New Hampshire Office of State Planning (OSP) acted as the lead agency in the effort to create the Great Bay National Estuarine Research Reserve and established a management committee that prepared the original management plan and nomination documents. In 1989, the Reserve was designated, making it the 18th estuary in the United States to join the System.

OSP also played an integral role in the designation process, administration, land acquisition, and design and construction of the Reserve's educational headquarters, the Great Bay Discovery Center. As the Reserve program became more fully operational, the management of the Reserve was shifted to the New Hampshire Fish and Game Department (NHFGD) under the Marine Fisheries Division (transfer was completed in 1995). OSP continues to monitor four conservation easements for the Reserve that were purchased through the Land Conservation Investment Program (LCIP).

As the guardian of the State's fish, wildlife and marine resources, NHFGD works in partnership with the public to:

1. Conserve, manage and protect these resources and their habitats.

2. Inform and educate the public about these resources.

3. Provide the public with opportunities to use and appreciate those resources.

As guardian of the State's living resources, *the executive director shall enter into cooperation with the departments of the federal government and of this and all other states, for the protection, propagation and preservation of all wildlife in this State, and shall execute all matters pertaining thereto, including a biological survey of the State* (State Statute 206:23).

Further, NHFGD is authorized to accept federal and other sources of funds, with the approval of Governor and Council, to conduct activities and hold property that support its mission (State Statute 206:39). This authority is essential as the Reserve expands its boundary and acquires lands for the purpose of protecting and managing coastal habitats and ecosystems.

2. Reserve Management Planning

Reserves are required by federal regulation, 15 C.F.R. sec. 921.13, to have a NOAA-approved management plan. Management plans are required by federal regulations, 15 C.F.R. sec. 921.33, to be updated every five years to:

- Provide a vision and framework to guide Reserves activities during a five-year period.
- Enable the Reserves and NOAA to track progress and realize opportunities for growth.
- Present Reserve goals, objectives, and strategies for meeting the goals of constituents.
- Guide program evaluations under Section 312 of the Coastal Zone Management Act.
- Enable the Reserves to acquire facilities, construction and land acquisition funds.

When the Great Bay site was designated in 1989, the management plan had already received federal approval to implement the objectives of the Reserve. The program grew slowly for the first ten years and then began to expand more rapidly. The Reserve is now facing different management issues and revised its goals and objectives for resource protection.

The GBNERR Management Plan builds upon the efforts of the original plan and covers a five-year period (2006 – 2010). Efforts to revise the Reserve's Management Plan began in 2000. During this planning process, two draft plans were prepared and made available for public comment before being submitted to NOAA for final approval.

The plan describes the Reserve's goals, objectives, and management issues, and identifies strategies or actions for research, education and interpretation, stewardship, public access, construction, acquisition, and resource protection. The role of Reserve staff in each of these areas is addressed. The management plan will serve to accomplish the following:

- Provide a description and summary of commonly known natural and cultural history of Great Bay.

- Highlight the accomplishments of the Reserve since its inception in 1989.
- Identify and discuss the current management issues facing the Reserve.
- Establish the Reserve's goals, objectives and strategies for the next 5 years and provide a framework for accomplishing these goals.
- Allow the Reserve to track its progress in meeting the stated goals and objectives.
- Serve as an external educational tool to inform the public of both the Reserve and the System mission and programs.
- Provide a framework for the Reserve to construct facilities and acquire property using federal funds.

As a non-regulatory entity, the Reserve's activities are governed by federal, State and local regulations. This management plan was prepared in accordance with all federal regulations (15 CFR Part 921).

Management Issues

The primary management issues facing the Reserve over the next five years include:

1. Land fragmentation from over development and urban sprawl – The Great Bay region continues to experience rapid development and population growth, which causes land fragmentation and threatens a wide variety of important land-based species. While habitat loss is less of an issue as a result of the Reserve's land protection strategies, fragmentation of key habitats remains a concern.

2. Decreased water quality – While in general the water quality of the estuary remains good or is improving, nitrogen concentrations continue to increase and need to be studied further. As the potential levels of non-point source pollution increase due to development, especially related to impervious surfaces, greater effort is required to reduce and remediate these pollutants.

3. Loss of shellfish – Primarily due to the introduction of shellfish disease, the standing stock of oysters has declined dramatically since the mid 1990s. New management strategies are required to increase and maintain future oyster stocks.

4. Invasive species – The number of new invasive species continues to increase causing numerous environmental impacts on native species. Increased monitoring of invasive species is needed as well as remediation strategies. The introduction of the Asian shore crab (*Hemigrapsus sanguineus*) and its impact on eelgrass beds, it is just one example. In some cases, new invasive species are displaying earlier invasives and little is known about the potential impacts.

5. Decline of key fish species – Rainbow smelt (*Osmerus mordax*) are a key fish species in the estuary. Over the past ten years, populations of smelt have been well below historical levels possibly due to loss of habitat and/or declining water quality. A major effort is required to determine why populations are declining and what can be done to restore the species to previous levels.

6. Ensuring proper stewardship of key parcels – The large increase in the number of acres being acquired by the Reserve puts additional pressures on staff to adequately manage these properties. The success of the Reserve in acquiring land has increased the need to provide public access under the guidelines established by NHFGD (lands being managed as Wildlife Management Areas). Balancing public access against resource protection is a high priority.

Chapter II
The Setting

Regional and Watershed Characteristics - Geographic Description of the Great Bay National Estuarine Research Reserve (GBNERR) Site

A. Introduction

Estuaries are tidally influenced ecological systems where rivers meet the sea and fresh water mixes with salt water, forming crucial nutrient-rich transition zones that provide habitat for birds, mammals, fish, and other wildlife. They are nurseries for many marine organisms in early stages of development as well as providing flood control during storms. Estuaries also serve as natural filters helping to maintain high water quality and provide a buffer to the coastline.

Great Bay estuary is a complex embayment and New Hampshire's largest estuarine system. Located on the New Hampshire and Maine border, the estuary includes the Piscataqua River, Little Bay and Great Bay (Short 1992a). A tidally dominated system, it receives ocean water from the Gulf of Maine and is the drainage confluence of seven major rivers with a total drainage area of 930 square miles, with the Lamprey River watershed being the largest (Jones 2000).

The estuary formed during the most recent deglaciation of the region approximately 14,500 years ago, creating a drowned river valley. Tidally induced and wind driven currents control circulation, mixing and the resuspension of sediments, all strongly influencing primary productivity. Great Bay has an average depth of nine feet with deeper channels that extend to over 55 feet. The main habitat types are mudflat, salt marsh, eelgrass, channel bottom and rocky intertidal (Short 1992a).

Since Colonial times, Great Bay and the connecting network of rivers have been used for transporting goods and raw materials for manufacturing and trade. For several hundred years, the estuary was a dumping ground for pollutants, including massive sawdust inputs, fish waste, untreated sewage, and textile mill and tannery chemicals. Due to the strong tidal influence, many of these contaminants were quickly flushed out of the system and are not visible to the casual observer (Short and Webster 1992). Today, many of the main tributaries, with the exception of the Bellamy and Winnicut rivers, carry treated sewage effluent, contributing bacteria and nutrients to the Great Bay estuary (Jones 2000).

B. Great Bay National Estuarine Research Reserve Boundary

The Reserve's delineated boundary includes the critical habitat lands surrounding Great Bay. The purpose of delineating such a boundary is to provide a targeted area in which to focus resources for the long-term protection of significant land and water areas. The area within the boundary represents the diversity of flora, fauna and habitats found within the estuary.

The Reserve's 1989 original boundary comprised 6,353 acres, including approximately 4,500 acres of tidal waters and wetlands **(**see **Figure 2.1)**. The Reserve's 2005 proposed boundary as outlined in this plan, encompasses 10,236 acres, including approximately 7,300 acres of open water and wetlands, and 2,935 acres of upland as well as an acquisition zone of 20,172 acres. The proposed boundary includes all of the Great Bay (including Little Bay), as well as portions of five of the seven major fresh water rivers - the Winnicut, Squamscott, Lamprey, Bellamy and Oyster - up to the first dams (see **Figure 2.2**).

Figure 2.1 Original GBNERR Boundary – 1989

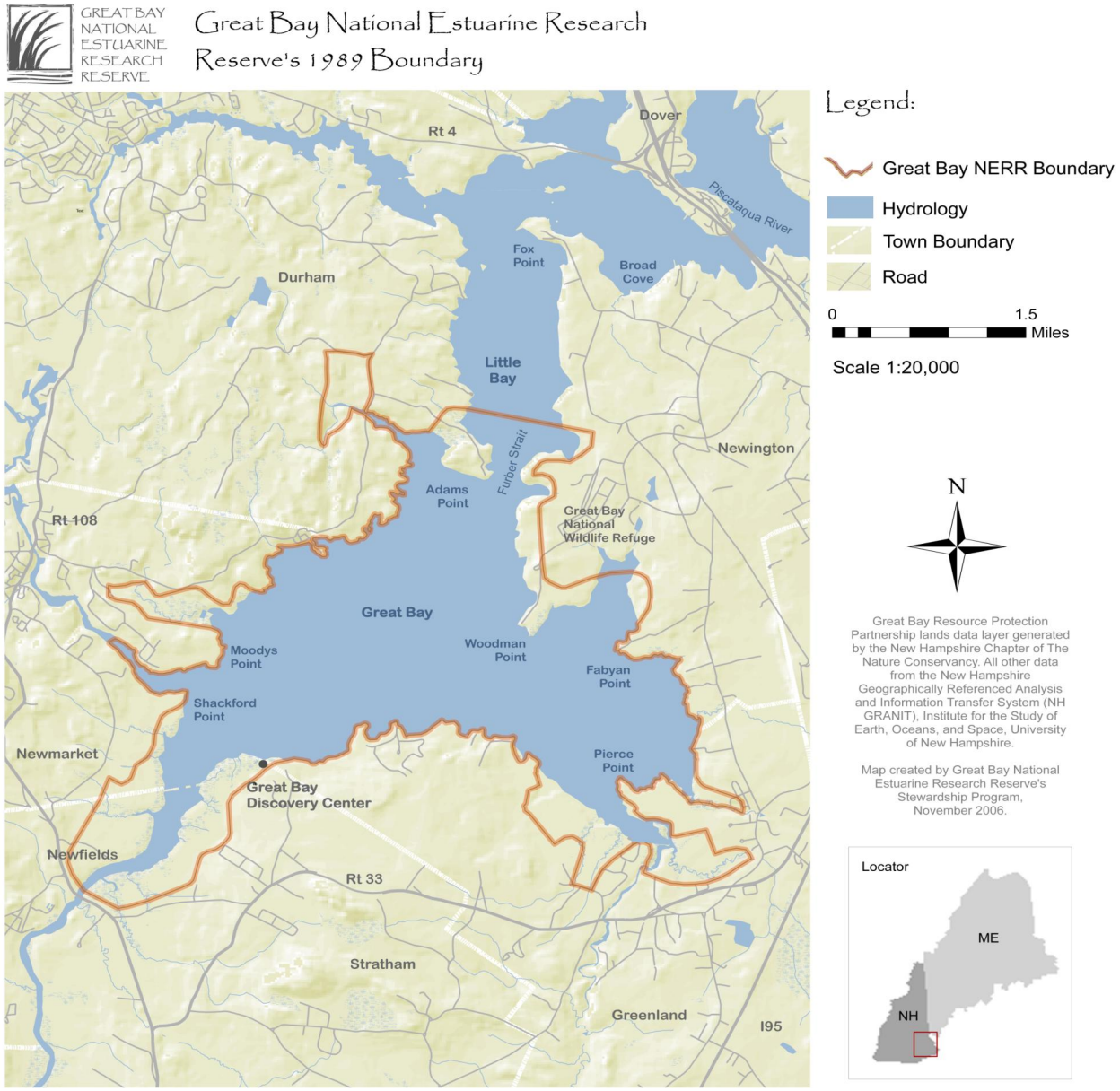
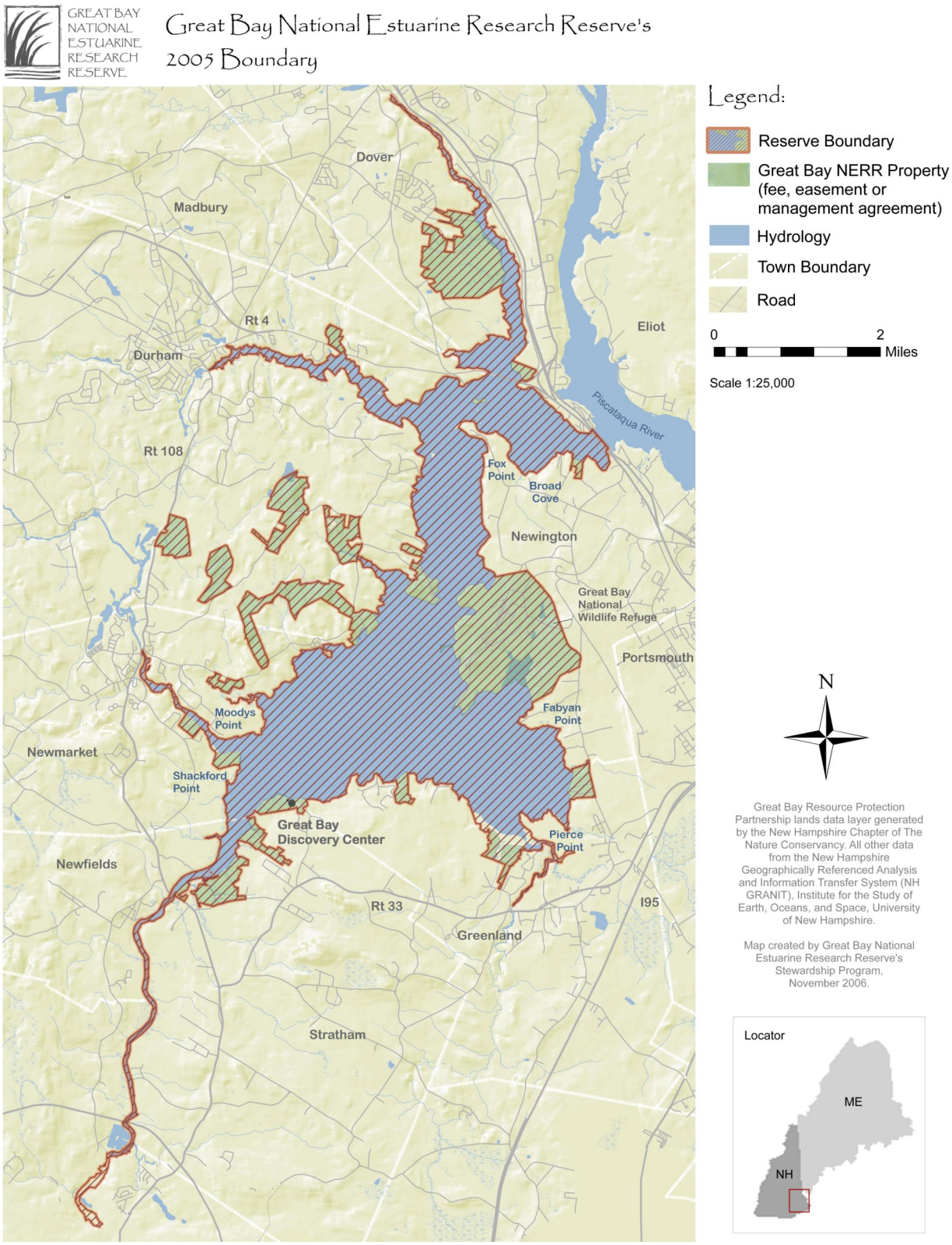


Figure 2.2 Proposed GBNERR Boundary - 2005



The Reserve's 2005 proposed boundary encompasses the entire 1,054 acre Great Bay National Wildlife Refuge, which previously was a military base and included only a buffer along the shoreline.

C. Regional Setting – The Gulf of Maine and Great Bay

The Great Bay National Estuarine Research Reserve is located within the *Acadian* biogeographic region, *Southern Gulf of Maine* providence, on the Maine – New Hampshire border. Great Bay is one of the nation's most recessed estuaries and is often referred to as New Hampshire's "hidden coast."

The Gulf of Maine is considered by many scientists and the public as one of the most pristine marine environments to be found on the east coast. As a result of its water circulation patterns and the combined productivity of its seaweed, salt marsh grasses, and phytoplankton, the Gulf of Maine is also one of the world's most productive water bodies (Conkling 1995, Apollonio 2002). Historically, it has been a source of livelihood for tens of thousands of commercial fishermen (Kurlansky 1997). More recently, recreation and tourism-related employment has been recognized as a major contributor to the region's economy.

Located within the Gulf of Maine watershed, the Great Bay estuary is a drowned river valley composed of high-energy tidal waters, deep channels and fringing mudflats. The estuary extends inland from the mouth of the Piscataqua River between Kittery, Maine, and New Castle, New Hampshire through Little Bay into Great Bay, a distance of almost 15 miles. Only the Bay of Fundy is considered to have stronger tidal currents in the northern Atlantic Ocean (Short 1992a).

The present boundary of the Reserve lies upstream of Furber Strait near Adams Point at the southern end of Little Bay and includes all of Great Bay as well as the drainage confluence of three major rivers, the Lamprey, Squamscott and Winnicut. Four additional rivers flow into the system between Furber Strait and the open coast – the Cocheco, Salmon Falls, Bellamy and Oyster. The Cocheco and Salmon Falls merge to form the Piscataqua River.

D. Hydrology

The Piscataqua River is an ocean-dominated system extending from the Gulf of Maine at Portsmouth Harbor and forming the border of New Hampshire and Maine to the fork of its tributaries, the Salmon Falls and Cocheco Rivers. These rivers, several small creeks and their tributaries and ocean water from the Gulf of Maine create the lower section of the ecosystem.

The tidal range is dramatic within Great Bay. The average depth of the embayment is nine feet with channels extending to over 55 feet. The water surface of Great Bay covers 8.9 square miles at high tide and 4.2 square miles at low tide, leaving greater than 50% of the Bay exposed at low tide (Short 1992b).

E. Geology

Great Bay Estuary, A Drowned River Valley

The region surrounding the Great Bay is included in the Seaboard Lowland section of the New England Province. Elevations in the area are generally less than 61 meters. Most hills are either bedrock covered with glacial till or drumlins. The Great Bay estuary basin is eroded into a

complex assemblage of metasedimentary, metavolcanic and plutonic rocks ranging in age from 345 to 600 million years old (Devonian to Ordovician geologic periods) (Notovny 1969, Ward 1992).

The bedrock that frequently outcrops along the shores of the estuary is divided into three geologic formations, the Kittery, the Eliot and the Rye. The Kittery and the Eliot formations meet along a north-south trending contact that extends under both Great and Little Bay. The Kittery Formation forms the western shoreline of Great Bay and portions of the Piscataqua River. It is composed of impure quarzite, slate, phyllite and schist.

The Eliot Formation forms the eastern shore of Great and Little Bays and portions of the upper Piscataqua River and is composed of argillaceous sediments which were metamorphosed into slate, phyllite and pyritic quartzite (Notovny 1969).

The surficial sediments in the Great Bay area have been strongly influenced by glacial advances and retreats during the Quaternary period. During the last major glaciation, the Wisconsin (which began 85,000 years ago), large ice sheets moving in a southeasterly direction, removed much of the overlying soils and eroded the underlying bedrock (Chapman 1974). Subsequently, extensive tills, drumlins, and marine sands, silts and clays that were deposited by the retreating glaciers were orientated in this direction (Delcore and Koteff 1989, Ward 1992).

More recently, modern tidal flats, salt marshes and muddy to cobble beaches have developed adjacent to the estuary and its tributaries. During the Quaternary, the huge continental glaciers, which periodically advanced and retreated across New Hampshire, caused the earth's crust to be depressed due to the immense weight of the ice. Following the ice removal, the crust rebounded as the weight of the glaciers was removed (Ward 1992).

During the most recent deglaciation, the crust remained pushed down, causing flooding of the land by the sea. At this time, sea level was approximately 160 feet higher than today. Then as the earth's crust rebounded 11,000 to 12,000 years ago, sea level dropped reaching a depth on the order of 100 to 160 feet below present (Birch 1990). The crust continues to rebound, at a rate similar to sea level rise; this balance may lessen the effects of the sea level rise on coastal areas.

Crustal depression in New Hampshire from glacial weight was significant. After glacial melt crustal rebound occurred, what we know as Great Bay today was formed. The seacoast region of New Hampshire rebounded approximately 200 feet after the loss of the glacial overcover. However, the uplift was not uniform throughout the region and Great and Little Bays represent a sag in the surface (Novotny 1969). The low-lying area was filled by rising sea level from glacial melting.

F. Habitats[1]

The Great Bay Reserve contains a diversity of habitats from the estuary to the uplands. The diversity of habitat is crucial to numerous species. The Reserve plays a critical role in the preservation of this diverse landscape and in the public's education. Towards those ends, the Reserve staff continually seeks to enhance its understanding of the Great Bay's natural communities. For example, the Reserve staff is a participating partner in a statewide Biodiversity Project, organized by NH Audubon (see Chapter VI, Resource Protection).

[1] All habitat descriptions are taken from Short, Sale, and Guy (1992).

Eelgrass Habitat

Eelgrass beds provide the largest spatial habitat distribution within Great Bay. They are characterized by the presence of the rooted marine angiosperm, eelgrass (*Zostera marina),* which is found extensively on muddy and sandy bottoms throughout shallow portions of the Bay. Eelgrass habitats have been shown to function as breeding areas and nursery grounds for the reproduction of finfish and invertebrates (Thayer *et al*. 1984). The beds are important for several reasons:

- Serve as a substrate for other plant and animal life;
- Consumed directly as food by grazing animals;
- Offer protection and security to other marine animals;
- Cycle nutrients in subtidal coastal waters;
- Entrap sediments and dissolved nutrients flowing across the community;
- Important contributor to ecosystem functions and life cycles of other estuarine organisms; and
- Used as an indicator of estuarine health.

Mudflat Habitat

The second most extensive habitat within Great Bay is the unvegetated intertidal mudflat. Higher vascular plants are absent from this community dominated by benthic microalgae (including diatoms). Microalgae are the primary producers and are important overall contributors to total estuarine system productivity for this low relief environment. The high densities of worms and bivalves often found in these mudflats are major attractants for predators such as crabs, birds, and fish as well as habitat for horseshoe crabs (*Limulus polyphemis*) and mudsnails (*Ilyanassa obsoleta*).

Salt Marsh Habitat

High and low salt marshes are a productive part of the estuarine environment and form the third most abundant habitat type within Great Bay. Historically viewed as wasteland, salt marshes are now valued as an important resource that provides wildlife habitat, protects the coastal zone from floods, and absorbs pollutants before they run into the Bay. Both high and low communities occur in areas protected from high-energy wave actions.

The low marsh mainly consists of cordgrass *(Spartina alterniflora)*, often exclusively. This community is influenced by semi-diurnal tides, and borders various intertidal communities. The upper edge of the low salt marsh is generally established at mean diurnal high water.

Most areas of high salt marsh are flooded irregularly, only during spring tides and characterized by higher species richness than a low salt marsh. They are generally dominated by saltmeadow cordgrass (*Spartina patens*), saltmeadow rush (*Juncus gerardii*) and saltgrass (*Distichlis spicata*). Salt marsh soils include Sulfihemists over sand, silt, or bedrock. The salinity in these marshes exceeds ten parts per thousand (ppt). Other high salt marshes along tidal rivers are classified as Sulfaquents with low surface salinity content of less than ten ppt.

The Great Bay's salt marshes, typical of New England, provide habitat for juvenile fish, feeding areas for birds, homes for numerous insect species, and a large supply of organic detritus that fluxes into the estuary annually (Teal and Teal 1962). Terrestrial mammals, such as deer, mink, otter and raccoon also utilize the salt marshes. The largest concentration of salt marshes is found along the Squamscott River. The Squamscott corridor is one of the priority areas for land protection.

Channel Bottom and Subtidal Habitat
The fourth major habitat type is the channel bottom /subtidal habitat. The substrata varies from soft mud to hard sand to gravelly cobble and rock. Several fish species utilize these habitats as adults. Oyster beds are also found in the shallow channel bottom and subtidal habitats.

Rocky Intertidal Habitat
The fifth major habitat is the intertidal hard rocky bottom, which occurs sporadically around the Bay fringing the shoreline and covering some extensive outcrops. The rocky shore is dominated by two macroalgal species, knotted wrack (*Ascophyllum nodosum*) and bladder wrack (*Fucus vesiculosus*). A major contribution of these seaweeds to the estuary is the release of algal reproductive structures and fragmented tissue into the estuarine detrital cycle (Josselyn and Mathieson 1978). These areas are important habitat for various crustaceans such as amphipods, isopods and green crabs, as well as predatory fish, wading birds and mudsnails. Plants found at the upland border include sea rocket (*Cakile edentula*), coastblite (*Chenopodium rubrum*), and knotweeds (*Polygonum spp*.).

Upland Forests and Fields
Surrounding portions of the Bay are acres of upland fields and forests. Communities of mesic central hardwood forests are found only feet from salt marshes leading to the Bay. These forested areas are shelter for many of the species that come to the estuary to feed. Commonly seen on the banks of Great Bay are white-tailed deer, raccoons, cottontail rabbit, red fox, woodchuck, and squirrels. Other portions of the uplands, within the Reserve boundary, are working farmlands. These areas provide open grassland habitat for ground nesting birds.

G. Cultural History

First Inhabitants
There is evidence of the rich cultural existence of Native Americans in the Great Bay estuary region. Archaeological digs at the Great Bay Discovery Center site unearthed numerous artifacts of American Indian occupations. The estuary's abundant natural resources including shellfish, finfish, waterfowl and crops, attracted Paleo-Indians to the Bay 4000 – 6000 years ago. Evidence of the Paleo-Indian stay includes an adze tool discovered from that period at Sandy Point. Shell middens at Adams Point confirm the presence of a base camp between 650 and 800 AD. Abenaki Indians of the Msquamskek tribe occupied the area during European colonization in the early 1600's (Short and Webster 1992).

The Piscataqua Gundalow
The extensive estuary with miles of navigable waterways made transportation by vessel easier than by wagons over roads. The early European settlers invented the Gundalow, a sailing barge. From the 1650's to the early 1900's Gundalows sailed the waters from miles up the rivers through the Bay and down the Piscataqua River to the Atlantic Ocean at Portsmouth. Being flat-bottomed, Gundalows could travel up almost any shallow river tributary with as little as four feet of water, a depth impassable to ships. Gundalows, unique to the estuarine system, carried many important goods such as cordwood, fish, salt marsh hay, and bricks made of Great Bay blue clay (Adams 1976, Short and Webster 1992).

Local Industries
Adams Point was the site of a popular resort during the 1800's. It was also home to a shipyard and farm. Throughout the upland areas are signs of the white pines that served as masts for the King's

ships. The watershed of Great Bay was clear-cut for wood to fire the brick kilns and for ship building. At its peak in the late 1800's, there were at least 43 brickyards producing bricks used in the construction of mills, factories, and breweries (Sparhawk 1983, Short and Webster 1992).

Lumber was another important natural resource harvested from the shores of the estuary. The water-powered sawmills were located on the waterways, which facilitated easy export. The timber industry was profitable as the lumber was used locally and exported. There was a downside; sawdust from the dozens of sawmills covered the Bay. Industrial mills and tanneries on the rivers of the estuary also contributed significant amounts of chemical pollution (Short and Webster 1992).

Salt Marsh Hay Farming

At the end of the 19th century, salt marsh farming was common in the Great Bay region. Salt hay was used for horse and cattle feed, thatch roofs, animal bedding, and mulch for local crops as well as for export. The hay was cut each fall, raked and stacked on to staddle posts, which served to keep it high and dry. The staddle posts held the hay throughout the winter and the hay was then transported by horses or Gundalows when needed. There are many salt marsh farming tools including scythes, staddle posts, and bog shoes worn by the horses currently on display at the Great Bay Discovery Center.

Modern Uses

When Greek entrepreneur Aristotle Onassis proposed building the Olympic Oil Refinery in the town of Durham along the shore of Great Bay in 1973, local citizens mobilized, and by exercising their right to "home rule," defeated the proposal by a margin of more than nine to one. This momentum fueled the grassroots petition to State and federal governments to designate Great Bay into the National Estuarine Research Reserve System in 1989. The grassroots activism demonstrated in the early 70's has continued through the 1980's to the present day. It is evidenced in many ways including the strong level of volunteerism enjoyed by the Great Bay Reserve and other conservation organizations in the seacoast region.

The sum of human impacts on the estuary can be viewed as both gains and losses over the years. Today local communities are no longer dependent on the estuary for economic survival. The dominant use of the estuarine waters today is mainly recreational. However, the health of the estuary and its recreational and commercial uses (such as lobstering) does translate into economic gains. The seacoast of New Hampshire enjoys a strong tourist economy, and businesses and communities cite the health and beauty of the environment as a significant factor in the high quality of life enjoyed in the seacoast (Jones 2000). Today, the estuary is healthier than it has been for over 250 years.

H. Environmental Impacts

The Great Bay has been under tremendous development pressure for the past two decades, which has impacted the Bay in several ways (see Chapter VI, Resource Protection). Development of land for residential and commercial purposes has contributed to the increased non-point and point source pollution. An example of the impacts of such development can be seen in the studies conducted on eelgrass (Jones *et al*. 1992, Jones 2000). Eelgrass habitat in the Bay has been affected by pollution; decreased water clarity from pollution reduces the amount of light reaching the eelgrass and reduces plant growth (New Hampshire Estuaries Project 2006). However, over the past two decades, new and upgraded sewage treatment plants have lessened the level of bacterial and nutrient pollution in the estuary (Jones *et al*. 1992).

Another development example is the industrialized uses along the shore of the lower estuary along the Piscataqua River where strides have been made in controlling point source pollution. Oil storage facilities and power plants plus an expanded port pose significant concerns about the health of the estuary. However, the State is actively involved in developing contingency plans in the event of a major oil spill catastrophe. The New Hampshire Fish and Game Department (NHFGD) has played an active role in the development of these plans as well as identifying critical habitat areas for protection from spills (see Chapter VI, Resource Protection).

Increased development has also raised concerns over the loss of existing as well as future opportunities for both water and land public access. Another source of concern is attributed to the increased demand for motorboat moorings in the estuary as motorboats are considered a potential pollution source (Jones 2000).

I. Facilities

The Reserve operates several facilities to support its mission. The Manager and Research Coordinator are based out of NHFGD's Marine Fisheries Division (MFD) in Durham, which includes a large conference room for meetings (capacity of 60). Also in Durham, the Reserve maintains a storage barn primarily used to house research gear and boats during the winter months. The MFD shares usage of this facility with the Reserve.

The Great Bay Discovery Center serves as the Reserve's visitor's center. The Center is located at Sandy Point in Stratham and includes an exhibit hall, a reception area, store, conference room, and offices for the education and stewardship staff. Also located at Sandy Point is the Depot House and Hugh Gregg Coastal Conservation Center. The Depot House serves as the residence for a caretaker and provides additional meeting and storage space. The Hugh Gregg Center, slated to open in 2006, will provide a large meeting area (capacity of 225), a kitchen, exhibit space, and research lab (see Chapter VIII, Facilities and Construction Plan).

J. Recreation

Residents and visitors are drawn to the Bay for its aesthetic and recreational value. The Great Bay estuary provides a variety of activities for the public including nature walking, boating, fishing and bird watching. Public access maps are available through the New Hampshire Coastal Program (NHCP) to assist the public in locating areas for various activities (see Chapter XI, Public Access). The Reserve is also committed to provide for appropriate increased public access on newly acquired lands.

Great Bay Access

Conservation and protection of New Hampshire's coastal resources continues to be a high priority for the State. NHFGD is charged with providing adequate and reasonable public access to the State's waters. In an effort to serve the recreation needs of New Hampshire residents, NHFGD owns several public access sites and is continually seeking to acquire new parcels, or to enhance existing facilities.

Existing Facilities include:

- *Chapman's Landing, Stratham* - This facility is designed to accommodate trailered boats and provides all tide access to Great Bay for fishing, waterfowl hunting and recreational boating via the Squamscott River.

- *Adams Point, Durham* – Trailored boat launching is limited at this site to mid to high tide only. This boat launch is frequently used by hunters, anglers and for oystering.
- *Depot Road, Stratham* – Primarily accessible at high tide for car-top boaters and waterfowl hunters, it is a popular launching area for kayaks and canoes.
- *Lamprey River, Newmarket* – Publicly accessible for ice-fishing and car-top as well as trailered boats.

Public Use

Recreational activities within the Great Bay estuary are extensive and diverse, including boating, fishing, birding, walking/hiking, and hunting.

Boating activities include sailing, fishing, motorboats, water-skiing, rowing, kayaking and canoeing. There are several access points, noted above, that accommodate both motorboats and car-top vessels (Short and Webster 1992).

Fishing is done from boats, bridges, or the shore. Finfishing is popular for striped bass, bluefish, eels, tomcod, shad, smelt, river herring, and flounder. Ice fishing is accessible from bob-houses on Great Bay and the Squamscott, Lamprey and Oyster rivers. Shellfishing for soft-shell clams and oysters has always been popular on the Bay (Short and Webster 1992). Although some beds have been closed due to contamination or designated safety zones, NHFGD has supported efforts to open more shellfish beds for recreation. The NH Estuaries Project under the Environmental Protection Agency (EPA) has made the reopening of shellfish beds a top priority by improving water quality.

Hunting, especially for waterfowl, is a traditional use in the Great Bay region. Public lands owned and managed by NHFGD are typically open to hunting. Enjoying winter waterfowl on the bay is a popular recreational activity both for waterfowl hunters and waterfowl watchers. Birdwatching is done at all sites (Short and Webster 1992). In the Town of Stratham, viewing sites have been improved to view osprey platforms located on protected lands at the mouth of the Squamscott River and the Great Bay Discovery Center.

K. Conclusion

The Great Bay estuary is one the nation's most important ecosystems. With its rich cultural history and diverse estuarine habitats, it provides an ideal setting for conducting long-term research and monitoring activities as well as educational programs. The Reserve's management plan has been designed to take advantage of these unique features.

Chapter III
Great Bay National Estuarine Research Reserve
Mission, Goals and Objectives

A. Introduction

Provided below are the missions, goals and objectives that have been developed for each chapter of the Management Plan. The action items to be accomplished are designed within certain timeframes as follows:

Short-Term:	1 to 2 years
Mid-Term:	2 to 3 years
Long-Term:	3 to 4 years
Ongoing:	Throughout the Management Plan time period

These are internal action items to be accomplished by staff members. The long-term goal is to use these actions to develop performance indicators that can be measured over time. The Estuarine Reserve Division (ERD) is working with NERRS to develop performance measures that meet this standard. As they become available, the Reserve will include these as part of program evaluation.

B. NERRS Mission, Goals, and Objectives and Performance Measures

National Estuarine Research Reserve System Mission Statement

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.

National Estuarine Research Reserve System Goals

(federal regulations, 15 C.F.R. sec. 921.1 (b))

Goal 1: Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;

Goal 2: Address coastal management issues identified as significant through coordinated estuarine research within the System;

Goal 3: Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;

Goal 4: Promote federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and

Goal 5: Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

Great Bay National Estuarine Research Reserve: Mission, Goals and Objectives

Mission of the Great Bay National Estuarine Research Reserve

The mission of the Great Bay Estuarine Research Reserve is to promote informed management of the Great Bay estuary and estuarine habitats through linked programs of stewardship, public education, and scientific understanding.

Goals and Objectives

Provided below are mission statements, goals and objectives for the Great Bay National Estuarine Research Reserve for each of the Management Plan chapters: Administration, Research and Monitoring, Resource Protection, Stewardship, Facilities and Construction, Education, Volunteer, Public Access, Boundary and Acquisition. Each chapter also includes action items to achieve the stated objectives.

Chapter IV Administration

Goal

Provide administrative leadership and resources necessary to fulfill the Reserve's mission as established in state and federal law, administrative rules and inter-agency agreements.

Objective 1: Staffing

Develop staff assessment tools and strategies for increasing staff effectiveness and efficiency.

Objective 2: Federal Relationship

Strengthen the existing partnership between the Reserve, NHFGD, State of New Hampshire and NOAA.

Chapter V Research and Monitoring

Goal

Improve the health of the Great Bay estuary and the watershed by conducting research and monitoring activities and providing information that promotes informed resource management.

Objective 1: Research and Monitoring Information Database

Develop a fundamental research and monitoring database to secure the necessary technology and resources to manage the information.

Objective 2: Monitoring Physical, Chemical and Biological Processes

Monitor physical, chemical and biological processes that either impact or reflect the health of estuarine ecosystems.

Objective 3: Habitat Classification and Land Use Database

Develop a database on major patterns of habitat classification and land uses within the Great Bay Reserve watersheds.

Objective 4: Accessing and Analyzing Ecological Features

Access and analyze two fundamental ecological features of GBNERR:
(1) Basic community structure in major habitat types (e.g., uplands, emergent wetlands, benthos); and
(2) Population trends of important "target species," including those of commercial, recreational, or conservation significance.

Objective 5: Restoration of Impacted Habitats

Collaborate, assist in and facilitate the restoration of impacted habitats in Great Bay.

Objective 6: Communication of Research and Monitoring Information

Communicate research and monitoring information, including potential funding sources, to resource managers, scientists, educators and the public.

Chapter VI Resource Protection

Goal

Provide for the long-term conservation and protection of the biodiversity of the Great Bay estuary and associated habitats.

Objective 1:

Support wetland restoration and management activities in the Great Bay estuary that promote biodiversity and conservation of critical habitats.

Objective 2:

Develop invasive species monitoring and control strategies.

Objective 3:

Develop and support activities that monitor, restore and protect identified species of concern.

Objective 4:

Actively participate in and support efforts to promote land conservation and land use regulations that are consistent with the Reserve's goals and policies.

Objective 5:

Promote the monitoring and improvement of water quality throughout the Great Bay estuary.

Chapter VII Stewardship

Goal

Maintain the ecological integrity of the Great Bay region by using a comprehensive stewardship approach to education, land acquisition, land management, and research and monitoring.

Objective 1: Stewardship Monitoring Programs

Expand the land monitoring program and increase opportunities for volunteers to participate in these efforts.

Objective 2: Property Management Plans

Develop and implement individual property management plans for the Reserve's protected properties based on a priority system developed by the Lands Committee and Marine Fisheries Division.

Objective 3: Restoration Projects

Assess, identify and implement restoration projects on lands owned by NHFGD that are within the Reserve boundary.

Chapter VIII: Facilities and Construction

Goal

Enhance the mission of the Reserve and its associated research, education, and stewardship programs through the maintenance and development of facilities necessary to support these efforts.

Objective 1: Program and Exhibit Space

Increase the amount of program and exhibit space with a special emphasis on providing additional meeting and classroom areas.

Objective 2: Trail and Public Access

Provide appropriate increased trail and public access on properties added to the Reserve through the land acquisition efforts of the Great Bay Partnership.

Objective 3: Maintenance of Reserve Facilities

Develop a comprehensive facilities and maintenance plan for the next five years to meet the future needs of the Reserve.

Chapter IX: Education

Goal

Design and implement a comprehensive program of education, outreach and interpretation based on solid scientific principles that strengthen

understanding, appreciation and stewardship of estuaries, coastal habitats, and associated wetlands throughout the Great Bay watershed.

Objective 1: Public Awareness

Increase the awareness and understanding of the value of the Great Bay estuary and estuarine systems by the public living in the Great Bay watershed.

Objective 2: Clearinghouse for Information

Serve as a clearinghouse for information about estuarine, coastal and Reserve management issues through the use of professional and accurate publications.

Objective 3: Educational Facilities

Develop and maintain educational facilities consistent with national guidelines for sustainable design and conservation planning.

Objective 4: Coastal Decision Makers

Develop and implement effective programs for coastal decision makers and other coastal partners about resource management issues that affect the sustainability of our estuaries and watersheds.

Objective 5: Program Evaluation

Continue to evaluate the effectiveness of Reserve sponsored programs on an ongoing basis.

Chapter X: Public Involvement and Volunteerism

Goal

Continue hosting and participating in activities that encourage residents within the Great Bay watershed to understand and support the Reserve's mission.

Objective 1: Recruit and Train Volunteers

Actively recruit and train volunteers to assist with conducting education programs and the operation of the facility.

Objective 2: Partnerships

Maintain active relationships and partnerships with public agencies and other organizations involved in conservation activities in the Great Bay area.

Chapter XI: Public Access

Goal

Provide appropriate public access to the Reserve's protected lands and waters, while protecting the inherent natural resource values of these lands and waters.

Objective 1: Land Access Points

Provide for appropriate access to Reserve properties that supports traditional recreational activities.

Objective 2: Public Awareness

Develop access points for appropriate water-based activities at key locations throughout the Reserve.

Objective 3: Public Outreach

Develop a wide range of outlets for distributing information about public access opportunities within the Reserve.

Chapter XII Boundary and Acquisition

Goal

Protect the critical estuarine resources and associated uplands of the Great Bay estuary while working in partnership with other agencies and organizations to provide for the long-term conservation of properties within the proposed 2005 Reserve boundary.

Objective 1: Land Protection

Protect the physical and biological integrity of the Great Bay estuary by recognizing that the watershed functions as a component of the ecosystem.

Objective 2: Identify Future Project Areas

Identify additional project areas for land acquisition.

Objective 3: Cultural Resources

Identify important cultural resources and develop a priority list for protection as these relate to ongoing land acquisition efforts.

Objective 4: Ecosystem Management

Manage Reserve properties from a watershed perspective that is designed to maintain and enhance the integrity of the ecological system.

Objective 5: Public Awareness

Raise public awareness and understanding of the natural attributes of the Great Bay estuary by emphasizing the interconnectedness of the ecosystem.

Chapter IV
Administration

A. Introduction

The administrative responsibility of the Reserve is through the New Hampshire Fish and Game Department (NHFGD). The program is part of the Marine Fisheries Division, which is based in Durham, NH. When the Reserve began in 1989, there were no dedicated staff members. The Office of State Planning handled all of the land acquisitions and development of facilities until 1995 when this role was transferred to NHFGD. The first fulltime employee (Manager) was hired in June 1990.

Today there are six full-time positions and three part-time positions. The Reserve has met all of its projected staff and financial needs. Based on an increase in federal funding, the number of staff members has increased as well as their status from part-time or contractual to fulltime with benefits as shown in Section D.

There have been few changes in the administrative set-up since 1995 when NHFGD assumed full authority for the program. NHFGD is actively involved with fish and wildlife management, threatened and endangered species, and protecting and managing unique areas. The Reserve also works closely with the NH Coastal Program (NHCP) and the New Hampshire Estuaries Project (NHEP), as well as many other partners, such as the University of New Hampshire (UNH) and the NH Department of Environmental Services (NHDES), to meet its goals and objectives. As federal funds continue to increase, there is a continued need to identify additional sources of match.

B. GBNERR Administration

Administration Goal

Provide administrative leadership and resources necessary to fulfill the Reserve's mission as established in State and federal law, administrative rules and inter-agency agreements.

1. Relationship to Federal Government

Coastal Zone Management Act

The federal authority that governs the NERR System is part of the CZMA. Section 313 of the act created the Reserve System. The CZMA has been re-authorized several times, the latest being the addition of the Coastal Protection Act of 1996. Further information on CZMA can be found at http://www.ocrm.nos.noaa.gov/czm/czm_act.html).

The State of New Hampshire also has a federally approved coastal management program. The New Hampshire Coastal Program (NHCP) has reviewed this Management Plan, and a certification that GBNERR is consistent with the State's program to the maximum extent practicable is on file with NHFGD. For more information, see C.F.R. sections 921.4(b) and 921.30(b).

Federal Agency Relationship

The Reserves are managed through the Estuarine Reserves Division (ERD) under the Office of Ocean and Coastal Resource Management (OCRM) within the National Ocean Service (NOS).

The Reserve receives all of its federal funding from ERD, which also serves the following functions:

1. Allocates and oversees the expenditure of all federal grants to be used for research, education, stewardship, operations, land acquisition and facilities development as they pertain to the Great Bay Reserve.

2. Coordinates and provides guidance in the development of policy and national programs that impact the entire Reserve System.

3. Works with OCRM to periodically evaluate the Great Bay Reserve operations as required by federal law (16 U.S.C. sec. 1461(f)) to ensure compliance with federal regulations and adherence with the approved management plan. The OCRM Evaluation Unit conducts 312 evaluations generally every three to four years. To date, the Reserve program has been evaluated four times since designation (1993, 1997, 2001 and 2005).

2. Relationship to State Agency

New Hampshire Fish and Game Department

The NH Fish and Game Department was established in 1865, in accordance with State law R.L 240:1 (RSA 206:1). As guardians of New Hampshire's fish, wildlife, and marine resources, the agency works in partnership with the public to:

- Conserve, manage, and protect these resources and their habitats.
- Inform and educate the public about these resources.
- Provide the public with opportunities to use and appreciate these resources.

The Reserve is managed through the NHFGD, Marine Fisheries Division. The Reserve Manager reports to the Chief of Marine Fisheries, who is responsible for all Fish and Game activities in the region. Reserve programs are designed to meet the Department's mission while complying with federal regulations.

The growth of the Reserve has placed an increased emphasis on the need to sustain a close working relationship with the NHFGD staff. NHFGD provides many in-kind and other critical services for the Reserve, especially in the area of general operations, law enforcement, and land acquisition and management as listed below:

- All Reserve staff are employees of NHFGD and eligible for State benefits as well as being covered by State personnel rules and regulations (through a collective bargaining agreement); salaries and benefits are matched by the Department at a 70/30 ratio (federal/State).

- The Department provides payroll, business and office support services to the Reserve, including computer technical services such as GIS.

- A Federal Aid Coordinator for the Department handles all NOAA grant awards and insures compliance with federal reporting requirements.

- The Research Coordinator and Reserve Manager have offices at NHFGD in Durham, NH, which also includes conference and meeting space.

- The Reserve staff works closely with the marine and wildlife biologists and the non-game program staff for programs and as information resources.

- The Stewardship Coordinator works in conjunction with the Lands Team and other staff on acquisition and land management issues.

- NHFGD provides two vehicles for Reserve use, a truck and a passenger van.

- The Conservation Officers enforce wildlife rules and regulations around Great Bay while patrolling lands within the Reserve boundary.

- The Public Affairs division serves to design and create publications and other media materials (including audio-visual) on Reserve programs.

3. Relationship to State and Local Agencies

NHDES is the primary environmental regulation agency for non-wildlife issues in the State. The Reserve works closely with NHDES in issues involving enforcement of key regulations affecting the estuary (see Chapter VI, Resource Protection). Water quality monitoring data from the Reserve's System-Wide Monitoring Program (SWMP) are used to help evaluate the State's compliance in meeting federal water quality standards. NHDES is also responsible for overseeing the NHCP.

The Reserve and NHCP share a number of common resource management objectives and the staffs of each organization meet annually to improve communication and coordination. NHCP is currently developing a Land Conservation Plan for NH's coastal estuaries under the Coastal and Estuarine Land Conservation Program (CELCP). This document will help guide the Reserve's land acquisition program through the Great Bay Resource Protection Partnership. NHCP is also involved in dam removal and other restoration projects that benefit the Reserve.

NHEP is another key partner that works closely with the Reserve. Currently under NHDES, it will move to UNH in 2006. With a focus on water quality, NHEP is involved in a number of management issues that support water quality monitoring and the reduction of non-point source pollution. While NHEP is focused on all of the State's estuaries, a great deal of its work occurs in the Great Bay watershed.

There are several local agencies that partner with the Reserve in sponsoring programs. The local Regional Planning Commission has been involved with the Reserve's coastal decision maker workshops. The only formal agreement is with the Rockingham County Conservation District in Exeter. They monitor a conservation easement along the Squamscott River that was protected through the State's Land and Community Heritage Investment Program (LCHIP).

4. Relationship to University of New Hampshire

UNH has been a partner in the development of the Reserve program. The Jackson Estuarine Lab (JEL) was constructed in 1970 on Adams Point overlooking Furber Strait (the connection between

Great Bay and Little Bay). Adams Point is managed by the Fish and Game Department and is located within the Reserve boundary. UNH also maintains a coastal lab in New Castle in Portsmouth Harbor. The University's involvement with the Reserve includes:

- The Marine Program, in conjunction with JEL, is responsible for the Reserve's water quality monitoring program (SWMP I). Funding for these activities is provided directly to UNH for this program. This includes funds for a SWMP technician and assistant (hired through UNH). Reserve staff (Manager and Research Coordinator) meets quarterly with UNH staff involved in this project. The Marine Program also coordinates other water quality programs in the estuary that provide valuable data to the Reserve.

- The Reserve is working closely with UNH and JEL scientists to develop a biological monitoring program (SWMP II).

- A number of key UNH faculty and staff serve on the Reserve's Research Advisory Board.

- UNH operates the Cooperative Institute for Coastal and Estuarine Environmental Technologies (CICEET), a NOAA funded program that provides substantial research dollars for projects within the Great Bay estuary. Great Bay serves as the host site for CICEET.

- UNH houses the Joint Hydrographic Center that is involved in mapping the entire bottom of the estuary.

- UNH is also home to the Sea Grant Program that serves coastal New Hampshire.

5. Relationship to Sea Grant

The UNH Sea Grant Program has been a vital partner in the educational activities of the Reserve. The Reserve works closely with Sea Grant staff to coordinate programs of mutual interest. Sea Grant sponsors the following programs:

- The Great Bay Coast Watch is a monitoring program that utilizes volunteers to test the water quality at shoreline locations throughout the estuary. The Watch also conducts shoreline surveys to look for pollution sources.

- Sea Grant manages the Marine Docent Program that provides trained volunteer educators. Many of these volunteers work out of the Great Bay Discovery Center.

- Sea Grant also sponsors a number of research projects throughout the estuary and helps to evaluate research projects supported by the Reserve.

6. Relationship to Cooperative Extension

The Cooperative Extension is a key member of the Natural Resource Outreach Coalition (NROC). The Reserve is a founding member of NROC, which is involved in assisting communities with a variety of coastal issues and supplements the Reserve's Coastal Training Program (CTP). The Cooperative Extension also has a representative on the Reserve's CTP advisory board (see Chapter IX, Education).

7. Support Organizations

Great Bay Stewards

In 1995, the Great Bay Stewards was formed to provide support for the Reserve and the Great Bay Discovery Center. The mission of the Stewards is the long-term protection and conservation of the Great Bay estuarine system by supporting education, land protection, research and the stewardship of Great Bay. This includes providing ongoing financial support for the design and production of the Reserve's newsletter, *Great Bay Matters*. The Stewards sponsor several annual events, including the Great Bay 5K road race that helps to raise funds in support of the programs at the Discovery Center.

More recently, the Stewards have expanded their outreach to the community and plan to offer scholarships to local high school and college students, and to participate in the NH Department of Transportation's (NHDOT) Adopt-a-Highway program.

C. GBNERR Internal Evaluation

The Reserve has developed numerous instruments for evaluating Reserve programs as follows:

Teacher Evaluations: Teachers who utilize the school programs at the Great Bay Discovery Center are asked to complete an evaluation form to determine the effectiveness of the Reserve's programs. Questions are both program broad and activity specific. The response rate is excellent with typically ninety-five percent (95%) of the teachers responding. At the close of each season, the Education Coordinator compiles all of the responses and the education staff looks for useful information to enhance the next season's programs.

Adult Education Evaluations: Adult programs include a written evaluation form. The responses have been used to determine future topics for the Center's adult clientele.

Center Visitor Evaluations: Visitors to the Great Bay Discovery Center are encouraged to provide written comments and suggestions. An example of a community feedback that resulted in a new program is the development of the Reserve's "Bay Views" program, an open forum for coastal decision makers.

Volunteers: The Reserve's volunteers are asked to complete a written evaluation of their volunteer program, the effectiveness of the training sessions, and to assess the Reserve program's strengths and weaknesses at the close of each season. The information, accompanied by on-going verbal communication, is utilized to strengthen the Reserve's programs. Having a part-time Volunteer Coordinator has enabled the Reserve to maximize the productivity of the staff at the Discovery Center (see Chapter X, Public Involvement and Volunteerism).

Needs Assessment

The design of the Reserve's Coastal Training Program (CTP) involves integrating evaluation into each workshop, program or activity. Emphasis is placed on meeting the needs of the coastal decision makers, and ensuring efficient and effective information dissemination.

Using federal funding from NOAA, the Reserve commissioned a report in 1997 to determine target audiences and needs assessment. The project was designed to evaluate target audiences and assess

their information needs. A goal of the project was to determine what information would be useful to municipalities and the best methods of delivering the information. This document provided the foundation for developing a more complete needs assessment under the national guidelines for establishing CTP.

D. Existing Staff

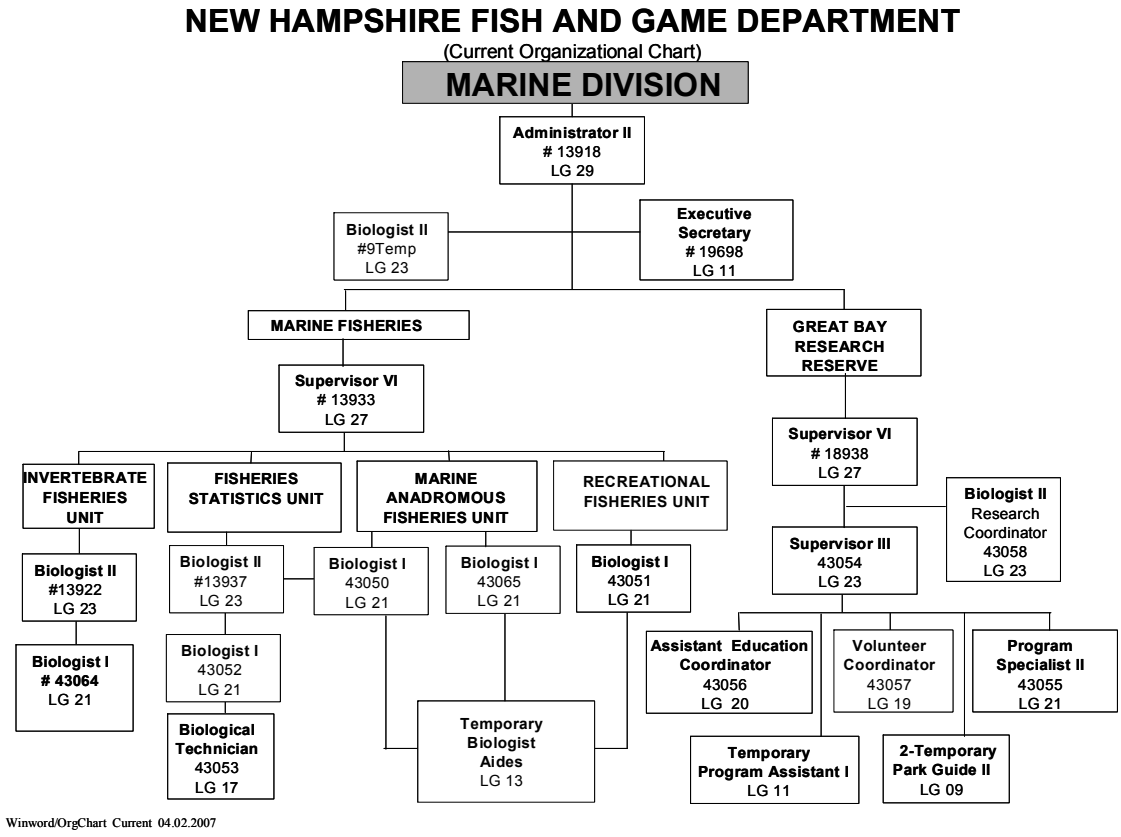
- Reserve Manager (Mgr.) — Fulltime with benefits
- Education Coordinator (EC) — Fulltime with benefits
- Research Coordinator (RC) — Fulltime with benefits
- Stewardship Coordinator (SC) — Fulltime with benefits
- Coastal Training Program Coordinator (CTP) — Fulltime with benefits
- Assistant Education Coordinator (AEC) — Fulltime with benefits
- Volunteer Coordinator (VC) — Part-time with no benefits
- Seasonal Park Guide (1) (PG) — Part-time with partial benefits
- Seasonal Park Guide (2) (PG) — Part-time with partial benefits

Functions	RESERVE STAFF								PARTNERS		
	Mgr.	EC	RC	SC	CTP	AEC	VC	PG	GBS	Advisory Board	Misc
Administration	X	X								X	
Education	X	X	X	X	X	X	X	X	X		X
Research & monitoring	X		X	X	X						X
Stewardship	X	X	X	X	X				X		
CDMW	X	X			X						X
CTP	X	X	X		X						X
Volunteer coordination		X	X	X	X	X	X	X	X		
Communications	X	X	X	X	X	X	X		X	X	
Enforcement	X	X		X							
Facility maintenance	X	X			X	X	X	X	X		

GBS – Great Bay Stewards
Misc. – Includes New Hampshire Coastal Program, New Hampshire Estuaries Project, New Hampshire Department of Environmental Services, and the University of New Hampshire (conducts SWMP under separate grant award).

Marine Fisheries Division staff assists with a number of Reserve projects. The Marine Fisheries Chief provides administrative support and marine biologists are involved in numerous research projects in the estuary. Current species that are being studied include lobsters, rainbow smelt, oysters, and horseshoe crabs (see **Figure 4.1** for an organizational chart of Marine Fisheries and Reserve staff).

Figure 4.1


NEW HAMPSHIRE FISH AND GAME DEPARTMENT
(Current Organizational Chart)
MARINE DIVISION
Administrator II
13918
LG 29
Biologist II
#9Temp
LG 23
Executive Secretary
19698
LG 11
MARINE FISHERIES
GREAT BAY RESEARCH RESERVE
Supervisor VI
13933
LG 27
Supervisor VI
18938
LG 27
INVERTEBRATE FISHERIES UNIT
FISHERIES STATISTICS UNIT
MARINE ANADROMOUS FISHERIES UNIT
RECREATIONAL FISHERIES UNIT
Biologist II
Research Coordinator
43058
LG 23
Supervisor III
43054
LG 23
Biologist II
#13922
LG 23
Biologist II
#13937
LG 23
Biologist I
43050
LG 21
Biologist I
43065
LG 21
Biologist I
43051
LG 21
Assistant Education Coordinator
43056
LG 20
Volunteer Coordinator
43057
LG 19
Program Specialist II
43055
LG 21
Biologist I
43064
LG 21
Biologist I
43052
LG 21
Biological Technician
43053
LG 17
Temporary Biologist Aides
LG 13
Temporary Program Assistant I
LG 11
2-Temporary Park Guide II
LG 09
Winword/OrgChart Current 04.02.2007

E. Administration Objectives and Action Items

Objective 1: Staffing

Develop staff assessment tools and strategies for increasing staff effectiveness and efficiency.

Action Item 1: Increasing Staff Capacity

Action: In order to increase staff capacity, the Reserve will establish a secure source of interns to assist staff with projects including field activities. UNH offers a number of opportunities for interns to support our educational, research, CTP and stewardship efforts. Additional internship and fellowship programs, including those offered through NOAA and other federal agencies, will be utilized as well. Grant funds will also be used to hire temporary staff for specific projects.
Responsible: Staff
Timeframe: Ongoing

Objective 2: State and Federal Relationship

Strengthen the existing partnership between the Reserve, NHFGD, State of New Hampshire and NOAA.

Action Item 1: Program Strategic Plans

Action: Develop strategic plans within the Reserve's program areas that match the federal work plans (e.g. Education Plan in 1999 and CTP in 2000).
Responsible: Manager
Timeframe: Ongoing

Action Item 2: State Support

Action: Work with NHFGD to identify potential sources of State matching funds, i.e. conservation decals for non-motorized boats, saltwater fishing license, etc.
Responsible: Manager
Timeframe: Ongoing

Chapter V
Research and Monitoring Plan

A. Introduction

Research and monitoring activities in the Great Bay National Estuarine Research Reserve (GBNERR) are based on the National Estuarine Research Reserve System's (NERRS) intent to develop and provide information that promotes informed resource management. Projects in the Great Bay estuary are being carried out by multiple and diverse interests including academic institutions, state and federal agencies, and consultants engaged in stand alone as well as collaborative projects.

The body of research and monitoring information related to the Great Bay estuary has been greatly enhanced by its proximity to the University of New Hampshire (UNH) in Durham. Individual projects are supported and conducted by scientists affiliated with UNH research programs such as the Jackson Estuarine Laboratory (JEL), the Cooperative Institute for Coastal and Estuarine Environmental Technologies (CICEET), the Joint Hydrographic Unit (JHU), and the Institute for the Study of Earth, Oceans and Space (EOS).

Strong partnerships have also been formed between academia and State agencies such as the New Hampshire Department of Environmental Services (NHDES) and GBNERR's parent agency, the New Hampshire Fish and Game Department (NHFGD). Key offices within NHDES act to shape research and monitoring projects, i.e. the New Hampshire Coastal Program (NHCP) and the New Hampshire Estuaries Project (NHEP). Coordination between UNH scientists and State agencies ensures that research done in and around Great Bay ultimately meets the needs of the resource management community.

The 1989 Management Plan specified eight objectives as well as three more general priorities for conducting research within the Reserve (NH Office of State Planning 1989). All of the objectives have been met over the past fifteen years. Priority one was the synthesis of existing baseline data. The research and monitoring efforts carried out in Great Bay have resulted in a body of knowledge of the physiochemical characteristics of the estuary, its bathymetry and hydrodynamic properties, the state of biological communities, as well as trends in land use patterns in the watershed.

The information is contained in myriad databases, gray literature reports, and peer-reviewed publications. Documents such as GBNERR's The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography (Short 1992a) and NHEP's A Technical Characterization of Estuarine and Coastal New Hampshire (Jones 2000) serve to summarize the existing knowledge. Additionally, much of the information and actual data are available via the internet.

Priority two of the 1989 Management Plan centered on comprehensive monitoring (NH Office of State Planning 1989). Currently, GBNERR conducts water, weather, and biological monitoring following NERRS protocols. Other examples of active monitoring efforts include NHDES's ambient water quality program, Great Bay Coast Watch volunteer water quality monitoring, United States Geological Survey (USGS) gauging stations, and NH Audubon's (NHA) monitoring of wintering eagles. Further, examples of monitoring conducted by NHFGD include rainbow smelt and juvenile finfish abundance, anadromous fish use of passage structures, horseshoe crab populations, and oyster stock density, reproduction and disease.

Priority three in the 1989 Management Plan addressed factors affecting the productivity and diversity of the Great Bay estuary (NH Office of State Planning 1989). While scientists at JEL are examining this topic on multiple fronts, this priority continues to be relevant and requires additional research. Impacts of nutrient loading, sediment transport issues, and invasive species are but a few of the topics requiring additional investigation. Additional funding support from CICEET has increased the opportunities for more research in these areas. UNH and NHEP are also exploring other potential sources of funding for research projects.

The Reserve has worked with NHEP and UNH to develop a synthesis of research needs for the Great Bay estuary (Smith 2004). As part of the NHEP State of the Estuaries conference in 2003, five primary themes emerged that link to specific management issues: data management, analysis, and dissemination; mapping and characterization needs; stressor/response/impact investigations; indicator development and use; and ecosystem level trophic dynamics and community changes. The synthesis document outlines research needs still relevant to the 1989 priorities as well as to future priorities.

The relevant research issues for the Reserve over the next five years center around water quality (especially nitrogen loading), shellfish disease and the decline in oyster populations, populations of key fish species such as rainbow smelt, impacts associated with the potential increase in the number of invasives, and the recent decrease in eelgrass bed densities.

B. NERRS Research Goals and Priorities

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 the Reserve System Research and Monitoring Plan 2006-2011 (NERRS 2006b), which identifies goals, priorities, and implementation strategies. 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.

1. NERRS Research Goals

Research at GBNERR is designed to fulfill the NERRS goals as defined in program regulations (15 C.F.R. sec. 921.50). These include:

Goal 1: Address coastal management issues identified as significant through coordinated estuarine research within the System;

Goal 2: Promote federal, state, public and private use of one or more reserves within the System when such entities conduct estuarine research; and

Goal 3: Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

2. NERRS Research Funding Priorities

Federal regulations, 15 C.F.R. 921.50 (a), specify the purposes for utilizing research funds:

- 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 has identified the following five priority research areas to complement the funding priorities outlined above:

1. Habitat and ecosystem processes
2. Anthropogenic influences on estuaries
3. Habitat restoration and conservation
4. Species management
5. Social science and economics

3. NERRS Research and Monitoring Plan

The Reserve System research goals are embedded in Goal 2 of the Reserve System Strategic Plan 2005-2010 (NERRS 2006a), *Increase the use of Reserve science and sites to address priority coastal management issues*, and are outlined in 2006-2011 Reserve System Research and Monitoring Plan (NERRS 2006b). They include:

- Biological, chemical, physical, and ecological conditions of Reserves are characterized and monitored to describe reference conditions and to quantify change.
- Scientists conduct research at Reserves that is relevant to coastal management needs and increases basic understanding of estuarine processes.
- Scientists have access to NERRS datasets, science products and results.
- The scientific, coastal management and education communities, as well as the general public, use data, product tools, and techniques generated at the NERRS.

Currently, there are two Reserve system-wide efforts to fund estuarine research. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research in the Reserves. The fellowship provides graduate students with funding for one to three years to conduct their research, as well as an opportunity to assist with the research and monitoring efforts 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. Proposals must focus on the following areas:

- 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; and
- Economic, sociological and/or anthropological research applicable to estuarine ecosystem management.

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. Detailed information about the program as well as application information can be found on-line at the following link http://nerrs.noaa.gov/Fellowship/welcome.html.

Secondly, research is funded through CICEET, a partnership program between NOAA and UNH. CICEET uses the capabilities of UNH, the private sector, academic and public research institutions throughout the United States, as well as the 27 Reserves that comprise NERRS, to develop and apply new environmental technologies and techniques.

4. System-Wide Monitoring Program (SWMP)

It is the policy of GBNERR to implement each phase of SWMP initiated by the Estuarine Reserves Division (ERD) and as outlined in the NERRS regulations and strategic plan:

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

Phase II – Site Profile, to include synthesis of data and information; and

Phase III – Implementation of the System-Wide Monitoring Program.

SWMP 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 purpose 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 reference sites. The program also takes a phased approach and focuses on three different ecosystem characteristics as follows:

- **Abiotic Variables**
  The monitoring program, established in 1995, currently measures water quality conditions, including pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, and water level. In addition, the program collects monthly nutrient samples at four stations and monthly diel samples at one station. Nutrient parameters analyzed include orthophosphate, ammonium, nitrite, nitrate, nitrite+nitrate, dissolved inorganic nitrogen, chlorophyll a, phaeopigments, and total suspended solids. Weather conditions, including air temperature, relative humidity, barometric pressure, wind speed, wind direction, total photosynthetically active radiation and precipitation, are monitored at one site on the edge of Great Bay. Each Reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.

- **Biotic Variables**
  The Reserve System is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available. In 2003, the Great Bay NERR piloted a technique to collect larval organisms and evaluated its suitability for adoption as a consistent approach for larval biomonitoring across the

NERRS. Initial NERRS biomonitoring efforts for submerged aquatic and emergent vegetation began in 2004. In 2005, UNH received funding from NERRS to expand the monitoring of eelgrass beds. This work is being done at JEL and builds upon previous efforts to monitor eelgrass beds throughout the estuary. Eelgrass bed characterization for plant density and identifying the threats from wasting disease and sediment loading are the critical issues being studied. These efforts will be done in conjunction with implementation of the Department's SAV Conservation Plan.

- **Watershed and Land Use Classifications**
  This component attempts 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 is to examine the links between watershed land use activities and coastal habitat quality. Land use maps and change analyses for Great Bay have been developed in partnership with the Complex Systems Research Center at UNH and the Coastal Change Analysis Program (CCAP) of the Coastal Services Center.

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.

GBNERR has fully implemented the first phase of SWMP, has developed protocols for phase two and will begin implementation when additional funding becomes available, and has access to data on land use patterns through work completed by NHEP and CCAP.

C. GBNERR Research and Monitoring

Research and Monitoring Goal

Improve the health of the Great Bay estuary and the watershed by conducting research and monitoring activities and providing information that promotes informed resource management.

Research and monitoring policies at the Reserve are aimed at accomplishing the goals, objectives, and actions discussed below. The Reserve's Research Coordinator position was added to the staff in 2000 and will become fulltime in 2006. The Research Coordinator has the responsibility of developing research and monitoring policies as well as integrating the program with other Reserve activities such as education and stewardship. The coordinator also works closely with Marine Fisheries staff to support research efforts of the NHFGD. GBNERR serves as the host site for CICEET, thereby providing additional opportunities for supporting research within the Reserve.

1. GBNERR Research Policies

Research within the Reserve is carried out by scientists associated with the organizations discussed above and by visiting scientists from other institutions. Although the Reserve does not directly fund outside research, it participates in national efforts that provide funding such as the NERRS Graduate Research Fellowship program. It also strongly supports research by interacting with

scientists and discussing potential collaborations, data gaps and sources, sampling locations, and previous research studies of interest.

Outside researchers often work with Reserve staff and collaborate with scientists at one of the associated facilities for assistance. They also are encouraged to contact the Research Coordinator during project planning. When possible, the Reserve attempts to provide housing, equipment, boats, and other materials as needed.

Researchers involved in projects that require permits from NHFGD or other federal and State agencies must work directly with the appropriate contacts to acquire proper documentation before any research is carried out. It is the sole responsibility of the researcher to be sure that all necessary permits have been obtained. However, Reserve staff will assist researchers in obtaining permits by providing guidance and information on procedures. The availability of Reserve services and resources varies depending on the time of year and level of activity. A long-term goal is to develop a research endowment fund through the Great Bay Stewards that would provide additional funds to researchers. Currently, the Stewards have limited funds to support short-term projects.

2. GBNERR Monitoring Policies

The majority of monitoring activities are conducted in partnership with UNH and JEL (i.e. SWMP water quality, weather, nutrient, and biological monitoring). The Reserve strives to meet the data needs specific to the Great Bay estuary through the cooperation and collaborative efforts with appropriate agencies and institutions.

As the biological monitoring component of SWMP expands, the Reserve envisions increasing the number of partners involved in this effort. The Research Coordinator, in cooperation with the GBNERR Research Advisory Board, will develop monitoring priorities. All scientists engaged in monitoring efforts within the estuary are encouraged to share results with the Reserve.

D. GBNERR Research and Monitoring Associations

1. Jackson Estuarine Laboratory

The University of New Hampshire's JEL is located at Adams Point on the shore of Furber Strait, which connects Great Bay and Little Bay. This 80-acre property is owned and managed by NHFGD as a Wildlife Management Area. The Laboratory is on a 2-acre site that is leased on a long-term basis from NHFGD. Since opening in 1970, JEL has become the focal point for estuarine research activities at UNH. It is the largest of three laboratories administered by the UNH Center for Marine Biology. Most of the research activities that occur in Great Bay are coordinated through JEL.

The facility consists of an 8,500 square foot laboratory building with an attached greenhouse and detached garage/storage area. There is a running seawater system with water, pumped directly from Furber Strait, available to the main laboratory, the greenhouse and an experimental area outside. Areas of interest of the faculty include the following:

- Coastal sedimentology
- Marine botany and zoology
- Microbiology
- Phycology

There is a wide diversity of research expertise at JEL. The resident staff includes six faculty who work in the four topic areas listed above. All GBNERR SWMP data collection is done by JEL staff under a cooperative grant award with NOAA and under the guidance of GBNERR. Campus-based faculty also conduct research at the site and collaborate with JEL scientists.

This diversity has resulted in the completion of several significant, interdisciplinary projects. Though basic ecological research in the estuarine environment continues to be a focus of JEL, a major emphasis in recent years has been on critical environmental and resource management issues. Detailed information can be found on-line at http://marine.unh.edu/jel/home.htm.

2. Cooperative Institute for Coastal and Estuarine Environmental Technology

In 1997, CICEET was established as a national center to fund the development of innovative environmental technologies. It is a partnership between UNH and NOAA, and is housed at Gregg Hall on the UNH campus in Durham. It disburses up to $3 million annually in research funds, including many projects associated with GBNERR. The focus of research is based on four topic areas:

1. Habitat degradation/loss and habitat restoration
2. Nutrient enrichment and eutrophication
3. Pathogens and toxic contaminants
4. Synthesis and integration of environmental data and information

The emphasis of these topic areas is on detection, prevention, and recovery. Through the Stormwater Center, CICEET is developing low-impact development systems to help improve water quality. Utilizing the Great Bay Discovery Center, the Reserve plans to serve as a demonstration site for some of these new tools offering an opportunity for evaluating their effectiveness. Current projects and results, including final reports, can be found on-line at www.ciceet.unh.edu.

3. New Hampshire Department of Environmental Services

The Reserve works with multiple offices within NHDES such as NHCP and NHEP. These partnerships result in a collaborative approach to priority setting of research and monitoring needs in Great Bay and coastal NH. The Reserve meets annually with NHCP to review research and other priorities and to establish collaborative activities. While NHEP is in the process of being transferred to UNH, it will continue to have close ties with NHDES. For more information about NHCP, go to www.des.state.nh.us and for NHEP, go to www.nhep.unh.edu.

Associations with NHDES staff facilitate increased cooperation on joint projects, sharing of equipment, increased awareness of potential funding opportunities, and improved knowledge of additional projects occurring within the Great Bay watershed. NHDES is also responsible for the opening and closing of shellfish beds throughout the estuary and works with NHFGD in monitoring shellfish for diseases.

4. GBNERR Research Advisory Panel

The Great Bay Research Advisory Panel provides GBNERR with feedback and suggestions on the research program direction and the scope of the Research Coordinator's work. Members of the Advisory Board include representatives from numerous academic programs at UNH including JEL,

the UNH Marine Program Director, the CICEET Co-Directors, and the Research Coordinator from the Wells NERR.

The panel convenes at least annually with additional meetings as needed. For example, the first major contribution of the panel was the suggestion to hold a workshop designed to develop a strategic plan for research in the Great Bay estuary. This idea evolved into a workshop held at the 2004 State of the Estuaries Conference that resulted in the "*Synthesis of Research Needs for the Great Bay Estuary*" document now being used to drive GBNERR involvement and facilitation of research.

The document is a product of a workshop attended by 77 participants from State and federal agencies, non-profits, academia, and town boards. The Reserve will continue to work with its partners to address the research needs outlined in the synthesis. To view this document, go to: http://www.nhep.unh.edu/resources/presentations/gbnerr.pdf.

5. Additional Monitoring Activities

Recent collaboration with the UNH Coastal Observing Center (UNH COC) resulted in the deployment of an estuarine monitoring buoy at one the Reserve's SWMP stations in the center of Great Bay. This new monitoring platform includes instrumentation such as in-situ nutrient sensors currently not included in SWMP. Continued partnership with UNH COC will help the Reserve provide better data to the coastal management community.

In addition to water quality, the Reserve is engaged in several volunteer monitoring projects that support biological monitoring. Every other weekend from January through March, volunteers count wintering waterfowl using Great Bay. This effort is coordinated with the waterfowl biologist at NHFGD who is responsible for waterfowl monitoring throughout the State. A technical report on wintering waterfowl was published in 1995. Also during the winter, volunteers from New Hampshire Audubon monitor winter eagle use in the estuary.

During the summer months, Reserve volunteers monitor 10-12 osprey nests weekly to document use and success of these birds. The number of nests has dramatically increased since 1989, when there was only one known nesting location.

The Marine Fisheries Division plans to expand its monitoring of rainbow smelt and the Reserve will be involved in looking at such issues as identifying and enhancing smelt spawning habitat. Part of this effort will include the removal of dams and other impoundments. As smelt populations have declined along the Atlantic coast, restoration of this fish is a high priority. Marine Fisheries is also involved in horseshoe crab monitoring and tracking the incidence of shell disease in lobsters.

The Reserve is also working with UNH and NHEP to determine the impact of invasives in the marine environment, and students studying invasive species in Great Bay have been supported through graduate research fellowships. For example, the number of species of tunicates has increased over the past ten years posing a potential threat to other species and aquaculture efforts. UNH researchers have now identified *Botrylloides violaceus*, an import from Asia, as the dominant tunicate species in parts of the estuary.

NHCP is also in the process of creating a NH Coastal Invasive Plant Management Area using the protocols established by other Cooperative Weed Management Areas (one example is the Adirondack Pack Invasive Plant Program; for more information, go to www.adkinvasives.com).

While the boundaries for the management area have yet to be established, it is likely most of the Reserve will be included. Several other groups and agencies will be involved and the information will assist resource managers in supporting efforts to control the spread of non-native species.

Ducks Unlimited (DU), in coordination with NHCP and JEL, created a salt marsh monitoring program in 2003. Although this is a statewide effort, a large percentage of the salt marsh is located within GBNERR. The Reserve is working to help recruit volunteers for the program and to develop protocols. As part of this effort, the incidence of Phragmites (common reed) is being tracked. To better understand the distinction between native and non-native Phragmites, the Reserve sponsored a workshop in 2005 to identify the genetic characteristics of each.

E. GBNERR Research and Monitoring Objectives and Action Items

Objective 1: Research and Monitoring Information Database

Develop a research and monitoring database while securing the necessary technology and resources to manage the information.

Action Item 1: Web-based Database
Action: Develop a web-based searchable database in coordination with JEL that contains citations of publications involving research of the estuary.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Short-term

Action Item 2: Track Research Activities
Action: Establish and implement mechanisms to track all Reserve research activities, and document accomplishments.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Short-term

Action Item 3: Catalog Monitoring Activities
Action: In collaboration with the University of New Hampshire, identify and catalog all physical, chemical and biological monitoring activities in the Great Bay estuary.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Ongoing

Objective 2: Monitoring Physical, Chemical and Biological Processes

Monitor physical, chemical and biological processes that either influence or reflect the health of estuarine ecosystems.

Action Item 1: Physical and Chemical Water Quality Evaluations
Action: Evaluate site-specific issues to determine sampling needs for characterizing specific impacts associated with wastewater discharges, impervious surfaces, and land-use changes and make the results available to appropriate coastal decision-makers as a continuation of SWMP phase I.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 2: Biological Monitoring
Action: Build institutional knowledge and relationships with UNH, NHCP and others in anticipation of implementing a national biological monitoring effort using existing protocols already in place through SWMP phase II. This effort will include incorporating data from NHCP's Coastal Volunteer Monitoring and Assessment Program (CVBAP) that collects data on macro-invertebrates in the Exeter, Lamprey, and Cocheco Rivers.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Ongoing

Action Item 3: Update Site Profile
Action: Update the 1992 Great Bay Site Profile through a collaborative effort involving JEL, CICEET and NOAA's Coastal Services Center. The update will be enhanced with SWMP abiotic, biological, and land use data. The final product will be made available in hard copy, CD and on the Web.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Long-term

Action Item 4: Update Research Synthesis
Action: Update the 2004 Synthesis of Research Needs to reflect changes to the estuary based on new environmental stressors and success of management efforts.
Responsible: Research Coordinator
Timeframe: Long-term

Action Item 5: Invasive Species Evaluation
Action: Catalog the existing documentation on potential effects of invasive species in the Reserve, both marine and terrestrial, and develop strategies for minimizing the impacts associated with these species.
Responsible: Research Coordinator/Research Advisory Committee
Timeframe: Ongoing

Action Item 6: Salt Marsh Monitoring
Action: Continue to work with other agencies and organizations to monitor the extent and range of salt marshes, including changes in plant species.
Responsible: Research Coordinator
Timeframe: Ongoing

Objective 3: Habitat Classification and Land Use Database
Develop a database on major patterns of habitat classification and land uses within the Great Bay Reserve watersheds to implement SWMP phase III.

Action Item 1: Habitat and Land Use Mapping
Action: Compile maps and related information from federal, State, and local agencies on Reserve and watershed habitat and land use types.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Tracking Land Use Changes
Action: Develop a protocol for routine updating and tracking of changes in land use and habitat distributions, and assessments of potential impacts on Reserve resources.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Mid-term

Objective 4: Assessing and Analyzing Ecological Features

Assess and analyze two fundamental ecological features of GBNERR:

(1) Basic community structure in major habitat types (e.g., uplands, emergent wetlands, benthos); and

(2) Population trends of important "target species," including those of commercial, recreational, or conservation significance (e.g., submerged aquatic vegetation, wading birds, threatened and endangered species, and other marine species such as lobsters, oysters and rainbow smelt).

Action Item 1: Monitoring Programs for Habitat
Action: Establish monitoring programs for major habitat types in the Reserve boundary that support and are consistent with NERRS SWMP protocols as appropriate.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Research and Monitoring for Habitat and Species
Action: Collaborate with appropriate partners including UNH and NHEP in other ongoing research and monitoring efforts involving habitats and species in Great Bay.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 3: Estuarine Responses to Nutrient Loading
Action: Continue to support the research examining changes in estuarine ecology as a result of nutrient loading.
Responsible: Research Coordinator
Timeframe: Ongoing

Objective 5: Restoration of Impacted Habitats

Collaborate, assist in and facilitate the restoration of impacted habitats in Great Bay.

Action Item 1: Restoration Efforts
Action: Partner with NHCP, DU, UNH, the Natural Resources Conservation Service (NRCS), and The Nature Conservancy (TNC) in habitat restoration efforts and develop strategies for implementation.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Impacted Habitats
Action: Assist in the identification of impacted Reserve habitats with a special emphasis on newly acquired lands and areas of critical importance as identified by NHFGD.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 3: Restoration Monitoring
Action: Work with partners to develop monitoring strategies to evaluate successful restoration efforts, building off of NERRS SWMP protocols as appropriate.
Responsible: Research Coordinator
Timeframe: Ongoing

Objective 6: Communication of Research and Monitoring Information

Communicate research and monitoring information, including potential funding sources, to resource managers, scientists, educators, and the public.

Action Item 1: Monitoring Data Display
Action: Continue to develop a real-time display at Sandy Point of water monitoring data from the Great Bay estuary datasonde(s).
Responsible: Research Coordinator/Education Coordinator
Timeframe: Ongoing

Action Item 2: Alternative Research Funding Sources
Action: Identify funding opportunities for research in Great Bay. This includes working with the NHEP to establish research priorities for funding.
Responsible: Research Coordinator/Great Bay Stewards
Timeframe: Ongoing

Action Item 3: Assessing Research Needs with Coastal Decision Makers
Action: Meet with coastal decision makers in the Great Bay watershed to develop and prioritize research needs.
Responsible: Research Coordinator/CTP Coordinator
Timeframe: Ongoing

Action Item 4: Partnering
Action: Collaborate with appropriate agencies involved in managing water quality in coastal NH to transfer information generated through monitoring projects.
Responsible: Research Coordinator
Timeframe: Ongoing

Chapter VI
Resource Protection Plan

A. Introduction

The Great Bay National Estuarine Research Reserve (GBNERR) has placed a high priority on protecting the estuary's natural resources. Protection efforts by the Reserve will assist in maintaining the Bay's historic and rural character, while protecting water quality and diversity of species and habitats in the estuary. The Great Bay watershed contains significant geological, historical, archaeological and ecological features. While Reserve lands are generally open to the public to enjoy these cultural and natural resources, the goal is to ensure their adequate protection.

The 1989 Management Plan identified the protection of the estuarine environment and resources as the highest priority for management (NH Office of State Planning 1989). Over the past ten years, the Reserve has actively pursued the acquisition and protection of additional lands. As a result, the Reserve is working towards expanding its boundary and increasing the acreage being managed through the NH Fish and Game Department (NHFGD).

At the same time, the Reserve has expanded its efforts in partnering with other State agencies, such as the NH Department of Environmental Services (NHDES), to develop additional protection strategies and to ensure that State regulations are properly enforced. The NH Coastal Program (NHCP) and the NH Estuaries Project (NHEP) share many of the same objectives and the Reserve works closely with these organizations to implement similar resource protection strategies.

B. Resource Protection Approach - National Estuarine Research Reserve System

Reserves must ensure that the site's boundary encompasses an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. This ecological unit serves as the basis for developing appropriate resource protection strategies.

The Reserve System approach for resource protection is to sponsor or conduct applied research to determine the most effective ways to protect and preserve the natural resources. This is followed by educational efforts that seek to translate research results for policy-makers and the public in order to improve resource protection at Reserve sites, and at similar sites within the Reserve's biogeographic region.

C. GBNERR Resource Protection

Resource Protection Goal

Provide for the long-term conservation and protection of the biodiversity of the Great Bay estuary and associated habitats.

The Reserve is committed to working on coastal management issues identified through a variety of sources within the State of New Hampshire and the Estuarine Reserves Division (ERD) of NOAA. The management issues fall into three categories, which provide a way to look at what is currently being done to help identify gaps in current State policies and find solutions to watershed-wide

resource management issues (see Chapter VII, Stewardship for the discussion of the integration of stewardship with resource protection efforts):

1. Protecting Rare and Endangered Species and Associated Habitats
2. Minimizing Human Impacts on Wildlife Habitat
3. Improving and Restoring Water Quality

1. Species and Habitat Protection Management Issues

Habitat Fragmentation

Habitat fragmentation, the splitting of natural ecosystems into smaller and more isolated parcels, is often the result of the building and infrastructure construction. Historically, the seacoast region has been the fastest growing region in the State and this growth trend is projected to continue over the next decade, if not longer (Sundquist and Stevens 1999). Habitat fragmentation may result in:

- The disruption of movement and foraging patterns of endangered and fragile species
- Insufficient minimum home ranges of some species
- Loss of biodiversity
- Edge effects - songbirds nesting near forest edges may experience higher densities of nest predators and brood parasites than exist in forest interiors

However, consistent and conscientious land use planning can lessen and/or avoid the disturbance to critical natural areas. In addition to employing land use planning, the application of mitigation and compensation measures can significantly lessen fragmentation effects, thus lessening the environmental impacts to animal and plant species and their habitats.

Working through the NH Coastal Program's Natural Resource Outreach Coalition (NROC), the Reserve encourages communities to evaluate several land use issues when developing municipal master and open space plans, (see Chapter IX, Education, Outreach and Interpretation for a full description of NROC). Among the land use management tools suggested by NROC is the development of municipal natural resource inventories, which serve as a summary of the natural features of the land. This process allows communities to document existing land conditions and habitats, guide conservation planning, review land use proposals requiring regulatory oversight and for land-use management planning.

Conservation and Habitat Protection

The Great Bay Resource Protection Partnership (GBRPP) is a group of organizations and agencies committed to protecting important habitats of the Great Bay region. The Partnership has undertaken a comprehensive, landscape-scale approach to conservation and habitat protection. The Partnership was originally formed in 1994 to support the North American Wetland Conservation Plan's Atlantic Coast Joint Venture by developing and implementing habitat protection strategies.

The Partnership's successful conservation activities are due to a collaborative approach. The Partnership seeks to:

- Promote creative solutions for habitat protection.
- Build upon the conservation efforts of already protected and restored lands.

- Coordinate resources, and identify and pursue a variety of funding opportunities.
- Promote communication and cooperation between partnering entities.

The Partnership's Habitat Protection Plan provides information about the important habitat resources and priority conservation lands in the region (Brickner-Wood 1997, revised 2000). Based on a habitat analysis of over 50 species of birds, fish and reptiles utilizing Geographic Information System (GIS) mapping and field knowledge, over 14,000 acres were identified and organized into 25 Significant Habitat Areas that range from 400 to 10,000 acres. The GIS information is available from several Principal Partner organizations, the University of New Hampshire and the Regional Planning Commissions. The Significant Habitat Areas are located in 24 communities, including the towns that abut Great Bay - Durham, Greenland, Newfields, Newington, Newmarket and Stratham. An updated version of the plan is scheduled for 2007.

Annual field inventories and studies are undertaken that contribute valuable data to further define important habitat areas. "Project Areas" are defined within Significant Habitat Areas and become the focus of protection efforts. Field data also assist with the long-term stewardship and management of protected lands.

Shoreline Development

Rapid shoreline development is a major issue within estuarine areas throughout the United States. Shorelines and coastal areas are in demand for residential development for their scenic value and also sought after by conservation organizations for their numerous ecological functions (Crossett *et al*. 2004). The most significant functions are floodwater control, wildlife habitat, aesthetic quality, recreation, pollution abatement and filtration, and unique natural features.

Development is associated with a considerable net decrease in habitats capable of supporting wildlife and natural communities and is the leading cause of habitat loss and alteration within the coastal watershed. What degree of development should be allowed in relation to the amount of shoreline to be protected in order to preserve the character of an estuarine environment is often difficult to determine. Other impacts include increased runoff from impervious surfaces.

The Comprehensive Shoreland Protection Act (CSPA; RSA 483B), effective July 1991, was created to protect New Hampshire shorelands, one of the State's most valuable and fragile natural resources. The CSPA sets minimum standards and requirements for development, use and subdivision of all land within 250 feet of the water's edge. NH Department of Environmental Services (NHDES) is responsible for implementing the CSPA and town officials can implement further restrictions on shoreland development.

As noted, the New Hampshire coastal watershed has been under increasing development pressures since the 1950's. Development impacts have had detrimental effects on wildlife areas and natural communities. The New Hampshire Comparative Risk Project is a public/private partnership that was started in 1993 to improve the understanding of such environmental risks. The ability of individual species to tolerate and adapt to habitat changes varies. The Project determined that most native species are unable to survive and reproduce in heavily developed areas. The Project further concluded that the most pronounced overall habitat loss in New Hampshire has occurred within the southeastern part of the State, where the Great Bay estuary is located (New Hampshire Comparative Risk Project 1997).

Historically, ownership of properties around the Great Bay estuary has been predominantly private, with scattered holdings owned by private-nonprofit organizations or governmental entities. The

private ownership of large land parcels has minimized the rate of development especially along the shoreline. However, due to an aging population and increased land values, more open space is being converted to house lots (Brickner-Wood 1997). The development of the remaining large land tracts has significant implications for habitat and water quality degradation.

As a result of these pressures, the Partnership designated land along the shoreline as the highest priority for protection. This effort has led to the purchase of numerous key properties.

Invasive Species

New Hampshire's estuaries and the coastal watershed support a diverse array of plant and animal species. However, not all species are native; many species found in the coastal watershed today result from historical introductions of plants and animals from around the world. Introduced plants and animals may compete with native species for resources. Competition often leads to reduced growth and survival of the native species. Especially competitive and prolific, introduced species may even cause extirpation of native species and reduce the overall biodiversity of an ecosystem. Some non-native and invasive plants (e.g., common reed, purple loosestrife) can form extensive monoculture stands, change ecosystem structure, and adversely affect wildlife habitat values (Gordon 1998, Able and Ragan 2000).

Degradation of salt marshes is associated with the encroachment of invasive plant species. These plants drastically reduce plant diversity in marshes as well as restrict fish and bird access to the marsh. Undersized culverts, tide gates, dredging and filling activities and stormwater runoff interfere with normal tidal flow and limit salt water from reaching portions of the marsh. These areas are then susceptible to invasion or changes in the diversity of species. Dealing with invasive species has been identified as a priority issue for all land and water areas within the Reserve boundary. Monitoring areas with altered habitats is the first step in identifying potential problems.

Several species of emergent plants are considered nuisances in tidal marshes including common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*). *Phragmities* becomes a problem after it colonizes disturbed soils surrounding or within marshes. Salt marshes within the estuaries are being altered as a result. Since the invasion of *Phragmities* in the 1960's, the salt marsh at the Sandy Point site has been losing the natural flora and fauna that inhabit the area. The

Phragmities became a problem when the freshwater inflow to the marsh increased as a result of additional impervious surface cover.

Aquatic invasive species also can be unintentionally brought into a water body. Posted signs at all boat launches urge boaters to ensure that all boat hulls and submerged trailer parts are clean, thus reducing the risk of transferring unwanted species into the estuary. A much larger risk is from the ballast waters of large ships that dock along the Piscataqua River.

Wetland Losses

The loss of wetlands in estuarine areas has been recognized both nationally and statewide as a major threat to the maintenance of healthy ecosystems. Wetlands provide flood storage and sediment control by serving as a natural aquatic filtering system and wildlife habitat. Wetland loss includes the erosion and destruction of salt marsh, seagrass and other estuarine habitats through processes that directly impact these environments.

Threats identified by NHCP as having a high impact on New Hampshire's degradation of estuarine wetlands include:

- Shoreline Development
- Pollution (point and nonpoint sources)
- Nuisance or exotic species
- Freshwater inputs and tidal restrictions
- Filling and dredging
- Human impacts caused by recreational activities (such as personal watercraft)

Losses of salt marsh and seagrass habitats, particularly human-induced losses, may be slow to recover due to the sensitive nature of these habitats. Many of the tidal marshes have been impacted by coastal development, including fragmentation caused by road construction and the deposition of fill on the marsh surface. In some cases, mitigation is required to offset the damage resulting from a particular project.

Mitigation options include creation, restoration, enhancement and protection of critical areas (projects may combine one or more of these options). These are the main strategies used to prevent further wetland loss. However, the opinion of the conservation community in New Hampshire shows a preference towards the conservation of existing wetland habitats with mitigation only as a second option.

Wetland restoration projects, especially in tidal waters, must go through a State wetland review and permitting process, and requires cooperation among all participating federal and State agencies. Those projects falling within the Reserve's boundary must comply with appropriate NERRS regulations (as stated under15 C.F. R. sec. 921.1 (d) and (e)).

Eelgrass Habitat Loss

Eelgrass (*Zostera marina)* is an important component of the estuarine environment. It is an extremely productive ecosystem and prevalent sub-tidal habitat in Great Bay. It has several distinguishing characteristics:

- Decomposing organic matter from the eelgrass beds enters the estuarine/nearshore detrital food web.

- Eelgrass leaves serve to slow water flow and enhance sediment deposition; its root systems further stabilize sediments.

- Eelgrass beds increase structural diversity of the estuary while providing substrata for algal and invertebrate attachment, as well as protection from predators for juvenile fish and invertebrates.

- Waterfowl feed on eelgrass and it serves as an important fuel for a food web based upon the decomposition of dead eelgrass leaves.

Due to these functions, eelgrass beds are protected as "vegetated shallows" under the Clean Water Act, and some are included within "Essential Fish Habitat" as designated by the Magnuson-Stevens Fishery Conservation and Management Act.

The problems of eelgrass die-off and loss of its associated habitat are of major concern for fisheries, waterfowl populations, and the overall health of the Great Bay estuary. The dramatic loss of eelgrass from the epidemic wasting disease during the period 1980 –1992 changed the character and functional relationships of organisms within the estuary (Short 1992a), and has been studied extensively by researchers at the University of New Hampshire (UNH).

Eelgrass Disease

Due to eelgrass wasting disease, dramatic declines of eelgrass distribution and productivity were documented in Great Bay during the 1980's. The low point of distribution was reached in 1989 and was followed by a period of rapid seed production and population recovery (Jones 2000, New Hampshire Estuaries Project 2006). As with the wasting disease that began in the 1930's, eelgrass growing in high salinity waters is most susceptible, while plants in lower salinity riverine sites are more resistant to infection.

A marine slime mold (*Labyrinthula zosterae*), which was suspected but never proven to be the cause of the 1930's wasting disease, has now been shown to be the causal organism responsible for the more recent outbreak. If conditions of salinity and temperature are right, *Labyrinthula* may transfer easily from plant to plant within dense eelgrass meadows. Detrital eelgrass leaves and ocean currents spread the disease (Short *et al*. 1987, Meuhlstein *et al*. 1988, Meuhlstein *et al*. 1991). *Labyrinthula* and the wasting disease symptoms are now found throughout most eelgrass populations on the east coast.

The die-off of the late 1980's affected as much as 80% of the eelgrass population within Great Bay. Each year was followed by only a partial recovery from germination the next spring. The persistence of available eelgrass habitats within the Bay has decreased in recent years. In the 1990's there were signs of eelgrass recovery in Great Bay and throughout the estuary. However, the die-off of eelgrass from the wasting disease has been exacerbated by problems of decreased water clarity resulting from nutrient loading and sedimentation resuspension within the estuary (Short 1992a, Jones 2000).

Eelgrass - Human Impact

Although the wasting disease caused serious loss of eelgrass, the long-term survival and success of eelgrass in our coastal waters will depend largely on estuarine water quality. Estuarine management is necessary to ensure the survival of eelgrass and the ecosystem it supports. Factors that are currently decreasing water quality need to be addressed in order to create a coastal environment that will sustain healthy eelgrass, as well as other marine organisms.

The decline of eelgrass in the Great Bay estuary has been a concern of local scientists. These losses have resulted from the recurrence of the wasting disease and eutrophication. As a result, several methods for artificial restoration of eelgrass beds by direct transplanting have been undertaken within Great Bay. Transplanting techniques were tested in June and July of 1990 in Great Bay. Methods included planting both adult plants and individual seedlings, anchoring multiple adult plants with a metal staple, and inserting plugs of plants in peat pots into holes in the sediment. A total of 885 units were planted in the three plots with an overall success rate of 77% after four months (success is defined as planting unit survival and expansion; Short 1992a, Carlson and Short 1991).

The current state of the eelgrass beds is much improved, as the population seems to have recovered from the last outbreak of the wasting disease. However, densities of the bed are a concern and further study is required. The Great Bay Discovery Center has an interactive exhibit that shows the effect of several water quality parameters on Great Bay organisms. The effect of turbidity on the growth rate of eelgrass is highlighted.

NHFGD has also developed a NH Submerged Aquatic Vegetation (SAV) Conservation Plan for coastal NH. The purpose is to preserve, conserve and restore, where scientifically possible, in order to achieve a net gain in SAV distribution. This plan was prepared under the guidelines established by the Atlantic States Marine Fisheries Commission (ASMFC 1997).

Habitat Mapping

A key to understanding the level of protection needed is to map the existing resource. The Reserve plays a central role in coordinating mapping efforts in the estuary and works with numerous State entities to keep these maps updated. Federal funds from ERD support the Reserve's use of maps through the Geographic Information System (GIS). Some of the current mapping efforts include:

Sea Floor Mapping

A Memorandum of Understanding between NOAA and UNH created the Joint Hydrographic Center (JHC). UNH also created the Center for Coastal and Ocean Mapping (C-COM) to provide a mechanism for broader based participation by the private sector and other governmental agencies. The centers have dual missions of research and education. The research mission focuses on developing and evaluating a wide range of state-of-the-art hydrographic and ocean mapping technologies. JHC plans to map the entire estuary over the next five years, and products from this effort will provide valuable information on marine habitats within the Reserve.

Oyster Beds

UNH's Center for Coastal and Ocean Mapping (C-COM) and Jackson Estuarine Lab (JEL) partnered with NHFGD to delineate oyster beds in the Great Bay estuary. Hydro-acoustic surveys were conducted by C-COM while JEL and NHFGD confirmed the data with divers who took video and quadrat samples over a wide range of oyster densities. The video and data were used by C-COM to analyze information generated during the acoustic surveys. The GIS based maps represent a quantitative assessment of oyster bed dimensions and density.

Eelgrass Beds

Scientists at JEL have mapped the eelgrass beds within the estuary. These are periodically updated to determine changes in the beds and to look for the presence of wasting disease. NHEP has also documented a decline in the densities of eelgrass beds throughout the estuary

over the past ten years. A continued effort to map these beds is critical to understand future changes.

Uplands
Significant wildlife habitat throughout the Reserve is modeled in cooperation with NHFGD and UNH's Complex Systems. Detail cover mapping is done on all Reserve fee owned lands, which assists in developing management plans. NHFGD is currently in the process of improving its GIS capabilities, which will allow for greater access to maps on Reserve lands.

Species of Concern
Protecting rare and endangered species is a traditional and fundamental approach to evaluating and conserving biodiversity. The Great Bay area currently supports three animal species that are considered rare or endangered on a global scale:

- Banded bog skimmer *(Williamsonia lintneri)* ranked G2S 1(a dragonfly)
- Brook floater *(Alasmidonta varicosa)* that is ranked G3 S 1 (a freshwater mussel)
- Bald eagle *(Haliaeetus leucocephalus)* ranked G3 S I (present use of Great Bay as a wintering area)

Statewide Threatened or Endangered Species:

- Common tern (*Sterna hirundo*) breeds in Great Bay (State Endangered)
- Upland sandpiper (Bartramia longicauda) breeds near Great Bay (State Endangered)
- Common loon (Gavia immer) migrates through Great Bay estuary (State Threatened)
- Osprey (Pandion Haliaetus) nests throughout the Great Bay estuary (State Threatened)

Great Bay is well known for its large winter populations of birds and as a major stopover point on the Atlantic migration corridor. The Great Bay estuary and adjacent habitats provide a major wintering and migration stopover point for 20 species of waterfowl, 27 species of shorebirds, and 13 species of wading birds (2001). Winter waterfowl counts at Great Bay average 5,000 birds, with 2,000 of those being black ducks (2001). Over 80% of all waterfowl that winter in New Hampshire's coastal areas are found in Great Bay.

The Partnership's Habitat Protection Plan (Brickner-Wood 1997, revised 2000) identified 53 species of concern and incorporated their habitat needs into further selecting priority Significant Conservation Areas in which to target land protection efforts. The Conservation Plan of the Great Bay Region (Stevens and Anderson, 1997) further identifies species of concern and habitat requirements. For further descriptions on species of concern, see Appendices A and B.

Waterfowl Monitoring
The monitoring of waterfowl in the coastal and estuarine region of New Hampshire is a high priority. NHFGD takes part in an annual mid-winter aerial survey of waterfowl wintering areas along the Atlantic coast. This annual survey is conducted to determine population trends in the region. Since 1991, the survey has been supplemented with the Reserve's annual Wintering Waterfowl Monitoring Program (January to April). Volunteers use spotting scopes and binoculars, and take a semi-monthly count of the waterfowl species at pre-determined sites on the estuary. The surveys are useful in determining long-term trends in wintering populations. These data are used by NHFGD in managing key waterfowl species. While some species have fairly stable populations, others have been in decline such as black ducks.

Partners In Flight

The Nongame and Endangered Wildlife Program of NHFGD is taking part in an international neotropical migratory bird conservation initiative, Partners In Flight – Aves de las Americas. The partnership was launched in 1990 by groups in North America, South America and Central America to cooperate on a simultaneous program of conservation at both ends of the migration route. NHFGD has promoted the program with a Partners-In-Flight Expo to help build awareness and support for neotropical migrant conservation in New Hampshire and abroad.

Horseshoe Crab Monitoring

In 1999, the Reserve began a long-term monitoring project of population trends of Great Bay's spawning horseshoe crabs in relation to water quality parameters. The project has several specific goals:

- To detect any relationship between abundance of spawning horseshoe crabs and water temperature, salinity, pH, dissolved oxygen, turbidity, and fecal coliform counts.
- To assess how horseshoe crabs are affected by changes in environmental conditions, including anthropogenic induced disasters.
- To monitor the relative health of New Hampshire's horseshoe crab populations.

Complementing this monitoring project is a habitat study to determine shoreline habitat associations and spatial distribution of spawning horseshoe crabs in Great Bay. In 2001, this study was taken over by the NHFGD Marine Fisheries Division with results used for State compliance with the Atlantic States Marine Fisheries Commission (ASMFC).

2. Human Impacts on Wildlife Habitat

Human activity can directly impact wildlife species. Common responses to the presence of humans include nest abandonment, changes in food habits, and physiological change. Many of these changes are of short duration, although long-term behavioral changes such as abandonment of preferred foraging areas and changes in food sources do occur. Over time, an increase in energy spent resulting from interrupted foraging may cause decreased productivity or even mortality.

Human activity may also indirectly impact species through habitat alteration. Characteristics of soil, vegetation, or aquatic systems can be altered as a result of human's recreational activities. Such alterations may affect wildlife food supply, shelter, or living space. In turn, impacts on food and living space may influence wildlife behavior, survival, reproduction, and/or distribution.

Recreation

New Hampshire's estuaries and the coastal watershed offer tremendous recreational opportunities for residents and visitors. Impacts of these activities on wildlife species and natural communities vary in intensity and type and include the following:

- Boating is becoming increasingly popular in the estuary; the number of mooring permits increased 5-fold between about 1975 and 1990 (Short 1992a). Many aquatic species that nest and forage in areas of frequent motorboat activity may be disturbed and find their habitat inaccessible. Motorboats have also been associated with an increase of oil and gas into the Bay. While the use of personal watercraft is minimal and generally confined to the river corridors, the potential exists for disturbance in salt marshes.

- Recreational finfishing takes place throughout the year on the Bay for a variety of species. Several species including Atlantic salmon (stocked through 2003) and shad are stocked by NHFGD to encourage the establishment and maintenance of natural populations.

- Historically, shellfishing has been popular on Great Bay. Currently shellfish resources are declining and many of the shellfish areas in Great Bay are closed to harvesting due to their proximity to sewage treatment plants or boat mooring areas.

The Reserve is involved with several agencies and organizations on issues relating to recreation:

- The Reserve staff coordinates with NHDES to receive pertinent information on the permitting process for docks and piers and to review applications for new installations.

- The NH Port Authority issues mooring permits and NHFGD Marine Fisheries Division works with them to review new applications. A long-term goal is to formalize the rules for issuing permits in sensitive areas.

- The effects of personal watercraft on the resuspension and erosion of salt marsh creeks was studied as a UNH sponsored project. The resulting data may affect future regulations.

- In the NHEP Management Plan (NHEP 2000), goals have been set for shellfish management. NHFGD is working with the Estuaries Project to achieve these goals:

  To achieve sustainable shellfish resources by tripling the area of shellfish beds that are classified as open for harvest; and

  To triple the quantity of harvestable clams and oysters in New Hampshire's estuaries.

Marine Debris

Existing and potential sources of marine debris in coastal New Hampshire include landfills, recreational boaters, commercial vessels, beachgoers, and litter from storm drains, pipes and solid waste disposal systems. Plastic, glass/bottles, metal cans, lobster traps, pipes and paper/packaging form the largest volume of marine debris.

There are several activities that the Reserve participates in to address this problem:

- Coastal Clean Up: The Reserve participates in the annual international coastal clean up; the Great Bay Discovery Center is a designated clean up site. This popular fall event, organized by the NHCP, engages community members of all ages in cleaning up litter around the Bay.

- In addition to the coastal clean up, the Reserve works with 5th graders from a local school to educate them about marine debris. This series of activities culminates with a field trip to clean up one of the Reserve's properties. In 2002, 60 children and chaperones removed 200 pounds of trash from Adams Point, one of our most utilized properties.

Dredging

A portion of the coastal waters of New Hampshire is subject to maintenance dredging. While Great Bay proper and its tributary rivers are not frequently dredged and are a low priority for future

dredging, the rivers were dredged a century ago to facilitate commercial trade and local commerce. The Cocheco River in Dover has been recently approved for dredging the saltwater portion of the river below the dam.

The NHCP is the chair of the Dredge Management Task force. The NHCP report, Dredging in New Hampshire (NHCP 1999), provided a synthesis of dredge related information for applicants, consultants, legislators, and other agencies involved in dredge related issues. Following are highlights of the dredging history in the Great Bay Estuarine system.

Federal Dredging Projects

- Squamscott River Dredging - This project was located on the lower 8.3 miles of the Squamscott River. In 1882, the US Army Corps of Engineers (Corps) began construction of a 40-foot wide channel, extending from Great Bay to the upper wharves at Exeter. The last section was dredged in 1903 to 5.5 feet deep, and a turning basin 200 feet long and 110 feet wide and five feet deep was constructed at the upper wharves. In 1911, the Corps straightened the channel near the Stratham Bridge.

  The authorized federal channel is in tidal waters downstream of the freshwater segment of the river designated under the NH Rivers Management and Protection Program. The New Hampshire Rivers Management and Protection Program was established in 1988 with the passage of RSA 483 to recognize and designate rivers to be protected for their outstanding natural and cultural resources. NHDES administers the program.

- Lamprey River – This project was constructed in 1883 to accommodate coal shipments to mills in Newmarket. It consists of a 2.5-mile long channel, five feet deep, extending from Great Bay to the area below the head of tide below Route 108 Bridge in Newmarket. This project is not included in the segment of river designation under the NH Rivers Management and Protection Program.

  In 1996, the freshwater section of the Lamprey from Bunker Pond Dam in Epping to the confluence with the Piscassic River near the Durham-Newmarket town was designated by the National Park Service as a Wild and Scenic River. This represents a total of 23.5 miles. Through a federal-State-local partnership, the Lamprey River Advisory Committee is involved with managing the program. GBRPP works closely with the Advisory Committee on land acquisitions within the Lamprey River corridor.

- Bellamy River – Completed in 1896, this dredging project consists of a new channel, extending from Little Bay to Sawyer's Mill, near the Route 108 Bridge. Due to the low clearance of the bridge, no shipping has been reported on the river in years, although recreational boating has increased.

- Cocheco River – Completed and last dredged in 1907, the existing project provides for a channel extending from the confluence of the Cocheco and Piscataqua rivers to the head of the navigation channel in Dover. Dredging of the river channel again in the Dover downtown area began in 2005 and will continue through 2006.

- Piscataqua River – As the State's only port, the Corps has undertaken numerous dredging projects since 1881 along the river and in Portsmouth Harbor. The strong tidal currents make keeping the river channel open for large ships a constant challenge but important to New Hampshire's economic growth.

Non-federal Dredging Projects

- Great Bay – In 1962 the Pease Air Force Base dredged 15,000 cubic yards between Thomas and Woodman Points.

- Little Bay – Great Bay Marina, Inc., dredged 556 cubic yards in 1991 and an unspecified amount in 1998 to deepen water off its docks.

- Piscataqua River – Dredged by the City of Portsmouth, NH Port Authority, and several private organizations since 1953.

NHFGD does not have permit issuance authority with respect to dredging activities. However, RSA 206:10 charges the Department with protecting, propagating and preserving the fish, game, and wildlife resources of the State. This law has led to a coordinated effort between NHFGD and NHDES for all dredging projects.

In 2001, a dredging project was proposed to enhance navigation on the Oyster River, a tributary to Great Bay. The Reserve supports dredging only when it is supported by science based research and accompanied by mitigation or restoration plans when necessary. Further, dredging within the Reserve may only occur in buffer areas and only if it is a long-term pre-existing use per federal regulations affecting Reserves, 15 C.F.R. sec. 921.1 (d).

Development and Sprawl

As noted, the seacoast of New Hampshire has experienced significant population growth during the last two decades leading up to the year 2000. As a result, many residents have voiced their concerns regarding the rate and type of growth occurring. One of the concerns has been identified as the impacts of sprawl - sprawl is defined as dispersed development outside of compact urban and village centers along highways and in rural countryside. Effects of sprawl include:

- Increased public costs for infrastructure investments.

- Negative impacts on natural resources such as loss of habitat and degradation of water quality.

- Loss of community identity and traditional rural character.

- Loss of economic opportunity by displacing investment from already existing buildings, facilities, and services to new development.

The State of New Hampshire is taking steps to control urban sprawl. In 1999, Governor Shaheen directed a council of ten agencies to inventory agency activities and identify existing measures that work to control sprawl. The goal of the Council was to do everything possible to "insure that our traditional communities and landscapes will be available for our children and future generations." The Reserve, working through NROC, utilizes "smart growth" strategies, developed by various agencies within the federal government to seek solutions to the environmental, social and economic problems posed by sprawl.

In 2000, funding for the Land Conservation and Heritage Investment Program (LCHIP) became available for statewide conservation projects in New Hampshire communities. This competitive grant program utilizes other sources of leverage for match, such as federal grant programs (i.e.,

USDA Farmland Protection Program), NHDES Water Supply Program funds and local funds. To become eligible for LCHIP funding, a community must establish a "Local Heritage Committee" to examine the community's cultural resources and prioritize protection objectives.

Aquaculture

As concerns for the future of seafood production in the New Hampshire seacoast area grows, aquaculture is being explored as a means of providing the fishing industry with an alternative to wild harvest fisheries. The University of New Hampshire through JEL has been involved in both shellfish and finfish aquaculture projects. JEL has made its scientific research on aquaculture available, and the Reserve will support ecologically beneficial aquaculture projects.

The NHFGD handles the permitting process. This process is stringent and is designed to ensure that any aquaculture practices will be conducted responsibly with regard to protecting the natural resources and traditional uses for the common good. Further, aquaculture within the Reserve may only occur if it is a long-term pre-existing use, 15 C.F.R. sec. 921.1 (d) and only in buffer areas.

Aquaculture within the Great Bay estuary has been limited to Little Bay and the Piscataqua River with the exception of an oyster aquaculture project in Great Bay using rafts from 1965-1969. Under the proposed 2005 boundary, Little Bay will be part of the Reserve and designated as buffer. The projects that occur here will have minimal impact on oyster bottom culture.

3. Water Quality

The ecological integrity of New Hampshire's estuaries depends on the quality of fresh and tidal waters flowing into them. A variety of anthropogenic stressors throughout the watershed affect water quality, which can impact the environment on which estuarine plant and animal communities depend. Stressors range from oil spills to dams and other flood control structures to impervious surfaces such as roofs and pavement. Inputs of sediments, nutrient, and toxic contaminants all reduce water quality and are considered nonpoint source pollution (Short 1992a, Jones 2000, NHEP 2006).

Maintaining high water quality is essential to the survival of the Great Bay ecosystem. The Reserve is fortunate to work jointly with a network of agencies and organizations toward this common goal. The Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) has provided much of the funding for this effort.

Shellfish

Oyster populations in the Mid-Atlantic and the Northeast U.S. have declined dramatically in the past four decades as a result of disease and poor recruitment (NHEP 2006). In addition to the economic loss, a drastic reduction in filtration capacity has resulted in increased turbidity and degraded water quality. Shellfish serve as eco-indicators of water quality in that they accumulate and concentrate bacteria, algal biotoxins, heavy metals and chemical pollutants (Jones 2000, NHEP 2006).

The Great Bay estuary has abundant shellfish resources that can be found in the tidal rivers as well as in both the Little Bay and Great Bay proper. In the Great Bay estuary, shellfish resources are harvested only for recreational use. Oysters (*Crassostrea virginica*) are of primary interest with mussels *(Mytilus edulis),* razor clams *(Ensis directus)* and soft-shell clams *(Mya arenaria)* also being harvested.

State and federal laws set water quality standards that determine whether shellfish can be harvested from given areas. To help prevent disease in consumers of raw shellfish, water quality standards use certain types of bacteria and their concentrations as indices of fecal contamination. New Hampshire's monitoring protocol is consistent with current National Shellfish Sanitation Program recommendations. A problem occurs when estuarine water overlying potential shellfish harvest sites becomes polluted with fecal material and contaminates shellfish. Shellfishing in these areas is then prohibited, resulting in limited public access to shellfish resources (Jones 2000).

Microbial Pollution

A potential contamination problem within Great Bay is the result of improperly treated effluent being discharged into the estuary during heavy rains and similar storm events. This is related to wastewater treatment facilities (WWTFs) and their capability to handle stormwater runoff. Depending on the tide, this material is rapidly carried into the central part of Great Bay where it contributes substantially to fecal coliform contamination. The problem of fecal contamination within the estuary goes hand in hand with problems of runoff and nutrient loading that are also major concerns, contributing to eelgrass decline and decreased water clarity (Short 1992a). A Technical Characterization of Estuarine and Coastal New Hampshire (Jones 2000) provides a synthesis of the research gathered about the effects of the WWTFs discharging into the Bay. This document is a source for resource managers to understand the trends in the water quality of the estuarine system.

Shellfish Bed Closures

The sewage contamination issue received a great deal of public attention during the late 1990's in New Hampshire, with the closing of clam and oyster beds in much of the Great Bay estuary. In response, the reopening of shellfish beds has emerged as a priority for New Hampshire regulatory agencies. According to the Reserve's site profile, Estuarine Profile of Great Bay (Short 1992a), threats to the shellfish resources are among the most critical management issues for the estuary. The closing of shellfish growing areas in the Great Bay estuary has a variety of results on the shellfish resources of the region:

- Lack of harvesting activity permits continued growth of the oysters to larger sizes.
- Disturbance from harvesting may in some cases be good for an oyster bed, knocking silt off shellfish and turning shells over and allowing for additional spat settlement surfaces.
- Closing some beds and leaving smaller and smaller areas open to harvesting may cause an intensifying depletion of resources on the harvest in the open areas.

NHFGD, in cooperation with NHDES, closes the shellfish beds after periods of heavy rain to protect the public from possible consumption of contaminated shellfish. The regulation of shellfish areas ensures the shellfish are not consumed from potentially unhealthy waters and that adequate recruitment is continuing.

Shellfish Diseases

Two protozoan parasites, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo), were first discovered in the Piscataqua River around 1983. In 1995, NHFGD first tested for the presence of these parasites in Great Bay and documented the widespread incidence of both. MSX and Dermo have contributed significantly to recent declines in the Great Bay oyster stock (Jones 2000, NHEP 2006).

Continued surveillance of disease conditions may indicate the pathogens' influence on oyster abundance variability. Testing of Great Bay Oysters for Two Protozoan Pathogens, a study conducted by NHFGD annually since 1999 and funded through NHEP, summarizes the distribution and effects of these pathogens (NHFGD 2005).

A UNH research project funded through CICEET addressed oyster restoration and the effects of the restored habitat on water quality (initiated summer 1999). The intent of the effort was to restore an oyster reef decimated by an outbreak of MSX using disease-resistant strains. While success of the project was limited, the potential for future shellfish restoration to improve water quality will be evaluated further.

Water Clarity/Water Quantity

The Estuarine Profile of Great Bay (Short 1992a) cites decreased water clarity as one of the major concerns to the health and productivity of the Great Bay estuary. Problems of decreased water clarity result from large amounts of suspended materials that reduce light penetration into the water, thereby limiting the primary production of key plants, including eelgrass, macroalgae, phytoplankton, and benthic microfauna. The causes of reduced water clarity are three-fold:

(1) Sediment inputs and resuspension that increase turbidity within the water column;

(2) Nutrient loading from both point and non-point sources of nutrient pollution, stimulating phytoplankton growth which reduces light penetration; and

(3) Decline of eelgrass reduces the filtering capacity of the ecosystem.

The problem of reduced clarity limits the primary productivity of benthic plants. The same conditions also contribute to the die-off of eelgrass by enhancing the wasting disease problem. Suspended sediments result primarily from upland run-off, tidal currents, wind mixing, boat traffic and shellfish harvesting in Great Bay. Sand, silt and clay from human disturbance in upland areas wash into streams that carry suspended materials into the estuary. Residential and commercial development as well as rapid rates of clearing and building also contributes suspended sediments. The ultimate effect of suspended sediments in an estuary is decreased light, which causes reduction in benthic plant growth, sometimes to the point of elimination (Short 1992a).

By installing over 400 monitoring wells around the Bay, CICEET is applying innovative technologies to assess the quantity and quality of groundwater inflow into Great Bay. Land use influence on the characteristics of groundwater inputs to the Great Bay estuary is being studied through this project (Ballestero *et al*. 2004).

Hazardous Waste and Contaminants

NHDES investigates the possibility of hazardous wastes and contaminants entering into estuarine waters at the former Pease Air Force Base and the Portsmouth Naval Shipyard. These and other potential sources of contamination to the estuary pose both human and ecological health risks of concern. The clean up and environmental restoration of these past hazardous waste disposal sites is currently underway through USEPA-CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) or RCRA (Resource Conservation and Recovery Act) programs (Short 1992a).

Located near the shores of Great Bay in Newington, the clean up at Pease Air Force Base began in 1993 (the base was closed in 1991). Environmental investigations found numerous sites where the

groundwater and soil were contaminated with petroleum products (mostly JP-4 jet fuel) and industrial solvents such as trichloroethylene (TCE). Remedial actions included groundwater treatment studies at four sites, soil removal at three sites, test pit operations at two sites, and three soil vapor extraction treatability studies. The long-term impacts and success of the remediation efforts are unknown.

At the Portsmouth Naval Shipyard, the U.S. Navy investigated the level of contaminants in the Great Bay estuary and their ecological and human health risk. The study provides an ecological framework to assess the potential impact of hazardous waste releases from the Portsmouth Naval Shipyard. Through this ecological study, conducted in part by scientists at the Jackson Estuarine Laboratory, a comprehensive baseline of the ecological conditions in the estuary will be developed. This baseline will allow monitoring and research activities to determine the long-term health and stability of the estuary (Loureiro Engineering Associates, Inc. and YWC, Inc. 1986).

The Great Bay estuary has been the recipient of numerous unquantified levels of substances, many of which may contribute to health risks. The discharge of contaminants into the estuary has not been monitored and the possibility of hazardous waste discharge from as yet unidentified small business or industrial sources poses a potential threat. Other Superfund sites within the watershed such as the Dover Toland site and Somersworth landfills may also contribute to the entry of contaminants.

Nonpoint Source Pollution

Stormwater runoff is considered a primary water quality issue for Great Bay. Pollution associated with stormwater runoff is considered nonpoint source pollution, because it does not come from a single point such as a discharge pipe, but from a single or defined area. Statewide, major impairments to lakes, ponds, rivers, and streams are due to non-point sources.

Nonpoint sources are now the major source of chronic water quality problems in Great Bay (NHEP 2006). Contaminated runoff can contain fecal bacteria, excess nutrients, oils and greases, toxic contaminants from pesticide and herbicide applications, toxic metals, and sediments eroded from shorelines and construction sites.

There are several ways in which the Reserve is involved with this issue of the Bay's water quality:

1. NHEP Management Plan: The New Hampshire Estuaries Project's Management Plan (NHEP 2000) provides a synthesis of the water quality profile of the Great Bay and the seacoast. The Plan serves as a comprehensive guide to coastal decision makers in many aspects, particularly the pollution and contamination issues the Great Bay watershed is facing as well as a series of action plans to combat degrading water quality.

2. Stormwater Management**:** The Center for Stormwater Technology Evaluation and Verification (CSTEV) is an independent field facility at UNH that tests stormwater control devices and their effectiveness under different environmental conditions. Started through CICEET, the Reserve is partnering with CSTEV to work with local officials dealing with stormwater issues. This effort is part of the Reserve's Coastal Training Program (CTP). (See CTP section of Chapter IX, Education, Outreach and Interpretation.)

3. System-Wide Monitoring Program (SWMP): The Reserve's twelve-year participation in SWMP has allowed the study and tracking of the water quality of the Bay. These data are compared to the activities around the Bay to detect the sources of entering pollutants. In

addition, they are used by the New Hampshire Department of Environmental Services to determine whether waters of Great Bay meet water quality criteria and to fulfill reporting requirements established by sections 303(d) and 305(b) of the Clean Water Act. NHEP has also established several monitoring stations in the lower part of the estuary; these data can be used in conjunction with the SWMP data to expand the data upon which an understanding of water quality in Great Bay can be built.

Methyl Tertiary-butyl Ether

Methyl Tertiary-butyl Ether (MTBE) is a gasoline additive that has been used over the past ten years in an effort to improve the nation's air quality (allows gasoline to burn cleaner). However, it has become evident the additive is appearing in NH's public water supplies and poses a major threat as a contaminant (NHDES 2002). MTBE's presence in large enough concentrations can be easily recognized by its characteristic kerosene odor. Little testing has been done related to MTBE's impact on humans (NHDES 2007), but already several major cities have been forced to close down public wells due to its presence. EPA has also established a standard for allowable concentrations.

The State of New Hampshire, through NHDES, has proposed to cut levels of MTBE. EPA plans to approve the State's effort to opt out of the federal reformulated fuel program, which requires higher levels of MTBE in gas sold in the State's four most populous counties, including the two coastal counties (Strafford and Rockingham). Estimates by NHDES suggest that 15 percent of all public water supplies have been contaminated and 40,000 private wells. Most of the contamination has occurred in the southern part of the State, including the coastal region (NHDES 2002, Ayotte 2004).

Point Source Pollution

Point source pollution classification is typified by both permitted and illegal direct discharges, and power plants are the most common point sources. While discharges are closely monitored and regulated through State and federal permitting processes, the demands of regional economic and residential growth challenge wastewater treatment plant capacities, spur demand for electric power, and accelerate the production of industrial waste products. Point source pollution, often characterized by continual low level contamination loading, tends to increase proportionally with regional growth (Jones 2000, NHEP 2006).

One potential source of pollution is the discharge of septic waste from boats. All State waters including the Great Bay estuarine system are considered "no discharge zones." Under the "no discharge rule" that took effect in 2004, boats with Type I and Type II marine sanitation systems must be secured or disabled when operating in a no discharge zone to ensure overboard discharge is not occurring. Boats with Type III systems must discharge wastes through an approved on-shore pump-out station. The Reserve distributes the NH Coastal Program's coastal access map, which delineates the local pump-out stations for boaters. Enforcement is the responsibility of the US Coast Guard (USCG) and NHDES.

Oil Spills

As NH's only port, over 700 million gallons of petroleum products (i.e. gasoline and home heating oil) are delivered annually to storage facilities in Portsmouth along the Piscataqua River. While oil spills are rare (the last minor incident was in 1996), they pose a significant threat (Jones 2000). As a result, NHFGD is involved with NHDES and USCG, along with numerous other federal and State agencies and local oil companies, in developing oil spill contingency plans. These plans meet the guidelines of the Oil Pollution Act (OPA).

NHDES manages an active oil response program through the Piscataqua River Cooperative. The principal members of the Cooperative are Sprague Energy Corporation, Irving Oil, and Public Service of NH. Twice a year, NHDES and the Cooperative organize a training exercise to prepare for a potential spill. The priority of the plan is to use booms to capture and collect the oil before it enters Great Bay proper. NHDES also maintains a permanent Incident Command Center at Pease Tradeport in Portsmouth as well as storage sheds loaded with oil spill response equipment including several within the Reserve boundary.

As part of the overall preparedness, NHDES has contracted with Tri-State Bird Rescue in Delaware. In the event of a spill, Tri-State would be called in to handle oiled wildlife and seabirds. With assistance from NHFGD, Tri-State has conducted training classes for volunteers and set up designated areas that could be used as rehabilitation field stations. The Reserve is actively involved in assisting NHFGD with this effort and in securing volunteers for training.

The Reserve also works the Coastal Response Research Center at UNH for the latest technology in cleaning up oil spills. The strong tidal currents in the estuary pose unique problems in using traditional oil booms. NHFGD has proposed that booms be used to direct spilled oil away from the main channel and towards the shoreline where it could then be collected. More information can be found at: www.crrc.unh.edu.

Nutrient Loading

Estuarine systems are sensitive to excessive nitrogen. Nitrogen is a naturally occurring nutrient essential for plants and algae. Too much nitrogen can promote unrestrained growth of nuisance algae. As the algae blooms die and decompose, they rob the water of oxygen, harming or killing estuarine and marine life (Howarth *et al*. 2000, National Research Council 2000).

Nutrient loading is the continual addition of nutrients from natural and human sources. The nutrient load to Great Bay from the tributary rivers comes from point sources (41%), non-point sources (48%), and from atmospheric deposition (11%). Nutrient loading occurs in all New Hampshire estuaries and their tributaries (Jones 2000).

Evidence suggests that nutrient concentrations within the main area of Great Bay have not changed significantly over the past twenty years until recently (NHEP's State of the Estuaries Report 2003 showed an increasing nitrate trend). Sources of nutrient contamination such as wastewater treatment effluent, lawn fertilizer, residential septic systems and runoff from impervious surfaces, will increase with human population growth and development pressures. Therefore, it is important to monitor nutrient levels in New Hampshire's estuaries to guard against further impacts.

While no widespread eutrophication effects have been observed, local isolated incidents of reduced oxygen levels and intense phytoplankton blooms have been observed in some freshwater tributaries of the Great Bay estuary. Documented effects of phytoplankton blooms in other areas are rare (Jones 2000). Thus, eutrophication and related impacts do not appear to be an imminent widespread problem.

SWMP includes measurements of inorganic nitrogen and phosphorus concentrations at four sites in the estuary. The data provide an excellent baseline from which short-term nutrient changes can be detected and are used by NHDES for assessing whether Great Bay waters meet nutrient criteria as required for 303(d) and 305(b) reporting for the Clean Water Act. The Great Bay Coast Watch, a program under UNH Sea Grant (see Chapter IX, Education), has been measuring water quality

parameters around the Bay since 1990. This monitoring work complements the Reserve's SWMP efforts by providing shoreline water quality data.

Rapid residential growth in the upper part of the watershed has raised concerns about the capacities of the region's wastewater treatment plants, especially in the City of Rochester. As a result, the NH Legislature authorized an act establishing a sewer and other water-related purposes district for Great Bay estuary. They also called for a commission to study implementing the recommendations of the NHEP Management Plan Update (NHEP 2005) and the potential for an outfall pipe that will serve the Seacoast. The commission will begin meeting in 2006.

D. Summary of NH Regulations

The information provided below is a list of the resource protection activities that are enforced by regulators. The list includes the lead regulatory agency responsible for the enforcement of the activities. In general, the State of New Hampshire's environmental regulatory authority is shared by a number of agencies, including NHFGD.

The Department of Environmental Services (NHDES) has the most significant responsibilities in terms of enforcing environmental regulations. They are responsible for controlling air and water pollution, wastewater treatment and management, and wetlands regulations. Many federal agencies also play a critical role in protection of the estuary.

Enforcement of Resource Protection

Activity	Agency
Boating safety	Marine Patrol
Hunting and Fishing Regulations	NHFGD
Pollution	NHDES, EPA
Dredging and Filling	NHDES, EPA, Army Corps of Engineers
Septic Design	NHDES, local town ordinances
Boating and Moorings	NH Port Authority and the US Coast Guard
Wetlands Violations	Wetlands Bureau, Department of Environmental Services
Agricultural Uses and Pesticides	NH Dept. of Agriculture, NRCS, EPA
Oil Spills	US Fish & Wildlife Service and US Coast Guard EPA and NHDES
Vandalism and Illegal Use	Town and City Police Departments, NHFGD

E. Resource Protection Objectives and Action Items

<u>Species and Habitat Protection</u>

Objective 1

Support wetland restoration and protection of the biodiversity of the Great Bay estuary and associated habitats.

Action Item 1: Wetland Mitigation
Action: Support mitigation projects approved by NHDES where appropriate and in coordination with NHFGD staff involved with restoration efforts.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Wetlands – Innovative management techniques
Action: Partner with other organizations and agencies to use non-regulatory and innovative management techniques to provide for the protection and management of coastal wetlands.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Objective 2:

Develop invasive species monitoring and control strategies.

Action Item 1: Invasive Species Monitoring Plan
Action: Reserve staff will create and implement a Reserve Invasive Species Monitoring Plan based on an inventory of invasive species. This plan will be adapted from management strategies used on TNC properties to control invasive species. Once the monitoring plan is underway a matrix will be completed and updated periodically to identify and track new invasive species.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Invasive Species Management Plan
Action: Maintain the ecological integrity of the Reserve's protected properties by effectively managing invasive species through the creation and implementation of a Reserve Invasive Species Management Plan in coordination with NHFGD.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Short-term

Objective 3:

Develop and support activities that monitor, restore and protect identified species of concern.

Action Item 1: Restoration of Eelgrass Beds
Action: Work in partnership with Jackson Estuarine Lab to support the restoration of eelgrass beds and implementation of the Department's SAV management plan.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 2: Oyster Beds Mapping
Action: Coordinate the surveying and mapping of oyster beds in conjunction with JEL in developing strategies to enhance oyster bed management.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 3: Hemlock
Action: Maintain the healthy status of hemlock forests by working cooperatively with the US Forest Service (USFS) on a long-term monitoring plan for this species. The plan will include an assessment of hemlock cover, identification of priority areas, investigation of prevention/control methods and implementation of Best Management Practices (BMPs).
Responsible: The Research Coordinator and Stewardship Coordinator will work cooperatively with UNH Forestry Department on a long-term monitoring plan.
Timeframe: Ongoing

Action Item 4: Species of Concern Rainbow Smelt Restoration Project
Action: In conjunction with the Marine Fisheries Division (NHFGD) and the Maine Department of Marine Resources, develop a restoration plan for rainbow smelt. This project will focus on assessing the threats to smelt populations and their habitat including water quality. It will also clarify the role of periphyton on the hatchability of smelt eggs.
Responsible: Research Coordinator
Timeframe: Short-Term

<u>Human Impacts on Wildlife Habitats</u>

Objective 4:
Actively participate in and support efforts to promote land conservation and land use regulations that are consistent with the Reserve's goals and policies.

Action Item 1: Land Protection Efforts - GBRPP
Action: Support the land protection efforts of the GBRPP through participation of Reserve staff and work with NHFGD to identify lands that enhance the mission of the Department to protect and manage wildlife.
Responsible: Stewardship Coordinator/Manager
Timeframe: Ongoing

Action Item 2: Information collection and dissemination
Action: Provide information to coastal decision makers regarding shoreline buffer regulations and practices, and work with NHDES to strengthen the enforcement of existing State regulations.
Responsible: Stewardship Coordinator/CTP Coordinator
Timeframe: Ongoing

Action Item 3: Regulation
Action: Work with NH Port Authority to identify sensitive areas (e.g., eelgrass and oyster beds) to adopt more formal rules to be used in regulating moorings and boat activities in the Great Bay estuary.
Responsible: Manager
Timeframe: Mid-Term

Action Item 4: Community Planning for Sprawl
Action: Continue working through NROC to utilize "smart growth" strategies, developed by the EPA, US DOT and HUD that seek solutions to the environmental, social and economic problems posed by sprawl.
Responsible: CTP Coordinator
Timeframe: Ongoing

Water Quality

Objective 5:

Promote the monitoring and improvement of water quality throughout the Great Bay estuary.

Action Item 1: Dredging
Action: Continue to coordinate with NHDES and NHCP for all dredging projects that will impact the estuary.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 2: Communication
Action: Maintain and strengthen communication between all parties engaged in testing for oyster pathogens within the Great Bay estuarine system and create a central source for information on testing results.
Responsible: Research Coordinator
Timeframe: Ongoing

Action Item 3: Water Quality - Monitoring Well Program
Action: Continue to support the assessment of the quantity and quality of groundwater inflow into Great Bay through the CICEET monitoring well program and work with communities to help them protect groundwater supplies.
Responsible: Research Coordinator/CTP Coordinator
Timeframe: Ongoing

Action Item 4: Public Education and MTBE
Action: The Reserve will work with NHDES to educate the public about the potential threats from high levels of MTBE in local drinking water supplies.
Responsible: Education Coordinator
Timeframe: Ongoing

Action Item 17: Oil Spill Contingency Plans
Action: Meet regularly with NHDES officials to review oil spill contingency plans and develop a database of commercial fisherman for notification of spills and boat assistance. The Reserve will also work with NHDES to identify additional staging areas for using booms and cleaning birds.
Responsible: Reserve Manager/Stewardship Coordinator
Timeframe: Ongoing

Chapter VII
Stewardship

A. Introduction

The Great Bay watershed has a combined total area of 1,084 square miles. The watershed is a diverse mosaic of important habitats including tidal and freshwater wetlands, salt marsh, mudflats, eelgrass beds, tidal channels and fields and forests (Short 1992a). The Great Bay watershed supports several species of concern, both federally and State endangered or threatened, and rare plant communities such as Atlantic white cedar.

The watershed is composed of fifty-four municipalities, 43 of which are in New Hampshire (ten in Maine and one in Massachusetts). Based on 1995 census data from the New Hampshire Office of State Planning, the New Hampshire portion of the area has a population of 250,000 residents. New Hampshire is also the fastest growing State in the northeast, with a 6.8% population gain from 1990 to 1998. The growth rate is expected to triple by 2020, with 85% of the growth concentrated on 33% of the land area in the State, principally in the four southeastern counties (including the two coastal counties, Rockingham and Strafford) (Sundquist and Stevens 1999).

The intense development pressures and population concentration being experienced by the New Hampshire seacoast has created significant and imminent threats to maintaining clean water, species diversity and unfragmented natural habitats. In response, many private and public conservation organizations have been active in efforts to protect significant habitat areas.

Landowner interest in sustaining and enhancing native wildlife populations remains high. There is a need to provide technical input that will assist decision-makers at the federal, State and local levels and guide land protection efforts. As a stakeholder in this region, the Reserve has been involved in developing and participating in activities, programs and partnerships that are designed to adequately deal with development pressure by using sound stewardship practices and services. The NH Fish and Game Department (NHFGD) is also in the process of completing a statewide Wildlife Action Plan.

In 2000, the Reserve hired a fulltime Stewardship Coordinator for the purpose of implementing a stewardship program at the Reserve. The coordinator is involved in preparing detailed management plans for individual properties, developing a property monitoring program, determining restoration strategies, overseeing the Reserve's GIS program, and a variety of other programs involving invasive species, rare and endangered species, and research and education.

B. National Estuarine Research Reserve System Stewardship

Over the past five years, the National Estuarine Research Reserve System (NERRS) has been working to create a national stewardship program based on the following priorities:

1. Reserve staff will have habitat and mapping protocols to characterize and monitor short-term variability and long-term trends in the extent and quality of estuarine habitats.

2. Identification of stewardship goals and ecological indicators will be based on public involvement.

3. Management and restoration of the tideland and upland habitats and ecosystem processes associated with the Reserve will be based on experimental design methodologies to the extent practicable.

4. Managers and advisory groups throughout the biographic region focusing on habitat restoration and management will have access to technical support from the Reserve.

National Restoration Initiative

NERRS has proposed a strategy to develop a system-wide approach to restoration science as described in the following goal and objective:

Goal:
To provide the scientific basis and technical expertise to restore, enhance and maintain estuarine ecosystems.

Objective:
To develop and transfer effective standardized techniques to identify, prioritize, restore, and monitor degraded or lost coastal habitat. Success will require a partnered approach, education and community involvement, regional coordination, and additional resources.

C. GBNERR Stewardship

The Reserve has incorporated the national priorities established by the National Estuarine Research Reserve System (NERRS) to develop a comprehensive stewardship program.

Stewardship Goal

Maintain the ecological integrity of the Great Bay region by using a comprehensive stewardship approach to education, land acquisition, land management, and research and monitoring.

Five primary management concerns were identified in the Great Bay National Estuarine Research Reserve's (GBNERR) 1989 Management Plan (NH Office of State Planning 1989). These were public awareness, impacts of increased visitor usage, maintaining the productivity and diversity of the estuary, the need to continue surveillance and enforcement, and to create a comprehensive resource database.

Current stewardship issues include endangered species management, maintaining biodiversity, protecting fisheries, controlling invasive species, urban sprawl and habitat fragmentation, protecting cultural resources, and preventing pollution.

To address these issues, different approaches are used. Reserve education staff and the Department's Public Affairs Division have greatly increased public awareness of the Reserve and the resources of the Bay. Visitor usage is rapidly increasing and will continue to be an ongoing issue. In large part, public access is controlled by the availability of parking.

Maintaining productivity and diversity has been greatly enhanced by the Reserve's acquisition of key properties and habitats making land management a focus of future stewardship activities. This effort has helped to minimize the effects of habitat fragmentation caused by rapid development.

Database needs have largely been met through GIS. This work has been done in partnership with the University of New Hampshire's Complex Systems Office and NHFGD as well as the State's Information and Technology office. A large-scale printer has been purchased by the Reserve in order to increase the capacity to produce full-size maps.

Public participation is a key part of this strategy. In addition to soliciting volunteers to assist with land management, a major priority of the Reserve is to promote compatible uses of the lands while maintaining long-term traditional uses such as hunting, fishing, bird watching and hiking. Most NHFGD lands are managed under a multi-use framework and are open to the public. Closures may occur to protect endangered and rare species and under other special conditions.

The Reserve serves as a clearing-house of information regarding watershed-wide natural resource issues. Through workshops, publications and partnership, the Reserve provides accurate information to the public. Many projects and endeavors fall under the NERRS Coastal Training Program (see Chapter IX, Education, Outreach and Interpretation).

Habitat Protection and Stewardship

1. Partners in Habitat Protection and Management

Diverse habitat is critical to sustaining a variety of fish and wildlife populations. Changes in habitat can directly affect a species' ability to forage and reproduce successfully. The Reserve's stewardship efforts are primarily focused on intertidal and upland land management on fee owned lands within the Reserve boundary. The uplands and intertidal habitat areas of the Reserve are managed by NHFGD in cooperation with State and local partners.

New Hampshire Fish and Game Department

As the lead agency for the Reserve, NHFGD is responsible for managing properties within the boundary. All of the Reserve's lands are designated as Wildlife Management Areas (WMAs), which are managed by rules and regulations according to State statute. For a complete description of these rules, see Appendix C**.**

Surveillance and enforcement is done through the Department's Law Enforcement Division (LED). Their activities include the enforcement of hunting and fishing regulations as well as controlling the use of snowmobiles and other mechanized recreational vehicles. Reserve staff works closely with Conservation Officers to monitor existing lands and how best to handle problems as they arise. In order to improve enforcement activities, the Stewardship Coordinator also keeps LED informed of new properties that have been acquired by the State and are managed by the Reserve.

The Executive Director has the authority to both establish areas for the protection and propagation of fish, game and marine species (State statute 212:19), to temporarily close areas to hunting and fishing (State statute 206:15-A), and to limit all terrain vehicles (ATVs) and trail bike usage (State statute 215-A:42). This authority is particularly important when managing for threatened or endangered species.

The Director also has the authority (State statue 212:19) to grant special use permits to control activities not covered by the rules for WMAs. NHFGD has developed a list of procedures that must be followed before a special use permit may be granted. This process allows all divisions to provide input before a permit is granted and to insure that Department lands are used in a manner consistent with management priorities.

The Lands Team is responsible for overseeing the management of the Department's WMAs as well as approving agricultural agreements with private individuals. They also are involved in developing appropriate signage and access. The Stewardship Coordinator is a member of the Lands Team and works closely with them to ensure the proper management of Reserve lands.

NHFGD is also in the process of completing a Wildlife Action Plan (WAP) for the State (due to be released in 2006). The Department worked with over 100 representatives from across the State to identify the priority conservation issues that make up the Plan. Via a web survey, over 1,250 individuals provided additional input. A core of biologists then selected 123 species and 27 habitats in greatest need of conservation. Four major elements were addressed in developing 131 species and habitat profiles: distribution and habitat, species and habitat condition, risk assessment, and conservation actions. The Plan will be used to help communities integrate wildlife habitat conservation into decisions in planning and regulating future development.

The Reserve will work with the Department in implementing the Plan. There is a critical need to obtain, store and manage data on the status and condition of wildlife within the Reserve. Current information is essential in providing the best conservation science and monitoring of the ecological health of species and related habitats. The next step following the release of the Plan will be to develop indices of relevant Great Bay species. Performance indicators can then be developed for priority species, which will allow for more informed decisions in acquiring future Reserve lands.

Great Bay Resource Protection Partnership (GBRPP)

The Great Bay Reserve was a founding member in 1994 of the Great Bay Resource Protection Partnership. The Nature Conservancy (TNC) is the lead negotiator and acquisition agent for the Partnership. Between 1995 and December 2004, the Partnership protected a total of 2,522 acres (33 properties) in the Great Bay region.

In the Crommet Creek Watershed and Great Bay Management Plan (Brickner-Wood and Bechtel 2000), the partners have identified several goals relating to the development and implementation of a landscape management approach that seeks to preserve lands in the Great Bay watershed as an identified conservation area:

- To maintain or improve current distributions of waterfowl and other migratory bird populations, and to help maintain optimum population levels, distributions, and patterns of migration.

- To protect, enhance, restore, and manage an appropriate distribution and diversity of wetland ecosystems and other habitats essential and significant for migratory birds, fish, shellfish and other wildlife.

- To protect, enhance, restore, and manage exemplary natural and characteristic coastal natural communities and habitats for rare, threatened, and endangered species of animals and plants, and natural communities.

- To provide for quality public recreational and educational opportunities compatible with the waterfowl and wildlife resources and their management.

- To manage a project area from a landscape perspective that adheres to sustainable designs that respects and protects the integrity of the entire ecosystem.

These principles are being integrated with NHFGD priorities to guide management decisions for Reserve properties. The Partnership is also involved in developing a trail system corridor that will increase public access while protecting critical habitats from potential human impacts.

US Fish and Wildlife Service (USF&WS)

The Great Bay National Wildlife Refuge is located within the proposed 2005 boundary of the Reserve. Opened in 1996, the site includes six miles of shoreline along Great Bay and totals 1,054 acres. The Reserve works with the Refuge to promote stewardship activities around the Bay. The Refuge is also a member of the Great Bay Resource Protection Partnership. Future activities include the restoration of salt marsh areas within the Refuge.

Marine Protected Areas (MPA)

In 2000, the President signed Executive Order 13158 on Marine Protected Areas to strengthen the protection of U.S. ocean and coastal resources. Executive Order 13158 defines MPA as "any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." These areas can include a wide variety of sites established for different purposes in areas of coastal and ocean waters. Great Bay NERR is included on the list of marine managed areas, which provides a framework for developing activities and programs that promote stewardship.

University of New Hampshire (UNH) Complex Systems: Geographic Information System (GIS) Mapping

The Great Bay Reserve works with the UNH Complex Systems Research Center for GIS mapping services. Complex Systems is linked to the State's Geographically Referenced Analysis and Information Transfer (GRANIT) program and is the leading producer of GIS information in New Hampshire. To assist with stewardship issues, Complex Systems has developed land use cover type maps to assist in directing appropriate resource management decisions.

Complex Systems has produced a Coastal CD-Rom for coastal decision-makers that includes:

- Background information on estuaries.
- Land-use planning tools.
- GIS data specific for each municipality.

NHFGD has established a GIS component as well and is working with the Reserve to enhance and improve GIS capabilities. This work is coordinated through the State's Information and Technology (IT) office. The Reserve's Stewardship Coordinator has full access to GIS and works with the Department's GIS coordinator to maintain appropriate databases.

The Reserve also has access to a new water quality monitoring and modeling program developed by the USGS called SPARROW (Spatially Referenced Regressions on Watershed Attributes). For example, there is currently a UNH research project to study nitrogen in NH's coastal watersheds using this program.

2. Cooperative Stewardship

During the 1980's, prior to 1994 and the Great Bay Resource Protection Partnership's land acquisition program, several properties were permanently protected within the Reserve boundary by public agencies and private organizations through a State funding source known as the New

Hampshire Land Conservation Investment Program (LCIP). Coordinated through the NH Office of State Planning (OSP), the program was responsible for all of the initial lands added to the Reserve that were not already part of NHFGD.

A key aspect of this highly successful program was to ensure long-term stewardship on permanently protected properties. Reserve easements with support from NHFGD will be monitored annually in partnership with the NH Land Conservation and Heritage Investment Program (LCHIP) under the Governor's Office of Energy and Planning (formerly OSP), including the Wiggin, Smaz, Conway, and Salt River easements.

Community Land Stewards

In 2001, the Community Land Stewards were formed to assist with managing NHFGD and Reserve lands. The volunteers are trained to monitor activities on protected properties (currently 15). The volunteers participate in a variety of activities determined by the property they steward. Activities may include:

- Invasive species control
- Trash pick up and monitoring for illegal dumping
- Participating in wildlife enhancement projects
- Monitoring recreational uses and trail maintenance

The Reserve plans to expand the program in 2006 to include more formal training for volunteers and to expand the number of properties being monitored.

University of New Hampshire Wildlife Management Students

UNH Wildlife Management students are required to complete a semester long, final year project. Through a cooperative effort with the Wildlife Management Program, a class and lab on the Reserve and Partnership lands is provided to students, which includes completing a detailed resource inventory (such as soils, vegetative cover types, invasive species and wildlife) and an outline of management plan guidelines for the property being studied. At the end of the semester students must present their findings to the class and Stewardship Coordinator. This effort began in 1999 as an integrated approach to education and stewardship.

Technical Assistance for Public and Private Landowners

Technical assistance is offered to private and public landowners through consultation in the development and review of property management plans. The location, character and condition of critical and significant habitats are identified and recommendations prepared to mitigate the effects of potentially adverse land management activities. Consistent with landowner objectives, Reserve and NHFGD staff offers opportunities to enhance habitat conditions for species of interest or concern. This work complements the efforts of UNH's Cooperative Extension Service, which serves as a valuable resource for private landowners. See Appendix D for a New Hampshire Guide of Programs for Conservation.

GBNERR Restoration

The history of the Great Bay estuarine system reveals that despite over 350 years of human impact, it remains relatively intact and remarkably resilient. Prior to 1900, all of the major rivers were dammed and extensive logging occurred throughout the watershed. Since that time, significant

human population growth and development has further altered and degraded habitats throughout the estuary. In 1942, UNH professor C.F. Jackson (namesake of the UNH Jackson Estuarine Lab) documented the steady declines of several key species that occurred over a long period of degradation. However, it is only in the past thirty years that we have begun to establish baseline data about the status of important species and habitats.

As a result, the Reserve has placed an increasing emphasis on the need for restoration. NHFGD and NH Coastal Program (NHCP) are currently developing a dam removal priority list for the next five years. Restoration of fish habitat will be a key component of this effort.

Great Bay Reserve Restoration Team

The Great Bay Reserve is working in partnership to assess the restoration needs of the Great Bay region. The Reserve's Research Coordinator serves on a team with NHFGD, TNC, NHCP, NHEP and JEL to determine the restoration needs of the Great Bay estuarine system. The effort includes working with the NH Department of Transportation (NHDOT) in identifying appropriate restoration projects associated with road improvement projects.

At the same time, TNC is partnering with JEL to publish a Great Bay Estuary Restoration Compendium (to be released in 2006). Restoration targets include salt marshes, eelgrass beds, oysters and softshell clams, and seven diadromous fish species. The document will serve as a useful reference guide in developing a restoration plan for GBNERR.

Future Threats

Climate change is an emerging threat to New Hampshire's native communities. Rising temperatures, increases in the frequency of extreme hot days, changes in precipitation and more intense storms are likely events if the rate of climate change accelerates. Each of these potential changes could affect the distribution and survival of native species and the natural communities that support them (New England Regional Assessment Group 2001). For example, milder winters are expected to increase the vulnerability of forests to insect pests such as the hemlock woolly adelgid.

Coastal ecosystems are also expected to be significantly affected by sea level rise, a result of climate change. This may cause increased flooding, loss of coastal wetlands and shoreline erosion (New England Regional Assessment Group 2001). Sea level rise has already risen by up to seven inches in Portsmouth Harbor over the past 100 years, and is expected to rise at least another 18 inches by 2100 if not earlier (U. S. EPA 1997). Because the coastal region of New Hampshire is highly developed for human use, ecological adaptation to climate change and rising sea levels may be especially difficult resulting in a greater need to develop appropriate restoration strategies.

D. Stewardship Objectives and Action Items

Objective 1: Stewardship Monitoring Programs

Expand the land monitoring program and increase opportunities for volunteers to participate in these efforts.

Action Item 1: Monitor Conservation Easements

Action: Monitor conservation easements on an annual basis and provide opportunities for landowners to evaluate the Reserve's stewardship role in managing and maintaining properties.

Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Funding for Easement Monitoring
Action: Secure ongoing funding to expand the monitoring of easements by LCHIP through the Governor's Office of Energy and Planning and other appropriate federal and State agencies.
Responsible: Manager
Timeframe: Long-term

Objective 2: Property Management Plans

Develop and implement individual property management plans for the Reserve's newly protected properties based on a priority system developed by the Lands Team and Marine Fisheries Division.

Action Item 1: Develop and Implement Property Management Plans
Action: Conduct resource inventories and complete property management plans for lands owned by NHFGD that are within the Reserve's boundary. Implement plans while adhering to resource conditions and developing a more ecological approach to management.
Responsible: Manager/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Boundary Marking and Signage
Action: Coordinate efforts with the NHFGD Lands Team to mark Reserve property boundaries and post boundary lines as well as primary access points.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 3: Property Maps
Action: Develop individual property maps to keep NHFGD (i.e., Land Resources Bureau, Wildlife and Law Enforcement) up to date on newly acquired lands and lands under conservation easement.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 4: Property Management Database
Action: Develop and maintain a Reserve property management database in coordination with the Land Resources Bureau.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Objective 3: Restoration Projects

Assess, identify and implement property restoration projects on lands owned by NHFGD that are within the Reserve's boundary.

Action 1: Develop a GBNERR Restoration Plan
Action: Work with identified entities to develop a restoration plan for the Reserve.
Responsible: Research Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Implementation of NHFGD Wildlife Action Plan
Action: Work with NHFGD in implementing the Wildlife Action Plan. This includes collecting data on the key species identified in the Plan.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 3: Funding for Restoration Activities
Action: Work with NRCS in developing restoration projects eligible for federal funding under the New Hampshire Wetland Reserve Program (WRP). This is a cost-share federally funded program. Eligible projects include creating public access points, brush management, seeding and fertilizing grassland areas, developing riparian buffers to prevent erosion, invasive species control, wetland restoration and enhancement, and wildlife habitat management.
Responsible: Manager/Stewardship Coordinator
Timeframe: Short-term

Action Item 4: Mosquito Control
Action: Work with local communities to develop methods to control mosquitoes while minimizing the use of chemical spraying. This includes strategic sampling to identify habitats with disease-carrying mosquitoes.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 5: Road Mitigation Projects
Action: Identify road expansion and improvement projects that will impact the Reserve and suggest potential restoration projects prior to construction.
Responsible: Manager/Stewardship Coordinator
Timeframe: Ongoing

Action Item 6: Climate Change
Action: Develop a long-term strategy and restoration plan for dealing with the impacts associated with climate change.
Responsible: Manager/Stewardship Coordinator
Timeframe: Long-term

Chapter VIII
Facilities and Construction

A. Introduction

Facilities are an extension of the Reserve and serve to promote the values of the program and create a unique identity for the public. The facilities are provided through the NH Fish and Game Department (NHFGD) and serve to meet the critical office and programmatic space needs of the Reserve program.

The Reserve's administrative offices are based at the Department's Marine Fisheries Division (MFD) in Durham. The Great Bay Discovery Center in Stratham serves as the Reserve's education headquarters. The facility includes exhibit and office space. Also located on the site is an historic railroad station that is used primarily as a caretaker's residence and the Hugh Gregg Coastal Conservation Center (scheduled to open in 2006). The Gregg Center will provide the Reserve with much needed meeting space. The Department also maintains several other facilities, including boat ramps that are located within the boundary.

B. Facilities and Construction Guidelines and Policies

Facilities and Construction Goal

Enhance the mission of the Reserve and its associated research, education, and stewardship programs through the maintenance and development of facilities necessary to support these efforts.

Facilities and Construction Guidelines and Policies

Accordingly, the Reserve has established three core *guidelines and policies* in developing new facilities.

1. Provide accessible facilities to fulfill the Reserve's mission while complying with the requirements of the Americans with Disabilities Act.

2. To the greatest extent possible, facilities will be designed and located to meet multiple needs and reduce maintenance costs.

3. Design facilities in support of the Reserve's mission to protect and improve the environment by incorporating sustainable features such as:

    - Promoting energy efficiency and using alternative energy sources
    - Installing composting toilets where feasible and other water conservation techniques
    - Designing parking areas that minimize runoff
    - Reducing disturbance of the surrounding terrain
    - Utilizing locally produced products

The planning process for any new facilities will include soliciting input from user groups expected to use the facility and neighbors affected by the project.

1. New facilities should serve as examples to the surrounding communities and visitors on how to best site and construct buildings and other structures. The process should include interpretive materials that convey the appropriate information (i.e., brochures, interpretive signage, computer programs, web page, etc.).

2. All landscaping should utilize native plants and other natural products that encourage others to follow suit.

3. Efforts to increase public access to Reserve managed properties should be done in a manner that minimizes any and all environmental impacts.

4. The Reserve should serve as a model for sustainable development practices.

C. Existing Facilities

The Great Bay National Estuarine Research Reserve maintains and manages a variety of physical facilities that include: buildings, outdoor structures, trails and boardwalks (see **Figure 7.1**).

1. Administrative Offices

The Reserve Manager and Research Coordinator are based at the Marine Fisheries Division headquarters on the University of New Hampshire campus in Durham. Twelve MFD staff members are located here, including a Division Chief, executive secretary, two wildlife biologists, and eight fisheries biologists and technicians. In addition, there are seasonal staff as well as local Conservation Officers for the seacoast region based here.

2. Storage Barn

Also located in Durham off Route 4 is a storage barn. This old New England-style barn came with a property purchased by the Great Bay Resource Protection Partnership and was turned over to NHFGD. The building is primarily used as winter boat storage for the Reserve and MFD as well as long-term storage for equipment. Based on space, other groups that work with the Reserve such as The Nature Conservancy may also store their boats there in the winter. Numerous repairs have been made to the structure over the past two years to keep it dry and secure.

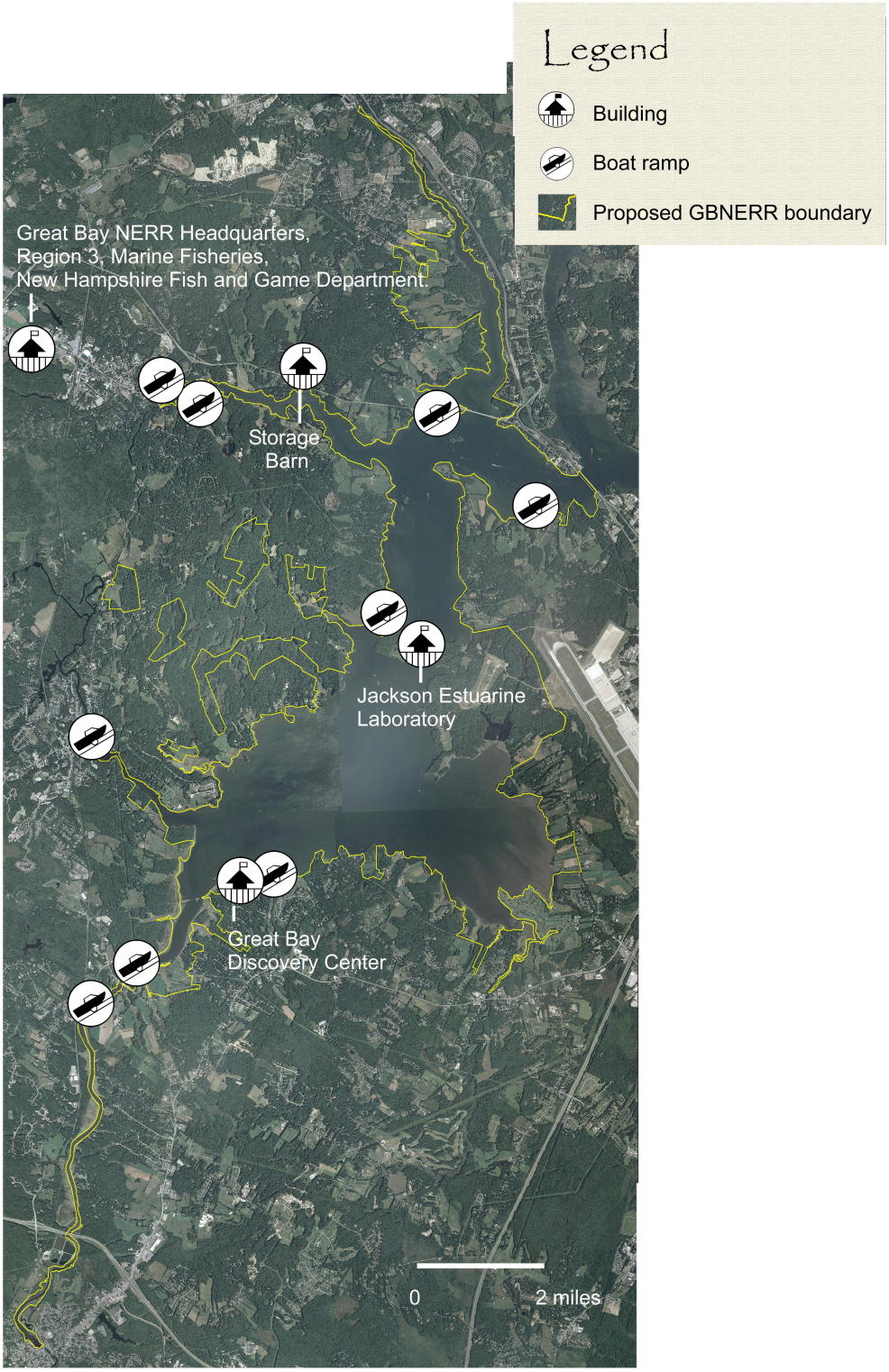
3. Great Bay Discovery Center and Grounds

The Great Bay Discovery Center Building

The primary building managed by the Reserve is the Great Bay Discovery Center, located on the shores of Great Bay in Stratham, NH. The Discovery Center officially opened in 1996 and serves as the Reserve's education headquarters and interpretive center.

The Discovery Center is located on a 50-acre site of mixed-upland forest, freshwater wetlands, and extensive salt marshes. The Discovery Center main building includes 5000 ft^2 of exhibit space on the main floor. Most of the education programs are run from this facility.

Figure 7.1 Great Bay NERR Facilities



The second floor of the Discovery Center includes a conference room and office space for most of the Reserve's employees. As the staff and programs at the Reserve have grown, space requirements need to be reassessed. Presently, in addition to seasonal workers, seven staff members work out of the Center:

1. Education Coordinator
2. Assistant Education Coordinator
3. Coastal Training Program Coordinator
4. Stewardship Coordinator
5. Volunteer Coordinator (part-time)
6. Park Guides (two positions, both part-time)

Depot Building

Adjacent to the Discovery Center is the Depot House. The building is a historic train station purchased in 1998 as living space for a caretaker and overnight accommodations for visiting researchers. The Reserve has upgraded its appearance by repainting the exterior to its original, historic colors. In addition, the property provides limited access to the Wiggin family cemetery and former house site (documented as a contact site with Native Americans).

Grounds

The Reserve also maintains a boardwalk, an outdoor pavilion, an amphitheater, trail system, native gardens and boat launch at the Center.

Boardwalk

The Reserve maintains a 1,700 ft. fully handicap accessible boardwalk and trail system that extends out into the salt marsh, offering year-round visitors a spectacular view of the Bay.

Gardens

The Discovery Center native gardening program began in 1998, and offers nine gardens. The gardens are planted with native plants and are accompanied by a descriptive "Growing Native" brochure.

Outdoor Gathering Spaces

On the grounds of the Great Bay Discovery Center there are two outdoor gathering places for staff and visitors:

- The pavilion, built in 1997, is a covered, power-supplied building overlooking the Bay.
- The outdoor amphitheater, built in 1999, is located in front of the Center and can seat up to 100 people.

Boat Launch

On the shores of the Bay is an access point and boat landing (limited tidal access and primarily used by small boats only).

Other Recreational Facilities

Other passive recreational facilities include an interpretive trail and boat launch at Adams Point in Durham (property maintained by NHFGD), and the site of the Jackson Estuarine Lab. This is a popular walking trail along a rocky shore portion of the Bay and offers views of Little Bay and

Great Bay. The Evelyn Browne Trail is located here and includes a trail guide that interprets the human history of the estuary.

D. Facility Needs

Since the Discovery Center's opening in 1996, the rapid success and increased participation of the Reserve programs has heavily impacted the Reserve's facilities. The Discovery Center is now being used at nearly full capacity. The offices at the NHFGD Marine Fisheries Division in Durham have also reached capacity limits. The increasing staff and program demands have created a need for additional office space and large meeting space.

There is great demand for the Reserve and other Great Bay based organizations and agencies to offer the public greater access to land. This is due to several factors. The primary factor is simply the significant increase in population that the seacoast of New Hampshire has experienced in the past two decades. Secondly, the increased exposure of the Reserve and other conservation efforts both in the media and through visitation has peaked interest (see Chapter XI, Public Access).

Facilities and grounds also require stewardship and management. Property management provides an opportunity to maximize the public's understanding of natural and cultural history as well as provide opportunities to deliver the Reserve's mission to new audiences (see Chapter VII, Stewardship.) Proper signage helps to identify the property and clearly mark trails, while informational materials such as interpretive brochures and informational kiosks serve an educational function.

There are five general areas of facility development to be addressed. All these areas are linked to Reserve programs and address needs outlined under the facilities and construction mission as follows:

1. Program and exhibit space
2. Trail and boat access
3. Office space
4. Visitor housing
5. Maintenance

1. Program and Exhibit Space

The rapid growth of public and school programs at the Discovery Center has greatly impacted the existing facility. Since 1996, usage at this facility has increased four-fold. A portion of this increased usage has been directed to the facilities located outside - people taking advantage of the pavilion (1997) and amphitheater (1999). The only indoor, fully protected meeting area at the Discovery Center is in the orientation room; the space is limited to less than 30 people. Additional indoor meeting space is a critical need.

Proposed Program Space – Coastal Conservation Center

In 2004, construction began on the Coastal Conservation Center. Designed to replicate an old New England hay barn, this facility (40 by 60 feet) will provide much needed program and training space. The facility is located immediately adjacent to the Discovery Center and provides easy access to the existing grounds and trail system. Its proximity next to the upland forest makes it an ideal site as a bird viewing area. The facility is being named after former Governor Hugh Gregg, who passed away in 2003.

The building will include two levels – a main floor and a lower level. The main floor will have a large meeting room to accommodate up to 200 people theatre style and offer additional exhibit space. The lower level will include a lab and classroom. A geothermal heating and cooling system will be installed as well as composting toilets. Exhibits will focus on the upland habitats of the estuary, showcasing recently acquired properties by the Reserve. The parking lot will be paved using a porous pavement process that was developed by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). The facility will be officially opened in 2006 and available for holding events and meetings while the lab and exhibits will be done over the next two years.

Chapman's Landing

Chapman's Landing on the Squamscott River currently offers all-tide boat access, ample parking as well as toilet facilities. Due to its proximity to the salt marsh and an osprey nest, NHFGD has designated this area as a Watchable Wildlife site and has recently installed a bird viewing observation deck. It includes a handicap accessible spotting scope.

2. Trail and Boat Access

Population growth and the addition of conservation lands in the Great Bay region have contributed to the demands for increased access to the Bay and other related recreational facilities. Several existing Reserve properties have been identified for new or improved access.

Trail Access

Sandy Point Boardwalk

The Sandy Point Boardwalk opened in 1992. It is a 1,700-foot interpretive trail that is fully handicap accessible. The boardwalk will need to be renovated within the next five years.

Wiggin Cemetery

The Sandy Point property includes the historic Wiggin cemetery where the State has been conducting archaeological digs since 1998. Access to the property is limited due to the Boston and Maine Railroad tracks. A proposed trail starting from the back of the Depot Station to the cemetery would allow visitor access to this historic site and provide an excellent opportunity for interpretive historical displays.

The proposed boundary expansion will enable the Reserve to significantly increase the amount of land under its jurisdiction. Since 1995, the collaborative land acquisition efforts of the Reserve and the Partnership have provided a number of opportunities for increased public access (see Chapter VI, Resource Protection Plan and Chapter XII, Boundary and Acquisition Plan). The Reserve plans to develop a recreational trail system with appropriate trailhead and parking locations on recently acquired lands that have been designated as buffer areas.

Possible trail routes include:

- ***Cocheco River (Martineau Property), Dover***
  The NHFGD tract connects directly to downtown Dover and offers exceptional access to the shoreline of the Cocheco River. The site also could be utilized as a launching site for the Reserve's kayak program. Currently, the Reserve has no public access points to the Cocheco. Due to its proximity to the City of Dover downtown, this tract of undisturbed

forest and shoreline provides an excellent opportunity for the Reserve to increase its recognition within this part of the watershed.

- ***Weeks Point, Greenland***
  The scenic property is located on Great Bay and features 1,000 feet of shoreline. The property contains a mixture of varied habitats including rocky shore, well-maintained hay fields and mixed forest types. Once appropriate parking is established, this site will draw visitors for year-round passive recreational activities. With its close proximity to Sandy Point, it provides an alternative location to send visitors.

- ***Crommet Creek Management Area, Durham***
  Crommet Creek is a high priority project area that the Partnership has focused on since 1994. The total area includes 3,000 acres of relatively undisturbed forests and wetlands. Several key parcels on land in this area have already been protected and additional properties are targeted for future conservation efforts (see Chapter XII, Boundary and Acquisition Plan).

  The Reserve and NHFGD will play a key role in managing many of these properties. There are several trail opportunities and a potential trailhead that offers easy access to downtown Durham and UNH. This area represents the largest tract of protected forested wetlands in the seacoast region and is an ideal location for public access.

- ***Jewell Hill (Pearson), Newmarket***
  Located in Newmarket, this tract abuts several properties owned by The Nature Conservancy. It offers spectacular views of the Bay and backs up to Crommet Creek providing a linkage to a trail system in that area.

Boat Access

There are three primary boat access points around the estuary that are managed by NHFGD and that are located within the existing Reserve boundary:

1. Adams Point
2. Chapman's Landing
3. Depot Road/Great Bay Discovery Center

The acquisition of new properties has increased potential opportunities for additional boat access. The Reserve plans to develop strategies, working in concert with NHFGD, to offer new boat access points. There is also all-tide boat access at Hilton Park in Dover, just outside the boundary.

3. Office Space

Office space for Reserve personnel is located at the Discovery Center and the Marine Fisheries Division building. The Center houses seven staff plus seasonal employees and interns. Two staff members are located at the Marine Fisheries building (Manager and Research Coordinator). Lack of adequate office space is an issue at both facilities.

To address this need, the Reserve plans to work with the Marine Fisheries Division to investigate alternative office space opportunities. Plans are also underway to expand the Marine Fisheries building to include additional offices. This would provide additional office space and may involve moving personnel from the Discovery Center to Marine Fisheries.

4. Researcher Housing

The Reserve has limited residential space for visiting researchers and other guests at the Depot Station. Additional housing options would allow the Reserve to attract a larger pool of scientists and others to Great Bay. Several of the Reserve's recent land acquisitions include structures that were previously used as private homes that could potentially provide additional housing space.

5. Maintenance

The Reserve has a maintenance plan for the Great Bay Discovery Center. The document provides a detailed description of indoor and outdoor maintenance of the facility. The plan encompasses both long range planning and on-going maintenance (weekly and monthly tasks) and is reviewed on an annual basis.

As properties with facilities are acquired and placed under Reserve management, maintenance plans will be written and followed by Reserve staff. Where appropriate, the Reserve works with the NHFGD staff on grounds upkeep and facilities repair. Due to the proposed boundary expansion and addition of protected properties within the boundary, the Reserve and NHFGD will continue to develop strategies for maintaining these newly acquired lands.

E. Facilities and Construction Objectives and Action Items

Objective 1: Program and Exhibit Space

Increase the amount of program and exhibit space with an emphasis on providing additional meeting and classroom areas.

Action Item 1: Education Center Construction
Action: Design and construct an education center with program and meeting space immediately adjacent to the Discovery Center.
Responsibility: Education Coordinator
Timeframe: Short-term

Objective 2: Trail and Public Access

Provide appropriate increased trail and public access on properties added to the Reserve through the land acquisition efforts of the Partnership.

Action Item 1: Great Bay Discovery Center Boardwalk
Action: Renovate the existing boardwalk at the Great Bay Discovery Center and expand the number of interpretive features along the trail.
Responsibility: Education Coordinator
Timeframe: Long-term

Action Item 2: Trail Access
Action: Provide trail access to the historic Wiggin cemetery at Sandy Point via the Depot Station.
Responsibility: Education Coordinator
Timeframe: Short-term

Objective 3: GBNERR Office Space Needs

Create additional office and workspace to meet the needs of the Reserve staff.

Action Item 1: Office Space NHDFG

Action: Develop a plan for expanding the Reserve's administrative offices at the Marine Fisheries Division.
Responsibility: Reserve Manager/Marine Fisheries Chief
Timeframe: Mid-term

Objective 4: Maintenance of Reserve Facilities

Develop a comprehensive facilities and maintenance plan for the next five years to meet the future needs of the Reserve.

Action Item 1: Facilities Maintenance Plan

Action: Establish, follow and update maintenance plans as needed for facilities and grounds, thereby ensuring that all Reserve facilities and grounds are operational and in good condition.
Responsibility: Manager
Timeframe: Short-term

Action Item 2: NHDFG - Facility Responsibilities

Action: Define the maintenance roles and responsibilities for all Reserve facilities and properties.
Responsibility: Manager
Timeframe: Short-term

Chapter IX
Education, Outreach and Interpretation

A. Introduction

Critical elements of the National Estuarine Research Reserve System's (NERRS) mission are education, interpretation, and outreach. In part, a Reserve must "...serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation."

Since its designation in 1989, the Great Bay National Estuarine Research Reserve (GBNERR) has implemented a wide range of educational activities for a broad spectrum of audiences. Once the Reserve administrative office was established in Durham (1990), the first programs were directed towards teachers training.

The Sandy Point property, located in Stratham and Greenland on the south side of the bay near the mouth of the Squamscott River, was identified as the key location for presenting educational programs. This fifty-acre site features a wide variety of habitats including some of Great Bay's most extensive salt marshes. The first programs held here involved workshops for teachers on salt marsh ecology and field trips for small groups of students, led by Marine Docents from the University of New Hampshire's (UNH) Sea Grant program.

In 1992, the Reserve contracted with the Gundalow Company (then under Strawbery Banke) to bring the Captain Adams Gundalow to Sandy Point for visiting school groups. The Captain of the vessel presented an overview of the cultural history of the bay, using the Gundalow as the backdrop. This program has been expanded to include a wider range of cultural events and remains our most popular school activity.

In 1996, the Great Bay Discovery Center was opened at Sandy Point in Stratham and continues to serve as the educational headquarters for the Reserve. The Center includes dedicated exhibit space with two saltwater tanks (1,000 square feet), an orientation room, a bookstore, and office space for 6-8 staff members. Outside there are additional exhibits including two model boats (a lobster boat and a Gundalow), a 1700-foot interpretive boardwalk and accessible trail, an educational pavilion, an amphitheater, and a Native American village.

Other facilities located at Sandy Point are the Depot Station, which serves as a caretaker residence, and the Hugh Gregg Coastal Conservation Center. The Gregg Center will provide additional meeting space and is scheduled to open in 2006.

The 1989 Management Plan (NH Office of State Planning 1989) identified two general educational goals: to provide a wide range of opportunities for the public and others, and develop educational tools to be disseminated. There also were five general objectives: help translate relevant research, establish a visitor's center, provide a variety of on-site experiences, develop a strong outreach effort, and encourage partnerships. All of these objectives have been met. While the emphasis has been on youth, the Reserve offers programs to all the audiences previously identified.

Forming partnerships have been a key to the Reserve's success. Working closely with UNH Sea Grant, marine docents are recruited and trained to help lead school programs. Sea Grant also sponsors boat trips in the Reserve. Much of the research within the estuary occurs at the Jackson

Estuarine Lab (JEL) and the Reserve staff works with scientists to interpret their research (i.e., eelgrass restoration, water quality efforts, etc.). The NH Coastal Program (NHCP) provides important information to local boaters and recreational enthusiasts. The NH Estuaries Project (NHEP) also works with the Reserve to distribute materials to the general public. Finally, the Great Bay Stewards were formed to serve as a friends group and offer educational programs as well.

In addition to the Discovery Center becoming known as a center of excellence for estuarine education, the Reserve holds activities at other key locations around the bay. The most successful of these has been an interpretive kayak program. Started in 1999, this program brings participants to locations throughout the entire estuary and has been extremely popular.

The 1989 Management Plan (Office of State Planning 1989) also outlined many specific recommendations for guiding future programs. While almost all of these programs were eventually implemented in one form or another, they have evolved in response to changing needs and a growing demand for information and materials. For example, the Researcher-in-the-School Program was never very successful. Instead, the Reserve has developed discovery boxes that allow a teacher in the classroom to focus on a specific subject (i.e., salt marshes, horseshoe crabs, etc.). The next step would be to use the national program, Estuary Live, to have the researcher in the field connected to the classroom.

The Reserve also put a great deal of effort into developing publications. In addition to a quarterly newsletter, there are numerous trail guides, a general brochure and map, a kid's activity booklet, a bird checklist, and profiles of individual estuarine species. All of these publications serve to deliver the Reserve's message to a broad audience. In partnership with UNH Sea Grant, there is a Great Bay Radio program that allows vehicles traveling through the Reserve to access local data and information about programs and natural history.

The success of these programs creates a strong foundation for conducting future activities. While the emphasis is on coastal training, there are many other avenues to continue to build upon to expand the educational opportunities. The most pressing need is for a dedicated meeting space for classroom activities and for training programs.

B. NERRS Education Goals and Priorities

National Estuarine Research Reserve System (NERRS)

To design and implement a comprehensive program of education and interpretation based on solid scientific principles that strengthen understanding, appreciation and stewardship of estuaries, coastal habitats and associated wetlands.

1. Education Plan

Under federal regulations 15 C.F.R. 921.13(a) (4), NERRS 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 Reserve System 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.

2. NERRS Education Goals

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education policy at Great Bay NERR is designed to fulfill the Reserve System goals as defined in the federal regulations under 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.

3. NERRS Education Objectives

Education-related objectives in the Reserve System Strategic Plan 2005-2010 include:

1. People are aware of the ecological, economic, historical, and cultural importance of estuarine resources.

2. People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems.

3. People apply science-based information when making decisions that could impact coastal and estuarine resources.

4. NERRS 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.

CTP 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. CTP 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.

C. GBNERR Education Goals and Priorities

Education, Outreach and Interpretation Goal

Design and implement a comprehensive program of education, outreach and interpretation based on solid scientific principles that strengthen understanding, appreciation and stewardship of estuaries, coastal habitats, and associated wetlands throughout the Great Bay watershed.

The education component of the Reserve's activities has historically been a program considered to have high priority and one that has been recognized as an asset. The Reserve has created innovative programs specifically aimed at encouraging participants to discover and understand the multifaceted functions, history and potential of the Great Bay. The Reserve's educational themes extend from the casual visitor to the lifelong residents of the area. The education programs occur in one of two realms: Programs based out of the Great Bay Discovery Center and broader, Reserve–wide programs and activities.

Educating the public about the importance of healthy coasts and estuaries takes place at the Reserve through a variety of means. The Reserve's Education Coordinator oversees the education, interpretation and outreach programs within the Reserve. The Reserve's education staff addresses the needs of various audiences through specific programs and governed by the following Reserve education program objectives:

Objective 1: Public Awareness

Increase the awareness and understanding of the value of the Great Bay estuary and estuarine systems by the public living in the Great Bay watershed.

Great Bay Educational Program Audiences

The Reserve's education programs successfully attract a broad audience including elementary and secondary school groups, college students, adults, researchers, local families, businesses, tourists and various senior groups. The staff has developed an array of tools to encourage participation at all age levels. The continued success of the program will involve constant tailoring of established programs to meet the interests of various audiences and the introduction of new programs as needed.

K- 12 Education

Estuary Exploration Programs

Great Bay Discovery Center's Estuary Exploration Programs are offered in the spring and fall to elementary school children and are tailored to the appropriate grade level. Fall programming emphasizes the cultural history of Great Bay as it relates to the natural resources with a visit to the American Indian fishing encampment and model lobster and Gundalow boats. Stories are told accompanied by artifacts about oystering, lobstering and salt marsh haying. A tour of the one-of-a-kind Piscataqua Gundalow gives students an historic perspective of navigating the Bay. Spring programs focus on the natural resources of the Bay. The experience broadens students' understanding of coastal New Hampshire's estuarine ecosystems, with a focus on hands-on activities. The programs address concepts such as non-point and point source pollution, habitats, and estuarine species. Staff and trained volunteers lead these interactive experiences.

Bay Ventures

Throughout the summer the Reserve hosts these summer programs for children ages 7-11. Each week the topics change with themes such as Creature Feature, ABC's of Arthropods, Adventures in Aquaculture and Great Bay Gumbo. The programs are two hours in length and consist of both indoor and outdoor activities, games and each child creates a craft to take home.

Teacher Training

Education Outreach

In an effort to supplement the Reserve's Estuary Exploration Programs and to reach students outside the Great Bay watershed, the Reserve has a variety of tools that teachers can use in their classrooms. These tools comprise the elementary education outreach program.

It's All Connected Educator's Workshops

It's All Connected is an integrated curriculum with science, language arts, social studies, math, and art. This unique curriculum was created specifically for the Reserve and it provides valuable

information on estuaries and their important role in coastal ecology. There are many opportunities for problem solving, creative thinking and writing. The curriculum may be used in total, or the educator may choose to select parts more appropriate for his/her classroom and geographic location. Proximity to the Great Bay estuary is not a necessity for implementation of significant components of the curriculum. This curriculum includes the water cycle, wetlands and the relationships of their inhabitants, the characteristics and value of the Great Bay estuary, human uses and impacts on the estuary and the estuarine and marine areas beyond Great Bay, focusing primarily on the Gulf of Maine.

Traveling Trunks

The Great Bay Traveling Trunk Program allows teachers, students, and other interested groups and individuals access to Bay-related artifacts, books, posters, videos, recordings, slides, curricula, puppets and more. Each individual trunk program is designed to bring the natural and cultural history of the Great Bay estuary into school classrooms statewide. Trunk materials are most appropriate for elementary age children. Trunk programs include: Horseshoe Crabs, Great Bay's Ancient Mariner!, Ospreys! and It's All Connected (see above).

General Audiences

Community Outreach

The Reserve has implemented programs and activities to target adult members of the community. Often these programs and events bring quality estuarine information to non-academic audiences.

Bounty of the Bay

The Reserve's Bounty of the Bay is a series of skills-based workshops offered on topics such as shellfishing, fly-fishing and waterfowl hunting. The courses are free and open to the public.

Public Events

The Reserve is involved in many events to educate the public on the significance of Great Bay. All of these are community-wide events where the Reserve and other coastal education partners promote the benefits of the estuary, and focus on the critical issues facing the resources.

Discover Wild New Hampshire Day

This popular celebration began in 1989 as a way to recognize Earth Day and the State's diversity of natural resources and outdoor activities. Each year, the Reserve participates in this event run by NHFGD.

National Estuaries Day and Coastweeks

Held in the fall of each year, Coastweeks and National Estuaries Day are a chance to communicate the concept that estuaries have national, regional and local importance. During this week, the Reserve hosts Great Bay Fest, an annual road race sponsored by the Great Bay Stewards and a shoreline cleanup in conjunction with the NHCP.

Bay Views

Each summer the Reserve hosts Bay Views, an adult speaker series, discussing a variety of issues relevant to coastal decision makers. All Bay Views programs are free, open to the public and are held Wednesday evenings in July and August at the Discovery Center. Topics have ranged from Gardening for Local Wildlife to Navigating the Bay to Sustainable Choices for Homeowners. Presentations by local scientists, storytellers, historians and naturalists offer the audience unique perspectives on a broad range of topics.

Jackson Estuarine Laboratory
Located at Adams Point, JEL is a source of cooperative education. The Reserve's ties with the Lab have created a symbiotic exchange of information. The breadth of research conducted at the Lab is often publicized by the Reserve. The findings of various studies are incorporated into informational kiosks located throughout the Reserve as well as in the exhibit room at the Discovery Center.

There is also an interpretive trail that leaves from the parking lot at JEL that focuses on the cultural history of the Bay (the Evelyn Browne Trail at Adams Point).

Interpretive Kayak Trips
The Reserve offers summer naturalist-guided kayak trips throughout the estuary. All trips are taken with a Reserve-owned fleet of kayaks and include a kayak lesson for beginners. As of the 2002 season, the program is offered to participants 18 years and older.

Waterfront Exploration
These programs are naturalist-led explorations along the edges of Great Bay. At low tide, the program focuses on the creatures of the mudflats and how they survive. At high tide, attention shifts to netting plants and animals that are floating in the Bay. This program is popular with families visiting the Center.

Ambassador Programs
Throughout the open season, the Great Bay Discovery Center offers a series of naturalist-guided walks along the boardwalk. A variety of walk themes have been developed focusing on subjects such as Gundalows, the water cycle, and the ecological zones found on site. There are future plans to develop a variety of walk themes from which visiting groups can choose.

Project Osprey
A joint venture between NHFGD, NH Audubon and Public Service of NH (PSNH) aims to foster a self-sustaining osprey population and to develop a comprehensive education program to teach the ecological components of the project. The mission is to unite corporate, government and non-profit resources and expertise to enhance the recovery of the State's osprey population and to promote overall public awareness of the importance of healthy ecosystems that support wildlife populations.

Great Bay 5K Road Race
The Reserve and the Great Bay Stewards jointly host an annual Great Bay 5K road race. This run is a way to introduce a greater public awareness of Great Bay as well as serve as the major fundraiser for the GB Stewards.

International Sister Reserve Program
In 1999, GBNERR established a sister Reserve program with Ireland's Marine Institute and the Shannon estuary to provide a framework for the exchange of information, resources and programs. This effort supports NOAA's Joint Statement to pursue collaboration in coastal zone management issues with the Marine Institute that was signed as part of President Clinton's Ireland and Northern Ireland Peace Initiative in 1995.

Objective 2: Clearinghouse for Information

Serve as a clearinghouse for information about estuarine, coastal and Reserve management issues through the use of professional and accurate publications.

Printed literature about the Reserve is locally distributed through brochures at the Discovery Center, kiosks, local libraries, Chambers of Commerce, the NHFGD and other tourist spots in seacoast New Hampshire. The Reserve also maintains a web page that provides information on all of its programs (www.greatbay.org).

Research Project Showcase

Individuals or groups outside of the Reserve staff conduct much of the research in the Great Bay region. In an effort to share the data collected through research, the Reserve will display research findings at the Discovery Center and the new Hugh Gregg Center through brochures and information kiosks. It is anticipated that by making the science available to the public, community members will be more likely to support recommendations derived from the research and practice stewardship in their own backyards.

Great Bay Matters

The Reserve publishes a seasonal newsletter (three times a year) for an audience that is both within the Great Bay watershed and beyond (current circulation is 3,000). The Reserve and Great Bay Stewards publish Great Bay Matters cooperatively. The articles in the newsletter encompass both organizations' activities as well as a section focused on the Great Bay Discovery Center. The scope of the publication includes results from research projects, general articles about the estuary, conservation information and a calendar highlighting upcoming events.

Marine Resources

Popular brochures at Sandy Point are the Marine Resources series, each focusing on a different animal found in Great Bay (eight in total). The handouts provide information about the biology, life history, food, predators and management of the animal. They are written for the general public to provide a better understanding of the species that inhabit the estuary.

Trail Guides

Trail guides are available for both the Sandy Point Trail and the Evelyn Browne Trail at Adams Point. The Evelyn Browne Trail Guide takes the walker through the human history of Great Bay explaining the significance of such artifacts as stonewalls and the Adams House, a summer resort from the mid-1800s.

The Sandy Point Trail Guide is written from a naturalist's perspective, concisely explaining the glacial effects on Great Bay, information about the ecological zones found along the trail, and how the Reserve is handling invasive species. Informational kiosks are located along both trails, supplementing these publications.

Objective 3: Educational Facilities

Develop and maintain educational facilities consistent with national guidelines for sustainable design and conservation planning.

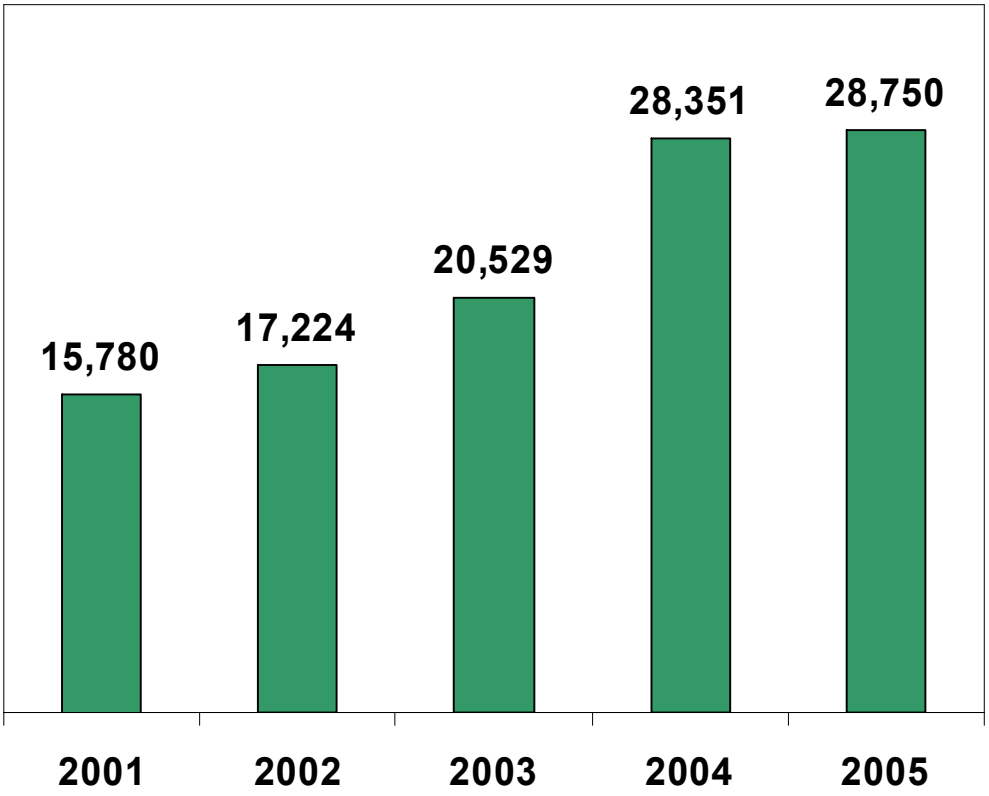
Great Bay Discovery Center

The Great Bay Discovery Center is the interpretive center and focus of the Reserve's education programs. The Center is located on 50 acres of mixed-upland forest, freshwater wetlands and extensive salt marshes representing the common habitats found around the Bay. The Center's exhibit space includes a large floor map and 3-D model of the estuary. Other exhibits include a hands-on Great Bay Café interpreting food webs, a touch tank, a display on the Reserve's water quality monitoring program, and cultural history artifacts. The Discovery Center attracts over 25,000 visitors annually (see **Figure 9.1**).

Figure 9.1

GREAT BAY NATIONAL ESTUARINE RESEARCH RESERVE
GREAT BAY DISCOVERY CENTER

VISITATION 2001-2005



Upstairs from the exhibit room is office space for the education and stewardship staff. There is also a small conference room that includes a reference library. As the staff and programs at the Reserve have grown, the need for additional meeting space became a high priority.

Great Bay Discovery Center Grounds

On the grounds of the Great Bay Discovery Center there are two outdoor gathering places for groups:

- The Pavilion is a covered, power-supplied building overlooking the Bay.
- The Amphitheater is located in front of the Center.

The Pavilion and amphitheater are places used by staff; the amphitheater is also available for public use. Visitors to the Center also visit the replica lobster boat and Gundalow, accompanied by an informational kiosk. The grounds also have two picnic tables open to the public. A "carry-in/carry out" policy discourages littering at the property.

A 1,700-ft handicap accessible boardwalk extends out into the salt marsh, offering year-round visitors a spectacular view of the Bay. The boardwalk contains several stops along the way with permanent kiosks describing the natural history of the Bay. Another path off the boardwalk, the "Woodland Walk" continues through upland forest, to a private wildlife viewing area.

The gardens at the Discovery Center have become a highlight for visitors. These native gardens are "adopted" and maintained by volunteers. The volunteer commitment entails doing the design, planting, weeding and general upkeep of the selected garden.

Objective 4: Coastal Decision Makers

Develop and implement effective programs for coastal decision makers and other coastal partners about resource management issues that affect the sustainability of our estuaries and watersheds.

Coastal Training Program (CTP)

Decisions made by coastal communities can have profound, long-term consequences for estuarine and coastal environments. Elected officials, land use planners, regulatory personnel, coastal managers, agriculture workers and anglers are key decision makers in the NH seacoast community. It is imperative that these decision makers have sound information on which to base management decisions.

GBNERR, guided by a national system-wide plan, is building the capability to address these information and technology needs through targeted training and education programs in the coastal and estuarine areas. The Reserve's education staff has been integrating CTP goals throughout program efforts. Having successfully met all of the NERRS requirements to be eligible for CTP implementation funds, the Reserve is now ready to expand the number of workshops and other materials available to coastal decision makers. This includes developing a CTP-related web site.

The Reserve also plans to work on CTP issues regionally. This will include partnering with the Wells NERR to present appropriate information about the larger Great Bay watershed (a component of the estuary in located in Maine) and coastal region. Other collaborations with New England-based reserves and NOAA entities are envisioned.

Natural Resource Outreach Coalition - NROC

Natural Resource Outreach Coalition (NROC) is a collaborative endeavor to support New Hampshire municipalities in their efforts to conserve and protect land, water, wildlife habitats and quality of life. NROC is based on the University of Connecticut project called the Non-Point Education for Municipal Officials (NEMO), an educational program for local land use officials that addresses the relationship of land use to natural resource protection.

The coalition, led by UNH Cooperative Extension with funding from NHCP, offers tools to help community leaders better understand the natural resources of their towns and the threats to those resources. It also provides recommendations for the actions necessary to sustain the resources and how to use this information as a basis for community planning and land-use decision making. In 2005, Plymouth State College in NH conducted an evaluation of the program.

The Reserve was a founding member of NROC, along with the UNH Cooperative Extension, UNH Sea Grant, NHCP, NH Department of Environmental Services, and Rockingham and Strafford County Conservation Districts. NROC's efforts include:

- Coordinating the educational and technical assistance of resources for the State's major natural resource and planning organizations and agencies.

- Serving as a clearinghouse and referral agent for available resources.

- Presenting educational and technical assistance programs to communities that emphasize both voluntary and regulatory tools for resource protection, especially those that illustrate the connection between natural resources, economy and quality of life.

- Helping community leaders to better understand their community's resources; threats to resources; actions necessary to sustain the resources; and the use of information as a basis for community planning and for making land use decisions.

The Reserve has participated in the creation of the NROC power point presentation "Dealing With Growth". The presentation adapts and expands NEMO materials to be relevant to the New Hampshire setting and is structured specifically for each town. Once a community has been given the presentation, the municipal officials may apply for additional workshops and seminars offered by NROC. Workshop topics include:

- Estate Planning for Land Protection
- Conservation Easements
- Natural Resource Inventories – Putting Them To Work
- Identifying and Protecting Groundwater Supplies
- Open Space Developments and Growing Greener
- Assessing Wildlife Habitat
- Creating and Implementing a Natural Resource Conservation Plan
- Geographic Information Systems (GIS) resources

Objective 5: Program Evaluation

Continue to evaluate the effectiveness of Reserve-sponsored programs on an ongoing basis.

In order to present the highest quality programs possible, the Reserve is committed to evaluating the effectiveness of its programs. CTP has an evaluation component already built into it. For the Reserve's general educational programs, evaluation instruments have been developed for teachers and volunteers. Programs are constantly being improved to meet the requirements of various user groups.

D. Education Objectives and Action Item

Objective 1: Public Awareness

Action Item 1: Estuary Exploration Program
Action: Continue offering the Estuary Exploration Program to students throughout New Hampshire and bordering states.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 2: It's All Connected Program
Action: Continue to annually offer the workshop It's All Connected to educators either at the Discovery Center or on-site at different schools.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 3: Traveling Trunks Program
Action: Expand the distribution of the Traveling Trunks to a wider audience.
Responsibility: Education Coordinator
Timeframe: Mid-term

Action Item 4: High School Kayak Program
Action: Develop new kayak programs for high school-aged individuals. This audience was identified as underserved in NOAA's 312 evaluation done in 2001.
Responsibility: Education Coordinator
Timeframe: Short-term

Action Item 5: Bounty of the Bay
Action: Continue working with staff within NHFGD, as well as other agencies, to co-host programs such as Bounty of the Bay workshops.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 6: Public Events
Action: Continue offering events to the public, such as National Estuaries Day and Coastweeks, which highlight the importance of the Reserve and the estuarine ecosystem.

Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 7: Communicate Research Results
Action: Continue to interpret and communicate applied research results to target audiences through public exhibits, brochures and kiosks.
Responsibility: Education Coordinator/CTP Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 8: Osprey Stewards Project
Action: Continue the Project Osprey Stewards project, including training volunteers as "nest monitors" and provide the partners with valuable data regarding the status of various nests throughout the estuary.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 9: Osprey Platform
Action: Construct an osprey platform at the Sandy Point property and install an osprey-viewing camera providing a live feed from the nest.
Responsibility: Education Coordinator
Timeframe: Mid-term

Objective 2: Clearinghouse for Information

Action Item 1: Land Acquisition Brochure
Action: Develop a new brochure for the Reserve incorporating the land acquisition program accomplishments and parcels.
Responsibility: Education Coordinator/Stewardship Coordinator/Manager
Timeframe: Short-term

Action Item 2: Great Bay Matters Publication
Action: Improve the overall quality and appearance of Great Bay Matters as well as increase its distribution to appropriate individuals and groups.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 3: Reserve Publications
Action: As publications are reprinted, develop a more common look and continue disseminating these publications through increased coordination with NHFGD's Public Affairs and other agencies such as Chambers of Commerce, town libraries and offices.
Responsibility: Education Coordinator
Timeframe: Ongoing

Action Item 4: Marine Resources Brochures
Action: Develop new marine resources brochures and increase distribution.

Responsibility: Education Coordinator
Timeframe: Short-term to mid-term

Action Item 5: Discovery Center Gardens
Action: Continue to update and provide a biodiversity brochure on the Discovery Center gardens and grounds, advocating using native New England plants.
Responsibility: Education Coordinator/Stewardship Coordinator
Timeframe: Short-term

Objective 3: Educational Facilities

Action Item 1: Education Programs
Action: Develop new education programs to complement new facility goals as well as meet needs identified in Estuary Exploration Programs.
Responsibility: Education Coordinator
Timeframe: Mid-term

Action Item 2: Great Bay Discovery Center Facility
Action: Replace flooring and update exhibits throughout the Great Bay Discovery Center.
Responsibility: Education Coordinator/Manager
Timeframe: Long-term

Objective 4: Coastal Decision Makers

Action Item 1: Needs Assessment
Action: Update the Reserve's needs assessment and market analysis to improve effectiveness of reaching coastal decision makers using the guidelines developed by ERD.
Responsibility: CTP Coordinator
Timeframe: Short-term

Action Item 2: Increase the number of Coastal Decision Maker Workshops
Action: Increase the annual number of coastal decision maker workshops from three to ten or more.
Responsibility: CTP Coordinator
Timeframe: Ongoing

Objective 5: Program Evaluation

Action Item 1: Needs Assessment
Action: Develop appropriate evaluation tools to assess effectiveness of educational and CTP programs.
Responsibility: Education Coordinator/CTP Coordinator
Timeframe: Ongoing

Chapter X
Public Involvement and Volunteerism

A. Introduction

Community involvement is a key method the Reserve uses to educate the public about the Great Bay National Estuarine Research Reserve (GBNERR). Through education residents will attain an increased awareness of the importance of the Bay, which will in turn promote support for protection and respect of its significant natural resources. GBNERR staff relies on the assistance of volunteers and the support of the community to spread the word about the program and to fulfill the mission of the Reserve.

B. Public Involvement and Volunteerism Mission and Goals

Public Involvement and Volunteerism Goal

Continue hosting and participating in activities that encourage residents within the Great Bay watershed to understand and support the Reserve's mission.

The Reserve strives to provide unique volunteer opportunities for people to dedicate their time in a way that is meaningful for the individual and to maintain active partnerships with public agencies and other organizations involved in conservation activities in the Great Bay area. To accomplish this, the Reserve has an active volunteer program and a part-time Volunteer Coordinator staff person.

C. Volunteer Program Development

1. Recruitment

At the advent of the spring season, the Reserve's Volunteer Coordinator seeks new community volunteers. To reach a varied audience, information about volunteer opportunities is printed in local papers, fliers distributed, presentations made at community forums, announcements at NHFGD kiosks, postings on the University of New Hampshire (UNH) and United Way web sites, and included in the Reserve's newsletter, Great Bay Matters. Listeners of Great Bay Radio and visitors to the web site (www.greatbay.org) are also informed about volunteer opportunities. The most likely recruitment source is word of mouth. Both staff and current volunteers often enlist their friends and family to join the Reserve volunteer community.

2. Volunteer Activities

Reserve volunteers are offered a variety of activities and programs to encourage their participation. These are structured to suit those who want to commit to a weekly schedule, to a one-day event or somewhere in between. The volunteers, in addition to these categories, often donate their time to working on projects unique to their interests or skills. There are six areas in which volunteers can participate and serve in Reserve functions:

Exhibit Room Facilitator

Introduces visitors to the Great Bay Discovery Center's exhibit room. Promotes public awareness and stewardship of estuarine systems.

Native Plant Gardner

Uses native plantings to provide a living example of how to create and enhance backyard biodiversity. The grounds showcase a wildlife cover garden, butterfly garden, native shrub garden, woodland shade garden and Native American garden.

Biological Monitoring Volunteer

These projects allow volunteers to be active participants in ongoing research projects. Studies have included an estuary-wide census of spawning horseshoe crabs and participation in a long-term winter waterfowl monitoring study.

Environmental Educator

Introduces visiting school groups to the natural and cultural heritage of Great Bay. The volunteer seeks to instill in children a sense of wonder about, and a connection with, the estuarine environment.

Community Land Steward

Community Land Stewards will take part in restoration, monitoring, and vegetation assessment projects within the Reserve. Maintenance and field assistance of the existing and new properties will be a part of their stewardship role.

Project Osprey Stewards

Project Osprey Stewards are individuals that monitor the five active osprey nests on Great Bay. Volunteers are trained to recognize the behavior of these birds and record this information during scheduled observation times. Biologists who are tracking the recovery of this species are using this data to track osprey populations.

3. Training

The Reserve staff invests significant effort training volunteers and holds training sessions throughout the year. During training, volunteers are given a comprehensive information packet including a history of the Reserve and a thorough description of the volunteer's duties. Many of the volunteers are also Marine Docents and have already received specialized training on marine issues and Great Bay from UNH's Sea Grant program.

Volunteers at the Great Bay Discovery Center are also encouraged to reference the volunteer handbook for further background information about the Reserve system policies and procedures, the flora and fauna on site and general references. This will be re-published in 2007.

The Reserve conducts an in-depth Navigator Training Program (initiated in 2000), to take place each off-season. Each meeting focuses on a specific aspect of Great Bay such as cultural history, natural history, salt marsh ecology, interpretive training techniques and the conservation activities in the Great Bay watershed. The program intends to create a cadre of volunteers who are comfortable interpreting the significant value of Great Bay to the public. The training has been an opportunity to invite coastal decision makers to learn more about the areas natural resources.

4. Feedback

Volunteers are asked to participate in an evaluation of the activities following training sessions and at the close of the season (November). This assessment is a chance for volunteers to critique the program or position either directly or anonymously. In addition to these formal feedback sessions, volunteers are encouraged to give comments or suggestions to the staff at any time.

D. Coordination and Partnerships

The Reserve maintains active partnerships with various coastal organizations. These liaisons bring together an array of individuals or groups with a common goal of supporting the Great Bay. This network of coastal organizations often works cooperatively on projects and on sharing information regarding issues of interest to the Reserve. These partnerships maintain communication and a feeling of teamwork in the New Hampshire seacoast region and often involve the same cadre of volunteers.

1. Great Bay Stewards

In 1995, the Great Bay Stewards was formed to provide support for the Reserve and the Great Bay Discovery Center. The mission of the Stewards is the long-term protection and conservation of the Great Bay estuarine system by supporting education, land protection, research and the stewardship of Great Bay. Currently there are more than 275 members of the Great Bay Stewards. The Stewards and the Reserve partner on a number of projects, including the Great Bay 5K road race and the naturalist-guided kayak tours, providing a multitude of opportunities for volunteer participation.

2. New Hampshire Coastal Program

Located within the NH Department of Environmental Services (NHDES), the New Hampshire Coastal Program (NHCP) is funded by the State and NOAA, through the Office of Ocean and Coastal Resource Management (OCRM). NHCP serves as the lead agency in coordinating policies and planning with the local coastal communities and several federal and State agencies to balance the preservation of natural resources of the coast with the social and economic needs of this and succeeding generations. The Reserve partners with the NHCP on a variety of activities to promote general awareness and stewardship towards the estuary and coast. Volunteer opportunities include the annual coastal clean up during Coastweeks.

3. Great Bay National Wildlife Refuge

Six miles of the Reserve boundary is also the western border of the Great Bay National Wildlife Refuge. The Refuge was designated to encourage the natural diversity of plant, fish, and wildlife species; to protect species listed as endangered or threatened; to preserve and enhance the water quality of aquatic habitats within the refuge; and to fulfill the international treaty obligations of the United States relating to fish and wildlife. The Reserve has received support from the Refuge on several biological monitoring projects via access to its land and work from volunteers.

4. New Hampshire Audubon

New Hampshire Audubon (NHS) protects and conserves wildlife and their habitat in New Hampshire through wildlife research and monitoring, technical assistance on wetland protection to municipalities and exhibits, events and publications. The Reserve distributes its publications and works cooperatively with NHS on projects such as Project Osprey. Audubon volunteers also participate in several Reserve monitoring programs.

5. New Hampshire Sea Grant

New Hampshire Sea Grant provides support, leadership, and expertise for marine research education and extension in northern New England. A component of the National Sea Grant College Program, NH Sea Grant is one of 29 plus programs. All are dedicated to promoting the understanding, development, wise use, and conservation of ocean and coastal resources. Sea Grant, along with UNH and NOAA, is a major supporter of Great Bay Coast Watch. The Great

Bay Coast Watch is a volunteer estuarine monitoring group who collects samples and tests several water-quality parameters of the Great Bay estuary. The Reserve supports Great Bay Coast Watch by hosting training sessions for their volunteers.

Marine Docents are volunteers who staff many of the Sea Grant Extension educationally based programs. Docents come from all backgrounds and all levels of experience. All participate in a five-month training course, beginning in the fall of each year. The Great Bay Discovery Center is among the sites that benefit from the Docent program. The Docents provide hundreds of volunteer hours each year to the Reserve. These hours are then used as match for the Reserve's federal grant for operations.

E. Public Involvement and Volunteerism Objectives and Action Items

Objective 1: Recruit and Train Volunteers

Actively recruit and train volunteers to assist with conducting education programs and the operation of the facility.

Action Item 1: Recruit Volunteers
Action: Continue to recruit volunteers through a multimedia approach.
Responsible: Education Coordinator/Volunteer Coordinator
Timeframe: Ongoing

Action Item 2: Training Program
Action: Develop and provide a biannual volunteer training program with appropriate training materials including an updated GBNERR Volunteer Training Manual.
Responsible: Education Coordinator/Volunteer Coordinator
Timeframe: Ongoing

Action Item 3: Evaluation
Action: Develop a formal evaluation process of the volunteer program.
Responsible: Education Coordinator/Volunteer Coordinator
Timeframe: Short-term

Objective 2: Partnerships

Maintain active relationships and partnerships with public agencies and other organizations involved in conservation activities in the Great Bay area.

Action Item 1: Expand Partnership Opportunities
Action: Work with local public agencies and other organizations in order to strengthen the volunteer program.
Responsible: Education Coordinator/Volunteer Coordinator
Timeframe: Ongoing

Chapter XI
Public Access Plan

A. Introduction

Great Bay has been called New Hampshire's hidden coast. Despite its size, compared to the rest of the State's coastline, access to the estuary has always been limited. However, as the Reserve becomes more successful in protecting the resources of the estuary and information about these efforts becomes more prevalent, there will be increased pressure for public access.

Since 1989, the Reserve has worked to improve existing access points to the estuary. Improvements include improved boat ramps and parking areas at Adams Point and Sandy Point. Both of these projects were completed through the NH Fish and Game Department's (NHFGD) Public Access Program. The NH Department of Transportation (NHDOT) also rebuilt the Reserve's only all-tide access point at Chapman's Landing. This was part of a bridge reconstruction project over the Squamscott River and included the addition of a new parking lot.

Trailheads have been established as well at Adams Point and Sandy Point; the latter including a handicapped accessible boardwalk and interpretive trail. Other trails are also in the planning process in buffer areas on some of the newly acquired lands.

Residents and visitors are drawn to the Great Bay area for its aesthetic and recreational values. New Hampshire's estuaries and the coastal watershed offer tremendous recreational opportunities for residents and out-of-state visitors. These include:

- Boating on Great Bay and Little Bay and rivers (motor and non-motor)
- Recreational fishing (including ice fishing)
- Shellfishing
- Hiking
- Geo-caching
- Wildlife viewing
- Nature photography
- Hunting and trapping
- Cross-country skiing and snow-shoeing
- Snowmobiling (on established trails approved by the State)

Reserve lands are managed to enhance the appropriate public use of Great Bay while maintaining the integrity of the land. The State has made efforts to make the existing access sites useful for a public with varying recreational activities such as bird watching, hiking and hunting. Other more intensive uses such as camping are generally not allowed except by special permission from the Executive Director of NHFGD.

B. Public Access Goal

Public Access Goal

Provide appropriate public access to the Reserve's protected lands and waters, while protecting the inherent natural resource values of these lands and waters.

To achieve this goal, the Reserve provides opportunities for public access, as appropriate, on existing and newly acquired lands by providing for limited parking and access to the waters that are within the Reserve boundary with an emphasis on small boats. The greatest needs are for hiking trails and boat access points. Great Bay also serves a large hunting population that requires access to both the land (primarily deer hunting) and the water (primarily waterfowl hunting).

C. Existing Access Points

NHFGD is charged with providing adequate and reasonable public access to State's waters. In an effort to serve the recreation needs of New Hampshire residents, NHFGD owns several public access sites and is continually seeking to acquire new parcels, or to enhance existing facilities.

1. Existing Public Uses

Recreational activities within the Great Bay estuary are extensive and diverse, including boating, fishing, birding, walking/hiking, and hunting. Boating activities include fishing, motorboats, waterskiing, rowing, kayaking and canoeing (Short 1992a, Jones 2000). There are several access points, noted above, that accommodate both motorboats and car-top watercraft.

Fishing is done from boats, bridges, or the shore. Finfishing is popular for striped bass, bluefish, eels, tomcod, shad, smelt, river herring, and flounder. Ice fishing is accessible from bob houses on Great Bay and several of the tidal rivers, i.e., Squamscott, Lamprey and Oyster. Shellfishing for soft-shell clams and oysters has always been popular on the Bay. NHFGD and NHDES have supported recent efforts to open additional shellfish beds for recreational use.

Hunting is a traditional use in the Great Bay region. Public lands owned and managed by NHFGD are typically open to hunting. Enjoying the winter waterfowl on the Bay is a popular recreational activity both for waterfowl hunters and waterfowl watchers. Bird watching is done at all sites.

2. Existing Boat Access Facilities

There are four boat access facilities maintained by NHFGD that are heavily used by the general public during the warm weather months. State-owned landings include:

- *Chapman's Landing, Stratham* – This facility is designed to accommodate trailered boats and provides all tide access to Great Bay for fishing, waterfowl hunting and recreational boating via the Squamscott River.

- *Adams Point, Durham* – This trailered boat launching site is limited to mid and high tide only. Hunters, anglers and oystering enthusiasts frequently use the Adams Point launch for easy access to Great Bay.

- *Sandy Point, Stratham* – Primarily accessible at high tide for car-top boaters and waterfowl hunters.

- *Lamprey River, Newmarket* – All tides access for ice fishing and car-top boats.

NHFGD has published an official boating and fishing access map that identifies public access sites statewide. The free publication denotes boat access sites, ski trails, and picnic areas. In addition to

providing geographic information, the guide includes information on boat safety, lead sinkers, and descriptions of popular fresh and saltwater species.

The New Hampshire Coastal Program produced a New Hampshire Coastal Access Map, free and widely available, directing visitors to key boating, fishing, hiking, picnicking, swimming and bird watching sites. The map also provides contact information for many seacoast resources.

3. Existing Access to Reserve Lands

Presently, parking access to Reserve lands is very limited (i.e.; Adams Point, Sandy Point, Chapman's Landing and the Greenland Wildlife Management Area). The Bellamy River Wildlife Management Area, part of the proposed 2005 boundary, also includes a parking area.

D. Additional Access Points

The Partnership's acquisition of several properties around Great Bay has created the opportunity for additional public access to the Bay. After ownership of land is transferred to NHFGD and property management plans completed, appropriate enhancements of public access sites will occur. This includes potential parking areas at the Weeks property in Greenland (pending approval from the NH Division of Historical Resources) and the Newsky property in Durham. The Reserve is also working with the Town of Durham to provide several access points in the Crommet Creek area where town land abuts recently acquired properties of NHFGD.

The Great Bay National Wildlife Refuge is 1,054 acres of land on the eastern shore of Great Bay that was formerly Pease Air Force Base. The Refuge, along with other recently acquired lands, offers a limited network of trails available to the public.

E. Public Access Objectives and Action Items

Objective 1: Land Access Points

Provide for appropriate access to Reserve properties that supports traditional recreational activities.

Action Item 1: Create a minimum of three additional public parking areas.
Action: Construct parking areas for six to eight vehicles at three sites.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Great Bay Trail
Action: Create a Great Bay trail system on existing and new Reserve properties and other publicly held lands that takes advantage of existing trails and diverts foot traffic from sensitive areas.
Responsible: Manager/Stewardship Coordinator
Timeframe: Ongoing

Objective 2: Water Access Points

Develop access points for a variety of appropriate water-based activities at key locations throughout the Reserve.

Action Item 1: Water Access Points
Action: Construct one new water access point at an appropriate location.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Informational Kiosks
Action: Provide up-to-date information about the Reserve and NHFGD including regulations concerning hunting and fishing at all kiosks associated with water access points.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Objective 3: Public Outreach

Develop a wide range of outlets for distributing information about public access opportunities within the Reserve.

Action Item 1: Keep Staff Informed about Public Access Sites
Action: Inform NHFGD and Reserve staff regarding the public access components of properties that are added to the Reserve.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Action Item 2: Access Information
Action: Make available to the public through various outlets including the Great Bay Discovery Center, the NHFGD official boating and fishing access map.
Responsible: Education Coordinator
Timeframe: Ongoing

Action Item 3: CD ROM Information
Action: Create a CD ROM that provides land and water access information for the entire estuary to be distributed to the general public.
Responsible: Education Coordinator/Stewardship Coordinator
Timeframe: Ongoing

Action Item 4: Passport to Great Bay
Action: Publish a Passport to Great Bay brochure that details public access information on all Reserve lands open to the public.
Responsible: Education Coordinator/Stewardship Coordinator
Timeframe: Short-term

Chapter XII
Boundary and Acquisition Plan

A. Introduction

The Great Bay National Estuarine Research Reserve's (GBNERR) original boundary was established in 1989. It includes five selected areas around the estuary, together with the tidal waters and mudflats of Great Bay proper. The 1989 boundary represents 4,471 acres of tidal waters and mudflats, and approximately 48 miles of shoreline. The upland area represents 1,150 acres, with approximately 800 acres that were identified for acquisition (ten properties). The Reserve's original 1989 boundary is shown in **Figure 2.1**.

The water portion includes all of Great Bay proper, the small channel from the Winnicut River and larger channels from the Squamscott and Lamprey Rivers that meet in the center of the Bay to form a main channel that connects to Little Bay at Adams Point. The shoreline and additional portions include sites in the towns around the estuary, ranging in size up to 400 acres and in character from salt marsh to rocky shore to open fields and forests.

The Reserve's 1989 boundary was determined by using the following criteria:

- Contains a unique variety of habitats and indigenous species.
- Considered to be a "manageable" size for a new Reserve and a staff of one; the sites contained in the Reserve at that time were located in close proximity making management possible with a limited staff.
- Tidal waters to the limits of mean high tide were considered under the jurisdiction of the State, and the quality of the water was monitored on a regular basis.
- Local ordinances and the State's authority provided some oversight for any proposed future land development of upland areas.
- Several landowners were willing to convey conservation easements on land that would provide additional preservation of unique sites, and enhanced the value of the Reserve.

The 1989 boundary suited the needs of the Reserve at the time of designation. Representation of various natural resources (salt marsh, tidal creeks, islands, woodlands, open fields) were within the Reserve as well as opportunity to provide a variety of uses such as education and interpretation, research, waterfowl hunting, boat access, and bird watching. At the same time, the surrounding area has experienced rapid population growth and development since 1989.

The proposed 2005 boundary reflects the growth and maturity of the Reserve's organizational, managerial, scientific, and educational capabilities. The proposed boundary better suits the principles listed in the federal regulations. Designated conservation areas as determined by the Reserve's land acquisition and habitat protection goals provide the rationale and ecological justification for the proposed boundary expansion. It also reflects the State's initial efforts to include Little Bay as part of the Reserve program, which did not receive federal approval. By using such a comprehensive approach, the Reserve will be better able to maintain the water quality of the Bay.

B. National Estuarine Research Reserve System (NERRS) Regulations

Reserves may expand their boundary to include those lands and/or waters that are necessary to protect the ecological units of the natural estuarine system for research purposes. Areas adjacent to these key land/waters that are essential to maintain the integrity of the ecological unit may also be incorporated into the boundary. The lands/waters identified for inclusion in the boundary must either be contiguous to the original boundary or the plan must demonstrate how these areas are necessary for reserve research and/or education programs. Additions should not be proposed for inclusion until they meet the criteria below:

1) Boundary should encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit.

2) Adequate state control of the site(s) must be established.

3) Site should be suitable for long-term research and be important for education and interpretive efforts.

Core Versus Buffer

Reserves must ensure that the site's boundary encompasses an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

Boundary size will vary greatly depending on the nature of the ecosystem. Reserve boundaries must encompass the area within which adequate control has or will be established by the managing entity over human activities occurring within the Reserve. Generally, Reserve boundaries will encompass key land and water areas representing core and buffer zones.

1. Core designated areas must be vital to the functioning of the estuarine ecosystem and must be under a level of control sufficient to ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary.

The determination of which land and water areas are ``key'' to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding on key land and water areas is that they should encompass resources representative of the total ecosystem, and which, if compromised, could endanger the research objectives of the Reserve.

2. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change, which reasonably could be expected to occur.

Reserves must show core and buffer areas on the reserve boundary map. When adding new lands within the boundary, the determination should be made jointly with NOAA.

C. New Hampshire Fish and Game Department (NHFGD) Land Acquisition Priorities

As the lead State agency for the Reserve, NHFGD is actively involved in land acquisition and land management. The Executive Director has the authority to both establish areas for the protection and propagation of fish, game, and marine species (State statute 212:19). Within the Department, the Land Resources Team handles these activities with an emphasis on habitat protection for maintaining and enhancing the State's wildlife marine resources.

New Hampshire Living Legacy Project

One such protection effort has been the Reserve's participation since 1999 in the New Hampshire Living Legacy Project (NHLLP), headed by University of New Hampshire (UNH) Cooperative Extension. New Hampshire Living Legacy Project is a statewide effort to preserve New Hampshire's natural communities and to develop an ecological reserve system.

The purpose of this project is to establish a well-coordinated, comprehensive system of public and private lands voluntarily dedicated to protecting the full spectrum of biodiversity in the State. Ecological reserves within the system may vary in size, location, ownership and protection strategy. Human uses of ecological reserves are encouraged, as long as those uses are consistent with the goals of the system and the protection of the features of biodiversity are supported by the individual reserve. Great Bay is located within the southern Gulf of Maine coastal lowlands ecoregion. The project goals include:

- Perpetuate elements of native biodiversity at all levels – genetic diversity, species, community, and ecosystem – including all stages of succession.

- Maintain ecological and evolutionary processes at the natural frequency and spatial scale on a portion of the landscape sufficient to perpetuate biodiversity.

- Provide comprehensive representation of physical elements.

- Serve to increase our understanding of the benefits of healthy, functioning ecosystems.

D. Boundary and Acquisition Plan Goal

Goal

Protect the critical estuarine resources and associated uplands of the Great Bay estuary.

To meet this goal, three guiding principles have been developed:

- Work in partnership with other agencies and organizations to provide for the long-term conservation and protection of properties within the proposed 2005 Reserve boundary and to support NHGFD's mission, consistent with the federal NERRS regulations.

- Manage Reserve properties from a watershed perspective that is designed to maintain and enhance the integrity of the ecological system.

- Raise public awareness and understanding of the natural attributes of the Great Bay estuary by emphasizing the interconnections of the ecosystem.

E. Proposed Boundary - Great Bay National Estuarine Research Reserve

The Reserve's proposed boundary includes conservation lands protected through December 2005, and additional properties targeted for protection based on the Great Bay Resource Protection Partnership's (GBRPP) Habitat Protection Plan (1997, revised 2000). The proposed boundary is a more comprehensive representation of the natural communities within the Southern Gulf of Maine province of the Acadian biogeographic region of the United States (see **Figure 2.2** and back cover overleaf for an expanded version). Additional studies by GBRPP, The Nature Conservancy (TNC) and the New Hampshire Natural Heritage Inventory reinforce the need for the protection of additional natural communities in the estuary.

This chapter identifies and explores three areas of justification in support of the proposed boundary expansion. A discussion is provided below that demonstrates how the proposed boundary better meets the vision and goals of both NERRS and NHFGD. The three areas of justification include:

1. Protection of Ecological Resources
2. Management
3. Education

Also identified are core and buffer areas as required by federal regulations. The 1989 Management Plan did not make any distinction between core and buffer areas (NH Office of State Planning 1989). Under the proposed 2005 boundary, all of the tidal water areas in Great Bay are to be designated core whereas Little Bay will be designated as buffer. There are five proposed upland areas to be listed as core areas under the boundary expansion (see **Figure 12.1**) as follows:

1. Rollins
2. Solomon
3. Wilcox
4. Underwood/Marsh Island
5. Shackford Point

1. Proposed Boundary - Ecological Justification

The conservation of the region's natural resources that need protection is based on viewing and understanding the Great Bay as an ecosystem, with various physical and biological components. The Great Bay estuarine system extends inland from the mouth of the Piscataqua River, through Little Bay to Great Bay proper. The watershed is 930 square miles and derives its freshwater inflow from seven major rivers - the Lamprey, Winnicut, Squamscott, Oyster, Bellamy, Cocheco and Salmon Falls (Short 1992a).

An extension of the boundary is proposed to the first tidal dams of the rivers draining directly into Great Bay and Little Bay. This includes five of the seven major rivers that drain the estuary – Lamprey, Winnicut, Squamscott, Oyster and Bellamy (see **Figure 12.2)**. The proposed Reserve boundary is more inclusive of the tidal estuary and also provides greater opportunity to direct research funds into the long-term study of a more representative portion of the estuarine system.

Land cover within the proposed 2005 boundary is primarily open water and mixed forestland uses, including unfragmented forest, riparian areas and wetlands, and other open lands. These have been

Figure 12.1 Core and Buffer Areas

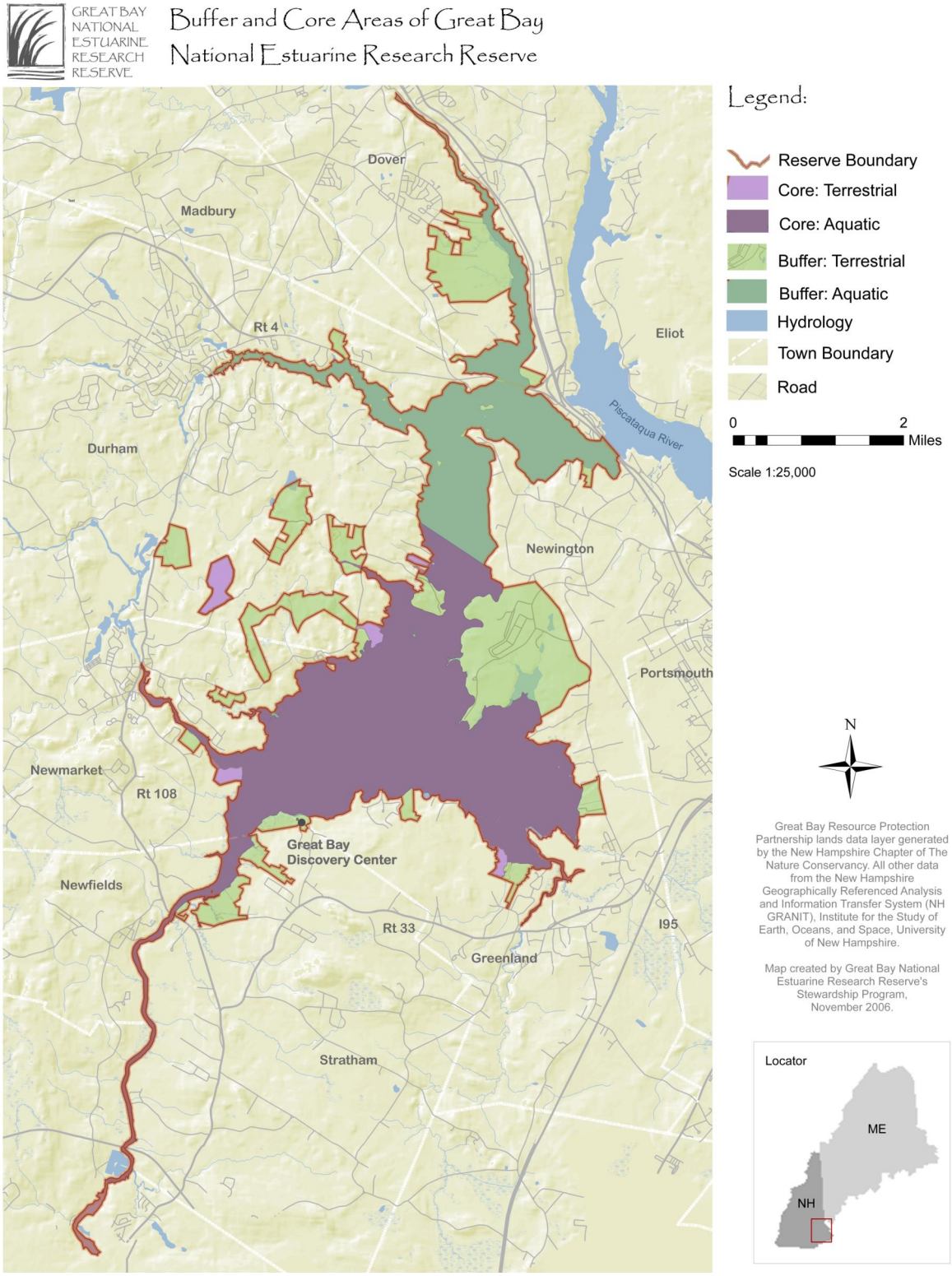
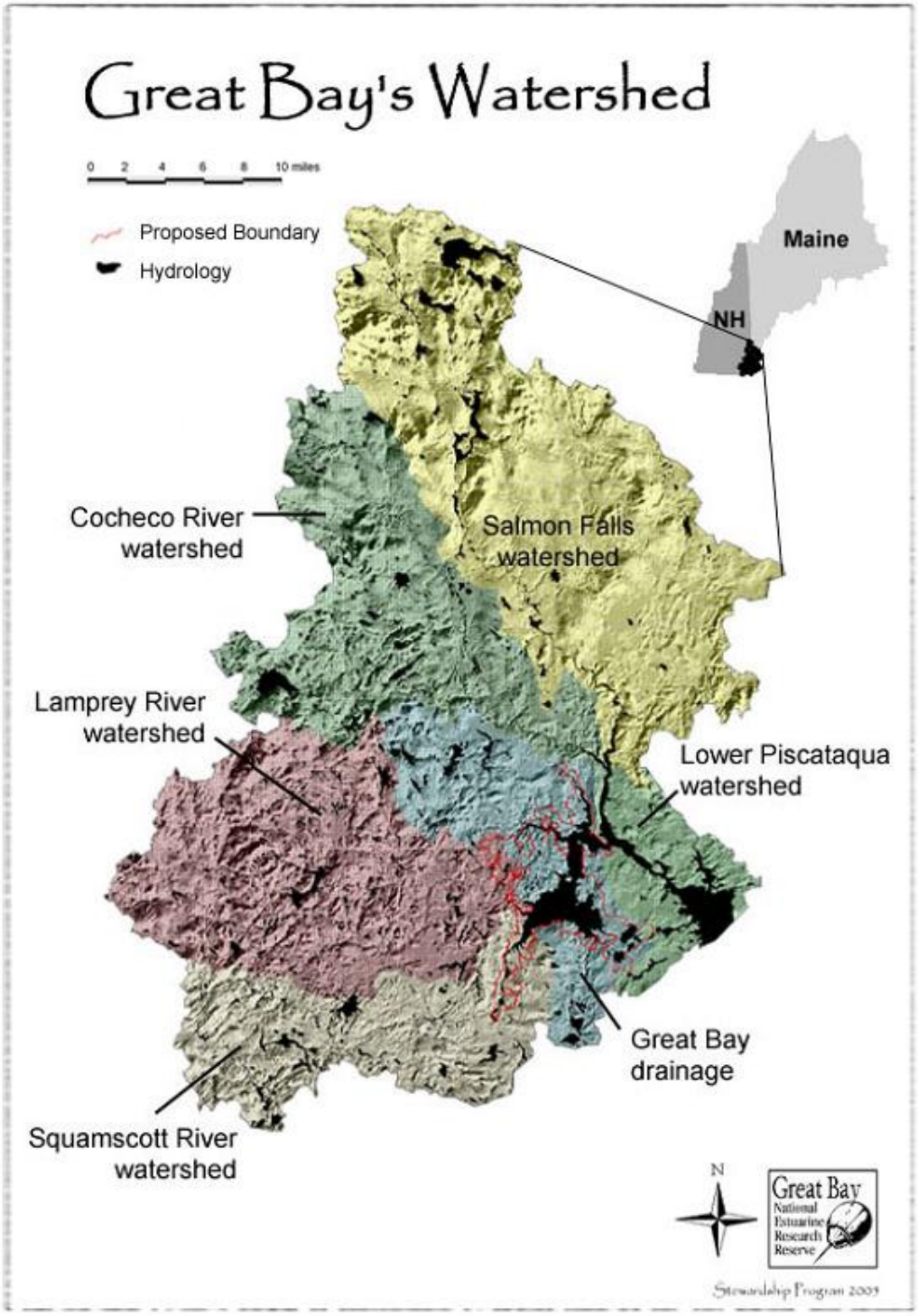


Figure 12.2 Great Bay's Watersheds



identified by NHFGD as statewide significant wildlife habitat. While the region is under tremendous development pressure, there are still large, unfragmented areas that remain. These are lands targeted for protection as buffer areas. Of special interest is the amount of forest cover within the proposed 2005 boundary that is considered forestland (see **Figure 12.3)**.

The proposed 2005 boundary will include the most important tidal and non-tidal wetlands within the region that are not contained within the 1989 boundary. Critical areas such as Atlantic white cedar swamps, vernal pools, salt marshes, and waterfowl breeding habitat are incorporated. Lands that have been highly impacted by commercial or residential development are generally not included in the proposed 2005 boundary.

Maintain Ecological Integrity of the Bay

New Hampshire is the fastest growing state in the Northeast, with a 6.8% population gain from 1990 to 1998 (NH Office of State Planning, 2000 Census). Rockingham County, which covers a large portion of the Great Bay watershed, is predicted to experience the most dramatic growth rate. Strafford County, which is located entirely within the northern half of the watershed, is also expected to grow substantially with a predicted growth rate of nearly 25 percent (Sundquist and Stevens 1999).

These figures exemplify the urgency the Reserve faces to encourage growth management strategies and to ensure long-term resource protection in this region. Maintaining the environmental quality of the Great Bay watershed requires that growth within the watershed be managed in a coordinated manner, cognizant of the natural constraints within the watershed. As part of an integrated planning focus of the Reserve, the Coastal Training Program (CTP) Coordinator will continue to work with the Natural Resources Outreach Coalition (NROC) and other appropriate partners to educate the public and coastal decision makers on the impacts of unplanned growth. These efforts will complement land acquisition and other conservation efforts in the Great Bay region.

Water Quality

The proposed 2005 Reserve boundary protects additional lands in the Great Bay watershed, which will have a direct, positive effect on the water quality of the Bay. According to the NH Estuaries Project's Management Plan (NHEP 2000), the priority water quality problems in Great Bay are:

- Bacterial contamination from impervious surface runoff, discharges from wastewater treatment facilities (WWTFs) due to overloading and malfunctions, other illegal discharges, and faulty septic systems.

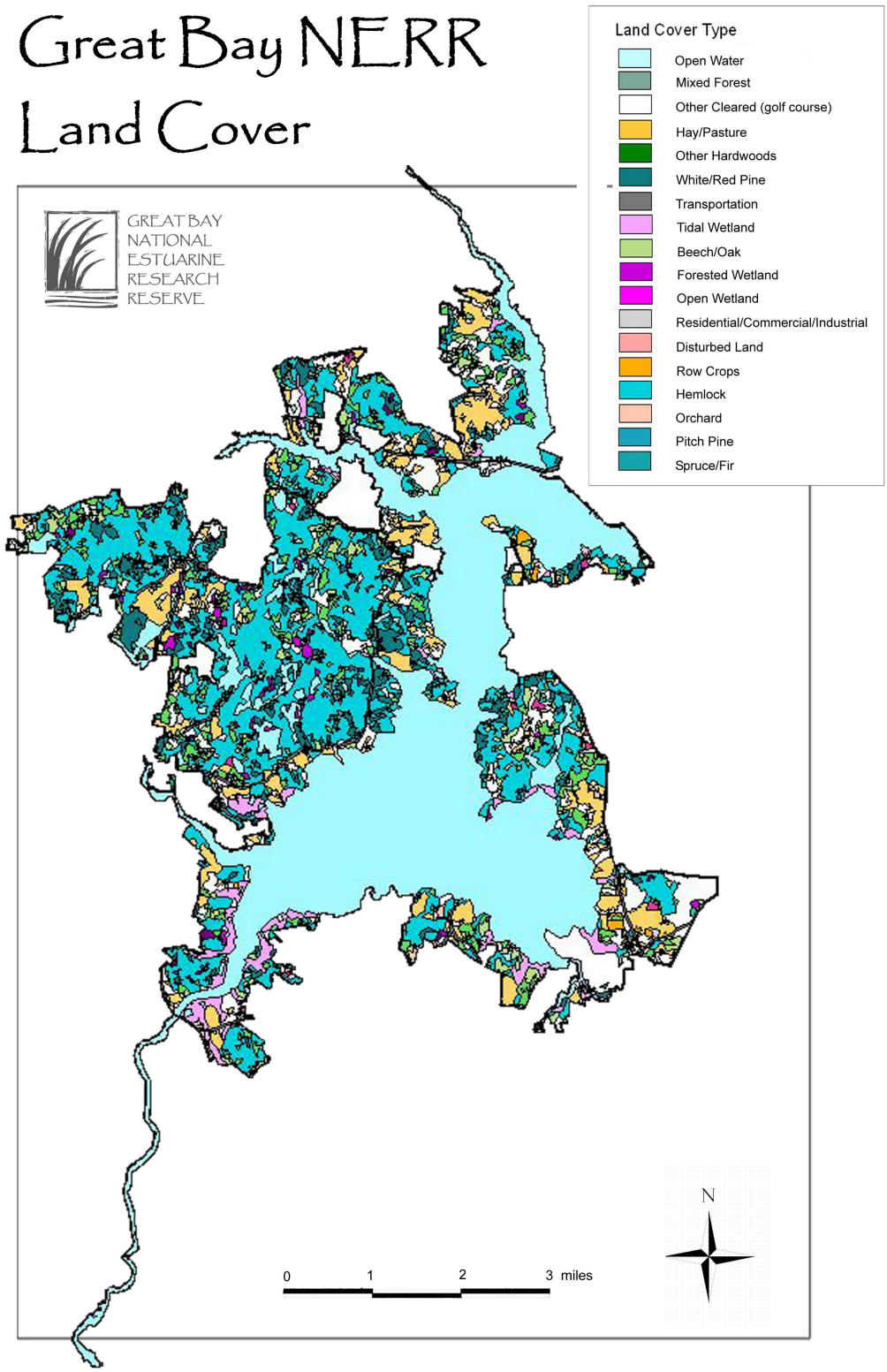
- Nutrient contamination from WWTFs and non-point sources such as tributaries, surface runoff, and septic systems.

- Toxic contaminants from historic industrial sites, oil spills, industrial and municipal wastewater, and storm water runoff.

- Sediments from upland watersheds or rivers from runoff.

Runoff brings nonpoint source (NPS) pollution into the Bay. Unlike pollution from industrial and sewage treatment plants, it comes from many sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into water bodies.

Figure 12.3 Great Bay NERR Land Cover



Water quality within the tributaries and estuary of the Great Bay ecosystem depends upon the filtering capacity of the upland forests and wetlands. When forest cover is cleared to the edge of rivers or wetlands, sediment and pollutants are more likely to degrade the water quality of the river or wetland, and eventually Great Bay. Intact forestlands help preserve the necessary natural filtering functions of the critical conservation areas (Chase *et al*. 1995).

The Reserve's participation in the System-Wide Monitoring Program (SWMP Phase I) includes the transmission of information from four data loggers deployed within the Great Bay estuary (see Chapter V, Research and Monitoring). The data loggers collect information from three tributaries and from the center of Great Bay proper (the estuary includes seven tributaries, Little Bay, and the Piscataqua River leading to the Gulf of Maine).

The proposed boundary includes Little Bay and five of the tributaries, thereby allowing an opportunity to incorporate a spatially comprehensive monitoring program and contribute to a more accurate reading of where pollutants are entering the estuary.

Land Protection and Environmental Impacts

Development of land impacts the environment in a number of ways, from impacts on water quality (caused by an increase in impervious surfaces and therefore run-off into receiving waters leading to increased siltation, bacterial contamination and nutrient availability) to habitat loss, degradation and fragmentation from residential and commercial development. Rare and threatened plant and animal species, or natural communities, may be affected directly by development or indirectly through fragmentation.

The 1990's witnessed a wide-scale effort by public and non-profit organizations and agencies seeking to effectively address, in a comprehensive manner, the land-use impacts caused by rapid development. These impacts have been documented by several studies, most notably by the Society for Protection of New Hampshire's Forests (SPNHF) and their publication New Hampshire's Changing Landscape: Population Growth, Land Use Conversion, and Resource Fragmentation in the Granite State (Sundquist and Stevens 1999, updated 2005).

Due to the biological importance of the Great Bay region (9% of State area, 18% of known rare species and exemplary natural communities) (Stevens and Anderson 1997), the Reserve and other organizations and agencies focused conservation efforts around Great Bay, with a specific attention to the target areas outlined in the original management plan (NH Office of State Planning 1989). As a result, a decade later, the Reserve has been fortunate to form an extensive network of partnerships and alliances that have created opportunities for a tremendous increase in the amount of protected land and potentially protected sites.

Great Bay Resource Protection Partnership (Partnership)

An indicator of the Reserve's ability to successfully undertake the proposed boundary expansion is its participation in the Great Bay Resource Protection Partnership. Through a coordinated and comprehensive landscape scale planning process, GBRPP is working to protect the significant habitat areas in the Great Bay (see Chapter VI, Resource Protection). The primary partners include the Reserve and NHFGD and the following federal agencies and private organizations:

- The Nature Conservancy (TNC), NH Chapter (Managing Partner)
- Society for the Protection of New Hampshire Forests (SPNHF)
- New Hampshire Audubon (NHA)

- Ducks Unlimited, Inc. (DU)
- US Fish and Wildlife Service (USFWS)
- US Environmental Protection Agency (EPA)
- US Natural Resources Conservation Service (NRCS)

As managing partner, TNC is responsible for securing grants and other funds to be used for land acquisition. This includes transferring acquired properties to the various partners for management. The Partnership also works with other governmental entities and regional land trusts. These groups include:

- Southeast Land Trust of New Hampshire
- Strafford Rivers Conservancy
- Bear Paw Regional Greenways
- Rockingham County and Strafford County Conservation Districts

The Partnership's collaborative approach to land conservation in the Great Bay region has provided the Reserve with a viable avenue for land conservation action around the Bay. The Partnership and the Reserve's land protection efforts have succeeded in protecting several of the key land areas included within the 1989 boundary. The Reserve's proposed 2005 boundary expansion plan reflects a growing "maturity" of the Reserve to effectively deal with land conservation issues and management. The position of Stewardship Coordinator was created to be involved with the management and stewardship of new lands. In addition, the Stewardship Coordinator efforts are complemented by the Reserve's continued collaboration with the Partnership.

The success of the Partnership's comprehensive, landscape-scale land protection effort provides a demonstrated need for the Reserve's proposed boundary changes. The proposed boundary creates important land acquisition opportunities for the Reserve.

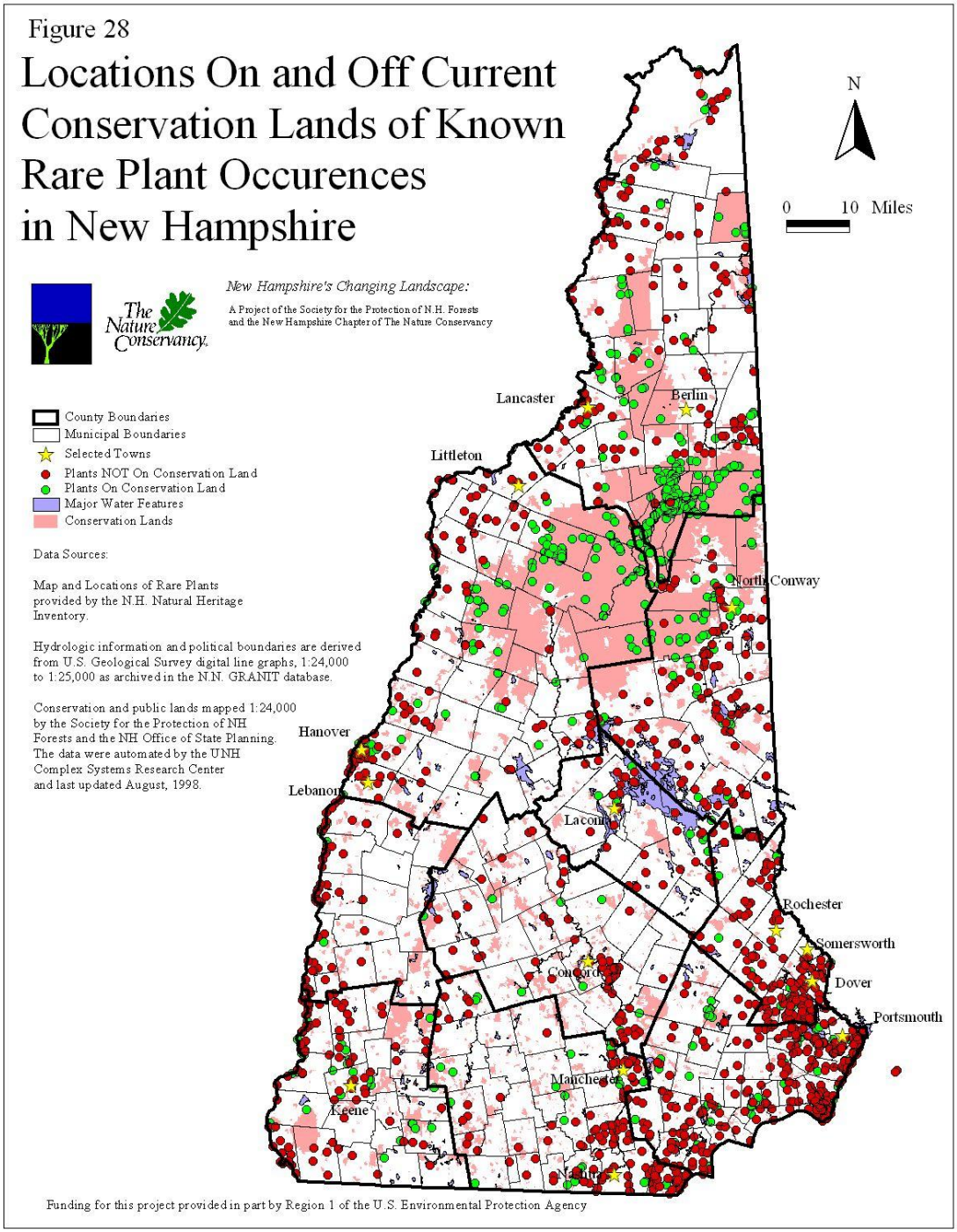
Funding for the Partnership's acquisitions come from a combination of sources: federal, State, local, private organizations, and private fundraising by nonprofit conservation organizations. The Reserve's 2005 proposed boundary provides an updated and more relevant framework for the Reserve to target the use of NOAA funds, and other federal and State funding sources. The funds can be used by the Reserve and Partnership to protect lands that are significant to the overall health and management of the Great Bay estuary. Between 1996 and December 2004, the Partnership has successfully protected 64 properties and over 4,000 acres of land.

Habitat Protection

Great Bay and the surrounding areas support a great diversity of plants and animals. Mammals, insects, mollusks, fish, reptiles, birds, and numerous types of animals depend on the Great Bay for habitat for at least part of the year. This array of species adds to the biodiversity of the ecosystem. The Reserve strives to maintain native biodiversity by protecting natural communities found in and around Great Bay. Protecting contiguous tracts of land can minimize potential adverse environmental impacts to ecological communities from improper use or over-development of land and marine resources.

In 1998, TNC and SPNHF mapped the locations of rare species in New Hampshire (Stevens and Anderson 1997). The study reveals that within the Great Bay region there are more concentrated clusters of rare plants, animals, and communities compared to the rest of the State (see **Figure 12.4**).

Figure 12.4 Rare Species in NH



The Great Bay region has been designated as a key protection area by several organizations. The following designations strengthen the need to conserve the natural resources of the area:

(1) North Atlantic Coastal Ecoregion

TNC has targeted Great Bay as a protection area within the North Atlantic Coastal Ecoregion. Ecoregional planning is designed to reduce the potential for redundancy or insufficient protection that is inherent when rare plants, animals, and natural communities are evaluated on a state-by-state basis rather than across their entire range (Beers and Davidson 1999).

(2) Partners In Flight

Partners In Flight was launched in 1990 in response to growing concerns about declines in the populations of many neotropical migrant bird species, and in order to emphasize the conservation of birds not covered by existing conservation initiatives. Partners In Flight is a cooperative international conservation effort with a goal to focus resources in the improvement of monitoring, research, management, and education programs involving birds and their habitats. The Great Bay estuary is within the targeted protection area (Partners in Flight 2000).

(3) New Hampshire Ecological Reserve System Project

The NH Ecological Reserve System Project was established to support a well-coordinated, comprehensive system of public and private lands voluntarily dedicated to protecting the full spectrum of biological diversity in the State. The Great Bay region supports 155 species of rare plants, 14 rare animals, and 35 species of rare natural communities. The mix of habitat and uniqueness of the estuary, particularly in a State with a coastline of only 18 miles, has made Great Bay a priority for protection by the statewide Ecological Reserve System Project (Short 1992a).

(4) Atlantic Coast Joint Venture

The North American Wetlands Conservation Act (NAWCA) and the North American Waterfowl Management Plan are under the jurisdiction of the US Fish and Wildlife Service. Great Bay has been identified as a Focus Area within the Atlantic Coast Joint Venture. The Partnership, created in part to support the goals of the Joint Venture, has protected land that supports the Joint Venture's stated goal to "protect and manage priority wetland habitat for migration, wintering, and production of waterfowl." A number of these projects fall within the proposed 2005 boundary (Atlantic Coast Joint Venture 2004).

(5) New Hampshire Estuaries Project

The NH Department of Environmental Services (NHDES), under the auspices of the US Environmental Protection Agency, administers the New Hampshire Estuaries Project. The NHEP developed a Management Plan (1999) that encompasses New Hampshire's estuaries, including Great Bay. Great Bay was identified to be among the most important natural resource areas within the State (NHEP 2000).

(6) Important Bird Area Program

Great Bay estuary has been designated an Important Bird Area (IBA). Through the joint efforts of Reserve staff working with UNH Cooperative Extension, NHFGD and NHA, Great Bay's nomination and designation is a first for New Hampshire. The IBA Program is an international bird and habitat conservation program created by Bird Life International. It currently has projects in 103 countries and 40 US states (Foss *et al*. 1994).

2. Proposed Boundary - Management Justification

Federal regulation, 15 C.F.R. sec. 921.11 (c) (5) states as one of the guiding principles for site designation the following:

> *"The site's compatibility with existing and potential land and water uses in contiguous areas as well as approved coastal and estuarine management plans."*

The Reserve has increased staff and formed partnerships to ensure that stewardship and management of the land is an integral part of the process as properties are considered for acquisition.

Staff Expansion

At the time the Reserve was established in 1989, there was no staff. A Manager was hired in June 1990. The Reserve boundary at that time reflected, in part, the limited capacity of the program. In the ensuing fifteen years, the Reserve staff has grown and increased its ability to adequately manage an expanded number of properties within the proposed boundary of the Reserve.

Partnerships

The Reserve works closely with The Nature Conservancy (TNC), the lead acquisition agent for the Partnership. TNC produced a Conservation Plan for the Great Bay Region (Stevens and Anderson 1997) using resource evaluations and natural community information provided by the New Hampshire Natural Heritage Inventory (NHI). The information was used to generate maps of the region and was integral in writing the descriptions of the Reserve and Partnership's properties. These data sets are now being used by the Reserve and other organizations to develop individual and watershed-based management plans.

The Reserve also works with TNC and other conservation partners who own and manage land within the proposed 2005 boundary. This collaborative approach is critical in dealing with such issues as protecting rare and endangered species, invasives, and managing public access.

Another key partnership is with the NH Coastal Program (NHCP), which is in the process of preparing a land conservation plan for New Hampshire's coastal watersheds under the Coastal and Estuarine Land Conservation Program (CELCP). The plan, to be released in 2006, will identify up to 75 focus areas for potential land protection and for guiding future development. This document will serve as an additional resource in identifying the highest priority areas for acquisition and management.

Cultural Resources

The Great Bay region was first settled in the early 1600's. One of the first trading posts was established at Dover Point, just outside of the Reserve boundary, in 1623. The Great Bay estuary quickly became a major area of commerce, especially for lumber and fish. By 1770, there were over 90 sawmills supporting an active lumber trade. The waterways of the estuary provided access to settlements on the tributaries. Bricks were another important product due to the presence of blue marine clay. In some parts of Great Bay, large areas of clay were excavated (Short 1992a).

Due to this economic boom during the 18th and 19th centuries, Great Bay is rich in cultural resources. In managing lands within the Reserve, a primary goal is to preserve and maintain these historic resources. The Reserve works closely with the NH Division of Historic Resources (NHDHR). State archaeologists have surveyed several historic sites on protected lands and have provided critical information about the local history of the area (see **Figure 12.5**).

Figure 12.5 Cultural Resources

Management and Stewardship Plans

As properties are acquired by the Partnership, resource inventories are conducted. A property's Resource Inventory documents the ecological factors such as:

- Natural communities
- Wildlife habitat
- Rare and endangered species
- Recreational activities
- Invasive species
- Restoration goals

Resource guidelines were produced for each property from the resource inventories. The plan (Brickner-Wood and Bechtel 2000) provides guidelines in areas such as management and restoration of habitat, wetlands, forestry and other areas, using the following considerations:

- Agricultural opportunities
- Timber management
- Water resources: wetlands, vernal pools, watercourses and beaver flowages
- Wildlife habitat considerations
- Restoration opportunities
- Recreational, cultural, historic and educational opportunities

The Reserve's Stewardship Coordinator will use these recommendations to create individual management plans for properties under Reserve management.

Once properties are transferred to NHFGD, each tract will have a detailed resource inventory including an inventory of forestry, wildlife and cultural resources. Five-year management plans will be completed for each tract including actions, responsible party, performance indicators plus desired completion date. Individual tract management goals will be evaluated by comparing functions of all lands within the Reserve and will incorporate Reserve programmatic functions through standardized and objective GIS protocol. The tracts will be designated as Wildlife Management Areas and managed cooperatively by Reserve and NHFGD.

Property Ownership and Management

NHFGD owns in fee or hold permanent conservation easements on 30 properties in the Great Bay region, totaling 1,646 acres (see **Figure 12.6**):

- 23 owned in fee, totaling 1,092 acres.
- 7 conservation easements, totaling 554 acres.

In further analysis of these 30 properties, 17 properties totaling 879 acres were protected and transferred to the Reserve and NHFGD through the collaborative efforts of the Great Bay Resource Protection Partnership during the time period January 1996 – December 2004. The 17 properties include (see **Figure 12.7**):

- 13 properties in fee, totaling 487 acres.
- 4 conservation easements, totaling 392 acres.

Figure 12.6 NHFGD Lands in Great Bay Region

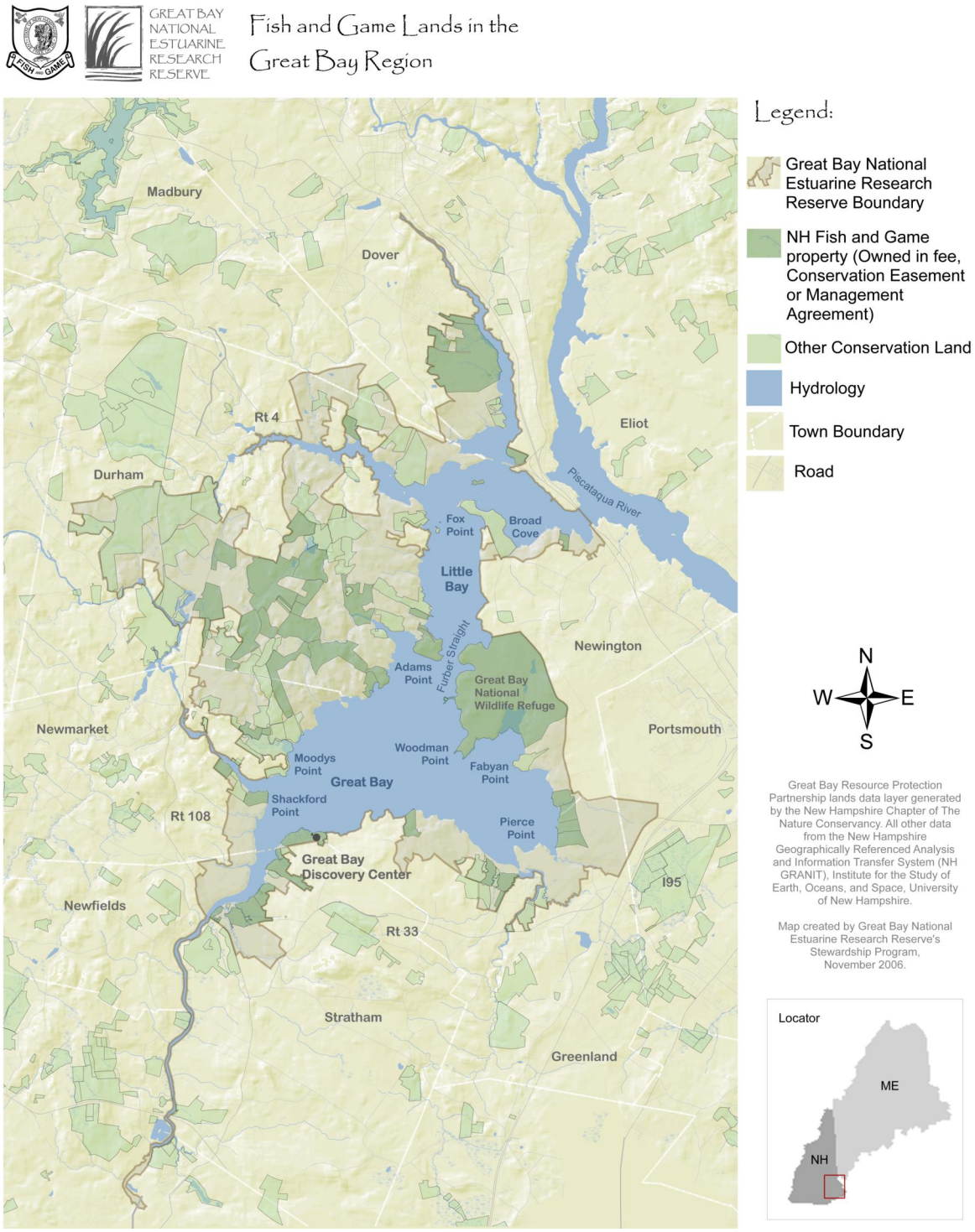
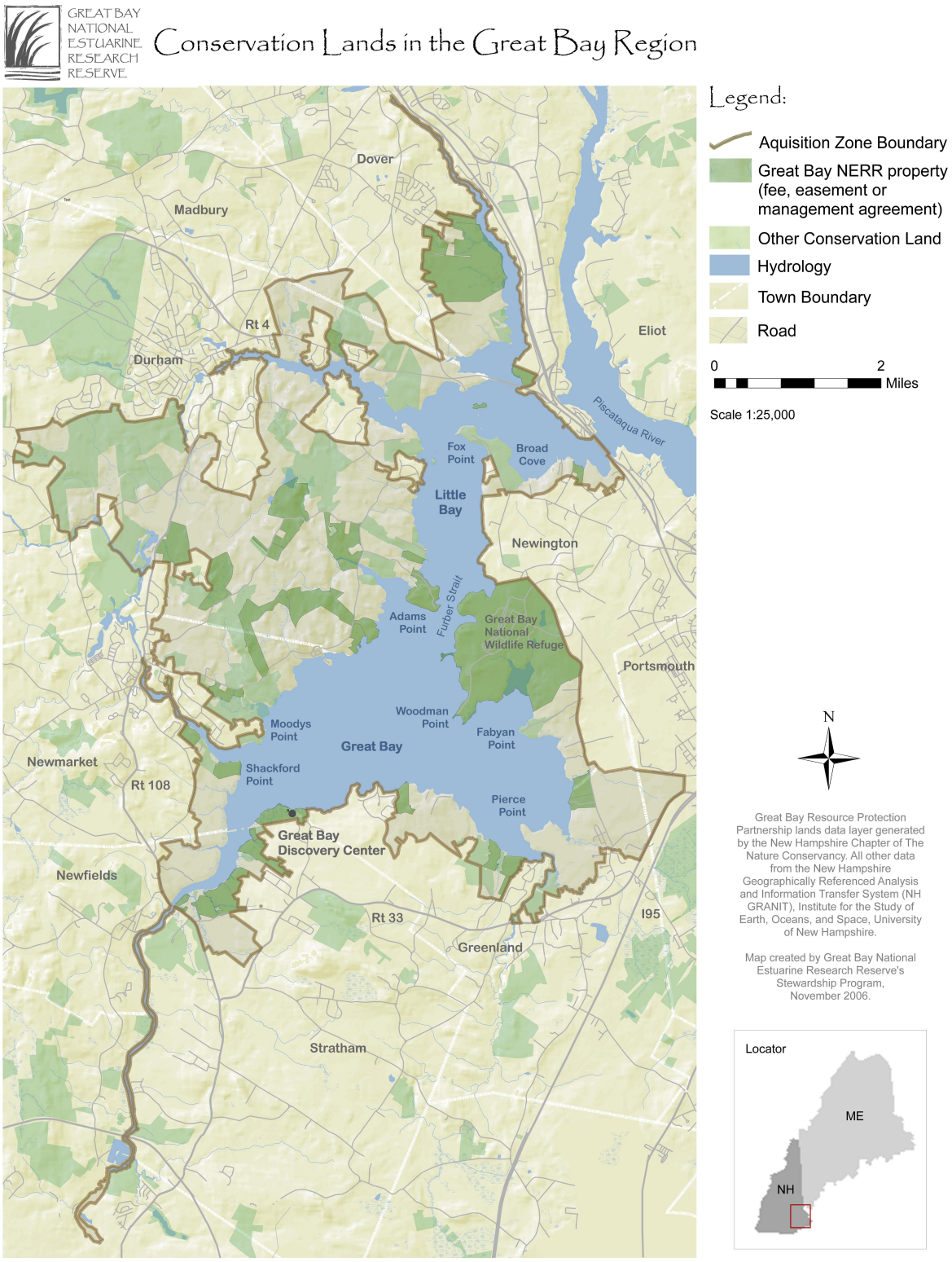


Figure 12. 7 Conservation Lands in the Great Bay Region



The Reserve's Stewardship Coordinator and Manager work with the Partnership and NHFGD staff throughout the entire land protection process, including the decision making of ownership and management of protected lands. Following the completion of a resource evaluation, the Partnership's Management Committee, of which the Reserve is a participating partner, develops recommendations for property ownership and management (see **Figure 12.8**).

3. Proposed Boundary - Education Justification

A site selection guiding principle in 15 C.F.R. sec. 921.11 (c), (6) reads:

> *The site's importance to education and interpretative efforts, consistent with the need for continued protections of the natural system.*

Since the inception of the Reserve, the staff has focused education and interpretation efforts primarily at the Great Bay Discovery Center, on the south shore of Great Bay. The proposed 2005 boundary fits within the federal regulation's guiding principle by tremendously increasing the opportunities for educating the public about the estuarine system. The Reserve has addressed the need for increased educational and interpretive opportunities through several actions that take a broader, watershed perspective toward educating the public. One example is the addition of interpretative kayak tours throughout the estuary.

Field Laboratory

Great Bay currently serves as a natural field laboratory for researchers. The proposed 2005 boundary would increase and diversify the areas capable of supporting NERRS long-term research and monitoring. This includes opportunities for extensive upland research.

Public Access

The Reserve's existing properties are multi-use, offering a variety of recreational pursuits. Based on individual property situations, different methods and strategies for acquisition - fee simple, conservation easements and other options – are considered. For buffer areas, traditional uses are maintained, working with staff to address high impact uses (i.e. snowmobiles on approved trails and horses). Protection of the most sensitive natural resources is always the highest priority. Every effort is made to allow public access with minimal impact on the resource.

F. Ecologically Valuable Land and Water Areas of the Reserve

The ecological, management, and education goals listed above will be applied when acquiring and managing properties. Protection efforts thus far have been focused on areas identified by Partnership's Habitat Protection Plan (Brickner-Wood 1997, 2000) and subsequent field studies and plans.

The Conservation Plan for the Great Bay Region (Stevens and Anderson 1997) describes the ecological significance of the Crommet and Lubberland Creeks. The report provides compiled lists of the natural communities and rare species found in the project area as well as other habitats bordering the Bay.

The property descriptions were developed as part of this plan and provide the Reserve with detailed information regarding the importance of protecting these lands. The descriptions below examine first the Crommet and Lubberland Creek watersheds, and then the tributaries flowing into Great and Little Bays and the unique characteristics within and along these rivers. The major acquisition zones are shown below (see **Figure 12.9**).

Figure 12.8 GBNERR Property Ownership Type

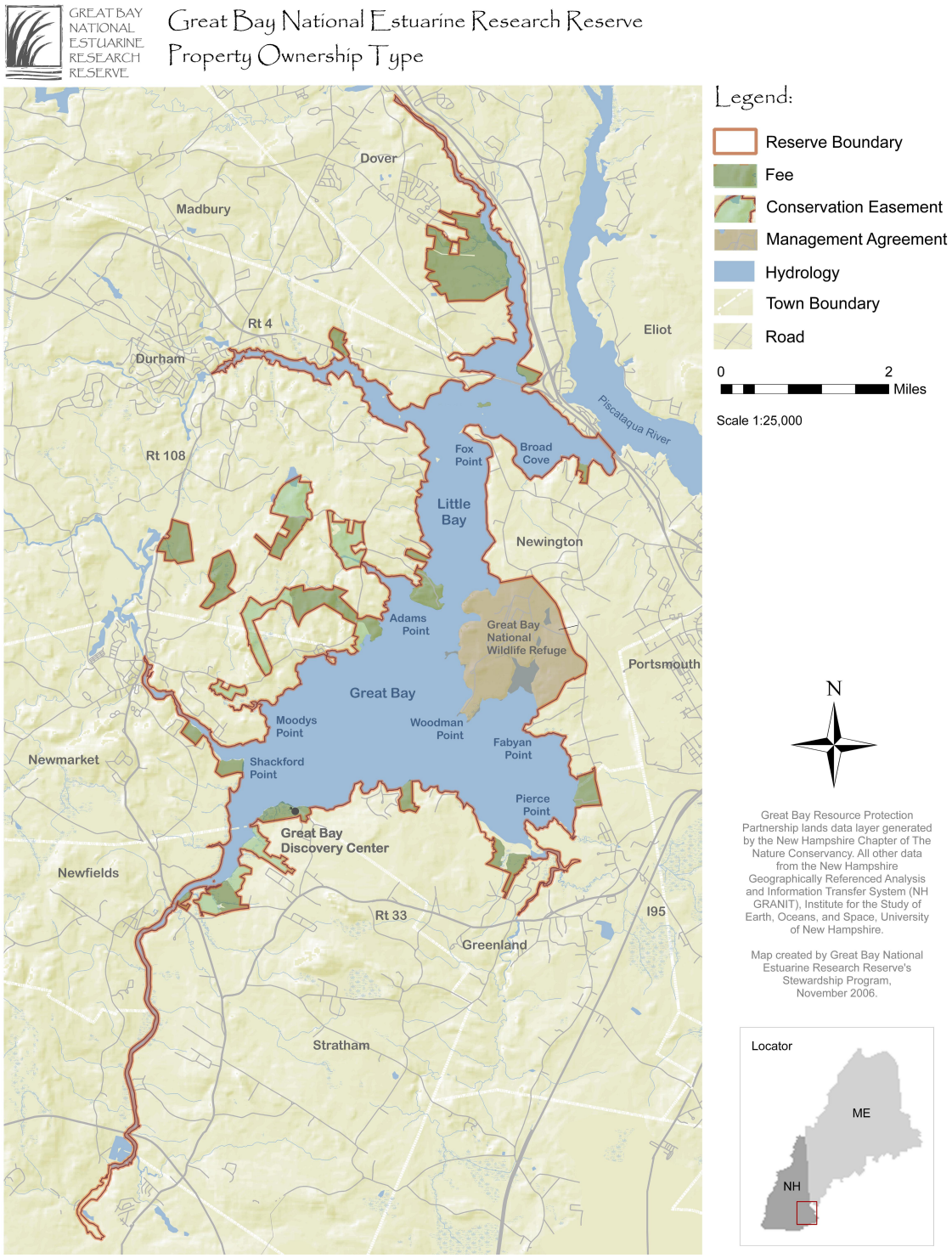
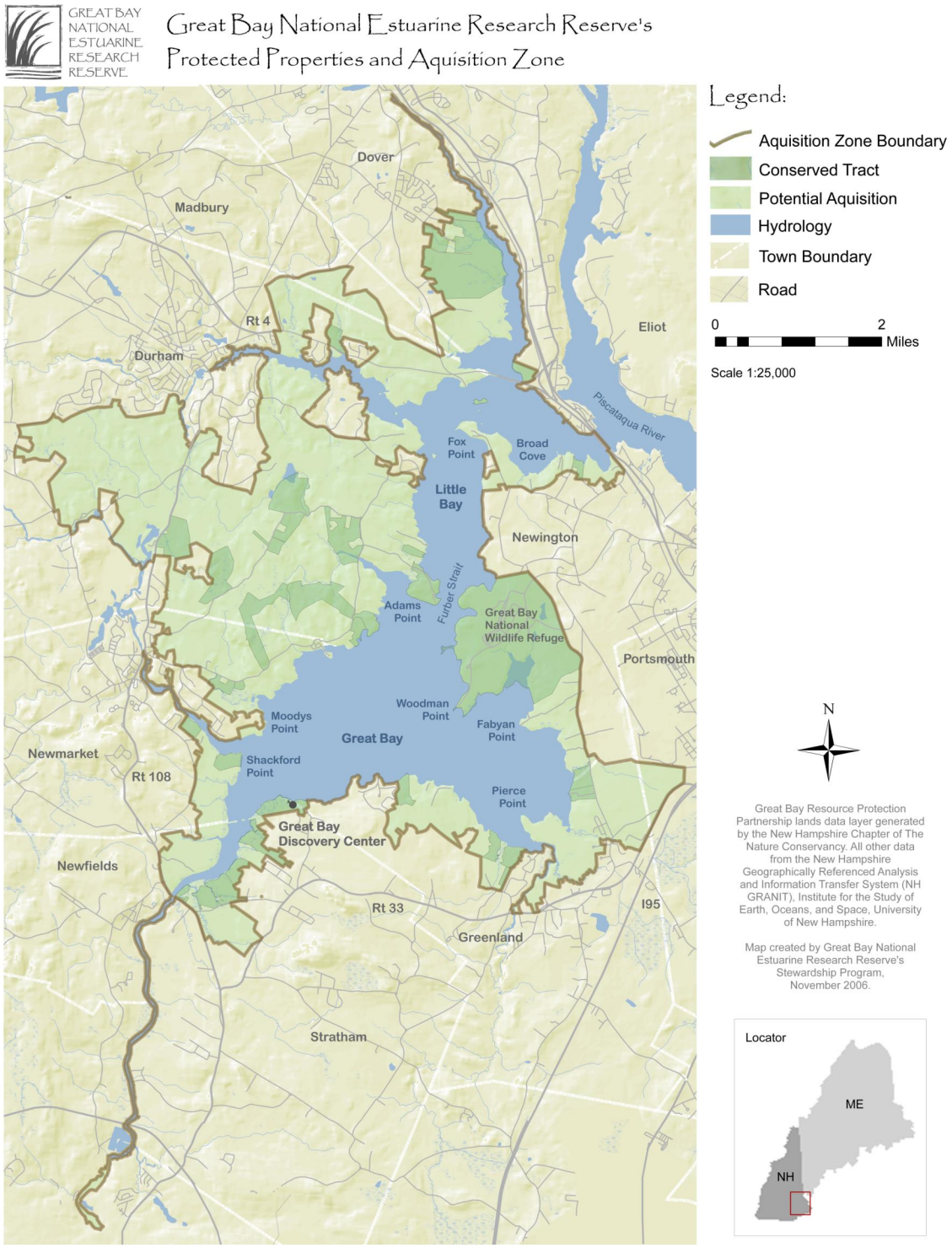


Figure 12.9 Protected Properties and Acquisition Zone



1. Crommet Creek and Lubberland Creek Site

Crommet Creek and Lubberland Creek Site Goal

Extend the Reserve's boundary to the Great Falls Dam, Town of Exeter and include properties identified by the Reserve.

The Crommet Creek and Lubberland Creek sites are contiguous areas located on the western shoreline of Great Bay. Although located within different sub-watersheds of Great Bay, the sites share many of the same ecological attributes such as exemplary salt marshes, tidal creeks, talus woodland, extensive wetlands, and estuarine shoreline. Notably, Crommet Creek, when combined with conservation of Lubberland Creek, provides one of the last opportunities to preserve a large, relatively unfragmented, tract of coastal landscape within reach of the shoreline of Great Bay.

Therefore, Crommet Creek and Lubberland Creek have been and will continue to be a focus of land protection activities. It has been targeted as a key land and water area by federal, State, regional and local entities. Several properties were protected through efforts in the 1980's by the Trust for New Hampshire Land (Land Conservation Investment Program), NHFGD, Town of Durham and The Nature Conservancy.

The Crommet Creek and Lubberland Creek sites are two of the few remaining, unfragmented natural areas around Great Bay that present an opportunity to preserve essentially an entire watershed containing the full spectrum of wetland and aquatic natural communities - estuarine, freshwater / brackish, and freshwater-associated with a tidal creek. The 3,500-acre Crommet Creek site includes the Crommet Creek watershed, contiguous unfragmented areas to the west, Durham Point Sedge Meadow, and associated shoreline areas, including Durham and Adams Point.

Much of Crommet Creek's watershed is forested and contains a notable and unusual concentration of wetland acreage found within a context of relatively light residential development and farming. Habitat for a globally-rare dragonfly is already protected within the site. The Crommet Creek site also contains extensive estuarine shoreline (see **Figure 12.10**).

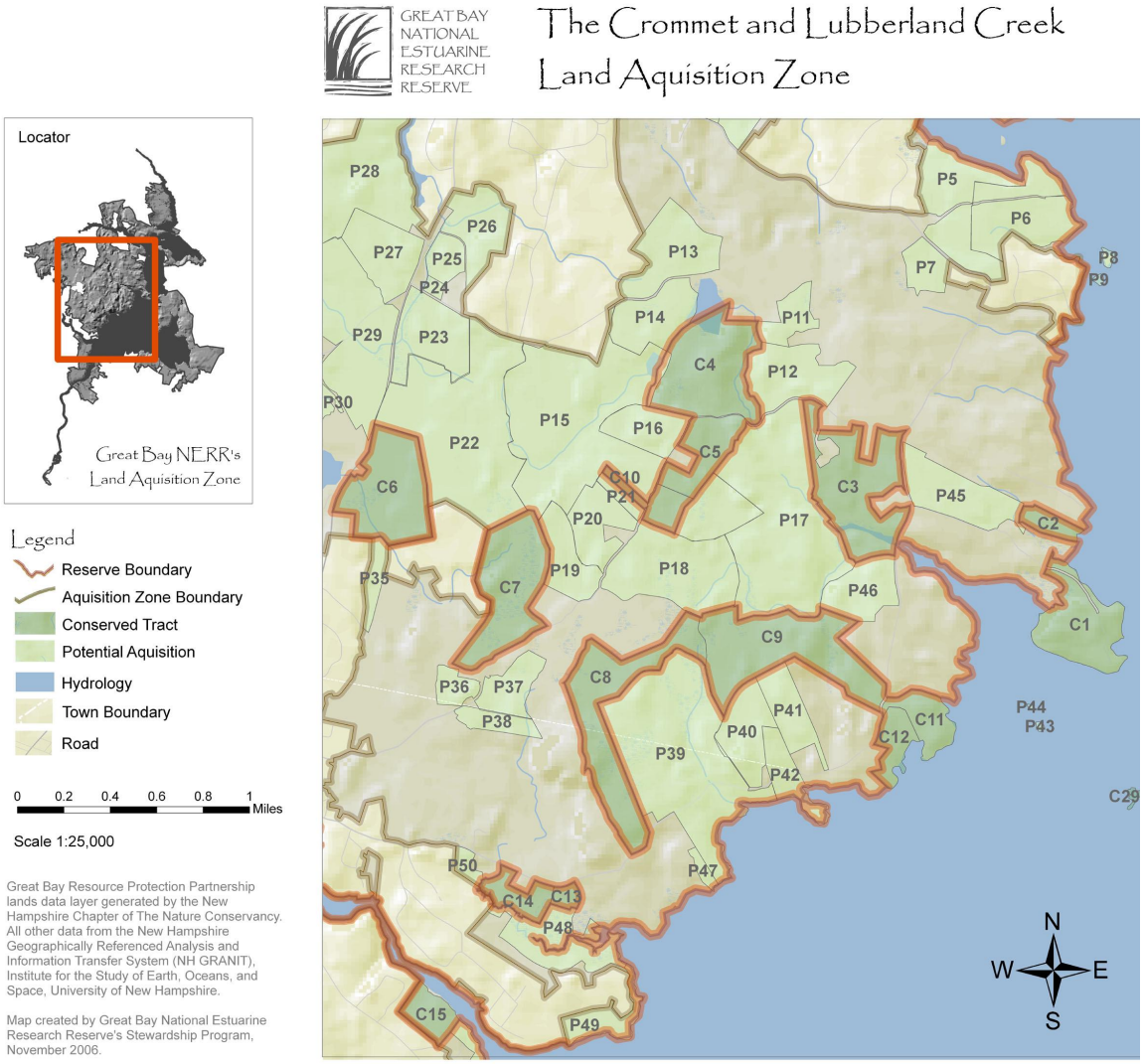
***Natural communities at Crommet Creek site include*:**

- Coastal rocky headland
- High and low salt marsh
- Vernal woodland pools
- Tidal creek beds
- Poor shrub fen
- Circumneutral woodland seep
- Medium-low graminoid/herbaceous emergent basin marsh
- Dry Appalachian oak-hickory forest
- Rich Appalachian oak-hickory talus woodland
- Semi-rich mesic Appalachian oak-hickory forest
- Basswood-ash-black maple stream bottom floodplain

Natural communities at Lubberland Creek site:

- High and low salt marsh
- Tidal creek beds
- Vernal woodland pools

Figure 12.10 Crommet and Lubberland Creek Land Acquisition Zone



- Rich Appalachian oak-hickory talus forest-woodland
- Appalachian oak-pine rocky ridge woodland/barren

Species at Crommet Creek and Lubberland Creek:

- *Haliaeetus leucocephalus,* bald eagle wintering area
- *Williamsonia lintneri*, the ringed boghaunter (a globally-rare dragonfly)

The ringed boghaunter has been documented at Durham Point Sedge Meadow, a preserve owned by TNC, and may utilize adjacent areas within the Crommet Creek watershed (additional studies are needed to document the range of the species).

Additional rare species and common natural communities clustered within the site design:
Natural Communities at Crommet Creek and Lubberland Creek:

- Beaver-influenced emergent marshes of various types
- Robust perennial basin marsh
- Unfragmented upland forest composed of characteristic coastal communities such as hemlock-beech-oak-pine

Important Species
There are 9 State rare plants occur at Crommet Creek:

- *Acer nigrum,* black maple
- *Agalinis maritima,* salt-marsh gerardia
- *Carex cristatella,* small-crested sedge
- *Ivafrutescens ssp. oraria,* marsh elder
- *Polygonum robustus,* robust knotweed
- *Ranunculus ambigens,* water-plantain spearwort
- *Scirpus pendulus,* lined bulrush
- *Scirpus robustus,* stout bulrush
- *Sparganium eurycarpum,* giant burreed

There are 2 State rare plants at Lubberland Creek:

- *Scirpus robustus,* stout bulrush
- *Viburnum rafinesquianum,* downy arrowwood

Ecological characteristics of the Crommet Creek and Lubberland Creek site

The Crommet Creek site contains essentially the entire watershed of Crommet Creek. Protection of the site would preserve the full spectrum of communities associated with the tidal creek, including high and low salt marsh at the mouth and lower reaches of Crommet Creek, transitional freshwater/brackish water zones below Dame Road, and the upper freshwater reaches of the watershed. Protection of the entire stream course, as well as adjacent uplands, maintains water quality and ensures the continuation of ecosystem processes.

The Crommet Creek and Lubberland Creek site supports two of the four extensive salt marsh areas around Great Bay. At the mouth of Lubberland Creek, there is an exemplary 18-acre salt marsh. It is part of a larger tidal wetland complex that includes a mosaic of high and low salt marshes, creeks, ditches, and salt pannes. The State-threatened stout bulrush *(Scirpus robustus*) is commonly found at this site. The salt marsh and tidal flats at the mouth of Lubberland Creek wrap

around Moodys Point to the north shore of the Lamprey River mouth. This salt marsh system is also exemplary and supports high and low salt marshes and brackish streams.

A second major feature of the Crommet Creek and Lubberland Creek site is the abundance of wetlands in the watershed. Wetland abundance may be explained in part by the rolling topography and close proximity of bedrock to the soil surface, allowing for the accumulation of water in numerous basins. These basins may be hydrologically isolated from nearby streams, or they may drain into one or more streams. Due to the gentle topography and the perched nature of the basins, some of the basins appear to drain at both ends into distinct sub watersheds. The basins are susceptible to flooding by beavers resulting in the development of various forms of emergent marshes and inland basin marshes.

Small-crested sedge *(Carex cristatella*) is found in a shallow emergent graminoid marsh formed through beaver flooding. The Lubberland Creek site also includes extensive interior wetland systems, including vernal pools that may be hydrologically connected to Crommet Creek.

Crommet Creek and Lubberland Creek are part of an area dominated by the wetland systems discussed above, as well as extensive upland forests composed of natural communities such as semi-rich mesic Appalachian oak-hickory forest, hemlock-beech-oak-pine forests, and dry-mesic Appalachian oak-hickory forests. When both tracts, found to the east and west of Dame Road (a dirt road) are combined, this area represents the largest single tract of predominantly natural land in the study area.

Threats to the Crommet Creek - Lubberland Creek site
There are four primary threats to the ecological health and stability of the Crommet Creek - Lubberland Creek site:

- Fragmentation
- Degraded Water Quality
- Extensive recreational use
- Cutoff from other conservation areas by major highways

Fragmentation
The greatest threat to the Crommet Creek and Lubberland Creek site is habitat fragmentation and loss in the form of residential development and intensive land use practices. In addition to the specific conservation targets, the Crommet Creek site presents an opportunity to protect an entire watershed as well as contiguous unfragmented lands. Additional residential development and new road construction would disrupt the continuity of this large natural area and cause many indirect effects, ranging from water pollution to songbird predation by household pets.

The best technique for mitigating this threat is to secure legal protection, through fee acquisition and conservation easements on undeveloped tracts in the watershed, with particular emphasis on large tracts adjacent to Crommet Creek, and contiguous tracts. Residential development threatens the ability of the Crommet Creek site to contribute to the protection of estuarine water quality and habitat. Protection of shoreline buffers is considered a primary priority within this site.

The second greatest threat to the Crommet Creek and Lubberland Creek site is the degradation of water quality and disruption of the hydrologic cycles, including disruptions of natural disturbance processes. Water quality is threatened by road construction, maintenance, and runoff, especially along Longmarsh, Dame, Great Bay and Durham Point Roads, and by increases in nutrient inputs

from leaking septic systems. These threats can be mitigated through cooperation with the Towns of Durham and Newmarket Highway Departments and through regular inspection of residential and commercial septic systems within the watershed. Appropriate riparian buffers, where logging and other intensive land uses are prohibited, should be instituted in order to protect water quality and riparian habitat (buffers vary from 150 to 1,800 feet) (Chase *et al*. 1995).

Forestland

The coastal region of New Hampshire has a long history of human land use and habitat alteration, and only small fragments of forest have not been shaped by human use. Crommet Creek, with its extensive acreage, creates an opportunity to allow the forest to mature and have natural disturbance processes be the primary agent of change. The presence of enriched bedrock and patches of unusual natural communities makes a no-cutting management strategy even more promising as a restoration tool.

Listed below are activities that threaten, to varying degrees, the conservation values of the site. Such activities require monitoring by the lead agency responsible for managing the site:

- Proliferation of exotic plant species
- Off-Road-Vehicle traffic through sensitive areas (for example, wetlands and talus forests)
- Collection or trampling of rare plants
- Recreational use that exceeds appropriate levels (including boating, mountain biking, and hunting)
- Pier construction
- Road expansion

In addition to safeguarding against the above threats, management of the banded bog skimmer requires particular attention to population trends and habitat quality. TNC has implemented a monitoring program, with funding from the NHFGD, to annually monitor the banded bog skimmer and evaluate the status of its habitat.

Ecological viability of Crommet Creek and Lubberland Creek

The feasibility of meeting ecological goals at Crommet Creek and Lubberland Creek is high. Due to the fact that much of the creek and immediate buffer areas are relatively undeveloped, land or conservation easement acquisition are the most important actions to take at Crommet Creek. GBRPP continues to work on land protection within the two sub-watersheds. The maintenance of the area in its existing healthy condition will ensure that the species and community conservation targets should remain viable. Due to the protected status of much of Lubberland Creek, the potential for maintaining the wetland and estuarine communities at this site is high.

Land Protection

Protected Properties in the Crommet Creek and Lubberland Creek Site

As of December 2005, the Reserve and NHFGD had fifteen protected properties in this site:

- Tract C1 to Tract C15

Tract s C2 (Rollins), C7 (Solomon), and C11 (Wilcox Point) and have been identified as core properties within the Reserve boundary.

Proposed Properties to be Protected in the Crommet Creek and Lubberland Creek Site
The Reserve will attempt to permanently protect the significant properties in the area as highlighted in Figure 12.10 (as of December 2005).

2. Lamprey River Site

Lamprey River Site Goal:

Expand the Reserve's boundary to the Mac Allen Dam, Town of Newmarket and include properties identified by the Reserve.

The Lamprey River begins in Northwood, New Hampshire, and courses 60 miles through six towns before becoming tidal in Newmarket and emptying into Great Bay (Lamprey River Advisory Committee 1995). The river has been designated for special protection at both the federal and State levels. In the summer of 2000, the Lamprey River was designated into the federal Wild and Scenic Rivers System, a program of the National Park Service, becoming only the second river in New Hampshire to receive such designation.

The proposed boundary would expand the 1989 boundary to the first dam on the Lamprey River, thereby supporting the goal of maintaining the ecological integrity of the Great Bay estuary. It would also include several small tributaries that flow into the Lamprey River (see **Figure 12.11**).

Lamprey River Area

- 133,760-acre watershed (209 mi^2)
- Includes portions of the towns of Northwood, Nottingham, Newfield, Newmarket, Exeter, Deerfield, Candia, Raymond, Epping, Fremont, and Lee
- Portions of the Lamprey River are designated Wild and Scenic
- Lamprey River has populations of the globally-rare small whorled pogonia (*Isotria medeoloides*)

Natural Communities

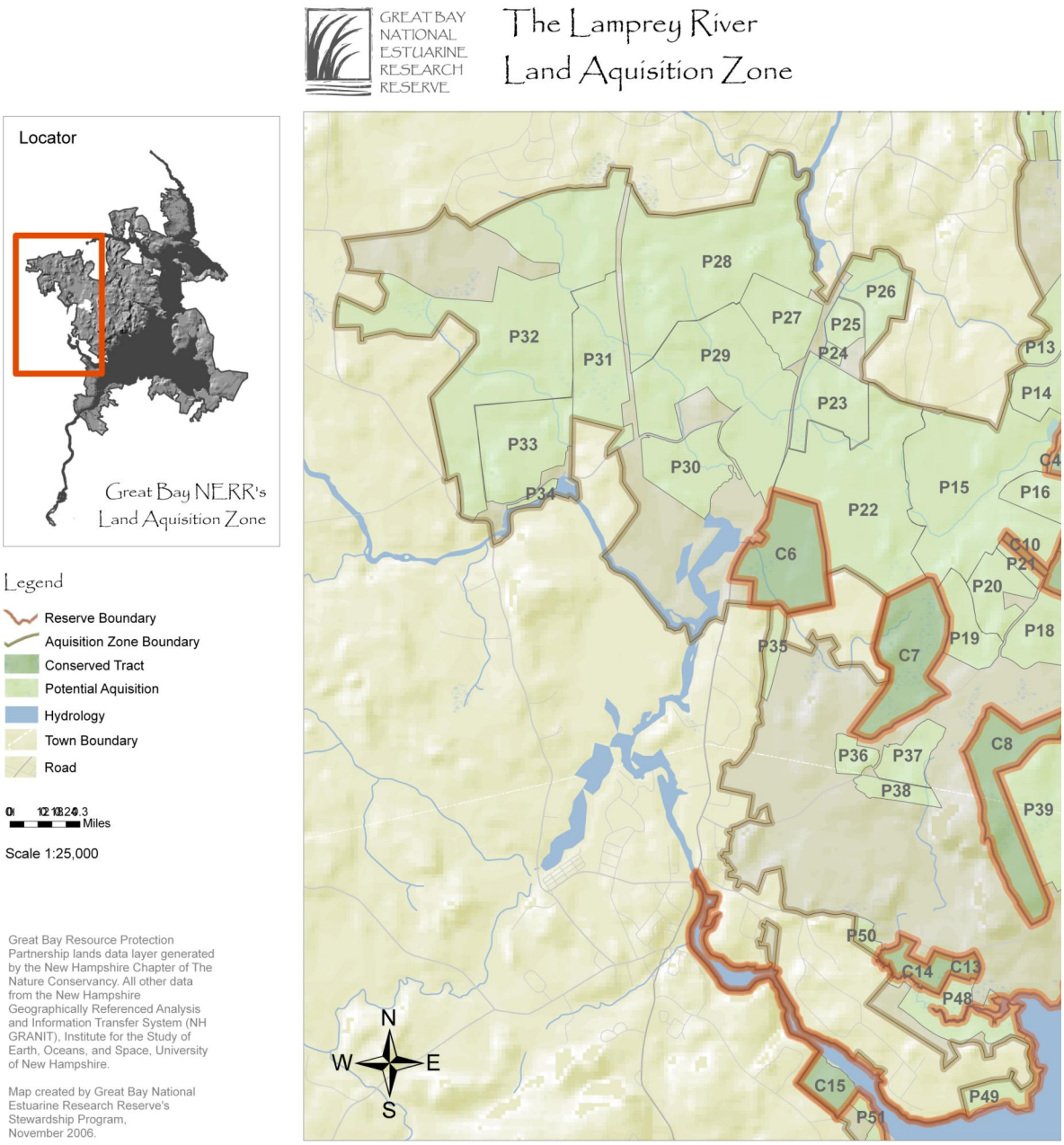
- Tidal creek beds
- Saline/brackish intertidal mudflats
- Brackish tidal riverbank mudflat/marsh
- High and low salt marsh

Important Species

There are 10 State-listed plant species supported at the Lamprey River site:

- *Agalinis maritima*, salt marsh gerardia
- *Aster tenuifolius*, large salt marsh aster
- *Eleocharis halophila*, small spike rush
- *Eleocharis parvula*, salt-loving spike rush
- *Iva frutescens* var. *oraria*, marsh elder
- *Lilaeopsis chinensis*, eastern lilaeopsis
- *Limosella subulata,* mudwort
- *Polygonum prolificum*, prolific knotweed
- *Samolus paraviflorus*, water pimpernel
- *Scirpus robustus*, stout bulrush

Figure 12.11 The Lamprey River Land Acquisition Zone



Ecological Characteristics of the Lamprey River Site

The Lamprey River mouth – also known as Moodys Point - extends from the culturally important mills in the Town of Newmarket downtown area of the Lamprey River to the river mouth at Great Bay. The site can be thought of as having two sections: the Lamprey River narrows (the tidal river section closest to Newmarket, up to the dam) and the river mouth, which includes Moody Point and Shackford Point.

The Lamprey River narrows section supports brackish tidal river mudflat/marsh and fresh/brackish inter-tidal flat. Six State rare plant species have been observed at the site since 1984. These plants are largely associated with the river's tidal mudflats. The mudflats are susceptible to disturbance to bank stability, light regime, and natural tidal action

Land Protection

Proposed Properties to be Protected in the Lamprey River Site:

The Reserve will seek to permanently protect the significant properties in this area as highlighted in Figure 12.11 (as of December 2005).

3. Squamscott River Site

Squamscott River Site Goal

Extend the Reserve's boundary to the Great Falls Dam, Town of Exeter and include properties identified by the Reserve.

The Squamscott River flows into the southwestern corner of Great Bay. It is one of three rivers that flow into Great Bay proper. The Squamscott River is currently partially protected; the portion of the river downstream of Route 108 in Newfields falls within the original Reserve boundary. Several properties in this area have been added to the Reserve's domain through the Great Bay Resource Protection Partnership and the former Land Conservation Investment Program (LCIP).

As stated, the purpose of the proposed 2005 boundary is to maintain the ecological integrity of the Great Bay estuary. From the stewardship and management perspective, the Reserve's energies are focused on the uplands in order to maintain water quality.

Along the Squamscott River site, the proposed 2005 boundary extends to the Great Falls Dam in the Town of Exeter. The proposed boundary extends eleven miles up river and will provide further water quality monitoring sites as well as Bay front property available for conservation. The Squamscott River Site has several significant conservation features:

- 81,920 acre watershed (128 mi^2).
- Includes portions of the Towns of Raymond, Chester, Sandown, Fremont, Danville, Brentwood, Kingston, East Kingston, Exeter, Kensington, Newfields, Stratham and Newmarket.
- The banks of the mouth of the river contain a significant portion of the estuary's salt marshes.
- The watershed has globally-rare Atlantic White Cedar swamps, swamp white oak floodplain forests and the brook floater (*Alasmidonta varicosa*), a freshwater mussel.
- A portion of the Exeter River is designated a State Rural River (NH Rivers Management and Protection Program, NHDES).

- Measures to improve the water quality of the Exeter River through new Wastewater Treatment Facilities have been relatively more successful than any other Great Bay tributary (Jones 1999).

Within the Reserve's 1989 boundary, the Squamscott River site connects Chapman's Landing, a State-owned boat launch near the mouth of the river, and the Sandy Point property on the Stratham - Greenland town line. The properties are linked by several additional properties protected by conservation and fee acquisition. There are additional properties in this site that are candidates for protection and land protection projects continue to be pursued in the Squamscott River site. The proposed 2005 boundary expansion would extend the boundary up the Squamscott River to the first fresh water dam – the Great Falls Dam, where the Squamscott River becomes the Exeter River.

The area along both sides of the Squamscott River represents a significant portion of the salt marsh in the estuarine system. Based on mapping from the National Wetlands Inventory, as well as tidal marsh studies of the State, a total of 2,230 acres of salt marsh are found in the Great Bay estuary, with the lower Piscataqua River, the Squamscott River, and Great Bay having the largest portions (Jones, 2002).

The Squamscott River mouth, which supports the single largest salt marsh in Great Bay, has undergone relatively light residential and commercial development, especially downstream of the Route 108 bridge in the town of Newfields. This site may represent the best opportunity to preserve the mouth of a major river tributary to Great Bay (see **Figure 12.12**).

Natural Communities of the Squamscott River Site

- Tidal creek beds
- High and low salt marsh
- Saline/brackish intertidal mudflats
- Brackish tidal riverbank mudflat/marsh
- Semi-rich mesic Appalachian oak-hickory forest
- Mesic Appalachian oak-sugar maple-beech
- Red maple basin swamps

Ecological Characteristics of the Squamscott River Site

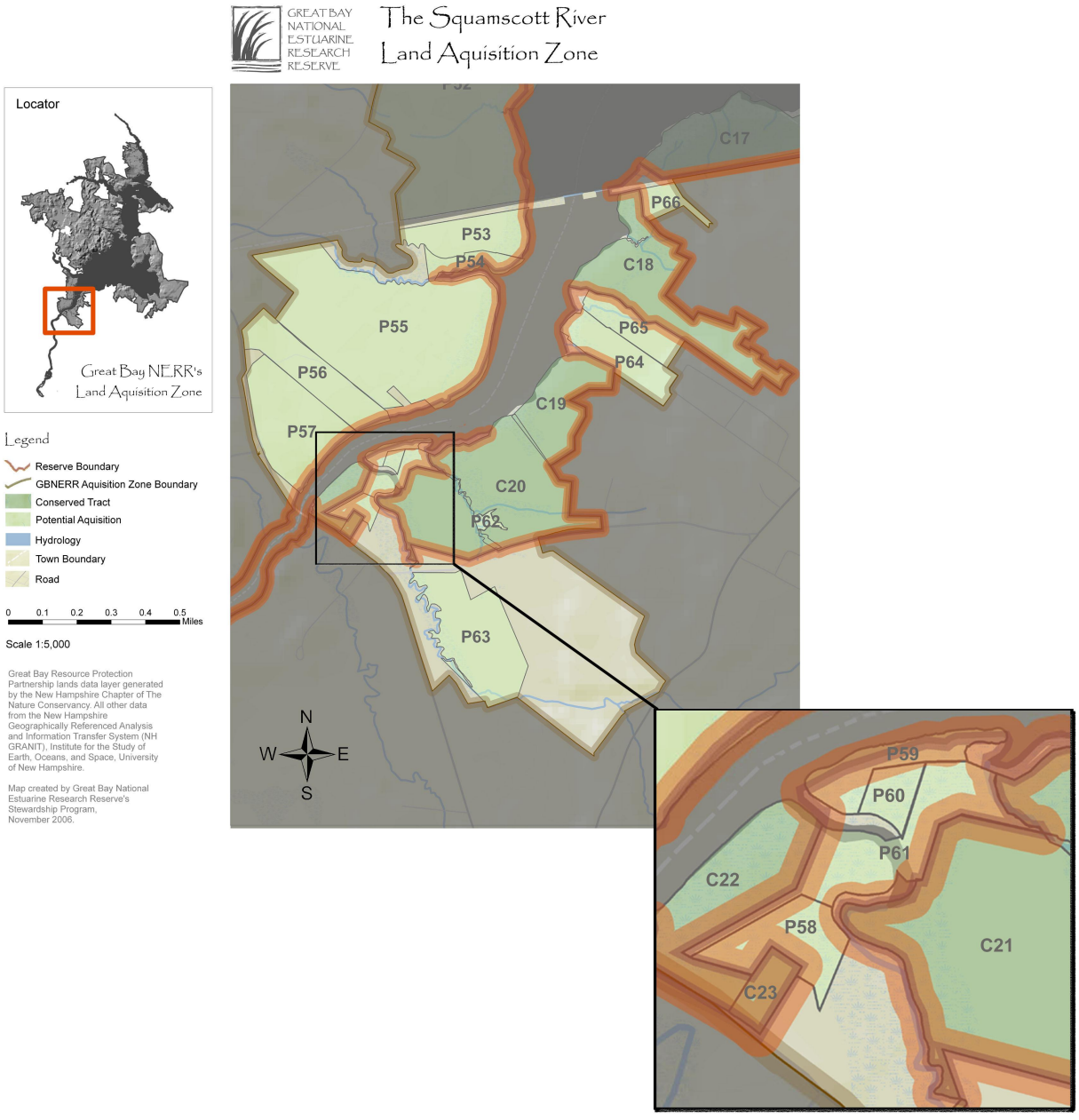
This moderately-sized tidal marsh supports brackish stream communities and high and low salt marshes.

- *Spartina patens*, salt meadow-grass
- *Distichlis spicata*, salt grass
- *Spartina alterniflora*, cordgrass

Less frequent species (< 1%) include:

- *Juncus arcticus* ssp. *littoralis*, Baltic rush
- *Sciropus robustus,* stout bulrush
- *Juncus gerardii*, black grass
- *Solidago semervirens*, salt marsh goldenrod
- *Atriplex hastate*, orache
- *Salicornia europaea*, samphire

Figure 12.12 The Squamscott River Land Acquisition Zone



- *Polygonum ramosissimum*, bushy knotweed
- *Phragmites australis*, common reed
- *Elytrigia repens*, quack grass
- *Festuca rubra*, red fescue
- *Asparagus officinalis*, asparagus
- *Carex hormathodes*, necklace sedge
- *Heirochloe odorata*, sweet grass

Species abundant in the low salt marsh:

- *Scirpus robustus*, stout bulrush
- *Spartina alterniflora*, cordgrass

Shallow salt pannes supported healthy populations of the following:

- *Eleocharis parvula*, small spike-rush
- *Spartina alterniflora*, cordgrass (short form)
- *Salicornia europaea*, samphire
- *Spergularia marina*, salt-marsh sand spurrey
- Suaeda linearis, southern sea-blite

Purple sulfur bacteria are common in the deeper panes where vascular plants are generally absent. Large areas of salt marsh needing inventory work continue to the southwest along the mouth of the Squamscott River. The following species have also been found:

- *Eleocharis parvula* (small spike-rush): This spike-rush was found in several salt pannes in the low salt marsh. Several hundred culms occurred with *Spartina alterniflora* (cordgrass; short form), *Salicornia europaea* (samphire), *Spergularia marina* (salt marsh sand-spurrey), and *Suaeda linearis* (southern sea-blite).

- *Iva frutescens var. oraria* (marsh elder): Three stations of *Iva frutescens* var. *oraria* (marsh elder) were documented in the salt marsh. Further study is recommended.

- *Scirpus robustus* (stout bulrush): *Scirpus robustus* (stout bulrush) commonly occurred in the low salt marsh and infrequently throughout the high salt marsh. Associates included *Spartina alterniflora* (cordgrass), *Spartina patens* (salt meadow-grass), *Juncus gerardii* (black rush), *Distichlis spicata* (salt-grass), and several other less-frequent species.

- *Mesic* (central hardwood) Forest: The mature mesic central hardwood forest covers about half of the site and is characterized by a variable mix of *Quercus rubra* (red oak), *Quercus alba* (white oak), *Pinus strobus* (white pine), *Acer rubrum* (red maple), and less importantly *Nyssa sylvatica* (black gum) and *Carya ovata* (shagbark hickory). Common understory species included *Gaylussacia baccata* (black huckleberry), *Kalmia angustifolia* (sheep laurel), *Aralia nudicaulis* (wild sasparilla), and *Osmunda cinnamomea* (cinnamon fern).

- Pockets of red maple swamps were found in poorly drained areas. Frequent canopy associates of the dominant *Acer rubrum* (red maple; 50% cover) in these wetlands were

Quercus bicolor (swamp white oak; 15% cover), *Ulmus Americana* (American elm; 5% cover), and *Nyssa sylvatica* (black gum; 1-5% cover). Numerous windthrows created areas of dense understory characterized by *Ilex verticillata* (swamp winterberry), *Lindera benzoin* (spice bush), *Viburnum lentago* (nannyberry), *Viburnum dentatum* var. *lucidum* (northern arrow-wood), *Alnus rugosa* (speckled alder), Onoclea sensilis (sensitive fern), *Osmunda cinnamomea* (cinnamon fern), *Carex intumescens* (inflated sedge), and several other less frequent species (<1%).

Land Protection

Protected Properties in the Squamscott River Site

As of December 2005, the Reserve and NHFGD had five protected properties, totaling 266 acres in this site.

Proposed Properties to be Protected in the Squamscott River Site

The Reserve will seek to permanently protect the significant properties in the area as highlighted in Figure 12.12 (as of December 2005).

4. Great Bay Site

Great Bay Site Goal

Extend the Reserve's boundary and include properties identified by the Reserve.

Land Protection

Protected Properties in the Great Bay Site

As of December 2005, the Reserve and NHFGD had seven protected properties in this site and established a management agreement on 1,050 acres with the USFWS (see **Figure 12.13**):

Tract C24 has been identified as a core property within the Reserve boundary.

Proposed Properties to be Protected in the Great Bay Site

The Reserve will seek to permanently protect the significant properties in the area as highlighted in Figure 12.13 (as of December 2005).

5. Oyster River and Bellamy River Sites

Oyster River and Bellamy River Sites Goal

Extend the Reserve's boundary to include Little Bay, and its tributaries, to the fresh water influence and include properties identified by the Reserve.

The inclusion of Little Bay and the rivers that flow into the Reserve boundary are essential as these bodies of water form Great Bay proper. The dominant tidal flow within the estuary is from the Piscataqua River through Little Bay to Great Bay.

Early protection efforts focused on the Crommet Creek watershed and Great Bay front properties. Since 2000, properties along the Little Bay shoreline and Bellamy River have been targeted for protection. Ecological characterizations of these areas are being developed (see **Figure 12.14**).

Figure 12.13 Great Bay Shoreline Land Acquisition Zone

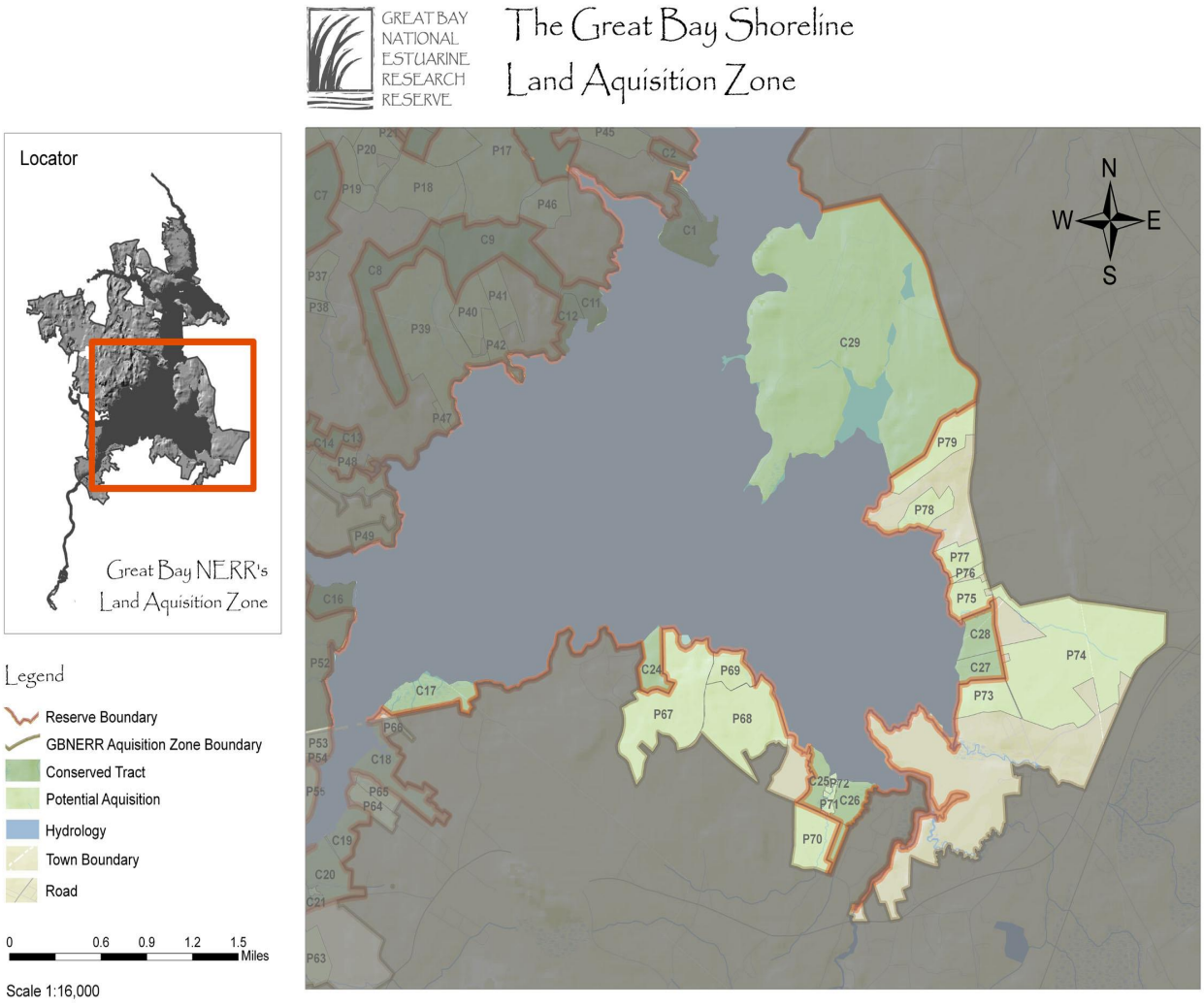
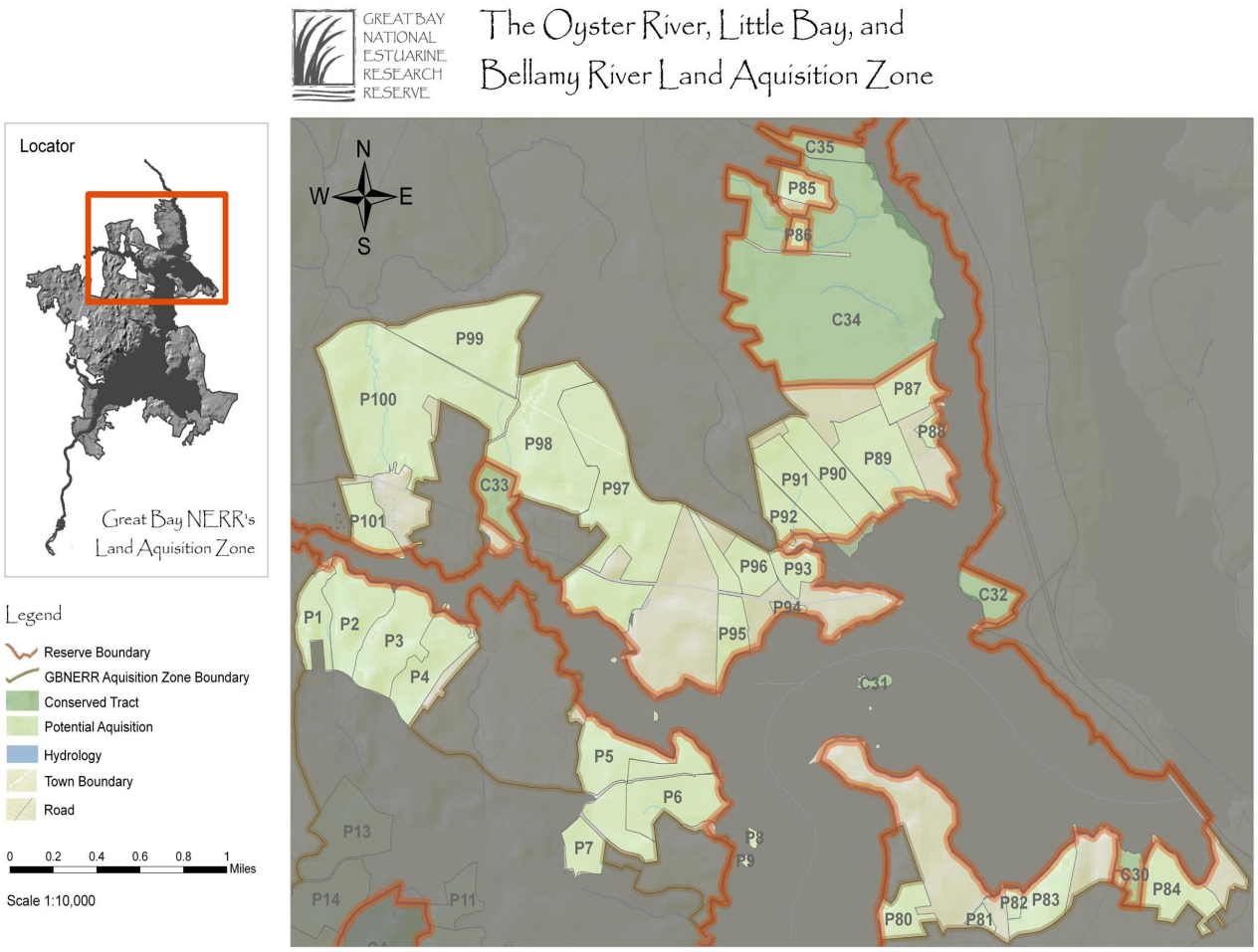


Figure 12.14 Oyster River, Little Bay, and Bellamy River Land Acquisition Zone



Oyster and Bellamy Rivers

- 40,320-acre watershed (63 mi^2).
- Includes portions of the towns of Barrington, Madbury, Dover, Lee and Durham.
- Watershed contains globally-rare populations of the plants northern blazing star (*Liatris borealis*), Eaton's quillwort (*Isoetes eatonii*), and the globally-rare dragonfly, ringed boghaunter (*Williamsonia lintneri*).

Natural Communities

- Low red maple-elm/musclewood/lady fern silt forest
- Red maple-black cherry/musclewood floodplain forest
- Southern hardwood-conifer seepage swamp
- Seepage marsh
- Vernal pools

Land Protection

Protected Properties in the Oyster River and Bellamy River Site

As of December 2005, the Reserve and NHFGD had three protected properties, totaling 450 acres in this site.

Proposed Properties to be Protected in the Oyster River and Bellamy River Site

The Reserve will attempt to permanently protect the significant properties in the area as highlighted in Figure 12.14 (as of December 2005).

F. Boundary and Acquisition Objectives and Action Items

Goal 1: Acquisition Plan

Work in partnership with other agencies and organizations to provide for the long-term conservation and protection of properties within the proposed 2005 Reserve boundary and to support NHFGD's mission, consistent with the federal NERR regulations.

Objective 1: Land Protection

Protect the physical and biological integrity of the Great Bay estuary by recognizing that the watershed functions as a component of the ecosystem.

Action Item 1: Partnerships and Acquisition

Action: To work with partners to acquire conservation properties identified in the proposed project areas.
Responsible: Manager/Stewardship Coordinator
Timeframe: Ongoing

Objective 2: Future Project Areas

Identify additional project areas for land acquisition.

Action 1: Update the Habitat Conservation Plan

Action: Continue to update the Habitat Conservation Plan for the Great Bay watershed in coordination with the Partnership and NHFGD Lands Team.

Responsible: Manager/Stewardship Coordinator
Timeframe: Ongoing

Objective 3: Cultural Resources

Identify important cultural resources and develop a priority list for protection as these relate to ongoing land acquisition efforts.

Action 1: Update Land Acquisition Maps
Action Item: Cross-reference identified cultural resources with properties targeted for protection by the Partnership and update the appropriate maps as necessary.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Objective 4: Ecosystem Management

Manage Reserve properties from a watershed perspective that is designed to maintain and enhance the integrity of the ecological system.

Action Item 1: Resource Property Descriptions
Action: Complete property resource inventories and descriptions for protected lands.
Responsible: Stewardship Coordinator
Timeframe: Ongoing
Action Item 2: Project Area Management Plans
Action: Develop regional management plans by identified watersheds for newly acquired lands.
Responsible: Stewardship Coordinator
Timeframe: Ongoing

Objective 5: Public Awareness

Raise public awareness and understanding of the natural attributes of the Great Bay estuary by emphasizing the interconnectedness of the ecosystem.

Action Item 1: Maps
Action: Develop a series of publications highlighting the lands that have been added to the Reserve. The purpose will be to stress the importance of protecting these lands while at the same time allowing limited public access.
Responsible: Stewardship Coordinator/GIS Coordinator
Timeframe: Ongoing

Bibliography

Able, K. W. and S. M. Ragan. 2000. Effects of common reed (*Phragmites australis*) invasion on marsh surface macrofauna: response of fishes and decapod crustaceans. Estuaries 23(5): 633-646.

Adams, J. P. 1976. Drowned Valley, the Piscataqua River Basin. University of New England Press, Hanover, NH.

Apollonio, S. 2002. Hierarchical perspectives on marine complexities: searching for system in the Gulf of Maine. Columbia University Press, New York.

Atlantic Coast Joint Venture. 2004. Atlantic Coast Joint Venture Strategic Plan. http://www.acjv.org/documents/acjv_strategic_plan.pdf

Atlantic States Marine Fisheries Commission (ASMFC). 1997. Submerged aquatic vegetation policy. ASMFC, Washington, D. C. 9 pp.

Ayotte, J. D., B. R. Mrazik, D. M. Argue, F. J. McGarry. 2004. Occurrence of methyl tert-butyl ether (MTBE) in public and private wells, Rockingham County, New Hampshire. U. S. Geological Survey and NH Department of Environmental Services. *http://pubs.usgs.gov/fs/2004/3119/pdf/FS2004-3119.pdf*

Ballestero, T. P., R. M. Roseen, and G. F. Bacca-Cortes. Land use influence on the characteristics of groundwater inputs to the Great Bay Estuary, New Hampshire. Final report submitted to the NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET).
http://rfp.ciceet.unh.edu/display/report.php?chosen=662

Beers, A. and S. Davidson. 1999. North Atlantic Coast Ecoregional Conservation Plan. The Nature Conservancy.

Birch, F. S. 1990. Radiocarbon dates of Quaternary sedimentary deposits on the inner continental shelf of New Hampshire. Northeastern Geology 12: 218-230.

Brickner-Wood, D. 1997 (revised 2000). Habitat protection plan for the Great Bay Focus Area. Great Bay Resource Protection Partnership, Durham, NH, and The Nature Conservancy, Concord, NH.

Brickner-Wood, D. and D. Bechtel. 2000. Crommet Creek and Great Bay Management Plan, Great Bay Focus Area, New Hampshire. Great Bay Resource Protection Partnership, Durham, NH, and The Nature Conservancy, Concord, NH.

Carlson, N. C. and F. T. Short. 1991. Test eelgrass restoration in Great Bay, New Hampshire. Final report to NH Fish and Game.

Chapman, D. H. 1974. New Hampshire landscape, how it was formed. New Hampshire Profiles, Portsmouth.

Chase, V. P., L. S. Deming, F. Latawiec. 1995. Buffers for surface waters and wetlands: a guidebook for New Hampshire municipalities. Audubon Society of New Hampshire, Concord, NH.

Conkling, P. W. (ed.) 1995. From Cape Cod to the Bay of Fundy: an environmental atlas of the Gulf of Maine. MIT Press, Cambridge, MA.

Crossett, K. M., T. J. Culliton, P. C. Wiley, T. R. Goodspeed. 2004. Population trends along the coastal United States: 1980-2008. National Oceanic and Atmospheric Administration, Silver Spring, MD.
http://www.oceanservice.noaa.gov/programs/mb/pdfs/coastal_pop_trends_complete.pdf

Delcore, M. and C. Koteff. 1989. Surficial geologic map of the Newmarket Quadrangle, Rockingham and Strafford Counties, New Hampshire. Preliminary map, Office of State Geologist, Department of Earth Sciences, University of New Hampshire, Durham, NH.

Foss, C.R., ed. 1994. Atlas of Breeding Birds in New Hampshire. Arcadia, Dover, NH.

Gordon, D. R. 1998. Effects of invasive, non-indigenous plant species on ecosystem processes: lessons from Florida. Ecological Applications 8(4): 975-989.

Howarth, R. W., D. Anderson, J. Cloern, C. Elfring, C. Hopkinson, B. Lapointe, T. Malone, N. Marcus, K. McGlathery, A. Sharpley, and D. Walker. 2000. Nutrient pollution of coastal rivers, bays, and seas. *Issues in Ecology* 7: 1-15.

Jones, S. H. 2000. A Technical Characterization of Estuarine and Coastal New Hampshire. The New Hampshire Estuaries Project, Portsmouth.

Jones, S. H., F. T. Short, and M. Webster. 1992. Pollution. In F. Short (Ed.), The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography (pp. 57-90). National Oceanic and Atmospheric Administration, Silver Spring, MD.

Josselyn, M. N. and A. C. Mathieson. 1978. Contribution of receptacles from the fucoid *Ascophyllum nodosum* to the detrital pool of a north temperate estuary. Estuaries 1:258-261.

Kurlansky, M. 1997. Cod: a biography of the fish that changed the world. Walker and Company, New York. .

Lamprey River Advisory Committee. 1995. Lamprey River Management Plan for the towns of Durham, Epping, Lee, and Newmarket.
http://www.des.state.nh.us/rivers/plans/lamplan.htm

Loureiro Engineering Associates, Inc. and YWC, Inc. 1986. Final Confirmation study report on hazardous waste sites at Naval Shipyard, Portsmouth, Kittery, Maine. Volume I. Loureiro Engineering Associates, Avon, CT. YWC, Inc., Monroe, CT. June 1986. A/E Contract No. N62472-83-C-1154.

Muehlstein, L. K., D. Porter, and F. T. Short. 1988. *Labyrinthula* sp., a marine slime mold producing the symptoms of wasting disease in eelgrass, *Zostera marina*. Marine Biology 99: 465-472.

Muehlstein, L. K., D. Porter, and F. T. Short. 1991. *Labyrinthula zosterae* sp. Nov., the causative agent of wasting disease of eelgrass, *Zostera marina*. Mycologia 83(2): 180-191.

National Estuarine Research Reserve System (NERRS). 2006a. Strategic plan: 2005-2010. National Oceanic and Atmospheric Administration, Washington, D. C. *http://nerrs.noaa.gov/images/pdf/StrategicPlan_Web.pdf*

National Estuarine Research Reserve System (NERRS). 2006b. Research and monitoring plan: 2006-2011. National Oceanic and Atmospheric Administration, Washington, D. C. *http://nerrs.noaa.gov/pdf/Research_Monitoring.pdf*

National Research Council. 2000. Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution. National Academy Press, Washington, D. C.

New England Regional Assessment Group. 2001. Preparing for a changing climate: the New England regional assessment overview. US Global Change Research Program. 96 pp. University of New Hampshire.

New Hampshire Coastal Program (NHCP). 1999. Dredging in New Hampshire: a review of projects, state permit procedure, and future dredging needs. New Hampshire Coastal Program, Concord, NH.

New Hampshire Comparative Risk Project. 1997. Report of ranked environmental risks in New Hampshire. NH Comparative Risk Project, Concord. *http://thejordaninstitute.org/nhenvrisk/reportmenu.htm*

New Hampshire Department of Environmental Services (NHDES). 2002. Revision of the New Hampshire state implementation plan for the adoption of measures to opt-out of the federal reformulated gasoline program. *http://www.des.nh.gov/ard/pdf/OFRFGaug02.pdf*

New Hampshire Department of Environmental Services (NHDES). 2007. Methyl t-Butyl Ether (MtBE): Health Information Summary. Environmental Fact Sheet, ARD-EHP-2. *http://www.des.nh.gov/factsheets/ehp/ard-ehp-2.htm*

New Hampshire Estuaries Project (NHEP). 2000. NHEP Management Plan. NHEP, Durham, NH.

New Hampshire Estuaries Project (NHEP). 2005. NHEP Management Plan, 2005 update. NHEP, Durham, NH. *http://www.nhep.unh.edu/resources/pdf/nhepmanagementplan-nhep-05.pdf*

New Hampshire Estuaries Project (NHEP). 2003. State of the Estuaries. University of New Hampshire, Durham, NH. *http://www.nhep.unh.edu/resources/pdf/2003stateofthe-nhep-03.pdf*

New Hampshire Estuaries Project (NHEP). 2006. State of the Estuaries. University of New Hampshire, Durham, NH. *http://www.nhep.unh.edu/resources/pdf/2006_state_of_the-nhep-06.pdf*

New Hampshire Fish and Game Department (NHFGD). 2005. Testing of Great Bay oysters for two protozoan pathogens. Final report to NHEP. *http://www.nhep.unh.edu/resources/pdf/testingofgreat-nhfg-05.pdf*

New Hampshire Office of State Planning. 1989. Great Bay National Estuarine Research Reserve Management Plan. National Oceanic and Atmospheric Administration/U. S. Department of Commerce, Washington, D. C.

New Hampshire State Planning and Development Commission. 1945. The Great Bay Plan: A Report to the 1945 Legislature. N. H. State Planning and Development Commission, Concord. 59 pp.

Notovny, R. F. 1969. The geology of the seacoast region, New Hampshire. New Hampshire Department of Resources and Economic Development, Concord. 46 pp., map.

Partners in Flight. 2000. Bird Conservation Plan for The Southern New England (Physiographic Area 09).

Short, F. T. 1992a. The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography. National Oceanic and Atmospheric Administration, Silver Spring, MD. 222 pp.

Short, F. T. 1992b. The estuarine hydrosystem. In F. Short (Ed.), The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography (pp. 31-38). National Oceanic and Atmospheric Administration, Silver Spring, MD.

Short, F. T., A. C. Mathieson, and J. I. Nelson. 1986. Recurrence of the eelgrass wasting disease at the border of New Hampshire and Maine, USA. Marine Ecology Progress Series 29: 89-92.

Short, F. T., P. F. Sale, and J. A. Guy. 1992. Characterization of estuarine habitats. In F. Short (Ed.), The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography (pp. 113-140). National Oceanic and Atmospheric Administration, Silver Spring, MD.

Short, F. and M. Webster. 1992. History of human activities and today's resource values in the Great Bay Estuary. In F. Short (Ed.), The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography (pp. 5-24). National Oceanic and Atmospheric Administration, Silver Spring, MD.

Sparhawk, T. G. 1983. Situs: an investigation into the effects of network connections on stratification using historical materials. Ph.D. dissertation, Department of Sociology, University of New Hampshire, Durham, NH.

Stevens, M. S. and J. E. Anderson. 1997. A conservation plan for the Great Bay region. The Nature Conservancy, Concord, NH.

Sundquist, D. and M. Stevens. 1999 (updated 2005). New Hampshire's changing landscape: population growth, land use conversion, and resource fragmentation in the Granite State. Society for the Protection of New Hampshire's Forests and The Nature Conservancy, Concord, NH. *http://www.spnhf.org/research/research-projects.asp*

Teal, J. and M. Teal. 1962. Live and death of the salt marsh. Audubon/Ballantine, New York.

Thayer, G. W., W. J. Kenworthy, and M. S. Fonseca. 1984. The ecology of eelgrass meadows of the Atlantic coast: a community profile. U. S. Fish and Wildlife Service FWS/OBS-84/24.

U. S. Environmental Protection Agency. 1997. Climate Change and New Hampshire. U. S. Environmental Protection Agency, Office of Policy, Planning and Evaluation EPA 230-F-97-008cc.
http://yosemite.epa.gov/OAR%5Cglobalwarming.nsf/UniqueKeyLookup/SHSU5BVJDV/$File/nh_impct.pdf

Ward, L. G. 1992. Estuarine geomorphology. In F. Short (Ed.), The ecology of the Great Bay estuary, New Hampshire and Maine: an estuarine profile and bibliography (pp. 39-43). National Oceanic and Atmospheric Administration, Silver Spring, MD.

Appendix A
Species of Concern

Key to Species Descriptions

Common Name - Common name of species
Scientific Name – Scientific name of species
Alpha Code – Designated four-letter alpha code for each species
Chronology – Identification of when each species uses the Great Bay Focus Area

B – Breeding
M – Migration
W – Wintering
L – Lifetime

NAWMP – Species is identified by the North American Waterfowl Management Plan

HP High priority species
P Priority species
A Affected species
SC Species of special concern
SA Species of special attention

FT&E - federally listed endangered and threatened species and formerly proposed Category 2 candidate species

E Federally listed endangered species
T Federally listed threatened species
C Formerly proposed federally Category 2 candidate species

NH T&E - State of New Hampshire listed threatened and endangered species

E State listed endangered Species
T State listed threatened Species

NHNHI – Species tracked by New Hampshire Natural Heritage Inventory (NHNHI) Elements were evaluated and ranked by the NHNHI on the basis of their global (range-wide) status (G) and their state-wide status (S)

G2, S2 Imperiled because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range.

G3, S3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range or vulnerable to extinction throughout its range because of other factors; in the range of 21 to 100 occurrences.

G4, S4 Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.

G5, S5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.

GU, SU Possibly in peril, but status uncertain; more information needed.

GH, SH Historically known; may be rediscovered.

A Accidental in the state; including species (usually birds or butterflies) recorded very infrequently, hundreds or thousands of miles outside of their usual range.

B A state rank modifier indicating breeding status for a migratory species.

E An exotic established in the state, may be native in nearby regions.

HYB Element of a hybrid species.

N A state rank modifier indicating non-breeding status for a migratory species.

P Indicated the element may potentially occur in the state.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

R Reported in the state; but lacking documentation that would provide a basis for either accepting or rejecting the report.

T Rank for a subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

Z Ranking not applicable

Appendix B
Threatened or Endangered Animal Species Found in the Great Bay Area

Common Name	Scientific Name	Chronology	NAWMP	FT&E	NHT&E	NHNHI
Insects						
Banded Bog Skimmer	*Williamsonia lintneri*	L		C	E	G2S1
Mollusks						
Brook Floater	*Alasmidontaa varicose*	L		C	E	G3S1
Fish						
Shortnose Sturgeon	*Acipenser brevirostrum*	BM		E	E	G3SH
Reptiles						
Blanding's Turtle	*Emydoidea blandingii*	L		C		
Spotted Turtle	*Clemmys guttata*	L		C		
Wood Turtle	*Clemmys insculpta*	L		C		
Waterbirds						
Common Loon	*Gavia immer*	MW	SC		T	G5S3B/SZN
Pied-billed Grebe	*Podilymbus podiceps*	BM	SC		E	G5S1B/SZN
Canada Goose	*Branta Canadensis*	BMW	A			
Atlantic Brant	*Branta bericla*	M	P			
Mallard	*Anas playrhynchos*	BMW	HP			
American Black Duck	*Anas rubripes*	BMW	HP			
Northern Pintail	*Anas acuta*	M	HP			
Green-winged Teal	*Anas crecca*	BM	A			G5S3B/SZN
Blue-winged Teal	*Anas discors*	BM	HP			G5S3B/SZN
American Wigeon	*Anas americana*	MW	A			
Northern Shovler	*Anas clypeata*	M	SC			
Wood Duck	*Aix sponsa*	BM	P			
Ring-necked Duck	*Aythya collaris*	M	P			G5S3B/SZN
Canvasback	*Aythya valisineria*	W	P			
Greater Scaup	*Aythya marila*	MW	A			
Common Goldeneye	*Bucechpha clangula*	MW	SC			G5S*3*
Bufflehead	*Bucephala alebeola*	MW	A			
Hooded Merganser	*Lophodytes cucullatus*	BMW	A			
Red-breasted Merganser	*Mergus serrator*	MW	A			
Common Merganser	*Mergus merganser*	MW	A			
Marsh and Wading Birds						
American Bittern	*Botaurus lentiginosus*	BM	SC			G4S3B
Virginia Rail	*Rallus limicola*	BM	SA			G5S4B
Sora	*Porzana carolina*	BM	SA			G5S3B

Shorebirds						
Piping Plover	*Charadrius melodus*	BM		T	E	G3SHB/SZN
Upland Sandpiper	*Bartramia longicauda*	BM	SC		E	G5S1
Short-billed Dowitcher	*Limnodromus griseus*	M	SA			
Sanderling	*Calidris alba*	BM	SA			
Seabirds						
Common Tern	*Sterna hirundo*	BM			E	G5S1
Arctic Tern	*Sterna paradisaea*	BM			T	G5SHB/SZN
Roseate Tern	*Sterna dougallii*	M		E	T	G3SHB/SZN
Least Tern	*Sterna albifrons*	BM			T	G4SHB/SZN
Landbirds						
Cooper's Hawk	*Accipiter cooperii*	BMW			T	G4S2B/SZN
Northern Goshawk	*Accipiter gentilis*	BMW		C		
Broad-winged Hawk	*Buteo platypterus*	BM	SA			
Bald Eagle	*Haliaeetus leucocephalus*	MW		T	ET	G3S1
Northern Harrier	*Circus cyaneus*	BM	SC			G5S2B
Osprey	*Pandion haliaetus*	BM			T	
Common Nighthawk	*Chordeiles minor*	BM			T	
Belted Kingfisher	*Megaceryle alcyon*	BM	SA			
Purple Martin	*Progne subis*	BM			T	G5S1B
Sedge Wren	*Cistothorus platensis*	BM	SC		E	G5S1B
Wood Thrush	*Hylocichla mustelina*	BM	SA			
Veery	*Catharus fuscescens*	BM	SA			
Loggerhead Shrike	*Lanius ludovicianus*	BM		C	E	G4SHB
Cerulean Warbler	*Dendroica cerulea*	BM		C		G4G1B
Louisiana Waterthrush	*Seiurus motacilla*	BM	SA			
Bobolink	*Dolichonyx oryzivorus*	BM	SC			
Henslow's Sparrow	*Ammodramuss henslowii*	BM		C	E	G4SHB
Seaside Sparrow	*Ammospiza maritima*	BM	SC			G4S1B

Appendix C
New Hampshire Fish and Game 902 Rules for Wildlife Management Areas

PART Fis 902 RULES APPLICABLE TO WILDLIFE MANAGEMENT AREAS

Fis 902.01 Applicable to All Areas.

(a) The fish and wildlife management areas listed in Table 901-1 shall be subject to the following:

(1) The taking of wildlife shall be permitted during the open seasons in accordance with the statutes and rules under RSA 206-215-B;

(2) Trapping rights shall be awarded as specified in Fis 902.03;

(3) Specific activities shall be allowed only with written permission of the executive director and shall only be permitted when these activities are compatible with the management of the particular area and do not adversely impact the fish and wildlife area or the managed activities;

(4) Activities for which permission may be sought shall include the following:

a. The operation of OHRVs, as defined in RSA 215-A:1, on bare ground;

b. Open fires;

c. Field trials;

d. Camping;

e. Removal or disturbance of natural resources such as but no limited to maple sugaring, archeological digs, mineral digs, prospecting or removing vegetation;

f. Organized horseback riding events; and

g. Overnight parking;

(5) All boats left overnight shall be identified by a current NH boat registration number or by attaching to the bow the owner's name and address;

(6) Decoys for the purpose of waterfowl hunting shall not be left unattended and shall be within unaided eyesight;

(7) The use or possession of alcoholic beverages shall be prohibited;

(8) The rules relative to boat access specified in Fis 1600 shall apply;

(9) No person shall construct structures such as but not limited to rope swings, diving platforms, or permanent tree stands and blinds; and

(10) Target practice shall not be allowed.

(b) Some fish and wildlife management areas listed in Table 901-1 shall be subject to additional regulations as specified in Fis 903.

Source. #1670, eff l1-20-80; ss by #2079, eff 7-5-82-; ss by #2839, eff 8-31-84; ss by #4934, eff 9-19-90; ss by #6332, INTERIM, eff 9-4-96, EXPIRED 1-2-97

New. #6765, eff 6-15-98

Fis 902.02 Dog Training on Fish and Game Lands.

(a) Dog training shall not occur from March 15 through July 15 of each year.

(b) Dog training activities shall not take place in newly planted agricultural fields.

(c) Call back pens shall be used only during daylight hours. All pens shall be labeled with the owner's name and address.

Source. #1670, eff l1-20-80;; ss by #2079, eff 7-5-82-; ss by #2433, eff 7-21-83; ss by #2839, eff 8-31-84; ss by #4934, eff 9-19-90; ss by #6332, INTERIM, eff 9-4-96, EXPIRED 1-2-97

New. #6765, eff 6-15-98

Fis 902.03 Award of Trapping Permits for State Managed Lands.

(a) Trapping rights shall be awarded for a 2 year period for all state managed lands for which the department has authority to award such rights.

(b) State managed lands shall be divided into trapping units as follows:

(1) A trapping unit shall consist of a specific area, determined by the director or his/her agent. Factors included in said determination shall be the wildlife reSources of the particular area, and the physical size limits of the land area one individual can conveniently trap.

(2) The boundaries of each such trapping unit on state managed lands shall be outlined on maps kept in the department's fish and wildlife division, which shall be open to public inspection during regular business hours at headquarters in Concord.

(3) Each trapping unit shall indicate known nuisance beaver control areas. "Nuisance beaver control areas" means any areas within a trapping unit in which the chief of inland fisheries and wildlife, after consultation with the conservation officer whose patrol includes the trapping unit, determines that beaver are creating a nuisance that is not compatible with the safety of humans or the planned use of the land.

(4) Whenever a nuisance beaver control area is identified after a permit for that unit has been issued the department shall notify the trapper, by telephone if possible, followed by a written letter that a new permit is being mailed to him.

(c) Trapping rights on state managed lands shall be awarded to properly licensed trappers as follows:

(1) Applicants for award of such trapping rights shall make application to the fish and wildlife division, on an application form for trapping state managed lands which shall include:

a. The name of the trapper;

b. Address and telephone number of the trapper;

c. A list of all trapping units in the state for which they wish to be awarded trapping rights; and,

d. If applicable, the name(s) and address(es) of helper(s);

(2) The list of trapping units listed shall be in the licensee's order of preference. For example, the first area listed shall be considered the applicant's first choice and the second area listed shall be considered the applicant's second choice; and

(3) Applications shall be received by the department on or before the second Monday of September.

(d) Trapping rights shall be awarded no later than September 20th by a random selection procedure done in the following manner:

(1) The first applicant selected shall be awarded trapping rights for the trapping unit listed as first choice on his/her application. The second applicant selected shall be awarded trapping rights for the first trapping unit on their application which has not been previously awarded;

(2) Random selection of applications shall continue, with each applicant being awarded trapping rights for the first trapping unit she or he listed on the application which has not been previously awarded; and

(3) The random selection process shall continue until trapping rights for all trapping units under the department's control which have been applied for, have been awarded.

(e) Permits shall become effective on October 1st of the year awarded and shall be valid for 2 years.

(f) Permits to trap and annual trapping report forms, as required pursuant to RSA 210:21, shall be mailed to successful applicants, who hold a valid trapping license, prior to the opening of that year's trapping season.

(g) All units not awarded during the drawing shall be issued after the drawing on a first-come first-served basis and these permits shall be valid for the remainder of the 2 year period from the drawing.

(h) No more than one individual shall be awarded the trapping rights for any one trapping unit.

(i) Permittees under this section shall be allowed to take on one or 2 helpers, who shall also be permitted to trap within the permittee's trapping unit, under the following conditions:

(1) A helper shall be a legally licensed trapper in New Hampshire;

(2) If the helper is convicted of a trapping violation which occurred in the permit area, the permittee shall lose all permits to trap state managed lands; and

(3) If a permittee shall add or remove a helper after a permit has been issued, the permittee shall return the permit to the department indicating the change and the department shall then issue a new permit.

(j) Permittees shall control the nuisance caused by beaver or eliminate the nuisance beaver within the nuisance beaver control area.

(k) Any permittee shall, within 7 days of being notified per Fis 902.03(b)(4), that his trapping unit has developed a nuisance beaver control area, shall control the nuisance caused by beaver, eliminate the nuisance beaver or turn in his permit for that area so that it shall be available for reissue.

(l) Upon proper notification and hearing in compliance with RSA 541-A:15 and Chapter Fis 200 the executive director shall revoke all permits to trap on state managed land that have been issued to a permittee when the executive director finds that the permittee has failed to comply with the provisions of Fis 902.03(i) and (j). Said permittee shall not be eligible to apply for a permit or to trap on state managed lands for a period of 3 years from the date of revocation.

(m) Any permittee who has not purchased a license by October 10 of either year his permit is effective or whose trapping license has been suspended or revoked for any reason shall forfeit all permits to trap state managed lands.

(n) Notwithstanding any other provisions of this section, the executive director shall issue a permit to trap state lands for any trapping unit which is not currently assigned to a trapper whenever a conservation officer identifies that there is a nuisance beaver problem located within the trapping unit. The permit shall be valid for the remainder of the 2 year period under which the trapping unit is managed or a minimum of one

trapping season. If less than one trapping season remains for a permit, the department shall reissue the permit to a trapper who shall be entitled to keep the permit for the next 2 year period under which the unit is managed.

Source. #1670, eff l1-20-80; ss by #2079, eff 7-5-82-; ss by #2839, eff 8-31-84; ss by #4635, eff 6-21-89; EXPIRED 6-21-95

New. #6292, eff 7-20-96

PART Fis 903 RULES APPLICABLE TO PARTICULAR WILDLIFE MANAGEMENT AREAS

Fis 903.01 Adams Point.

(a) Adams Point in Durham shall be subject to the following provisions:

(1) Unauthorized persons shall not be allowed to go beyond the gate between 10:00 p.m. and 4:00 a.m., except that individuals shall be permitted beyond the gate in order to fish;

(2) No parking shall be permitted on the entrance road; and

(3) The speed limit within the area shall be 10 m.p.h.

Source. #1670, eff l1-20-80; ss by #2079, eff 7-5-82-; ss by #2839, eff 8-31-84; amd by #4334, eff 10-1-88; ss by #4934, eff 9-19-90; ss by #6332, INTERIM, eff 9-4-96, EXPIRED 1-2-97

New. #6765, eff 6-15-98

Appendix D
New Hampshire Guide of Programs for Conservation

State Programs

1) Nonpoint Source Local Initiatives Grants (Section 319 Grants) – New Hampshire Department of Environmental Services

For watershed management efforts. Grants given to associations, organizations, agencies.

2) Watershed Restoration Grants (Section 319 Restoration Grants) – New Hampshire Department of Environmental Services

Grants can be given to farmers, watershed associations, conservation districts, non-profit organizations, regional planning agencies, and municipalities to implement practices that help restore impaired waters.

3) Local Water Protection Grants (Drinking Water Source Protection) – New Hampshire Department of Environmental Services

To protect public drinking water sources. Water suppliers, municipalities, conservation districts, and non-profits are eligible to apply.

4) Fisheries Habitat Conservation Program – New Hampshire Fish and Game Department

To conserve fisheries habitat through a watershed approach. Landowners wishing to protect/enhance fisheries habitat can apply for funding.

5) Wildlife Habitat - Small Grants Program – New Hampshire Fish and Game Department

For restoring, sustaining, or enhancing wildlife habitat on privately owned land. Owners of private, municipal, corporate or other non-governmental lands can apply for funds to implement habitat-improving practices

6) Transportation Enhancement Program – New Hampshire Department of Transportation

Provides funding for scenic highway projects and mitigation of water pollution due to highway runoff.

7) Community Conservation Assistance Program – University of New Hampshire Cooperative Extension Service

Assistance for project guidance and training for community projects through municipalities and non-profit conservation groups.

8) Forest Legacy Program – New Hampshire Department of Resources and Economic Development

Provides up to 75% of the purchase price for development rights to forestlands from willing sellers. Streamside land is among program priorities. Rights are held by the state in perpetuity, while the landowner retains all other rights, including the right to harvest timber.

9) Land and Water Conservation Fund Program (LWCP) – New Hampshire Department of Resources and Economic Development

Provides grants to state and municipal agencies for outdoor recreation and conservation projects.

10) New Hampshire Land and Community and Heritage Investment Program (LCHIP)

A grant program for conserving and preserving NH's most valuable natural, cultural, and historical resources. Grant applications for the purchase of land/buildings or restoration of structures are accepted from tax-exempt 501(c)(3) organizations, municipalities, or other political subdivisions of the State.

Federal Programs

1) Conservation Reserve Program (CRP) – USDA Farm Service Agency

For converting highly erodible land to vegetative cover. Annual rental or other incentive payments for certain activities are offered. Cropland owners and operators who have owned or leased the land for at least 1 year can apply for funds.

2) Farmland Protection Program (FPP) – USDA Natural Resources Conservation Service

Provides matching funds to help slow the conversion of farmland to non-agricultural uses. An entity holds the conservation easement deed, and land must contain important farmland soils, and an NRCS conservation plan. The easements are for 30 years, but priority is given to perpetual easements.

3) Wetlands Reserve Program (WRP) – USDA Natural Resources Conservation Service

To protect/enhance wetlands through conservation easements or cost-share agreements. Technical assistance and cost-share funding (or a permanent easement) are available for landowners with eligible wetlands.

4) Partners for Fish and Wildlife (PFW) – US Fish and Wildlife Service

To restore, improve, and protect fish and wildlife habitat on private lands, private landowners, private organizations, towns and municipalities can apply for cost-sharing funds.

5) Wildlife Habitat Incentives Program (WHIP) – USDA Natural Resources Conservation Service

A voluntary cost-sharing program to improve wildlife habitat on non-federal land. NRCS will help landowners or land managers develop a wildlife habitat plan based on their management objectives.

Memorandum of Agreement
Between the
National Oceanic and Atmospheric Administration
And the
New Hampshire Fish and Game Department
Detailing the State-Federal roles in the
Management of the Great Bay National Estuarine Research Reserve

This Memorandum of Agreement states the provisions for the cooperative management of the Great Bay National Estuarine Research Reserve (Great Bay NERR) in the State of New Hampshire, between the New Hampshire Fish and Game Department and the National Oceanic and Atmospheric Administration's (NOAA) Office of Ocean and Coastal Resource Management (OCRM).

WHEREAS, the State of New Hampshire has determined that the waters and related coastal habitats of Great Bay NERR provide unique opportunities for study of natural and human processes occurring within the estuarine ecosystems of the state to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities, and provide scientific information for effective coastal zone management in state of the State of New Hampshire; and

WHEREAS, the State of New Hampshire has determined that the resources of the Great Bay NERR and the values they represent to the citizens of the State of New Hampshire and the United States will benefit from the management of these resources as part of the National Estuarine Research Reserve System; and

WHEREAS, the National Oceanic and Atmospheric Administration has concurred with that finding and pursuant to its authority under section 315 of the Coastal Zone Management Act of 1972, as amended (CZMA, 16 U.S.C. 1461) and in accordance with implementing regulations at 15 CFR 921.30 has designated the Great Bay NERR; and

WHEREAS, the New Hampshire Fish and Game Department, as the agency designated by the Governor of the State of New Hampshire is responsible for managing the Great Bay NERR and acknowledges the value of state-federal cooperation for the long-term management of the reserve in a manner consistent with the purpose of their designation; and

WHEREAS, the management plan describes the goals, objectives, strategies/actions, administrative structure, and institutional arrangements for the reserve, including this MOA and others;

NOW THEREFORE, in consideration of the mutual agreements herein, the National Oceanic and Atmospheric Administration and the New Hampshire Fish and Game Department agree to the following:

ARTICLE I: STATE-FEDERAL ROLES IN RESERVE MANAGEMENT

A. New Hampshire Fish and Game Department Role in Reserve Management

The New Hampshire Fish and Game Department shall:

1. be responsible for compliance with all federal laws and regulations, and ensure that the Great Bay NERR management plan is consistent with the provisions of the CZMA and implementing regulations;

2. ensure protection of the natural and cultural resources of the reserve, and ensure enforcement of the provisions of state law, including rules and regulations of the New Hampshire Coastal Program under the New Hampshire Department of Environmental Services;

3. ensure adequate, long-term protection and management of lands included within the reserve boundary;

4. annually apply for, budget, and allocate funds received for reserve operations, research and monitoring, education and stewardship; and as necessary, land acquisition and reserve facility construction;

5. conduct and coordinate research and monitoring programs that encourage scientists from a variety of institutions to work together to understand the ecology of the reserve ecosystem to improve coastal management;

6. conduct and maintain programs that disseminate research results via materials, activities, workshops, and conferences to resource users, state and local agencies, school systems, general public, and other interested parties;

7. provide staff, and endeavor to secure state funding for the manager, education coordinator and research coordinator;

8. secure facilities and equipment required to implement the provisions within the reserve management plan;

9. ensure adequate funding for facilities operation and maintenance;

10. maintain effective liaison with local, regional, state, and federal policy makers, regulators and the general public;

11. respond to NOAA's requests for information, particularly cooperative agreement and grant progress reports and evaluation findings, including necessary actions and recommendations, made pursuant to Section 312 of the CZMA; and

12. serve as principal contact for issues involving proposed boundary changes and/or amendments to the reserve management plan;

13. expend funds in accordance with federal and state laws, the reserve management plan, and annual funding guidance from NOAA.

B. Federal Role in Reserve Management

NOAA's Office of Ocean and Coastal Resource Management shall:

1. administer the provisions of the Sections 315 and 312 of the CZMA to ensure that the reserve operates in accordance with goals of the reserve system and the Great Bay NERR management plan;

2. review and process applications for financial assistance from the New Hampshire Fish and Game Department, consistent with 15 CFR 921, for management and operation, and as appropriate, land acquisition and facility construction;

3. advise the Great Bay NERR of existing and emerging national and regional issues that have bearing on the reserve and reserve system;

4. maintain an information exchange network among reserves, including available research and monitoring data and educational materials developed within the reserve system;

5. to the extent possible, facilitate NOAA resources and capabilities in support of reserve goals and programs.

C. General Provisions

1. Nothing in this agreement or subsequent financial assistance awards shall obligate either party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.

2. Upon termination of this agreement or any subsequent financial assistance awards to the New Hampshire Fish and Game Department, any equipment purchased for studies to further this agreement will be disposed of in accordance with 15 CFR 24.32.

3. A free exchange of research and assessment data between the parties is encouraged and is necessary to ensure success of cooperative studies.

D. Other Provisions

1. Nothing in this agreement diminishes the independent authority or coordination responsibility of either party in administering its respective statutory obligations.

Nothing in this agreement is intended to conflict with current written directives or policies of either party. If the terms of this agreement are inconsistent with existing written directives or policies of either party entering this agreement, then those portions of the agreement which are determined to be inconsistent with such written directives and policies shall be invalid; but the remaining terms not affected by the inconsistency shall remain in full force and effect. At the first opportunity for revision of this agreement, all necessary changes shall be made by either an amendment to this agreement or by entering in a new superseding agreement, which ever is deemed expedient to the interested parties. Should disagreement arise on the interpretation of the provisions and/or amendments of this agreement that cannot be resolved by negotiations at the operating level of each party, the area(s) of disagreement shall be stated in writing by each party and promptly presented to a mutually approved mediator for non-binding mediation. If the parties cannot agree on the choice of a mediator or if the mediation does not resolve the dispute to the mutual approval of the parties, the parties are free to pursue any other legal remedies that are available.

ARTICLE II: REAL PROPERTY ACQUIRED FOR PURPOSE OF THE RESERVE

As well as acknowledging the rest of the requirements set forth at 15 CFR 921, the New Hampshire Fish and Game Department specifically acknowledges and will fully comply with conditions set forth at 15 CFR 921.21 (e), which specify the legal documentation requirements concerning the use and disposition of real property acquired for reserve purposes with federal funds under Section 315 of the CZMA.

ARTICLE III: PROGRAM EVALUATION

The Office of Ocean and Coastal Resource Management Division of NOAA will schedule periodic evaluations of Great Bay NERR performance in meeting the terms of this agreement, financial assistance awards, and the reserve management plan. Where findings of deficiency occur, NOAA may initiate action in accordance with the designation withdrawal or interim sanctions procedures established by the CZMA and applicable regulations at 15 CFR 921.40-41.

ARTICLE IV: EFFECTIVE DATE, REVIEW, AMENDMENT AND TERMINATION

A. This agreement is effective on the date of the last signature on this agreement and shall be in effect until terminated by either party.

B. This agreement will be reviewed periodically by both parties and may only be amended by the mutual written consent of both parties.

C. This agreement may be terminated by mutual consent of both parties, or by NOAA if NOAA withdraws designation of the reserve within the reserve system, pursuant to

applicable provisions of the CZMA and its implementing regulations as described under 15 CFR 923 Subpart L, or if NOAA finds that the New Hampshire Fish and Game Department fails to comply with this MOA. The agreement may be terminated by the New Hampshire Fish and Game Department with or without cause; should this agreement be terminated, reimbursement of unexpended funds from financial assistance awards shall be determined on a pro rata basis according to the amount of work done by the parties at the time of termination. Additionally, reimbursement for land purchased and facilities constructed with NOAA funds shall be consistent with terms and special award conditions of financial assistance awards.

D. If any clause, sentence or other portion of this MOA shall become illegal, null or void for any reason, the remaining portions of this MOA shall remain in full force and effect.

E. No waiver of right by either party of any provision of this MOA shall be binding unless expressly confirmed in writing by the party giving the waiver.

IN WITNESS THEREOF, the parties have caused this agreement to be executed.

_____	_____
David M. Kennedy Director Office of Ocean and Coastal Resource Management National Ocean Service National Oceanic and Atmospheric Administration U.S. Department of Commerce	Lee E. Perry Executive Director New Hampshire Fish and Game Department
_____	_____
Date	Date