

An aerial photograph of the Wells National Estuarine Research Reserve. The image shows a large, winding estuary with sandy banks and shallow water. The surrounding landscape is lush green, with dense forests and open fields. In the distance, there are rolling hills under a blue sky with scattered clouds. The text "Wells National Estuarine Research Reserve" is overlaid in white, bold, sans-serif font at the top of the image.

Wells National Estuarine Research Reserve

MANAGEMENT PLAN 2019 – 2024

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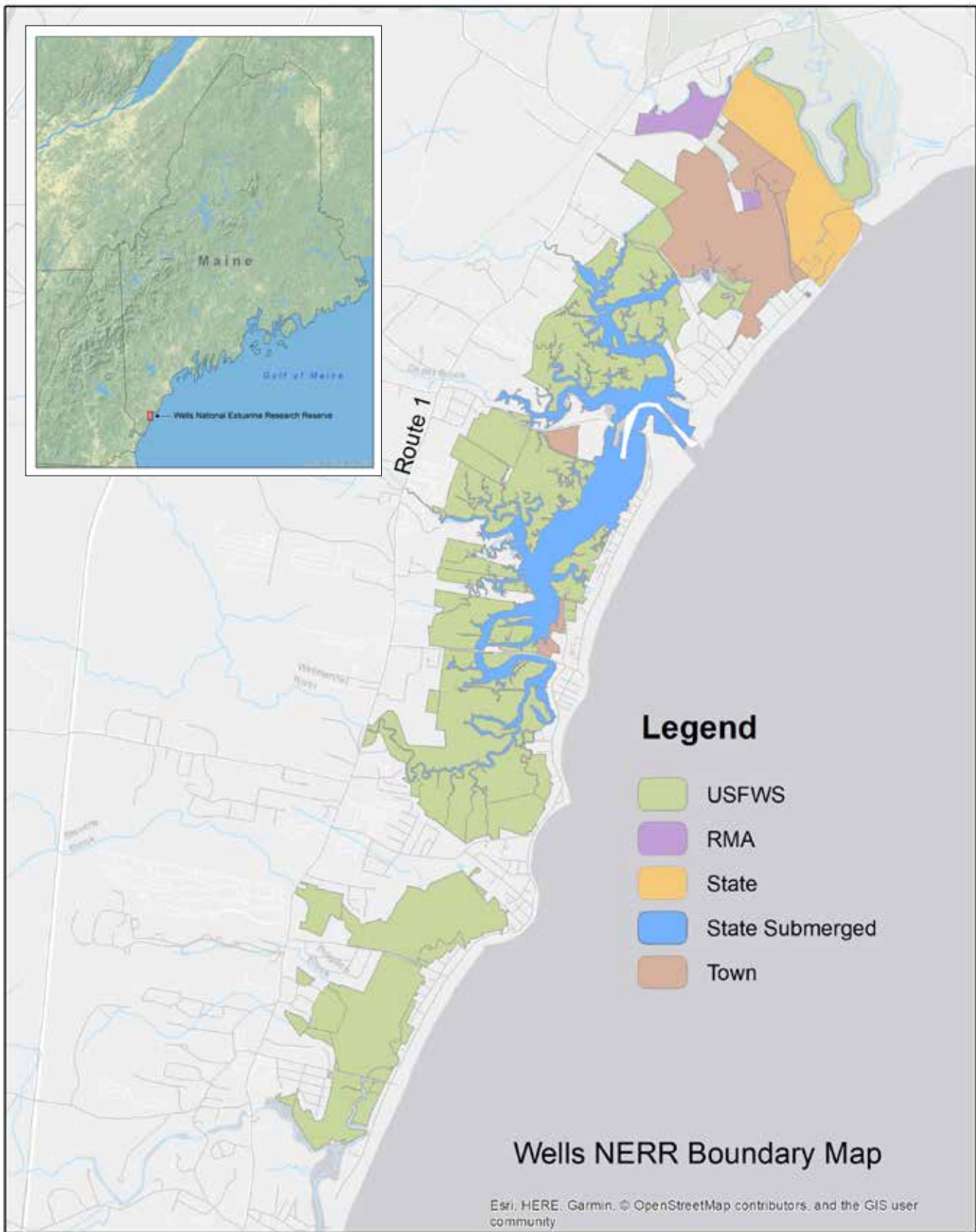
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Table of Contents

Executive Summary.....	iii
Introduction to the National Estuarine Research Reserve System	1
Introduction to the Wells Reserve.....	7
Strategic Plan 2019–2024	16
Accomplishments 2013–2018	19
Education	27
Coastal Training Program	37
Research and Monitoring.....	41
Resource Management and Stewardship	53
Public Access.....	61
Volunteers	65
Administration	69
Boundary and Acquisition Plan.....	77
Facility Development and Improvement.....	83
Appendix A-1: MOU with National Oceanic and Atmospheric Administration	91
Appendix A-2: MOU with US Fish and Wildlife Service	96
Appendix A-3: MOU with Maine Bureau of Parks and Lands (Laudholm Park)	101
Appendix A-4: MOU with Maine Bureau of Parks and Lands (submerged lands)	104
Appendix A-5: MOU with Town of Wells	106
Appendix A-6: MOU with Laudholm Trust	108
Appendix B: Federal Consistency Determination	111
Appendix C: Response to Review from Partners and Public Comment.....	113
Appendix D-1: Laudholm Farm Easement.....	115
Appendix D-2: Wells Harbor Easement	126
Appendix E-1: Act to Establish Wells National Estuarine Research Reserve	136
Appendix E-2: Act to Amend Location.....	141
Appendix F: Rules for Public Use.....	143
Appendix G: Natural Resource Laws	144
Appendix H: 15 CFR part 921 – NERRS Regulations.....	154
Appendix I: Coastal Zone Management Act.....	176



Executive Summary

The Wells Reserve

The Wells National Estuarine Research Reserve (Wells Reserve) was designated a National Estuarine Research Reserve (NERR) by the National Oceanic and Atmospheric Administration (NOAA) in 1984.

The Wells Reserve is the only NERR in Maine and one of two located in NOAA's Acadian Biogeographic Region. It is situated on the southern Maine coast and comprises 2,250 acres of upland fields and forests, riparian areas, salt marshes, dunes, beaches, and submerged lands within the watersheds of the Little River, Webhannet River, and Ogunquit River. Parcels of conserved land owned by the U.S. Fish and Wildlife Service; the Town of Wells; the Maine Department of Agriculture, Conservation and Forestry; and the Wells Reserve Management Authority make up the Reserve.

In addition to the conservation land, the Wells Reserve includes two building campuses that support the Reserve's mission. One is the Laudholm campus, a cluster of farm buildings on the National Register of Historic Places, which includes all the buildings once owned by the Lord family. This campus serves as the center for visitors and for the research, education, and stewardship programs. The other is the Alheim Commons, a property that includes a small office building and two housing facilities for visiting scientists, educators, and resource managers.

Part of a National System

The Wells Reserve is part of the National Estuarine Research Reserve System. Created by the Coastal Zone Management Act of 1972, the NERR System provides a network of representative estuarine ecosystem

areas suitable for long-term research, education, and stewardship. More than one million acres of estuarine lands and waters are currently included within the 29 federally designated reserves. The NERR System is a federal-state partnership administered by NOAA's Office for Coastal Management. NOAA and coastal state partners collaborate to set common priorities and to develop system-wide programs. Additionally, NOAA provides support for state partners and national cohesion of the NERR System. State partners carry out locally relevant and nationally significant programs at individual reserves and their service areas, and provide day-to-day management of resources and programs.

Individual reserves represent specific biogeographic regions of the United States, areas where climate and plant and animal communities are similar. Eleven regions and 29 sub-regions have been described along U.S. coasts. The NERR System is designed to include representative sites from all sub-regions and additional sites to represent specific types of estuaries. Each reserve implements education, research, and stewardship programs relevant to its bioregion and to the state in which it is located. The Wells Reserve is within the southern Acadian biogeographic sub-region.

Purpose and Scope of the Plan

This Management Plan describes major programs of the Wells Reserve and their objectives and strategies for the next 5 years. The Reserve seeks to address pressing local and regional management issues, which closely mirror the priorities of the NERR System. These include climate change and its impacts on coastal ecosystems and communities, development pressures,

land use change impacts on coastal habitats, and water quality degradation.

This is the fifth edition of the Wells National Estuarine Research Reserve Management Plan. Previous editions were approved by NOAA in 1985, 1996, 2007, and 2013. This document is an update of the 2013-2018 plan.

Since the adoption of the last management plan, the Wells Reserve has implemented all of its core and system-wide programs. It has also secured many science, education, and conservation grants that greatly expanded the Reserve's value to southern Maine communities. The Reserve made significant repairs to all of its buildings, installed solar arrays that supply all electricity needs, upgraded buildings and heating systems for energy efficiency, and incorporated energy conservation into operations. Program accomplishments include restoring riverine and fisheries habitats in southern Maine watersheds, renovating the water tower, adding an accessible trail at Wells Harbor, installing climate change exhibits in the Visitor Center and along trails, and helping partners acquire priority conservation lands. The Reserve established many new partnerships with communities and organizations and began new education, training, and research projects in numerous communities in York and Cumberland counties. Wells continued its close collaborations with the three other research reserves in the New England region and with other partners.

This edition of the Management Plan serves as the primary guidance document for the operation of the Wells Reserve's core and system-wide programs in research and monitoring, education and coastal training, and resource management and stewardship. In addition, it provides guidance on the acquisition of land to be added to the Reserve, and on the construction and renovation of buildings that support NERR programs. The Management Plan guides the Reserve in important related programs, such as volunteerism and outreach to communities to encourage stewardship of coastal resources in southern Maine. This Plan includes important background on the Reserve, including its setting, history, rules and regulations, cooperative agreements, governing laws, and key natural resource laws.

Chapters

Education

The goal of the education program is to design, implement, and support quality science-based programs that promote stewardship of the Gulf of Maine and coastal environments through understanding and appreciation of ecological systems and processes.

The Reserve is a regional center for education, training, and outreach on coastal, estuarine, and watershed ecology. Education programs at the Wells Reserve inform and engage audiences on the functions and values of coastal ecosystems and ways to manage those systems sustainably. Education programs translate research into readily available information, promote stewardship of coastal resources, and provide a conduit for research findings to reach coastal decision-makers and communities. The Education Program's goal is to provide high quality, science-based programs for people of all ages. Current and future education focus areas include engaging docent program and interpretive walks; thought-provoking events and lectures; quality children's and school programs based on Maine standards; stimulating internships and field studies; updated interpretive trails; and publications, teacher trainings, and outreach to community groups.

Coastal Training Program

Through this system-wide initiative, the Wells Reserve provides decision-makers in Maine communities with science-based information to encourage the wise stewardship of coastal resources. This is done through workshops, seminars, conferences, and community partnerships, as well as the development and distribution of information on appropriate topics. This program is also the major science-translation venue of the Reserve, so its staff collaborate closely with the Research Program. The Coastal Training Program's goal is to be one of the most effective programs of its kind in the State of Maine and throughout the NERR System.

Research and Monitoring

The Research Program studies and monitors natural and human-induced change in Gulf of Maine estuaries, coastal habitats, and adjacent coastal watersheds,

and produces science-based information needed to protect, sustain, or restore them.

Reserve scientists participate in research, monitoring, planning, management, and outreach activities locally, regionally, and nationally. The program supports field research along Maine's southwest coast from the Kennebec River to the Piscataqua River. Focus areas include estuarine water quality, salt marsh habitats and natural communities, distribution and abundance of fish and shellfish, salt marsh degradation and restoration science, and climate change and its effects on ecosystems and individual species.

The Research Program participates in the System-wide Monitoring Program and maintains links to other regional and national ocean-and coastal-observing systems. This program monitors water quality, weather, biological change, landscape change, and surface elevations in estuaries. The next step for the program is to progress toward becoming a NOAA Sentinel Site.

Resource Management and Stewardship

The Wells Reserve strives to exemplify wise coastal stewardship through sound natural resource management within its boundaries and through its partnerships in the communities of southern Maine. The diverse habitats encompassed by the Reserve support distinct plant and animal communities that require specific stewardship approaches. Some Reserve habitats are relatively pristine, while others are under ecological stress associated with past land-use practices and the spread of invasive species.

Because of its habitat diversity and management challenges, the Wells Reserve serves as an excellent location to experiment with innovative resource management activities, to conduct research, and to offer education programs.

Through community-based stewardship programs, the Reserve encourages individuals and organizations to recognize connections between land-use actions and environmental quality, and to take responsibility for protecting coastal watersheds. The Reserve assists communities with watershed management, land conservation planning, and habitat restoration.

Public Access and Visitors

The Wells Reserve allows public access to its grounds and facilities for environmental education, scientific research, and outdoor recreation. It also provides a gathering place for its partners and for select private activities. The Reserve is open every day and has more than 30,000 visitors annually.

The Reserve must continually improve the condition of its facilities. High-priority projects in coming years include improving campus lighting, improving paved surfaces and stone-dust pathways, adding accessible trails, and searching for ways to make the visitor experience to the Reserve one of the best in the NERR System and throughout Maine.

Volunteers

One of the great strengths of the Wells Reserve is its spirit of volunteerism, which was essential to the establishment of the Reserve and remains a key to delivering programs and operating the site. More than 400 people contribute over 15,000 hours annually to advancing the Reserve's mission. Volunteer programs are directed through a close collaboration with Laudholm Trust. The Reserve will continue to place a strong emphasis on volunteer recruitment, training, and retention, as they are so vital to everything we do.

Boundary and Acquisition

The Reserve strives to conserve lands necessary for protecting its resources, thereby ensuring a stable environment for research, education, and public enjoyment. The Reserve will focus on protecting a high-priority upland "buffer" parcel while identifying opportunities to protect parcels that adjoin existing protected salt marshes and will allow for saltmarsh migration.

Facilities Development and Improvement

The Reserve provides safe, comfortable buildings and equipment needed by staff and volunteers to accomplish program strategies; to provide visitors with a place to learn about coastal ecosystems; and to preserve the historic site's architectural heritage. Reserve facilities are centered in two locations, the Laudholm campus and the Alheim Commons property.

In coming years, the Reserve will upgrade facilities and infrastructure to conserve energy, convert to renewable energy sources, adapt the Barn Complex and other buildings to current safety codes, and improve access and safety through better lighting and paving.

Administrative

The Reserve is the only NERR unaffiliated with a state natural resource agency or university; the public-private partnership's oversight is vested in the Reserve Management Authority, an independent state agency established in 1990. The RMA Board of Directors have

a property, management, or program interest in the Reserve. They represent the U.S. Fish and Wildlife Service; Town of Wells; Laudholm Trust; Bureau of Parks and Lands (Maine Department of Agriculture, Conservation and Forestry); the Maine Coastal Program (Maine Department of Marine Resources); and the National Oceanic and Atmospheric Administration. A governor-appointed scientist also serves on the Board. The Reserve Director reports to the RMA at quarterly meetings. As an independent state agency, the Reserve is administratively flexible and nimble, with the ability to develop and implement a range of programs and projects in a timely manner.

Introduction to the National Estuarine Research Reserve System

The Value of Estuaries

Estuaries are coastal areas where salt water from the sea mixes with fresh water from rivers. They comprise some of the most productive ecosystems on Earth. Whether they are called a bay, a river, a sound, a bayou, a harbor, an inlet, a slough, or a lagoon, estuaries are the transition between the land and the sea.

Estuaries are dynamic ecosystems that provide essential habitat for plant and animal life. They serve as nurseries for numerous plant and animal species, some of which humankind depends on. Wetlands on the shores of estuaries help protect human communities from flooding. They act as buffers against many coastal storms that would otherwise flood developed inland areas.

Estuaries also serve as filters; many pollutants produced by humans are filtered from water as it passes from upland areas through the plant communities of estuaries. This filtering process protects coastal waters.

Estuaries provide important recreational opportunities, such as swimming, boating, wildlife watching, hiking, sightseeing, and photography.

Estuaries, however, are easily altered and degraded by human activities. Pollution, sedimentation, and other threats can damage the habitat that so many wildlife populations depend on for survival. Creating a greater understanding of estuaries among the citizens of the United States, and encouraging the stewardship of these vital areas, is the focus of the National Estuarine Research Reserve System.

The NERR System

The National Estuarine Research Reserve System was created by the Coastal Zone Management Act of 1972, as amended, to augment the National Coastal Zone Management Program, which is dedicated to comprehensive, sustainable management of the nation's coasts.

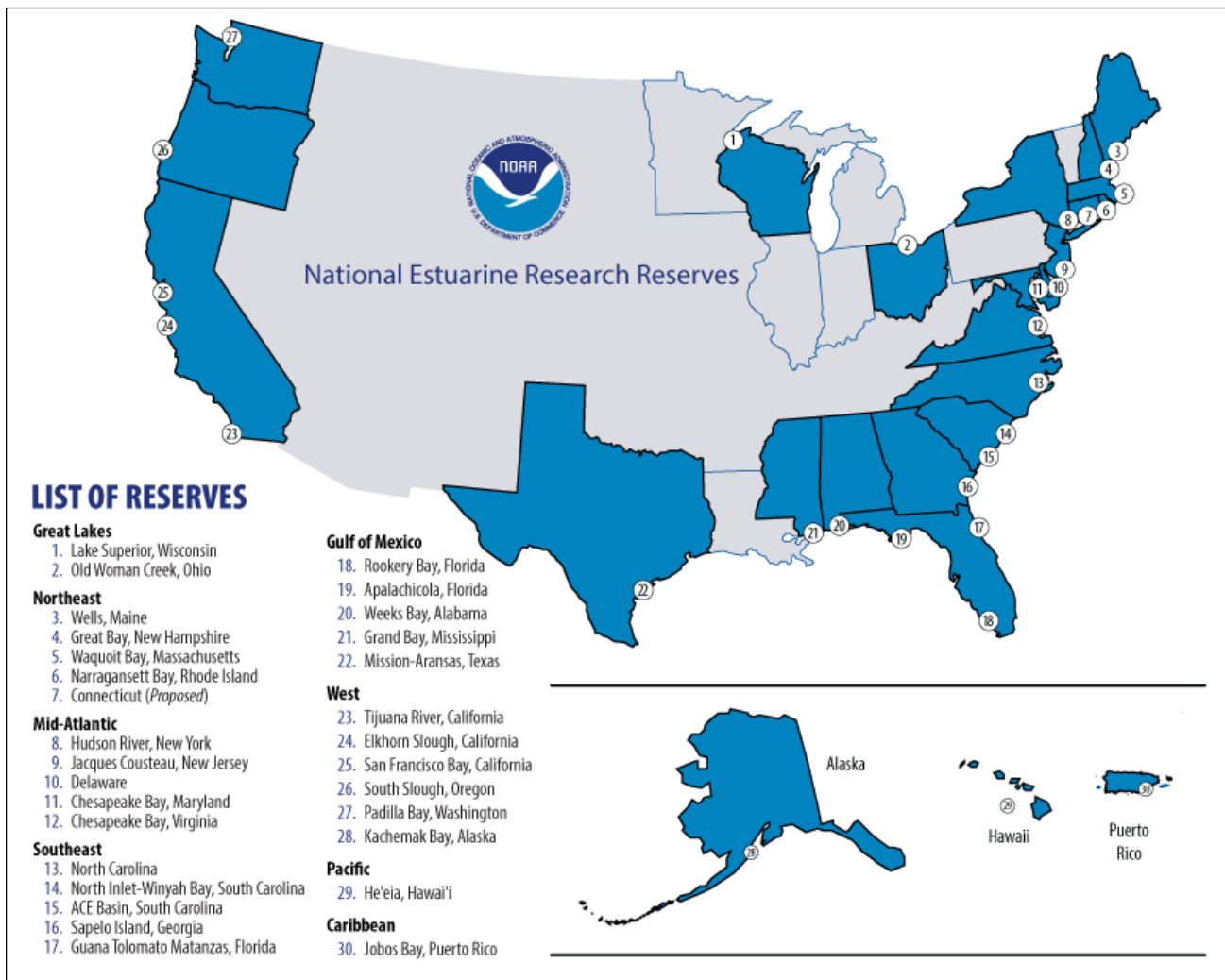
The reserve system is a network of protected areas representative of the various biogeographic regions and estuarine types in the United States. Reserves are established for long-term research, education, and interpretation to promote informed management of the nation's estuaries and coastal habitats (15 C.F.R. Part 921.1(a)). The system currently consists of 29 reserves in 24 states and territories, protecting over one million acres of estuarine lands and waters.

The National Estuarine Research Reserve System is a partnership program between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. NOAA provides funding, national guidance, and technical assistance. The state partner manages reserve resources on a daily basis and works collaboratively with local and regional partners.

Estuaries are biologically rich, economically valuable, and highly vulnerable ecosystems. The vision and mission of the reserve system reflect the importance of these systems within our communities.

Vision: Resilient estuaries and coastal watersheds where human and natural communities thrive.

Mission: To practice and promote stewardship of coasts and estuaries through innovative research, education, and training using a place-based system of protected areas.



The National Estuarine Research Reserve System program goals, from federal regulations 15 C.F.R. Part 921.1(b), include the following:

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

NOAA and the states work together to create a dynamic five-year reserve system strategic plan to meet these program goals and NOAA's mission of science, service, and stewardship. The 2017-2022 Reserve System Strategic Plan focuses reserve core strengths of research, education, and training on three core issues: environmental change, water quality and quantity, and habitat protection and restoration. The reserve system's strategic plan goals are as follows:

1. **Protecting Places:** Enhance and inspire stewardship, protection, and management of estuaries and their watersheds in coastal communities through place-based approaches.
2. **Applying Science:** Improve the scientific understanding of estuaries and their watersheds through the development and application of reserve research, data, and tools.
3. **Educating Communities:** Advance environmental appreciation and scientific literacy, allowing for

science-based decisions that positively affect estuaries, watersheds, and coastal communities.

Biogeographic Regions and Boundaries of the NERR System

NOAA has identified 11 distinct biogeographic regions and 29 subregions in the United States, each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of February 2019, the system includes 29 reserves and one state in the process of designating a reserve.

Each reserve boundary will vary depending on the nature of the ecosystem. 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. Reserve boundaries encompass areas for which adequate state control has been or will be established by the managing entity over human activities occurring within the reserve. Reserve boundaries include a “core” area of key land and water encompassing resources representative of the total ecosystem, which if compromised could endanger the research objectives of the reserve, as well as a “buffer” area designed to protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. Buffer areas may also include areas necessary for facilities required for research and interpretation. Additionally, buffer areas are identified to accommodate a shift of the core area as a result of biological, ecological, or geomorphological change that could be reasonably expected to occur. (15 C.F.R. Part 921.11 (c)(3))

NERR Administrative Framework

The process for federal designation of a national estuarine research reserve has many steps and involves many individuals and organizations. While each reserve is a partnership program between NOAA and a coastal state, many entities collaborate to support the designation of a reserve. Other partners include federal and state agencies, nonprofit groups, universities, and members of the local community. For more information on the designation process, see coast.noaa.gov/nerrs.

Upon designation, the reserve implements the approved management plan and is eligible for NOAA financial assistance on a cost-share basis with the state. Management plans provide a vision and framework to guide reserve activities during a five-year period and enable the reserves and NOAA to track progress and realize opportunities for growth. Each management plan contains the reserve goals, objectives, and strategies supported by programs focused on research and monitoring, education and outreach, training, and stewardship. They also outline administration, public access, land acquisition, and facility plans and needs, as well as restoration and resource manipulation plans, if applicable.

Reserves are increasingly confronted with complex questions regarding new uses in or near reserves that may or may not be compatible with the reserve system’s mission. A thoughtful and comprehensive management plan provides a foundation for addressing these challenges to protect and manage reserve resources wisely and ensure that the public and coastal decision makers value and protect coastal resources.

NOAA administers the reserve system and establishes standards for designating and operating reserves, provides support for reserve operations and system-wide programming, undertakes projects that benefit the reserve system, and integrates information from individual reserves and programs to support decision-making at the national level. Additionally, NOAA periodically evaluates reserves for compliance with federal requirements and with the individual reserve’s federally approved management plan, as mandated under Section 312 of the Coastal Zone Management Act (15 C.F.R. Part 921.40).

NOAA currently provides leadership and support for three system-wide programs, including the System-Wide Monitoring Program, the K-12 Estuarine Education Program, and the Coastal Training Program, as well as a national program to support collaborative research in the reserve system. NOAA also provides support for initiatives focused on the reserve system’s priorities.

Research and Monitoring

The National Estuarine Research Reserve System’s mission provides that reserves are protected and managed to afford opportunities for long-term

research. Research at each reserve is designed to fulfill the reserve system goals as defined in the regulations (15 C.F.R Part 921(b)).

To sustain these system goals, the 2017-2022 Reserve System Strategic Plan outlines research objectives to maintain and expand biophysical and socio-economic monitoring to track environmental change, increase the use of collaborative research to address decision-maker needs, and ensure that scientific, education, and management audiences can use the data and tools developed by the system.

Research is supported through the National Estuarine Research Reserve System Science Collaborative, a program that focuses on integrating science into the management of coastal natural resources. The program integrates and applies the principles of collaborative research, information and technology transfer, and adaptive management with the goal of developing and applying science-based tools to detect, prevent, and reverse the impacts of coastal pollution and habitat degradation in a changing environment. The program is designed to enhance the reserve system's ability to support decisions related to coastal resources through collaborative approaches that engage the people who produce science and technology with those who need it. In so doing, the Science Collaborative seeks to make the process of linking science to coastal management decisions, practices, and policies more efficient, timely, and effective and share best practices and examples for how this can be done.

Environmental monitoring is supported through the System-wide Monitoring Program (SWMP), which provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of regional or local concern. The System-wide Monitoring Program Plan describes SWMP and its role in supporting the National Estuarine Research Reserve System's mission and strategic goals, details the existing capacity, and outlines an implementation and development plan for the program. SWMP monitors short-term variability and long-term changes in water quality, biological systems, sea level and lake level change impacts on coastal habitats, and land use and land cover characteristics of estuaries and estuarine ecosystems for the purpose of informing effective coastal zone management. The program is designed to enhance

the value and support the vision of the reserves as a system of national reference sites and focuses on three ecosystem characteristics:

1. **Abiotic Characteristics:** Abiotic measurements are taken using standard protocols, parameters, and approaches that describe the physical environment, including weather, water quality, and hydrological conditions. The monitoring program currently provides data on water temperature, specific conductivity, pH, turbidity, salinity, concentration of dissolved oxygen, and water depth. Meteorological data include air temperature, relative humidity, barometric pressure, wind speed, wind direction, rainfall, and photosynthetically active radiation (PAR). In addition, the program collects monthly nutrient and chlorophyll a samples at all stations and monthly diel samples at one SWMP data logger station. Data are Federal Geographic Data Committee compliant and available via the Reserve System Centralized Data Management Office.
2. **Biotic Characteristics:** Reserves are focusing on monitoring habitats and biodiversity.
3. **Watershed and Land-use Classifications:** The reserve system is examining the link between watershed land use and coastal habitat quality by tracking and evaluating changes in coastal habitats and watershed land use and land cover. This element is guided by the Reserve System Habitat Mapping and Change Plan.

Education

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

To sustain these system goals, the 2017-2022 Reserve System Strategic Plan outlines education objectives to increase coastal residents' and visitors' awareness and ability to improve stewardship of estuaries, coastal watersheds, and their communities; improve educators' and students' understanding and use of the reserve system and NOAA resources for place-based and inquiry-based learning; and grow and motivate the next generation of coastal professionals through access to programs and facilities that facilitate

research, resource management, and educational opportunities.

Reserves conduct formal and informal education activities, as well as outreach activities that target culturally diverse audiences of educators and students, environmental professionals, resource users, and the public. Education and public programs, interpretive exhibits, and community outreach programs integrate elements of reserve system science, research, and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

The reserve system is committed to providing tomorrow's leaders with the knowledge and understanding of our nation's oceans and coasts to be responsible stewards. To fulfill this commitment, the reserve system has created the K-12 Estuarine Education Program (KEEP) to increase the estuary literacy of students, teachers, and the public. KEEP helps students and teachers learn about essential coastal and estuarine concepts, develop data literacy skills, and strengthen their critical-thinking, team-building, and problem-solving skills. 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 activities. Community education and outreach is another priority for the reserve system. Community education programs foster behavioral change to promote resource conservation. These programs work with audiences whose choices directly impact the integrity of our estuaries and their associated watersheds.

Training

The reserve system has a responsibility to educate coastal decision makers and supports the reserve system goals, as defined in the regulations (15 C.F.R. Part 921(b)).

To sustain these system goals, the 2017-2022 Reserve System Strategic Plan outlines coastal training objectives to ensure that coastal decision-makers and environmental professionals understand and effectively apply science-based tools, information, and planning approaches that support resilient estuaries and coastal communities.

The Coastal Training Program provides up-to-date scientific information and skill-building opportunities to coastal decision-makers responsible for making decisions affecting coastal resources. The target decision-maker groups vary according to reserve priorities, but generally include groups such as local elected or appointed officials, managers of both public and private lands, natural resource managers, coastal and community planners, and coastal business owners and operators. They may also include groups such as farmers, watershed councils, professional associations, recreation enthusiasts, researchers, and more.

Reserves are uniquely positioned to deliver pertinent information to local and regional decision-makers given their place-based nature. Coastal Training Program coordinators know the local people, places, and science and are able to skillfully convene training participants and experts to address coastal management issues. Training programs are built upon solid and strategic program documents, including an analysis of the training market and assessment of audience needs. Coordinators then work with the results to identify how their program can best address local and reserve system priority issues.

Partnerships are integral to the success of the program. Reserves work closely with state coastal management programs, Sea Grant Programs, and a host of local partners in determining key coastal resource issues, target audiences, and expertise to deliver relevant and accessible programs.



Introduction to the Wells Reserve

Physical Setting—Overview

Geography

The Wells National Estuarine Research Reserve is located in the Town of Wells in southern York County, Maine. It encompasses 2,250 acres: 1,864 acres of uplands and wetlands, plus 386 acres of submerged lands. It is in the geographic heart of the Gulf of Maine watershed, an area that extends from Cape Cod, Massachusetts, to Cape Sable, Nova Scotia. The Gulf of Maine incorporates diverse interconnected coastal habitats that all contribute ecosystem functions.

The Reserve includes estuaries found at the mouths of the Webhannet River, Little River, and Ogunquit River. These river systems arise in the sandy glacial outwash plain of southern Maine and empty into the Wells embayment, a sandy basin extending about 10 miles along the coast from the Ogunquit River to the Kennebunk River. Wells embayment mixes freely with the Gulf of Maine, a semi-enclosed sea bounded to the south and southeast by underwater banks and to the west, north and east by Massachusetts, New Hampshire, Maine, New Brunswick and Nova Scotia. The Gulf is one of the world's most biologically productive environments.

With its low relief and extensive marshes, the Wells Reserve typifies the southern portion of the Acadian biogeographic region. This region extends along the northeast Atlantic coast from the southern tip of Newfoundland to Cape Cod and is characterized by a well-developed algal flora and boreal biota. The shoreline is heavily indented and frequently rocky. The sea has a large tidal range and is strongly influenced by the Labrador Current.

The Reserve is located in the Gulf of Maine Coastal Lowland Subsection—one of 19 eco-regions in Maine identified by the U.S. Forest Service, The Nature Conservancy, and the Maine Natural Areas Program. This subsection is a 20-plus mile-wide band that extends from the Piscataqua River (between Maine and New Hampshire) to Casco Bay. It is characterized by a relatively smooth coastline of large headlands, broad bays, and sandy beaches. The terrain is relatively flat, with elevations rarely rising above 200 feet.

Geology

The southern Maine landscape has been shaped primarily by glaciation. During the last Ice Age, the Laurentide ice sheet covered the region, pressing on the earth's crust and causing land to subside. As glaciers melted about 14,000 years ago, the land began to rebound and the sea level fell. Coastal basins, embayments, and watercourses have been formed over geologic time through interactions between sea level and glacial movement. Meteorologic, hydrologic, and oceanographic processes have contributed by scouring, eroding, and transporting substrates into today's coastal configuration.

Surficial geologic deposits at the Wells Reserve are strongly influenced by this geologic history. The Reserve has four deposit types: Swamp and Tidal Marsh, composed of peat, silt, clay and sand; Glacial-Marine, composed of sand underlain by silt and clay; Beach and Dune, composed of sand, gravel, and fine sediment, such as silt and clay; and Glacial Till, composed of sand, silt, clay, and gravel. Swamp and Tidal Marsh is the most common deposit type at the Reserve.

Soil formations in the Reserve tend to have gentle slopes, rapid permeability, and slow surface runoff. Water tables are at or near the surface throughout most of the Reserve. Along the immediate coast, soils are generally deep sands (where beaches occur) or shallow sandy loams that are well to excessively drained.

Hydrology

The Webhannet River watershed has a drainage area of 8,964 acres (14 square miles), entirely within the Town of Wells. The Webhannet's major tributaries are Depot Brook, Eldridge River, and Blacksmith Brook. Extensive wetlands and salt marshes near the Webhannet River mouth empty into Wells Harbor, which flows to the Wells embayment via a dredged channel between two jetties.

The Little River is formed by the confluence of the Merriland River and Branch Brook. Together, the three waterways have a drainage area of 20,057 acres (31 square miles). The Merriland River has its headwaters in the City of Sanford and crosses the Town of Wells. Branch Brook originates from several springs near the Sanford municipal airport and serves as the border between the towns of Kennebunk and Wells. The Kennebunk-Kennebunkport-Wells Water District draws public water from Branch Brook, reducing its flow to the Little River. The Little River estuary flows to the Wells embayment via a salt marsh protected by an unarmored double-spit barrier beach.

The Ogunquit River watershed covers approximately 13,300 acres (or 24 square miles) in the towns of Wells, York, Ogunquit, and South Berwick. Green Brook is a major tributary, with Tatnic Brook and several smaller tributaries also converging with the main stem of the river. The expansive salt marshes of the Moody Division of Rachel Carson National Wildlife Refuge are located behind a 2-mile-long barrier beach and dune system. The Ogunquit River empties into the Gulf of Maine in the Town of Ogunquit.

Gulf of Maine

The Wells Reserve is situated in the geographic center of the Gulf of Maine's shoreline in a transition area where the sandy beaches of southern New England are interspersed with the dominant rocky shoreline found in mid-coast and eastern Maine. The Gulf of Maine is a dynamic system with cold ocean waters, deep basins, shallow banks, and dramatic tidal ranges in places. Its

waters span 36,000 square miles (93,240 sq km) and 60 major rivers flow into it. The shoreline includes the Canadian provinces of Nova Scotia and New Brunswick and the states of Maine, New Hampshire, and Massachusetts.

Water in the Gulf generally flows counterclockwise, traveling southwestward from New Brunswick and Nova Scotia. Its cold waters enter the Gulf through the Northeast Channel south of Nova Scotia, with an occasional influx of warmer water from the Gulf Stream. The tidal range in the Gulf of Maine is large, with the highest tides in the world occurring in the Bay of Fundy. Semi-diurnal tides have a typical range of 8.5 to 9.8 feet in the Wells embayment. Strong tidal currents keep the waters of the Gulf of Maine well mixed, which increases the availability of nutrients to zooplankton and higher-trophic animals. The monthly mean wave height in south coastal Maine is greatest from November to March and is lowest in July and August. Annual mean wave height is almost 20 inches.

Maine is planning for a 2-foot rise in sea level by 2100. Sea level rise is expected to continue the erosion of beaches and dunes in southern Maine and, with more upland areas inundated by spring tides, salt marshes will migrate landward. River banks and saltmarsh channels will also erode.

The Gulf of Maine is among the fastest-warming bodies of water on the planet. Seawater temperatures have risen 2°F since 1970 and could rise another 6–8°F in the coming decades. As seawater chemistry changes, acidification is increasing, which will affect the health, abundance, and composition of plant and animal communities.

Climate

The climate of south coastal Maine is the mildest in the State of Maine. As a rule, south coastal Maine has pleasant summers and falls, cold winters with frequent thaws, and unpredictable springs. The Reserve's weather station indicates average annual temperatures ranging from 45 to 49°F (7.2 to 9.4°C). Twelve weeks per year show average temperatures below freezing, and the warmest 8 weeks of the year average around 68°F (20°C).

Autumn has the greatest number of sunny days and the least cloudiness. There appears to be moderate reduction in sunlight in the first few weeks of July,

perhaps due to fog as newly warmed inland air meets the still cold air at the ocean's surface. Winters can be severe, but begin late and often extend into the springtime. Heavy seasonal snowfalls of over 100 inches (254 cm) occur about every 10 years. True blizzards are rare, but strong coastal storms referred to as nor'easters (due to prevalent wind directions) are fairly common and can cause serious coastal flooding and damage. The White Mountains, to the northwest, keep considerable snow from reaching the area and help moderate temperatures.

Normal monthly precipitation is remarkably uniform throughout the year. Winds are generally light, with the highest velocities being confined mostly to March and November. Temperatures well below 0°F are recorded frequently each winter. Cold waves sometimes come in on strong winds, but extremely low temperatures are generally accompanied by light winds. The average freeze-free season is 139 days. Mid-May is the average occurrence of the last freeze in spring; the average first

Vegetation and Habitats

The vegetation of Gulf of Maine Coastal Lowland Subsection resembles that of the Atlantic Coastal Plain to the south. Ecosystems that reach their northern extensions here include sandplain grasslands (found at the Kennebunk Plains Wildlife Management Area, located 6 miles west of the Reserve) and oak-hickory forests (found around Mount Agamenticus). The largest coastal pitch pine communities in Maine occur on the well-drained, nutrient-poor sandy soils in Scarborough, Kennebunk, and Wells. Small stands of pitch pine-scrub oak and the state's most extensive salt marshes are located in this region.

Botanical surveys completed at the Wells Reserve identified three major terrestrial habitat types: upland fields and forests, wetlands, and beach and dune.

Upland Fields and Forests

Prior to European settlement, oak-pine forest covered lands now encompassed by the Wells Reserve.



The Gulf of Maine is separated by an imaginary line between Cape Cod and Nova Scotia.

Beginning in the mid-17th century, forests were cleared for timber, farming, and fuel. As farms were abandoned in the 19th and 20th centuries, fields were largely supplanted by forests through natural succession. The Reserve displays this land-use evolution with five upland habitats: mowed fields, old fields, shrubland/early successional forest, oak-pine forest, and mixed second-growth forest.

Mowed Fields

With the decline of farming and maturation of forests in New England, the Reserve's open fields and grasslands are valuable from a regional landscape perspective. About 90 acres are mowed annually to provide habitat for species requiring grasslands (ground-nesting birds such as bobolinks and meadowlarks), early successional vegetative stages, and large areas of open space. Keeping fields mowed also maintains a tie to the agricultural history of Laudholm Farm.

Old Fields

Adjacent to the Reserve's mowed fields, two "old fields" are succeeding to shrubs such as barberry, honeysuckle, and bayberry. Apple and hawthorn trees line the field edges and hedge rows. White pine and poplar forests overtaking these old fields retain various herbs and grasses as undergrowth.

Shrublands / Early Successional Forest

In unmowed areas along field borders, and in the understory of forest patches, native shrubs such as

blueberry, Virginia rose, and alder grow alongside non-native species. As succession proceeds, these areas provide cover, nesting habitat, and forage for a number of specialists dependent on such habitat. These shrubby areas are managed to maintain sufficient coverage to benefit those species.

Oak-Pine Forest

An oak and pine community occurs adjacent to mowed fields on the northern upland portion of the Reserve. Red maple is a major component of most of the oak-pine forest stands. Other tree species occur in the canopy or sub-canopy but do not attain dominance. At most sites, heath shrubs dominate the understory, with blueberries being most abundant.

Mixed Second-growth Forests

These woods have been disturbed through harvesting or some other form of manipulation and lack strong characteristics of a particular forest type.

Wetlands

Five types of major wetlands have been identified on the Wells Reserve: red maple swamp and floodplain, shrub swamp, vernal pool and wet meadow, brackish marsh, and salt marsh.

Salt Marsh

Covering about 1,200 acres, this is the dominant sub-habitat of the Wells Reserve. Salt marshes of the Little River and Webhannet River estuaries have formed behind double barrier spits over the past 3,000



This mossy bog is a wet meadow habitat that supports flora and fauna not found elsewhere on the reserve.

to 4,000 years. The marshes contain intricate drainage channels (natural and man-made) and creeks lined by small scarps or ridges, and are dotted with pools and salt marsh pannes. The dominant plants are *Spartina patens* and *Spartina alterniflora*.

Red Maple Swamp and Floodplain

These are found along the banks of the Merrilland River and Branch Brook, as well as the lowlands between the Reserve campus and adjacent salt marshes. Red maple is the dominant overstory tree, and alder and winterberry holly are the dominant shrubs. A well-developed herbaceous layer contains various sedges, ferns, and wetland herbs.

Shrub Swamp

These are found in the upper reaches of the Little River and in areas where flow is impeded and water lies stagnant. Close to the open salt marsh of the Little River, north of Route 9, is an intermingling of freshwater and saltwater flora.

Brackish Marsh

Upriver from the estuaries, marshes continue to occur in the intertidal environments, changing from salt marsh to brackish marsh to tidal freshwater marsh. The largest and most visible brackish marsh at the Reserve occurs north of Drakes Island Road. Tidal flow was once restricted to this marsh, but an improved culvert and self-regulating tide gate were installed in 2005, increasing tidal flow.

Vernal Pools and Wet Meadow

Small areas of freshwater wetlands dot the upland landscape. Several vernal pools are critical habitat for obligate species such as yellow- and blue-spotted salamanders, fairy shrimp, and wood frogs. A single wet meadow, or mossy bog, holds cranberry bushes, cottongrass, and three species of wild orchid.

Intertidal Wetlands

Intertidal habitats include portions of the salt marsh, high energy dynamic beach areas (inlets and tidal deltas) at the mouths of the rivers, and retreating barrier beach areas bordering developed areas. Sediment in these areas reflects diverse geologic history and forces that continue to sort and shape these intertidal habitats. Mud flats, coarse to fine grained sands, cobbles, and boulder beaches contribute to the diversity of habitat and associated flora and fauna in each area. Intertidal invertebrates

provide an important food source for resident and migrating birds and fish.

Beach and Dune

Laudholm Beach is among the few undeveloped sand beaches remaining in Maine. It and Crescent Surf Beach form a double-spit barrier beach that protects the Little River estuary. A low, partially vegetated foredune exists near the river mouth. Landward of the foredune are stable backdunes and heavily vegetated washover areas.

The shoreline between Laudholm Beach and the mouth of the Webhannet River is known as Drakes Island Beach. A seawall extends along this beach, behind which lies single-family residential development with few undeveloped lots.

Key Species

Flora

Botanical surveys and observations at the Wells Reserve have identified nearly 500 species of vascular plants. Along the coastline, the Reserve has several species of submerged aquatic vegetation (eelgrass and widgeongrass, for example), and several species of dune vegetation (beach grass and beach pea, for example). Salt marsh is the dominant habitat type at the Reserve, and these expansive habitats include an abundance of smooth cordgrass, salt marsh hay, black rush, and glasswort. Rare plant species occur in the uplands include slender blue flag iris and sassafras. Both are at the northern limit of their ranges. Two varieties of eastern Joe-Pye weed occur on the Reserve. In the uplands, non-native shrubs are pervasive, particularly Japanese barberry.

Invertebrate Fauna

The Webhannet and Little River estuaries are important breeding areas for intertidal and subtidal invertebrates.

The marine and estuarine invertebrates are the most diverse group of organisms at the Reserve, and include 14 phyla. Representatives of some of the phylogenetic orders of invertebrates at the Reserve include Mollusca, Nematoda, Protozoa, and Arthropoda. They and other phyla are found in salt marshes, mudflats, sandy substrates, and in the water column. Invertebrates common in the mudflats include the soft-shell clam,

the clam worm, the blood worm, and the common periwinkle. Common species of mollusks found in sandy substrates include blue mussels, surf clams, razor clams, and jingle clams. Common invertebrates that occur in the salt marsh include the ribbed mussel, green crab, lobster, grass shrimp, sand shrimp, and a range of gastropods and amphipods.

Vertebrate Fauna

The Reserve's various habitats support diverse animal communities. Vertebrate communities include resident and migrant species of fish, amphibian, reptile, bird, and mammal.

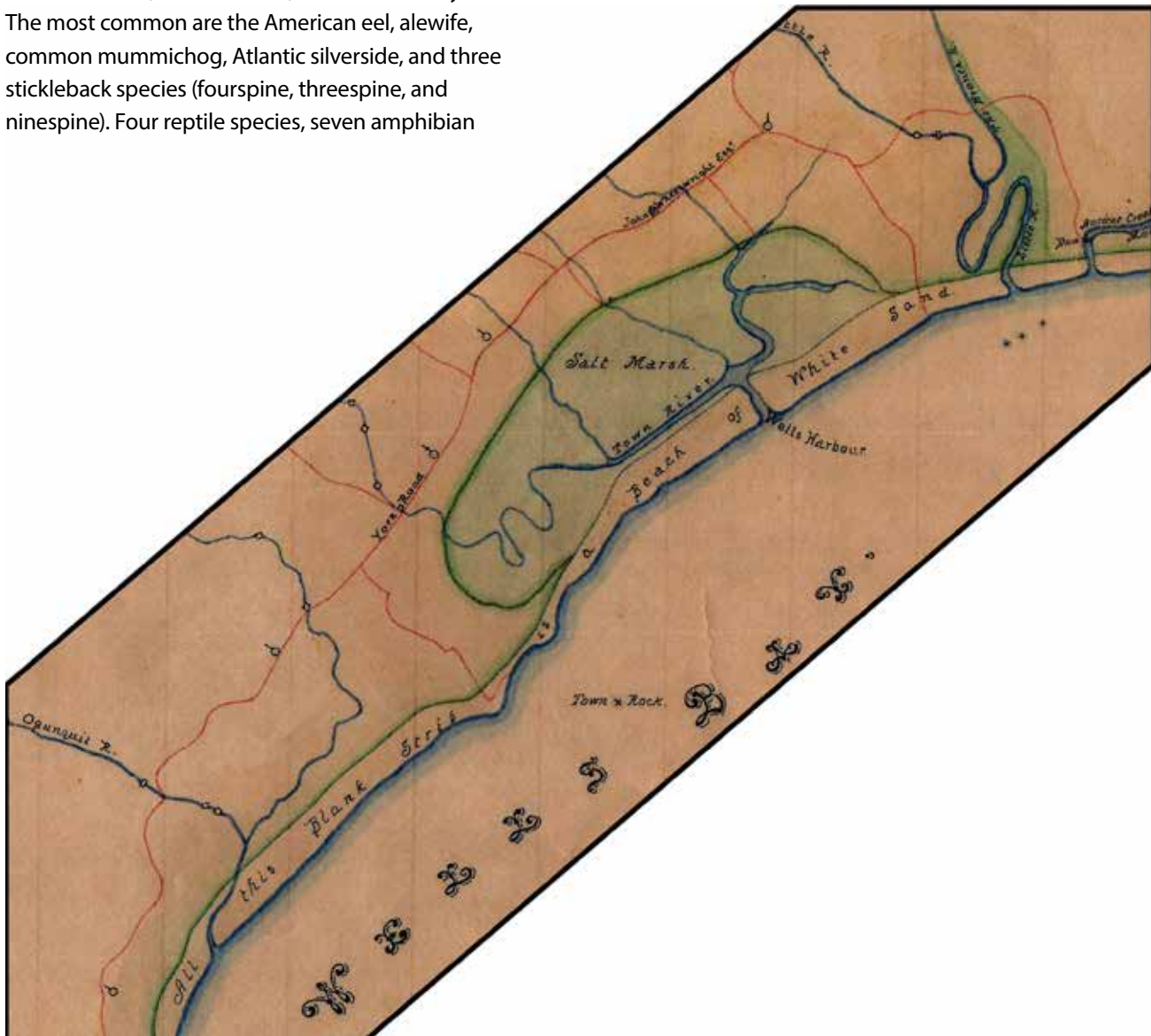
Fifty-five fish species from 30 families have been documented in the Little River, Webhannet River, Merriland River, Branch Brook, and Wells embayment. The most common are the American eel, alewife, common mummichog, Atlantic silverside, and three stickleback species (fourspine, threespine, and ninespine). Four reptile species, seven amphibian

species, more than 265 bird species and at least 32 mammal species have been documented at the Reserve.

Detailed information on the setting and species of the Wells Reserve can be found in the *Site Profile of the Wells National Estuarine Research Reserve*, published in 2007. This document has chapters on geomorphology, hydrogeography, climate and weather, habitats, flora and fauna, and other information relating to the 2,250-acre site. The Site Profile also lists the common and scientific names of flora and fauna found at the Reserve.

Cultural History

The southwest coast of Maine was occupied by Native Americans for thousands of years before European settlement in the 1640s. Although no



A 1794 map captures the vicinity of modern-day Wells Reserve.

formal archaeological surveys have been completed at the Wells Reserve site, the Abenaki tribes probably used the lands and waters of this area as they had in other parts of New England. The Native Americans of the region were nomadic, traveling to various places in search of the abundance of plants and animals that existed seasonally on the coastal plain of Maine. Unlike sites farther east, the Reserve has no prominent shell middens.

The early European settlers found this rich diversity of plants and animals when they arrived in south coastal Maine in the early 17th century. Anglo-American colonial sites dating from the early 1600s may lie within or close to the Reserve, particularly in the upland forests adjacent to the Little River estuary and on the upper reaches of the Webhannet River.

The site of the Reserve campus was first recorded as being settled in 1642. Thereafter, over the next 350 years, it was occupied by four families the Boades, the Symonds, the Clarks, and the Lords. The site and its residents played prominent roles in the history of Wells.

Henry Boade first appeared in Maine in 1636. In 1641, he moved to what would become known as the Town of Wells and chose an upland meadow at the highest point of land on the coast to be the site for his estate. Mr. Boade was appointed chairman of the Town's first board of selectman and served as town commissioner.

Boade sold the property to William Symonds, a selectman, frequent member of the annual grand jury, and the overseer of wills. His occupation of the site ended with King Philips War.

The Clark family acquired the farm in 1717 and retained ownership while farming the property for more than 150 years.

Throughout these 250 years, the landscape changed dramatically. A patchwork of habitats, both wild and manipulated by Native Americans, became mostly agricultural. Fields for crops and livestock replaced forests and shrublands. A regular, predictable pattern was imposed on the landscape.

In 1881, George Clement Lord, president of the Boston and Maine Railroad, purchased the property from the Clark family. His purchase coincided with the progressive farm era of the late 19th century, when well-to-do individuals and families purchased New England farms and applied the latest technological advances

(both in equipment and buildings) to farming. His sons, and later his grandson, managed the farm.

George Clement Lord II began his role in 1914. He was a town selectman, a state representative, a state senator, and served on the Maine Governor's Council. He was active in many farming organizations and was president of the York County Breeder's Association. The heyday of the farm ended in 1952 when the Laudholm Guernsey dairy cow herd was dispersed at auction. Increasingly, the farm buildings fell into disrepair.

In 1978, the people of Wells and neighboring communities banded together to save the derelict Laudholm Farm. They created Laudholm Trust to prevent the property from being developed. Laudholm Trust, in partnership with NOAA, successfully purchased and protected 240 acres, which included the historic buildings.

This acquisition was combined with the conservation holdings of other entities to form the Wells Reserve. It included over 1,000 acres of adjacent marsh and coastline within Rachel Carson National Wildlife Refuge and 147 acres managed for conservation and recreation by the Maine Bureau of Parks and Lands. Since that time, the Reserve and its partners have protected and incorporated additional significant lands and buildings into the Reserve.

The Laudholm Farm complex was entered upon the National Register of Historic Places on October 20, 1983, based upon its local significance. Two properties with a farmhouse, attached barn, and outbuilding purchased in 2008 are now also on the National Register. Many of the buildings have been renovated and adapted to serve the core program functions of the Wells Reserve. More information on the history of the Reserve is found in *Laudholm: The History of a Celebrated Saltwater Farm*, by Joyce Butler.

Community Growth and Land Use

The Wells Reserve is located in York County, one of Maine's fastest-growing regions. Significant population growth and second-home development continue to alter the social and ecological landscapes of Wells, Ogunquit, Kennebunk, Kennebunkport, and most other coastal towns in York County. Rural landscapes are assuming a suburban character. Large homes with intense landscaping schemes are replacing smaller homes along waterways. Condominium development

introduced dense housing complexes in what were formerly blocks of forest.

While year-round residency is relatively small, populations of coastal towns swell in the summer. In 2017, Wells had a year-round population of 9,869, but its peak summer population was 38,330. Ogunquit had a year-round population of 1,337 and a peak population of 10,207 people.

Population Growth

York County's population grew from about 197,000 in 2010 to 204,000 in 2017. This 3.6-percent increase is lower than the 5.6% change seen between 2000 and 2010, but above average for the state during the time period. York County continues to be the second fastest growing region in the state for new year-round and seasonal residents. While growth rates leveled off after the 2010 census, York County is projected to continue to grow and add population over the next decade (2018 to 2028) at a rate higher than the statewide average, as it is close to the Boston metropolitan area and the growing suburban communities of southern New Hampshire and Greater Portland.

Considered rural five decades ago, the towns in south coastal Maine have evolved into commuter communities, with many residents living in Wells, Kennebunk, Kennebunkport, Ogunquit, York, and other nearby towns but traveling to Greater Boston, southern New Hampshire, and Portland for work. The two major employment industries in this part of Maine include defense and tourism, followed by other service and manufacturing industries. Tourism has a significant influence on land use, as Wells and nearby communities have become popular places for second homes.

Land-Use Planning

Over the past decade, Wells, Ogunquit, Kennebunk, and Kennebunkport have continued to update their comprehensive plans, have adopted ordinances to protect natural resources, and have supported the conservation of land. Wells and York have routinely set aside municipal funds for significant conservation projects. In addition, regional land trusts (Great Works Regional Land Trust, Kennebunk Land Trust, York Land Trust, Kittery Land Trust, and Kennebunkport Conservation Trust), as well as statewide conservation groups (Maine Coast Heritage Trust and The Nature Conservancy), have protected land in the area, with

an emphasis on parcels adjacent to rivers, streams and biologically diverse areas.

Marine-Related Activities

Wells Harbor, at the Webhannet River mouth, has a public boat launch that is used by an estimated 3,000 boaters each year. While the harbor is designed for 150 commercial fishing and recreational vessels, it currently can accommodate 105 due to sand accretion. The harbor and its navigation channel are routinely dredged to remove sand, with the last dredge taking place in spring 2018. Dredged sand was deposited on Drakes Island Beach.

Recreational fishing and clamming are popular in the Reserve's estuaries. Marine areas adjacent to the Reserve have become popular for summer whale-watching cruises and naturalist cruises focusing on nearshore marine life.

Tourism and Travel

In 2016, 35.8 million people visited Maine, according to the Maine Office of Tourism. About 25% of these visitors came to the south coastal region of Maine, which includes the coastal towns of York County and southwestern Cumberland County. Local chambers of commerce strongly promote tourism seasons that run from mid-May to mid-October. The towns of Wells, Ogunquit, Kennebunk, Kennebunkport, and York are popular tourist destinations, with many hotels and restaurants filling to capacity between late June and mid-September.

Water Quality

The Reserve's three river systems have good water quality, based on the state's water quality classifications. These waters receive no major point-source discharges, but non-point sources are sometimes significant. Fecal coliform levels can spike after rain events and snow melt, resulting in closure of shellfish beds.

Key Issues Affecting the Reserve

The overarching ecological issue facing the Reserve and south coastal Maine relates to drastic alteration of the region's rural wooded landscape through intense residential and commercial development. Among the threats to watershed health are:

- Loss of forested buffers along stream and estuarine shorelands. (Maine defines shoreland as 250-ft terrestrial borders along the edges of surface water features, such as streams, lakes, rivers, and estuaries.)
- Conversion of shoreland to intensively managed lawn or turf (homes, golf courses, etc.) or asphalt (roads, drives, parking lots).
- Excessive stormwater runoff and associated lack of groundwater recharge. In southern Maine, all freshwater runoff drains to the sea.
- Changes in the landscape and landforms due to climate-induced sea-level rise, and erosion of riparian lands due to increased rain from large storm events.
- Increasing demands on limited freshwater for drinking, landscape maintenance, and waste treatment.
- Increased contamination of coastal food webs through non-point-source pollution associated with urban and suburban development and with transportation, industry, and energy facilities “up wind.”
- Hydrological modifications associated with dams, roads, causeways, tide gates, dikes, and drained wetlands.

Strategic Plan 2019–2024

The Wells National Estuarine Research Reserve developed and adopted a revised strategic plan in conjunction with the development of this Management Plan. Below are the Vision, Mission, five core goals, three supporting principles, and strategic objectives of the Reserve's 2019–2024 Management Plan. All the strategic objectives and their strategies are incorporated into each relevant chapter.






Vision

Resilient estuaries and coastal watersheds where human and natural communities thrive.

Mission

To understand, protect, and restore coastal ecosystems of the Gulf of Maine through integrated research, stewardship, environmental learning, and community partnerships.

Core Goals

-  Goal I: People appreciate and understand natural environments, make informed decisions, and take responsible actions to sustain coastal communities and ecosystems.
-  Goal II: Reserve research and monitoring promote better understanding of coastal ecosystems and this science is conveyed to decision-makers to meet coastal management.
-  Goal III: Coastal communities have the capacity to better protect, manage, and restore coastal habitats.
-  Goal IV: People understand the causes and effects of climate change and have the knowledge and tools needed to make informed decisions and adapt.
-  Goal V: The Wells Reserve is a model site and resource for exemplary coastal stewardship that fosters an understanding of the ecological connections among land, water, climate, and people.


Supporting Principles


1. Staff and volunteers maintain a collaborative and collegial environment. The values and contributions of each individual are recognized as enriching the organization.
2. The organization has a strong financial foundation that builds capacity and enriches programs.
3. People understand, and are inspired to remember, the Reserve's role in advancing coastal stewardship through science, education, and conservation.

Strategic Objectives


For each objective, the colored Roman numerals to the left illustrate its most direct contribution to one or more of our Core Goals.


Interpretive Education


 Objective 1: Field-based science education programs are designed and delivered to promote stewardship of the Gulf of Maine watershed and coastal environments through understanding and appreciation of ecosystems.


 Objective 2: Educational use of the site is optimized and public awareness of its ecological and cultural significance is increased.

Coastal Training Program

 Objective 1: Training participants will indicate intent to apply natural- and social-science-based information in coastal decision-making.

 Objective 2: An annual forum will be provided for elected and appointed decision-makers to share coastal resilience strategies to advance the region's resilience in a changing climate.

 Objective 3: Collaborative watershed efforts are supported in the region to sustain watershed ecosystem services including safe drinking water, flood protection, and pollution filtration.

 Objective 4: Trainings, workshops, and technical assistance are designed to address partner and stakeholder needs identified each year through needs assessments, evaluations, and consultations with the CTP Advisory Committee.

Research and Monitoring

II IV Objective 1: Coastal food webs and habitats are investigated to gain a better understanding of their underlying physical and biological processes and their response to natural changes, climate-driven changes, and human activities.

II V Objective 2: Visiting investigators and staff are provided with opportunities and resources to conduct independent or collaborative research at the Reserve and in the Gulf of Maine region.

II IV Objective 3: The development and implementation of regionally coordinated ecological monitoring of coastal habitats is promoted, and staff continue to maintain and expand upon the System-wide Monitoring Program.

Resource Management and Stewardship

I II V Objective 1: Habitats within the Reserve are managed to sustain biodiversity and ecosystem functions while providing opportunities for research, education, and public enjoyment.

III Objective 2: A watershed approach to stewardship and land use planning enhances the quality of water resources in south coastal Maine.

I III Objective 3: Assistance and expertise are provided to communities and organizations to conserve, restore, and manage coastal habitats.

Public Access

I II V Objective: Access for scientific research, environmental education, appropriate outdoor recreation, nature appreciation, and public events is provided while ensuring the protection of the Reserve's natural resources and its historic buildings and grounds.

Volunteers

I V Objective: A dedicated and productive volunteer corps is recruited, supported,

and retained, thus augmenting all aspects of Reserve programs.

Administration

I II III IV V Objective: An administrative structure is in place so the Reserve's mission is fulfilled and it conforms to federal and state law and agency agreements.

Boundary and Acquisition

V Objective: Lands are conserved to protect diverse natural resources and to ensure a stable environment for research, education, and nature appreciation.

Facility Development and Improvement

V Objective 1: Ongoing and evolving program needs of research, education, stewardship, and assembly activities are maintained and improved; safe and comfortable buildings for staff and partners are provided; and visitors are provided with facilities in which to learn about coastal ecosystems and the landscape history of the site.

V Objective 2: Carbon emissions and resource consumption are reduced through conservation measures and the use of renewable energy.

Resilient estuaries and coastal watersheds where human and natural communities thrive.



Powered by the Sun

By switching to solar energy, we are helping to protect the environment.

A Changing Climate

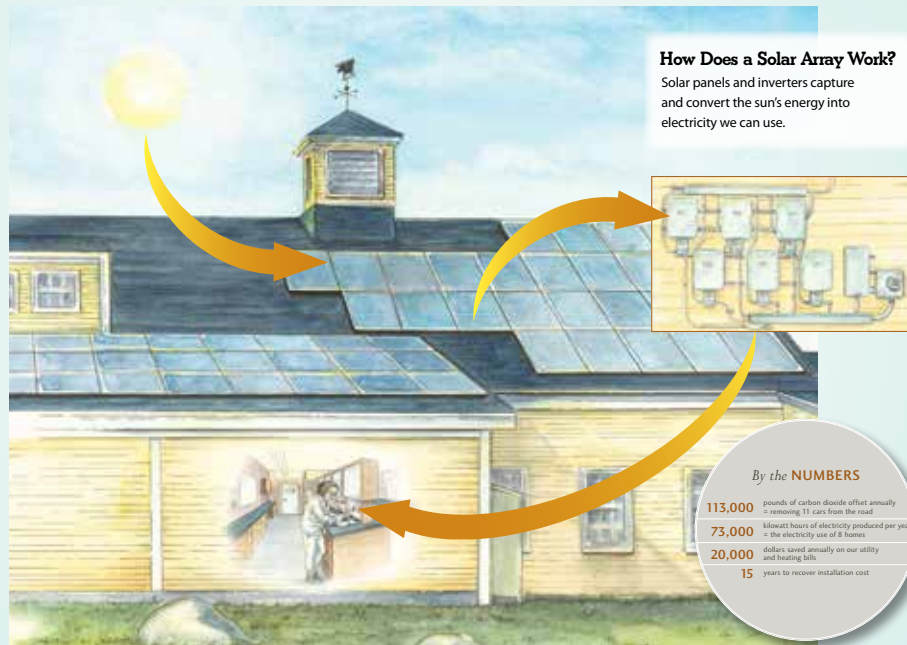
Our atmosphere contains gases that form an insulating blanket around the Earth, holding in some heat from the sun and releasing the rest. When people burn fossil fuels, such as oil, coal, and gas, more heat-trapping gases are added to our atmosphere. Earth's insulating blanket becomes thicker, so it holds in more heat. Our lands and oceans warm up, making our future more uncertain.

What Can We Do?

When we cut fossil fuel use and switch to clean, renewable energy sources like solar and wind, we decrease the amount of heat-trapping gases going into the atmosphere. If enough people and their communities make this switch, the impacts from climate change will be reduced.

Going Solar at Wells Reserve

We were the first nonprofit in Maine to go 100% solar. Our solar arrays generate enough energy to meet all our electricity needs. We are reducing our carbon footprint while using resources responsibly, because future generations depend on the actions we take today.



Solar arrays supply 73,000 kilowatt-hours of energy annually, meeting all the Reserve's electricity needs. A trail sign explains how and why.

Accomplishments 2013–2018

Facilities and Property

100% Solar & Energy Efficiency: Initiated and completed a 5-year energy conservation and alternative energy initiative (called “Conserve and Convert”) that resulted in Reserve being the first non-profit/government agency in the state to switch to solar energy for all of its electricity. On two campuses, engineered, purchased and installed four large solar arrays, made building envelope improvements, and switched to energy-efficient equipment to reduce our use of electricity and fossil fuels in our operations.

New Float and Launch Site: Installed a new floating dock and boardwalk between the Little River Overlook and salt marsh. This dock system is used for launching kayaks during public programs, and also as an interactive teaching station during spring and fall school programs and summer camps. The dock system also used for environmental monitoring activities.

New Accessible Trail: Created a handicapped-accessible 1/8-mile-long trail adjacent to Wells Harbor with an expansive overlook on the Webhannet River salt marsh. This is the Reserve’s first universally accessible trail.

Climate Change Exhibits: Installed new Visitor Center exhibit components, including an interpretive panel explaining the causes and effects of climate change and two interpretive graphic rails that explain solutions for climate change and what actions the Reserve is taking. Custom switch plates were also placed in public spaces around campus to convey the solar-power message. A trailside sign about solar power was placed in view of the Maine Coastal Ecology Center photovoltaic array. Three signs were installed along the

trail to the beach to educate visitors about sea level rise at different elevations.

Property Transferred: With the passing of life tenants on two properties purchased over the years, the Reserve worked with attorney and family heirs to move material possessions out and fully transfer properties for use by the Reserve. The buildings on the “North Estate” and “South Estate,” as the two properties are now called, were cleaned out for Reserve use, with substantial interior work done on the South Estate building that now houses the on-site caretaker.

Interpretive Education

Head Start Story Hours: After securing funding, offered two years of preschool story hour programs for thirteen Head Start centers in the community. Each center visited the Reserve in the fall, winter, and spring for a story reading, related nature craft, and a short trail walk. Each child received a copy of the featured storybook and a finger puppet, each parent received a copy of Rachel Carson’s *Sense of Wonder*, and each family was given a gas card to help with their transportation costs to the Reserve.

Deaf-Education Teacher Workshops: Collaborated with Waquoit Bay Reserve, Narragansett Bay Reserve, Boston University, and The Learning Center for the Deaf to facilitate three deaf-education Teachers on the Estuary workshops at Waquoit Bay. Two of the workshops were offered for Boston University deaf-education graduate students and the third was offered for teachers and interpreters from deaf-education schools in Maine, Massachusetts, and Rhode Island. Deaf-education videos were created to introduce concepts like estuaries, watersheds, and water quality.

Wells Harbor Interpretive Trail Signs: Developed two interpretive signs for the Reserve's new Webhannet Marsh Trail, a trail map sign for the trailhead kiosk, and an interpretive sign installed at the Wells Harbor dock. The interpretive signs focus on the site's dredging and marsh degradation history, the beneficial services that estuaries provide for wildlife and people, and the System-wide Monitoring Program.

Solar Energy Interpretive Trail Sign: Developed a solar energy interpretive trail sign installed outside of the Reserve's Coastal Ecology Center, where the roof's solar panels are within view.

Climate Change Lecture Series: Implemented a new Climate Stewards evening lecture series, featuring prominent speakers delivering seasonal presentations on climate change research, alternative energy solutions, effects of sea level rise, and more.

Bird-Themed Education Kit: Created a new Feathered Friends Traveling Trunk, complete with educational materials and activities for teachers to use in their classrooms for multi-week rental periods.

Yankee Woodlot Interpretive Trail Signs: Developed four new sustainable-forestry interpretive signs for the Yankee Woodlot, a 34-acre parcel being managed for the production of timber while protecting water quality, enhancing wildlife, and accommodating recreation. Each sign has a QR code that links to short videos related to the sign content. A self-guided educational booklet was also created, allowing visitors to learn more at seven marked posts along the trail.

Picture Post: Installed a new Picture Post on the Yankee Woodlot Trail to measure seasonal change through digital photography, leading to a greater understanding of how landscapes change over time.

Farm History Interpretive Trail Signs: Created seven new interpretive signs focusing on the history of Laudholm Farm and the significance of its historic buildings.

Silent Spring Essay Contest: Completed the coordination of a statewide Rachel Carson Silent Spring environmental essay contest for seventh graders in partnership with Rachel Carson National Wildlife Refuge.

National Association of Interpretation Certifications & Trainings: Education staff received the National Association of Interpretation's (NAI) Certified

Interpretive Trainer certification. They then hosted and facilitated two four-day NAI Certified Interpretive Guide trainings for New England interpreters.

Kayak Guide Certifications: Education staff received Registered Maine Guide kayak certifications, enabling them to lead public kayaking programs on the Reserve's estuary.

Forestry Teacher Workshop: Collaborated with Project Learning Tree to host a teacher training where educators learned how to set up their own forest plots to study invasive species, soundscape ecology, and other forestry topics.

Underserved Classroom Nature Stations: Provided free Traveling Trunk education kits to an underserved Portland elementary school, along with nature-related equipment (binoculars, magnifying glasses, and field guides) so teachers could set up permanent Sense of Wonder Nature Stations in their classrooms.

Reading the Landscape Trail Guide: Created a self-guided Reading the Landscape trail activity, linking the indoor Visitor Center exhibits with the outdoor trail system.

Art & Nature Veterans' Workshops: In partnership with Art Hope, a nonprofit dedicated to the promotion of creative wellness, offered three seasonal art and nature workshops for Veterans.

Climate Change Lesson Plan & Teacher Workshops: Created a Sentinel Site Lesson Plan in collaboration with the three other New England Reserves, with the objective of helping teachers and students understand the impacts of sea level rise on salt marshes and the significance of blue carbon. The activities in the Plan were shared with TOTE workshop participants at each New England Reserve.

Phenology Certification: Education staff completed the USA-National Phenology Network's Local Phenology Leader Certification course, providing training in the creation and implementation of a long-term phenology monitoring program.

Pollinator Garden: Coordinated the establishment and planting of a pollinator garden in partnership with the Reserve's Master Gardeners and Pollinate New England. The garden has seventeen different native pollinator-friendly plant species and over 150 individual plants, and will serve as a platform for future educational programs.

Training and Community Engagement

Coastal Training Program trainings: Integrated and involved each sector in coastal training and technical assistance activities to foster the use of science in coastal management, conservation, and restoration. The impact of the team approach was reflected in the range, scope, and diversity of 135 evaluated workshops to nearly 5,000 people.

Cape Neddick River Watershed Restoration Project: Coordinated the Non-Point Source project to reduce bacteria inputs, decrease the number of annual beach postings, and garner support for the future implementation of more bacteria reduction efforts in the watershed through an active outreach campaign. Used native plants along the river to deter Canada Geese congregating.



Creating a buffer of native plants along the Cape Neddick River.

Decreasing Vulnerability for Beach-based Businesses: Engaged coastal business owners in the Kennebunks to increase awareness of their risk to natural disasters by facilitating a Tourism Resilience Index self-assessment. The index was adapted for New England businesses from a Mississippi-Alabama Sea Grant publication. Lessons learned were shared with businesses, municipalities, local and national climate adaptation professionals, and the Reserve System.

Sustaining Coastal Landscapes and Community Benefits: Collaborated with Clark University, Franklin Pierce University, and NOAA to develop and test an interdisciplinary ecosystem services approach to improve the impact of NERRS science on riparian buffer management. The project integrated ecological science, economics, and communications research with a Collaborative Learning stakeholder engagement process.

Qualitative Research for Sustaining Coastal Communities: Collaborated with Dr. Verna DeLauer of Franklin Pierce University to develop and present three online training models to the NERRS CTP Coordinators to build competencies in social science.

Climate Change Vulnerability Assessment Tool for Coastal Habitats: This process facilitates development of management strategies for Reserve habitats using climate change scenarios. The Wells and Great Bay reserves engaged habitat experts to assess current knowledge and design actions to minimize climate impacts to salt marsh sparrow habitat in Maine and New Hampshire.

Northeast Regional Resiliency Project: In an effort to increase coastal resilience in the Northeast, partnered with NOAA, northeast Reserves, and Maine Coastal Program to develop tools, information, and approaches to support the expanded implementation of green infrastructure, or living shorelines.

NOAA Digital Coast Fellow: Identified local coastal-wetland decision-makers and determined their needs for ecosystem-service valuation information. Evaluated NERRS and local coastal managers' use of NOAA's Digital Coast resources and provided recommendations for ways the Digital Coast can improve tools, data, or products related to coastal wetland change and ecosystem-service valuation.

Successful Adaptation and Indicator Metrics: As part of a national NSC climate adaptation project with Susanne Moser, launched the Better Safe Than Sorry collaborative partnership. Decision-makers from the ten coastal southern Maine communities come together annually to share and learn the latest climate change adaptation strategies.

The New England Climate Adaptation Project: Engaged local communities with the Massachusetts Institute of Technology, The Consensus Building Institute, and the University of New Hampshire. The project developed a stakeholder assessment and downscaled climate predictions for each of the participating communities. Scenario-based role-play simulation games about climate adaptation were deployed and evaluated in each community to test people's attitudes and willingness to take adaptation action.

Bridging the Gulfs—Interdisciplinary Methods for Stakeholder Engagement: Wells and Mission-Aransas reserves collaborated to offer two system-wide

trainings in the Gulf of Mexico and Gulf of Maine to share lessons learned from collaborative research projects in each region. Training built competencies in the NERRS for using social science methods in collaborative research projects.

The Sandy Dialogues: Partnered with Jacques Cousteau Reserve to bring disaster response experiences of New Jersey coastal communities impacted by Superstorm Sandy to Maine. Local decision-makers from Maine visited Sandy-impacted areas. A follow up series of Maine workshops enabled representatives from New Jersey to share storm-related experiences with southern Maine communities.

The Saco Estuary Project: This 5-year NSF-funded Sustainability Solutions Initiative project used sustainability science to engage researchers at the Reserve and the University of New England with local stakeholders in baseline ecosystem research. The project was designed to develop locally relevant indicators of ecosystem health in the Saco estuary.

Regional Blue Carbon Workshop: This northeastern regional state-of-the-science workshop advanced blue carbon research. The workshop was attended by over 30 scientists working on the topic in Canada and New England.

Salmon Falls Watershed Collaborative: Coordinated a partnership of more than 20 federal, state, and local governments, water districts, land trusts, and regional-planning entities working across state boundaries on source water protection on the Salmon Falls River.

Saco Watershed Collaborative: Provided facilitation and workshop development for the Saco Watershed Collaborative. This 1700-square-mile watershed in Maine and New Hampshire is a drinking-water source. The University of New England leads the collaborative with funding support from Poland Spring and Maine Water. Members include representatives of local, state, and federal government, non-governmental organizations, and land conservation organizations.

State and Regional Conference Support: Provided design and facilitation support for regional biannual Beaches Conference, annual Maine Land Trust Network Conference, and Maine Water and Sustainability Conference.

Coastal Access Legal Issues: Organized and hosted a series of six presentations over 2 years featuring legal and policy experts on private ownership and public

access rights to the coast. Led in partnership with Maine Sea Grant, the series featured discussions and perspectives among experts.

Unmanned Aerial Systems (UAS) in Coastal Stewardship: With the Alliance for Coastal Technologies and the Northeast Regional Association of Coastal and Ocean Observing Systems, offered a UAS workshop on "Practical Uses for Drones to Address Management Problems in the Coastal Zone."

Research and Monitoring

Habitat Mapping and Change: Produced and delivered the Habitat Monitoring and Change base map products to NOAA's Office for Coastal Management for quality control review and acceptance.

MIMIC (Marine Invasive Monitoring and Information Collaborative): In collaboration with the Massachusetts Office of Coastal Zone Management and the Casco Bay Estuary Partnership, established and maintained 17 sites in coastal Maine as long term monitoring sites for marine invasive species.

Soundscape Ecology: With Purdue University's Human-Environment Modeling and Analysis Laboratory and the University of New Hampshire Environmental Acoustics Laboratory, initiated a soundscape ecology program to record and analyze the soundscape of representative habitats within the Reserve.

UAS: The Way Forward: Developed "The Way Forward: Unmanned Aerial Systems for the National Estuarine Research Reserves," a roadmap for the adoption of unmanned aerial system (drone) technology into estuarine and upland habitat restoration and management.

Sentinel Sites: Collected data on vegetation transects, sediment elevation tables, and made considerable progress on vertical control methodology and implementation in accordance with SSAM-1 protocols and guidance. This includes a cooperative agreement with NOAA CO-OPS to manage a water-level station in Webhannet River Harbor to collect accurate and local water levels as part of our Sentinel Site initiative.

eDNA: Collaborated with University of Maine and University of New Hampshire to design and implement pilot environmental DNA (eDNA) monitoring programs in Casco Bay and at several Reserve sites with the aim of developing eDNA sample collection and analysis protocols, along with training materials and

recommendations for the appropriate use of eDNA in estuarine bio-monitoring.

Blue Carbon: Investigated the accounting of carbon storage in estuarine systems through collaborative research that directly measured sediment organic carbon. Assessed a common approach for indirectly estimating sediment organic carbon at eight National Estuarine Research Reserves.

Sea-Run Fishes: Partnered with Saint Joseph's College to investigate physiological impacts of restocking efforts of brown trout in the Mousam River.

Coastal Fisheries: Collaborated with the Massachusetts Division of Marine Fisheries and the University of New Hampshire to assess lobster shell disease through reproductive quality and output in southern New England and coastal Gulf of Maine waters.

Larval Fishes: Maintained and expanded a decade-long time series on the abundance and population structure of the larval fish assemblage within the Webhannet River estuary. Over 400 sampling events have collected 32 species at the larval stage.

CO-OPS Agreement and Equipment: Established a cooperative agreement with the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) to maintain, service, and manage the tide gauge at Wells Harbor. The gauge permits the Reserve to maintain local, accurate, and vertically controlled water level data for research and management.

Southern Maine Fish Species of Greatest Conservation Need: Completed a regional assessment of diadromous fish populations under a statewide grant meant to improve resource conservation and planning efforts. Efforts were targeted at streams where diadromous species population status was unknown. Several rivers were found to support previously undocumented populations of diadromous species.

York River Fisheries Survey: Diadromous fish species and habitat in the York River were assessed through conventional sampling, environmental DNA sampling, and GIS analysis as part of the Wild and Scenic River Program Study. Products included a regional analysis of the significance of the York River rainbow smelt population, mapped spawning habitat, and riparian land use assessment, as well as several online ESRI Story Maps.

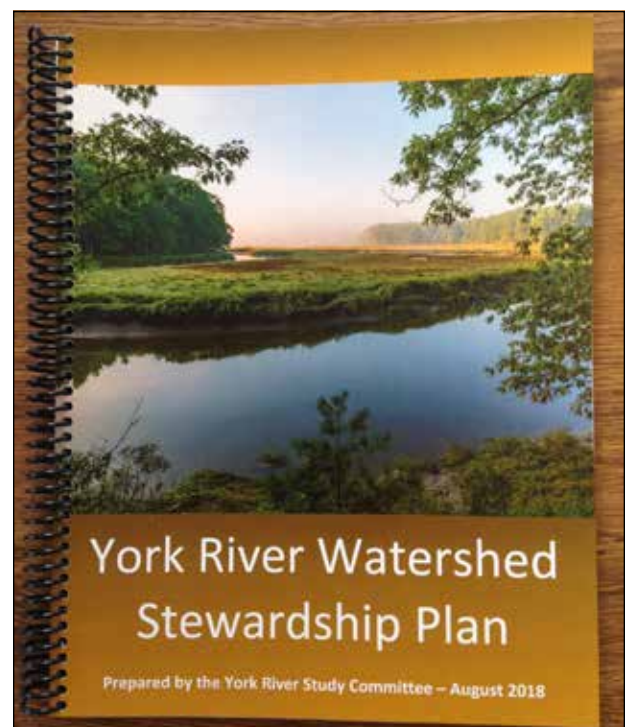
Green Crab Impacts on the Marsh: Joined a multi-year, multi-partner study to assess sub-tidal green crab populations along the southern coast of Maine and to identify burrowing activity in adjacent tidal marshes. This project piloted the use of computed tomography (CT scan) to analyze sub-surface root density and showed evidence of crab burrowing and a correlated impact on below-ground biomass.

Southern Maine Beach Profile Monitoring Program: Coordinated local volunteers, participating municipalities, and scientists to continue 20 years of critical data on the status of one of southern Maine's most vital and valuable natural resources.

Volunteer River Monitoring Program: Collected annual water quality data in the Mousam and Kennebunk rivers as part of the state's Volunteer River Monitoring Program.

Stewardship, Conservation, Restoration

Wild and Scenic Stewardship Plan: As part of the York River Study Committee, developed, completed, and distributed the 150-page Stewardship Plan that contains information and recommendations on how to best manage and care for the river. After significant





Removing a derelict dam reconnected the Kennebunk River with 7 miles of brook habitat for the first time in at least six decades.

outreach, the plan was accepted by residents and elected leaders of the four towns in the watershed, with votes to have the Congressional delegation proceed with national legislation to designate the river a Partnership Wild and Scenic River by the National Park Service.

Goff Mill Brook Dam Removal: A dam was removed at the head of tide in Goff Mill Brook, restoring fish passage for resident and diadromous species. The restoration was carried out through a collaborative process involving state and federal agency, non-governmental organizations, and community partners, and required significant public engagement.

Branch Brook Fishway Restoration: A non-functioning fish ladder in Branch Brook was restored and improved to allow year-round upstream passage for diadromous and resident fish. The project created a unique partnership between the Reserve and the Kennebunk-Kennebunkport-Wells Water District, which operates the associated dam, resulting in a 10-year memorandum of understanding to collaboratively operate and maintain the structure.

York River Salt Marsh Restoration: Tidal flow was restored to a previously impounded 5.5-acre pond maintained by a private golf course. The Reserve facilitated resolution of unforeseen impacts to the golf course through collaborative planning and engagement of project partners and regulators.

Barrier Removal in Branch Brook: A stream barrier at a collapsed trail crossing on Branch Brook was removed as part of a professional training offered to regional restoration practitioners. The project built on an existing partnership with the local water utility and engaged more than 10 agency and non-governmental partners.

TNC Stream Habitat Restoration Partnership: The Reserve entered a 3-year partnership with The Nature Conservancy to plan and carry out restoration of riverine and estuarine habitat connectivity through collaborative partnerships with road managers, natural resource agencies, non-governmental organizations, and community members. An inventory of prioritized projects was developed and stakeholders were

engaged in the development of six restoration projects.

Mousam River Habitat Assessment: Studied stream temperature in the lower Mousam River, determining that conditions are poor for native cold-water fish species. Provided findings to stakeholders in the Mousam hydropower relicensing process including the Federal Energy Regulatory Commission.

Landscape Conservation: Continued active participation in the Mount Agamenticus to the Sea Conservation Initiative, a 10-member coalition that has conserved land and water across the southern Maine landscape. Initiated with the Kennebunk-Kennebunkport-Wells Water District a coalition examining permanent protection of land within Little River / Branch Brook, one of the Reserve's targeted watersheds.

Model Timber Harvest: In accordance with the Integrated Natural Resource Plan, the 30-acre Yankee Woodlot Demonstration Forest underwent a significant tree harvest. Through a series of public workshops during and after the harvest, the project served as a model for landowners on how to cut trees while protecting wildlife habitat and water and enhancing recreational opportunities.

Upland Habitat Restored: With Rachel Carson National Wildlife Refuge and the Natural Resource Conservation Service, continued long-range efforts to maintain, enhance, and expand early successional habitat for the New England cottontail and other species dependent on scrub-shrub and young forest habitat.

Deer Numbers Controlled: With Maine Department of Inland Fisheries and Wildlife, continued the deer management plan at the Reserve, which calls for reducing deer numbers and revitalizing native plants, shrubs, and trees.

Restoring the Chestnut: With the American Chestnut Foundation, established a small grove of disease resistant American Chestnut trees in the Yankee Woodlot Demonstration Forest.

Tree Buffer: With Maine Forest Service and Project Canopy Program, planted 30 trees between abutters and the Reserve's entrance road to create a visual buffer and wildlife corridor between the properties.

Orchid Study: With the Smithsonian Institution and North American Orchid Conservation Center, participated in orchid mapping and harvesting of

seeds and roots for research on orchid species and bacterial associations.

Disaster Response Plan: Developed the Reserve's first Disaster Response Plan focusing on preservation, protection, and recovery of natural landscapes and water resources in the case of severe storms, wildfires, hazardous material spills, and nuclear accidents. With the Town of Wells Emergency Management Agency, established an ongoing relationship to provide input into the town's Emergency Management Plan and also provide weather, tide, GIS, and drone-captured information during severe weather and other emergency incidents.

Vernal Pool Study: With the Maine Department of Environmental Protection and the Mount Agamenticus to the Sea Coalition, provided resources for training vernal pool survey volunteers and offered the general public vernal pool walks.

Public Information and Publications

Coastal Access Law Guide: In an effort to educate and inform residents and visitors of coastal ownership and access, teamed up with Maine Sea Grant and the Coastal Program to write, edit, design, print, and distribute the publication *Public Shoreline Access in Maine: A Citizen's Guide to Ocean and Coastal Law*.

Coastal Access Guides: Co-edited and partnered with the Maine Coastal Program to produce the Maine Coastal Public Access Guide, a three-volume set of publications with information on public and non-profit association properties where the public can access the coast for boating, walking, fishing, and other recreational pursuits.

New Website: Contracted a web design firm to build and launch a new website, incorporating legacy and fresh content, in a responsive format for improved user experience and search-engine ranking.

New Trail Map: A pocket-size trail map, the Reserve's longest-running publication, was revised and updated to include the Webhannet Marsh Trail and trails at the Rachel Carson NWR.

Butterfly Brochure: In cooperation with expert volunteers, developed and distributed a color brochure: "Common Butterflies of the Wells Reserve at Laudholm."

Volunteers

Volunteer Advisory Committee: Established a Volunteer Advisory Committee of combined staff and volunteers, meeting periodically to discuss the recruitment, training, support, and recognition of volunteers.

Team LORAX: Established and trained a cadre of 12 volunteers who are dedicated to forest management tasks, including freeing apple trees from invasive plants, managing Yankee Woodlot Demonstration Forest tasks, planting visual buffer trees, and managing invasive plants in other habitats.

Volunteer Program Hours and Value: Continued to foster a robust and tailored volunteer program that supports all aspects of the reserve, serving as a model for the NERR System for the way we engage and grow the volunteer force. Each year, on average, volunteers contributed over 14,000 hours, translating to over \$300,000 in value.

Volunteer Recruitment Fair: Implemented new events to recruit and support volunteers, including recruitment fairs in 2015 and 2018, a targeted orientation to the research lab with time to meet staff and learn about projects, and a “potluck trivia” event that educates volunteers about Reserve history and mission through the use of games.

Volunteer participation in NOAA 312 review: For the first time, the Volunteer Program was incorporated into the NOAA 312 Review as a main theme alongside the core program themes of education, research, monitoring, stewardship, and facilities.



The Reserve hosts annual Volunteers for Peace work camps.

Youth Volunteers: Expanded the presence of youth volunteers performing community service at the reserve, through outreach to schools, continued relationships with school and faith youth groups, and new partnerships with Career Journeys (Maine Department of Vocational Rehabilitation) and Wells Middle School. Developed a youth volunteer registration form and distributed it to area schools.

Dorothy Fish Coastal Resource Library: The library is run exclusively by three volunteers. Because of their expertise and innovation, over 3,500 volumes can be viewed and requested through the Maine InfoNet Library System. This system serves coastal professionals and students in the region and the nation.

Annual Works Camps: Annually hosted between 5 and 10 international volunteers in a 3-week work camp through the Vermont-based Volunteers for Peace. Applied for and hosted AmeriCorps NCCC teams (National Civilian Conservation Corps), who work on major stewardship projects at the Reserve for a period of 4 to 8 weeks.

Awards

The staff and a volunteer received the following awards:

- Coastal Training Program Director Dr. Christine Feurt – NERRS/NERRA Award for Outstanding Contributions to the NERR System
- CTP Coordinator Annie Cox – CTP Associate of the Year (2016)
- Education Director Suzanne Kahn – The Wildlife Society Conservation Education Award
- Stewardship Coordinator Tin Smith – U.S. Environmental Protection Agency Lifetime Environmental Merit Award
- Executive Director Paul Dest – NOAA Dr. Nancy Foster Habitat Conservation Award
- Volunteer Betsy Smith – Gulf of Maine Council on the Marine Environment Visionary Award (2017)

Education

Introduction

The Wells Reserve is a regional center for education, training, and outreach on coastal, estuarine, and watershed ecology. Reserve interpretive education programs inform and engage audiences in learning about coastal ecosystems. Audiences include thousands of regional residents and visitors of all ages, including K-12 school groups, families, day campers, and teachers. Families and K-12 students are more of a year-round priority audience, whereas campers and teachers attend programs during specific seasons and targeted weeks. Education programs translate research into readily available information, increase environmental literacy, and help promote stewardship of the environment. All interpretive education programs link to at least one of the following themes: climate change, water quality, habitats, and land use change.

Many changes have been made to this chapter since the last management plan was published. Two new staff members brought with them their own interests, resulting in goals to provide new Native American and phenology programming. The addition of an accessible trail within the Reserve's trail system opens opportunities for providing interpretive programs specifically geared toward visitors with mobility issues. An increase in the size of school groups visiting the Reserve requires that we look for ways to expand our team of docent leaders seek ways to better accommodate larger groups. It is challenges and opportunities such as these that fostered changes within the Interpretive Education plan.

Objectives and Strategies

Objective 1

Field-based science education programs are designed and delivered to promote stewardship of the Gulf of Maine watershed and coastal environments through understanding and appreciation of ecosystems.

Strategies

- Expand Traveling Trunk offerings to include a broader array of themes, while maintaining and updating the current collection.
- Enhance the docent program by improving training resources, developing incentives, reviewing evaluation methods and recruiting more docents.
- Support citizen and student monitoring related to landscape change.
- Continue to develop and offer programs that incorporate literature and creative arts.
- Expand access by increasing handicap accessibility to programs.
- Integrate climate change education into public and K-12 programs to promote climate literacy, specifically through the implementation of an ongoing Climate Stewards evening lecture series, the integration of a climate focus for Teachers on the Estuary workshops, a citizen science phenology program, and climate walks.
- Enhance the capacity of Reserve staff to design and execute better evaluations of all education programs.
- Expand program evaluation, increase the return rate, and develop a system for capturing data.
- Develop learning objectives for regularly scheduled interpretive education programs.

- Continue to develop programs in collaboration with the Reserve’s Research, Stewardship, and Coastal Training programs.
- Continue to enhance the educational content of the website, through blog posts, videos, testimonials, and an increased number of images.
- Work toward designing middle school ecology programs that can accommodate larger groups of students.
- Develop and facilitate interpretation workshops (National Association of Interpretation Certified Interpretive Guide) and field-based teacher trainings, including annual Teachers on the Estuary (TOTE) workshops.
- Research opportunities to lead community members, including volunteers, on estuary-based experiential education trips throughout the state, country, and abroad.
- Expand our program offerings and presenters to integrate more racial and ethnic diversity.
- Increase visitors’ awareness of pre-colonial and modern indigenous people.
- Use interpretive techniques to create meaningful connections between the site and visitors, resulting in enhanced gratitude and respect, and thus inspiring future stewards.
- Use program evaluation results to help guide future programming needs.
- Collaborate with like-minded community organizations and visiting research scientists.
- Offer culturally rich programming that interprets the historical use of estuaries, the land, and the sea in Wells, the state of Maine, and New England.
- Maintain the existing suite of high quality coastal ecology programs for K-12 students in southern Maine and southeast New Hampshire.
- Promote cultural, racial, socio-economic, and gender equity and access in all Reserve education activities.
- Integrate into programs possible solutions to humans’ effect on the environment.
- Foster increased investment in the Reserve from local year-round residents, through volunteer opportunities and program participation.

Objective 2

Educational use of the site is optimized and public awareness of its ecological and cultural significance is increased.

Strategies

- Increase the marketing, visibility, and promotion of K-12 field trips, Traveling Trunk rentals, Discovery Program, exhibits, day camps, scholarship opportunities, and teacher trainings.
- Promote the Coastal Resource Library and expand its collection.
- Develop self-guided K-12 educational materials for the exhibits that promote quality interaction.
- Maintain the Discovery Program backpack contents.
- Develop a plan to make better use of the Forest Learning Shelter.
- Explore the possibilities of building a field ecology lab in close proximity to the salt marsh for use with school groups.
- Improve the video recording capacity in the Mather Auditorium, the largest indoor program space on campus.

Guiding Principles

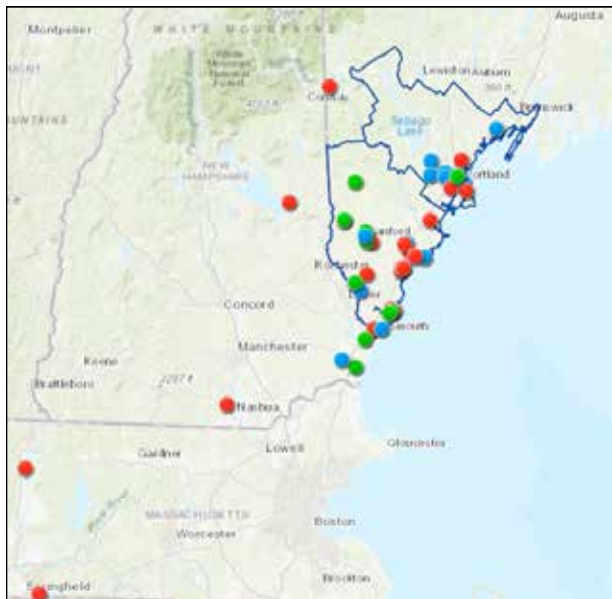
- Develop innovative, discovery-based, interactive field and laboratory experiences to further visitors’ connection to place.

Thematic Focus

All interpretive education programs focus on one or more themes: climate change, water quality, habitats, and land use change. Of the three primary K-12 field trip options, the grades K-2 program has stewardship of wildlife and habitats at its core; the grades 3-5 program takes students to the marsh for water quality testing and delves into the world of plankton; and the grades 6-12 program is centered on estuaries with the concepts of watersheds and water quality highlighted. The Reserve’s public programs cover an array of topics, from a climate change evening lecture series to kayaking tours of the estuary. The Reserve’s Visitor Center exhibits speak of land use change over time, taking visitors through history and showing the effects of both human and non-human activities on the landscape.

Geographic Scope

Wells Reserve education programs mainly cover southern Maine and southeastern New Hampshire. School programs attract teachers and students from a radius of approximately 60 miles, and public programs reach a much expanded audience through tourists. The Reserve’s target local audience lives in York and Cumberland counties. In the next 5 years, we will seek



Reserve field trip programs mainly draw schools from York and Cumberland counties, but their reach extends well outside the core area. Map shows Exploring Estuaries (blue), Microscopic Marvels (red), and Wild Friends in Wild Places (green).

funding to bring more underserved communities to the Reserve for both school and camp programs. Our recent work with the deaf education community through a Teachers on the Estuary grant opened our eyes to the need for additional programming for this population. In addition, there is a large immigrant population in the Portland area and we aim to provide opportunities for those students to experience nature at the Reserve.

K–12 Education Standards

The Reserve’s field-based school programs are aligned with the Next Generation Science Standards (NGSS). In the next 5 years, we plan to align the Traveling Trunks and Discovery Program. The NGSS express what students should know and be able to do at various checkpoints during their education. These standards challenge communities, schools, and teachers to work together in implementing effective instructional strategies to achieve high expectations for all students.

Field-Based School Programs

Guided Programs

The Wells Reserve offers three field-based field trip programs for school groups. Each program provides students with the opportunity to understand, appreciate, and engage in hands-on science while

exploring the marsh and trails. In the next 5 years, we will strive to make our programs even more interactive and student-focused. Our K-12 programs are led by a mix of Reserve staff and trained volunteer docents. The programs are divided by grade level.

Grades K-2: Wild Friends in Wild Places is facilitated in partnership with the Center for Wildlife located in nearby York, Maine. This program accommodates up to 70 students. During half of this 3-hour program, rehabilitated non-releasable animal ambassadors from the Center for Wildlife are used to teach about native wildlife and their behaviors, characteristics, and life needs. Ambassadors may include an opossum, bat, falcon, hawk, owl, or turtle. The other half of this program gets students on the Reserve trails searching for signs of wildlife and exploring habitats. Teachers are given comprehensive “nature journals” to use with students in the classroom before or after their visit. Each journal has activities that relate to the animal ambassadors and habitats that the students experience during their trip. The goal of this program is to enhance environmental stewardship among participating students and teachers.

Grades 3-5: Exploring Estuaries gives elementary school children the chance to spend 3 hours on the trails learning about coastal ecology. This hands-on program includes a comprehensive teacher packet that provides background information and activities for use before and after school field trips. During field trips, up to 72 students are divided into docent-led groups of 12 or fewer students. Each group visits several activity stations in four Reserve habitats, where students learn about adaptations, estuary functions, tides, salinity, food webs, watersheds, and beach ecology. By focusing on local habitats and watersheds, Exploring Estuaries helps students to make connections between their everyday actions and the health of our waterways and the ocean.

Grades 6-12: Microscopic Marvels allows students to investigate biotic and abiotic factors interacting within the estuary ecosystem. During this 3-hour program, groups of up to 36 students spend half of their time on the salt marsh collecting water quality data and the other half in the Teaching Lab observing and identifying live plankton. The lab portion culminates with a STEM-based activity called Plankton Olympics, where student teams build and test their phytoplankton prototypes with the goal of creating a neutrally buoyant



or slow-sinking design. Microscopic Marvels increases student knowledge of plankton and the biotic and abiotic factors affecting them, leading to a heightened appreciation for the intricate web of life in the estuary and ocean. In the next 5 years, the education team will explore the possibility of building a field ecology lab near the salt marsh. This would optimize teaching and learning time by eliminating the half-mile walk between the saltmarsh and Teaching Lab.

Between 2014 and 2018, education increased its number of programs delivered by 12 percent overall, with a 200 percent increase in Wild Friends in Wild Places, a 160 percent increase in Microscopic Marvels, and a 50 percent decrease in Exploring Estuaries. The number of participating students has grown 325 percent in Wild Friends and 815 percent in Microscopic Marvels, but declined by 39 percent in Exploring Estuaries. The shifting popularity between programs

has increased demand on docent volunteers and education staff members. In addition, schools want to bring increasingly large groups for field trip programs and sometimes the Reserve does not have the capacity to accommodate them. In the next 5 years, we plan to create new self-guided school programs for larger groups that will not require a docent or staff member as a guide. To address the drop in Exploring Estuaries programs, we will reach out to schools that have not visited recently. Evaluations have been positive for this program over the years, so we don't know the reason for the decrease in visitation.

Self-guided Programs

Through self-guided programs, teachers have the option of working with Reserve educators to access curriculum and rent equipment (soil corers, binoculars, refractometers, etc.) to meet specific program needs while exploring the trails with their students. In the

next 5 years, we aim to provide self-guided program offerings related to Native cultures and art in nature. We also plan to make our Traveling Trunks, especially the Tree Trunks, more user-friendly for on-site use.

The Reserve's Discovery Program provides an opportunity for participants to learn about several topics through interactive trail booklets and associated backpack materials. Water Wonders explores the water cycle and watersheds; Habitat Hike ventures through the forest, field, and estuary; and Time Travels investigates glaciers, Native American land-use practices, and European colonization. Each participant purchases a Discovery booklet from the Visitor Center gift shop, and the group borrows a backpack full of educational materials for use with the activities outlined in the booklet. Each booklet has a mascot associated with it (mummichog, porcupine, and turkey). Along the trails, there are numbered posts with the mascot images affixed. These posts correspond with numbered stops within the booklets. At the end of each participant's trail journey, Discovery mascot pin prizes are distributed by Visitor Center volunteers. These Discovery Program trailside education resources appeal to a wide variety of groups, including schools, scout troops, and families. In the next 5 years, we will evaluate backpack contents and make replacements and upgrades as needed.

Day Camps

There are full-day and full-week day camp offerings on a variety of topics for children ages 6 to 15 during the summer and school vacation weeks. Campers explore habitats, play games, do intriguing science experiments, and create crafts. Recent camps have explored the salt marsh, tide pools, birds, reptiles and amphibians, life under a log, plankton, fish, wildlife survival, insects, and more. All camps strive to have campers outdoors as much as possible, fully immersed in habitat discovery on the trail system. In the next 5 years, we will explore innovative and expanded uses of the Forest Learning Shelter, a seasonal, screened, one-room building in the woods, for camp activities. We will also explore new ways to promote day camps to a broader audience.

Traveling Trunks

The Education Program offers several curriculum kits for teachers and other educators to use off-site. These

Traveling Trunks either extend a group's field trip visit to the Reserve or provide a lower-cost environmental education alternative that can be administered without paying the program fees and transportation costs of field trip programs. Rental periods range from 1 to 3 weeks and fees vary. Topics currently include Maine wildlife, trees, birds, and estuaries. Each Traveling Trunk has a multitude of activities with corresponding materials. The Safari in a Box was developed by the Maine Department of Inland Fisheries & Wildlife and the Reserve is a rental host site. This kit includes animal track replicas, scat replicas, and furs. Tree Trunks, developed in partnership with Project Learning Tree for grades K-5 and 6-12, provide teachers with tree cross-sections, leaf samples, forestry equipment, field guides, and more. In the next 5 years, we plan to make these two tree kits more of an on-site option for visiting school groups who explore forest ecology on our trails. The Estuaries Trunk has myriad materials to teach elementary students about the water cycle, watersheds, fish migration, sand, water quality, and other coastal topics. The Feathered Friends Trunk is all about birds and includes activities relating to migration, eggs, nesting, beaks, adaptations, and songs. In the next 5 years, the Reserve hopes to become a host site for the BatsLive Trunk, created by Project EduBat and focusing on the vital ecological and economic importance of bats as well as the threat of white-nose syndrome. In the next 5 years, the education team will align each of its trunks with Next Generation Science Standards, when applicable, and proactively work to get these resources known to educators and teachers within the local community. In addition, we will inventory each trunk and update materials as needed.

Teacher/Educator Training

The Education Program offers annual Teachers on the Estuary (TOTE) workshops, geared toward science teachers, that are research- and field-based programs that improve teacher and student understanding of the environment using local examples. TOTE workshops provide resources and experience to support the incorporation of estuary and watershed topics into classroom teaching, while promoting estuary literacy and environmental stewardship. Topics exploring environmental change, such as sea-level rise and phenology, are explored in TOTE workshops as well. Each year, we enhance these workshops and

incorporate new topics and activities. In recent years, we have worked with the deaf education community in New England through Watershed Stewardship in Action workshops, conducted in partnership with other New England reserves. In the next 5 years, the education team will seek funding to continue working with this underserved population.

In addition to teacher trainings, the Reserve offers multi-day National Association of Interpretation Certified Guide and Certified Trainer workshops for informal educators, facilitated by the Reserve's certified education staff. In the next 5 years, citizen-science workshops will be offered for formal and informal educators, as well as workshops featuring the Reserve's suite of Traveling Trunks.

Docent Naturalist Program

The Wells Reserve has an active and vital docent naturalist program through which volunteers are trained to lead programs for school groups, community groups, and the general public. The docent corps is essential to the Education Program throughout the year and adds greatly to its capacity.

Docents come to the Reserve with a variety of backgrounds that enrich the volunteer community. In addition to completing trainings and leading groups, many docents attend public programs and travel to broaden their experience and knowledge in natural history.

The Education Program ensures that docents are knowledgeable guides, as docents are required to complete extensive training. This includes an orientation session, skill building sessions, and specific program sessions (e.g., *Microscopic Marvels*, *Secrets of the Salt Marsh*). Docents also attend a staff-coordinated field trip, offered in an effort to celebrate docent contributions. This enjoyable outing strengthens docent relationships and provides professional development.

After they attend training sessions, docents shadow and co-lead programs with staff or experienced docents before leading tours on their own. Enrichment opportunities are available monthly through our lectures, walks, and other educational offerings. Docents continue to co-teach after the training phase is completed, which improves skills through collaboration, provides more leadership for large

groups, and builds community within the docent corps.

To ensure the quality of the docents and their experiences, several types of evaluation are administered at the Reserve. These include evaluations of trainings by docents, evaluations of school programs by teachers, and evaluations of docent-led programs by Reserve educators.

Recognition is paramount to retaining quality volunteers. The Reserve aims to develop meaningful relationships with docents by acknowledging their impressive impact on program delivery and by providing rewards, such as end-of-season trips and saying "thank you" as often as possible. In the next 5 years, we aim to recruit more docents to fill our increasing school program needs. Our goal is to have and sustain a team of 20 docents by 2024. We also will aim to provide an expert-led docent training on equity and inclusion, as they relate to interacting with Reserve visitors.

Public Programs

A diverse mix of programs is offered to residents, tourists, and community groups throughout the year. These programs may be indoors or outdoors, general or specific, directed or interactive.

Between May and September, monthly Climate Stewards lectures bring specialists on climate change issues to the Reserve. Lunch 'n' Learn talks are informal presentations between September and June that often highlight Reserve research, natural history, or staff and volunteer travels. Attendees are encouraged to bring a brown bag lunch to eat while they learn.

Docent-led interpretive walks are offered during the summer. Current walks include *Secrets of the Salt Marsh*, *Life Between the Tides*, *Laudholm's Farming Past*, and *Nature Walk*. They address the history of Laudholm Farm, bird life, signs of wildlife, seasonal topics in natural history, tidal habitats, wildflowers and other Reserve plants, and estuarine ecology. These tours appeal to both residents and tourists.

Customized programs are offered to groups such as scouts, homeschoolers, and other community organizations upon request. These tend to focus on wildlife conservation, estuary ecology, and beach studies.

Special Programs are 2- to 3-hour sessions that families or adults can experience together. These programs



often explore specific topics related to plants and animals, Native American cultures, estuary ecology, and wellness. They typically occur on our seven miles of trails and while kayaking, and are led by staff or guest presenters.

Special events are offered onsite throughout the year. Winter Wildlife Day is facilitated in partnership with York County Audubon and Center for Wildlife during February school vacation week. This free event includes live animal ambassador programs, tracking walks along the trails, and wildlife activities and crafts. In April, the Reserve offers an Earth Day Celebration during school vacation week. A variety of community organizations join us for this event, offering bird walks, seed planting, wildlife crafts, and other nature-based activities. Reserve educators also facilitate a beach clean-up and nature walk. In September, the Reserve holds its annual Punkiniddle festival on National Estuaries Day. There are estuary activities, traditional artisans demonstrating their crafts, outdoor games, pumpkin decorating, and fall harvest activities.

In the next 5 years, we plan to expand our literature and creative arts programming, add climate change walks to our offerings, and provide targeted programs for visitors with mobility issues. The latter will be facilitated on our main campus and at our new wheelchair-accessible trail at Wells Harbor. In general, we also hope to recruit a more ethnically diverse cadre of guest presenters and offer more programs that provide solutions to humans' effects on the environment. We will also explore the possibility of

leading trips off-site locally with community members, and eventually trips to estuaries overseas.

Exhibits

The Reserve's interpretive exhibits open a window on the world of coastal research and landscape change. They draw upon the resources of the site — its land and water, its plant and animal communities, its human history — and demonstrate the importance of stewardship to cultural identity and environmental health.

The two major exhibit areas are in the Visitor Center and the Maine Coastal Ecology Center (MCEC) exhibit wing. Exhibits in the Visitor Center, dedicated in 2011, explore how the landscape of southern Maine's coastal lowlands formed naturally over thousands of years and how that landscape both shapes and is shaped by the people who inhabit it. Some 2017 additions explore climate change, renewable energy, and sea-level rise. Exhibits within the Ecology Center describe research at the Reserve and throughout the Gulf of Maine, while building awareness of how that research links to resource management and personal choices. Completed in 2002, these exhibits are at the end of their useful life. In the next 5 years, we will evaluate whether to install new exhibits in the MCEC, or make a different use of this space. In the coming years, we will also develop self-guided exhibit exploration options in the Visitor Center for visiting school and community groups. For example, a scavenger hunt for younger students might help them to focus and learn more effectively while exploring the exhibits.

Trail/Site Interpretation

Interpretive signs along trails and on buildings give visitors an opportunity to learn informally about the site and its resources. The Education Program works with the Laudholm Trust Communications Director to revise existing signs and create new interpretive signage as funding is available. Current signs focus on solar energy, sustainable forestry, sea-level rise, forest succession, salt marsh communities, vernal pool inhabitants, salt marsh restoration, landscape change, historic building interpretation, and other pertinent topics. There are 37 signs along the trails of the Reserve, as well as tree identification signage.

The Discovery Program provides an opportunity for families, community groups, and schools to learn



about several topics through an interactive trail booklet and associated backpack full of materials. This program is discussed in greater detail under Field-Based School Programs.

In the next 5 years, we hope to add a storybook trail (children's picture-book images and text, enlarged) for visitors with small children to enjoy as they walk. We will also explore building a Native American hunting hut with an accompanying interpretive sign. And we intend to review the condition of all of our signs to determine whether some need to be replaced.

Information Dissemination

Beyond the onsite program offerings, exhibits, and trailside education, the Reserve's education messages are shared through event presentations, a newsletter, and social media. Laudholm Trust's Communication Director is the editor of *Watermark*, a newsletter filled with compelling stories about the Reserve's work. Education staff members submit articles for inclusion in this publication and also write blog posts for the website. The Communication Director promotes interpretive education program offerings year-round through communication channels. In the next 5 years, we plan to expand our dissemination efforts through increased blog posts, video clips, and flyer distribution. The education team will also continue to attend and

exhibit at interpretation and environmental education events. In addition, we intend to provide more information on our website regarding the accessibility of our trails, programs, and exhibits. To broaden the reach of lectures, we will seek funding for a video recording system in the auditorium.

Program Evaluation

The Reserve currently has an evaluation component in place for its school field trips, teacher workshops, select public programs, and camps. Participants complete a paper or online evaluation, providing valuable feedback and comments regarding the quality of the program, its leaders, and recommendations for improvement. In the next 5 years, we will continue to improve and refine our strategy to help guide the Reserve's interpretive education evaluation plan and outcomes. We will explore offering incentives to visitors who complete program evaluations in an effort to boost completion rates. We also plan to evaluate more programs and increase our observations of docent leaders. Over the next 5 years, we hope to develop a more comprehensive system for compiling our evaluation data in a digital format.

Written evaluations help the Reserve's education team to enhance and improve its programs and provide

direction regarding new programming. Our public program evaluations have been overwhelmingly positive. In the 2017 and 2018, for example, 94 percent of kayaking participants rated their experience a 5 on a 5-point scale and the remaining evaluators rated their experience a 4. Similarly, 94 percent of Climate Stewards lecture attendees rated their satisfaction at least 8 on a 10-point scale. Some school-program evaluations have included comments like these:

- The interactions with the animals gave the students a personal connection to the wildlife and helped them to have empathy for animals they would not normally have the chance to connect with.
- I honestly felt this was one of the best field trips I have ever been on as an educator. I really enjoyed the experience and hope that you continue to offer the same experience in future years!
- I really enjoyed watching the hands-on learning unfold. Students were given the freedom to learn in a truly remarkable outdoor classroom.
- The presenters were awesome. It was great that they gave the children wait time to answer the questions. I have a lot of children in my class that need this. They didn't try to rush them. They also were very flexible when the children saw something that was unexpected. They showed the children that they were excited too.

Citizen Monitoring

The Reserve has Picture Posts that enable environmental monitoring by citizens, students, and community organizations through digital photography. Each wooden post is topped with an octagon that helps citizen scientists frame a series of photos of the surrounding landscape. Participants upload their images to a website managed by the University of New Hampshire, where changes at that post can be observed over time. In this way, citizens document landscape and seasonal change. The Reserve has four posts, two of them available to the public (Knight Trail and Yankee Woodlot). The Reserve plans to expand our citizen science network for this ongoing project.

In the next 5 years, the Education Program will introduce a phenology program to study the annual life cycles of selected plants and animals. Recording regular observations is meant to measure phenological trends over long time periods. Placing phenological data in the context of other environmental data, such as weather and water quality data already collected

by the Reserve, will help us more effectively predict environmental responses to climate change and implement better management practices that adapt to these changes. As part of this effort, the Reserve will work toward becoming a long-term plant and animal monitoring site in connection with the University of Maine Cooperative Extension. This project will expand our citizen science and climate literacy learning opportunities to community members and visitors through regular volunteer monitoring and public programs. The information collected will be submitted to the National Phenology Network database and used to inform national, regional, and perhaps site-specific decision making.

Coastal Resource Library

The Dorothy Fish Coastal Resource Library is a specialty library with a collection focused on water quality, coastal ecology, and aquatic ecology, among other topics. The library is staffed by volunteers one morning each week, and is opened by appointment any time during business hours. The library collection of over 2,400 volumes can be searched online and an interlibrary loan service enables statewide access to books, articles, and theses. We will continue to promote this valuable resource and increase our collection.

A puppet and storybook nook in the Maine Coastal Ecology Center exhibit area extends the library's reach across campus. In addition, many children's books are featured in the Visitor Center exhibits. Each of these exhibit collections incorporates titles from the library. Although the exhibit copies are not available for lending, visitors are directed to the library where duplicate copies can be signed out.

Seasonal preschool story hours for children ages 3-5 and their caregivers are conducted in the library. These free programs attract families that have often never before visited the Reserve. Books from the library's extensive children's collection are featured with a reading, related craft activity, and trail walk.

In the next 5 years, the Education Program plans to incorporate storybook trails (see Trail/Site Interpretation). The storybooks highlighted on the trails will be available in the library, thus helping to promote the library's offerings to the community.



Coastal Training Program

Introduction

The Coastal Training Program (CTP) acknowledges and respects the critical role that local and regional decision-makers, natural resource providers, businesses, and citizens play in determining the character and condition of Maine's coastal areas. Decisions about land use, infrastructure, development and maintenance, and public health and safety are influenced by regulations, policy, planning processes, scientific findings, and best management practices. Developing effective CTP activities requires awareness that underlying the seemingly pragmatic decision-making process is a complex system of human values, attitudes, and motivational forces. The path leading to the application of scientific findings must navigate through these aspects of decision making. The CTP is designed to use the collaborative potential of shared values, the pride associated with a diverse system of professional practice, and commitment to community and place as a resource, to improving the application of science to coastal management.

To accomplish objectives of the NERRS Strategic Plan, the CTP is designed around social science based principles. These principles indicate that people act to sustain the coastal resources of the Gulf of Maine based upon knowledge of the value of those resources, combined with knowledge of the impacts their actions have on what they value. The CTP promotes protection, stewardship, and conservation of natural resources and ecosystem services in the Gulf of Maine by supporting coastal decision-makers in their work. The CTP supports coastal decision-makers by increasing their knowledge and competencies to protect coastal habitats and build community

resilience. By facilitating the assessment and evaluation of the outcomes of decisions, actions, and policies, the CTP trainings, workshops, and technical assistance accomplish goals of the NERRS Strategic Plan and contribute to building community resilience. The CTP integrates interdisciplinary science-based approaches to achieve outcomes that sustain the social and ecological systems of the coastal zone.

Program Context

The CTP focuses on communities and watersheds in southern Maine and coastal New Hampshire. However, it has been, and will continue to be, involved in select Maine coast-wide initiatives and projects. The original Market Analysis and Needs Assessment (2002) identified municipal officials as the target audience for the CTP and this remains the priority audience for this strategic planning period. This audience represents diverse roles and job descriptions, including elected officials, paid professionals, and professionals and community members serving on volunteer town boards. Paid professionals included in the municipal audience include Town Managers, Planners, Code Enforcement Officers, Public Works, Town Engineers, Water and Wastewater Managers, and Harbor Masters. Included in the municipal audience are those volunteers serving on Planning Boards, Site Plan Review Boards, Conservation Commissions, Town Councils or as Selectmen. Volunteer boards are in many cases the backbone of the decision making process at the local level. In addition to municipal audiences, the Market Analysis and Needs Assessment identified land trusts, watershed and river associations, open space planning committees, and state and federal employees as audiences for CTP, and they continue to be part of

the CTP target audience. Training development uses a systems approach to facilitate collaboration among these audiences as they tackle complex environmental issues from diverse organizational perspectives. The CTP provides technical assistance in the region for application of the Collaborative Learning approach developed and tested during the first fifteen years implementing the program. This adaptable approach facilitates the work of diverse stakeholder teams to accomplish regional goals for protection, stewardship, and conservation of natural resources and ecosystem services. Through NERRS Science Collaborative grants, the CTP develops trainings and technical assistance aimed at building the national capacity of the system to design, conduct, and evaluate collaborative science approaches to coastal management in alignment with system-wide plans.

Since the 2013-2018 Wells National Estuarine Research Reserve Management Plan, the following reflections have shaped this guidance document: 1) There are many organizations working up and down the Maine Coast with similar organizational or program missions as the CTP yet a conduit for knowledge exchange is lacking; therefore the CTP broadened its advisory committee to encompass most of these organizations to allow an exchange of ideas, identify respective niches and roles, and to support, transfer, and build upon each other's work; 2) Training on communication best practices tailored to audience needs' (e.g., how natural resource providers can communicate climate change impacts) is in constant demand and well attended; 3) Transfer of knowledge from practitioner to practitioner (e.g., decision-maker from one town to another) through training or facilitated workgroups catalyzes local and regional action. 4) Training needs and gaps for CTP priority audiences are identified through the program's iterative process: needs assessment for training; evaluation of projects, workshops, and trainings; listening and synthesizing partner and priority audience needs during workgroup sessions.

Objectives and Strategies

CTP objectives are accomplished through technical assistance, formal workshops, trainings, and conferences. These events are collaboratively planned and implemented with partner groups and the CTP advisory committee members, including

representative from the following: Bowdoin College, Casco Bay Estuary Partnership, Great Bay National Estuarine Research Reserve, Gulf of Maine Research Institute, Hancock County Soil and Water Conservation District, Island Institute, Maine Audubon, Maine Coastal Program, Maine Drinking Water Program, Maine Natural Areas Program, Maine Sea Grant, Schoodic Institute, Southern Maine Planning and Development Commission, and the Piscataqua Region Estuary Partnership.

The CTP provides technical assistance to audiences and partners including facilitation, stakeholder engagement, Collaborative Learning methodologies, project management, and event planning and management. The CTP contributes to regional coastal management through membership in on-going working groups and committees that address specific coastal management issues; participation on advisory boards of partner organizations; consultations with CTP audiences; membership on research teams, and attendance at municipal meetings to provide expert testimony on coastal management.

The CTP contributes to system-wide priorities through NERRS Science Collaborative Grants and participation on national project teams (e.g., the ongoing NERRS Science Collaborative Successful Adaptation Metrics and Indicators Project). Priority goals and objectives identified in the NERRS Strategic Plan (2017-2022) for protecting places, applying science and educating communities are tightly linked to the CTP program and are reflected in the objectives below.

Objective 1

Training participants will indicate intent to apply natural and social science-based information in coastal decision-making.

Strategies

- Identify and translate emerging research and technology tailored to the needs of coastal decision-makers.
- Increase the application of management-relevant research and monitoring results by decision-makers in support of coastal management.
- Share innovative communication strategies and methods to translate science effectively and support collaborative decision-making.

- Provide a minimum of 8 workshops and trainings annually for watershed management, climate adaptation planning, stakeholder engagement and/or habitat conservation and restoration.

Objective 2

An annual forum will be provided for elected and appointed decision-makers to share coastal resilience strategies to advance the region's resilience in a changing climate.

Strategies

- Host community decision-makers at the annual Better Safe than Sorry Fall workshop
- Provide a conduit to communicate funding and research opportunities throughout the year
- Highlight cutting edge climate science through workshops and engagement as stakeholders in projects
- Check in biannually with the NERRS Successful Adaptation Indicators and Metrics (SAIM) cohorts
- Collaborate with the CTP Advisory group and Maine and New Hampshire Climate Adaptation Professionals to exchange best practices with each networks' stakeholders

Objective 3

Collaborative watershed efforts are supported in the region to sustain watershed ecosystem services including safe drinking water, flood protection and pollution filtration.

Strategies

- Identify and engage diverse partners and stakeholders in appropriate and strategic approaches to sustaining watershed ecosystem services.
- Facilitate science translation and dialogue about the need for and application of scientific research to improve management and policy decisions to sustain ecosystem services.
- Maintain participation and workshop planning support for the Salmon Falls Watershed Collaborative, Saco Watershed Collaborative, and Mount Agamenticus to the Sea Conservation Initiative.

Objective 4

Each year trainings, workshops, and technical assistance are designed to address partner and

stakeholder needs identified through needs assessments, evaluations, and in consultation with the CTP Advisory Committee.

Strategies

- Assess the science, technology, and information needs of decision makers in accordance with needs assessments and feedback from conducted programs.
- Respond to those who voice a need for science-based information and technology relevant to coastal management.
- Evaluate programs to determine how participants apply the information and knowledge they obtain.
- Evaluate research translation and application for contributions to measurable environmental outcomes.
- Facilitate communication of decision-maker needs for science to researchers.
- Participate on local, regional, state and national committees to share work at different scales with partners and stakeholders.
- Outcomes
- Diverse stakeholder workgroups promote protection, stewardship, and conservation of natural resources and ecosystem services in the Gulf of Maine
- Improved ability of partners and stakeholder groups to collaboratively facilitate sustainable land use practices, habitat conservation and restoration and to build community resilience.
- Decision makers increase their knowledge of sustainable land use and conservation practices to maintain ecosystem services and build community resilience.

Program Delivery

Capacity

The CTP is managed internally by the CTP Coordinator and CTP Director who work collaboratively with the Stewardship Coordinator, other Reserve staff, and Laudholm Trust. This team communicates regularly to collectively develop and manage CTP events. The team collaborates to integrate research, monitoring, stewardship, and education activities into trainings that are relevant to coastal decision-makers and system-wide priorities. During the past 5 years, funding from the NERRS Science Collaborative has enabled the Wells Reserve CTP to increase outcomes and impact. Base

funding for CTP funds the CTP Coordinator and Director are 24 hours per week. Additional funding from grants supports an additional 8 hours per week for these two positions. In the absence of grant funding, the outcomes of the program would be reduced.



Training Themes

The CTP is guided by priorities identified in the Wells Reserve's original market analysis and needs assessment, the current CTP Strategic Plan, and 15 years of evaluations of CTP activities. The Wells Reserve's CTP has benefited from a series of NERRS Science Collaborative funded research projects providing rigorous assessments of the partner and stakeholder audience served by the program. These sources support two priority training themes for the program: 1) Habitat, biodiversity, and ecosystem services conservation; and 2) watershed approaches to pollution prevention and mitigation. Climate change, with its associated impacts on habitat, biodiversity, storm intensity and frequency, sea-level rise, and community resiliency, is a nationally significant issue. Climate change adaptation and mitigation are integrated within the two priority training themes.

The two overarching training themes are addressed through the six priority training topics identified from stakeholder and target audience needs, covering the following:

- Strategies for balancing economic growth and development with quality-of-life values such as rural character, local agriculture, recreation, scenic views, clean water, and wildlife habitat.
- Methods for incorporating scientific information about the cumulative impacts of management and policy into decisions affecting natural resources.

- Ecosystem approaches to conservation and restoration of coastal habitats and biodiversity.
- Methods for incorporating valid economic implications of land conservation and watershed management into decision making.
- Use of science-based Best Management Practices for sustaining water quality and quantity.
- Management strategies and policies that sustain ecosystem services and support community resilience in a changing climate.

Evaluation

Evaluation of CTP is incorporated into the process of development, marketing, and delivery of training and technical assistance and is linked to the goals and objectives identified in the 2002 Market Analysis, past and current Strategic Plans, and systemwide CTP program goals connected to the NERRS Strategic Plan. CTP Performance Measures are used to evaluate programs and document progress of NERRS identified goals for CTP.

CTP evaluation methodologies fall under three general categories: needs assessments; performance evaluation monitoring; and outcome tracking. These methodologies are applied as appropriate to evaluate all CTP activities. Workgroups are measured against agreed upon outcomes, The Saco River Watershed Collaborative progress is evaluated against the group's action plan during conference calls and annual face-to-face meetings. For workshops and trainings needs assessments and performance evaluation monitoring questions are used. Evaluation data is processed, archived, and used in grant reporting, program design processes, and formal and informal internal organizational development.

Formative evaluations guide new directions for the CTP. Participation on regional work groups, NERRS Science Collaborative projects and collaboration with CTP Advisory Committee members and other partners provide ideas for new directions, emerging training topics and innovative approaches. Emerging ideas may begin as technical assistance and progress to formal workshops.

Twice a year, the CTP Coordinator submits all performance measure data to the Executive Director.

Research and Monitoring

Introduction

The Research Program studies and monitors change in Gulf of Maine estuaries, coastal habitats, and adjacent coastal watersheds, and produces science-based information needed to protect, sustain, understand, or restore them. In a typical year, the program directs or assists with more than 20 studies involving dozens of scientists, students, and staff from the Reserve, academic and research institutions, resource management agencies, and environmental and conservation groups.

Reserve scientists participate in research, monitoring, planning, management, and outreach activities locally, regionally, and nationally. The program supports field and lab research mainly along Maine's southwest coast from the Kennebec River to the Piscataqua River, including nearshore and offshore waters. Within this region, effort is focused on the coastal compartments from Great Bay, New Hampshire, to Casco Bay, Maine, which are characterized by numerous marsh-dominated estuaries, embayments, tidal creeks and rivers, and barrier beaches.

The Research Program focuses on investigations of coastal food webs, the species of interest that depend on them, the habitats that support them, and the human-mediated and natural disturbances that alter them. In addition, the program actively promotes the development and implementation of regionally coordinated ecological monitoring of coastal habitats along a gradient from least disturbed to restored to most disturbed. These activities are accomplished through committee work, meetings, workshops, presentations, and reports. New efforts within the Research Program include the development of

programmatic ties with more academic institutions and governmental agencies.

Climate-driven disturbance is an underlying force that needs to be measured and assessed in natural and altered habitats. The impacts of a changing climate on coastal areas will be expressed across ecosystem variables such as changes in air, water and soil temperature; water chemistry; quantity, timing, and intensity of precipitation; intensity of storm events; sea-level rise, and species distributions and movements.

The Reserve is committed to establishing and maintaining a NERRS Sentinel Site, as described in "Sentinel Sites Guidance for Climate Change Impacts," as part of its ongoing System-wide Monitoring Program. It has already incorporated many Application Module 1 protocols (SSAM-1) into its monitoring program (e.g., vegetation monitoring, vertical control of water quality stations, surface elevation tables).

The Research Program works across the reserves and with the Coastal Training, Education, and Stewardship programs to assess the needs of local communities relative to climate-driven changes in coastal habitats.

NERR System Research Overview

The NERR System provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by national plans that identify goals, priorities, and implementation strategies. This approach, when used



in combination with the education, training, and outreach programs, helps to 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.

Research policy at the Wells Reserve is designed to fulfill the NERR System goals as defined in program regulations.

The three research themes are:

1. Addressing coastal management issues identified as significant through coordinated estuarine and coastal research within the NERR System;
2. Promoting federal, state, public, and private use of one or more reserves within the NERR System when such entities conduct estuarine research
3. Conducting and coordinating estuarine research within the NERR System, gathering and making available information necessary for improved understanding and management of estuarine areas.

The strategic science goal for the system strives for scientific investigations to improve understanding and inform decisions affecting estuaries and coastal watersheds. Objectives toward this science goal include to: (1) expand capacity to monitor change in water resources, habitat, and biological indicators; (2) improve understanding of ecological effects of climate drivers and pollution; (3) quantify ecosystem services of coastal watersheds and estuaries; and 4) utilize social science research to further stewardship.

System-wide Research Programs

In addition to external grant opportunities through state, federal, and foundation-based sources, the NERR System has two system-wide research programs that provide funding support to all reserves.

NERRS Science Collaborative

The Science Collaborative is a multifaceted program that focuses on integrating science into the management of coastal natural resources. The program integrates and applies the principles of collaborative research, information and technology transfer, graduate education, and adaptive management with the goal of developing and applying science-based tools to detect, prevent, and reverse the impacts of coastal ecosystem dynamics

and habitat degradation in a time of climate change. This program is designed to enhance the NERRS ability to support decisions related to coastal resources through collaborative approaches that engage the people who produce science and technology with those who need it (i.e., end-users). In so doing, the Science Collaborative seeks to make the process of linking science to coastal management decisions, practices, and policies more efficient, timely, and effective and to share best practices and examples for how this may be accomplished.

Davidson Graduate Research Fellowships

The goal of the Margaret A. Davidson Fellowship is “to build the next generation of leaders in estuarine science and coastal management by affording graduate students the opportunity to conduct collaborative science that addresses key reserve management issues, partake in professional development opportunities, and receive quality mentoring to support their professional growth.” Each 2-year fellowship will offer graduate students enrolled in a M.S. or Ph.D. program the opportunity to conduct estuarine research within a National Estuarine Research Reserve. A strong emphasis will be placed on mentoring the fellows at a local and national level, as well as providing professional development opportunities to build knowledge and skills to enter the workforce. The proposed outcomes of this fellowship program include (1) support the next generation of leaders in estuarine science and coastal management; (2) develop a strong network among fellows that remains post fellowship and into their careers; (3) build prestige and strong reputation for NERRS as developers of these leaders and; (4) address critical reserve management priorities through high quality research. Research conducted by fellows will support the 2017-2022 NERRS Strategic Plan and the focus areas of the Wells Reserve’s Research and science objectives.

Objectives and Strategies

Objective 1

Coastal food webs and habitats are investigated to gain a better understanding of their underlying physical and biological processes and their response to natural changes and human activities.

Strategies

- Examine the ecology of estuarine and coastal habitats and food webs in coastal Gulf of Maine waters.
- Evaluate the effectiveness of coastal habitat restoration in the Gulf of Maine, and the response of coastal habitats to changing patterns of coastal water inundation.
- Support investigations considering the quantity and quality of estuarine and watershed resources (e.g., viable migratory fish habitats).
- Promote the investigation of linkages (e.g., larval fish ingress) between estuaries and open water in the Gulf of Maine.
- Promote a landscape ecology approach to the conservation of coastal lands and watersheds.
- Collaborate with other agencies to determine coastal research needs relevant to resource management, and conduct research projects to meet those needs.
- Participate in system-wide scientific work groups addressing how wetlands, estuaries, and nearshore ecosystems respond to land use within coastal watersheds.
- Provide scientific support for education, outreach, and training efforts to manage and protect freshwater and tidal shore-lands in watersheds.

Objective 2

Visiting investigators and staff are provided with opportunities and resources to conduct independent or collaborative research at the Wells Reserve and in the Gulf of Maine region.

Strategies

- Train, mentor, and provide guidance to undergraduates, graduate students, post-doctoral associates, and citizen scientists.
- Support visiting researchers by providing access to facilities, lab resources, field sites, staff, and interns.
- Participate in the NOAA Margaret A. Davidson Fellowship Program (formerly, the Graduate Research Fellowship Program) to offer opportunities for graduate research fellows to make contributions in the fields of aquatic, estuarine, and coastal science.
- Cultivate and promote programmatic affiliations with new and existing academic institutions, and collaborate with institutions on specific research projects.

- Share information, personnel, equipment, and facilities with partners to facilitate research.

Objective 3

The development and implementation of regionally coordinated ecological monitoring of coastal habitats is promoted, and staff continue to maintain and expand upon the System-wide Monitoring Program (SWMP).

Strategies

- Fully implement and expand SWMP, including bio-monitoring, land-use change analyses, and habitat mapping.
- Integrate core elements of SWMP into the SSAM-1 Initiative, with a focus on changes in marsh elevation, vegetation community structure, and inundation and sea-level rise.
- Collect, maintain, and QA/QC consistent SWMP data for weather, water quality, nutrients, vegetation and land-use change using standardized protocols and technologies set forth by the NERRS Data Management Committee and the Centralized Data Management Office (CDMO).
- Organize, review, document, and submit quality-controlled SWMP data to the CDMO on a quarterly basis as well as to manage real-time data available to end-users.
- Promote and increase awareness of SWMP data within the Gulf of Maine scientific community through attendance and participation in local and regional monitoring working groups, regional monitoring associations, conferences, workshops, symposia, and public speaking opportunities.
- Link SWMP and other monitoring efforts with the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) and the national Integrated Ocean Observing System (IOOS).
- Contribute to local, regional and national initiatives involving restoration science and coastal habitat monitoring.
- Subsidize system-wide telemetry efforts through the continued support and trouble-shooting of telemetry systems, and provide up-to-date technical telemetry training at the annual Technician Training Workshop (TTW), sponsored by CDMO.

System-wide Monitoring Program

The System-wide Monitoring Program (SWMP) provides standardized, quality-controlled data on national estuarine environmental trends while allowing

the flexibility to assess coastal management issues of regional or local concern. SWMP is guided by a NERR System plan last updated in 2011. Its principal mission is to collect quantitative measurements of short-term variability and long-term changes in weather, water chemistry, biological systems, and land use / land cover characteristics of estuaries and estuarine ecosystems for the purposes of informing effective coastal zone management. The program is designed to enhance the value and vision of the reserves as a system of national reference sites. SWMP focuses on three ecosystem characteristics:

1. Abiotic measurements describe the physical environment, including weather, water chemistry, and hydrological- and sediment-related parameters. Data follow standard parameters, protocols, and approaches that are compliant with Federal Geographical Data Committee standards and are shared through the Centralized Data Management Office.
2. Biotic measurements focus on habitats and biodiversity through habitat mapping and ichthyoplankton monitoring.
3. Watershed and land-use classification examines the link between watershed land use and coastal habitat quality. This element is guided by the NERR System Habitat Mapping and Change Plan.

Abiotic Monitoring

Water Quality, Weather, and Hydrology.

Water quality parameters are collected at 15-minute intervals by YSI 6600 EDS or EXO2 datasondes at four stations located at the heads-of-tide and mouths of the Webhannet and Little River estuaries. Parameters include water temperature, specific conductance, pH, turbidity, dissolved oxygen (in both % and mg/l), and water level / depth. Chlorophyll a, orthophosphates, combined nitrate / nitrite, silicates, and ammonia are collected via monthly grab samples at all four monitoring locations. One station also houses a sampling regime that samples every 135 minutes (to cover an entire tidal cycle) using an ISCO automated water sampler.

Weather data is also obtained in 15-minute intervals. A Campbell Scientific CR1000 weather station located on the Laudholm campus collects air temperature, relative humidity, wind speed and direction, barometric

pressure, precipitation, and photosynthetically active radiation.

All abiotic data undergo quality control tests and are submitted to Centralized Data Management Office, where they are archived and made available for dissemination. Data from two water quality stations and the weather station are also delivered in “near-real-time” via the NOAA GOES satellite system and are available on the web at www.nerrsdata.org.

Coastal Ocean Acidification Monitoring (proposed, elective)

In an effort to gain a better understanding of the role of estuaries in the larger context of coastal ocean acidification (COA), the Reserve continues to work with external partners as well as other reserves to acquire the funds, equipment, and technical skills to consistently monitor, and adequately address the increasing threats of COA. The Reserve will further leverage existing datasets and infrastructure from SWMP as well as existing relationships with regional monitoring associations (e.g., Northeast Coastal Acidification Network) and other agencies (NOAA Ocean Acidification Program) to build a robust and sustainable COA network. This provides an opportunity for cross-sector collaboration with end-users to address realistic needs.

Biological Monitoring

Vegetation Monitoring

We employ methodologies similar to those described in Roman and others (2001: ‘Monitoring salt marsh vegetation: a protocol for the long-term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. Kingston: USGS Patuxent Wildlife Research Center, Coastal Research Field Station, University of Rhode Island) to assess the relationship between upland land use, elevation, and the abundance of common emergent marsh plants. These three land use classifications are used to stratify our marsh into discrete sampling transects. Our transect boundaries extend orthogonally from the upland border of the marsh vegetation to the seaward transition of vegetation to bare substrate. Within these long-term monitoring sites, a total of 5 permanent plots with associated groundwater monitoring wells have also been established along each transect, following NERRS standard protocols of Moore and Bulthuis (2003:

'Biomonitoring proposal: Mapping and monitoring of emergent and submerged aquatic vegetation in the Reserve System'. 17th Annual NERRS Meeting, Charleston, SC. 22 pp).

Plant communities within these established areas are surveyed using the point-intercept quadrat method and groundwater salinity data is also collected. The position and elevation of each quadrat are recorded using a total survey station. The Wells Reserve currently participates in a New England-wide NERR vegetation data synthesis collaborative (funded through the NERRS Science Collaborative, 2018) to provide tools and methods for comprehensive vegetation analysis to provide the first regional trend analyses of sentinel site vegetation and marsh surface elevation change in response to sea-level rise. We anticipate that our results will inform the improvement of sentinel site protocols but also establish a prototype methodology for the analysis of marsh condition. These efforts will build on existing collaborations in New England to supply larger geographic scale trend analyses of data from Reserves nationally, as well as other regional analyses for entities with similar data.

Soundscape Monitoring (elective)

In tandem with our stewardship program, we have piloted a long-term soundscape monitoring program looking specifically at phenological changes in fauna within disparate habitats of our Reserve, as well as before-after comparisons of changing terrestrial landscapes. These efforts are being partially supported by the University of New Hampshire's acoustic studies program. This initiative will be further bolstered by NERRS Science Collaborative Capacity Funds (2018) aimed at providing technical training.

Larval Fish Monitoring (elective)

The Reserve has monitored ichthyoplankton assemblages at Wells Harbor for more than 10 years to understand how a changing ocean environment is impacting the composition and timing of larval fish communities. To date, 32 species have been found. Some, such as the commercially important Atlantic herring (*Clupea harengus*), have been present in samples every year and show strong seasonal cycles. Species such as red hake (*Urophycis chuss*) and black sea bass (*Centropristis striata*) did not appear in samples until 2013, after an anomalous warming period in the Gulf of Maine. The ichthyoplankton

assemblage shows strong seasonal structure dominated by several distinctly "spring" or "fall" species. Future analyses will couple fish assemblage data with SWMP parameters.

Land Use and Habitat Change

This component examines the link between watershed land-use activities and coastal habitat quality and employs the NERR System's Habitat Classification Scheme and Coastal Change Analysis Program.

Data Management

Data collected through SWMP are compiled electronically at the Centralized Data Management Office (CDMO), Belle W. Baruch Institute for Marine Biology and Coastal Research, University of South Carolina. The CDMO provides automated primary quality assurance and quality control reviews of all incoming data and metadata. Reserve staff conduct a secondary review on a quarterly basis before data are posted as authenticated. The CDMO compiles and disseminates all data and summary statistics online for researchers, coastal managers, educators, and other interested parties.

Telemetry, or the delivery of near real-time data to remote users, is an important element of SWMP. The NERR System uses the Geostationary Operational Environmental Satellites system, a critical component of the Integrated Ocean Observing System. SWMP 15-minute data are transmitted hourly via this satellite system so they can be used by agencies, including the National Weather Service, to inform forecasting and modeling. SWMP data is also used by the New England Regional Association of Coastal Ocean Observing System (NERACOOS).

A Reserve staff member serves as SWMP's National Telemetry Support Technician, assisting other reserves with basic troubleshooting and maintenance of their stations.

The Reserve promotes awareness of SWMP data and products within the Gulf of Maine scientific community through attendance and participation in local monitoring working groups and efforts. The NERACOOS data distribution web portal provides an active link to the Reserve's telemetered SWMP data, and to the CDMO data retrieval web portal.

Sentinel Site Development

The Reserve participates in a national program dedicated to developing a standardized approach to answering management questions across a broad geographic scale, as outlined in NOAA's Coastal Habitat Response to Changing Water Levels: NERR Sentinel Site Application Module 1 guidance document (SSAM-1). This program allows each Reserve "to examine the interplay of water levels, elevation, and plant communities at scales relevant to local, regional, and national decision makers." Building on these foundational elements, the Reserve is in the process of developing a comprehensive Sentinel Site monitoring



Taking saltmarsh surface readings with a Sediment Elevation Table.

plan (estimated draft completion, 2019). In line with this, the Reserve is implementing a suite of activities, as described in the 2012 Reserve System Sentinel Site Guidance Document, to assess the relationship between vegetative communities (emergent vegetation) and sea-level rise. Surface elevation tables and pore water chemistry monitoring, in tandem with our vegetation monitoring transects, help to link SWMP data to a network of vertically controlled water level stations, to allow precise measurement of local sea-level changes, changes in marsh elevation and

vegetation communities, and the subsequent impacts these variables might have on key habitats within the Reserve. We are also working in partnership with NOAA's National Geodetic Survey and the Center for Operational Oceanographic Products and Services to support the development of SSAM-1 sites and increase the capacity for the Reserve to collect accurate and precise water level observations within their systems.

Research Themes

Estuarine Water Quality & Degradation

Water quality is monitored continuously (data are collected every 15 minutes) at four, long-term stations using automated data loggers, as part of SWMP. Discrete water samples to determine dissolved inorganic nutrient concentrations (orthophosphate, ammonia, combined nitrate/nitrite, dissolved inorganic nitrogen, silica, and chlorophyll a) are also collected monthly at these sites to understand seasonal trends in nutrient concentration in our local estuaries. Nutrients are also sampled over a 24-hour period at one station to determine diurnal variations in nutrient concentrations and to understand how they vary across tidal cycles.

Our water quality monitoring and associated research has contributed to the designation of several "Priority Watersheds" in south coastal Maine by the Maine Department of Environmental Protection (DEP). This designation is used to help prioritize nonpoint source (NPS) water pollution control efforts and attract local communities to take action to restore or protect waters impaired or threatened by NPS pollution.

Nutrient data collected by the Reserve as part of SWMP and in collaboration with the DEP have been used to develop policy relating to regulation of dissolved oxygen and nitrogen in estuaries. Our data and expertise were used in a fact sheet on indicators of estuarine eutrophication in the Gulf of Maine, produced by the Gulf of Maine Council on the Marine Environment's Ecosystem Indicator Partnership.

Climate Change Impacts on Salt Marsh Habitats & Communities

Factors that control the dynamics and vigor of salt marsh plant communities and marsh peat formation determine the ability of a salt marsh to persist in the face of sea-level rise. Through a combination

of experimental manipulations and long-term monitoring, we are producing data to answer questions concerning the sustainability of natural and restored salt marsh habitats in this region. These studies address land-use impacts, nutrient-plant relations, plant community responses to physical and hydrologic disturbance, and the relative contribution of short-term natural events (e.g., storms) and human activities (e.g., dredging, tidal restriction) on patterns of sediment accretion and erosion.

The Reserve's marshes and beaches are among the best-studied sites nationally with regard to long-term accretion and erosion. The barrier spits that protect these marshes have also been well studied, especially with respect to alterations due to human activity and sea-level rise. The Saco River and York River estuaries and Casco Bay have also been studied in this regard by the Reserve scientists and collaborators.

Understanding Changing Coastal Habitats

Rapid changes in both climate and ocean chemistry are reshaping ecosystems in ways that affect resources and ecosystem services. The Reserve is interested in the impacts of these drivers on estuarine and coastal



Invasive invertebrates covering native kelp.

ecosystems and their related implications to ecosystem function. To this end, our goals are to continue efforts to assess and understand changing coastal habitats.

One of these efforts includes our continued work on marine invasive species monitoring and research. Invasive European green crab (*Carcinus maenas*) populations have exploded statewide with devastating losses to Maine's intertidal resources, including soft-shell clam flats, eelgrass beds, and salt marshes. Research staff will continue studies and partnerships that investigate changes in green crab population dynamics (size, densities, sex ratios, timing of spawning, etc.) as well as the impacts of this crab on intertidal habitats through acoustic telemetry and trapping surveys with local fishers in the area.

A Research Associate will continue to act as state coordinator for the Marine Invader Monitoring and Information Collaborative (MIMIC), which monitors marine invasive species and manage volunteers at 17 long-term sites in Coastal Maine. The results of this monitoring will be entered into the iMap online invasive species database housed at the Maine Natural Areas Program for access by managers, educators, and other scientist/researchers. The data is also available through the lead agency, The Massachusetts Office of Coastal Zone Management. We will continue to partner with the Casco Bay Estuary Partnership to expand monitoring and outreach to the island communities of Casco Bay. A Research Associate will continue to represent the Reserve on the Maine Marine Invasive Species Coalition (MeMISCO) and attend the annual meeting of the Maine Invasive Species Network (MISN).

Aquatic Resource Restoration in Southern Maine Watersheds

The Reserve will continue to explore restoration and management opportunities in coastal watersheds from the Salmon Falls River to the Scarborough River, giving priority to actions that will improve stream habitat connectivity and tidal flow in saltmarsh systems. The Project Manager will work with The Nature Conservancy of Maine to assess potential salt marsh and sea-run fish restoration projects in southern Maine. The Project Manager will also continue working in Cape Elizabeth and Scarborough to study impacts of road/stream crossings in the Spurwink River marsh and the potential vulnerability of this infrastructure to climate change and sea-level rise. The Reserve will

work with a stakeholder citizens committee in the York River watershed to advance restoration goals of the York River Stewardship Plan, and with the Maine Stream Connectivity Workgroup to facilitate and advance aquatic resource restoration.

Estuarine and Coastal Fisheries in the Gulf of Maine

Climate change has had a recent and pronounced effect in the coastal waters of the Gulf of Maine. For example, changes in the thermal structure in shallow coastal areas, including estuarine systems, are having profound and adverse effects on economically- and ecologically-important marine species such as lobsters, crabs, and finfish. Indicators of this decline may include reduced fecundity, failure of females to mate, and insufficient or low quality sperm being passed to females. As we expect a changing ocean climate to persist, stressful environmental conditions could impede Gulf of Maine fauna, making it critical to understand how changing environmental parameters might affect a variety of life-history characteristics. An ongoing collaboration with academic and state collaborators is aimed at quantifying changes in lobster reproductive output. Our continued research efforts will help to inform fisheries and coastal resource stakeholders through empirical studies and predictive modeling.

The Jonah crab (*Cancer borealis*) has emerged rapidly as a fishery, with landings more than quadrupling over the past 20 years. Because of this increased fishing effort, a fisheries management plan has been recently implemented. To ensure the long-term health of the Jonah crab fishery, the Research Program is assessing growth rates and determining implications of harvesting techniques. The Research staff work with state and federal partners to provide data that will guide management decisions (e.g., stock assessments).

Novel Tools to Assess Species of Greatest Conservation Need

Environmental DNA (eDNA) presents an opportunity to harness new technology and fundamentally improve the Reserve's capacity to monitor biological communities. The Research Program plans to expand eDNA monitoring while developing best practices and analyses based on this management tool. The Reserve will work with partners at the University of

New Hampshire, University of Maine, Casco Bay Estuary Partnership, and Maine Coastal Program to develop a cost-effective method for monitoring estuarine species of interest, with a focus on anadromous rainbow smelt populations. The Reserve will apply eDNA methods to generating up-to-date information on the status of rainbow smelt populations in small coastal streams where information is lacking.

Salt Marsh Degradation and Restoration

Since 1991, the Reserve has been studying the impact of tidal restrictions on saltmarsh functions and values, and saltmarsh responses to tidal restoration. Salt-marsh ecosystems in the Gulf of Maine sustained themselves for nearly 5,000 years in the face of sea-level rise and other natural disturbances. Since colonial times, large areas of salt marsh have been lost through diking, draining, and filling. Today, the remaining marshes are well protected from outright destruction, but over the past century, and especially since the 1950s, salt marshes have been divided into fragments by roads, causeways, culverts, and tide gates. Tidal flow to most of these fragments is severely restricted, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Currently, we are studying how adjacent land use change is altering the amount and quality of freshwater flow into Gulf of Maine marshes.

Academic and Institutional Partnerships

The Reserve maintains professional relationships with colleagues at the University of New Hampshire, the University of New England, University of Massachusetts Lowell, Northeastern University, Boston University, Dartmouth College, Antioch New England Graduate School, Bates College, the University of Maine, Saint Joseph's College, York County Community College, Unity College, and the University of Southern Maine. We have begun to explore formal program partnerships with some of these partner institutions. Programs to be considered include academic-year course offerings by Reserve staff, undergraduate and graduate on-site field research courses, expanded coastal research and training opportunities for students and faculty, and semester-long research internships for undergraduates.

Research Program staff work with undergraduate and graduate interns during both the academic year and the summer field season. The staff also work closely with non-profit groups and citizen scientists, particularly on watershed, fish passage, and estuarine water quality monitoring projects.

The Research Director participates on graduate thesis committees at the University of New Hampshire, the University of Maine, and the University of New England.

Government Partnerships

The Research Program staff interacts regularly with staff from state and federal agencies, directly and within partnerships, to determine coastal research needs relevant to resource management and to provide scientific support for education, outreach, and training efforts related to freshwater and tidal shorelands. The Reserve regularly collaborates with the National Marine Fisheries Service Community Restoration Program, the U.S. Environmental Protection Agency (EPA) Casco Bay and Mass Bays Estuary Programs, the EPA Office of Ecosystem Protection, the U.S. Geological Survey, Maine Sea Grant, New Hampshire Sea Grant, and Rachel Carson National Wildlife Refuge. Research staff also collaborate with the Maine Coastal Program, the Maine Department of Inland Fisheries and Wildlife, the Maine Department of Marine Resources, the Maine Department of Transportation, and the Maine Department of Environmental Protection.

When opportunities permit, the Research Program cooperates with municipalities. Examples of town-level cooperation include an assessment of the ecological effects of docks and piers in the York River estuary, a study of the sustainability of the Saco River watershed, a study of the importance of buffers to water quality in the Little River watershed (Wells and Kennebunk), and a comprehensive assessment of the fisheries in the York River estuary as part of a National Wild and Scenic Rivers System initiative.

Mentoring and Internships

The Research Program staff works with undergraduates, graduate students, and interns during both the academic year and the summer field season. In a given year, program staff works closely with 10 to 20 interns. In general, students work on Reserve-

sponsored research projects. Many students work for credit or to meet a service requirement, while others receive stipends from project funds. Three reliable programs for successful candidates include the NOAA 5-colleges consortium, the NOAA Hollings Scholarship Program, and the University of Southern Maine “Canis Major” program.

Research Program staff work closely with citizen scientists, particularly on watershed and estuary water quality monitoring projects. The research program benefits enormously from the time, energy, enthusiasm, and interest of these students and volunteers. In return, participants often use their experience at the Reserve as a step toward environment-related employment or graduate study. Benefits continue well after the internships have ended; there is often continued interaction between the Reserve and former interns as they progress in their professions.

Scientifically Engage External Audiences

The Research Director and staff dedicate time to engage scientifically in several contexts. They may:

- host or participate in local, state, regional, and national scientific meetings
- lead or take part in trainings, webinars, and workshops to support their professional development and growth
- present to local and regional community groups on Reserve science and management projects
- participate in state, regional, and national steering committees and working groups
- contribute to Reserve communications vehicles, such as the website and newsletters
- produce project completion reports
- submit manuscripts to peer-reviewed journals
- review manuscripts and proposals
- train emerging scientists
- encourage and facilitate research by visiting investigators

Research findings are routinely shared as oral presentations, posters, abstracts, technical reports, and peer-reviewed publications.

The Research Program organizes meetings and workshops on topics as varied as soundscape ecology, ocean acidification, nanosatellite and drone

technology, environmental DNA, and fish-passage restoration.

Research Program staff contribute to the development of regional coastal monitoring and research initiatives and provide oversight and planning for coastal monitoring, management, habitat protection, and restoration programs. Participation in working groups and steering committees allows the Reserve to contribute science information and perspective, and to develop alliances and partnerships with representatives from other entities with complementary missions.

Site Profile

In January 2007, the Reserve published the Site Profile of the Wells National Estuarine Research Reserve, a 326-page document that details the Reserve's physical and biological resources. The Site Profile includes plant and animal species lists, past research and monitoring projects, and contemporary and future research needs. The Site Profile is a comprehensive reference document targeted at researchers and resource managers carrying out projects in south coastal Maine. It is available online (wellsreserve.org/project/site-profile).



The Reserve assigns habitats to four management zones — public and administrative, active management, conservation, and protected — to control types and levels of access and activity. This approach permits research, education, resource management, and public enjoyment while providing adequate protection to sensitive areas and species.

Resource Management and Stewardship

Introduction

The Wells Reserve strives to exemplify wise coastal stewardship through sound natural-resource management within its borders and through its conservation partnerships in southern Maine and around the Gulf of Maine. Along with research, environmental monitoring, education, and training, stewardship of natural resources is a major program component of the Reserve.

The Reserve encourages individuals and organizations to recognize connections between land-use actions and environmental quality, and to take responsibility for protecting coastal watersheds through personal stewardship, municipal and state planning, land management activities, habitat restoration, and land acquisition.

The diverse habitats encompassed by the Reserve support distinct plant and animal communities requiring specific stewardship approaches. Woodland and fields are in large part resilient to human use, while salt marshes, dunes, beaches, vernal pools, and bogs are more sensitive to human impacts. Rare native plants and animals require specific management approaches.

Some parts of the Reserve are relatively pristine, while other areas are under ecological stress associated with past land-use practices and the spread of invasive species. A large deer population has contributed to the spread of invasive plants and human health issues associated with Lyme disease.

As envisioned in the Coastal Zone Management Act, the role of the Wells Reserve in coastal resource management and stewardship extends beyond

Reserve boundaries. To accurately reflect the scope of the stewardship program, this chapter has two components: the stewardship of natural resources within the Reserve (Site-Based Stewardship); and community-based activities (Community-Based Stewardship) in watershed protection, habitat restoration, and regional land-conservation activities.

Objectives and Strategies

Objective 1

Habitats within the Reserve are managed to sustain biodiversity and ecosystem functions while providing opportunities for research, education, and public enjoyment.

Strategies

- Use the Reserve as a demonstration site for coastal stewardship and best management practices.
- Maintain and enhance habitats for plant and animal species, particularly those that are threatened, endangered, or of special concern.
- Monitor, control, and prevent the spread of non-native plant species that threaten native plants and animals.
- Restore native coastal and upland ecosystems and monitor the success of the restoration activities.
- Protect pristine habitats by directing public, staff, and visiting investigators to less sensitive areas.
- Maintain a system of trails, woods roads, and accesses to safely accommodate staff and visitors.
- Monitor public use of the site and continually assess visitor impacts on natural resources and on the core programs of research and education.

- Conserve priority lands using established evaluation criteria.
- Implement conservation strategies to protect the Reserve's watershed resources.
- Develop strategies to mitigate, prepare for, respond to, and recover from the effects of natural and man-made disasters.
- Investigate emerging technologies for beneficial use in natural resource management.

Objective 2

A watershed approach to stewardship and land use is promoted to enhance the quality of water resources in south coastal Maine.

Strategies

- Help support and guide the implementation of existing watershed surveys and management plans.
- Develop surveys and management plans for priority watersheds in southern Maine and support and guide their implementation.
- Disseminate information and provide technical assistance to municipalities, organizations, agencies, and individuals on watershed management issues.
- Support new and growing community-based watershed groups.
- Create and maintain partnerships with organizations and individuals that support watershed approaches to environmental management.
- Objective 3
- Assistance and expertise are provided to communities and organizations to conserve, restore, and manage coastal habitats.
- Strategies
 - Engage and work with conservation commissions, land trusts, and the local water district to protect lands within the Reserve's targeted watersheds.
 - Provide networking and training opportunities to help municipalities and organizations increase their effectiveness and capacity to conserve lands.
 - Serve as a center for providing southern Maine land conservation organizations with geospatial and technological support such as geographic information systems, unmanned aircraft systems, and other technical support.

- Participate in and contribute to statewide and multi-state planning, conservation, and stewardship efforts that lead to the protection of coastal lands.
- Provide information and technical support to help citizen groups, organizations, and individuals identify and complete coastal habitat restoration projects.
- Provide support for long-term monitoring of abiotic and biotic elements of restored habitats.

Resource Management

Management Framework

Wells Reserve lands and waters are owned by four entities: Maine Department of Agriculture, Conservation and Forestry (147 land acres), U.S. Fish and Wildlife Service / Rachel Carson National Wildlife Refuge (1,428 acres), Town of Wells (249 acres), and Reserve Management Authority (40 acres). The Maine Department of Agriculture, Conservation and Forestry Reserve also owns 386 acres of submerged lands within the Reserve, though a portion of these are within the Wells Harbor Federal Navigational Channel and so are excluded from the Reserve.

Management of lands owned by the state, the town, and the Reserve Management Authority follows actions outlined in the Reserve's Integrated Natural Resources Management Plan: Terrestrial, Freshwater, and Barrier Beach Habitats – 2013 to 2023. The Reserve also relies on recommendations developed by the Stewardship Advisory Committee. Federal lands are managed by the U.S. Fish and Wildlife Service / Rachel Carson National Wildlife Refuge.

Natural Resource Protection

Reserve administrative processes and town, state and federal regulations protect the Reserve's natural resources. Maine's natural resources, including those within the Reserve boundary, are protected by various laws, including the core laws of the Maine Coastal Program. These apply to the state, municipal, and federally owned conservation land and water within the Reserve. The U.S. Fish and Wildlife Service monitors and enforces laws within the National Wildlife Refuge. State natural resource agencies enforce laws on state and municipal lands.) A summary of applicable state and federal natural-resource laws is in the Appendix.

The Reserve works closely with state and federal natural resource agencies in protecting Reserve

resources. Staff and trained volunteers routinely monitor human activities, wildlife, and habitats within the Reserve's protected area and staff report violations to the appropriate state enforcement agency. Additionally, each state and federal agency has a representative on the Reserve's Stewardship Advisory Committee. As a result, the agencies remain informed about issues that may affect the Reserve and can address them quickly.

The Reserve cooperates with the following agencies in the areas under their purview:

- Maine Department of Inland Fisheries and Wildlife: Inland fish and wildlife populations and anadromous fish.
- U.S. Fish and Wildlife Service: Trust resources including threatened and endangered species, migratory birds, and anadromous fish.
- Maine Department of Environmental Protection: Wetlands and beaches.
- Maine Department of Marine Resources: Marine fisheries, anadromous and catadromous fisheries, and boating in tidal waters.
- National Marine Fisheries Service: Marine mammals and migratory fish.
- Town of Wells: Public safety, town planning.

Management Zones

The Reserve has assigned habitats to four management zones: Public and Administrative, Active Management, Conservation, and Protected. These management zones are used to control the types and levels of access and activities at the Reserve. They allow research, education, resource management, and public enjoyment while providing adequate protection to sensitive areas and species.

An extensive trail system allows visitors visual access to the full range of habitats that make up the Reserve. These trails provide opportunities to view and learn about wildlife and their habitats even when visitors are near or within habitats receiving protection or intensive management.

Public and Administrative Zone (Buffer)

This zone includes a campus of buildings, pathways, parking lots, and other infrastructure to accommodate employees, visiting researchers and educators, and the public. This area is the most intensively used on the

Reserve property and supports large and small events and activities. It includes the Visitor Center, barn, auditorium, Maine Coastal Ecology Center, parking area, entrance road, and the landscaped grounds that immediately surround these facilities. A second area within the public and administrative zone contains the buildings and immediate surroundings of the Alheim Commons property. Stewardship in the public and administrative zone relates primarily to building upkeep and grounds maintenance. Management activities within the zone include mowing and snow removal.

Active Management Zone (Buffer)

This zone consists of 90 acres of fields and shrublands. These include the grounds surrounding the Visitor Center and six fields that have a long agricultural history. Shrubs along the perimeter of these fields form an edge habitat valuable to wildlife. Stewardship within this zone is guided by the Reserve's Integrated Natural Resources Management Plan (open-field management section). Management activities within the zone include prescribed burns, mowing, brush-hogging, and periodic tree cutting. These activities benefit some wildlife species, specifically those dependent on early-successional habitats. The Reserve's open-field management plan sets these goals for managing fields and shrublands:

- Maintain the fields for their visual appeal, historical value, and ecological significance.
- Provide habitat for a range of grassland-nesting birds and other wildlife that use open fields for feeding, nesting, roosting, and hunting.
- Control and curtail the spread of non-native species.
- Encourage the growth of native grasses and rare plants that need full sunlight to thrive.
- Maintain and increase the population of New England cottontail rabbits.
- Regenerate desirable shrub species, such as alders, to provide edge habitats for birds and mammals.
- Provide educational opportunities for the public on topics of natural succession, habitat change, and land-use history.

Conservation Zone (Buffer)

This zone comprises most of the Reserve's forests and shrublands. Stewardship and resource management within this zone is intended to maintain relatively

undisturbed, natural habitats. It focuses on minimizing disturbance to plants and wildlife, while ensuring public safety. Management activities within the zone include tree and shrub cutting and trail maintenance.

Protected Zone (Core)

This zone includes areas deemed in need of greatest protection because they support sensitive species (state or federal rare, threatened, or endangered species) or sensitive habitats. Sensitive habitats within the Reserve include dune systems; beaches for piping plovers, least terns, red knots, and other birds; salt marshes; freshwater wetlands (including streams, vernal pools, forested wetlands, and wet meadows); and tidal waterways. Stewardship within this zone requires that areas are closed except by permit for specific interpretive education programs, research projects, or stewardship and management activities.

Wells Harbor

Wells Harbor (Webhannet River) was first dredged in 1964 by the Army Corps of Engineers. It was partially dredged in 1974, but sediment continued to fill the harbor's Federal Navigation Channel, so it was dredged again in 2000-2001, and has since had maintenance dredging. In 1998, the Wells Reserve began a multi-year project to monitor the effects of Wells Harbor dredging on salt marshes. Pre- and post-dredge data have been used to assess the effects of dredging on salt marsh accretion and erosion in the context of natural events and processes. In 2018, the upland that was created by the original dredge spoils was put to good use—the Reserve and Town of Wells completed a ½-mile accessible trail adjacent to Wells Harbor.

Resource Management

The Reserve has been working on resource management projects that address both long-standing and recently emerging issues.

Disaster Response Plan

A disaster response plan was developed in 2015 using a template provided by five reserves located along the Gulf of Mexico after a brutal hurricane season affected them all. The plan focuses on minimizing the effects of a disaster on water quality and natural landscapes.

The Reserve used a Hazard Identification and Risk Assessment to identify the most likely disaster

events for this location. These include severe storms, catastrophic wildfires, hazardous material spills, and nuclear incidents. Reserve staff are represented on the Town of Wells Emergency Management Team and the York County Emergency Management Agency. They support local and regional response efforts with mapping and weather information.

Deer Population Control

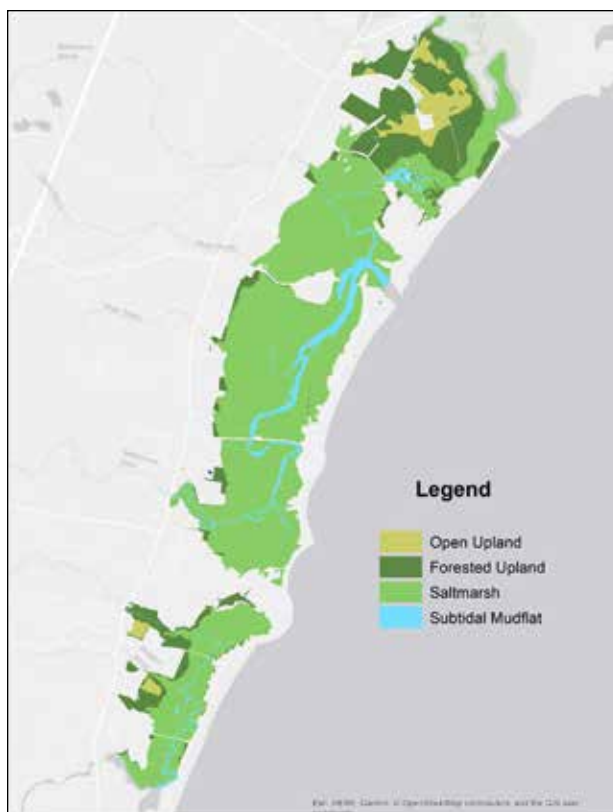
Some forested habitats of the Reserve have been severely damaged by white-tailed deer. Deer browsing has restricted regeneration of native woody and herbaceous vegetation and has favored non-native plants, such as Japanese barberry and Asian honeysuckle. Restoring forested habitats requires reducing deer population density and controlling or removing invasive plant species. The Reserve and its Stewardship Advisory Committee, the U.S. Fish and Wildlife Service, the Maine Department of Inland Fisheries and Wildlife, the Town of Wells, and adjacent landowners instituted a controlled hunt of white-tailed deer in 2002. The limited bow hunt has been successful and a long-term commitment to the program has reduced and maintained the deer herd at a size nearer to carrying capacity. The deer population was about 100 per square mile when the deer-reduction program began, but in 2006 the population was about 80 per square mile. The ideal deer density for the southern coastal region of Maine is 15 per square mile. Periodic deer pellet counts help determine deer population densities.

Invasive Plant Control

In 2010, the Reserve completed a woody and herbaceous invasive plant survey. Thirty species of invasive plants were identified and mapped. Several methods of invasive plant management have been implemented over the past 5 years. These include mechanical removal and herbicide applications to control barberry and honeysuckle. The Integrated Natural Resources Management Plan concentrates invasive plant management in areas of the property that will benefit the most from specific actions.

Early Successional Habitat Management

The New England cottontail was listed as an endangered species in Maine and made a candidate



Habitat types of the Wells Reserve

species for federal listing in 2007. A significant population of these native rabbits was once found on the Reserve, though their numbers have dwindled in recent years. This prompted an effort to increase the availability of native early successional habitat not only for the cottontail but for other species dependent upon early-successional habitat. In 2008, the Reserve received a Wildlife Habitat Improvement Program grant from the Natural Resources Conservation Service, which included funding for management activities through 2021.

The Reserve is participating in a rabbit translocation project in coordination with the Maine Department of Inland Fisheries and Wildlife. Twenty rabbits that were captive-bred elsewhere in New England were radio-collared and released at the Reserve in 2017 and 2018. Rabbits are monitored via radio tracking and mortalities are investigated.

Open Field Management

The Reserve adopted an open-field management plan in 2002 with the goals of halting natural succession and maintaining open fields. This plan is folded into the Integrated Natural Resources Management Plan.

The Reserve uses mowing and prescribed burning to protect and improve habitat for grassland nesting birds, including bobolinks and meadowlarks. This habitat type is in decline throughout the northeastern United States. The fields are also important for the monarch butterfly, whose life-cycle depends on milkweed, which is abundant in the Reserve's fields. The open fields afford visitors views of the ocean and southern Maine landscape and are part of the site's agricultural heritage.

Forest Management

Using the Integrated Natural Resources Management Plan as a guide, each forest patch has been surveyed and specific management objectives and recommendations identified. As part of this plan, the Reserve reestablished the Yankee Woodlot Demonstration Forest, which was partially harvested in 2012 as part of a demonstration project to educate area woodlot owners on the processes necessary to manage a forest for specific purposes — from planning to harvesting to long-term management. The Reserve continues to monitor the effects of the harvest and will plan future harvests to improve wildlife habitat.

Using New Technologies

The emergence of unmanned aircraft systems, commonly known as drones, provides an opportunity to gather aerial imagery with greater detail than is available using other methods. Wells has worked with other reserves to produce proof-of-concept projects in habitat mapping, marine debris monitoring, beach erosion mapping, retrieval of ghost traps (untethered lobster and crab traps), and video/photographic support for public outreach.

The Reserve also deploys sound-recording devices in various habitats as a long-term monitoring tool. Audio recordings provide the ability to answer questions about the relationships between humans and biotic and abiotic environments.

Community-Based Stewardship

The Reserve works with conservation partners in southern Maine and throughout the Gulf of Maine to accomplish its coastal stewardship mission. For the most part, these activities occur beyond the Reserve boundary. Community-based stewardship involves

efforts in watershed protection, land conservation, and habitat restoration.

Targeted Watersheds

The Wells Reserve encompasses one of the largest interconnected back-barrier saltmarsh systems in the state. The rivers that drain into this system, and their surrounding uplands, are largely in good condition and lightly developed. But southern Maine's landscape is threatened by development and protecting the Reserve's targeted watersheds is crucial for ecosystem viability.

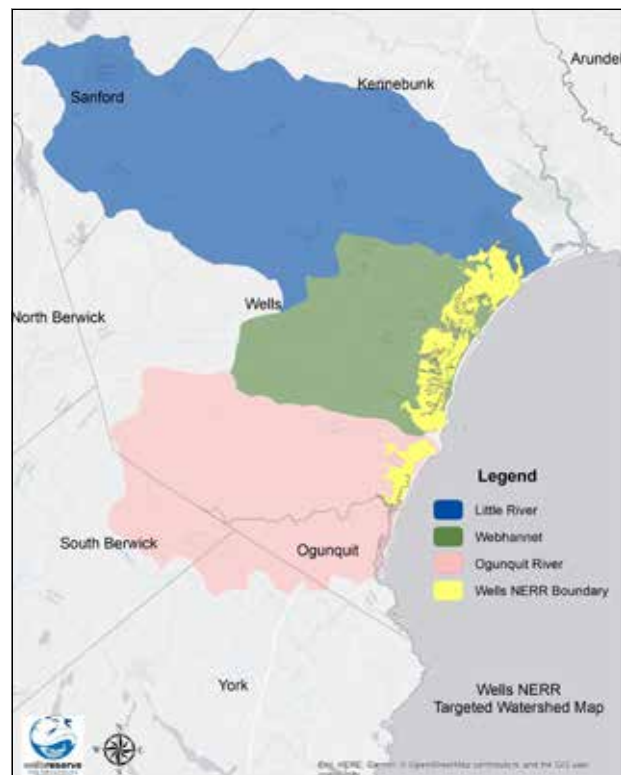
Little River Watershed

Two main tributaries, Branch Brook and Merriland River, form the Little River watershed. The Branch Brook headwaters are at the Kennebunk Plains and Wells Barrens, rare sandplain grasslands that have been the focus of land acquisition by conservation organizations and the local water district for over 25 years. This watershed is also the drinking water supply for three towns. Over the next 5 years the Reserve, in tandem with its conservation partners, will work with the water district on prioritizing, and potentially permanently protecting, high priority conservation lands in the Branch Brook watershed.

The Reserve, the Town of Wells Conservation Commission, and Great Works Regional Land Trust have been working for over two decades to protect land along the Merriland River and its headwaters. The headwaters include the Fenderson Wildlife Commons, a 500-acre protected area with unfragmented forests and wetlands that support diverse community types (sphagnum bogs, vernal pools, four-season flowing springs, red maple swamps). The watershed includes part of the Great Haith, 410-acre conservation area that is one of North America's southernmost raised bogs. This natural area and its surrounding wooded wetlands have been the focus of land acquisition efforts by the Town of Wells for 25 years.

Webhannet River Watershed

The headwaters of this river flow from a series of extensive wetlands west of Interstate 95 (including part of the Great Haith). At this time, much of this land is in a natural condition but very little is permanently protected. The proximity to both U.S. Route 1 and the ocean makes these lands increasingly vulnerable to development. The Wells Conservation Commission



and the Reserve have identified lands along the main stem and adjacent to the Great Haith as priorities for protection.

Ogunquit River Watershed

The headwaters of this river originate in the Tatic Hills, which have long been a priority for conservation organizations. The Tatic Hills is approximately 10,000 acres encompassing portions of Wells, Ogunquit, South Berwick, and York. Its geological history accounts for unique bedrock, shallow soils, numerous pocket wetlands, and vernal pools. The density of vernal pools is among the highest in New England. The significance of the area for its exceptionally high level of biodiversity has been officially recognized by the State of Maine Natural Areas Program, The Nature Conservancy, and other organizations.

Watershed Protection

The Reserve works with land trusts, municipalities, government agencies, watershed groups, and other organizations to protect, manage, and restore coastal watersheds, and to encourage public stewardship of watershed resources. Activities include coordinating watershed surveys and developing management plans; developing and implementing comprehensive watershed conservation strategies; creating and

distributing GIS data and maps on watershed resources; organizing workshops, conferences, and meetings; and participating in watershed events and initiatives throughout the Gulf of Maine. In this program area, the Stewardship Program is well integrated with the Coastal Training Program, providing training, programs, services, and information to decision-makers in southern Maine.

Land Conservation and GIS Center

The Wells Reserve's integrated programs of research, education, and stewardship provide valuable assistance to organizations involved in coastal land protection. For over two decades the Reserve, as part of its stewardship mission, has worked closely with government agencies, municipalities, and land trusts to identify and conserve important coastal lands in southern Maine.

The Stewardship Program provides geographic information system (GIS), global positioning system (GPS), and other spatial products and services to organizations in southern Maine, and in some instances to organizations in other Gulf of Maine states. The program also provides technical assistance in areas such as policy, natural resource information, and conservation plan development. With this information, organizations and individuals make better decisions about the conservation of the coastal landscape, prioritizing which lands to conserve.

The Stewardship Program helped create, and is an ongoing partner in, the Mt. Agamenticus to the Sea Conservation Initiative, a 10-member coalition of nonprofit organizations and governmental agencies working together on landscape-scale conservation. The coalition focuses on approximately 48,000 acres that encompass varied habitats in Maine's six southernmost coastal zone communities. Over the next 5 years, the Reserve will continue to be an active partner with the goal of protecting more lands within this coastal landscape.

The Reserve extends assistance to other watersheds in southern Maine's coastal zone communities: Spruce Creek and Salmon Falls River (Kittery and Eliot); Josias River (Ogunquit); Mousam River (Kennebunk), and Kennebunk River (Kennebunk and Kennebunkport).

Habitat and Species Restoration

The Reserve works with partner organizations to plan, implement, and monitor habitat restoration and resiliency projects in southern Maine. Reserve staff apply adaptive management strategies to support restoration efforts by resource managers, such as land trusts and municipalities, by providing scientific expertise, field data collection and analysis, grant writing and administration, and project management and coordination.

Methods developed by the research program enhance restoration outcomes. Examples include using environmental DNA tools to detect anadromous fish populations in coastal streams and tidal-marsh monitoring and assessment protocols developed for the NERR Sentinel Sites Application Module (SSAM).

The Reserve participates in regional collaborative restoration networks in Maine and New England, including the Maine Stream Connectivity Work Group and the Maine Tidal Restoration Planning Committee (provisionally known as the Coast Wise Initiative). These networks provide expert support for restoration practitioners; develop initiatives to advance the quality and pace of restoration through education, training, and funding opportunities; and facilitate collaboration between resource managers and conservation partners.

Aquatic Organism Passage

In 2013, the Reserve partnered with the Wells, Kennebunk, and Kennebunkport Water District (KKWWD) to repair and upgrade a fish ladder at the filtration-plant dam on Branch Brook. Funding was raised primarily by Wells Reserve through grants from The Nature Conservancy, U.S. Fish and Wildlife Service, and Maine Coastal Program. The Reserve and water district signed a cooperative agreement to operate, maintain, and monitor the performance of the new fishway. Post-restoration monitoring identified target native fish species using the restored fish ladder in the 3 years following restoration. Monitoring of the river will continue.

The Reserve partnered with the water district again in 2014 to remove a stream barrier on Branch Brook at a snowmobile trail crossing, where collapsing stone abutments created a small dam and impoundment. The project was used as a training for regional restoration

practitioners in techniques for manual stream barrier removal projects in remote locations with no vehicle access. Twenty participants from 11 organizations participated in the 2-day project. A manual-removal equipment kit is held at Reserve for use by regional partners. Removal of the stream barrier restored habitat connectivity to more than 7 miles of stream habitat occupied by native brook trout and sea lamprey.

In 2015, the Reserve led efforts to remove a small dam at the head of tide on Goff Mill Brook, a tributary to the Kennebunk River in Arundel. Reserve staff worked with the landowner to develop the project and collaborated with several organizations to raise funding, primarily through the Trout Unlimited Embrace-a-Stream program. Removal of the dam restored tidal exchange in the brook and allowed unobstructed fish movement between freshwater and estuarine stream habitats. Post-restoration monitoring identified estuarine and diadromous species, including several species of concern, using the restored stream habitat.

Tidal Marsh Restoration

The Reserve supports citizen groups in identifying projects that will restore saltmarsh habitats, providing

scientific information to facilitate them, assisting in their implementation, and employing standard monitoring and evaluation protocols for measuring success. As the restoration science database grows, the Reserve collaborates with stakeholders throughout the Gulf of Maine to manage restored sites, document success, and advance the practice of saltmarsh restoration.

The Reserve partners with The Nature Conservancy in coordinating restoration efforts in southern Maine's coastal stream and wetland habitats. The Reserve assesses regional restoration opportunities and communicates with resource managers and municipalities in support of priority projects. This partnership led to collaborative project planning and fundraising for restoration at tidal stream crossings in the Spurwink Marsh in Cape Elizabeth and Scarborough and the York River in York. These communities now act proactively to address infrastructure vulnerability to coastal flooding and to restore tidal marsh habitat based on scientific analysis and planning tools.



Public Access

Introduction

The Wells Reserve offers public access to its grounds and facilities for environmental education, scientific research, nature appreciation, and appropriate outdoor recreation. It also provides a gathering place for its partners and for select private activities. The Reserve Management Authority has established “Rules for Public Use” (see Appendix D).

Objective and Strategies

Objective

Access for scientific research, environmental education, appropriate outdoor recreation, nature appreciation, and public events is provided while ensuring the protection of the Reserve’s natural resources, historic buildings, and grounds.

Strategies

- Provide safe, clean, and attractive facilities for public use.
- Maintain a system of trails to safely accommodate low-impact recreation and provide access for scientific and educational programs.
- Maintain Visitor Center and Information Kiosk to properly welcome and orient visitors to the Reserve and its mission.
- Expand access for people with disabilities by making more trails accessible and by ensuring that Reserve facilities accommodate people with disabilities.
- Monitor public use of the site and continually assess visitor impact on wildlife and habitats.
- Conduct periodic studies to determine the number of people who visit the Reserve annually.

- Make trail and facility improvements to ensure that all visitors have an enjoyable and safe stay.
- Establish new trails to enhance the visitor experience and provide new learning opportunities.
- Update rules as needed to ensure they meet the needs of the site’s natural resources and visitors.
- Expand the visibility of the Reserve and its educational and recreational offerings through better signage.
- Promote and encourage the appropriate use of the Wells Reserve and its facilities, including the library, auditorium, exhibit area, and the teaching lab.

Audiences, Hours of Operation, and Fees

More than 30,000 people visit the Wells Reserve each year. They come to walk trails, to watch wildlife, to enjoy scenery, to do research, to ski and snowshoe, and to participate in guided activities, programs, and events.

Residents of nearby communities visit the Reserve regularly. Many other people visit from throughout the northeastern United States and eastern Canada. Some visitors come from other regions of North America and overseas. The Reserve is one of the most popular natural attractions in York County.

The Reserve is open every day from 7am to sunset, totaling about 4,000 hours annually. The Visitor Center and exhibits are open about 1,700 hours per year. To date, the Reserve is within its visitor carrying capacity. The Stewardship Advisory Committee, through site inspections, has determined that the Reserve could accommodate more visitors without negatively impacting natural resources or detracting from the site’s quietness. The following schedule is in effect:

Trail Hours

- Every day, 7 am to sunset

Visitor Center Hours

- April 1 to Memorial Day weekend: Mon–Fri 10-4
- Memorial Day weekend through Indigenous Peoples Day: Every day 10-4
- Indigenous Peoples Day to December: Mon–Fri 10-4
- December to Early April: Closed

Fees

Admission fees are in effect Memorial Day weekend through Indigenous Peoples Day. Fees are reviewed and established by the Reserve Management Authority at the start of each calendar year. Members of Laudholm Trust enjoy free admission (except for special events) and program discounts.

Points of Access to the Reserve

Wells Reserve is readily accessible via major roadways. It is minutes from the Maine Turnpike (Interstate 95), U.S. Route 1, and State Route 9. Maine Department of Transportation location signs are posted on the north and southbound sides of the Maine Turnpike, U.S. Route 1 at Laudholm Farm Road and State Route 9 at Skinner Mill Road. By car, the Reserve is about 90 minutes from Boston and 30 minutes from Portland, Maine. The Reserve is less than 10 minutes from the Wells Transportation Station (Amtrak).

The Wells Reserve has two vehicle access points: a main access road and parking area off Skinner Mill



Road and a service entrance at the end of Laudholm Farm Road. The main access road ends in a paved 75-car parking lot within view of the campus. This is the most appropriate and most commonly used public entry point to the Reserve. The oval lot includes bus parking and three spaces marked for visitors with disabilities. An attractive and informative kiosk stands along the single path leading from the lot to the campus, and the first floor of the restored farmhouse serves as the Visitor Center.

The service entrance extends to a loop road in the center of the campus and to the North Estate. The campus loop includes a 4-car parking area, which is used by visitors with disabilities and for special purposes.

The Alheim Commons property, at 100 Laudholm Farm Road, has a gravel parking area with space for about 20 cars, though most of them are meant to accommodate people staying in the dormitory. The Yankee Woodlot Trail connects the Alheim campus to the rest of the Reserve property.

The Webhannet Marsh Trail is located off Harbor Road, 2 miles from the Laudholm campus. The ½-mile trail, accessible to people with disabilities, includes a saltmarsh overlook and interpretive signs. There is ample parking at the trailhead, including dedicated spaces for visitors with disabilities.

Permitted Activities—Lands

The Wells Reserve strives to allow appropriate public access consistent with natural resource protection. Low-intensity recreational uses are allowed to the extent they do not conflict with the operation of the Reserve for research and education. The Reserve offers ample opportunities for the public to enjoy the site's cultural heritage and diverse habitats while restricting access to sensitive areas.

Public recreation and Reserve programs are concentrated within a 500-acre area surrounding the Laudholm campus. The 7-mile foot-trail system can be accessed from the Laudholm Farm campus and from the Alheim Commons property. People who wish to leave trails must obtain permission from the Executive Director. Visiting researchers, educators, and resource managers who are permitted to leave trails are encouraged to minimize their impact in restricted areas.

The Reserve does not have a public boat-access facility. However, there is one State-sponsored boat launch

facility within the Reserve boundary on the Webhannet River at Wells Harbor. It is owned and operated by the Town of Wells and is open to the public. Visitors to the main campus to the Reserve are allowed to bring car-top, hand-carried crafts (such as kayaks and canoes) and transport them by foot along the Barrier Beach Trail to Laudholm Beach. It is about a ½-mile walk from the parking area to the beach access point.

Permitted Activities—Facilities

The Reserve’s historic facilities are desirable for a range of activities. The Reserve permits outside groups to schedule events and activities, providing they do not conflict with the programs of the Reserve and do not negatively impact natural or cultural resources. The Wells Reserve allows partner organizations — those who share the Reserve’s coastal stewardship mission — to use the facilities. Laudholm Trust uses facility rentals to raise funds to benefit the Reserve.

Wildlife Sanctuary Designation

Portions of Reserve are designated as a wildlife sanctuary (the “Wells Sanctuary”) by the Maine Department of Inland Fisheries and Wildlife (DIF&W). The Wells Sanctuary includes Reserve lands owned by the Town of Wells and the Bureau of Public Lands, as well as sections of Rachel Carson National Wildlife Refuge. The sanctuary designation makes illegal the activities of trapping, recreational hunting, and the taking of wildlife by other means. However, since 2002 the DIF&W and the Reserve have had a special archery hunt with the goal of reducing the deer population on the Reserve and adjacent lands. This “deer reduction program” is not open to the public.

On Reserve lands that are part of the Rachel Carson NWR, federal National Wildlife Refuge regulations apply. Thus, hunting is allowed on parts of the Rachel Carson NWR within the Wells Reserve that are outside the designated Wildlife Sanctuary.

Rules and Regulations

The Reserve Management Authority has adopted rules that govern access to and activities on the Reserve property (Appendix D). Public safety and environmental laws are enforced by State, Federal, or local agencies, as described in the Administrative Plan.

These key rules are shared on signs at public access points, the trail map, and the website:

- Walk only on trails.
- Carry out what you carry in.
- Do not collect plants, animals, shells, or other natural objects.
- We do not allow dogs and other pets, smoking, bicycles on trails, camping, drones and other remote-controlled aircraft, fires, or feeding wildlife.
- Dogs must be leashed and are allowed only on the Yankee Woodlot and Webhannet Marsh trails.
- Trapping and hunting are not allowed except by special permission.

Public Access Challenges

As with any protected area with many visitors, the Reserve must monitor public use and visitation to ensure rules are followed, visitors are safe, and trails and access roads and paths are well maintained.

Ongoing challenges over the next 5 years include:

- Keeping abreast of changes in society and new uses of the outdoors. Adapting rules to meet those changes, to safeguard habitats and the visitor experience. Recent rule changes prohibit the use of unmanned aerial aircraft (drones) and e-cigarettes.
- Paving pathways and roadways that are over 30 years old and have crumbled in some places. The ability to patch and repave these areas as needed is vital to ensure continued easy and safe access.
- Improving access for people with disabilities, both to trails and to facilities.
- Examining and monitoring facilities to ensure they meet standards for safety and all building codes.
- Replacing the Laudholm campus lighting system, both along the access path and in the parking lot, with a more effective, energy-efficient system.
- Addressing the ongoing problem of dogs, both leashed and unleashed, on Laudholm Beach. This activity is particularly worrisome during shorebird nesting season. Scheduling routine enforcement is difficult due to the beach’s distance from the Laudholm campus.
- Recruiting volunteer Rangers, who patrol trails during the peak visitation season, who are vital to the safety of our visitors and their adherence to rules, and Visitor Center and Welcome Hut attendants, who are on the “front lines” of greeting, informing, and collecting fees from visitors.
- Being vigilant in enforcing rules when outside parties rent facilities on the Laudholm campus. Over the past decade, Laudholm Trust has increased rentals to raise revenue for Reserve operations. With high numbers of people (100 to 200+) present on weekends, the Trust hires caretakers to monitor activities.



"Moose 5," an NCCC*AmeriCorps team that assisted the Reserve for several weeks in 2017, takes a break from a beach cleanup. Coordinated state, federal, and international volunteer programs help staff and local volunteers accomplish intensive projects.

Volunteers

Introduction

The Wells Reserve volunteer program engages a diverse corps of more than 400 people who contribute more than 16,000 hours annually to advance the Reserve's mission. Volunteers' dedication is the reason the Reserve exists and thrives. Every part of the Reserve is supported by volunteers, ranging from docent-led programs such as Exploring Estuaries to window restoration for the historic buildings. In return, volunteers benefit from their involvement. They connect socially, learn new skills and concepts, utilize their existing skills and talents, and gain life-enhancing experiences. Volunteer programs are directed in close collaboration with Laudholm Trust.

Objective and Strategies

Objective

A dedicated and productive volunteer corps is recruited, supported, and retained, thus augmenting all aspects of our programs.

Strategies

- Recruit and retain a volunteer corps to help accomplish program goals and objectives.
- Foster a culture of inclusiveness and empowerment by understanding and meeting the needs of volunteers. Value the career and life experiences of each volunteer.
- Facilitate opportunities for volunteers to gain knowledge of coastal ecology and other subject areas needed to augment programs and operations.

- Ensure that volunteers are well trained for the tasks they take on and feel valued and appreciated.
- Provide ongoing feedback to volunteers, fostering supportive growth in their positions.
- Receive feedback from volunteers using both formal and informal methods.
- Gain knowledge from volunteer programs in the region and across the NERR System to place the Wells volunteer program in context and learn from others' experiences.

Volunteer Positions

Volunteers fill many roles and accomplish many tasks. They greet visitors, answer phones, teach school groups, lead nature walks, develop educational materials, tend the grounds, improve and patrol trails, run the library, scrape and paint, perform administrative tasks, assist with research projects and enter research data, distribute program information, assist ad hoc committees, monitor environmental conditions, and work with partner organizations on behalf of the Reserve. Volunteers represent a good cross-section of the year-round and seasonal residents of the Reserve's surrounding communities

Many volunteers serve on the Reserve's advisory committees that meet regularly to guide Reserve staff on research, education, training, and stewardship programs and issues. The Laudholm Nature Crafts Festival is coordinated and run by about 200 volunteers. The other large Reserve and Laudholm Trust event, Punkinfiddle: A National Estuaries Day Celebration, is largely planned and staffed by 100 volunteers. Volunteers play key roles with Winter Wildlife Day, Earth Day, and other educational events and community celebrations. In addition, volunteers



are involved in projects through collaborations between the Reserve and the Town of Wells, Rachel Carson National Wildlife Refuge, Maine Sea Grant, Maine Department of Environmental Protection, local schools, businesses, York County Audubon, local land trusts, and other partners.

Volunteer Recruitment

The Reserve recruits new volunteers in both formal and informal ways. One of the most effective methods of recruiting new volunteers is positive word of mouth from staff, volunteers, and community members. Volunteers often recruit other volunteers. Formal recruitment efforts include the Reserve's annual volunteer recruitment fair, community volunteer fairs, outreach to schools and community groups, United Way events and website, newspaper and magazine articles, the Reserve's website, a volunteer e-mail newsletter, and listings. A brochure detailing volunteer opportunities is available at programs, events, and in the Visitor Center. Individuals who contact the Reserve's volunteer office are interviewed, given a tour, and leave their interview with a plan to get started.

Students frequently approach the Reserve as an avenue for meeting their academic community service requirements. A number of younger volunteers come through work experience programs such as Career Journeys, or volunteer as part of school or faith groups, and summer camps.

Additional sources of volunteers include corporate groups and service organizations. Annually, the Reserve applies for AmeriCorps NCCC (National Civilian

Community Corps) teams who come for four to eight weeks each year. The Reserve also recruits six to eight international Volunteers for Peace for three weeks each summer. These teams of young and energetic individuals provide concentrated volunteer effort that allow the Reserve and Laudholm Trust to accomplish major stewardship, maintenance, and fundraising projects.

Volunteer Training

Volunteering provides opportunities to use and update existing skills and to learn new ones. Staff and experienced volunteers train new volunteers. Volunteers often team up with others until they are comfortable on their own. New trail rangers patrol the trails in pairs; new volunteer naturalists (docents) shadow experienced volunteers through educational tours. Volunteers are not trained just "once," but update their training, often in the spring, ahead of the busy tourist season. Volunteers who interact with the public receive training in customer service, point-of-sale systems, safety procedures, Reserve rules, and the essential tasks related to their volunteer position.

In many cases, Reserve programs — public lectures, talks, hikes — are used for volunteer training. Training on new education initiatives that relate to Visitor Center operations are provided for volunteers as needed. For example, the Visitor Center volunteers received separate trainings on exhibits and the Discovery Backpack Program, ensuring that they are familiar with each of these popular educational resources.

The most intensive volunteer training is for docents. Their education includes at least 25 hours of classroom and field training, with additional opportunities for enrichment. Docent training sessions take place in the spring, summer, and fall. Education staff and guest speakers (including research staff) provide docents with the knowledge and practice needed to lead watershed-based environmental education programs.

The Research Program provides thorough training tailored to specific research projects. Water quality, beach profiling, and invasive species monitoring training is extensive enough to give participants the confidence to perform their tasks independently or with a team of fellow volunteers.

Evaluating Volunteers and the Volunteer Program

Volunteers are not formally evaluated, but instead receive feedback through training and on-the-job experience. Feedback for volunteers and from volunteers often happens in groups, providing opportunities for collaborative problem-solving between volunteers and staff. Volunteers often have a knack for knowing whether a job is a good fit. If a particular job is not a good match for the skills and interests of a volunteer, efforts are made to find a task that is.

Docents are provided with more formal feedback than other volunteers. Education staff regularly observe volunteer docent naturalists and share feedback from teacher surveys. In addition, efforts

are underway to implement a more formal evaluation protocol for this group.

Rewarding Volunteer Involvement

All volunteers have complimentary access to the Reserve year round. Volunteers are celebrated and honored by the Reserve and Trust staff through a volunteer recognition event in August, a festive holiday party in December, and other events throughout the year, such as field trips, potlucks, kayak outings, and tours of the research lab. At the volunteer recognition event, awards recognizing exceptional service are given to highly dedicated volunteers. The most important rewards for volunteers are the constant "thank you," notes, and appreciation they receive from Reserve and Trust staff.



Administration

Introduction

The Wells National Estuarine Research Reserve administrative plan outlines the organizational relationships and human resources needed to fulfill the Reserve's mission. The Wells Reserve management framework enables coordination and cooperation among land-holding entities of the Reserve and organizations involved with programs and activities. It provides for consultative decision-making, compliance with applicable regulations, and integration of major program areas.

Program areas administered by the Wells Reserve include research and monitoring, education and training, conservation and stewardship, facilities and administration, and visitor and volunteer services.

Objective and Strategies

Objective

The administrative structure is in place so that Reserve's mission is fulfilled and it conforms to federal and state law and agency agreements.

Strategies

- Maintain an administrative structure that provides an effective and efficient process to formulate and implement policies and programs.
- Provide adequate staffing and funding to accomplish the full range of responsibilities of a NERR.
- Provide an administrative structure that encourages the integration of education, research and stewardship programs.

- Design and support workplace policies and programs that result in committed people fulfilling their professional potential as they accomplish their work with pride and enjoyment.
- Build relationships and strengthen collaborations with existing partners, and establish partnerships with additional organizations to further the goals of the Reserve.
- Strengthen and maintain communication and collaboration between the boards of the RMA and Laudholm Trust.
- Review and evaluate all programs and the strategic plan annually, making adjustments as needed.
- Maintain and strengthen the partnership with volunteers and advisory committees to fulfill the Reserve's mission and conduct its programs.
- Ensure long-term financial stability for carrying out Reserve research, education, and stewardship programs.
- Support efficient, long-term management of estuarine and coastal ecosystems through cooperative relationships with the Maine Department of Agriculture, Conservation and Forestry; the U.S. Fish and Wildlife Service; the Town of Wells; the Maine State Planning Office; Laudholm Trust; and other partners.
- Implement administrative and financial procedures and programs to ensure efficient management of Reserve personnel and funds.

Administrative Structure: Reserve Management Authority

The Wells Reserve is a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the State of Maine. Administrative oversight is vested in the Reserve Management

Authority (RMA), an independent state agency established in 1990 by the Maine Legislature to support and promote the interests of the Wells Reserve (see Appendix A). As specified in “An Act to Establish the Wells National Estuarine Research Reserve Management Authority” (LD 2031):

The authority shall manage and sustain the coastal lands and other resources within the reserve, further coordination and cooperation among state agencies, the Town of Wells, the United States Fish and Wildlife Service, and the Laudholm Trust, develop and implement programs for estuarine research and education, and provide public access and opportunities for public enjoyment compatible with the protection of the reserve’s natural resources.

As an independent entity, not part of any state natural resource agency or university, the Reserve is responsible for the development and implementation of its own policies in all areas of administration and management. Accepting this responsibility enables the organization to be administratively flexible and adaptable, thus allowing for improved program delivery.

Representation on the Reserve Management Authority Board of Directors

The RMA is composed of representatives having a property, management, program, or financial interest in the Wells Reserve. RMA members represent the Bureau of Parks and Lands/Maine Department of Agriculture, Conservation and Forestry; Rachel Carson National Wildlife Refuge/U.S. Fish and Wildlife Service;

the Town of Wells; Laudholm Trust; the Maine Coastal Program/Maine Department of Marine Resources; and the Office for Coastal Management/NOAA. A Governor-appointed scientist with an established reputation in the field of marine or estuarine research also serves on the RMA board of directors.

Maine Department of Agriculture, Conservation and Forestry

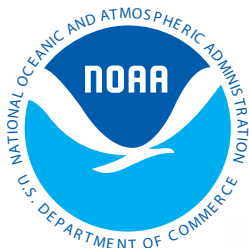
The Maine Department of Agriculture, Conservation and Forestry (formerly the Department of Conservation) holds title to 469 acres within the Wells Reserve. Of these, 147 acres are beach, salt marsh, and upland just south of the Little River and about 322 acres are submerged tidal lands (lands below the mean low-water mark, including beaches and other shoreline areas and tidal rivers upstream to the farthest natural reaches of the tides). The Commissioner, or the Commissioner’s designee, serves on the RMA board.

U.S. Department of the Interior, Fish and Wildlife Service

The U.S. Fish and Wildlife Service owns and manages the Rachel Carson National Wildlife Refuge, 1,425 acres of which are within the Wells Reserve. The Region 5 Director of U.S. Fish and Wildlife Service, or the Regional Director’s designee, serves on the RMA board.

Town of Wells

The Town of Wells owns 258 acres of uplands and wetlands in the Wells Reserve, including the historic Laudholm Farm campus. The Wells Board of Selectmen designates a representative, traditionally a Selectman, to serve on the RMA.



Laudholm Trust

Laudholm Trust, a 501(c)(3) nonprofit organization, provides most of the local non-federal match for Wells Reserve operations and capital needs. The Trust uses member contributions, corporate donations, foundation grants, and rental income generated from the Reserve site to support the Reserve. The Laudholm Trust Board of Trustees designates a representative, traditionally the Trust President, to serve on the board.

Maine Coastal Program

The Director of the Maine Coastal Program, within the Maine Department of Marine Resources, serves on the RMA as an ex-officio, non-voting member.

U.S. Department of Commerce, NOAA

The NOAA National Ocean Service / Office for Coastal Management (OCM) administers the National Estuarine Research Reserve System. The Director of the OCM, or the Director's designee, serves on the RMA board as an ex-officio, non-voting member.

Interagency Memoranda of Understanding

The RMA and its partners have entered several MOUs to guide site administration. A complete copy of each MOU is in Appendix A. They include:

- RMA and NOAA: This MOU describes the purposes of the Wells Reserve and the state and federal agency roles in its management.
- RMA and U.S. Fish and Wildlife Service: This MOU describes rights, responsibilities, and obligations of each entity within the Wells Reserve.
- RMA and Maine Department of Agriculture, Conservation and Forestry: This MOU describes rights and responsibilities regarding submerged lands within the Wells Reserve.
- RMA and Maine Department of Agriculture, Conservation and Forestry: This MOU describes rights and responsibilities regarding 147 acres of state-owned uplands within the Wells Reserve.
- RMA and Town of Wells: This MOU establishes a framework for coordination and collaboration between the Wells Reserve and the Town.
- Wells Reserve and Laudholm Trust: This MOU explains and outlines the roles and responsibilities of each organization's chief executive (Executive Director and President) and the details of their collaboration and partnership.

Other Partner Roles and Responsibilities

In addition to the organizations that are represented on the RMA, Wells Reserve collaborates with a wide range of local, state, and federal partners on the development and implementation of research, education, and stewardship programs. Here is an overview of some key partners and a brief description of their collaborations with the Wells Reserve:

- The Maine Department of Inland Fisheries and Wildlife preserves, protects, and enhances inland fish and wildlife resources. A representative from this agency serves on the Stewardship Advisory Committee.
- The Maine Department of Marine Resources conserves and develops marine and estuarine resources.
- The Maine Department of Environmental Protection protects and restores natural resources and enforces the state's environmental laws. A representative from this agency serves on the Stewardship Advisory Committee.
- The Natural Resources Conservation Service (U.S. Department of Agriculture) helps people conserve, maintain, and improve the nation's natural resources and environment.
- The University of Maine System: The State university system includes two public universities that have active coastal and estuarine research and education programs — the University of Southern Maine (USM) and the University of Maine (UMaine). Faculty and staff at USM and UMaine collaborate with Wells Reserve researchers, educators, and natural resource managers.
- The University of New England (UNE) is an independent university with numerous degree programs, including emphases on environmental studies and marine science. Faculty at UNE collaborate with Wells Reserve researchers and educators.
- York County Community College (YCCC) is a community college located in Wells. The Wells Reserve and YCCC have had a MOU since 2016. The two organizations collaborate on classes for students in marine and environmental topics. The classes are held at the Reserve and are taught by Reserve staff.
- St. Joseph's College, a small liberal arts college located in Windham, Maine, and the Wells Reserve have had an MOU since 2016. The two organizations collaborate on research and education projects.

- The Casco Bay Estuary Partnership (CBEP) is an EPA-designated National Estuary Program that works to protect the health and integrity of Casco Bay. CBEP collaborates with the Wells Reserve on research, education, and outreach projects.
- The Piscataqua Region Estuary Partnership (PREP) is a designated National Estuary Partnership that seeks to protect the health of the estuaries of New Hampshire and southernmost Maine. The Reserve collaborates with PREP on projects of shared interest. A staff person of the Reserve serves on PREP's Management Committee.
- The Southern Maine Planning and Development Commission (SMPDC) is a council of governments that coordinates efforts for economic development and resource management. A representative from this agency serves on the Coastal Training Program Advisory Committee. The Reserve and SMPDC routinely collaborate on projects.
- York County Audubon fosters understanding, appreciation, and conservation of the natural world. The society collaborates broadly with the Wells Reserve, including research, monitoring, and education projects.
- Numerous land trusts and conservation commissions collaborate with the Reserve on land conservation, education, and stewardship projects in watersheds of coastal zone communities in southern Maine.
- University of Maine Cooperative Extension (Master Gardener Program) and the Reserve have a cooperative agreement. The organizations collaborate on public education and outreach programs of mutual interest. The extension maintains native plant and vegetable gardens at the Reserve that demonstrate best practices.

NOAA's Roles and Responsibilities

The Office for Coastal Management establishes standards for designating and operating reserves. It also provides support for reserve operations and capital projects (land and buildings). OCM undertakes projects that benefit the reserve system and integrates information from individual reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. sec. 921.40, the OCM periodically evaluates NERR operations for compliance with federal requirements and with the individual Reserve's federally-approved management plan.

The NERR System is a federal/state partnership. Management of each Reserve is the state partner's responsibility, but NOAA cooperates and assists the

states and reviews the progress of programs through written semi-annual reports submitted by the Reserve. Pursuant to Section 312 of the Coastal Zone Management Act, NOAA conducts thorough, site-based performance evaluations every 5 years, ensuring the Reserve is complying with NERR System goals and its approved management plan. If deficiencies are found in the operation of a reserve, NOAA will work with the Reserve to correct them.

OCM staff, in particular the Program Specialist, communicate regularly with the Reserve staff. This communication strengthens the partnership between the Reserve and OCM; it familiarizes OCM with Reserve program accomplishments and challenges, and solidifies the concept that the individual Reserve is part of a national system.

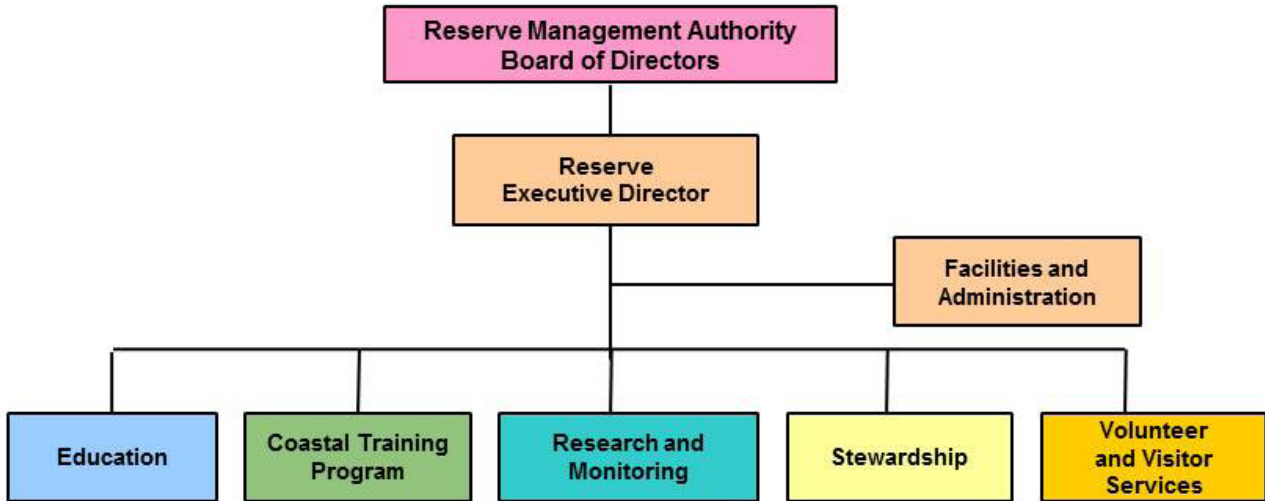
Maine Coastal Program and Maine Sea Grant Program

The Wells Reserve has close ties to two other NOAA programs: the Maine Coastal Program and the Maine Sea Grant Program at the University of Maine.

The Maine Coastal Program was instrumental in establishing and designating the Wells Reserve in the mid-1980s, both by requesting the grants from NOAA for acquisition and by providing invaluable assistance in the designation documents. The close partnership continues. Collaborations include research addressing coastal management, outreach to decision-makers with training and information, statewide interpretive education projects addressing coastal issues, land acquisition and protection planning, and the restoration of coastal habitats. The Coastal Program Director serves on the Reserve Management Authority board and on the Reserve's Coastal Training Program (CTP) Advisory Committee.

The Maine Sea Grant Program has a statewide leadership role in marine research, education, and extension activities that focus on coastal and marine issues. The program promotes the use of marine science research and education in the development, management, and stewardship of marine and coastal resources. Wells Reserve and Maine Sea Grant collaborate often on projects of mutual interest and the Reserve's Executive Director serves as a permanent member of the Maine Sea Grant Policy Advisory Committee. To further strengthen the partnership, and

Wells National Estuarine Research Reserve: Organizational Chart



to enable Maine Sea Grant to work more effectively in southern Maine, the Reserve provides an office for a Sea Grant Extension Associate at the Wells Reserve. The Associate collaborates with Wells Reserve staff on research and outreach projects and serves on the CTP and Education Advisory committees.

Laudholm Trust Partnership

Laudholm Trust is one of the founding organizations of the Wells Reserve and continues to be the primary partner in raising the funds needed to meet the non-federal match for NOAA operations and capital grants. This makes the Wells Reserve a public *and private* partnership, which is unique in the National Estuarine Research Reserve System. In addition to grants for operations, the Trust provides key financial support for the construction and land acquisition projects that advance the goals of the Reserve. Members of the Trust's Board of Trustees also serve on the Reserve's advisory committees, providing expertise and input on a range of issues.

To ensure communication and collaboration, one to two Executive Committee members of the Trust routinely attend the quarterly RMA meetings.

The Trust's ability to raise funds and build membership in support of the Reserve's core programs, in addition to helping address priority capital and land acquisition needs, will be essential to the Reserve's ability to accomplish the goals outlined in this Management Plan.

Reserve Staff Responsibilities

At the Wells Reserve, full-time and part-time staff are responsible for most mission-related planning and implementation. Year-round, the staff averages 15 people, but that number often doubles between spring and fall when interns, temporary staff, and seasonal staff are hired. In addition, the Reserve has many project-based contractors throughout the year. The following summaries represent actual staff responsibilities at the time this management plan was prepared.

The Executive Director serves as the chief executive of the organization and is responsible for the overall management of the Reserve, including the development of all policies, personnel, buildings and grounds, budgets and finances, contractors, and protected area. The Executive Director reports to the RMA board of directors.

The Facilities Manager is responsible for coordinating all aspects of maintenance for Reserve buildings, vehicles, and grounds, including light construction work.

The Accountant is responsible for financial management, payroll, benefits and human resource administration, and office management.

The Research Director coordinates and directs the Wells Reserve research and monitoring programs. This position is responsible for the administration, management, and development of all facets of research and monitoring, including supervisory responsibilities.

The Monitoring Coordinator/Research Associate is responsible for implementing the System Wide

Monitoring Program. This person also helps to implement the research program and manage the research laboratory.

The Project Manager is responsible for assisting with, and overseeing, research and monitoring projects. This person also coordinates river restoration projects.

The Education Director designs and supervises the Wells Reserve education, outreach, and interpretive programs. She plans and evaluates these programs and supervises staff and volunteer educators.

The Education Program Coordinator works closely with the Education Director, overseeing school, docent training, and other public education programs, as well as assisting with Teachers on the Estuary and other education projects.

The Volunteer and Visitor Services Program Director is responsible for the operation of the Visitor Center, exhibit areas, and other public spaces at the Reserve; for the volunteer program; and for the operation of the library. This position also assists the Accountant with office management tasks and supervises seasonal employees.

The Coastal Training Program (CTP) Director manages all aspects of that program, supervises staff and interns, and conducts social science research.

The CTP Coordinator handles day-to-day operations of the Coastal Training Program and pursues related projects.

The Stewardship Director works closely with the Executive Director on stewardship projects and issues on lands within the Reserve boundary. The position is also responsible for the Geographic Information Systems and collaborates closely with the Research Program staff.

Research, Education, and CTP Assistants help implement the Wells Reserve's core programs.

In-Kind Staff Roles and Responsibilities

The Laudholm Trust Communications Director devotes time to Reserve communications and public relations needs, consulting with the Executive Director and program directors on projects and issues. The Laudholm Trust Operations Director assists the Executive Director with general administrative tasks.

Volunteer Roles and Responsibilities

Wells Reserve has over 400 volunteers who assist in the following areas.

- Volunteer Naturalists (docents) guide school groups and lead public tours.
- Visitor Center Volunteers greet visitors, respond to their needs, answer the phone, and handle sales in the gift shop.
- Rangers walk the trails on weekends from mid-May through mid-November. They answer questions for visitors, communicate problems via radio, monitor trail conditions, encourage compliance with rules, and monitor wildlife.
- Office Assistants do word processing and database management, special projects, and mailings.
- Maintenance Volunteers help with property upkeep, including painting, repairs, light construction, mowing, snow removal, and odd jobs.
- Parking Booth Volunteers greet visitors as they arrive. They collect and record admission fees and provide information about the Reserve and the events of the day.
- Library Assistants manage collections in the Coastal Resource Library and work on the organization's archive.
- Research Volunteers participate in projects including water quality monitoring, beach profiling, shoreline surveys, marsh restoration, larval fish studies, marine invasives monitoring, and beach clean-ups.
- Special event volunteers help with the planning and implementation of Winter Wildlife Day, Earth Day Celebration, Punkinfiddle on National Estuaries Day, and other events.

Wells Reserve Advisory Committees

Seven standing committees advise the Wells National Estuarine Research Reserve on a range of facility and program issues. Committee members represent government agencies, research institutions, academia, community organizations, schools, and Laudholm Trust.

The Education Advisory Committee provides guidance to the Education Director and Program Coordinator on efforts to educate residents and visitors about coastal ecosystems. The committee's advice addresses on-site programs, exhibits, guided tours, interpretive trails and signs, and community outreach. The committee

also recommends educational uses of Reserve facilities (library, teaching lab, historic structures).

The Research Advisory Committee provides guidance to the Research Director on research and monitoring activities in southern Maine's coastal watersheds and in salt marshes throughout the Gulf of Maine. The committee also explores links and partnerships between Wells Reserve and other institutions in New England conducting marine research.

The Stewardship Advisory Committee provides guidance to the Stewardship Director and the Executive Director on protecting the natural and cultural resources of Wells Reserve while providing for research, education, recreation, and interpretation. The committee's advice addresses habitat and wildlife management, control of exotic species, and protection of sensitive, threatened, and endangered species.

The Building Advisory Committee provides guidance to the Executive Director, the Facilities Manager, and the RMA on buildings and lands of the main campuses (Laudholm and Alheim Commons) and the North and South estates. The committee's advice addresses the historical integrity, maintenance, and appearance of structures and grounds, site improvements, and construction projects.

The CTP Advisory Committee provides guidance to the Coastal Training Program Director and Coordinator on programs to support coastal decision-makers.

The Volunteer Advisory Committee provides guidance to the Volunteer and Visitor Services Program Director on program direction and implementation, including recruitment, retention, and training for volunteers.

The Library Advisory Committee helps the Volunteer and Visitor Services Director and the Education Director to develop and maintain the Coastal Resource Library. The committee assists with organizing and improving collections and archives and staffing the library.

In addition to these standing advisory committees, ad-hoc committees and task forces are formed when particular needs arise.

Wells Reserve Program Integration Strategy

The Wells Reserve integrates its programs through inter-program meetings, shared staff responsibilities, and linkages developed for specific projects. The Executive Director organizes gatherings and briefings where ideas, information, and project updates are exchanged among Laudholm Trust and Reserve staff.

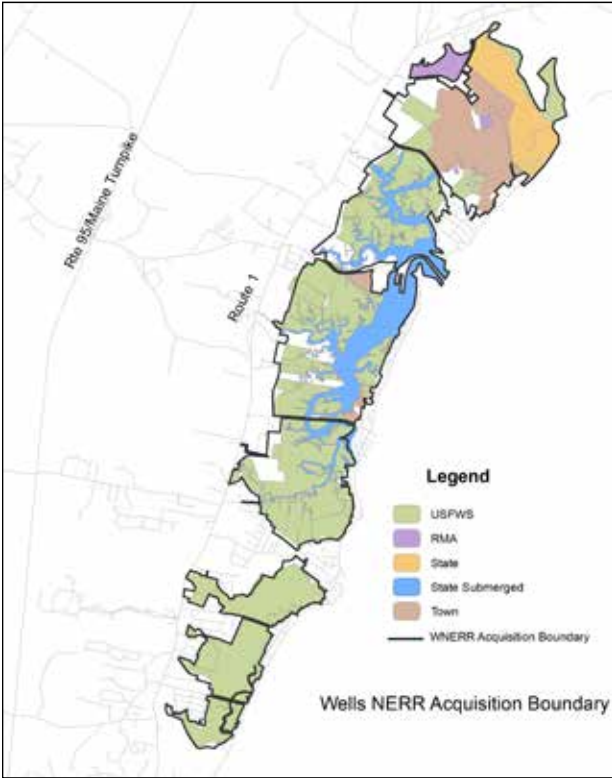
Program staff also meet to address specific projects and issues. The Stewardship Director, Education Director, CTP Director and Coordinator, and Research Director identify, implement, and coordinate programs and products for the public and coastal decision-makers.

Integration is achieved at the staff level when individuals share duties. For example, the Stewardship Program encompasses on-site natural resource management, GIS, and stewardship activities in the communities in the region. This program plans and implements resource management within the boundaries of the Reserve, but also works on initiatives in communities that involve land acquisition planning and habitat restoration. The program is also integral to the implementation of research projects and in helping with SWMP implementation.

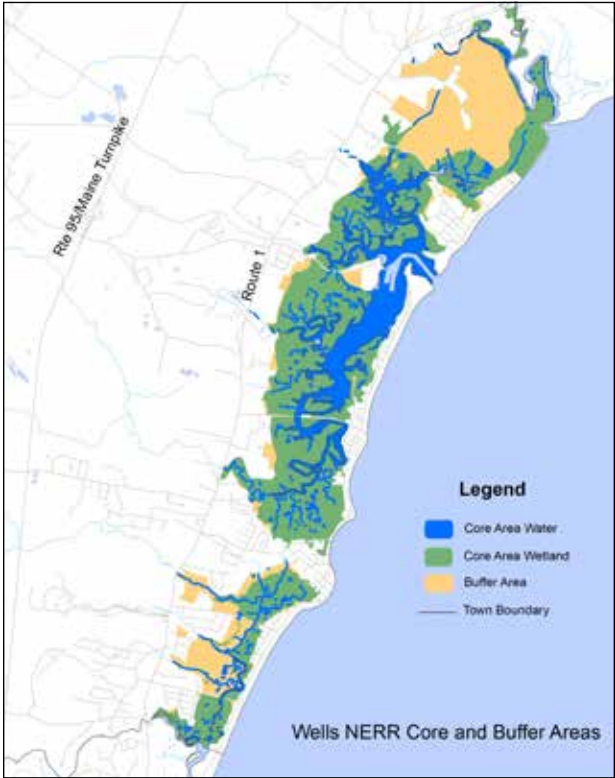
Many Wells Reserve projects require the expertise of staff from other programs. The CTP Director, for example, collaborates with the Research Director on projects that require scientific studies and assessments. When writing proposals and grant applications, the Research Director always incorporates a training and education component, ensuring that whatever science is developed will include a communications component. The CTP staff routinely partner with the Stewardship Director on workshops and training activities.



The Reserve's highest priority parcel lies along Laudholm Farm Road across from the Alheim Commons property.



The Wells Reserve acquisition boundary, showing protected areas (shaded) and areas eligible for acquisition using section 315 funds.



Wells Reserve protected lands, indicating core and buffer areas.

Boundary and Acquisition Plan

Introduction

With its federal, state, municipal, and non-profit partners, the Wells National Estuarine Research Reserve protects a network of lands that represent diverse ecosystems and watersheds in south coastal Maine.

The Reserve protects properties within its boundary that constitute both core and buffer areas. These parcels are important to maintaining the ecological integrity of estuaries and for allowing the Reserve to conduct research and education programs. The rivers and streams flowing into the Reserve's estuaries are under continued development pressure. This growth threatens the functions of estuarine ecosystems by fragmenting habitat, damaging wetlands, and degrading water quality upstream of the Reserve.

This chapter describes the priorities and strategies the Reserve uses to acquire properties near or adjoining the Reserve's current protected lands and within its recognized boundary, and to assist partners in acquiring larger contiguous tracts within three targeted watersheds, especially those tracts that border rivers, tributaries, and wetlands whose waters eventually feed the Reserve's estuaries.

As part of its conservation and stewardship mission, the Reserve also works with land-conservation organizations in coastal-zone communities of southern Maine to protect key coastal and estuarine lands outside its boundary and targeted watersheds. The Resource Management and Stewardship chapter has information on conservation partnerships elsewhere in the Reserve's service area.

Background

When the Wells Reserve was established, its designated boundary was entirely within the Town of Wells between the Little River and Eldridge Road. It followed the shoreline on the east (excluding developed sections) and crossed uplands and salt marsh on the west. The Reserve's 1,600 acres included property owned by the U.S. Fish and Wildlife Service, Town of Wells, and (then) Maine Department of Conservation. The acreage also included key parcels acquired for the purpose of forming the Reserve.

In 2003, the Maine Legislature passed, and the Governor signed, Legislative Document 777, which revised and clarified Maine law addressing the location of the Reserve. With NOAA approval of the 2007-2012 Management Plan, the Reserve extended its boundary to the Ogunquit River and added 359 acres of salt marsh (a core area) within the Moody Division of Rachel Carson NWR.

Also in 2003, Laudholm Trust transferred 35 acres known as the Alheim Property to the Wells Reserve Management Authority. This parcel holds the Reserve's residential campus, a managed woodlot, and interpretive trail. With the approval of the 2007-2012 Management Plan, this property was incorporated into the Reserve's buffer area.

In 2005, the Reserve purchased and protected 2.5 acres of fields adjacent to the Reserve's service road. This parcel had been the highest priority land acquisition project for the Reserve since its founding. With the approval of the 2007-2012 Management Plan, it was incorporated into the Reserve's buffer area.

In 2008, Reserve purchased a 2.5-acre parcel, with farmhouse and barn, adjoining the field parcel. This property currently houses the Reserve’s caretaker and is intended as a future education center. With the approval of the 2013-2018 Management Plan, this parcel was incorporated into the Reserve’s buffer area.

Geographic information systems have enabled the Reserve to define and calculate its acreage more accurately than when it was established. Rather than boundary surveys and measures shared by partners, the Reserve now uses GIS to determine its total area is 2,250 acres held by four organizations:

- U.S. Fish and Wildlife Service/Rachel Carson National Wildlife Refuge: 1,428 acres
- State of Maine Department of Agriculture, Conservation and Forestry: 533 acres (includes submerged lands)
- Town of Wells: 249 acres
- Wells Reserve Management Authority: 40 acres

Objective and Strategies

Objective

Lands are conserved to protect diverse natural resources and to ensure a stable environment for research, education, and nature appreciation.

Strategies

- Protect the highest priority property within the Reserve’s boundary.
- Identify and map existing undeveloped properties and prioritize them for acquisition.
- Increase public awareness of the value of land conservation to ecosystems and communities.
- Make protected property accessible for research, education, and public enjoyment.
- Help secure Section 315 funds and non-federal matching funds for land conservation projects.

Core and Buffer Areas

The land and water areas within the designated Reserve boundary consist of core areas and adjacent buffer areas (Figure). Core areas include sensitive ecological units essential to the functions of estuaries: main stems of rivers (freshwater and estuarine sections) and associated submerged lands, freshwater and saltwater

wetlands that abut rivers, and dunes associated with beaches. Access to these areas is limited because human activities could pose a risk to their ecological integrity and the Reserve’s ability to monitor and study them. Core areas are managed to ensure the continuance of long-term research, monitoring, and educational activities.

Buffer areas are designed to protect the ecological integrity of core areas and to provide additional protection to estuarine and

riverine-dependent species. These areas are suitable for educational programs, public use, and appropriate active management. Buffer areas may include hiking trails, observation platforms, interpretive signs, and other alterations of the land that advance the Reserve’s mission.



Principal Federal Funding Sources

As a National Estuarine Research Reserve (NERR), the Wells Reserve can apply for funds through Section 315 of the Coastal Zone Management Act (NERR Construction and Acquisition Fund). These funds are to be used for the acquisition of properties—either core or buffer areas—within the approved acquisition boundary of the Reserve. When funds are available, Reserves compete for funds from the NERR Construction and Acquisition Fund. The federal funding may not exceed an amount equal to 50 percent of the costs of the land and waters, and the interests therein.

Principal Non-Federal Funding Sources

Non-federal matching funds for 315 funds come from Laudholm Trust, the state’s Land for Maine’s Future Program, the Maine Outdoor Heritage Fund, and private foundations.

Benefits of Protecting Land

The Reserve has long recognized the benefits of protecting land, both in its buffer and core areas and in its broader targeted watersheds. Land acquisition can

protect coastal ecosystems and expand opportunities for research, monitoring, education, and outreach. The Reserve's boundary and acquisition philosophy derives from 15 CFR 921, which applies specifically to delineating a Reserve's boundary.

Ecology

Section 921.11(c)(3) requires "assurance that the Site's boundaries encompass an adequate portion of key land and water areas of the natural system to approximate an ecological unit to ensure effective conservation."

The Reserve's boundary provides these heightened assurances by helping to maintain the integrity of coastal watersheds and protecting water quality and habitat diversity. The Reserve works with organizations, agencies, and communities to identify and conserve critical resources whose destruction or degradation could diminish the Reserve's estuarine resources.

Maintain the Integrity of Coastal Watersheds

Coastal land-use patterns in southern Maine are changing from rural forest and farmland to suburban sprawl. Development is fragmenting habitat, affecting wetlands, and degrading water quality and aquatic habitats. These alterations directly and indirectly affect coastal resources and estuarine-dependent species.

Coastal communities, which already have the region's densest populations, are experiencing high rates of growth. Vacant oceanfront property no longer exists in Wells. Building lots along the salt marsh edge are rare and expensive. Development pressure now falls on upland acreage, particularly along the banks of coastal rivers and streams. Newly developed areas tend to have large areas of natural vegetation replaced by impervious surfaces, intensively managed lawns, and non-native plant species.

Without conservation efforts, land along the major watercourses flowing through the Wells Reserve will continue to be lost or negatively impacted by development. The Reserve risks gradually become a biological island—a protected place surrounded by human development, disconnected from other thriving natural areas with consequent ecosystem imbalances and resource deterioration.

In addition, as sea level rises in the Gulf of Maine, saltwater wetlands will extend landward. Protecting

edge and upland parcels adjoining current wetlands will allow their expansion with less disruption to human communities.

Protecting Water Quality

Clean water is essential to the economy of southern Maine. Coastal communities depend on attracting visitors to their extensive sandy beaches with swimmable water. Wells and surrounding towns obtain drinking water from local rivers. Residents and visitors derive work, sustenance, and recreation from local fish and shellfish.

Toxic contaminants that settle onto roads, parking lots, and other impervious surfaces are carried to estuaries in stormwater. Pathogens, nutrients, and toxins from faulty septic systems, pet waste, landscaping, and overtaxed wastewater treatment facilities also diminish water quality.

To a significant extent, the quality of water and aquatic habitats in the tributaries and estuaries of the Reserve depends on upland forests and wetlands, which filter sediments and pollutants, provide shade, reduce erosion and channelization, and support the food web. Protecting forested riparian zones is critical for assuring high water quality throughout watersheds.

State and local land-use ordinances do not always prevent degradation or assure maintenance of high-quality water over the long term. Conserving riparian and aquatic buffers is the most effective, and lasting, method of protection.

Habitat Protection

The Webhannet River, Little River, and Ogunquit River watersheds support the plant and animal species that use riparian lands exclusively and those that rely on rivers for breeding habitat and travel corridors. Over the years, partner organizations such as Rachel Carson NWR, Wells Conservation Commission, Great Works Regional Land Trust, and the Wells/Kennebunk/Kennebunkport Water District have protected more than 3,500 acres of land in these three watersheds. The Reserve intends to continue working with partners on conserving tracts of land within these watersheds that will help with landscape-scale habitat protection. Although this acreage is not within the Reserve boundary, these efforts have been crucial to the long-term integrity of the Reserve's protected land.

Education, Outreach, and Training

The Wells Reserve educates the public and coastal decision-makers about estuarine ecosystems and coastal watersheds. Most of the Reserve's education and training programs have occurred at the main campus and in the salt marshes, estuarine areas, and uplands adjacent to it. Additional protected property increases opportunities for the Reserve to educate the public by providing greater access and more diverse habitats.

New interpretive trails in different habitat types expand opportunities for educational programs, while allowing increased access by visitors, school groups, day campers, and student researchers. Water quality and plankton outreach programs aimed at local middle schools, high schools, and adult education classes, would be enhanced by student access to upstream sites in the Reserve's targeted watersheds.

When evaluating parcels for acquisition, the Reserve will consider "the site's importance to education and interpretive efforts, consistent with the need for continued protection of the natural systems" [15 C.F.R. 921.11(c)(6)].

Research and Monitoring

National Estuarine Research Reserves encompass "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" [15 C.F.R. 921.11(c)(3)].

Evaluation Criteria

When assessing parcels for possible acquisition, the following attributes or conditions would be considered favorable:

- Is adjacent to existing protected land or is a large block of unfragmented, undeveloped land.
- Includes riparian land in the targeted watershed areas along the main stems and or major tributaries.
- Includes upland that will allow for the migration of marshes as sea level rises.
- Connects with other conservation lands.

- Includes riparian land along the main stems of the rivers upstream from the estuaries.
- Contains land in a natural or restorable condition.
- Provides opportunities for environmental education, scientific research, or habitat management.
- Is within the proposed Wells Reserve boundary and targeted watersheds.
- Contains documented land or water resources of significant ecological value.
- Is owned by someone interested in conservation options.

When assessing parcels for possible acquisition, the following attributes or conditions would be considered unfavorable:

- Expensive for monitoring or stewardship.
- Contains known or suspected environmental-hazardous substances.
- Likely to be degraded or severely compromised by adjacent land uses.
- Inaccessible to staff and visitors for education, research, or stewardship.
- Includes buildings or other large structures that cannot be used, subdivided, or sold.
- Priced above an appraised fair market value.

Priorities for Acquisition

Buffer and Core Areas—Section 315 Funds

Several parcels of land within the Reserve boundary continue to be of high interest to the Reserve, particularly those parcels that are near or adjoin current protected lands. These include both core (salt marshes) and buffer (uplands) areas.

The 27-acre Spiller Property (buffer): This parcel is located across Laudholm Farm Road from the Reserve's Alheim Commons property. Most of the property abuts conservation land of the Wells Reserve and Rachel Carson NWR. It consists of field, forest, wetland, and active farmland habitats that provide for a variety of wildlife species. Protecting this parcel would increase contiguous, publicly-owned land in the Reserve, and would allow active habitat management and a new trail linked with the current trail system. This is the highest acquisition priority for the Wells Reserve and has been for 15 years.

Adjacent Parcels along Rivers and Estuarine Areas (core and buffer): Most properties surrounding the Reserve's protected area have already been conserved or developed, but some relatively small parcels (less than 10 acres) could still contribute to the protection of fresh and estuarine waters in the Webhannet and Merriland river watersheds. These lands adjoin, or are close to, town, state, or federal conservation land. Over the next 5 years, the Reserve will work with Rachel Carson NWR to identify these small parcels through GIS mapping and prioritize them for acquisition. Highest priority will be given to wetland parcels or upland areas that will allow marshes to migrate.

Means of Acquisition

Approaches to Land Protection

When the Wells Reserve determines that a parcel within its acquisition boundary meets evaluation criteria, it will explore these options for protecting the land.

Fee Simple Purchase

The Wells Reserve will purchase the title and all rights associated with a property. In all but extraordinary circumstances, the purchase price will not exceed Fair Market Value as determined by an appraisal and current market conditions.

Conservation Easement

The Wells Reserve will purchase a conservation easement on the property as long as the conditions of the easement ensure the protection of resources of value to Reserve programs. The purchase price will not exceed Fair Market Value as determined by an appraisal and current market conditions.

Donations

The Reserve will accept donations of land and easements or negotiate their purchase below market value if at all possible. The value of a full or partial donation will be used to match Federal or State land acquisition funds.

Other Methods

The Wells Reserve will consider other appropriate conservation options, such as acquiring land with a Reserved Life Estate or mitigation lands. In consultation with the Stewardship Advisory Committee, the Executive Director and Stewardship Director review all conservation efforts that involve the Reserve, either as

principal participant or as a member of a partnership, to determine the impact of public perception. This review will determine whether the goals and objectives of the Reserve are clearly articulated and understood by the public. An information and outreach component will be part of each successful acquisition. If needed the Education Director and CTP Director will provide assistance assessing public perception and designing the information and outreach component of the acquisition.

Holding Title to Acquired Lands

The Reserve Management Authority or one of its partners would hold title to any property obtained within its acquisition boundary. Any property acquired using NOAA funds (Section 315 or Coastal and Estuarine Land Conservation Program) must be held by a non-federal entity.

- The RMA is one of four State of Maine natural resource agencies that can, by statute, hold title to conservation land. It manages lands pursuant to the Reserve management plan and agreements therein.
- The Town of Wells conservation lands ordinance gives management responsibility for conservation lands to the Wells Conservation Commission. The Commission manages its lands consistent with town ordinances and any granting entity's requirements.
- The Maine Department of Agriculture, Conservation and Forestry / Bureau of Parks and Lands can hold title to conservation land. The agency and the RMA would develop a memorandum of understanding to address management of its property.
- The U.S. Fish and Wildlife Service would have management responsibility for any lands held by that agency.



Facility Development and Improvement

Introduction

Wells Reserve facilities have to accommodate a broad range of programs and activities — offices for staff, visiting educators and researchers, and partner organizations; laboratories for scientists, teachers, and students; a maintenance and repair shop; interpretive exhibit areas; classrooms; auditorium; gift shop; welcome area; public library; meeting rooms; storage areas; spaces for public events; outdoor shelter for education programs; dormitory living spaces for visiting scientists, educators, and natural resource managers; and a building for caretakers.

Reserve facilities used for these purposes are in two locations: the Laudholm campus, an assemblage of more than a dozen renovated historic farm buildings plus one building constructed in 2001; and the Alheim Commons property, an adjacent parcel holding three buildings ½ mile from the Laudholm campus. The Laudholm campus area includes a core area (the main campus for Reserve and Trust activities) and two extended areas: 1) the North Estate, which consists of numerous old farm outbuildings that, with the exception of two garages, are currently vacant and used for storage, and 2) the South Estate, which consists of a farmhouse, serving as the caretaker residence, an attached barn, and an outbuilding.

In sum, the Reserve holds more than 35,000 gross square feet of building space, about ½ mile of paved roads providing access to the site; parking for 75 cars at the Laudholm campus and 15 cars at the Alheim Commons campus; and about 5,000 feet of boardwalk on its trails.

Over the past 5 years, the Reserve has made occupied buildings more energy efficient through “green retrofits,” and is now generating 100% of its electricity with solar arrays.

Continuing priorities for the Reserve are to:

- provide facilities to meet the evolving core program needs of research, monitoring, training, education, and stewardship
- keep up with maintenance and repair needs of all facilities and equipment
- continue efforts to switch to alternative energy sources and to conserve energy
- work with Laudholm Trust to build an endowment fund for capital improvement projects and building and equipment repair and maintenance

This chapter is divided into three sections. Section 1 describes existing facilities and their uses and needs. Section 2 describes needs for energy conservation and renewable energy. Section 3 lists the Reserve’s primary facility priorities.

Objectives and Strategies

Objective 1

Ongoing and evolving program needs of research, education, stewardship, and assembly activities are maintained and improved; safe and comfortable buildings for staff and partners are provided; and visitors are provided with facilities in which to learn about coastal ecosystems and the landscape history of the site.

Strategies

- Maintain and improve existing facilities for research, education, training, and stewardship activities.

Continually evaluate facilities to ensure that program needs are met.

- Continue to evaluate interior and exterior structural needs of all buildings and the grounds.
- Adapt and retro-fit buildings, both interior and exterior, so they meet all public safety standards for staff and visitors.
- Make facilities available to partner organizations for uses compatible with the Reserve's mission.
- Recruit and retain qualified Building Advisory Committee members to provide guidance on building maintenance, construction, and energy conservation and generation.

Objective 2

Carbon emissions and resource consumption are reduced through conservation measures and the use of renewable energy.

Strategies

- Reduce electrical energy consumption in buildings and equipment through more sustainable operational practices and more efficient use of buildings.
- Replace outdated heating system in Visitor Center and install new, energy-efficient system.
- Insulate and better weatherize buildings to further enhance energy conservation.
- Purchase and install infrastructure that relies on renewable energy (e.g., solar water-heating systems and car-charging stations) and install a new solar array to meet growing alternative electrical demands of the Reserve.
- As appliances, vehicles, and other equipment wear out, purchase replacements with greater energy efficiency.
- Incorporate sustainable standards into building and equipment maintenance and operations.

Section 1: Existing Facilities — Description and Needs

Laudholm Campus: Main Campus and Forest Learning Shelter

Since designation, the Laudholm campus facilities have been renovated (or, in one case, newly constructed) and have received periodic maintenance and repairs.

Laudholm Farm is listed on the National Register of Historic Places. It played a long and important role in the cultural history of the Town of Wells and the

region. Laudholm is not a typical Maine farm. Rather, the buildings reflect the “progressive farm era” of New England, when wealthy individuals or families purchased farms, made substantial infrastructure improvements, and implemented the latest farming technology. Laudholm Farm was farmed from the mid-1640s through the mid-1970s. To help document and share this rich history, the Reserve published a book, *Laudholm: The History of a Celebrated Maine Saltwater Farm*, in 2005.

After the Reserve was designated in 1984, the buildings were restored and renovated to adapt them to their new use as a coastal and estuarine research, education, and stewardship institution. Since then, the Maine Coastal Ecology Center was built (opened 2001). A Forest Learning Shelter along the Saw-whet Owl Trail was constructed in 2006.

Visitor Center: Main Farmhouse (includes ell and woodshed)

This large, three-story Greek-revival farmhouse is the focal point for the Laudholm campus. It was built in sections between 1720 and the 1890s. With its wrap-around porch and dormered windows, it is an impressive and appealing structure for visitors. This building was renovated in the late 1980s after the Reserve was designated. The exterior restoration was designed to recreate the appearance of the farmhouse during the residence of the George C. Lord family (late 19th to mid 20th century).

The first floor of the main farmhouse houses the office for the Volunteer and Visitor Services Director, a meeting/gathering room for volunteer docents and rangers, a public reception area and gift shop, a storage area, and interpretive exhibits designed, fabricated, and installed in 2011 and 2017. The second floor holds offices for the Reserve Director, Finance/Office Manager, and Laudholm Trust staff; a meeting room; a kitchen and dining area; and a utility room. The third floor holds four offices for Education and Coastal Training Program staff and a Maine Sea Grant extension associate. Current uses of the farmhouse will continue.

The farmhouse is well maintained and in generally good condition, but its radiant heating system, installed 30 years ago, is failing and cannot be effectively repaired. Electrical needs are met with solar energy.

Barn Complex (includes auditorium and library)

This impressive structure was built around 1904. The Hay and Horse Barn (48 feet by 100 feet) and the attached Dairy Barn (35 feet by 70 feet) are wood-framed, clapboard-sided structures that complement the farmhouse. The interior of the hay barn has horse stalls and tack rooms. The converted dairy barn retains some of its original cow stalls. The barns were fully restored in the late 1980s and early 1990s, with additional work done in succeeding years to accommodate emerging needs. In 2003, the roof was repaired and resingled, and in 2008 the entire exterior was painted.

The maintenance shop and equipment garage are located on the ground floor of the Hay and Horse Barn. The first floor of the Hay and Horse Barn is used for events and programs mid-spring through late fall. Some areas are used for storage, and one room is used as a seasonal classroom. The restored Dairy Barn houses the Mather Auditorium, which accommodates 75 people for lectures, workshops, and other events. Adjacent to this is a small kitchen facility and the Dorothy Fish Coastal Resource Library. The library has a unique collection of books, periodicals, reprints, and reports centered on the topic of coastal ecology and management. It includes a librarian's office and a computer workstation with internet access for public use.

While some repairs and ongoing maintenance are needed, the barn complex is well maintained and structurally sound. All of the electricity for the Barn Complex is generated by solar energy. Current uses of the Barn Complex will continue.

To meet public safety standards and evolving needs, the Barn Complex must be retrofitted to incorporate fire suppression infrastructure and proper egress for emergencies. This work is a high priority, as the Barn Complex is intensively used for public programs and events.

Maine Coastal Ecology Center

The 6,000-square-foot Maine Coastal Ecology Center (MCEC), completed in 2001, is a newer facility that complements the style of adjacent historic structures. The Ecology Center holds offices for research and stewardship staff and interns; a research laboratory; a Geographic Information System center; an interpretive exhibit area (installed 2004); a break room; and a

laboratory specifically designed for teaching. The teaching lab is housed in Laudholm Farm's former milk house (creamery), which was renovated and attached to Ecology Center during the 2001 construction. In 2007, a 200-square-foot environmental research chamber adjoining the research laboratory was installed. This climate-controlled room allows for experiments on ecological processes of coastal systems to occur year-round. The Ecology Center is in excellent condition and needs only ongoing maintenance and repair. Solar arrays installed on this building in 2013 provide all of its electrical needs.

Ice House

This small, one-story structure beside the main farmhouse is used for storage. It is in good condition and will need periodic maintenance and repair.

Water Tower

Built around 1904, the water tower was fully restored — with a replica of the original water tank constructed — in the early 1990s. The water tower has no practical value but is of great interest to visitors, as it is part of the historic landscape of the Laudholm Farm campus. Over the last 10 years, the wood decking and railings of this structure rotted to a point where their full replacement was needed. Major repairs and painting were completed in 2018. This structure is in excellent condition.

Gazebo/Well House

This small octagonal structure was built in the 1880s. In addition to its decorative and historic value, visitors enjoy the views from its shelter. In 2011 the structure was restored. It is in excellent condition.

Forest Learning Shelter

This is a 20-foot by 30-foot building is located along the Saw-whet Owl Trail, about ¼ mile from the parking lot. It is accessible by walking or, with permission, by automobile for people with disabilities. The Forest Learning Shelter is used by the Education Program as a classroom, particularly by those teaching the public about forest ecology. The Shelter is a three-season facility, ideally suited for use May through October. It is in good condition, requiring only regular maintenance and repair.



Laudholm Campus: North Estate and South Estate

Two parcels, each containing several buildings, came into the full ownership of the Reserve over the past 5 years. Each was purchased by the Reserve in the past, but were subject to life tenancy agreements with the prior owners. Both life tenants passed away over the past 5 years, so the Reserve now has full control and use of the properties.

South Estate

Former Diane Lord House (circa 1850)

This house on 2½ acres of land was purchased by the Reserve in 2008. It includes a farmhouse with attached barn and one small outbuilding (called the Root Cellar). In 2009, the roofs of the farmhouse and root cellar were reshingled. In 2017, the farmhouse underwent significant repairs to prepare it for occupancy. It was totally rewired with new lighting fixtures and smoke/heat sensors added throughout. A new furnace, and a heating system on the second floor, were installed at that time. The interior was repainted and other repairs were made on the first and second floors. Now in good condition, this house is currently the home of the caretaker.

There is an educational use intended for part of this building, most likely in the attached barn. When this

occurs, this section of the building will be named the Mattina Proctor Environmental Education Center and will serve as a classroom and presentation area for education programs. However, the barn will need significant capital improvements to adapt it for use as an educational facility: interior renovation, roofing system, and repairs to the exterior (clapboard replacement and paint).

The root cellar is in stable condition, but it is boarded up and not used. It received new roof singles in 2009. A potential future use of this building is for an artist's studio and a wildlife-watching blind.

North Estate

In 2007 and 2008, structures on the North Estate received significant maintenance and repair. Roofing systems, foundations, sills, clapboards, and other sections of the buildings were either repaired or replaced.

Manure Shed (circa 1905)

This building was restored after the Reserve was established. It is in good condition and is used for storage. This is the most appropriate use for this building.

Sheep Barn (circa 1890-1900)

The Sheep Barn would be a difficult facility to renovate for future program use. One option would be a 30-seat

classroom and public gathering place, but a major renovation would be required. The only practical and realistic future use for this building is for equipment and vehicle storage.

Farmer's Cottage and Wood Shed (circa 1830–1850)

The Farmer's Cottage served as the residence of the Lord family, including a member who was the Reserve's caretaker from 2003 through 2012. It has been vacant since 2012. The Farmer's Cottage has the potential to serve as summer accommodations for visiting scientists or as caretaker quarters. The cottage was partially renovated and winterized during the caretaker's occupation, but the facility will require significant repair before it can be occupied again.

The wood shed, a barn-like structure adjacent to the Farmer's Cottage, is in fair condition. It could be used for storage should the Farmer's Cottage be reoccupied.

Killing House (early 1900s)

This small structure is in good condition and was maintained regularly by a member of the Lord family, who used it as a summer cottage from the 1980s through 2008. It has sat vacant since then. It could be used as a summer living space and has the potential to be winterized. This structure would be ideal as housing for a visiting investigator in research, education, or stewardship. It could also be used for additional office space. However, before being adapted to a new use, it will need significant repairs and restoration.

Chick Brooder Building / Little Residence (circa 1916)

This one-time chicken-rearing facility was renovated in the 1930s and was used as a summer residence by a member of the Lord family. Like the Killing House, this structure would be ideal as housing for one visiting investigator working on research, education, or stewardship projects at the Reserve. It could also be used for additional office space. Before being adapted to a new use, it will need significant repairs and restoration.

Bull Barn (early 1900s)

The largest building on the Life Estate is currently used for storage. It could meet facility needs of the research and education programs, such as an interpretive exhibit hall, a multi-purpose classroom with spaces for 30 to 40 people, a library, or a seawater lab and a chamber for live organism study. Before being adapted

to new uses, the Bull Barn will need to undergo significant repairs and restoration.

Auto Garages (1907/1920s)

These two buildings provide storage for Reserve vehicles, maintenance equipment, and other materials.

Brooder House

This shed-like structure is used for storage, which is also its most likely future use.

Alheim Commons Residential Campus

For two decades, the Alheim property served as the Laudholm Trust headquarters. In 2004, the Trust donated the buildings and the land to the Reserve, which has since used the facilities mainly as a residential campus. One building serves as an office and meeting space. Three solar arrays recently installed on this property meet all of the campus's electrical needs.

Alheim Commons Dormitory (2006)

To accommodate the need for housing for partners, the Reserve disassembled and removed an old farmhouse with attached barn that stood on this property for over 150 years. The old structure was taken down piece by piece, with plans by the contractor to rebuild it elsewhere. In its place the Reserve built the 4,000-square-foot Alheim Commons, a 20-bed dormitory that opened in 2006. It provides accommodations for scientists, educators, interns, and resource managers collaborating with the Reserve. The building is in good condition and will only need routine maintenance and repair.

Alheim Commons Studio (circa 1900)

This outbuilding served for many years as a storage facility for Laudholm Trust. In 2006, it was renovated and converted to a one-room, year-round office and meeting space. It is currently being used as the office for the National Estuarine Research Reserve Association.

Ranch-style House – Post-Doc House (circa 1960s)

This building, which was donated to the Reserve, was moved to the Alheim property in 1998 and renovated to serve as housing for a Reserve post-doctoral research associate or other staff members. In 2011, the furnace was replaced and a new propane heating

system installed. In 2016 and 2018, the building underwent some significant repairs, including new electrical and interior renovations. The house is now in good condition, requiring only regular maintenance and repair.

Section 2: Energy Conservation and Renewable Energy

To the greatest extent possible, the Reserve has always followed sustainable and ecological practices in its construction and renovation activities. By remodeling and adapting centuries-old buildings to new uses over the past 30 years, the Reserve has met two of environmentalism's three "Rs" – "reuse" and "recycle" (the third is "reduce"). Since it was established, the Reserve has constructed three new buildings (the Maine Coastal Ecology Center, the Forest Learning Shelter, and the Alheim Commons dormitory). In each case, the facilities were constructed with sustainable practices in mind — using wood harvested and milled sustainably in Maine, energy efficient heating systems, and environmentally friendly building materials. As part of standard practice, the Reserve continuously examines ways to recycle materials and reduce its carbon output.

At the start of our previous Management Plan (2013-2018), the Reserve embarked on a 5-year energy conservation and renewable energy project called the "Conserve and Convert Initiative." The Reserve installed four solar arrays that generate 73,000 kWh of electricity a year and, through energy conservation initiatives reduced its electrical and fossil fuel consumption. Today, the Wells Reserve gets 100% of its electrical energy through the on-site solar arrays and has reduced its fossil fuel consumption (compared to pre-2013) by 20%.

Despite these successes, the Reserve continues looking for ways to conserve energy and switch to renewables. The Reserve has replaced "energy hog" equipment with efficient units, installed window inserts to reduce cold-air penetration into the Visitor Center and other buildings, and instituted energy-smart operations.

Because the Laudholm campus is on the National Register of Historic Places, the Reserve follows the U.S. Department of Interior guidelines for historic buildings in construction and repair practices and works closely with the Maine Historic Preservation Commission.

Section 3: Facility Priorities

Although the Reserve has numerous ongoing needs and special projects, the following six priorities have been identified for 2019-2024:

1. Replace the 30-year old heating system in the Visitor Center with a new, energy-efficient system while tightening the building's envelope and improving its insulation.
2. Retrofit the Barn Complex and other public-use buildings with fire suppression infrastructure and better exits and entryways.
3. Repave driveways, walkways, and parking areas and install a new exterior lighting system on the Laudholm Campus to improve public safety and stormwater runoff.
4. Install photovoltaic systems: To meet the growing demands for electricity as Reserve programs grow, maintain 100% on-site generation of electricity needs. The South Estate barn is ideally situated for solar panels.
5. Install a circulating-seawater laboratory to meet new and ongoing research needs by renovating a room and installing equipment. The Coastal Ecology Center or a North Estate building would be candidates for the lab's location.
6. Renovate and restore the South Estate barn and sections of the house to create the Mattina Proctor Environmental Education Center with classroom and presentation spaces.

National Historic Preservation Act

Section 106 of the National Historic Preservation Act requires federal agencies to take into consideration the effects an agency's projects may have on historic properties. The State Historic Preservation Office is given an opportunity to review all building construction and land acquisition projects to ensure historic resources are protected. The Maine Historic Preservation Commission serves this role in Maine. As a partner with NOAA, the Reserve complies with the provisions of Section 106 on all of its projects, communicating with representatives of the Commission and moving forward with projects once it has reviewed and approved them.

Appendices

A. Memoranda of Understanding

- National Oceanic and Atmospheric Administration and Reserve Management Authority
- U.S. Fish and Wildlife Service and Reserve Management Authority
- Maine Department of Public Lands and Reserve Management Authority — Beach and Uplands
- Maine Department of Public Lands and Reserve Management Authority — Submerged Lands
- Town of Wells and Reserve Management Authority
- Laudholm Trust and Reserve Management Authority

B. Federal Consistency Determination

C. Response to Review from Partners and Public Comment

D. Conservation Easements

- Deed on Laudholm Farm
- Deed at Wells Harbor

E. State of Maine Legislation

- Act to Establish Wells National Estuarine Research Reserve
- Act to Amend the Laws Regarding the Location of Wells National Estuarine Research Reserve

F. Rules for Public Use

G. Natural Resource Laws

H. Federal Regulations

I. Coastal Zone Management Act, section 315