RYE
New Hampshire
NATURAL RESOURCES INVENTORY

2021

Photo credit: NewEnglandToday-Travel

NATURAL RESOURCES INVENTORY

TOWN OF RYE

NEW HAMPSHIRE

December 2021

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RYE CONSERVATION COMMISSION
RYE, NEW HAMPSHIRE

October 2021

The Rye Conservation Commission is pleased to present the following Natural Resource Inventory ("NRI") for Rye.

A Natural Resource Inventory is required by New Hampshire's RSA 36-A:2. By identifying and describing natural resources in a local setting, a natural resource inventory (NRI) provides a strong foundation for proactive conservation planning and informed decision making. RSA 36-A:2 states "conservation commissions shall conduct researches into local land and water areas and keep an index of all open spaces and natural, aesthetic or ecological areas within the city or town." The NRI is a working document that should be used in Rye's Master Plan, specifically Chapter 7.

The NRI describes the Town's natural resources with maps and explanatory text to help identify areas of high value for wildlife habitat, water quality, recreation, and other resources. Having this information will allow all of us to prioritize protection and take proactive management steps to insure long-term viability of these resources. The Conservation Commission believes that these steps are important for the Town's future cultural, economic, and community well-being.

If you have any questions about any of the information contained in the NRI, please contact one of the Conservation Commissioners. We hope you enjoy the information provided herein, as well as Rye's wonderful natural resources!

Suzanne McFarland, Chair
Sally King, Vice Chair
Mike Garvan, Clerk

Jaci Grote
Heather Reed
Susan Shepcaro

Danna Truslow
Jeff Gardner
Karen Oliver

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ABBREVIATIONS

CWA	Clean Water Act
DES	Department of Environmental Services
FBE	FB Environmental Associates
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
LID	Low Impact Design
NFIP	National Flood Insurance Program
NH GRANIT	New Hampshire Geographically Referenced Analysis and Information Transfer
NHFGD	New Hampshire Fish and Game Department
NHWAP	New Hampshire Wildlife Action Plan
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resources Conservation Service
NRI	Natural Resource Inventory
NSSP	National Shellfish Sanitation Program
PCBs	Polychlorinated Biphenyls
PCS	Potential Contamination Source
PFC	Perfluorinated Chemicals
RCC	Rye Conservation Commission
RCCD	Rockingham County Conservation District
RCRA	Resource Conservation and Recovery Act
RCSA	Regulations of Connecticut State Agencies
SELT	Southeast Land Trust
SLAMM	Sea Level Affecting Marshes Model
SLR	Sea Level Rise
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
WHPA	Wellhead Protection Area
WSS	Web Soil Survey
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

This Natural Resource Inventory (NRI) report was prepared by FB Environmental (FBE) for the Town of Rye and the Rye Conservation Commission to provide a detailed description and analysis of the town's natural resources. This NRI was developed to be useful to all municipal departments – not just the Conservation Commission. Results presented herein demonstrate that the Town of Rye contains abundant, diverse, and valuable natural resources that significantly contribute not only to the ecological richness and biodiversity of the town, but also the quality of life for the community. The Natural Resource Inventory will serve as a tool to help guide future municipal planning and conservation efforts throughout the town.

This NRI is not and should not be viewed as a conservation plan of action. Rather, it is an encyclopedia of information based on the best currently available data, with a measure of interpretation and preliminary recommendations about what is important to conserve from an ecological perspective. The NRI is a baseline characterization, and thus comprises a beginning of what should be an ongoing process of updates and refinements.

As part of the NRI process, FBE compiled and created relevant Geographic Information Systems (GIS) shapefiles which provide a means to visualize and further analyze Rye's natural resources information.

Fifteen maps were created to illustrate Rye's natural resources and character. These maps depict the town's watersheds and surface water resources, geology and groundwater resources with their potential pollutant sources, floodplains and sea level rise inundation areas, flood mitigation areas, salt marsh migration projections, water quality impairments and use restrictions, forest resources, prime wildlife habitat and priority areas for conservation, forest soils, soil limitations, prime farmlands, scenic resources, conservation lands, and areas of unfragmented land.

The Town of Rye has experienced steady population growth and development since the 1960s. There are currently over 1,930 acres of conserved land within the town and this number is continuously growing. Much of this conserved land consists of Appalachian Oak-Pine, salt marsh, temperate swamp, and wet meadow/shrub wetland land habitats. Conserving these habitats helps preserve important ecosystems and ecosystem functions such as stormwater and flood control and the filtering of pollutants and increases recreation areas and scenic vistas.

Rye has four named streams (Bailey Brook, Berry's Brook, Seavey Creek, and Witch Creek) totaling 11.5 miles of waterways, and almost 26 miles of unnamed streams (including the two branches of what is locally known as Parsons Creek). Many of these begin as freshwater headwater or tributaries that become brackish as they approach harbors or the Atlantic Ocean. There are also 114 acres of ponds in Rye. The largest, Eel Pond, spans 39 acres near the southeastern corner of Rye. Marsh Pond is located near the intersection of Brackett Road and Parsons Road. Other major ponds are found along Bailey's Brook, including Burke Pond, Brown's Pond, and Locke Pond. The major wetland systems in Rye surround Rye's streams. There are an estimated 1,654 acres of freshwater wetlands and 909 acres of saltwater wetlands in Rye. The salt marshes serve as an interface between the beaches and marshes and the uplands. Rye's wetlands and floodplains provide flood storage and offer pollutant attenuation. Approximately a quarter of Rye is within the 100- or 500-year floodplain. 2,113 acres (including some wetlands and floodplains) provide flood

risk mitigation and pollutant attenuation (3,741 acres). These areas will help lessen the impacts of sea level rise and increasing storm intensity.

Most of Rye is served by public water suppliers including the Rye Water District and Aquarion Water Company. Water is drawn from the stratified drift aquifer in Rye and bedrock wells. The stratified drift aquifer covers an area of 1,696 acres in the southwest area of town.

Using numerous spatial datasets from the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT), United States Geological Survey (USGS), and FBE, FBE identified areas within the town having the highest natural resource values. In 2020, the New Hampshire Fish and Game Department (NHFGD) conducted a habitat condition analysis to identify areas of highest habitat and ecologically intact areas, which are identified in this NRI as "Prioritized Habitat Blocks." The six contiguous prioritized habitat blocks, or prioritized conservation areas, identified are: Seavey Creek/Fairhill Swamp/Wallis Marsh, Lower Berry's Brook, Upper Berry's Brook North, Awcomin Marsh, Packer Bog/Upper Berry's Brook South, and Bailey Brook.

These priority conservation areas encompass much of the town's mapped wetlands and streams and areas mapped as part of NHFGD's 2020 Wildlife Action Plan which identified them as valuable habitat, in addition to larger areas of unfragmented land, some of which are already protected. In total, these six priority conservation areas cover approximately 3,484 acres, or 41% of Rye's total area.

The greatest threat to the natural resources and ecology of the town of Rye is habitat loss and alteration resulting from development and from climate change altering the landscape. It's important to note, however, that preservation of entire conservation priority areas is not feasible, nor does FBE recommend it. Much of the mapped areas are privately-owned lands that contribute, through taxes, to the economic stability of the town. Rather, a balanced approach to conservation and development which incorporates a suite of land use planning and conservation tools is recommended, as careful attention to growth in Rye will help to ensure sound stewardship of the town's natural resources.

Rye Harbor

Photo Credit: Marinas.com

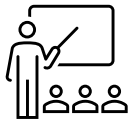
1. INTRODUCTION

1.1 NATURAL RESOURCES INVENTORY DEFINED

A natural resources inventory (NRI) is a document that identifies and describes important naturally occurring resources within a given locality via written descriptions of resources, maps, and associated documentation of mapped data. A comprehensive NRI provides the basis for land conservation planning and facilitates the incorporation of natural resources information into local land-use planning and zoning. An NRI can be useful to (Stone, 2001):

Document current conditions so that changes over time can be assessed

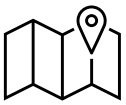
Develop a Conservation Plan



Educate local officials and the public regarding a community's natural resources

Initiate and support land protection efforts

Identify and protect important fish and wildlife habitat



Provide a basis for land use planning efforts

Develop or update the Natural Resources section of a town's Master Plan

Preliminarily evaluate effects of proposed land use and zoning changes

Develop amendments to existing zoning ordinances

Screen development proposals

An NRI is a tool to help achieve some of the goals listed above. While an NRI is useful in the planning process, it is generally not suitable for site-specific issues. An NRI may be used as a screening tool by identifying areas where site-specific assessments may be required (Stone, 2001). As new and revised information emerges, NRIs may need periodic updating and refining, but the initial NRI provides a baseline for observing changes over time (Stone, 2001).

1.2 RATIONALE

To protect local natural resources, they must first be located and identified. Until an NRI is conducted, and the information is compiled, a given community will not have a clear picture of all the resources present, where resources are located, and which are significant to them, and why.

Land use decisions made at the local level have a large role to play in the fate of natural resources at the local scale. Communities frequently need to make decisions affecting natural resources, but very often don't have adequate information available to back those decisions. By identifying and

describing natural resources in a local setting, an NRI provides communities with a strong foundation for more informed decision-making. It also encourages participation in identifying and protecting natural resources important to the community and provides information that will support careful land use planning, voluntary land conservation, and improved natural resource protection measures.

By compiling geospatial information and creating maps and their associated data tables and descriptions, an NRI helps a community visualize its natural resources geographically, enabling a better understanding and appreciation of the community's natural resources in combination with the human infrastructure and community resources they rely on (Stone, 2001).

1.3 GOALS OF THE RYE NATURAL RESOURCES INVENTORY

- ✓ Incorporate relevant reports, plans, and studies regarding natural resources in Rye into the NRI
- ✓ Map and describe significant natural resources in the Town of Rye
- ✓ Educate the public and local officials regarding Rye's natural resources and potential threats
- ✓ Promote the conservation, protection, and responsible management of the natural resources of the Town
- ✓ Protect the Town's water quality, surface waters, wetlands, and groundwater resources
- ✓ Identify areas of ecological value and habitat corridors that cross town boundaries
- ✓ Protect the natural ability of the landscape to withstand flooding and other changes due to climate change
- ✓ Maintain recreational opportunities through protection, appropriate management, and interconnection of conserved areas

1.4 GENERAL METHODOLOGY

This town-wide Natural Resources Inventory is based on the methodology outlined in Natural Resources Inventories – A Guide for New Hampshire Communities and Conservation Groups by the University of New Hampshire Cooperative Extension (Stone, 2001). The following sections of this document describe the types and potential threats to the different natural resources found in the town of Rye. Geographic Information System (GIS)-based data and maps related to each resource are presented in Appendix A. For each category of natural resource (e.g., water and geologic resources, wildlife and habitats) included in this document, a description of the resource category and its extent in the town is provided, as well as any known or potential threats to that resource. Discussion of the important natural resources that should be prioritized for long-term protection and recommendations for improving conservation and protection measures for the identified resources are also provided.

1.5 DISCLAIMER AND DATA LIMITATIONS

Much of the data utilized in this NRI is comprised of stock data sets obtained from the state GIS clearinghouse, NH GRANIT. Many of these data layers were created from remotely sensed data (e.g., aerial photography, digital orthophotos, satellite images) and large landscape-level mapping projects. As a result, the data layers are intended to be viewed at certain scales (generally 1:24,000/1:25,000) and have specific accuracy levels. NH GRANIT maintains a continuing

program to identify and correct errors in these data but makes no claims as to the validity or reliability, or to any implied uses of, these datasets. As a result, **the data presented herein should be used for planning purposes only.** If greater data precision is required, this inventory should be supplemented with field surveys or other on-the-ground methods of data collection.

There may also be minor data discrepancies throughout this document due to the variety of source materials and mapping standards used. The reader is encouraged to refer to the original referenced sources if specific data inconsistencies need to be resolved. Geographic information system (GIS) data presented in the maps within Appendix A represents the best currently available data and information at the time of data collection. Cross-comparison with the Rye Conservation Commission's records indicates that some of the state-level data for Rye is outdated. One example is the Conservation Parcel information. To ensure that this NRI used the most current information, data was retrieved from both the NH GRANIT database and the Town of Rye Assessor's office. FBE, in consultation with the Rye Conservation Commission, updated the GIS information for use in this document.

1.6 PROJECT AREA

Rye is situated on New Hampshire's Seacoast region between Interstate 95, the Piscataqua River Estuary, and the Atlantic Ocean, and borders the city of Portsmouth and the towns of Greenland, North Hampton, and New Castle. Encompassing 8,580 acres (approximately 13 square miles) in Rockingham County, Rye contains eight miles of Atlantic Ocean coastline and the notable coastal attractions of Wallis Sands and Jenness State Beaches, Odiorne Point and Rye Harbor State Parks (Appendix A, Map 1). According to 2019 census data, the population of Rye reached 5,470, an increase of 172 individuals or 3.2% over the 2010 population of 5,298. Rye's bustling and historic community attracts visitors due to its cultural heritage and natural beauty, offering many recreational opportunities such as swimming, trail walking, bird watching, fishing, cycling, and cross-country skiing. Outdoor enthusiasts also come to Rye for sailing, kayaking, stand up paddle boarding, surfing, and whale watching tours.

Rye Harbor

Photo Credit: seacoastlately.com

2. WATER AND GEOLOGIC RESOURCES

Water resources including both surface waters and groundwater resources are some of a community's most valuable assets. Most drinking water sources – whether public or private – depend on subsurface water in sand and gravel aquifers or bedrock. Wetlands, both estuarine and freshwater, provide habitat for a diverse array of wildlife, provide flood storage and resilience, and protect both water quantity and water quality. Surface waters and their floodplains also offer flood attenuation, wildlife habitat, and recreation, and are key scenic resources. These aspects of Rye's water resources are discussed in detail below.

2.1 MAJOR WATERSHEDS

Precipitation hitting the land surface will either seep below the soil as groundwater or flow downhill as runoff, until it reaches a water body. A watershed is a unit of the land surface formed by topographic divides that direct water toward a given water body. Rain falling on one side of the divide drains into one water body, while rain falling on the other side of the divide drains to a different water body, and each water body has its own watershed. Watersheds can be identified and mapped by tracing a line along the highest elevations, often along high points and ridgelines. Activities, impacts, or changes on the landscape within a given watershed are passed downstream by the water flowing through or across the watershed that reaches the receiving waterbody.

The majority of Rye is within the Berry's Brook-Rye Harbor drainage (Hydrologic Unit Code ID: 010600031002), as defined by the US Geological Survey (USGS). Within the Berry's Brook-Rye Harbor drainage, FBE delineated the following eleven sub-watersheds using ArcGIS analyses: Bailey Brook, Berry's Brook, Chapel Brook, Unnamed tributary drainage (Golf Course drainage), Rye Harbor North, Rye Harbor South, Seavey Creek, Parsons Creek North, Parsons Creek West, Witch Creek, and direct drainage to the Piscataqua River Estuary and the Atlantic Ocean. As shown in Appendix A, Map 2, the area labeled "Direct Drainage" is comprised of areas of the watershed where surface water runoff flows directly into a body of water without first flowing into a stream, as is the case with Portsmouth Harbor, Hampton Harbor, and the Atlantic Ocean.

2.2 SURFACE WATERS

2.2.1 PONDS AND STREAMS

Ponds and streams are key elements of aquatic ecosystems that provide valuable habitat for fish, wildlife, and plants, as well as important recreational opportunities including swimming, boating, and fishing. These values depend on good water quality, which can be threatened by some human activities in the surrounding watershed. Ponds are classified into three trophic classes based their biological productivity, or the amount of living material supported within them, primarily in the form of algae. Oligotrophic ponds are prized for their clear waters, while eutrophic ponds typically experience regular algae blooms. Ponds are sensitive to the nutrients they receive from waters that drain their watersheds. Nutrients are needed for natural growth, but excessive nutrients, especially phosphorus, can encourage excessive growth of algae and cyanobacteria in ponds, a process known as eutrophication.

Rye Coastline
Photo Credit: NewEnglandWithLove.com

Rye contains 114 acres of waterbodies classified as "Lake/Pond," comprising approximately 1.3% of the town's total area. The largest, Eel Pond, is a 39-acre pond at the southeastern end of Rye. Eel Pond has been classified by the New Hampshire Fish & Game Department (NHFGD) as a eutrophic warm water fishery supporting white perch (*Morone americana*) with a maximum depth of four feet (NHFGD, n.d. a).

Rye is also home to 42 miles of mapped streams, both freshwater and tidal. Some of the ponds and streams in Rye discharge to the Piscataqua Estuary (a portion of which is known as Little Harbor), including Berry's Brook, Seavey Creek, and Witch Creek, while the rest flow to the Atlantic Ocean (Parsons Creek and Bailey Brook). Some small streams are not included in the above estimate because they are not mapped. Intermittent streams, which carry water for only a portion of the year, are often too small to be captured in regional mapping studies. Mapped or not, streams and their adjacent riparian corridors are important habitat and travel corridors for the town's terrestrial and aquatic wildlife. In addition, many bird species are attracted to water and the food sources that are located nearby. There are five named watercourses in Rye (Table 1) and numerous miles of additional unnamed streams in the town.

Trophic Classes of Ponds

Oligotrophic ponds are the most pristine and are characterized by high water clarities, low nutrient concentrations, low algae concentrations, minimal levels of aquatic plant weed growth, and high dissolved oxygen concentrations near the pond bottom.

Eutrophic ponds have low water transparencies, high nutrient concentrations, high algae concentrations, large stands of aquatic plants, and very low dissolved oxygen concentrations near the pond bottom.

Mesotrophic ponds have qualities between those of oligotrophic and eutrophic lakes. It is important to note, however, that not all eutrophic ponds are so due to human activity. Shallow waterbodies with forested watersheds with extensive wetlands, may be naturally eutrophic.

The State of New Hampshire uses a stream order system to classify rivers and streams. Stream order is a method for classifying the relative location of a stream reach within the larger river system. Streams that have no branches are designated as first-order streams. When two first order streams come together, they form a larger, second-order stream. When two second-order streams come together, they form a larger, third-order stream, and so on (See illustration below, Figure 1).

Town of Rye and Estuary

Photo Credit: WallpaperFlare.com

Fourth order and higher streams are protected under the NH Comprehensive Shoreland Protection Act. Headwater Streams (first-order streams) that have a watershed area of less than one square mile are considered "primary" headwater streams. The health of larger streams, rivers, and other surface waters downstream in a watershed, depends in part upon an ecologically healthy and functioning primary headwater stream network. Headwater streams are particularly important for maintaining water quality due to the sheer number of square miles that drain into them in most watershed drainage systems, and their ability to attenuate contamination if they are conserved. In Rye, headwater streams account for 51% of total mapped stream miles (see Appendix A Map 1 and Table 1).

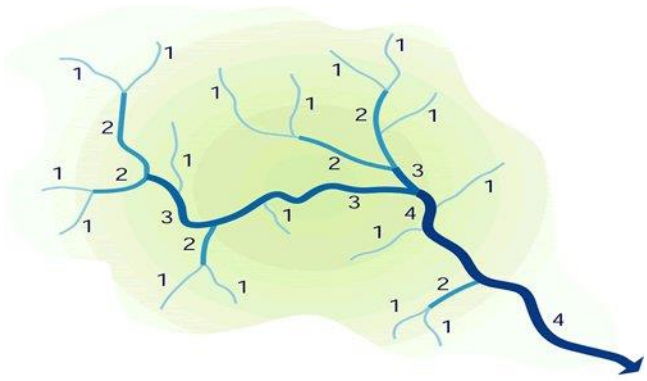


Figure 1. Illustration of the stream order system used in New Hampshire (USEPA, n.d.)

These areas contain especially important natural resources and provide important habitat, which are vulnerable to degradation by improper forestry practices and land use changes. Protections put in place by state regulations can also threaten the delicate ecosystem of streams in Rye or public health. For example, NHFGD states that "all fish species caught [in Berry's Brook] must be immediately released" due to elevated concentrations of mercury, PCBs, and dioxin in the water of Berry's Brook (NHFGD, 2020a). Following rules set by NHFGD helps ensure fish populations remain stable and ecosystems remain balanced.

Table 1. Order and length of named watercourses in Rye, NH.

Watercourse Name	Stream Order	Length in Rye (miles)
Bailey Brook	1-3	3.8
Berry's Brook	1-4	4.5
Parsons Creek	1-3	2.6
Seavey Creek	3	1
Witch Creek	1-4	2.2

If adequately conserved, primary headwater streams protect the quality and value of larger streams, rivers, lakes, and estuaries. The benefits provided by primary headwater streams include reduction of sediment delivery downstream, reduction in nutrient loading (nitrogen and phosphorus), flood storage and control, and aquatic habitat. Primary headwater streams and their adjacent vegetation provide areas for wildlife habitat and add protection for fish and other animals living in the primary headwater streams and the larger streams into which they feed (Ohio EPA, 2015).

Disruption of the hydrologic and biological processes of primary headwater streams takes a cumulative toll on the health of the whole river system. Proper functioning of primary headwater streams can help maintain base flow (the amount of stream flow which is maintained between precipitation or snow melt events) downstream in times of drought. Primary headwater streams

are a key determinant in the overall condition of the river system (Ohio EPA, 2015). Maintaining good water quality in headwater streams is also critical to overall watershed health.

2.2.2 FRESHWATER AND TIDAL WETLANDS

Wetlands are an integral part of Rye's natural resources. They remove excess nutrients and sediment from water, slow the flow of and store floodwaters, promote groundwater infiltration, and provide habitat for a vast array of vegetation and wildlife. Wetlands also provide recreational, educational, and research opportunities while adding to the visual resources of the town (US Fish & Wildlife Service, 2021).

The National Wetlands Inventory (NWI) administered by the US Fish and Wildlife Service is the most important national-scale data source for wetland maps and classifications. The principal types of wetlands with standing water in the spring have been mapped from aerial photos and can be easily viewed, downloaded, and shared online as GIS files. The resulting NWI maps contain errors of omission (and less frequently, errors of commission) and therefore do not depict all wetlands in a given area, as some are not easily detected by examining aerial imagery, especially small wetlands and vernal pools. Vernal pools are seasonal depressional wetlands that typically fill during the spring or fall. They are often small and under forest canopy which makes them difficult to detect on aerial imagery. Therefore, it is likely that NWI maps underestimate the number of wetlands in Rye. While these inaccuracies are known to exist in NWI data, the NWI maps nevertheless are very useful in serving as a baseline reference to locate wetlands.

There is a diversity of wetland types in Rye, including palustrine, lacustrine, estuarine, and marine wetlands (see inset to the right). Rye contains approximately 2,563 acres of mapped wetlands, representing approximately 30% of the town's total area (Table 2; Appendix A, Map 6). See Section 4.1.2 for a description of hydric soils in Rye.

Wetland Types Defined

Palustrine: Non-tidal, freshwater, wetlands dominated by emergent and woody vegetation (trees, shrubs, ferns, forbes, mosses, or lichens). Or, wetlands that contain the following: (1) < 20 acres, (2) lacking active wave-formed or bedrock shoreline features, (3) water depth is < 8.2 ft, and (4) salinity from ocean-derived salt water is < 0.5 ppt.

Lacustrine: Wetlands that are located in a topographic low point, contain ≤ 30% of emergent vegetation, are ≥ 20 acres. If active wave-formed or bedrock shoreline features are present or the maximum water depth is > 8.2 ft, a wetland < 20 acres can be classified as Lacustrine. These wetlands can be either tidal or non-tidal as long as salinity concentrations from ocean waters are < 0.5 ppt.

Estuarine: Deepwater tidal habitats semi enclosed by land with unobstructed or sporadic access to an open ocean. Estuarine waters consist of mixing freshwater and marine waters.

Marine: Areas of open ocean exposed to wave action and tidal fluctuations. Salinity concentrations are > 30 ppt. Examples include shallow bays and coasts with exposed rocky islands.

(US Fish & Wildlife Service, 2021)

Wetlands in the United States are typically classified using the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin, Carter, Golet, & LaRoe, 1979). This water resource classification system was developed by the United States Fish and Wildlife Service (USFWS) and is commonly referred to as "Cowardin Classification" (Appendix B). The Cowardin

Classification is used to define wetlands and other aquatic resources by their landscape position, cover type, and hydrologic regime (see Section 4.1.2 for a discussion on hydric soils). Special modifiers can be added that describe water regime/chemistry, soil types, or disturbances.

For the purpose of this document, wetlands are grouped according to the Cowardin System, Subsystem, and Class. Note however that in the section below, wetlands appearing on New Hampshire Wildlife Action Plan (NHWAP) maps are simplified and combined as one of five categories – Floodplain Forests, Northern Swamps, Temperate Swamps, Peatlands, Marsh and Shrub Wetlands.

Table 2. Rye, New Hampshire wetlands and associated Cowardin classifications.

Cowardin Classification	Acres	Percent Total Wetland Area
Aquatic Bed, Intertidal, Estuarine (E2AB)	14	0.5
Emergent, Intertidal, Estuarine (E2EM)	649	25.3
Unconsolidated Shore, Intertidal, Estuarine (E2US)	224	8.7
Aquatic Bed, Littoral, Lacustrine (L2AB)	43	1.7
Aquatic Bed, Intertidal, Marine (M2AB)	22	0.9
Persistent, Emergent, Palustrine (PEM1)	60	2.4
Palustrine forested broad-leaved deciduous (PFO1)	902	35.2
Palustrine forested needle-leaved evergreen (PFO4)	317	12.4
Palustrine forested (dead trees) (PFO5)	14	0.6
Broad-Leaved Deciduous, Scrub-Shrub, Palustrine (PSS1)	284	11.1
Semi-permanently flooded ponds (PUBF)	4	0.2
Permanently flooded ponds (PUBH)	29	1.1
Total	**2,563**	**100**

2.2.3 VERNAL POOLS

The authoritative resource on the science and conservation of vernal pools is provided by Calhoun and Klemens (2012) *Best development practices: conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States.* They give the following description of vernal pools:

> ...seasonal bodies of water that attain maximum depths in spring or fall and lack permanent surface water connections with other wetlands or water bodies. Pools fill with snowmelt or runoff in the spring, although some may be fed primarily by groundwater sources. The duration of surface flooding, known as hydroperiod, varies depending upon the pool and the year; vernal pool hydroperiods range along a continuum from less than 30 days to more than one year (Semlitsch, 2000). Pools are generally small in size (< 2 acres), with the extent of vegetation varying widely. They lack established fish populations, usually as a result of periodic

> drying, and support communities dominated by animals adapted to living in temporary, fishless pools. In New Hampshire they provide essential breeding habitat for one or more wildlife species including Ambystomatid salamanders (*Ambystoma* spp., called "mole salamanders" because they live in burrows), wood frogs (*Lithobates sylvaticus*), and fairy shrimp (*Eubranchipus* spp.).

Vernal pools can either be stand-alone (referred to as "classic" vernal pools) or part of larger wetland complexes (e.g., an area of pooled water in a large, forested wetland). The pools and their adjacent terrestrial habitat contribute significantly to the overall biodiversity of Northeastern landscapes. They produce large quantities of frogs that serve as the base of the food chain. Even though vernal pools typically cover a small area, they provide numerous important functions including flood water detention, aquifer recharge, nutrient cycling, and denitrification. However, due to their small size and seasonality, vernal pools are often overlooked or discounted and are therefore disproportionately impacted by development, notably suburban sprawl (Klemens, Davison, & Oko, 2012).

Vernal pools undoubtedly exist and have been identified in Rye. As of the writing of this report, however, there have been no formal public efforts to survey and map vernal pools throughout the town except when development is proposed, and wetlands are mapped by the applicant's wetland scientist.

2.2.4 PRIME WETLANDS

New Hampshire law provides a unique process for towns to enact special protection for "Prime Wetlands" in their jurisdiction. The New Hampshire Department of Environmental Service's Prime Wetlands in New Hampshire Communities webpage (Bennett, 2012) provides the following description:

> Under New Hampshire law (RSA 482-A:15 and administrative rules Env-Wt 700), individual municipalities may elect to designate wetlands as "prime wetlands" if, after thorough analysis, it is determined that high-quality wetlands are present. Typically, a wetland receives this designation because of its large size, unspoiled character, and ability to sustain populations of rare or threatened plant and animal species. Field and "desktop" data are used for the evaluation process.
>
> After high-value wetlands are identified, the municipality holds a public hearing before the residents of the community to vote on the designation. Once the municipality approves the wetlands for designation as prime, the municipality provides to the Department of Environmental Services (DES) Wetlands Program a copy of the study and tax maps with the designated prime wetlands identified. DES reviews the submission from the municipality to ensure that it is complete and in accordance with Env-Wt 702.03.
>
> Once the town's prime wetland submission is considered complete and approved, DES will apply the law and rules that are applicable to any future projects that are within the prime wetland or the 100-foot prime wetland buffer.

There are currently 33 towns in New Hampshire that have designated prime wetlands. This designation provides a means by which these towns can provide additional protection to wetlands that are particularly unique or sensitive to disturbance by restricting construction or earthwork in

Saltmarsh in Rye

Photo Credit: FBE

or within 100 feet of these resources. Currently, Rye does not have any wetlands with this designation, though the Wetland Conservation District (§ 190-3.1 of the Rye Code) does provide rules and regulations for the protection of wetlands beyond state regulations.

2.2.1 THE ATLANTIC OCEAN

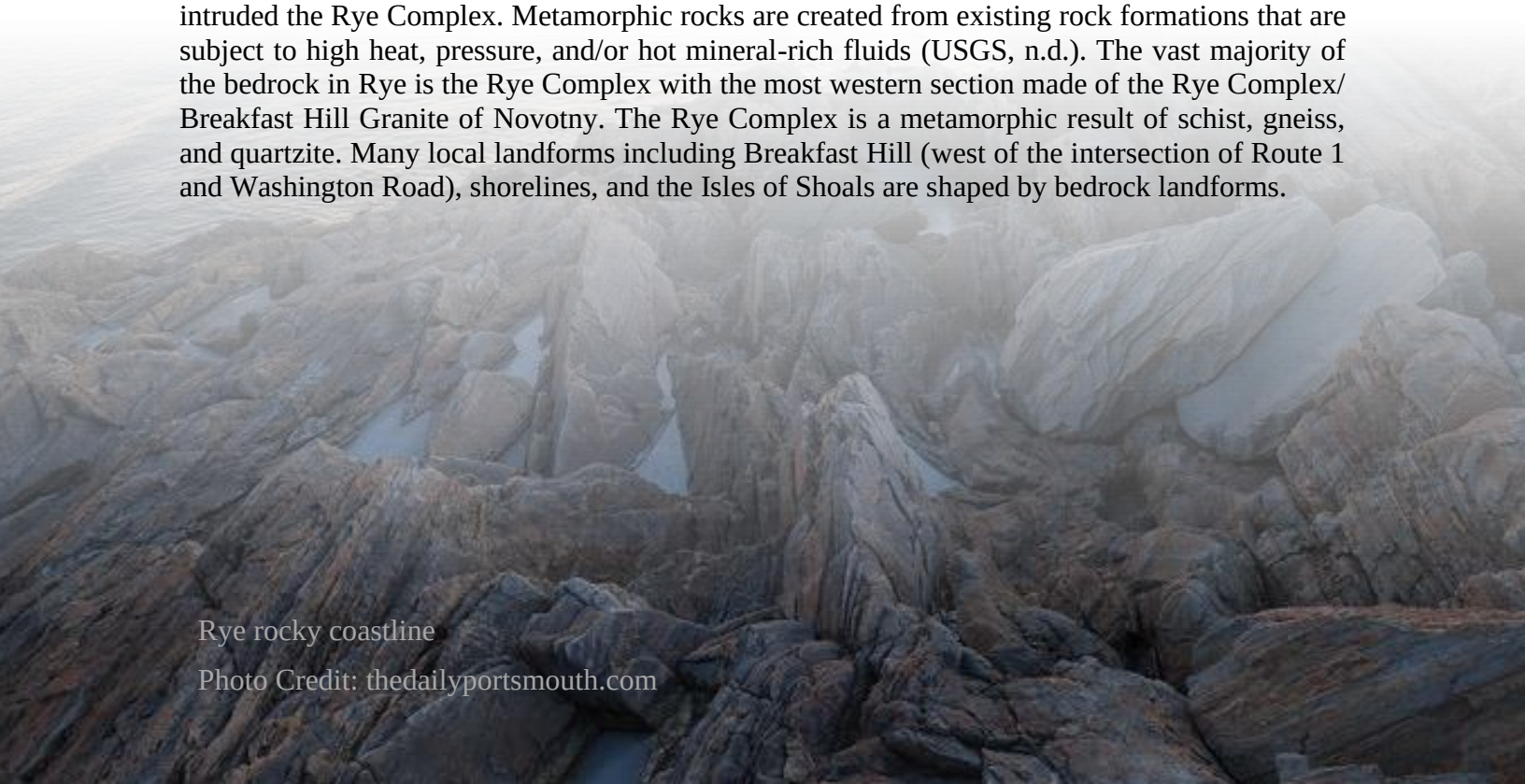
The coastline of Rye covers approximately eight miles and represents 52% of the New Hampshire mainland coastline. Waters along Rye's coastline are derived from the Labrador Current or the "Cold Wall" current which brings cool, oxygen rich water south from the Davis Strait, through the Labrador Sea, and along the northeast coast of the United States. These currents and the nearshore rocky geologic features create the habitats necessary to sustain the fisheries and recreational opportunities that have played key roles in Rye's history (see Section 2.6 Aquatic & Marine Habitats). Four of the Isles of Shoals are within the jurisdiction of Rye: Star Island, White Island, Lunging Island, and Seavey Island. These rocky islands in the Atlantic Ocean are a haven for coastal wildlife, are an integral part of the scenic resources in Rye, and a key element of the history of settlement in Rye. For more about the Isles of Shoals, see Section 5.1.4.

2.3 BEDROCK, SURFICIAL GEOLOGY AND SAND AND GRAVEL RESOURCES

2.3.1 BEDROCK GEOLOGY

Bedrock geology describes the solid rocks underlying the looser and softer soils, sediments, and deposits at the Earth's surface. A region's bedrock sets the template for the formation of the soils, surficial geology, rivers, lakes, and other features of the landscape. Over eons, bedrock, along with the shallow deposits of materials left by the retreating glaciers mixed with oceanic elements, is weathered and transformed into soil. For this reason, geologists term the underlying rocks the "parent material" of soils.

The bedrock underlying Rye is of metamorphic origin, meaning rocks formed by transformation of older rocks under tremendous heat and pressure deep below the surface. From two converging rock formations, a migmatite was created when a quartz-feldspar granitic gneiss and pegmatite intruded the Rye Complex. Metamorphic rocks are created from existing rock formations that are subject to high heat, pressure, and/or hot mineral-rich fluids (USGS, n.d.). The vast majority of the bedrock in Rye is the Rye Complex with the most western section made of the Rye Complex/ Breakfast Hill Granite of Novotny. The Rye Complex is a metamorphic result of schist, gneiss, and quartzite. Many local landforms including Breakfast Hill (west of the intersection of Route 1 and Washington Road), shorelines, and the Isles of Shoals are shaped by bedrock landforms.



Rye rocky coastline

Photo Credit: thedailyportsmouth.com

2.3.2 SURFICIAL GEOLOGY

Surficial geology describes the looser rocks and unconsolidated materials that lie above bedrock and below the ground surface. Understanding surficial geology is important because the characteristics of materials below the earth's surface influence soils, water resources, and the feasibility of constructing buildings, utility lines, and roads. Materials deposited by running water typically consist of sand and gravel carried into valleys and other low-lying areas.

Between 10,000 and 15,000 years ago, the land area of New Hampshire emerged from the last ice age. The melting and receding ice caused dramatic changes in the landscape. Mountains were rounded by glacial erosion. Chunks of bedrock were picked up and dragged for miles, then left behind as the large glacial boulders, called erratics. When the glaciers receded, the rock and debris frozen within the ice were left behind in various formations, depending largely upon the speed at which the glacier receded and how much melting water was flowing from the glacier. These formations contain various sized particles and are classified by the shape of formation, the thickness, and the type and size of particles found (Goldthwait, Goldthwait, & Goldthwait, 1951).

Streams and rivers flowing from the melting glaciers formed the stratified drift aquifers (layered sand and gravel) now used for many water supply wells. Stratified drift aquifers have been surveyed statewide by the USGS using drilling and data extrapolation methods (Mack & Lawlor, 1992). Other finer materials such as silts and clays are deposited in still or slow-moving water in marshes, lakes, ponds, and bays. The pattern of a general northwest to southeast direction of the receding glaciers of over 12,000 years ago can be seen today in most of New England (Billings, 1980). This process formed the rivers, lakes, and wetlands that we see today.

Along with bedrock, surficial deposits commonly determine soil composition and therefore may affect agricultural viability. Sections 4.1 Soils of Special Importance and 2.4.1 Aquifers & Groundwater provide more details on some of the natural resources in Rye that are influenced by the area's surficial geology. Further details about New Hampshire geology are available at *www.nhgeology.org*.

2.3.3 SAND AND GRAVEL RESOURCES

According to Google Earth imagery (10/10/20), there are no active sand or gravel pits in the Town of Rye. Former areas of gravel extraction in town include the Garland Well area, Grove Road Landfill, and the current transfer station. Sand and gravel extraction operations remove vegetation from target parcels of land to extract the underlying geologic resources. If improperly managed, this process can contribute to erosion and sedimentation of nearby waterways. There are three areas identified by the USGS's open-source soil data platform, the Web Soil Survey, as "pits, sand and gravel" in Rye; however, inspection via Google Earth imagery revealed all three areas are forested and/or developed; no open excavation is present.

2.4 AQUIFERS, GROUNDWATER, WELLS, AND WELLHEAD PROTECTION AREAS

2.4.1 AQUIFERS AND GROUNDWATER

An aquifer is a geologic unit or formation, such as sand and gravel deposits or fractured bedrock, that contains a useable supply of water. A stratified drift aquifer consists mainly of layers of sand and gravel, which are saturated and can yield water to wells or springs. In New Hampshire,

stratified drift aquifers are the most productive in supplying large-volume water needs such as public water supply wells (Medalie & Moore, 1995). Based on GIS data obtained from NH GRANIT, approximately 1,696 acres (20% of Rye's land area) is underlain by stratified drift aquifers. A key measure of an aquifer's ability to supply water is transmissivity, the amount of water that can pass through the entire saturated thickness of the aquifer (ft^2/d). Some of Rye's stratified drift aquifers have very high transmissivity of over 4000 ft^2/d. These areas are mostly found in the southern half of the town spanning an area approximately from the intersection of Washington Road and Central Road to the southwestern town border and east to approximately the intersection of Central Road, and Cable Road (Appendix A, Map 3). A high-yielding fractured bedrock aquifer also underlies much of Rye. The Rye Complex (OZrz) is the source of groundwater for three public water supply wells. Also identified in Appendix A, Map 3, are state-designated Groundwater Classification Areas represented by transmissivity. These areas are all classified by the NHDES as class GA2, or "high-yield stratified drift aquifers mapped by the USGS that are potentially valuable sources of drinking water" (NHDES, The New Hampshire Groundwater Protection Act: RSA 485-C, An Overview., 2020).

2.4.2 WELLS AND WELLHEAD PROTECTION AREAS


Photo Credit: Rye Water District

The Rye Water District provides drinking water for most Rye residents. Operating from three wells along Garland Road, the Water District serves approximately 4,000 residents and maintains 300 hydrants (Rye Water District, 2021). The first of these wells, the Garland Well, was established in 1977 to pump water from the stratified drift aquifer in an effort to transition away from purchasing and piping drinking water from the City of Portsmouth. Two additional wells, Bailey Brook and Cedar Run, were later installed to provide additional supply. Drinking water is still purchased from the City of Portsmouth for residents along Wentworth Road, Heather Drive, Harborview Road, Frontier Road and Elizabeth Lane. Additionally, the Jenness Beach and Rye Beach areas are supplied by water from Aquarion Water Company in Hampton, New Hampshire. A public well on Central Road near Cable Road is also in the Aquarion Water Company well network.

Each of the Rye Water District and Aquarion wells are surrounded by a sanitary radius up to 400 feet. These wells are also surrounded by wellhead protection areas (WHPAs) which expand past the sanitary radius to include the area from which groundwater flows to the well (Appendix A, Map 3). The size of this radius varies depending on how many gallons of water per day are extracted from the aquifer. Both the sanitary radius and WHPA are designed to protect the drinking water sources from contamination. This helps protect water quality and public health and avoids increased costs of additional water treatment caused by contamination. NHDES provides grants and technical assistance to communities to protect groundwater supplies, with the preferred approach of permanently protecting "sensitive areas immediately around public water supply wells" through land conservation. In addition, managing land use activities by following best management practices (BMPs) and the prohibition of high-risk activities within the immediate areas through local controls (NHDES, 2015) protects groundwater.

The wellhead protection areas cover 38% of the area of Rye. Approximately 14% of these wellhead protection areas is under permanent land conservation. The entire extent of the wellhead protection areas is additionally safeguarded by the Rye Planning Board's Aquifer and Wellhead Protection overlay district (Appendix A, Map 3).

2.4.3 SOURCES OF CONTAMINATION

The US Clean Water Act (CWA) categorizes sources of pollutants such as nutrients into two major groups: point source pollution and nonpoint source (NPS) pollution. Point sources are regulated under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program. This section describes these two types of pollution, their key contributing sources, and the process of regulating and controlling pollutants.

Point Source Contamination Sources

Point source pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal treatment plant, permitted stormwater outfall, or a regulated animal feeding operation, making this type of pollution relatively easy to identify. According to the CWA and Regulations of Connecticut State Agencies (RCSA) § 22a-426-1-9, point sources are defined as follows:

> *"Point source means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture."*

Section 402 of the CWA requires all such point source discharges to be regulated under the NPDES program to control the type and quantity of pollutants discharged. NPDES is the national program for regulating point source pollution through issuance of permit limitations specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and 405 of the CWA.

The NHDES operates and maintains the OneStop database and data mapper which houses data on Potential Contamination Sources (PCS) within the State of New Hampshire. Identifying the types and locations of PCS within the watersheds may help identify sources of pollution and or areas to target for restoration efforts. Within Rye, these data identify potential sources of pollution to both surface water and groundwater resources. See Appendix F and Appendix A, Map 3 for potential point sources of pollution in Rye.

Non-point Source Contamination Sources

Fertilizers: When lawn and garden fertilizers are applied in excessive amounts, in the wrong season, or just before heavy precipitation, they can be transported by rain or snowmelt runoff to streams, wetlands and other surface waters where they can promote cultural eutrophication and impair the recreational and aquatic life uses of the waterbody.

Agriculture: Agriculture in the Town of Rye includes small patches of cropland and pastureland. Agricultural activities, including horse boarding and riding, community gardens, and residential gardens add to the aesthetic of Rye, but when improperly managed can be sources of excess nutrients entering Rye's surface waters through stormwater runoff.

Agricultural activities and facilities with the potential to contribute to nutrient impairment include:

- Plowing and earth moving
- Fertilizer and manure storage and application
- Livestock grazing
- Animal feeding operations and barnyards
- Paddock and exercise areas for horses and other animals and
- Leachate from haylage/silage storage bunkers

Diffuse runoff of farm animal waste from land surfaces (whether from manure stockpiles or cropland/pastureland where manure is spread), as well as direct deposition of fecal matter from farm animals adjacent to surface waters, are significant sources of agricultural nutrient pollution in surface waters (EPA, 2003). Farm activities like plowing, livestock grazing, vegetation clearing, and vehicle traffic can also result in soil erosion which can contribute to nutrient pollution.

Excessive or ill-timed application of fertilizer or poor storage which allows nutrients to wash away with precipitation not only endangers streams, ponds, and other waters, but also means those nutrients are not reaching the intended crop or lawn. The key to nutrient application is to apply the right amount of nutrients at the right time. When appropriately applied to soil, synthetic fertilizers or animal manure can fertilize crops and restore nutrients to the land. When improperly managed, fertilizers and manure can enter surface waters through several pathways, including surface runoff and erosion, direct discharges to surface water, spills, and other dry-weather discharges, and leaching into soil and groundwater.

Pets: In residential areas, fecal matter from pets can be a significant contributor of nutrients and fecal pathogens to surface waters. On average, a dog produces 200 grams of feces per day, containing concentrated phosphorus and nitrogen (CWP, 1999). If pet feces are not properly disposed, these nutrients can be washed off the land and transported to surface waters by stormwater runoff. Pet feces can also enter surface waters by direct deposition of fecal matter from pets standing or swimming in surface waters.

Wildlife: Fecal matter from wildlife such as geese, gulls, other birds, deer, and beaver may be a significant source of nutrients and pathogens in some watersheds. This is particularly true when human activities, including the direct and indirect feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP, 1999). Congregations of geese, gulls, and ducks are of concern because they often deposit their fecal matter next to or directly into surface waters. Examples include large, mowed fields adjacent to streams where geese and other waterfowl gather, as well as the underside of bridges with pipes or joists directly over the water that attract large numbers of pigeons or other birds. Studies show that geese inhabiting riparian areas increase soil nitrogen availability (Choi, et al., 2020) and gulls along shorelines increase phosphorus concentration in beach sand pore water that then enters surface waters through groundwater transport and wave action (Staley, He, Shum, Vender, & Edge, 2018). When submerged in water, the droppings from geese and gulls quickly release nitrogen and phosphorus into the water column, contributing to eutrophication in freshwater ecosystems (Mariash, Rautio, Mallory, & Smith, 2019). On a global scale, fluxes of nitrogen and phosphorus from seabird populations have been estimated at 591 Gg N per year and 99 Gg P per year, respectively (with the highest values derived from arctic and southern shorelines) (Otero, De La Peña-Lastra, Pérez-Alberti, Osorio Ferreria, & Huerta-Diaz, 2018). Additionally, other studies show greater concentrations of nitrogen, ammonia, and dissolved organic carbon downstream of beaver impoundments when compared to similar

streams with no beaver activity in New England (Bledzki, Bubier, Moulton, & Kyker-Snowman, 2010).

***Septic Systems and Public Sewer*:** Rye is primarily serviced by individual or community septic systems. Residents and businesses in the southeastern portion of the town along Ocean Boulevard near Cable Road, Eel Pond, South Road, and Church Road are serviced by the Town of Hampton Wastewater Treatment Facility (CAI, n.d.).

Untreated discharges of sewage (domestic wastewater) are prohibited regardless of source. An example of an NPS discharge of untreated wastewater is from an illicit discharge of wastewater or insufficient or malfunctioning septic systems. When properly designed, installed, operated, and maintained, septic systems effectively reduce bacteria and phosphorus concentrations from sewage through the leach field. Nitrogen loading is more complex. Depending on soil type and groundwater conditions, some systems are a source of nitrates to groundwater and ultimately surface waters. Age, overloading, or poor maintenance can result in system failure and the release of nutrients, bacteria, and other pollutants into surface waters (EPA, 2002). Nutrients from undersized or poorly maintained systems can enter surface waters through surface overflow or breakout, stormwater runoff, or groundwater.

2.5 FLOODPLAINS AND FLOODWATER STORAGE

Floodplains are areas of low elevation typically adjacent to streams, rivers, estuaries, coasts, or other surface waters into which a water body overflows during high flow events such as heavy rain, storm surges, or snowmelt. Coastal flooding specifically is due to high wind and wave action, storm surges, and sea level rise associated with global warming. Floodplain areas are subject to reoccurring flooding. The Federal Emergency Management Agency (FEMA) produces flood hazard maps through the National Flood Insurance Program (NFIP) for communities as a resource for understanding and insuring against flood risk. FEMA's flood zones are based on the 100-year flood frequency (1% annual chance of being flooded during any year) and 500-year flood frequency (0.2% annual chance of being flooded during any year). When mapped, there is a small difference between the total area inundated with floodwaters under each scenario (See Appendix A, Map 4).

A 100-year flood is a term used to describe a storm that has a 1% chance (or 1-in-100 chance) of occurring in any given year. Relating this to a homeowner's mortgage, there is a one-in-four chance over a 30-year mortgage that a storm of this magnitude could occur and has the potential to cause flooding and damage (Wake, et al., 2019). FEMA reports that just one inch of floodwater can cause up to $25,000 in damage to a home (FEMA, n.d.). The baseline for determining the volume of precipitation produced by a 100-year storm comes from historical records of precipitation, groundwater and streamflow records, and computer modeling results. These models do not include projections of climate change impacts flooding hazard severity, notably future increases in the intensity and frequency of storms and future sea level rise. According to the *New Hampshire Coastal Flood Risk Summary – Part I: Science*, "The magnitude of daily extreme precipitation events has increased by 15-38% in NH's coastal watershed since the 1950s" (Wake, et al., 2019). According to the National Weather Service, a rainfall event producing between 6.29 and 12.3 inches of rain within a 24-hour period would be classified as a 100-year storm event (National Weather Service, n.d.). One recent example of a 100-year storm event was the Nor'easter that passed through the seacoast on March 5, 2018 (USGS, n.d.). Additional past significant flood events that have impacted Rye include superstorm Sandy in 2012 and a December 2011

Nor'Easter, both causing inland and tidal flooding, and the Patriot's Day Nor'Easter storm of 2007, causing inland flooding due to 6.5" inches of rain. In 2014-2016, King Tides also caused tidal flooding in Rye even in sunny weather (Town of Rye, 2017).

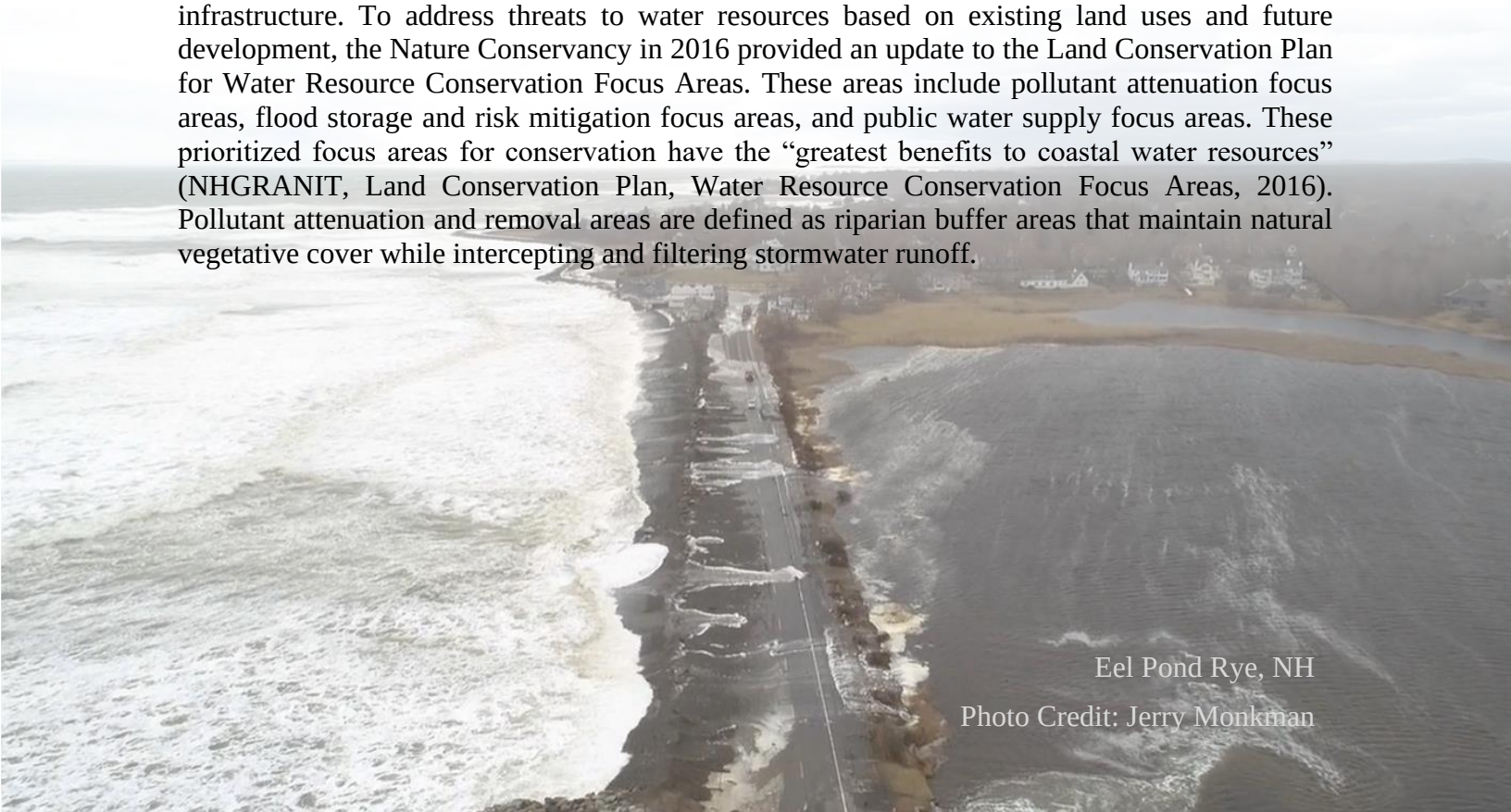
With the most coastal miles of New Hampshire's seven coastal municipalities and extensive freshwater and tidal wetlands, Rye's natural resource assets are particularly susceptible to flooding impacts and future increased severity of coastal storm surges (See Appendix A, Maps 4 and Map 5). At-risk areas include, but are not limited to, Odiorne Point State Park and neighborhoods along NH-1A, Parsons Road, and Straw's Point Road south of Rye Harbor.

Tidal and freshwater wetland systems provide essential flood storage capacity during storm events, and other coastal natural features such as beaches and rocky shoreline serve as natural defensive barriers to help protect against storm surges and erosion. Natural undeveloped land, especially on the coast, helps reduce Rye's risk and vulnerability to future increases in coastal storm flooding and sea level rise (Town of Rye, 2015).

With rising sea levels and increased storm surge, existing marsh systems may disappear, migrate inland to higher elevation, or a combination. High water levels can drown salt marshes, which in turn converts salt marshes into mudflats and mudflats into subtidal zones. In developed areas where there is no space for natural habitat to retreat or migrate inland, marshes may disappear altogether. Habitat and species loss will likely be greatest in areas where marsh systems cannot retreat or migrate inland. Storm surges can also cause sedimentation in habitat that lies behind beaches, smothering shellfish beds. Saltwater intrusion into freshwater wetlands can affect habitat that was formerly freshwater turned brackish (NH Coastal Risk & Hazards Commission, 2016). Altered coastal habitats can affect the timing of nesting and migration for seabirds (NHFGD, 2015).

2.5.1 FLOOD STORAGE AND RISK MITIGATION

Flood storage and risk mitigation areas are defined as areas that have high flood storage capacities, or sponge-like areas, that can reduce the risk of floods in downstream areas, or areas of lower elevations. These areas include those that will help mitigate the effects of sea level rise on infrastructure. To address threats to water resources based on existing land uses and future development, the Nature Conservancy in 2016 provided an update to the Land Conservation Plan for Water Resource Conservation Focus Areas. These areas include pollutant attenuation focus areas, flood storage and risk mitigation focus areas, and public water supply focus areas. These prioritized focus areas for conservation have the "greatest benefits to coastal water resources" (NHGRANIT, Land Conservation Plan, Water Resource Conservation Focus Areas, 2016). Pollutant attenuation and removal areas are defined as riparian buffer areas that maintain natural vegetative cover while intercepting and filtering stormwater runoff.



Eel Pond Rye, NH

Photo Credit: Jerry Monkman

The study used a computer model that has been widely applied to assess impacts of sea level rise on US coastal areas, the Sea Level Affecting Marshes Model (SLAMM), dividing flood storage areas into two tiers. Tier 1 is the top 30% (by area) of flood storage capacity and includes SLAMM conservation priorities up to 2 meters of sea level rise. Tier 2 is the top scoring flood storage areas in each HUC 12 watershed (hydrologic unit code that refers to a local watershed level) not included in Tier 1. In total, there are 2,113 acres of flood storage areas in Rye. These areas are primarily located in the northern portion of the town from Odiorne Point State Park, through the Parsons Creek sub-watersheds and along the western town boundary line in the Berry's Brook sub-watershed. These larger areas are also identified as risk mitigation areas and therefore containing a high priority for conservation efforts to minimize risk of sea level rise on developed areas. Additional flood storage areas are scattered along the coastal marshes west of NH-1A (Appendix A, Map 5).

Pollutant attenuation areas are also categorized into two tiers. Tier 1 areas are identified through GIS analyses, and Tier 2 areas are identified through manual inspections. (Appendix A, Map 5). In total, there are 2,741 acres of pollutant attenuation areas in Rye of which most are a part of the prioritized habitat blocks through the Connect THE Coast initiative (See Section 3.5 describing Wildlife Conservation Priority Areas).

2.5.2 SALT MARSH MIGRATION

Sea level rise is a growing concern for coastal communities across the world. According to the SLAMM, Rye currently has 3,089 acres of waters, marshes, swamps, and estuarine wetlands (36% of the town's total area) (of which 188 acres is open ocean). See Section 2.2.2 for a description of estuarine wetlands. Since intertidal wetlands directly connect to ocean tides and sea levels, these wetland types have been at the forefront of modeling for the effects of sea level rise on marsh ecosystems.

In 2014, the NHFGD ran the SLAMM for coastal communities to estimate the changes in marsh area and habitat type as a result of climate change (particularly sea level rise). Under different scenarios of sea level rise, this model tracks the rise of water levels and the salt boundary in 25-year time steps and predicts changes to wetland habitat based on known relationships between wetland types and tide ranges. For this NRI, results of this model were collected under the "protection-on" scenario to depict the potential for marsh migration into upland areas considering current land use and development. This scenario requires a low-elevation pathway to saline water. The purpose of these data is to guide conservation efforts protecting coastal wetland areas likely to provide the highest quality of wildlife habitat and withstand the longest in the wake of climate change (NHGRANIT, 2014).

Three different scenarios were conducted to model the estimated changes in salt marsh area and habitat type (Table 3). Under the scenario that depicts 0.5 meters of SLR from 2000 to 2025, an additional 390 acres of Rye would become waters, marshes, and swamps, bringing the total area for these habitats to 3,479 acres (41% of Rye's total area). Under the scenario that depicts one meter of sea level rise from 2000 to 2025, 1,904 additional acres would become waters, marshes, and swamps in Rye to bring the total area of these habitats to 4,993 acres (58% of the town's total area). Under the final scenario of two meters of SLR from 2000 to 2025, 3,166 additional acres would become waters, marshes, and swamps in Rye, bringing the total area of these habitats to 6,255 acres (73% of the town's total area), more than double the initial condition. See Appendix C for the SLAMM wetland type definitions.

The habitat type that will increase in area the most is projected to be regularly flooded marsh areas, followed by tidal flats.

Table 3. Rye, New Hampshire SLAMM compared to the initial condition of 2000. Each scenario, 0.5-meter sea level rise (SLM), one meter, and two meters, are compared back to the initial condition, not to each other. The SLAMM model by the NHFGD does not include the Isles of Shoals.

Habitat Type	Initial Condition in 2020 (total acres)	0.5m SLR by 2025 (additional acres)	1m SLR by 2025 (additional acres)	2m SLR by 2025 (additional acres)
Estuarine Beach	**3**	0	**51**	**77**
Estuarine Water	**74**	**113**	**248**	**299**
Inland Fresh Marsh	**184**	0	0	0
Inland Open Water	**79**	0	0	0
Inland Shore	**2**	0	0	0
Irregularly Flooded Marsh	**615**	**167**	**191**	**203**
Ocean Beach	**48**	**1**	**164**	**245**
Ocean Flat	**2**	0	0	0
Open Ocean	**188**	**4**	**15**	**23**
Regularly Flooded Marsh	**104**	**48**	**797**	**1,159**
Rocky Intertidal	**15**	0	0	0
Swamp	**1,286**	0	**9**	**10**
Tidal Flat	**261**	**15**	**42**	**627**
Tidal Fresh Marsh	**13**	0	0	0
Tidal Swamp	**212**	0	0	0
Transitional Salt Marsh	**2**	**42**	**387**	**523**
TOTAL:	**3,089**	**+390**	**+1,904**	**+3,166**

2.6 WATER QUALITY

The State of New Hampshire is required to follow federal regulations under the Clean Water Act (CWA) with some flexibility as to how those regulations are enacted. The main components of water quality regulations include designated uses, water quality criteria, and antidegradation provisions. The Federal CWA, the NH RSA 485-A Water Pollution and Waste Control, and the New Hampshire Surface Water Quality Regulations (Env-Wq 1700) form the regulatory basis for water quality protection in New Hampshire, including the state's regulatory and permitting programs related to surface waters. States are required to submit biennial water quality status reports to Congress via the USEPA. The reports are named for the relevant sections of the CWA; the first provides an inventory of all waters assessed by the state (the "Section 305(b) report") and the second lists the waterbodies that do not meet the state's water quality standards (the "Section 303(d) list").

2.6.1 DESIGNATED USES AND WATER QUALITY CLASSIFICATION

The CWA requires states to determine water quality standards for all surface waters in their jurisdiction. Water quality standards have two components, designated uses and water quality criteria. Designated uses are the desirable activities and services that surface waters should be able

to support, and include uses for aquatic life, fish consumption, shellfish consumption, drinking water supply, primary contact recreation (swimming), secondary contact recreation (boating and fishing), and wildlife. In New Hampshire, NHDES defines these designated uses (Table 4). Surface waters can have multiple designated uses. Water quality criteria are measurable numerical or qualitative thresholds that define whether a water body is safely providing the uses for which it is designated.

Table 4. Designated uses for New Hampshire surface waters (adapted from (NHDES, 2018)).

Designated Use	NHDES Definition
Aquatic Life	Waters that provide suitable chemical and physical conditions for supporting a balanced, integrated, and adaptive community of aquatic organisms.
Fish Consumption	Waters that support fish free from contamination at levels that pose a human health risk to consumers.
Shellfish Consumption	Waters that support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.
Drinking Water Supply After Adequate Treatment	Waters that with adequate treatment will be suitable for human intake and meet state/federal drinking water regulations.
Primary Contact Recreation	Waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water.
Secondary Contact Recreation	Waters that support recreational uses that involve minor contact with the water.
Wildlife	Waters that provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life.

In Rye, the following surface waters are classified as impaired for aquatic life due to the following reasons: Berry's Brook for dissolved oxygen saturation and pH, Eel Pond for dissolved oxygen saturation and chloride, and the Lower Sagamore Creek for dissolved oxygen and estuarine bioassessments. Criteria for Aquatic Life Use ensure that waters provide suitable habitat for the survival and reproduction of desirable fish, shellfish, and other aquatic organisms. Additionally, Berry's Brook, an unnamed brook to Marsh Road Pond, Parsons Creek, an unnamed brook to Bass Beach, Rye Harbor, Witch Creek, and the Atlantic Ocean to and surrounding the Isles of Shoals that are in New Hampshire are listed as impaired for fish consumption for polychlorinated biphenyls (PCBs). Criteria for Fish Consumption Use indicate a threshold in which waters support fish free from levels of contamination that pose a human health risk to those consuming the fish (Appendix A, Map 7).

Berry's Brook underwent testing in November 2016 for the presence and concentration of perfluorinated chemicals (PFCs), which have been associated with health concerns. PFCs are not naturally found within the environment and can persist for long periods. The Conservation Law Foundation, a state representative, and a group of residents performed the sample collection at Berry's Brook. According to this sampling, Berry's Brook was found to contain PFCs of 194 parts per trillion (ppt), 124 ppt higher than the EPA threshold of 70 ppt (Block, 2016). Additional

sampling under varying environmental conditions at multiple places is recommended to expand this database to better represent the Berry's Brook watershed.

As mentioned in Section 2.5.1, conservation efforts should prioritize areas with high pollutant attenuation and removal abilities such as riparian buffers of natural vegetative cover adjacent to waterways. Vegetative buffers slow the surface runoff of rainwater, limiting erosion associated with stormwater. In addition, vegetative buffers can help reduce the concentration of pollutants entering a waterbody or wetland (including chloride, nitrogen, phosphorus, bacteria, etc.) by up taking and retaining the stormwater and filtering sediment. In total, there are 2,741 acres of pollutant attenuation areas in Rye, of which most are a part of the prioritized habitat blocks through the Connect THE Coast initiative (see Section 3.5).

2.7 AQUATIC AND MARINE HABITATS

2.7.1 FISHERIES

Rye's coasts, estuaries, and tidal marshes and flats contain diverse fisheries and supporting habitats. Public access to recreational fishing is provided at the Rye Harbor Marina and Odiorne Point State Park on Little Harbor. Both sites have public boat ramps. Rye's coastal and marine habitats support fish, mammals, migratory birds, aquatic vegetation, microscopic communities and more. Some common marine mammal sightings include harbor porpoise, harbor seals, grey seals, harp seals, northern fur seals, fin whales, humpback whales, north Atlantic right whales, and pilot whales. Common fish species include striped bass, bluefish, American eel, alewife, rainbow smelt, and haddock. The presence of new species expanding their range to the waters offshore of New Hampshire is evidence of the warming waters. A total of 262 seabird and migratory species have been observed at the Isles of Shoals according to eBird (an online database of bird observations) and 305 bird species have been observed along the New Hampshire coast (eBird, 2021). There is likely a large overlap of species spotted from these two locations.

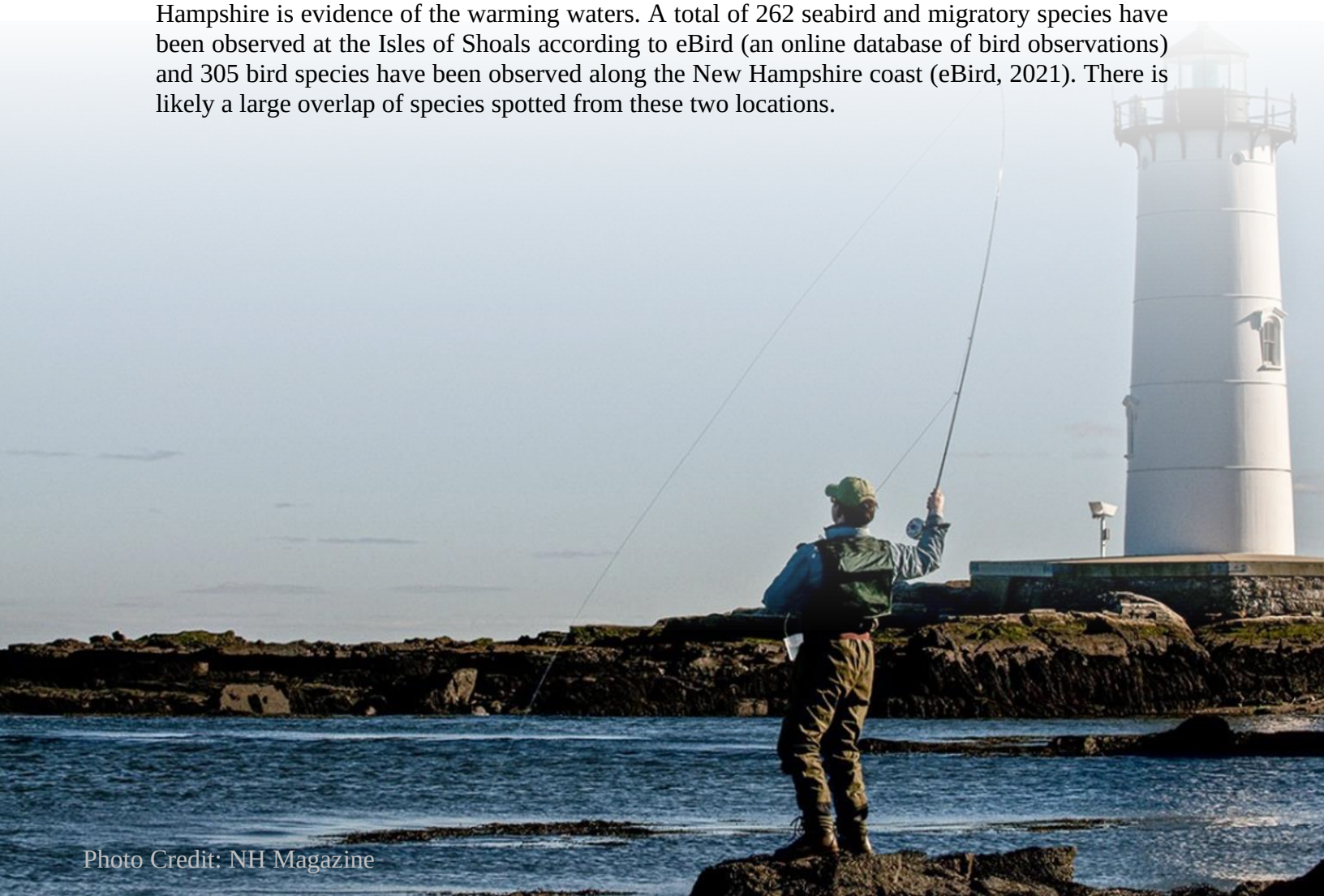


Photo Credit: NH Magazine

2.7.2 SHELLFISH

Shellfish harvesting, including aquatic shelled mollusks such as clams and oysters and crustaceans such as lobsters and crabs, plays a large role in Rye as it does in the culture of many coastal New England towns. These aquatic species provide many ecosystem functions including filtering sediment from the water column. Local fishermen supply restaurants and residents year-round (at the Rye Harbor Marina dock) with American lobster (*Homarus americanus*), Atlantic rock crab (*Cancer irroratus*), Jonah crab (*Cancer borealis*), dog whelks (*Nucella lapillus*), quahog/cherrystone (*Mercenaria mercenaria*), blue mussels (*Mytilus edulis*), eastern oysters (*Crassostera virginica),* softshell clams (*Mya arenaria*), little neck clams (*Protothaca staminea*), Atlantic surf clams (*Spisula solidissima*), razor clams (*Siliqua patula*), and Atlantic sea scallops (*Placopecten magellanicus*).

Invasive crabs pose a threat to native mollusk fisheries in Rye. The invasive green crab (Carcinas maenas) and the Asian shore crab (Hemigrapsus sanguineus) were first spotted in NH in the mid 1990's and 1998 (USGS, 2018). Due to their ability to thrive in a variety of environmental conditions, including warming ocean temperatures, they are threatening the NH native crustaceans. Unfortunately, there is no established fishery market for these crabs although green crabs are often used as a bait species. Current studies are underway by the NH Green Crab Project and local universities to find markets for these species to help maintain their overabundance and decrease the overpopulation and competition for resources with native crustaceans (USGS, Hemigrapsus sanguineus, 2018; New Hampshire Sea Grant, 2021).

Under the authority granted by RSA 143:21, RSA 143:21-a and RSA 487:34, NHDES uses a set of guidelines and standards known as the National Shellfish Sanitation Program (NSSP) for classifying shellfish growing areas (NHGRANIT, 2015). The town of Rye contains areas of approved shellfish harvesting (parts of the Atlantic Ocean), and areas of restricted, prohibited/ safety zone, or prohibited/ unclassified shellfish harvesting. Most noticeably, the

Shellfish Harvesting Classifications

Restricted: When marine water quality monitoring is not available for the area or if the sanitary survey shows a limited degree of pollution, including from non-human sources, the area may be classified as restricted. Shellfish harvested commercially from restricted growing areas cannot be marketed directly. They must be transplanted to approved growing areas for a specified amount of time, allowing shellfish to naturally cleanse themselves of any contaminants before they are harvested for market.[1]

Prohibited: This classification applies to growing areas near sewage treatment plant and industrial outfalls, marinas, and other pollution sources. Commercial shellfish harvests are not allowed from prohibited areas.[1]

Safety Zone: A designated portion of the shellfish waters adjacent to a source of contamination (such as an outfall) in which harvesting of shellfish would be prohibited. It exists between conditionally approved growing areas and the source of pollution.[2]

Unclassified: Waters that have not had a sanitary shellfish harvest area survey completed.[3]

[1] (EPA, 2021)
[2] (EPA, 1974)
[3] (FDACS, n.d.)

mouth of the Piscataqua River has been identified as a prohibited/safety zone, as well as Witch Creek and Berry's Brook estuaries. The waters within the Isle of Shoals archipelago contain the same designation. Restricted areas for shell fishing include radii around public beaches. Rye Harbor is classified as prohibited/unclassified for shellfish harvesting.

According to the 2018 NHDES 303(d) list of impaired waterbodies, Sagamore Creek, Eel Pond and Berry's Brook are listed as impaired for aquatic life. Additionally, the waters between Rye's mainland and the NH Isles of Shoals, part of Parsons Creek, and other smaller tributaries in the Seavey Creek and Berry's Brook drainage are listed as impaired for fish and or shellfish consumption due to elevated concentrations of polychlorinated biphenyls and/or Dioxin (including 2,3,7,8-TCDD) (NHDES, 2018). See Table 4 in section 2.6.1 for descriptions of each designated use.

2.8 SUMMARY OF THREATS AND RECOMMENDATIONS FOR PROTECTING WATER AND GEOLOGIC RESOURCES

The goal of water resource protection is to ensure water resources remain in their highest possible quality for ecosystem health and community wellbeing and/or use. Water quality degradation can be caused by natural events or by human actions. Climate change for coastal communities is reshaping coastal water resources through sea level rise, salt marsh migration, and through an increase in storm frequency. Development can also pose a threat to water resources by increasing stormwater runoff from impervious surfaces, introducing pollutants to watersheds.

Recommendations to protect water resources start by identifying problem areas. These are areas that contribute disproportionate amounts of pollutants to surface waters. These pollutants can include sediment, phosphorus, nitrogen, oils and greases, household chemicals and soaps, heavy metals, and bacteria. These sources can be identified through watershed surveys, long-term water quality monitoring and investigatory sampling, and septic system surveys.

As of the writing of this report, there have been no formal efforts to map vernal pools throughout the town. See Section 3.6.2 for recommendations for vernal pools.

Best management practices (BMPs) are often implemented to help reduce the impact development has on an adjacent or downstream environment. Rye contains many major sub-watershed areas, all of which have precious natural resources such as wetlands. See section 7.2.3 (Developed Lands and Considerations for Further Development) for approaches and recommendations to lessen the impact development can have on land and water resources.

Community education and involvement. Bringing the community in through educational opportunities, citizen science, and stewardship is an invaluable method of working toward protecting water resources. Having a diverse network of stakeholders helps incorporate each facet of the community: from the residential to commercial to agricultural sectors, the need for a healthy environment and safe surface and groundwater is a fundamental human need. Continued public awareness and outreach campaigns will aid in growing the concern and involvement of all to protect these resources. **Encourage reduced fertilizer, pesticide, and herbicide use on town property as well as private residential lawns.** These chemicals contribute to pollution of watercourses and waterbodies through stormwater runoff. **Improve the condition and protection of riparian areas through education**. An education program geared toward the importance of natural stream buffers and their restoration has an important place in Rye due to the presence of many headwater stream systems.

Septic Systems. Old, mistreated, or malfunctioning septic systems are notorious for leaching pollutants into surface and groundwaters. Excess nutrients in waterbodies can increase algal growth and decrease water clarity, intrinsic values, and property values. Additionally, excessive bacteria in waterbodies can contribute to beach closures and shellfish harvesting restrictions and/or closures. However, there are other sources of pollutants (including bacteria) than septic systems, which include a flock of pigeons roosting under a bridge above a waterbody or other wildlife and waterfowl. A comprehensive septic system inventory (or database) and/or risk assessment could be used to track maintenance and replacement history of systems within the watershed; this would be managed by the town, especially if a wastewater inspection and maintenance program is put into effect and enforced by the town. "Septic socials" are a great outreach tool to spread awareness of proper septic maintenance. Socials are an opportunity for neighborhoods to come together to socialize, while also learning about keeping healthy septic systems. Landowner groups can also benefit by coordinating septic system pumping discounts.

The Town of Rye contains many **overlay districts and planning board regulations** to protect the environment from the effects of development. The town currently has overlay districts including the Wetlands Conservation District, Flood Hazard District, Coastal Area District, Aquifer and Wellhead Protection District, and the Rye Landfill Groundwater Management Zone. With the purpose to protect public health and safety, the overlay districts guide land use activities within these areas. It is imperative that the extent of these overlay districts be continuously reviewed for possible updates as the environment continues to change, marshes migrate, and new wetlands develop.

Continue monitoring water quality through long-term monitoring programs. An annual water quality monitoring program is necessary to track the health of surface waters in the watersheds. Information from the monitoring program will provide feedback as to the effectiveness of management practices and help optimize management actions through an adaptive management approach. Targeted monitoring programs can also help to pinpoint locations within a watershed likely contributing to degradation and thus identifying areas for remediation. Long-term monitoring programs, similar to the Parsons Creek study, should be established within the Berry's Brook and Rye Harbor sub-watersheds due to their water quality impairment designations.

Establishing Measurable Milestones. A restoration schedule that includes milestones for measuring restoration actions and monitoring activities in the watershed is critical to the success of these efforts. In addition to monitoring, several environmental, social, and programmatic indicators can be identified to measure progress. Setting benchmarks allows for periodic updates to an action plan, maintains and sustains the action items, and establishes a plan relevant to ongoing activities.

Environmental indicators are a direct measure of environmental conditions used to evaluate the relationship between introduced and existing pollutants and the environment. These indicators can track the progress of implemented BMPs. Programmatic indicators measure watershed protection and restoration activities such as the number of parcels with new conservation easements, number of septic system upgrades, number of culverts remediated, etc. Lastly, social indicators measure changes in social or cultural practices and behavior that lead to implementation of management measures. This can be the number of volunteers participating in educational events, workshops, trainings, or BMP demonstrations.

3. WILDLIFE AND HABITATS


Photo Credit:
Seacoast Science Center

3.1 WILDLIFE HABITATS

Wildlife habitats in New Hampshire are mapped and inventoried by the New Hampshire Fish and Game Department (NHFGD). NHFGD collaborated with partners in the conservation community to create the state's first Wildlife Action Plan (WAP), completed in 2005 and updated in 2010, 2015, and 2020. The plan, which was mandated and funded by the federal government through the State Wildlife Grant program, provides New Hampshire decision-makers with important tools for restoring and maintaining critical habitats and populations of the state's species of conservation and management concern. The plan is a comprehensive wildlife conservation strategy that examines the health of wildlife populations and prescribes specific actions to conserve wildlife and associated vital habitat before they become rarer and more costly to protect. The Wildlife Action Plan is the most comprehensive wildlife assessment ever completed in New Hampshire. It was updated in 2020; information from it is incorporated into this report.

The sections below describe the habitat types present in Rye according to the Wildlife Action Plan. (Table 5; Appendix A, Map 8). Definitions of each wildlife habitat discussed below can be found in Appendix D. It is important to note that the habitat features developed by the Wildlife Action Plan and used in this study are predictive and may not reflect actual on-the-ground features, because the modeling processes used in the Wildlife Action Plan drew on many natural resource factors (e.g., soils, slope, solar aspect, vegetation) to identify those areas with high potential to contain the types of habitats mapped. In most cases, the natural communities of wildlife identified in this way will be found in those locations; however, the exact extent and distribution of patches of identified habitats may not match existing field conditions. Only careful field reconnaissance can determine the actual location and extent of natural communities and habitat features.

Forests cover approximately a third of Rye. Forest ecosystems provide for biological diversity, natural communities, scenic landscapes, and recreational opportunities. Forests also support the economy through the forest products industry in addition to a suite of ecosystem services including clean air, clean water, and carbon storage (Morin, et al., 2007).

Table 5. New Hampshire Wildlife Action Plan Habitat Type and acreage for Rye, New Hampshire.

Wildlife Action Plan Habitat Type	Acres	% Total Area
Appalachian Oak-Pine	2,632	31%
Coastal Island	47	0.6%
Developed Impervious	1,281	15%
Developed or Barren Land	961	11%
Dune	54	1%

Wildlife Action Plan Habitat Type	Acres	% Total Area
Grassland	393	5%
Hemlock-Hardwood-Pine	193	2%
Lowland Spruce-Fir	0.7	<0.01%
Peatland	225	3%
Salt Marsh	791	9%
Temperate Swamp	856	10%
Wet Meadow/Shrub Wetland	617	7%
Open Water	576	5.39%

Note: Appledore Island, Smuttynose Island, Duck Island, Malaga Island, and Cedar Island of the Isles of Shoals are located in the jurisdiction of Maine and are therefore not included in the WAP statistics. Islands of the Isles of Shoals included in the WAP include Lunging Island, White Island, Star Island, and Seavey Island.

***Appalachian Oak-Pine Forests**:* This is the most dominant forest type and habitat type in Rye, covering 2,632 acres, or 31% of the town's total area. It is present throughout the town, from Odiorne Point State Park in the north to the southern and western most extents.

***Hemlock-Hardwood-Pine Forest**:* This covers only 193 acres, or approximately 2% of the town's area, even though it is the most common habitat type in New Hampshire. It is predominant in the northeastern portion of the town and decreases in occurrence south along the coast and inland to the west.

***Lowland Spruce-Fir**:* Rye contains 0.7 acres mapped as lowland spruce-fir forest (<0.01% of the town's total area). These small areas exist within salt marsh habitats and where the elevation is below 20 feet. These areas are likely not providing the habitat benefits as mentioned above due to their small size and fragmentation.

Grasslands: Rye contains 393 acres mapped as grasslands (approximately 5% of the town's total area). The areas are not concentrated but rather occur in patches throughout the town, most often adjacent to roadways.

***Temperate Swamps**:* The wildlife action plan has mapped 856 acres (10% of the total area of Rye) of temperate swamp in Rye. These swamps are situated in lower elevation areas of the town and are typically embedded in Appalachian Oak-Pine forests and wet meadow/shrub wetlands.

Wet Meadows and Shrub Wetlands: Rye contains 617 acres mapped as wet meadow and shrub wetlands (approximately 7% of the town's total area). These areas are sporadically distributed throughout the town, primarily in areas with freshwater inputs.

Peatlands: Rye contains 225 acres mapped as peatlands (approximately 3% of the town's total area). These areas are sporadically distributed throughout the town but are all located west of the NH-1A roadway.

Salt Marshes: Rye contains 791 acres mapped as salt marshes (approximately 9% of the town's total area). These areas are commonly found along the shoreline of Rye where tidal streams branch up into the landscape and where development is minimal. Salt marsh habitats are most prevalent in the northern portion of Rye in the Piscataqua River Estuary, and surrounding Rye Harbor and Parsons Creek.

Dunes: Rye contains 54 acres mapped as coastal sand dunes (approximately 1% of the town's total area). These areas are commonly found along the shoreline of Odiorne Point State Park, Wallis Sands State Beach, and at/near Jenness State Beach as well as occurring intermittently along the coast.

Coastal Islands: The WAP maps include 47 acres (0.6%) of coastal island habitat in Rye, including Star Island, White Island, Lunging Island, and Seavey Island.

Developed Habitats: According to the WAP, the town of Rye contains two forms of developed habitat; developed impervious, and developed or barren land. Impervious areas are areas that have hardscape surfaces such as roadways, paved driveways, roofs, and other areas that precipitation cannot infiltrate. Developed impervious areas account for 1,281 acres, or 15% of the town. Developed or barren land areas typically consist of lawns and maintained fields and account for 961 acres, or 11% of Rye.

3.2 WILDLIFE ACTION PLAN HABITAT RANKS

Using habitat types mapped in the New Hampshire Wildlife Habitat Land Cover dataset with the addition of streams, rivers, lakes, and ponds, New Hampshire Fish and Game biologists analyzed which habitat patches are in the best relative ecological condition in the state. This analysis indicates to what degree a particular patch of habitat has good biological diversity (particularly in terms of rare species), is connected to other similar patches in the landscape, and is negatively impacted by humans. Within each habitat type, patches were ranked into one of four categories: 1) Highest ranked in the state by ecological condition; 2) Highest ranked in the biological region by ecological condition; 3) Supporting landscapes; and 4) Not top ranked. (See Appendix A, Map 9).

Highest ranked in the state by ecological condition: This rank compares each habitat type regardless of where it occurs in the state. It includes the top 15% by area of each habitat, except for certain rare or important cover types that are 100% included (e.g., alpine areas, dunes, salt marshes, rocky shores). Critical habitat for state-listed species is included as well (NHFGD, 2020b).

Highest ranked in the biological region by ecological condition: As New Hampshire is ecologically diverse, habitats were ranked within their ecoregional subsection. Ecoregional subsections reflect broad regional patterns of geomorphology, stratigraphy, geologic origin, topography, regional climate, and dominant associations of potential natural vegetation. (Traveling south to north in the state, one can easily notice the disparity between landscapes. Therefore, comparing the North Country to the southeast is not a balanced approach.) A total of nine ecoregions in New Hampshire have been identified by The Nature Conservancy. Within each biological region (calculated separately for terrestrial versus wet habitats) the top 30% of each habitat was included, except areas already included within the highest ranked in the state. Some high priority natural communities as ranked by the New Hampshire Natural Heritage Bureau were added to highlight the importance of plant diversity in habitat quality (NHFGD, 2020b).

Supporting landscapes: The landscape surrounding both ranking types described above was also identified as being critical. The condition of a habitat patch will deteriorate if the surrounding landscape is degraded. This ranking consists of the remainder of the top 50% of each habitat type, and some very intact forest blocks (NHFGD, 2020b).

3.2.1 UTILITY OF HABITAT RANK INFORMATION

A principal use of the Wildlife Action Plan Habitat Rank dataset is to prioritize parcels for land protection. The data can be used in the decision-making process in combination with other locally collected information on a given parcel's resources such as forest stand types, wildlife sightings, recreational trails, scenic views, and water resources.

Another use is comprehensive conservation planning. For towns and conservation organizations, taking a proactive approach and considering an entire geographic area prior to making land-use decisions is critical. Wildlife habitat can enhance the character of a town, provide protection from flooding, protect water resources, and provide educational opportunities. Considering where the best habitats for those things are in a given town/region, so that both economic development and natural resources protection occur in the right places, is crucial to the long-term quality of life in that particular area (NHFG, 2016).

3.2.2 A PRIMER ON HABITAT CONNECTIVITY

Fragmentation of habitat units into smaller, isolated sub-units is the major factor in the reduction and loss of biodiversity (i.e., plants, animals, and habitat types) in the Northeast and nationwide (Johnson & Klemens, 2005). To maintain native biodiversity, it is critical to ensure that remaining habitat areas are large enough to support viable wildlife populations and that they are arranged in a fashion that facilitates movement of animals across the landscape (Miller, Klemens, & Schmitz, 2005).

To ensure that development is compatible with native species that are sensitive to development, core habitat areas and corridors that connect them must be accommodated. In general, larger core areas are better able to support viable wildlife populations than smaller ones. Connections between core areas are of the utmost importance as they facilitate animal dispersal among core areas thus enabling genetic exchange and preventing local species extirpations. These connections are typically referred to as "corridors." Note that a corridor for wildlife is not a narrow, linear green strip between core areas; rather, it is a broad swath of habitat connecting core habitat areas. Corridors may not be as pristine as the core areas they connect, but they do provide secondary habitat and most importantly, facilitate movement of wildlife among core areas (Miller, Klemens, & Schmitz, 2005). Individual conservation decisions can be more beneficial to wildlife if targeted parcels is placed in context of the matrix of wildlife habitat and corridors across the landscape (Miller, Klemens, & Schmitz, 2005).

The Priority Conservation Areas presented in Appendix A, Map 9 are based largely on remote-sensed data. Important areas *within* these areas can be further identified by gathering field-based information on the distribution of development-sensitive wildlife throughout the town. An example of valuable information that can be collected is the vernal pool surveys discussed in Section 5.5 below.

3.3 RARE PLANTS, ANIMALS, AND EXEMPLARY NATURAL COMMUNITIES

Rare plant and animal species documented in Rye are inventoried by the Natural Heritage Bureau (NHB) of the New Hampshire Division of Forests and Lands, in cooperation with the New Hampshire Fish and Game Non-Game and Endangered Wildlife Program. Generalized information on the presence of these species and communities is available from the NHFGD. According to the Department's list of "Species of Greatest Conservation Need" by habitat and by town," (NHFGD, 2020c) the species and natural communities/systems listed in Appendix E have been documented to likely exist in Rye based on known or predicted broad distributions. The specific locations of rare species and communities are not available for this study due to data release policies of the NHB and NHFGD. As described above in Section 3.2, information on rare species and communities has been incorporated into the Wildlife Action Plan's Habitat Rank.

3.4 NATIVE AND NON-NATIVE PLANT SPECIES

A **native** plant is a part of a given ecosystem that has developed over hundreds or thousands of years in a region or ecosystem. (The word native should be used with a geographic qualifier. All plants are native somewhere, but only plants that have been established for hundreds or thousands of years in New Hampshire are considered native to New Hampshire.) A **non-native** plant is a plant introduced to a new place or new type of habitat where it was not previously found, whether

intentionally or accidentally. Not all non-native plants are invasive. Many non-native plants that are introduced to new places cannot reproduce or spread readily without continued human help (e.g., many ornamental plants). An **invasive** plant is one that is both non-native and able to establish in many areas, grow quickly, and spread to the point of disrupting existing native plant communities or ecosystems. A **naturalized** plant is a non-native species that does not need human help to reproduce and maintain itself over time in an area where it is not native. Naturalized plants do not, over time, become native members of the local plant community. Many naturalized plants are found primarily near human-dominated areas. Since invasive plants also reproduce and spread without human help, they are considered naturalized. Naturalized invasives are a small, but troublesome, sub-category of naturalized plants.

3.4.1 NATIVE PLANT SPECIES

The University of New Hampshire Cooperative Extension has published a table of native trees, shrubs, and vines important for wildlife habitat (UNH Cooperative Extension, New Hampshire's Native Trees, Shrubs, and Vines with Wildlife Value, 1995). Rye contains many of these species including American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*), shagbark hickory (*Carya ovata*), red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), and native bittersweet (*Celastrus scandens*). These species are common throughout New Hampshire and the Seacoast and can be found through many of Rye's trails. Native salt marsh plant species include tall-form smooth cordgrass (*Spartina alterniflora*), salt marsh hay (*Spartina patens*), spike grass (*Distichlis spicata*), short-form smooth cordgrass (*Spartina alterniflora*) and sea lavender (*Limonium nashi*) and are common throughout New Hampshire's salt marshes (NHFGD, 2020e). These species have adapted to become tolerant of fluctuating water levels and salinity concentrations.

Red maple

Eastern hemlock

American beech

3.4.1 NON-NATIVE PLANT SPECIES

Non-native, invasive vegetation can have deleterious effects on the ecology, scenic quality, and quality of public recreation in a given area. All three of these attributes stand to be compromised by the unchecked spread of non-native, invasive plants. Non-native, invasive plants outcompete native species, and with their loss so follows the loss of their native pollinators and other dependent wildlife. The seed and berry crops produced by non-native invasives are in most cases less nutritious to birds than those produced by native species. Climbing vines can be unsightly, as are

dense thickets of non-native invasive species, both of which are capable of rendering foot paths impassable

Disturbed areas, whether it is natural or resulting from human activity, are particularly susceptible to the establishment and spread of invasive species. In riparian areas, combinations of frequent ice and water scour, fertile floodplain soils, increased sunlight, and water transport of seeds and plant fragments provide excellent conditions for non-native, invasive plants to establish, grow, and spread.

In 2010, Odiorne Point State Park created an Invasive Plant Management Plan to help combat the threats invasive species create on native habitats (FB Environmental, 2010). Invasive species identified in Odiorne Point State Park included purple loosestrife (*Lythrum salicaria*), common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), oriental/Asiatic bittersweet (*Celastrus orbiculatus*), morrow's honeysuckle (*Lonicera morrowii*), glossy buckthorn (*Frangula alnus*), autumn olive (*Elaeagnus umbellata*), European barberry (*Berberis vulgaris*), and common reed (*Phragmites australis*).

With the goal of restoring native habitats while improving recreational opportunities for park visitors, the plan includes techniques of general invasive plant management. Often, invasive plant management includes an Integrated Vegetation Management (IVM) approach. An IVM approach utilizes multiple strategies including mechanical, biological, chemical, and cultural treatment methods. Any method chosen to target invasive species must include a monitoring plan to track the effectiveness of the eradication and to eliminate regrowth.

Purple loosestrife

Common reed

Asianic bittersweet

Multiflora rose

3.4.2 THREATS POSED BY INVASIVE SPECIES

Invasive plants pose a direct threat to New Hampshire's natural and working landscapes. The aggressive growth of these species can have negative effects on forest regeneration (following timber harvest, disease, fire, etc.), increase the cost of agriculture, and threaten recreational experiences (e.g., by rendering hiking trails impassable and disrupting views). Invasive plants out-compete native species for sunlight, nutrients, and space by growing quickly enough to crowd out

native species. Thus, shifts to invasive species dominance may alter wildlife habitat by eliminating native foods, altering physical structure of an area, and destroying bird nesting opportunities.

Invasive species are considered the second greatest threat to worldwide biodiversity after habitat loss (Marden, 2011). Most invasive plants in the U.S. were deliberately introduced. It is humans' decisions regarding species introductions and land use that led to the spread of these species. Conservation biologist Michael Klemens coined the term "subsidized species" to characterize invasive species that have attained population levels that have adverse effects on ecosystem function and human activities.

Considering the wealth and breadth of ecologically and historically significant features and recreational opportunities in Rye, invasive species management is worthwhile as it provides a suite of benefits, including the restoration of native land cover types, the improvement of recreational opportunities for town residents and visitors, and the improvement of access to historically significant sites.

Invasive species pose a considerable threat in Rye. Species with the greatest threat to wetlands include purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*). These two plants are known to spread rapidly, forming monocultures that outcompete native wetland species in a relatively short time. Best management practices require multiple approaches including inventory and mapping, control at ecologically important or vulnerable sites, local policy, and regional partnerships. Best management practices have been employed with the Rye Conservation Commission partnering with Rockingham County Conservation District on a multi-year invasive species treatment program in several sites including Awcomin and Wallis Marshes and the Town Forest.

Several non-native, invasive insect species are known to occur in New Hampshire including the emerald ash borer (*Agrilus planipennis*), hemlock wooly adelgid (*Adelges tsugae*), red pine and elongate hemlock scales (*Matsucoccus resinosae, Fiorinia externa*), winter moth (*Operophtera brumata*), and balsam wooly adelgid (*Adelges piceae*). Of these, only the emerald ash borer, hemlock wooly adelgid, and elongate hemlock scale have been documented in Rye. For more information on non-native, invasive insects, visit the NHBugs website at https://nhbugs.org/.

3.5 WILDLIFE CONSERVATION PRIORITY AREAS

Areas of the town with the highest natural resource values were identified by the NHFGD through the 2020 Wildlife Action Plan. As mentioned above, areas of highest ranked habitat in both New Hampshire and in the biological region as well as their supporting landscapes have been identified as priority areas for wildlife conservation, using a co-occurrence model developed by the New Hampshire Fish and Game Department. These rankings were developed through a co-occurrence analysis by overlaying raster images in GIS. The raster images used in the co-occurrence analysis consisted of the town as a surface divided into a regular grid of cells. For each raster (e.g., wetlands, agricultural soil), each cell containing a given natural resource feature was assigned a value of one. Individual raster layers were then overlaid on top of one another to determine which areas of the town support the greatest number of significant natural resources. NHFGD has since replaced this original co-occurrence model with the New Hampshire Wildlife Action Plan Habitat Ranks (discussed in Section 3.2).

The 2020 WAP identified a total of 2,495 acres (29% of the town) as highest ranked habitat in New Hampshire. An additional 562 acres (7%) are identified as highest ranked habitat in the

biological region. Lastly, 1,680 acres (20%) are identified as supporting landscapes. The Nature Conservancy has studied wildlife action plans, regional conservation plans, state conservation plans, and spatial models to develop the Connect THE Coast publication and associated documents. Through this initiative, wildlife corridors have been identified which connect lands with important wildlife habitat features. If protected, these corridors will help wildlife move across the landscape through unfragmented areas.

Connect THE Coast has also identified blocks of prioritized habitat that represent where conservation efforts should be focused for the largest wildlife habitat benefit (Appendix A, Map 9). There are six blocks of prioritized habitat within Rye, all of which encompass priority ranked habitats and supporting landscapes from the WAP.

Bailey Brook: 577 acres in the southern portion of Rye between Grove Road, West Road, Central Road, and South Road.

Seavey Creek/ Fairhill Swamp/ Wallis Marsh: 873 acres extending from Odiorne Point State Park south to Washington Road while staying east of Brackett Road.

Lower Berry's Brook: 253 acres located between Upper Berry's Brook North and Seavey Creek/ Fairhill Swamp/ Wallis Marsh.

Packer Bog/Upper Berry's Brook South: 594 acres located in the most southeastern part of Rye, north of Washington Road and west of Lang Road.

Upper Berry's Brook North: 365 acres located west of Sagamore Road and Wallis Road.

Awcomin Marsh: 822 acres located in the drainage area to Rye Harbor and extends north to Washington Road, south to Cable Road, and west to Central Road.

Seavey Creek Rye, NH

Photo Credit: Philip Case Cohen

3.6 WILDLIFE AND HABITAT THREATS AND RECOMMENDATIONS FOR ACTION

Rye faces a challenge of how to best balance prudent economic growth, land ownership, and responsible stewardship of its natural resources while accounting for climate change. A healthy functioning environment is often placed in opposition to economic growth and human quality of life. Clean air, clean water, and ecosystem services provided by natural systems are essential to maintaining a high quality of human life. If communities can disregard the oppositional model of environmental conservation vs. human progress, they can begin to have a broader discussion on how to achieve both (Klemens, Davison, & Oko, 2012).

3.6.1 CONSIDERATIONS AND CAVEATS

Priority conservation areas are not being mapped solely for land preservation– Preservation of entire Conservation Priority Areas is not feasible, nor do we recommend it. Much of the mapped areas are privately-owned lands that contribute, through taxes, to the economic stability of the town. Rather, a balanced approach to conservation and development which incorporates a suite of land use planning and conservation tools is recommended.

Development and other land-use activities outside of the Conservation Priority Areas need to remain mindful of environmental and land use issues– Regardless of location, all development proposals should receive careful review and consideration of potential environmental impacts and where they are positioned within Rye's landscape.

Conservation opportunities may occur outside of the Priority Conservation Areas– Small or isolated areas outside of the Conservation Priority Areas may contain previously unknown significant species or natural communities that have high conservation value.

3.6.2 THREATS AND RECOMMENDATIONS FOR ACTION

Prime Wetlands: Rye is among the 33 towns in New Hampshire that have designated prime wetlands. Prime Wetland designation provides a means by which towns can provide additional protection to wetlands that are particularly unique or sensitive to disturbance by restricting construction or earthwork in or within 100 feet of these resources. While prime designation does offer additional protection to a subset of wetlands within the town, the Conservation Commission may wish to first spearhead a town-wide inventory of vernal pools (see following section). Information obtained during the vernal pool inventory may be useful for the Prime Wetland designation process should the town wish to pursue it in the future.

Vernal Pools: New Hampshire's Nongame and Endangered Wildlife Program within NHFGD encourages citizens to document the locations of vernal pools using a downloadable form and/or through their New Hampshire Wildlife Sightings website, a web tool for reporting wildlife observations throughout the state. More information regarding documenting and reporting New Hampshire Vernal Pools can be found in the NHFGD report, "Identifying and Documenting Vernal Pools in New Hampshire" (Marchand, 2016).

Though NHFGD likely has some vernal pool information for Rye, it is recommended that vernal pools be formally documented throughout the entire town. Hiring consultants to document pools throughout the entire town would be unnecessary and not cost-effective. Instead, the work could be carried out by trained citizen scientists, as has been accomplished in numerous towns in Maine through the Maine Municipal Vernal Pool Mapping Project. In addition to the financial advantages

of using volunteers, engaging local citizens also increases awareness of natural resources, instills a sense of place and community pride, and encourages local control over quality of life through participation in planning for the future (Morgan & Calhoun, 2012). More information regarding the use of citizen scientists to map vernal pools can be found in the Morgan and Calhoun's (2012) Maine Municipal Guide to Mapping and Conserving Vernal Pool Resources. The authors mention that while the focus of their publication is to provide guidance to Maine municipalities, their methodology is appropriate for any region interested in local, collaborative conservation planning and is applicable at a variety of scales.

Lastly, Morgan and Calhoun (2012) mention that interpretation of aerial photography is the best available method for remotely identifying potential vernal pools at the municipal scale. While aerial imagery is the "gold standard," the use of LiDAR data is becoming increasingly common. LiDAR is a form of remote sensing that uses laser light pulses to help reveal highly detailed information about a landscape. While interpretation of aerial imagery involves the use of paired 9 x 9-inch stereo contact prints viewed under a mirror stereoscope or viewing digitized images in 3-D on a specialized computer screen, LiDAR requires the use of sophisticated computer modeling. Sean MacFaden of the University of Vermont Spatial Analysis Lab has developed a very accurate method of remotely sensing vernal pools with LiDAR data using Object-based Image Analysis and eCognition software.

Peatlands: Threats to peatland habitats are development, altered hydrology (amount and flow of water), and unsustainable forest harvesting. NPS pollutants, such as road salt, lawn fertilizers, and pesticides, also threaten this habitat by altering the acidity and nutrient concentrations. Establishing vegetated buffers around this habitat is one conservation strategy that will help minimize the threats to peatland habitats by slowing stormwater runoff, promoting groundwater recharge, and filtering nutrients and sediment from runoff.

Salt Marshes: By building up more peat, salt marshes can gain elevation and even keep pace with rising sea level, unless the rate of sea-level rise becomes too great. An estimated 30-50% of New Hampshire's original salt marsh habitat has been lost to development. Mosquito control efforts have also sometimes resulted in negative impacts to salt marshes through poorly designed drainage ditches or other attempts to drain marshes (Rye Conservation Commission, 2017). Effective conservation strategies for salt marshes include restoring and protecting the remaining salt marsh habitat and the surrounding upland buffer habitat.

Coastal Habitats: As beachgoers, we can all help by staying off dune habitats and obeying restricted area signs and fences. Habitat protection, education, and enforcing laws and regulations are a few of the conservation strategies for dunes.

Inland Habitats: Inputs of sediment, pesticides, and fertilizers are sources of pollution that threaten temperate swamp habitats. Actions to conserve temperate swamps include supporting the Division of Forests and Lands in the implementation of the hemlock woolly adelgid action plan and working with foresters to use Best Management Practices outlined in the document "Good Forestry in the Granite State."

Incorporating habitat conservation into local land use planning, protecting unfragmented blocks, and adopting sustainable forestry are a few examples of conservation strategies for Appalachian Oak-Pine forests.

Invasive Plant Species: Many resources currently exist for the maintenance and eradication of common invasive species found in New Hampshire's coastal communities. The Rockingham County Conservation District (RCCD) has developed and implemented a *Phragmites* control program and created management practices for Japanese knotweed and glossy buckthorn removal (Rockingham County Conservation District, n.d.). The Odiorne Point State Park Invasive Plant Management Plan is another invaluable resource which presents management strategies that can be applied throughout Rye (FB Environmental, 2010).

Promote the use of native plant species in Rye. Review of development proposals should include the promotion of native plantings in landscaping plans. Public education and outreach about invasive species through garden clubs and other civic groups is another effective strategy.

Improve habitat diversity through land management. Reducing lawns and mowing of fields, planting of field edges with trees and shrubs with deep strong roots, and creating small forest openings all provide opportunities for increasing biodiversity on small as well as large parcels.

Eel Pond Rye, NH

Photo Credit: RedFin.com

4. SOILS AND AGRICULTURE

4.1 SOILS OF SPECIAL IMPORTANCE


Photo Credit: Ryemeadow Farm

Soil is the unconsolidated mineral and organic matter on the immediate surface of the earth that serves as a natural medium for the growth of plants. Understanding the nature and properties of soils is critical to managing and conserving natural resources. Different soil types throughout the town have developed from the interaction of several natural phenomena, including climate, surficial geology, topography, and vegetation.

The US Department of Agriculture's Natural Resources Conservation Service (NRCS) studies and inventories soil resources across the country. Soil surveys contain detailed soils maps, data tables, and text narratives that assist in determining appropriate uses for the land. Soil surveys also contain predictions of soil suitability for selected land uses and highlight limitations and hazards inherent in the soil and the impact of selected land uses on the environment.

The NRCS groups soils based on their capability to produce commonly cultivated crops and pasture plants without deteriorating over a long period of time. These classifications are based on numerous criteria that include, but are not limited to, the soil's salinity, parent material, capacity to hold moisture, potential for erosion, depth, texture, and structure, as well as local climatic limitations (e.g., temperature and rainfall). These units are further sorted based on land capability such as farmland, wetland, and forest soils. Soil classifications are designed to guide choices in land use and soil management.

4.1.1 FOREST SOILS

Soil is an important component of the forest ecosystem as it helps regulate important ecosystem processes, including nutrient uptake, decomposition, and water availability. Soils provide trees with anchorage, water, and nutrients. In turn, trees and other forest vegetation contribute to the creation of new soil as leaves and other vegetation rot and decompose (Food and Agriculture Organization of the UN, 2016).

Forest soils are generally subjected to fewer disturbances than agricultural soils, which are regularly plowed and planted. Forest soils typically do not receive external inputs from human management activities (e.g., fertilizer, manure, herbicides, insecticides, fungicides). Instead, they rely on internal soil nutrient cycling to support plant nutritional needs (Smith, Miles, Perry, & Pugh, 2007).

Disturbances to forest soils are mostly associated with timber harvesting and clearing for development. As with other elements of the forest, soils tend to show the effects of disturbances for many years. Activities and events, including land use change, wildfire, drainage, and timber harvest, can greatly affect soil characteristics, which in turn will affect forest productivity and health, which includes water quality and quantity (Smith, Miles, Perry, & Pugh, 2007).

The terrain features, topography, and soils that provide the foundation for today's forests can be traced to the action of glacial ice or melt water as the last glacier retreated northward. As a result, there is considerable variability in soil types across the town. Most variability in tree species and

forest composition is due to differences in underlying soil type, available nutrients, and moisture (Thorne & Sundquist, 2001).

Soils mapped by the NRCS for each county soil survey have been grouped into six "Important Forest Soils Groups" based on interrelated soil characteristics such as: texture and moisture or wetness; inherent limitations of the soil for forest management (e.g., steep slopes, shallowness, boulders, rock outcrops); and typical forest successional trends on certain soil types (Thorne & Sundquist, 2001). The three most important forest soil groups in Rye are described below and shown in Appendix A, Map 10.

Group 1A forest soils include deeper, loamy soils, moderately- to well-drained, and are considered prime northern hardwood forest soils. Certain soil series in the group are also good for hemlock growth. In Rye, these soils account for approximately 579 acres or about 7% of the town's total area.

Group 1B consists of sandy or loamy soils that are moderately- to well-drained. These soils are good for growing northern hardwoods including paper birch, beech, and oak. This forest soil group covers 2,473 (29%) of the town's total land area.

Group 1C soils consist of outwash sands and gravels and support the growth of white pine. These soils constitute about 1,712 acres (20%) of the town's total area.

In total, approximately 4,764 acres (56%) of Rye's land area is comprised of important forest soil. The majority of that area is currently undeveloped. Lunging Island, White Island, Star Island, and Seavey Island of the Isles of Shoals are all classified as having 1B soils.

4.1.2 DEVELOPMENT AND SOILS

Development should occur on soils capable of supporting infrastructure, with adequate soil drainage and stable, non-eroding soils. Soil drainage characteristics are based on a soil's permeability - the ability of air and water to move through it. Permeability depends on the soil's density, structure, and texture, which determines the size, shape, and continuity of pore spaces. Texture is one of the most important characteristics since it influences many other properties of soil such as suitability for irrigation needs, erosion potential, and fertility. Soil texture describes the proportionate distribution of different sizes of mineral particles in a soil such as clay, silt, and sand.

Hydric Soils: Generally, sandy soils tend to be lower in organic matter content and fertility; low in ability to retain moisture and nutrients; and well-drained and therefore well-suited for road foundations and building sites. Fine-textured soils are generally more fertile, contain more organic matter, and are better able to retain moisture and nutrients. Clay soils, the finest-textured soils, drain slowly, are more difficult to manage for cultivation, and are poorly suited for building sites (particularly septic systems and basements) and for road construction. NRCS classifies such soils as "hydric soils." These soils are frequently ponded or flooded for extended periods during the growing season.

Hydric soils are divided into four groups, group A to group D. Group A soils have low runoff potential, therefore water percolates easily through the soil. These typically contain over 90% sand and less than 10% clay. Group B soils have moderately low runoff potential, therefore water percolates easily through the soil. These typically contain between 50-90% sand and 19-20% clay with some silt and loam properties. Group C soils have moderately high runoff potential; therefore,

water does not percolate as easily through the soil. These soils are typically less than 50% sand and between 20 and 40% clay with some loam, silt loam, and sandy/silty loams. Lastly, group D soils have high runoff potential; therefore, water does not percolate easily through the soil. These soils are typically less than 50% sand and greater than 40% clay. Dual hydrologic soil groups, such as A/D, B/D, or C/D, contain the properties of the first letter's category but have a water table within 60 centimeters of the surface (USDA, Part 630 Hydrology National Engineering Handbook - Chapter 7, Hydrologic Soil Groups, 2007). (See Appendix A, Map 11).

Soils with shallow distances to groundwater are often poorly suited for development. Over 3,459 acres (40%) within the town are less than 69 centimeters above the water table. The remaining 5,103 acres (59%) have a depth to water table of over 200 centimeters.

Soil erosion hazard is the soil's rating for how likely it is to erode, and is dependent on a combination of factors, including land contours, climate conditions, soil texture, soil composition, permeability, and soil structure (O'Green, Elkins, & Lewis, 2006). Soil erosion hazard should be a primary factor in determining the rate and placement of development within a watershed. According to the Web Soil Survey's Land Management and Erosion Hazard metadata, a rating of "slight" indicates little to no erosion is likely to occur, "moderate" indicates some erosion is likely to occur, meaning roads or infrastructure may require occasional maintenance with simple erosion control practices, and "severe" indicates that significant erosion to the landscape is expected, indicating roads and other infrastructure will require frequent maintenance and large erosion control practices.

Most of the watershed areas in Rye were classified as having "slight" erosion hazard (81%), followed by "moderate" (8%), "severe" (<1%), and not rated (11%) (Appendix A, Map 11). These areas of moderate and severe erosion hazards are scattered throughout the town. The Isles of Shoals are not included in these statistics.

Development should be restricted in areas with highly erodible soils due to their inherent tendency to erode at a greater rate than what is considered tolerable soil loss. Highly erodible soils pose more risk to water quality, so these areas require more effort and investment to maintain soil stability and function within the landscape, as well as stormwater management practices that prevent runoff from reaching water resources.

4.1.3 AGRICULTURAL SOILS

The Farmland Protection Policy Act of 1981 was established to ensure that Federal programs are compatible with state and local governments and private programs and policies to protect farmland. The NRCS uses the following three farmland soil classifications in New Hampshire for the purpose of carrying out the provisions of this Act (USDA, 1981):

Prime Agricultural Soils: Prime agricultural soils have sufficient available water capacity to produce the commonly grown cultivated crops adapted to New Hampshire. They have high nutrient availability, generally low slope and low landscape position, are not frequently flooded, and contain less than 10% rock fragments in the top six inches. The land may currently be in crops, pasture, or woodland; but not urbanized, built-up land, or water areas. It must either be used for producing food or fiber or be available for these uses.

In Rye, these soils account for approximately 288 acres, about 3% of the town's total area.

Soils of Statewide Importance: Farmland of statewide importance is land, in addition to prime and other unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. The state government designates farmland of statewide importance with the concurrence of the NRCS State Conservationist. Generally, these farmlands nearly qualify as prime farmland and can produce high yields of crops when treated and managed according to acceptable farming methods.

These soils constitute about 1,621 acres, approximately 19% of the town's total area.

Soils of Local Importance: Soils of local importance include soils that are not prime or of statewide importance, but that have local significance for the production of food, feed, fiber, forage and oilseed crops. These lands are designated by local agencies with the concurrence of the NRCS State Conservationist and may include tracts of land that have been designated for agriculture uses by local ordinance.

These soils constitute about 1,167 acres, approximately 14% of the town's total area.

In total, approximately 3,076 acres (36%) of Rye is comprised of agricultural soil (Appendix A, Map 12). The highest concentrations of these soils are found in the central and southern parts of the town in areas not classified as wetlands. Rye's best agricultural soils, prime agricultural soils, are found in small patches throughout the center and southeastern portions of the town (and a small patch in the far west). The Isles of Shoals do not contain any prime farmland soils.

4.2 ACTIVE FARMLANDS

Farmlands are areas of land producing crops such as hayfields, consumable crops, and orchards. Farmlands also include areas of land used for pastures and the grazing of livestock including but not limited to horses, cows, goats, pigs, and sheep. According to the 2020 New Hampshire Agricultural Census, the State of New Hampshire contains 4,123 farms covering over 425,000 acres. Although the history of agriculture in New Hampshire shows a decreasing trend in size, dairy production, and hay alone in New Hampshire for 2020 reached a value of over 55 million dollars. According to the 2017 New Hampshire Agricultural Census, Rockingham County contains 618 farms covering 32,231 acres (USDA, 2020; USDA, 2017).

Farmlands are ecosystems as well and provide benefits aside from producing crops and livestock. Farmland meadows, grasslands, and scenic vistas provide habitat and connective pathways for many wildlife species and contribute to the cultural identity and history of New Hampshire. While New Hampshire is predominately forested, farmland habitats are key ecosystems due to the biodiversity and economic diversity they provide.

In 2015, the Town of Rye contained 217 acres of active agricultural land, the lowest on record since the start of data compilation in 1962 (Rye Conservation Commission, Chapter 7 - Natural Resources, 2017). The nine-acre Goss Farm, located at the corner of Harbor Road and Ocean Boulevard, was purchased by the Town of Rye in 2010 and is managed by the Rye Conservation Commission. The Goss Farm is used to promote local agriculture, engage Rye schools with educational opportunities, and protect water quality by way of buffered areas adjacent to wetlands and marshes.

Rye includes many small privately owned and operated farms such as Centennial Farm, Cobble Hill Farm, and Ryemeadow Farm. Ryemeadow Farm on Wallis Road is a 22-stall boarding facility for horses with an adjacent paddock. Ryemeadow Farm uses Rye Town Forest and Wallis Sands

Beach for trail rides. Fox Meadow Farm, located on Central Road, offers after-school and summer camp horse riding programs for children. Independence Farm and Driftwood Equestrian, located on Washington Road, is a boarding and training facility for horses. Independence Farm also contains an easement where 60 acres must remain as farmland. The farm provides riding lessons, trail rides, and a practice arena for those competing.

In addition to these farming and animal husbandry operations, many residents likely have small vegetable farms on their properties used to produce local produce and for hobby which may include chickens. There are no industrial sized farms such as dairy or cattle farms, or concentrated animal feeding operations in Rye.

4.3 AGRICULTURE, FORESTRY, AND SOIL THREATS AND RECOMMENDATION FOR ACTION

Agricultural areas play an especially important role in preserving open space and historical resources. Development and an increase in infrastructure and transportation networks serve as the largest threats to soils of special importance and farmlands as more people flock to the seacoast. Because Rye contains relatively few areas of agriculture, conserving these areas for their environmental, cultural, and historical benefits should be prioritized. One method is to create an agricultural profile for the town. UNH Cooperative Extension describes the agricultural profile as "a comprehensive overview of a community's agricultural industry. It includes information pertaining to soil type and acres, number and type of farms, zoning and agricultural land use, economic impact, protection of natural resources, farmland acres lost to development, and related issues of concern" (UNH Cooperative Extension, 2001).

Goss Barn

Photo Credit: Nextdoor.com

5. SCENIC RESOURCES

5.1 SCENIC AREAS

Scenic areas provide appealing views of the natural resources and the cultural and historic heritage of a region or town. The surrounding landscape helps shape scenic areas, routes, and vistas that contribute to the appeal of a community. Rye's coast draws local, regional, and international visitors who come in part to enjoy the scenic views. Scenic views not only enhance quality of life, but maintaining these views ensures the viewed environments, or "viewsheds," are conserved or maintained for their natural aesthetics, habitats, and ecosystem functions. Protecting scenic resources requires preserving both the vista and the scenic viewpoint. Preserving open spaces also serves to enhance the small town or rural character for which Rye is known.

White Island Lighthouse

Photo Credit: Erika Mitchell/ Thinkstock

5.1.1 COASTLINE

Under RSA 253 Sections 17 & 18, towns in New Hampshire may designate a roadway (other than Class I or Class II state highways) as a Scenic Road. New Hampshire Route 1A, including the entirety of New Hampshire Route 1A in Rye, has been designated as a scenic byway spanning 18.5 miles from Portsmouth to Seabrook (NH.gov, 2015). The coastline is home to many state parks including Odiorne Point, Wallis Sands, Rye Harbor, and Jenness Beach State Parks. Eight scenic areas have been identified along Ocean Boulevard (New Hampshire Route 1A) by the New Hampshire Coastal Program: Little Harbor, Berry's Brook Estuary, Fairhill-White Cedar Swamp, Odiorne Point State Park, Eel Pond/Cedar Swamp Run, Burkes Pond (and Browns Mill Pond), Rye Ledge, and the Isles of Shoals. See Sections 5.1.4, 5.1.5, and 2.2.1 for information regarding the Isles of Shoals, Odiorne Point State Park, and Eel Pond, respectively, as well as Appendix A, Map 13.

These sandy beaches and parks attract many visitors, especially during summer. The parking lot at Wallis Sands State Beach can accommodate up to 500 cars. Rye Harbor State Park, also called Ragged Neck, offers street parking for its visitors, as well as a tented area for events and weddings up to 200 people, with the stunning views of the harbor, ocean, and Isles of Shoals as a backdrop. Jenness State Beach at the southern end of the Rye coastline can accommodate up to 67 cars and like the other two northern beaches, provides vistas of the Atlantic Ocean. Visitors enjoy recreational activities such as swimming, surfing, fishing, sunbathing, playing in the sand, and quality time with friends and family. The state beaches in Rye support initiatives to keep the beaches clean by encouraging visitors to carry out what they carry onto the beach and prohibiting pets.

Rye Harbor State Park offers scenic views of the Atlantic Ocean, Isles of Shoals, and Rye Harbor. Visitors partake in saltwater fishing and picnicking on the lawn or at picnic tables. Constructed in 1939 and protected by two jetties, Rye Harbor houses commercial and private fishing boats at docks and moorings. Rye Harbor is an important hub for coastal commercial activity, supporting lobstering, fishing, whale-watching, and boat maintenance. According to the Rye Harbor Master, as of the summer of 2021, Rye Harbor contained a total of 156 moorings permitted by the New Hampshire State Port Authority, with a waitlist of 131 individuals. Little Harbor, between New Castle and Rye, is mostly used today as an access route connecting Sagamore Creek to the Atlantic Ocean.

Where the Rye coastline is not beach or sheltered estuary, rocky shoreline habitats thrive. These ecosystems contain a plethora of life from phytoplankton and seaweed to snails, sea urchins, bivalves, barnacles, sea stars, crabs, lobster, and more. The Seacoast Science Center, located at Odiorne Point State Park, provides the opportunity for school children and summer camps to experience and learn about the rocky shoreline through interactive hands-on lessons in the intertidal zone as well through educational exhibits inside its facility.

Wallis Sands State Beach

Photo Credit: Steve Hedin

5.1.2 PASTURELAND

Pasturelands and farmland are scenic resources that provide an exposed scenic view. These areas also contribute to scenic resources by carrying on the historic and cultural identity of small New England agricultural communities. Although Rye does not have any large areas of pastureland, several smaller examples such as Goss Farm provide invaluable open spaces and habitats for many meadow species while preserving historic and agricultural lands.

5.1.3 SALT MARSHES

Salt marshes are tidal wetlands existing in the transition zone between ocean and upland that are characterized by periodic tidal inundation, with salt-tolerant grasses the dominant vegetation. They are among the most productive ecosystems in the world and provide vital habitat for wildlife including many bird species such as snowy egrets, great blue herons, and salt marsh and Nelson's Sparrows. The salt marshes of Rye are dynamically colorful ecosystems throughout the year. Most of the vegetation in a salt marsh follows a seasonal pattern with bright greens and lush vegetation in the summer, to red and orange grasses in the fall, and tan or snow-covered vegetation over winter. From the Scenic Byway of New Hampshire Route 1A, Rye's salt marshes are viewed looking west providing for incredible sunset viewing year-round as pinks, reds, oranges, yellows, and purples dance across the sky and reflect on the open waters adjacent to the marsh.

Salt marshes also attract bird watching enthusiasts who scan the marsh grasses and skies for migrant and resident species. According to the eBird website, 10 of the 17 endangered or threatened birds of New Hampshire have been identified in Rye's salt marshes: northern harrier (*Circus cyaneus*), least tern (*Sterna antillarum*), common tern (*Stema hirundo*), common loon (*Gavia immer*), peregrine falcon (*Falco peregrinus*), cliff swallow (*Petrochelidon pyrrhonota*), common nighthawk (*Chordeiles minor*), pied-billed grebe (*Podilymbus Podiceps*), purple martin (*Progne subis*), and eastern meadowlark (*Stumella magna*).

5.1.4 NEW HAMPSHIRE ISLES OF SHOALS

The Isles of Shoals is an archipelago approximately six to ten miles off the coast of Rye, New Hampshire and Kittery, Maine. Evidence of Native Americans hunting on the islands dates back to 6,000 years ago. In the 1600's Captain John Smith built a colony of fishermen on the Isles of Shoals. Europeans harvested cod and used camps such as the Isles of Shoals to dry and salt the catch for shipment to England or continental Europe. Magra and Meskans (2006) describe the historical importance of cod:

> "The American Revolution was to some extent a fight over the big slow-moving codfish. Codfish were by far colonial New England's biggest export. The codfish was so important to New England that John Adams made sure the British allowed the US fisherman access to the Grand Banks and other banks off Newfoundland as part of the Treaty of Paris. Adams believed the fledgling country needed a thriving fishery in order to have trained mariners to serve in the navy. The US Congress agreed with him and in 1792 decided to pay fishermen a bounty for catching codfish."

The islands are now occupied with private homes, a seasonal hotel, and the Shoals Marine Laboratory (Maine). Four islands are included within Rye's jurisdiction: Star Island, White Island, Seavey Island, and Lunging Island. White Island and Seavey Island in the southeastern end of the

archipelago are owned by the State of New Hampshire and are managed by the New Hampshire Department of Natural and Cultural Resources. These two islands are connected during low tide by a land bridge. One of New Hampshire's two lighthouses can be found on White Island, as well as a coastal weather station. As part of Rye's Historic District, Seavey Island and White Island have been subject to restoration projects through the New Hampshire Audubon and the NHFGD. The Rye Conservation Commission continues to promote the protection and preservation of the cultural, social, and architectural history of Seavey and White Islands.

The Oceanic Hotel can be found on Star Island, approximately seven miles off the coast of New Hampshire. Each summer from June to September, thousands of visitors flock to the island to enjoy the scenery, historic architecture, grounds, gardens, oceanic vistas, and to explore the island. Built in the late 1800s, the Oceanic Hotel can seasonally house up to 300 guests. Many visitors venture to the island for the day or for one of the many conferences the island hosts. Conferences cover a range of topics from natural history and ecology, to painting and yoga. The Star Island Arts Group attracts many scenic artists each year to come together and share their love for capturing the beauty of the Isles of Shoals. Many of the paintings created by these artists are sold at the island's gift shop to help raise funds to benefit Star Island. Operated and maintained by the Star Island Corporation, Star Island remains a gem of the seacoast. Star Island strives to operate in a sustainable manner while providing for the visitors. Sustainable initiatives on the island include rainwater collection and filtration for drinking water, the use of salt water for flushing bodily waste, a solar array which can power up to 60% of the energy Star Island requires, and more. To learn more about the sustainable initiatives on Star Island read about the Gosport Initiative on the island's website.

The Oceanic Hotel on Star Island

Photo Credit: Aimee Tucker

5.1.5 ODIORNE POINT STATE PARK

Owned and operated by the New Hampshire Division of Parks and Recreation and adjacent to the Atlantic Ocean, Odiorne Point State Park contains a variety of ecosystems, habitats, vistas, and historical importance for the Town of Rye. Spanning 330 acres, the Park contains walking trails, picnic areas, historical structures, viewing points of Fort Stark in New Castle as well as the Isles of Shoals and multiple lighthouses, and the Seacoast Science Center. The Seacoast Science Center is a collaboration of the Audubon Society, the Friends of Odiorne Point State Park, the Seacoast Science Center Inc., and the University of New Hampshire Sea Grant Program. Offering educational, interpretive, and hands-on programs for school groups, camps, and the public, as well as summer concerts, the center is an integral part of the seacoast community. The center provides visitors with indoor exhibits on a variety of topics including beaches, Gulf of Maine wildlife, whales and seals, ocean reefs, educational displays, and interpretive talks, as well as outdoor tide pool lessons and explorations. Guests also enjoy guided walks of the parks on the trails leading to remnants of World War II military structures, original cellar holes, and stone walls.

Odiorne Point State Park welcomes undergraduate and graduate student researchers, volunteer naturalists, and professional consultants to conduct research on the many ecosystems present. Wildlife habitat at the park includes the rocky intertidal shoreline, sandy beaches with dunes, salt marshes, meadows, upland shrub forests, and both salt and freshwater ponds connecting to tidal creeks and mudflats with extensive flood plains.

In 1999, planning consultants the Thoresen Group prepared the Odiorne Point State Park and White Island Master Plan (Thoresen Group, 1999). This plan contains an in-depth inventory of natural features, historic and military features, as well as visitor center facilities and programs with targeted recommendations for each category. Odiorne Point State Park also has a Management Plan for the Cultural Landscape Features of Odiorne Point State Park (2002), and an Invasive Plant Management Plan (FB Environmental, 2010).

Photo Credit: Seacoast Science Center

5.2 SCENIC RESOURCE THREATS AND RECOMMENDATIONS FOR ACTION

Major threats to the scenic resources of Rye include habitat degradation and fragmentation from increased development and an increase in seasonal visitors. An increase in seasonal population can create new stressors for the ecosystem to provide for these guests such as an increased need for fresh drinking water, and an increase in both solid waste and septic waste generated.

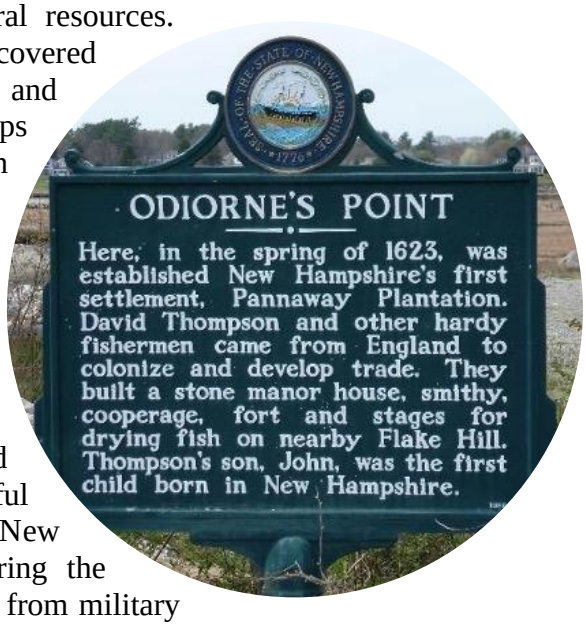
One of the largest scenic resources in Rye, the Coastal Byway, allows families, motorcyclists, and bicyclists over 18 miles of vistas of the Atlantic Ocean and the shoreline. According to the New Hampshire Coastal Byway Corridor Management Plan, residents of the New Hampshire seacoast may experience the influx of seasonal visitors as a burden to their status quo (Rockingham Planning Commission, New Hampshire Coastal Byway Corridor Management Plan, 2015). Visitors to the Coastal Byway have found there are too few areas to pull off and enjoy the vista, and many that do exist lack comprehensive signage identifying the pull off areas, lack proper infrastructure to cross the berm and view the ocean, and lack adequate landscaping. A new kiosk has been installed along the western side of the Coastal Byway just south of Washington Road. A second sign exists along the western side of the Coastal Byway across from the Rye Harbor. The idea of adding pullover areas is polarizing and many residents feel that the number of existing pullover areas is adequate. The Coastal Byway Corridor Management Plan, prepared by the Rockingham Planning Commission, also identifies recommendations for the Scenic Byway which include but are not limited to creating a Byway logo and markers, creating a unified signage program of cultural, historical, and natural resources, making zoning updates for scenic views, improving general landscaping of scenic viewing areas, improving the accessibility of existing pullouts, and creating salt marsh viewing and interpretation areas (Rockingham Planning Commission, New Hampshire Coastal Byway Corridor Management Plan, 2015).

Identifying a Visitor Information Center for the town would also help visitors make the most of their visit to enjoy the natural resources and become informed about conservation and restoration practices within the town.

The community can weigh in and assist with the prioritization of action items and implementation of these recommendations through town-based surveys. Also, through surveys, the community can identify popular scenic areas, areas from which vistas are viewed, and important community features. Appendix H of the Natural Resource Inventory Guide created for the town of Madbury, New Hampshire describes a method for identifying cultural, natural, and historical features important to the public (UNH Cooperative Extension, 2001).

Threats to other scenic resources include reforestation of pastureland, sea level rise and increased storm surge on salt marshes and the Isles of Shoals, and overuse of the Isles of Shoals and Odiorne Point State Park. Each of Rye's scenic treasures must be experienced and maintained in a sustainable fashion which can adapt to accommodate changes due to climate change and resulting from an expected increase in both residents and visitors. The Isles of Shoals communities are leaders in sustainable initiatives including energy production, water use, and waste management. The Green Gosport Initiative of Star Island strives to not only create a continually improving system for the island, but to educate visitors with practices they can bring back to the mainland (Star Island Corporation, Green Practices, 2020).

6. HISTORIC AND CULTURAL RESOURCES



Rye is a historic community rich in historic and cultural resources. Archaeological excavations out on the Isles of Shoals have uncovered Native American activity dating back to approximately 800 and 1200 A.D. when the islands were first used as fishing camps (Star Island Corporation, History, 2021). Prior to European settlement, the seacoast of New Hampshire contained many native communities including one with about 200 members near what is now Rye Harbor. With European settlement in the early 1600s, the seacoast and Isles of Shoals became home to fishermen who worked to create one of the busiest fishing ports in New England. The first documented European settlement in Rye can be found at Odiorne Point State Park, dating from 1623. Early residents of Rye profited from the thriving fishery offshore and were also successful farmers. Exports of these goods made their way to other New Hampshire, Maine, and Massachusetts communities. During the American Civil War, fishermen were granted an exemption from military service.

Tourism in Rye began in the 1840s with the establishment of a railroad to transport visitors to and from the seacoast. Hotels sprouted up in Rye and Portsmouth and extended out to the Isles of Shoals with the Appledore Hotel on Appledore, which burned down in 1914, and the Oceanic Hotel still operating on Star Island. Further residential developments were created in the early 1900s with the establishment of Ocean Boulevard, while inland areas mostly remained farmsteads. Odiorne Point was developed for military purposes during World War II to create Fort Dearborn (New Hampshire State Parks, 2019). The primary objective of Fort Dearborn was to protect Portsmouth Harbor and the Naval Yard from naval attack.

Environmentalism in Rye soared in the 1970s with the birth of the popular environmental movement in the US. Along with many residents of New Hampshire, Rye citizens protested the proposed development of an oil refinery in Durham, which was scrapped. Also, during this period conservationists in Rye moved to preserve open space of some 50 acres in Rye. Goss Farm was acquired by the Town to preserve a part of Rye's agricultural heritage and engage the community in agriculture (Rye Historical Society, 2021) and (Rye Historical Society, 2016).

Rye has a long history molded by the natural resources available to it and follows the same trend as many early colonial settlements in New England. Today, Rye has its own museum and historical society devoted to preserving and promoting its history.

7. PUBLIC, CONSERVED, AND RECREATIONAL LANDS

Conserved open space is an integral part of the Rye community. Through the years, residents have taken the initiative to preserve these resources and ecosystems for the greater benefit of residents, visitors, and the environment. With the help of the community, the Town of Rye has continuously acquired plots of land and forests through donations, town funds, grants, bonds, and easements including The Jim Raynes Forest, Cedar Run, Brown Lane Farm, Goss Farm, and many more. Through a town-wide vote in 2003, the Open Space Fund was established with an allotted $5 million bond. Additional funds were approved by town voters in 2014 ($3 million) and 2020 ($3 million) to continue land acquisition and protection efforts. In total, there are over 1,930 acres of conserved land in Rye (22% of the land in town) spread between 55 locations, including areas owned by the town (63%), the state (21%), the federal government (4%), and private owners (12%). The geographic information systems (GIS) database for conservation land in Rye was updated by FBE with the best available information to reflect updates including additional parcels under conservation not included in the NHGranit or Town Assessor's files as well as landowner and land protection status for these parcels based on input from the Rye Conservation Commission. Continued stewardship of this database is needed.

7.1 FOREST LANDS

7.1.1 TOWN OWNED AND MANAGED BY THE RYE CONSERVATION COMMISSION

The Town of Rye owns several areas of conserved forest, the Town Forest, Marden Woods, Varrell Woods, Seavey Acres, Rand Woods, Jim Raynes Forest, Brown Lane Farm, Cedar Run, and White Horse conservation land. The majority of these parcels were protected with Conservation Commission funds and are protected through conservation easements. These properties are managed by the Rye Conservation Commission, are publicly accessible and contain recreation trail networks. Motorized vehicles are prohibited on all properties. Residents and visitors enjoy these trails throughout the year as areas for scenic walks, trail running, dog walking, and snowshoeing. The Rye Middle School utilizes the Town Forest for its natural study program.

The **Town Forest** is located in the center of town within the Awcomin Marsh prioritized habitat conservation area, comprising the second largest unfragmented land block in Rye at 222 acres (Appendix A, Map 9, Map 14). Protected through a conservation easement held by the Rockingham County Conservation District, this area of conserved land contains areas of grassland, Appalachian Oak-Pine, hemlock-hardwood pine, temperate swamp, wet meadow/shrub wetland, peatland, salt marsh, and open water. The Town Forest is not only a place of recreation for the community, but an active natural area with the purpose of preserving the scenic, undeveloped, and open land for the community and environment to protect habitats and environmental quality. The

Town Forest trail network welcomes hiking, dog walking, birdwatching, biking, snowshoeing, and cross-country skiing. The Town protects the natural integrity of the forest with carry in, carry out policies and a trail color system that designates trails to avoid during wet and muddy conditions with bog bridges to maintain trail health (Rye Conservation Commission, n.d.).

Varrell Woods was acquired by the town in 1996. Varrell Woods is contiguous with the Town Forest and the Awcomin Marsh conservation area. Connecting areas of preserved land is an integral part of a conservation approach aimed at wildlife habitat protection. Wildlife corridors are created or enhanced with the increased connectivity of preserved diverse land allowing wildlife to traverse their ecosystems more safely.

Marden Woods is a 24-acre property managed by the Rye Conservation Commission for recreation and conservation. Visitors can enjoy both Appalachian Oak-Pine forests and temperate swamps while they walk, jog, ski, or bike the trails.

Whitehorse conservation land is in the southwestern part of the town and is approximately 93 acres. Located within the Packer Bog/Upper Berry's Brook South prioritized conservation area, this conservation land includes wet meadow/shrub wetlands, temperate swamps, and Appalachian Oak-Pine forests.

Rand Woods, approximately 71 acres, is best used for hiking and wildlife viewing. The designated limited trail area contains two trails covering a total distance of 1.06 miles through developed/open land and Appalachian Oak-Pine

Cedar Run Conservation land covers 28 acres. Visitors can enjoy walking, dog walking, biking, and wildlife viewing through grassland, Appalachian Oak-Pine, and hemlock-hardwood-pine forests.

Seavey Acres, approximately 59 acres, is located within the Lower Berry's Brook prioritized conservation area. Containing two trails covering a total distance of 1.57 miles, this habitat includes salt marshes, Appalachian Oak-Pine, and hemlock-hardwood-pine. Promoted activities include wildlife viewing, hiking, hunting in season, and other passive recreation.

Brown Lane Farm, approximately 82 acres, is located within a wildlife corridor near the southwestern corner of Rye. This area extends into wet meadow/shrub wetlands, Appalachian Oak-Pine forests, developed or barren land, and grassland. The trail area is well marked and abuts the Southeast Land Trust's (SELT) Rand Parcel. The combined trail system provides opportunities for lengthy walks and abundant wildlife viewing.

The Airfield Conservation parcel is approximately 11 acres and abuts the Whitehorse conservation land and is used for passive recreation but excludes biking. A deed restriction on the land prohibits hunting.

Other protected forest areas include those located within Odiorne Point State Park (see section 5.1.5).

7.2 PUBLIC, CONSERVED AND RECREATION LANDS

7.2.1 TOWN OWNED OPEN LANDS

Open space can come in many forms from farmland to ball fields to marshes. The Goss Farm, located at the corner of Harbor Road and Ocean Boulevard, was purchased with Conservation bond funds for the Town of Rye in 2010 with 49% of the funds coming from USDA Farm and

Ranchland funding. Goss Farm is primarily conserved for the protection and preservation of prime agricultural soils. The farm promotes local agriculture, engages Rye schools with agricultural educational opportunities, provides 23 community garden plots, and protects water quality through the implementation of buffered areas adjacent to wetlands and marshes. The importance of the Goss Farm is heightened by its location abutting the Awcomin salt marsh. In 2011 the Goss Barn was listed in the NH State Register of Historic Places. The barn was restored in 2014 with money provided by the passing of a warrant article designated for that purpose. The Rye Conservation Commission and the community continue to plan for Goss Farm's preservation and raise money for ongoing improvements on the 9-acre property.

Open space and recreational areas also include ball fields. Those owned by Rye include Parsons Field, the Rye Recreation Area, as well as the Rye Jr. High and Elementary school fields. Lastly, marshes provide areas of open land for wildlife and recreational viewing such as the Awcomin Marsh, Bemis Marsh, Marsh Pond, Massacre Marsh, and Wallis Marsh. See the following sections for additional marsh ecosystem information: Section 3.1 Wildlife Habitats, and Section 5.1.3 Salt Marshes.

7.2.2 EASEMENTS

A conservation easement is "a legally binding agreement between a landowner and the easement holder that restricts use of the land subject to the terms of the easement" (RSA 477:45-47). Conservation easements protect the natural resources of a property (wildlife habitat, water resources, agricultural soils, recreational potential, open space, etc.) by constraining the potential allowable uses of the property (or a portion of the property). The easement remains with the land in perpetuity, so that if the land is sold or transferred the subsequent owners must abide by the easement as well (UNH Cooperative Extension, n.d.). Placing land into a conservation easement ensures that area of land will never be developed for commercial, residential, or industrial uses.

As of 2012, the Town of Rye held 14 easements protecting a total of 256 acres. These include easements for the Philbrick property and Goss Farm, both of which were conserved under agricultural easements for the protection of agricultural soils. Other types of easements have been utilized to specifically protect Rye's water and wetland resources, and wildlife habitat emphasizing the protection of established wildlife corridors.

7.2.3 DEVELOPED LANDS AND CONSIDERATIONS FOR FURTHER DEVELOPMENT

Resiliency must be designed into existing and future infrastructure due to the climate change impacts of temperature, precipitation, water levels, wind loads, storm surges, wave heights, soil moisture, and ground water level changes (Ballestero, Houle, Puls, & Barbu, 2017). Nine strategies that can aid in minimizing the adverse effects associated with climate change are (McCormick & Dorworth, 2019):

1. **Installing Green Infrastructure:** Planning for greener infrastructure requires that people think about creating a network of interconnected natural areas and open spaces needed for groundwater recharge, pollution mitigation, reduced runoff and erosion, and improved air quality for the communities being developed. Examples of green infrastructure include forest, wetlands, natural areas, riparian (banks of a water course) buffers, agricultural land, and flood plains; all of which already exist in the watershed and have minimized the damage created by intense storms in the past. As future development occurs, people must be able to maintain or even increase these natural barriers to reduce runoff of pollutants into freshwaters.

2. **Using Low Impact Development (LID) Strategies:** Use of LID strategies requires that people replace the traditional approaches to stormwater management that uses curbs, pipes, storm drains, gutters, and retention ponds with innovative approaches such as bioretention, vegetated swales, and permeable paving.
3. **Minimizing Impervious Surfaces:** Today two-thirds of our impervious surfaces come from roads, highways, and parking lots; people must minimize impervious surfaces by creating new ordinances and building construction design requirements which reduce imperviousness of new development. Parking lot design requirements should promote infiltration of runoff and roads should consider space for pedestrians, bicyclists, and mass transit. Increasing our transportation choices reduces the need for more pavement. Private property owners can also increase the permeability of their lots by incorporating permeable driveways and walkways.
4. **Encouraging Riparian Buffers and Maintaining Flood Plains:** Town ordinances should forbid construction in flood plains, and in some instances flood plains should be expanded to increase the land area which will accommodate larger rainfall events. People also need to preserve and create riparian (vegetated) buffers and filter strips along waterways to slow runoff and filter pollutants.
5. **Protecting and Re-establishing Wetlands:** Wetlands are increasingly important in high runoff areas because wetlands hold water, recharge groundwater, and mitigate water pollution. The watershed contains many large natural wetlands that must be preserved. Preservation efforts may include invasive plant management, restoring natural structure (i.e., from stream channelization and/or ditching) and function (i.e., restoring bottom elevations) within the ecosystem. Protecting wetlands can also stem from using a watershed-wide approach where the understanding is made those actions within the watershed impact the receiving waterbody or wetland. All strategies listed here are likely to help reduce the impact of not only climate change, but also from human impact and development within the watershed, and overall improving wetland health. See resources provided by the EPA for wetland protection and restoration.
6. **Encouraging Tree Planting:** Trees help manage stormwater by reducing runoff and mitigating erosion along surface waters. In addition, trees cool heat islands in more developed areas and provide shade for pedestrians.
7. **Promoting Landscaping Using Native Vegetation:** Communities should promote the use of native vegetation in landscaping, and landscapers should become familiar with techniques which minimize runoff and the discharge of nutrients into waterbodies (Chase-Rowell, Davis, Hartnett, & Wyzga, 2012). For lists of some native vegetation utilized in landscaping see the University of New Hampshire Cooperative Extension document New Hampshire's Native Trees, Shrubs, and Vines with Wildlife Value or the NHDES document for Native Shoreland/Riparian Buffer Plantings for New Hampshire.
8. **Slowing Down the Flow of Stormwater:** To slow and infiltrate stormwater runoff, a variety of techniques can be employed. Roadside ditches can be armored or vegetated and equipped with turnouts, settling basins, check dams, or infiltration catch basins. Rain gardens can retain stormwater while water bars can divert water running down roads and walkways into vegetated areas for infiltration. Water running off roofs can be channeled into infiltration fields and drainage trenches (UNH Cooperative Extension, 2007).
9. **Coordinating Infrastructure, Housing, and Transportation Planning**: People should coordinate planning for infrastructure, housing, and transportation to minimize impacts on natural resources. Critical resources including groundwater must be conserved and remain free of pollutants especially as future droughts may deplete groundwater supplies.

7.2.4 UNFRAGMENTED LAND BLOCKS

Unfragmented land blocks are areas including wetlands but excluding open water that are not divided by developed features such as roads, powerlines, development. Natural watercourses such as streams and rivers are included since they often fragment a land area to prohibit the passage of some terrestrial animals. FBE identified unfragmented blocks of land using ArcGIS analyses Rye contains over 50 areas of unfragmented land blocks ranging in size from 20 acres to over 715 acres. As shown in Appendix A, Map 15, the two largest blocks of unfragmented land exist in and around the Awcomin Marsh (including the Town Forest land), and in and around the Packer Bog/Upper Berry's Brook South prioritized habitat blocks (see Appendix A, Map 9). The primary dividers of land blocks in Rye are roadways and streams. There are approximately 64 miles of roads in Rye which cut through forests, wetlands, and grasslands. However, the majority of Rye is characterized by having unfragmented land blocks between 100 and 500 acres in size which is largely due to Rye's achievements in land conservation and zoning regulations protecting wetland areas which are not suitable for development.

7.3 THREATS TO PUBLIC, CONSERVED, AND RECREATIONAL LAND AND RECOMMENDATIONS FOR ACTION

7.3.1 RECOMMENDATIONS FOR LAND PRESERVATION

Add area via purchase or conservation easement to existing protected areas. This recommendation epitomizes the saying that the whole is greater than the sum of the parts. Adding to existing protected areas buffers those areas from external impacts (e.g., stormwater runoff, noise pollution). Increasing the size of a given protected area also reduces "edge effects" which include changes in vegetation structure and species composition, temperature, as well as predation and parasitism levels, all of which can have deleterious effects on populations of area-sensitive wildlife species. In Rye, conserving land in the Awcomin Marsh Area could effectively increase the size of the Town Forest while also protect the water quality of the Rye Harbor sub-watershed.

Continue to actively seek partnerships with local and regional land trusts and other conservation organizations to conserve land in Rye. The Rye Conservation Commission has effectively partnered with regional land trusts such as the Southeast Land Trust (SELT) and the Rockingham County Conservation District to hold easements on acquired lands. Land use partners can be instrumental in acquiring land, holding conservation easements, and facilitating conservation projects.

Enhance resident education and communication of local land ordinances, best management practices, and actions. Hold informational workshops for new landowners and developers on relevant town ordinances, conservation easements, and watershed goals. Reach out to businesses such as museums, camps, libraries, to coordinate education and outreach opportunities.

7.3.2 RECOMMENDATIONS FOR LOCAL LAND USE PLANNING

Avoid large-lot zoning. Increasing the size of buildable residential lots is often considered to be a "quick fix" to limit sprawl-type development. This change to zoning results in a development pattern that appears to be "green," with fewer houses and more trees visible. An unintended consequence of this practice is to spread the impacts of development across a larger area, destabilizing and often eliminating local populations of wildlife that are sensitive to development (i.e., require tracts of land absent of roads, driveways, houses, and lawns).

Increase building setbacks in shoreland zones. The land adjacent to a lake, pond, river, or stream, when left in its natural state, plays an important role in filtering runoff, shading streams and rivers, protecting and stabilizing banks and shorelines, and reducing erosion. Some of the benchmark standards that should be built into ordinances for protecting water quality within the shoreland zone include mandatory setbacks for primary structures, mandatory buffers between development and the waterbody, and impervious cover restrictions.

The State of New Hampshire's minimum setback requirement is 50 feet as dictated by the Shoreland Water Quality Protection Act. Some towns in New Hampshire, including Rye, go beyond the State minimum and require a setback of 100 feet. This 100-foot setback has proven to be very effective at protecting water quality (Merrell & Moore, 2013).

Consider novel types of development, including Traditional Neighborhood Design (TND) and conservation subdivisions. By clustering housing, it is possible to reduce the amount of impact of associated infrastructure (e.g., roads) and to reduce the overall "footprint" of a given development. Conservation subdivisions could be encouraged or mandated in conservation priority areas, as this type of development has been shown to have less negative impact on open space, wildlife and their habitat, and water quality, than unlimited outward expansion of low-density development into undeveloped areas (i.e., sprawl) (Hawkins, 2014).

Rye's zoning ordinance does contain a provision for conservation subdivisions (referred to as cluster layout in the ordinance). The town permits the clustering of up to 20 housing units for the preservation of open space, to promote more efficient use of land, and to provide flexibility in subdivision design "if at least 50% of the parcel is preserved as common open space" and permanently protected via a conservation easement (§ 190-4.1D(16)). It is also prudent to mandate that conserved open space on one development parcel connect to the open space on another parcel when possible.

Consider expanding low-impact development practices. Low impact development (LID) refers to a wide range of techniques specifically designed to limit the adverse effects that poorly planned development can have on water quality. Some examples of LID techniques include minimization and/or disconnection of impervious surfaces, development design that reduces the rate and volume of runoff, and reduction of the pollutant loads within runoff. Common types of techniques include but are not limited to curb-free roads, swales, bioretention cells, tree box filters, infiltration trenches, rain barrels, and rain gardens. Rye can help protect water quality and wildlife habitat by mandating the use of LID in new and renovated developments.

Land development regulations in Rye contain mandatory implementation of LID for new development to reduce the volume of stormwater runoff, increase water quality protection, and to maintain a site's pre-development hydrology (Land Development Regulations § 202-9.2).

More information on LID techniques can be found on the Center for Watershed Protection's website: www.cwp.org and within the New Hampshire Homeowners Guide to Stormwater Management available through NHDES: https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/homeowner-guide-stormwater.pdf.

Amend the existing wetland regulations to better protect wetlands and the organisms they support. Wetlands, along with the terrestrial areas adjacent to them, tend to be biodiversity hotspots. Unfortunately, wetlands are often still impacted due to development. New Hampshire's

wetland regulations protect water quality and aquatic and terrestrial wildlife through best management practices, culvert and bridge design requirements, and overall project avoidance and minimization (Env-Wt 307.02, 307.04, 307.06, 307.10(g), (i), (k), 605, 609, 904.01, and 904.07).

Rye's zoning regulations specify a 100-foot naturally vegetated buffer from the edge of all tidal marshes, bays, estuaries, tidal rivers and creeks and their tributaries, as defined by the highest flooding of the ocean tides; as well as from the edge of all natural perennial streams and vernal pools. In addition, there are specific wetland resources throughout town that have a 100-foot buffer as well which include from the edges of Eel Pond, Burke's Pond, Brown's Pond, and East Rye Pond as defined by the high-water mark; as well as freshwater wetlands one acre or larger in size located within the Berry's Brook watershed. The town also implements a 75-foot buffer from the edge of all non-tidal wetlands, which include ponds and palustrine wetlands (Appendix B), greater than or equal to one acre in size and are not one of the specifically identify resources listed above. Rye may wish to eliminate its non-tidal wetland size requirement; therefore, stating all wetlands regardless of size, must be protected via a 75-foot buffer. Buffers provide additional protection of wetlands, water quality, and wildlife habitat. **Formally adopt and apply "Best Management Practices" and "Best Development Practices" that can help to reduce impacts to biodiversity during both town-wide planning and individual site review processes**. Examples of such manuals are Best Development Practices Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States (Calhoun & Klemens, 2002) and Forestry Management Guidelines for Vernal Pool Wildlife (Calhoun & deMaynadier, 2004). Additional BMPs from other organizations and agencies may also prove useful, such as "Wetlands Best Management Practices Techniques for Avoidance and Minimization" (NEIWPCC, NHDES, & EPA, 2019).

8. THREATS AND RECOMMENDATIONS

This NRI was created with the intent to provide a detailed description and analysis of Rye's natural resources and serve as a resource to help guide future municipal planning and conservation efforts. This NRI should not be viewed as a conservation plan of action, but rather as an encyclopedia of information based on the best currently available and interpreted data. The valuable natural resources in Rye are sensitive ecosystems that need protection from ill-managed development, environmental pollution, and climate change.

Each preceding chapter within this NRI has included a section for *threats and recommendations* pertaining to the natural resources included in the chapter. Threats may include sources of contamination, examples of ecosystem stressors, etc., while recommendations explain approaches the town may wish to consider moving forward to prioritize long-term protection and improving conservation measures for the identified natural resources.

Protecting water, wetlands, and geologic resources (including aquifers) is the core of many conservation efforts with the goals of ensuring quality of ecosystem function, public health, and recreation/scenic resources. These resources may be threatened by pollutant sources including but not limited to impervious sources, malfunctioning septic systems, wildlife waste, ill managed fertilizer use, and certain land use practices. Rye is at the forefront of experiencing the impacts of climate change in New Hampshire. Having the longest coastline in New Hampshire with an abundance of tidal marshes, Rye has and will continue to have coastal flooding from storm surges, king tides, and sea level rise. Marshes will migrate and habitats will change. Recommendations to

reduce these detrimental effects includes establishing BMPs throughout the watershed at both residential and municipal scales, using low impact design practices on homes and commercial buildings, establishing measurable milestones for restoration efforts, continued and expanded water quality monitoring programs, and public education and involvement. For more information regarding water and geologic resources in Rye as well as their threats and recommendations for long term health, see Section 2.

Rye is a haven for many species of wildlife including terrestrial and marine mammals, amphibians, reptiles, fish, and birds. Each year, migratory birds travel to or through Rye. Ten of the 17 species of birds listed as either threatened or endangered in New Hampshire have been seen in Rye. Threats to wildlife and habitats can include the spread of invasive plant and insect species, and habitat modification from both anthropogenic and climatic disturbances. Due to the abundance of unfragmented land, land cover types, and wetlands in Rye, in 2020, the NHFGD identified 29% of the town as having the highest ranked habitat in New Hampshire. Connect THE Coast then identified six areas of prioritized habitat areas within Rye as representing the most important areas for conservation efforts to support sensitive ecosystems, ecosystems of environmental resilience through climate change, and protect wildlife. Threats to wildlife and habitats include encroaching development, environmental pollution, invasive species, and more. This is not to say development should not occur within areas identified as primary conservation areas, but rather, development should be mindful of these sensitive ecosystems and strive to have as little negative impact as possible. Habitat protection, education, and targeted land management efforts will help Rye's ecosystems thrive. For more information regarding wildlife and habitat areas as well as their threats and recommendations for long term health, see Section 3.

Soil types determine which land use practices may thrive and which may not be recommended. 56% of Rye's land area is comprised of important forest soils designated by NRCS. 36% of Rye is comprised of soils suitable for agricultural practices. Soil structure may hinder development in certain areas based on hydric soil classifications, distance to the water table, and the likelihood of soil erosion to occur. The largest threat to farmlands and agricultural soils in Rye is the conversion of agricultural lands to development or forest because there are so few areas of agriculture in Rye. Recommendations for conserving agricultural lands while benefiting the surrounding environment include developing an agricultural profile for the town. To reduce the effects of soil erosion on streams and ponds, it is recommended to reduce disturbance of soils classified as having high erosion potential and to establish vegetated buffers along/around surface waters. For more information regarding soils and agriculture within Rye, see Section 4.

Photo Credit: Magicseaweed.com

One of Rye's greatest treasures is its iconic scenic beauty and surrounding landscape. Containing a scenic road, multiple state beaches, Odiorne Point State Park, marinas, lighthouses, and four of the Isles of Shoals, visitors flock to Rye's seacoast each year to enjoy everything Rye has to offer. Degradation of Rye's scenic resources may occur if the pressures from visitors and development surpass what the environment can sustain. An increase in or high level of visitors comes with an increase in solid waste produced, amount of drinking water required, and amount of wastewater produced. Recommendations to sustainably manage Rye's scenic resources may include establishing a visitor information center paired with an environmental education. Surveys of the community would reveal preferences for where to establish scenic viewing points and/or nature trails. All established points for scenic vistas and trails should contain placards with information regarding the environmental value of the surrounding environment to increase public education regarding Rye's natural resources. For more information regarding scenic resources in Rye, see Section 5.

There are over 1,930 acres of conserved land in Rye, most owned by the Town of Rye (63%). Town forests serve not only as preserved habitats for wildlife and ecosystem functions, but as an outlet for those looking to recreate in nature. Recommendations for enhancing and expanding conservation land in Rye includes educating the public on conservation easements and acquiring easements on town-owned land, all while continuing to build partnerships with local and regional land trusts. Land fragmentation poses a threat to habitats by segmenting parcels of land. Two of the largest blocks of unfragmented land in Rye overlap with two of the areas identified as high priority conservation areas. The main divider of habitats in Rye is roads. As development increases, efforts should be made to abide by low impact development practices, minimizing impervious surfaces, avoiding large-lot zoning, and incorporating TND and conservation subdivisions. As more land is protected, the Rye Conservation Commission should work actively with the Town Assessor's office and other entities maintaining and sharing geographic information systems (GIS) data, such as NH GRANIT, to keep these databases up to date. For more information regarding public, conserved, and recreational lands in Rye, see Section 7.

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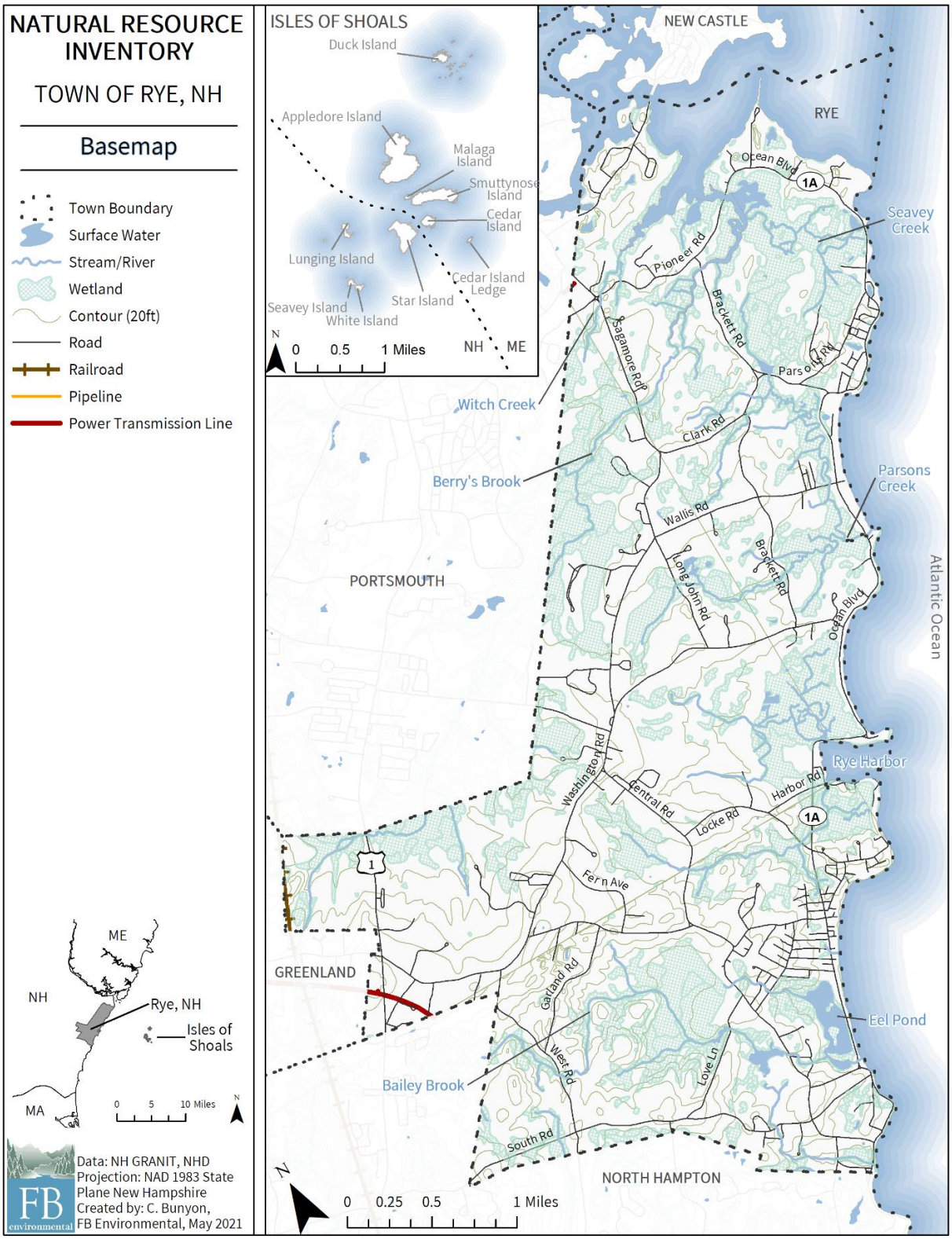
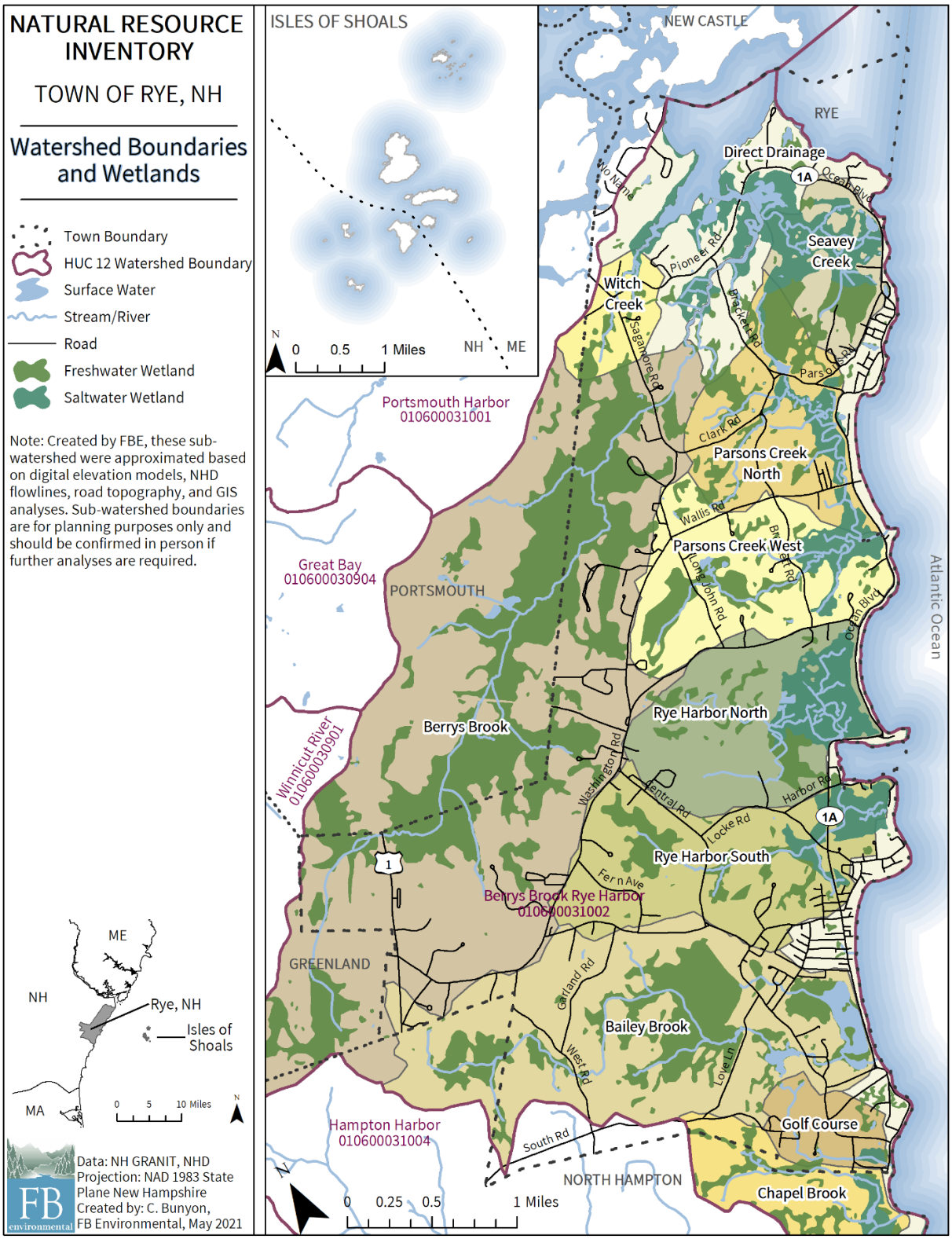
Appendix A: Maps

Map 1



Return to Section 1.6 or Section 2.2.

Map 2



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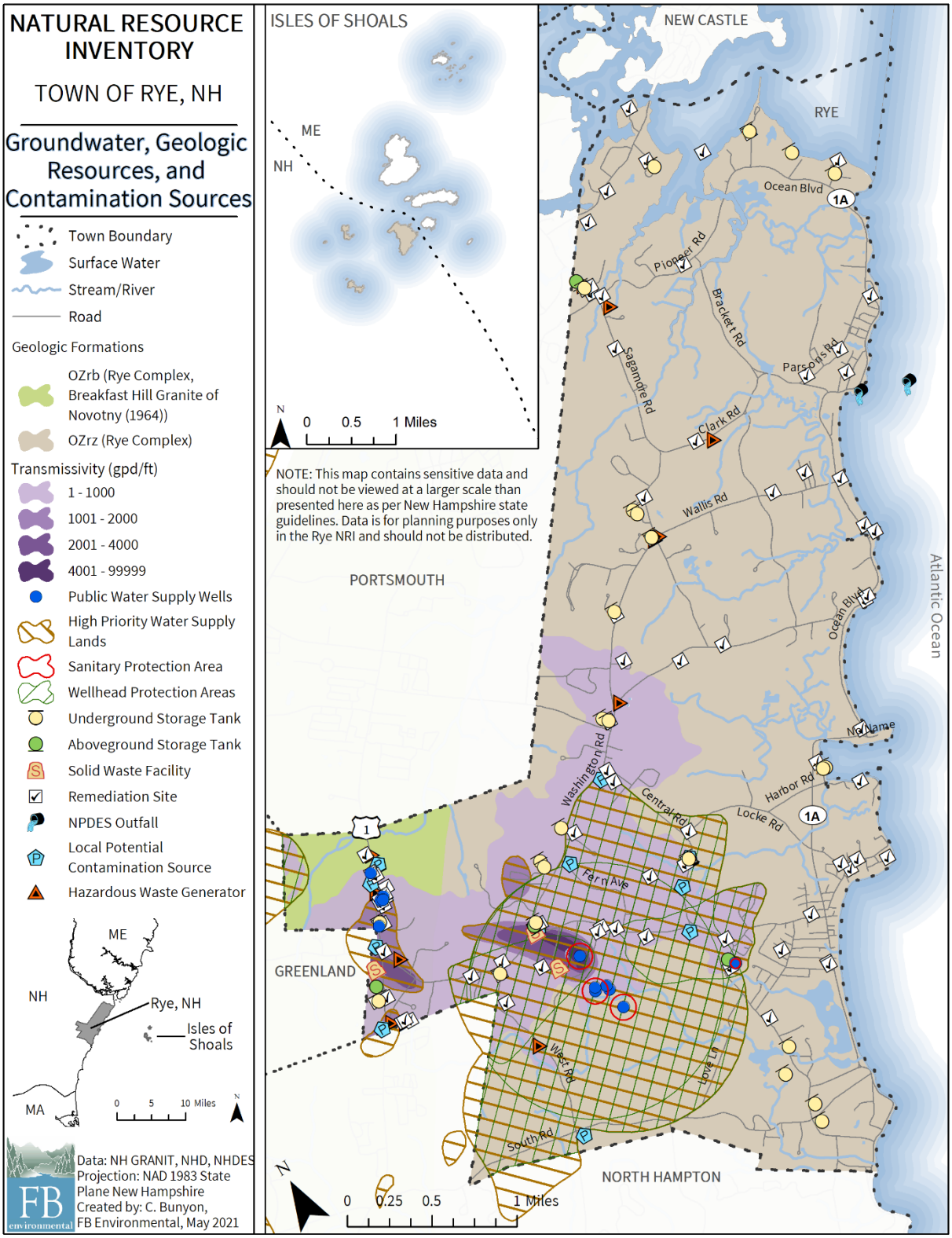
Map 3



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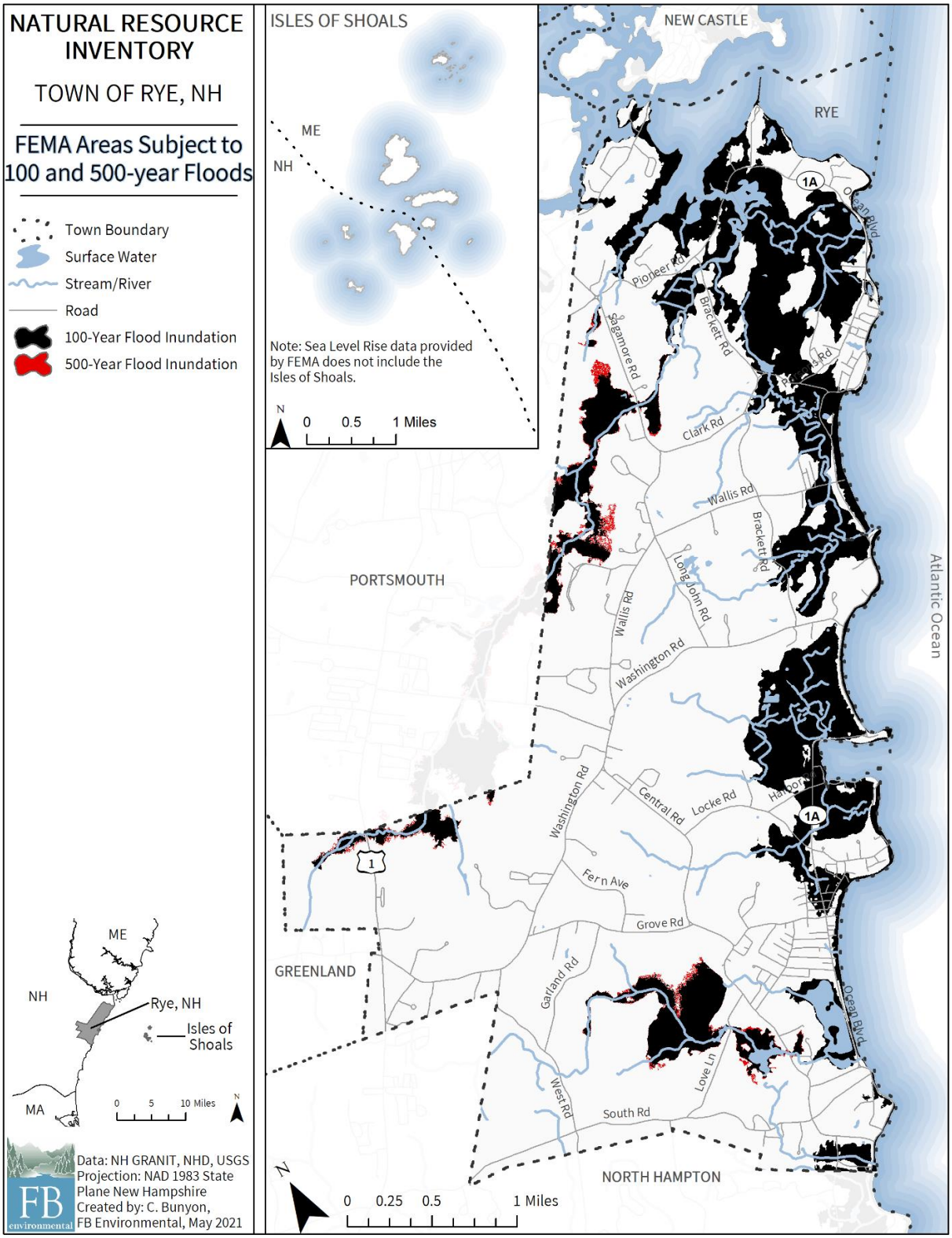
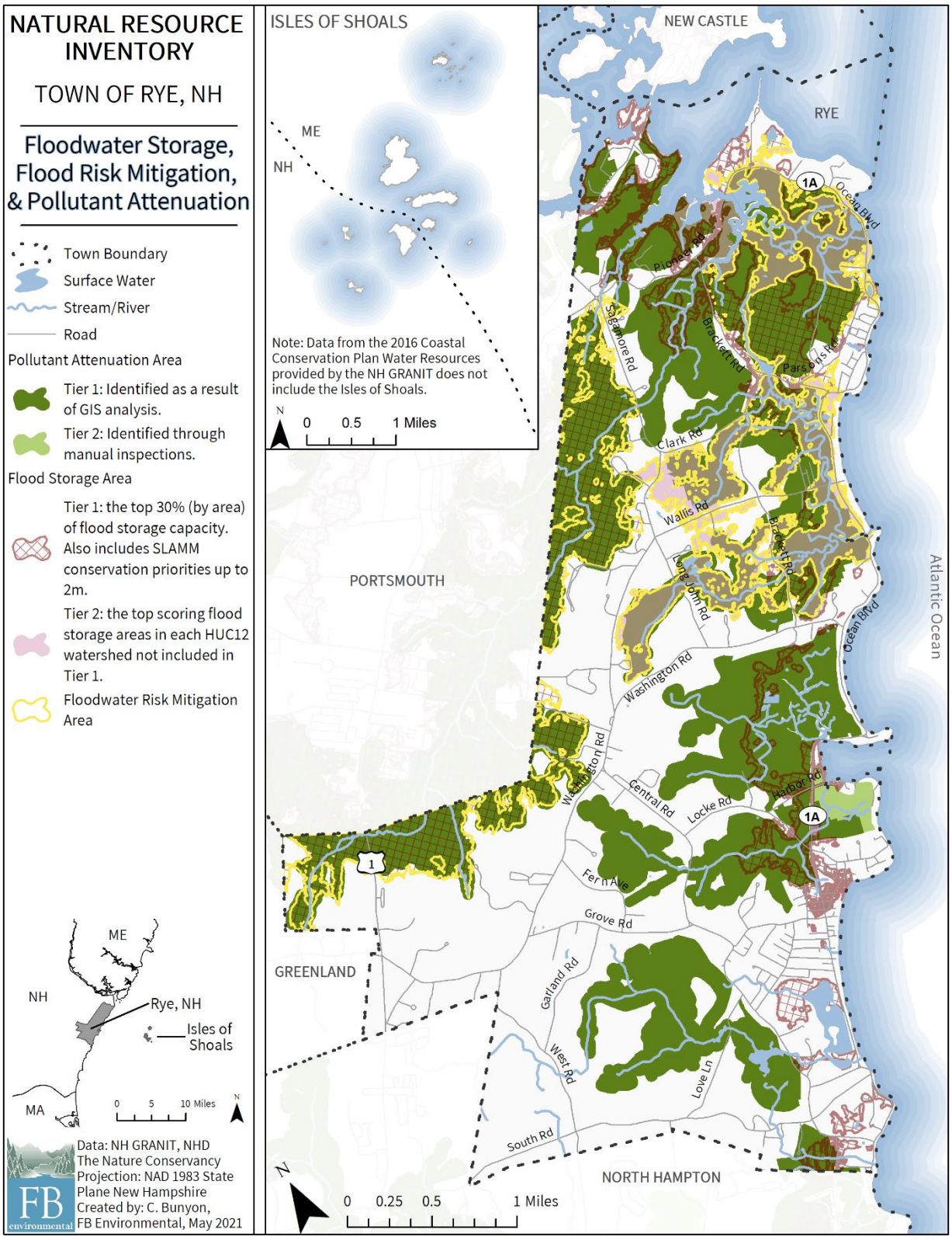
Map 4



Return to Section 2.5.

Map 5



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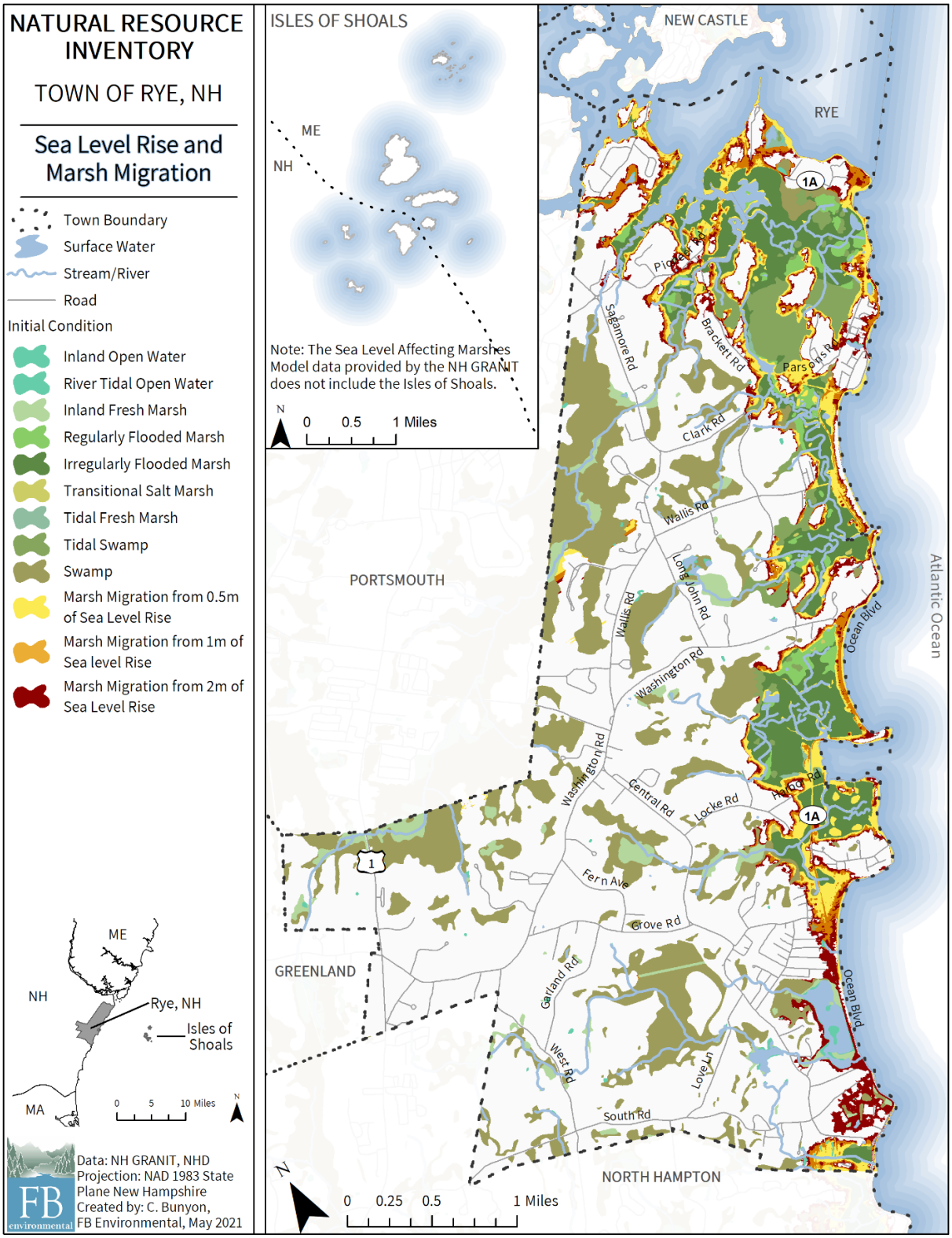
Map 6



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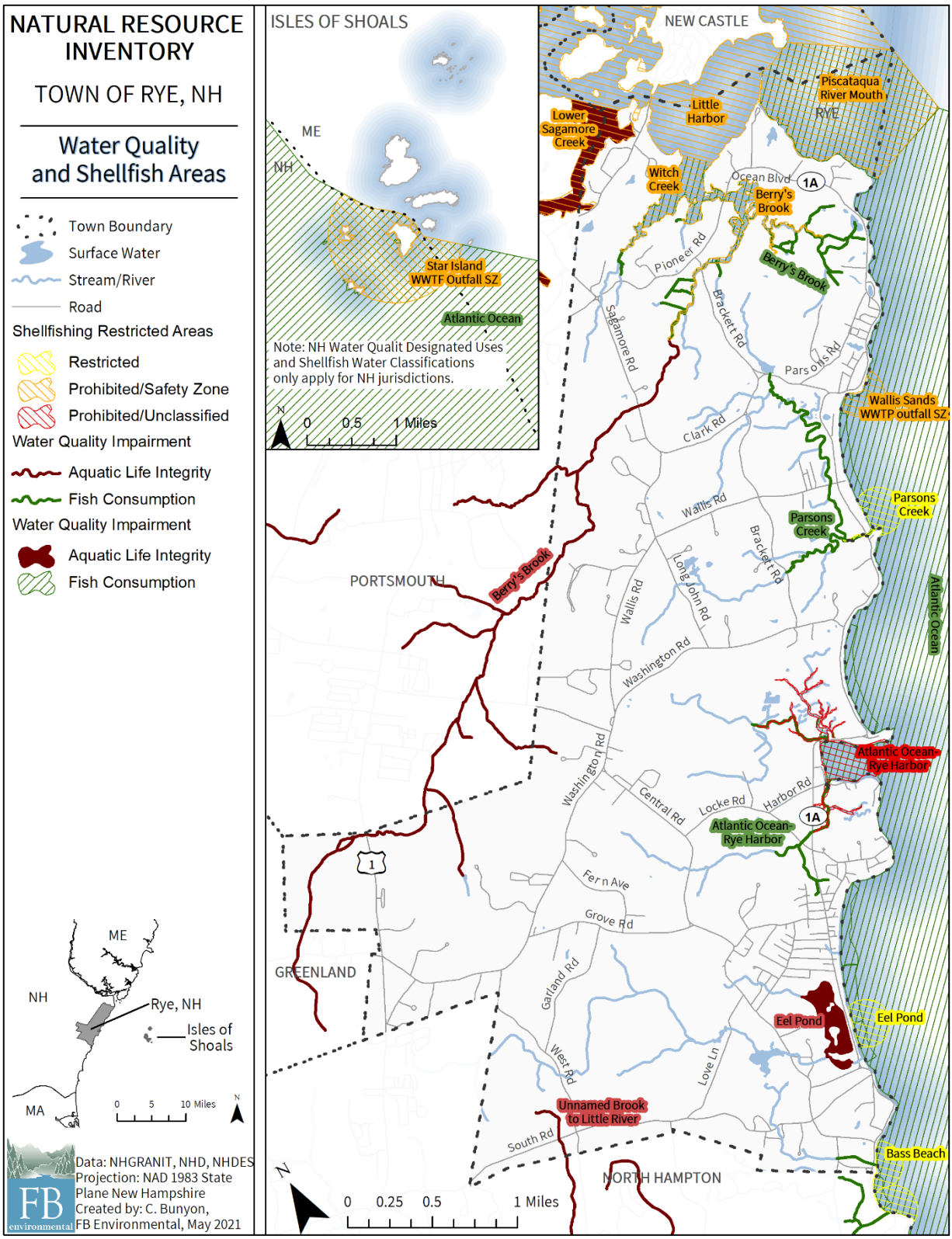
Map 7



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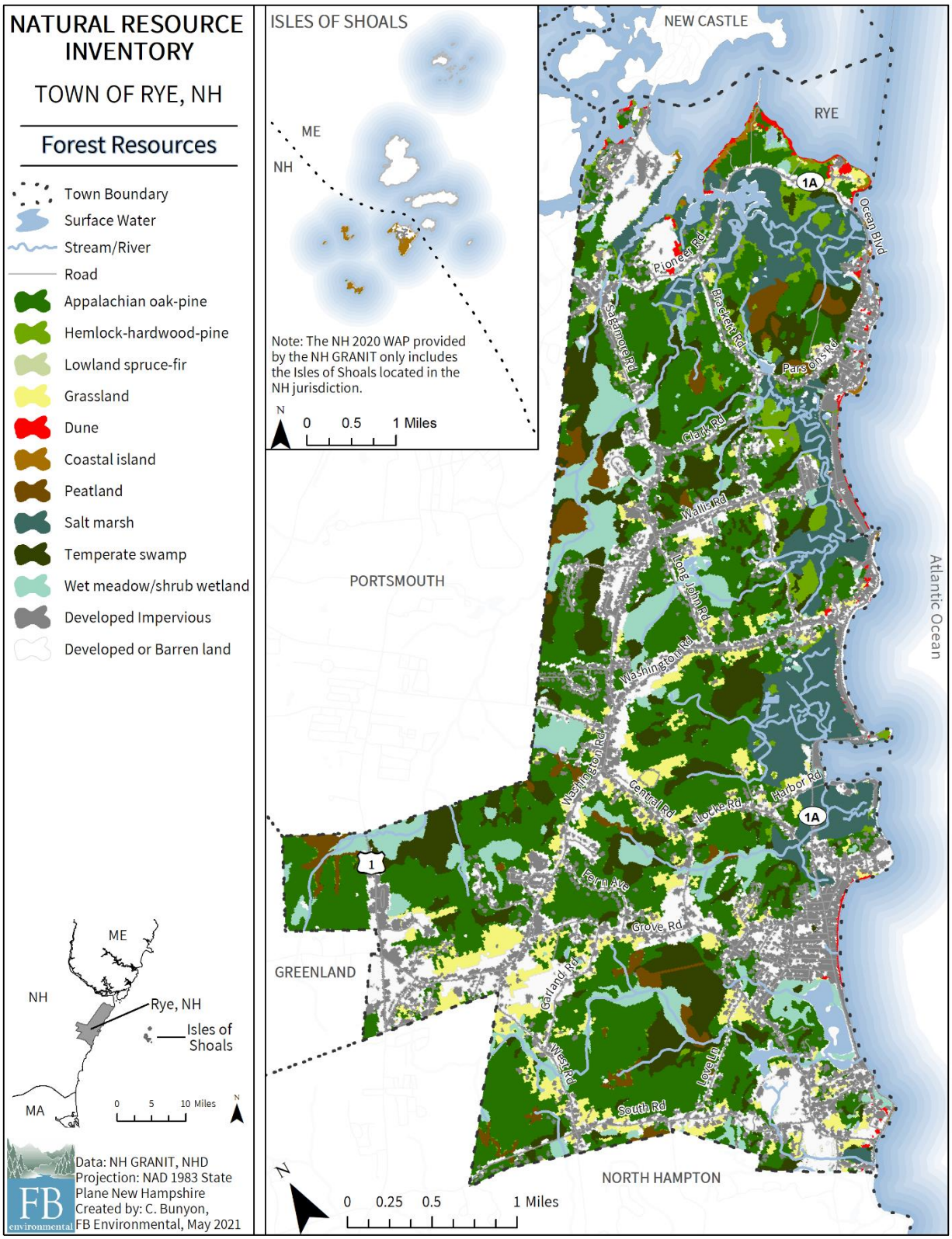
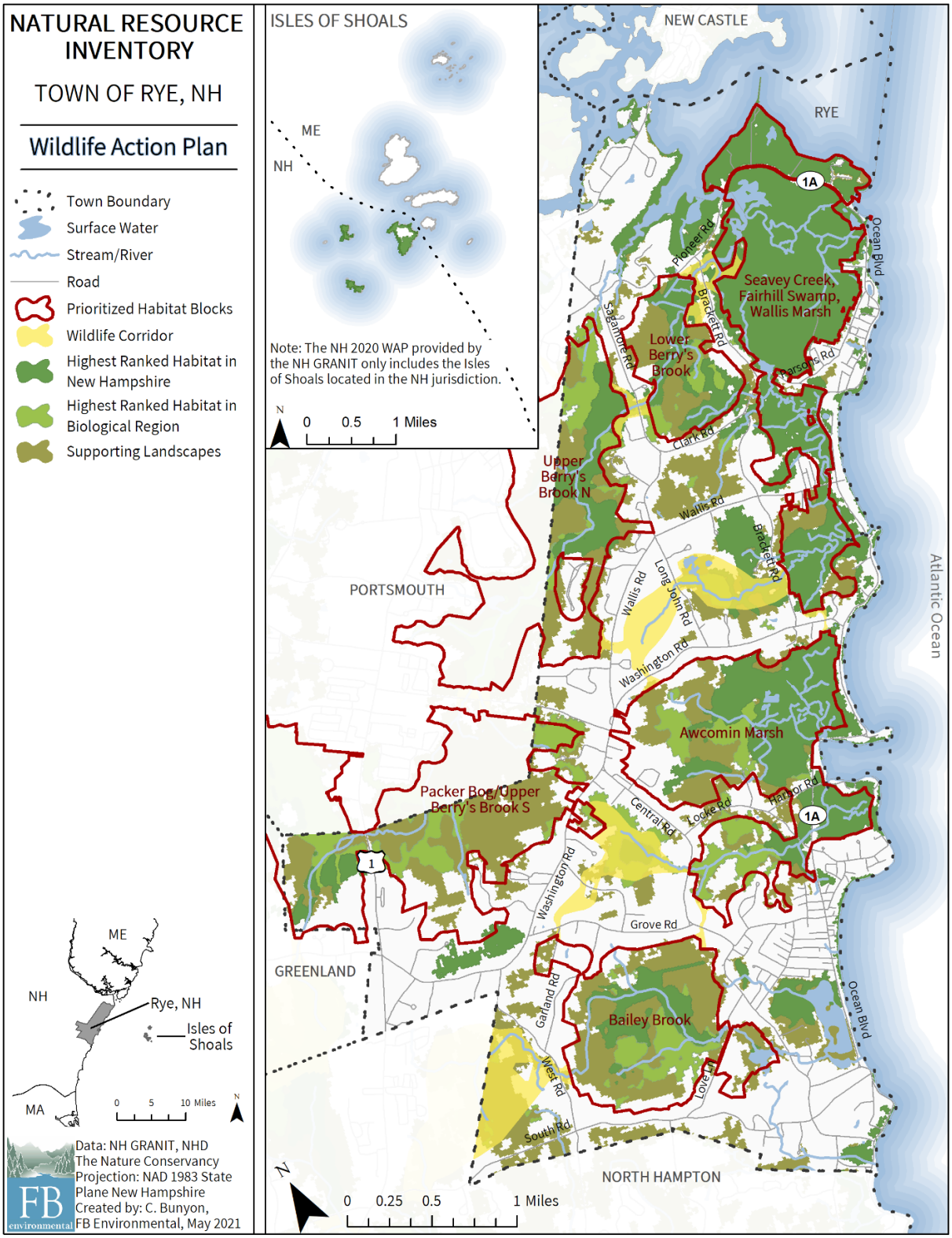
Map 8



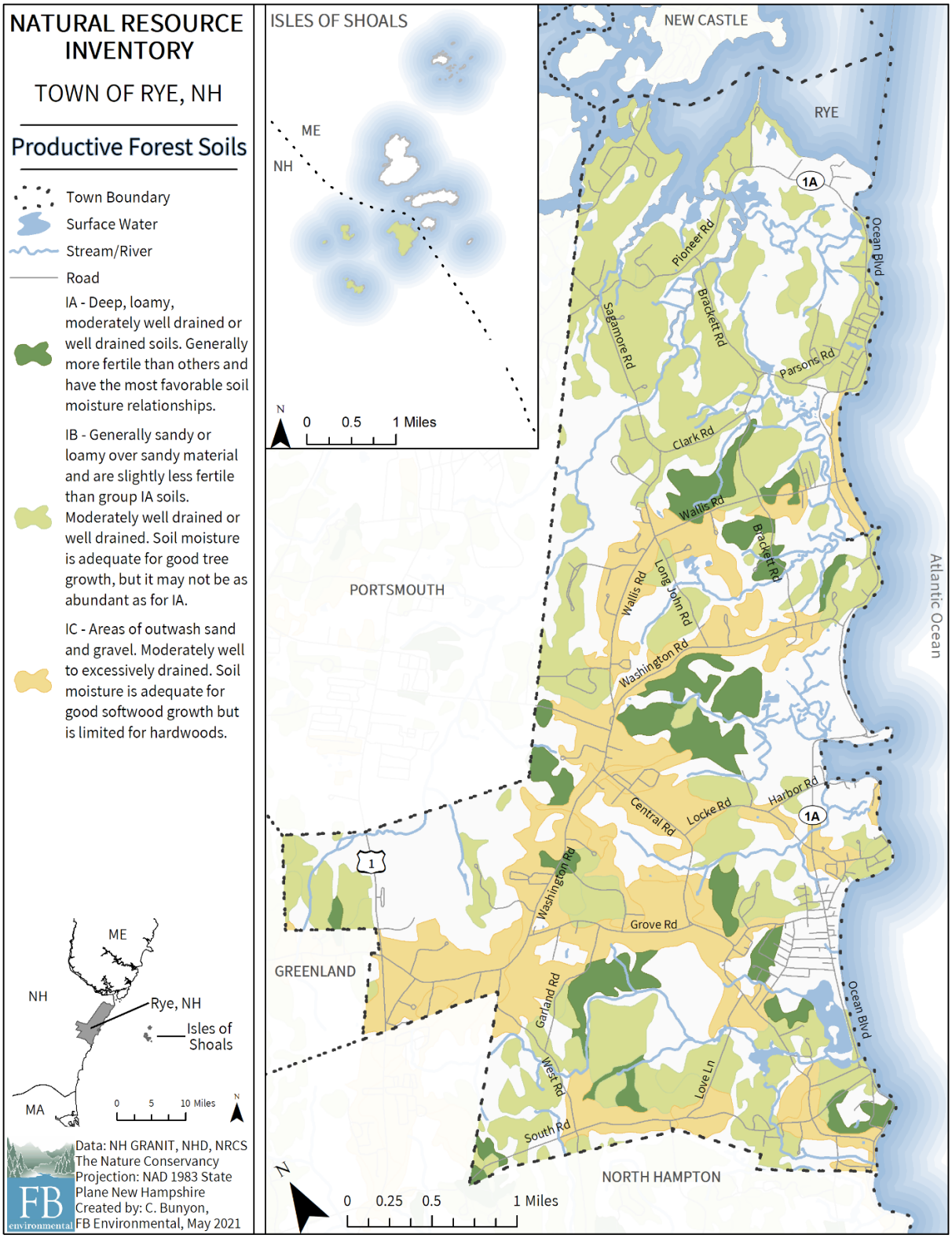
Return to Section 3.1.

Map 9



Return to Section 3.2, Section 7.1, or Section 7.2.

Map 10



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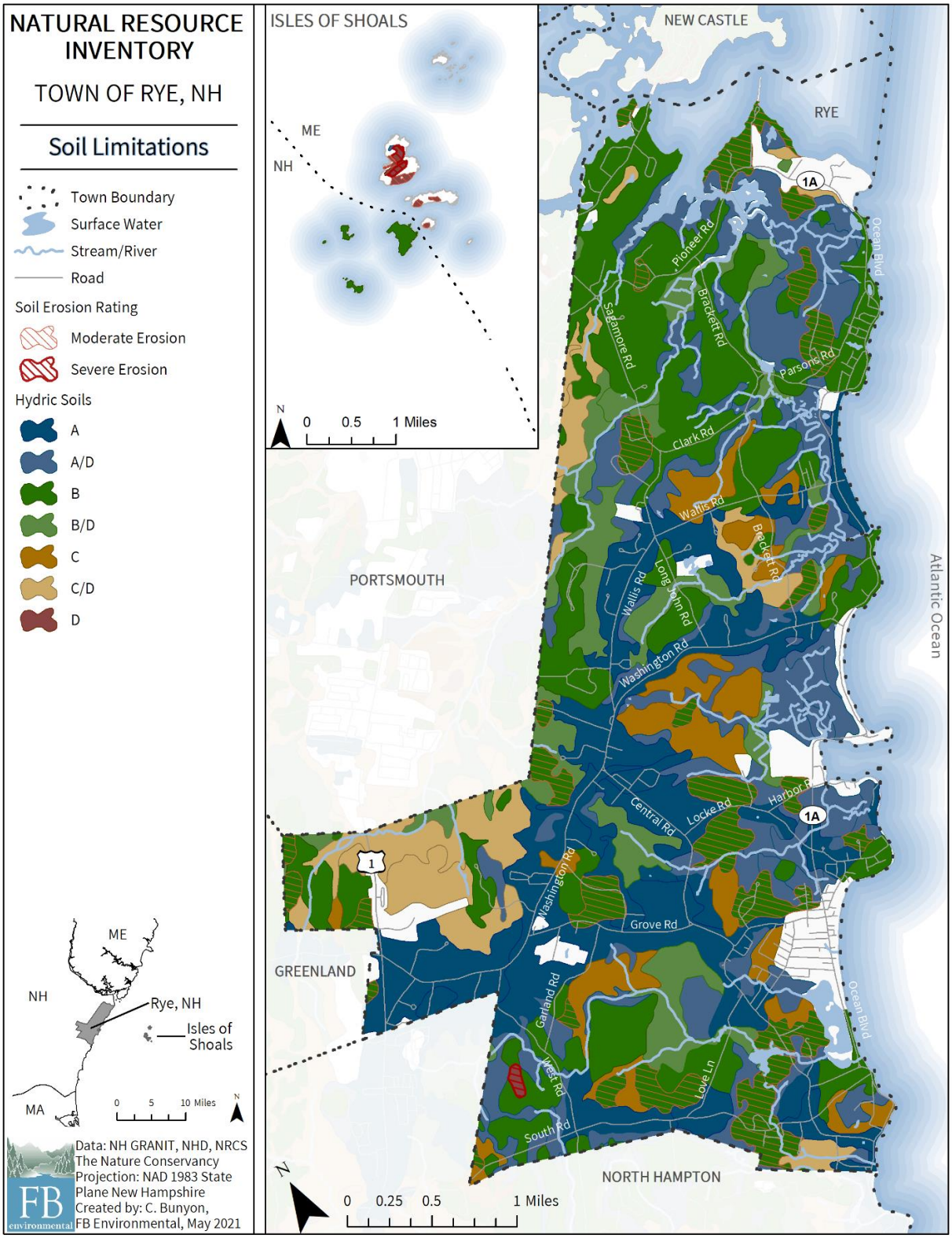
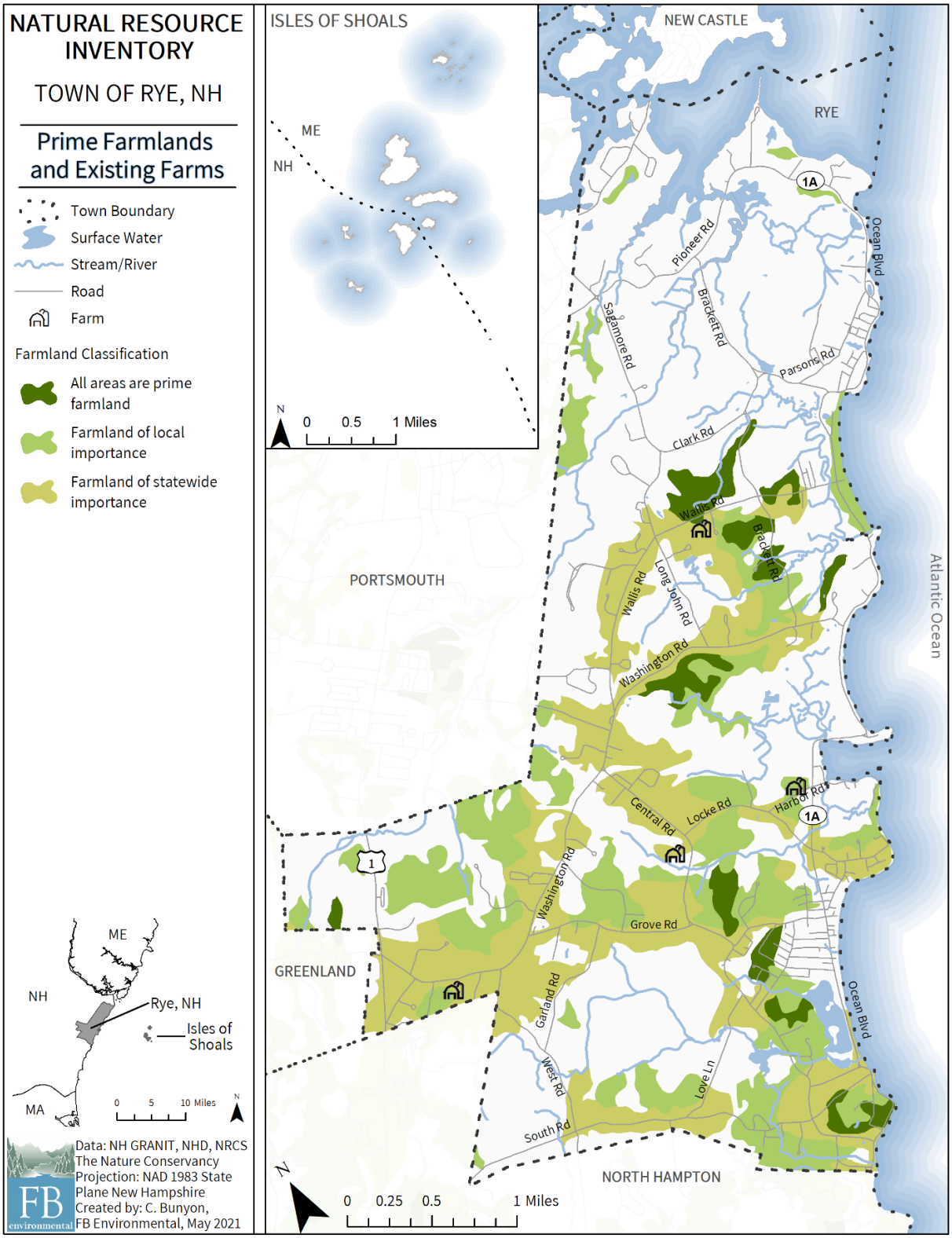
Map 11



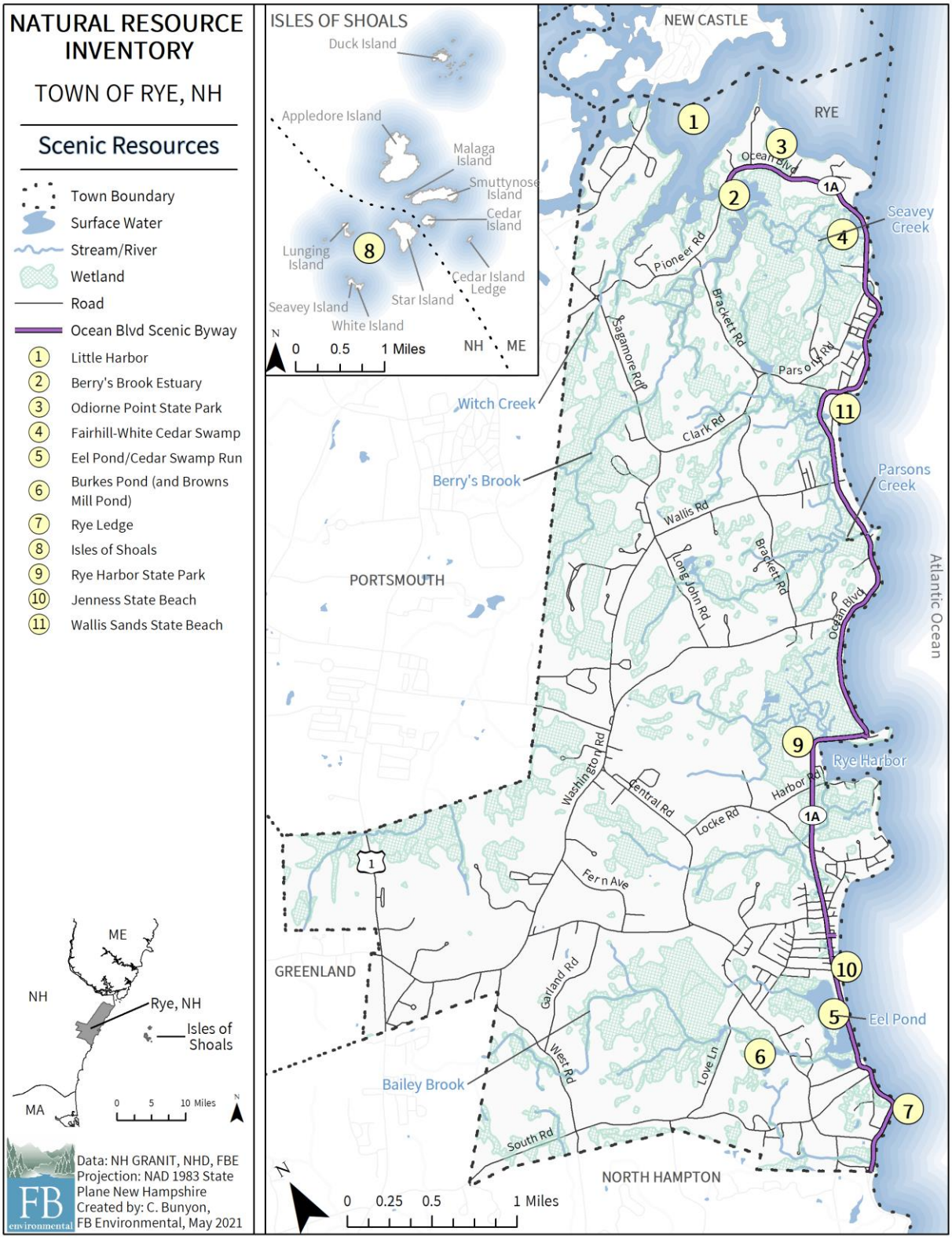
Return to Section 4.1.

Map 12



Return to Section 4.1.

Map 13



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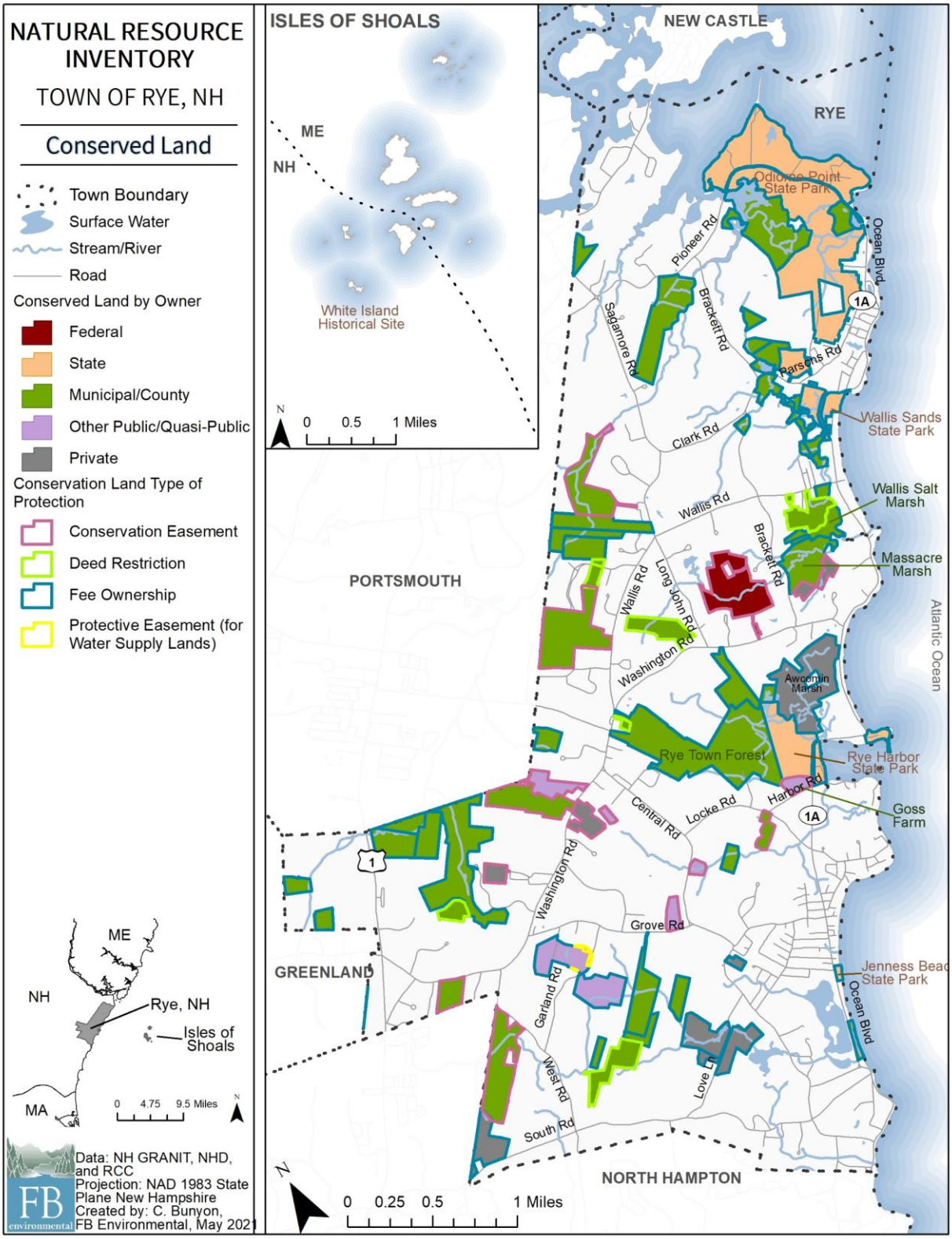
Map 14



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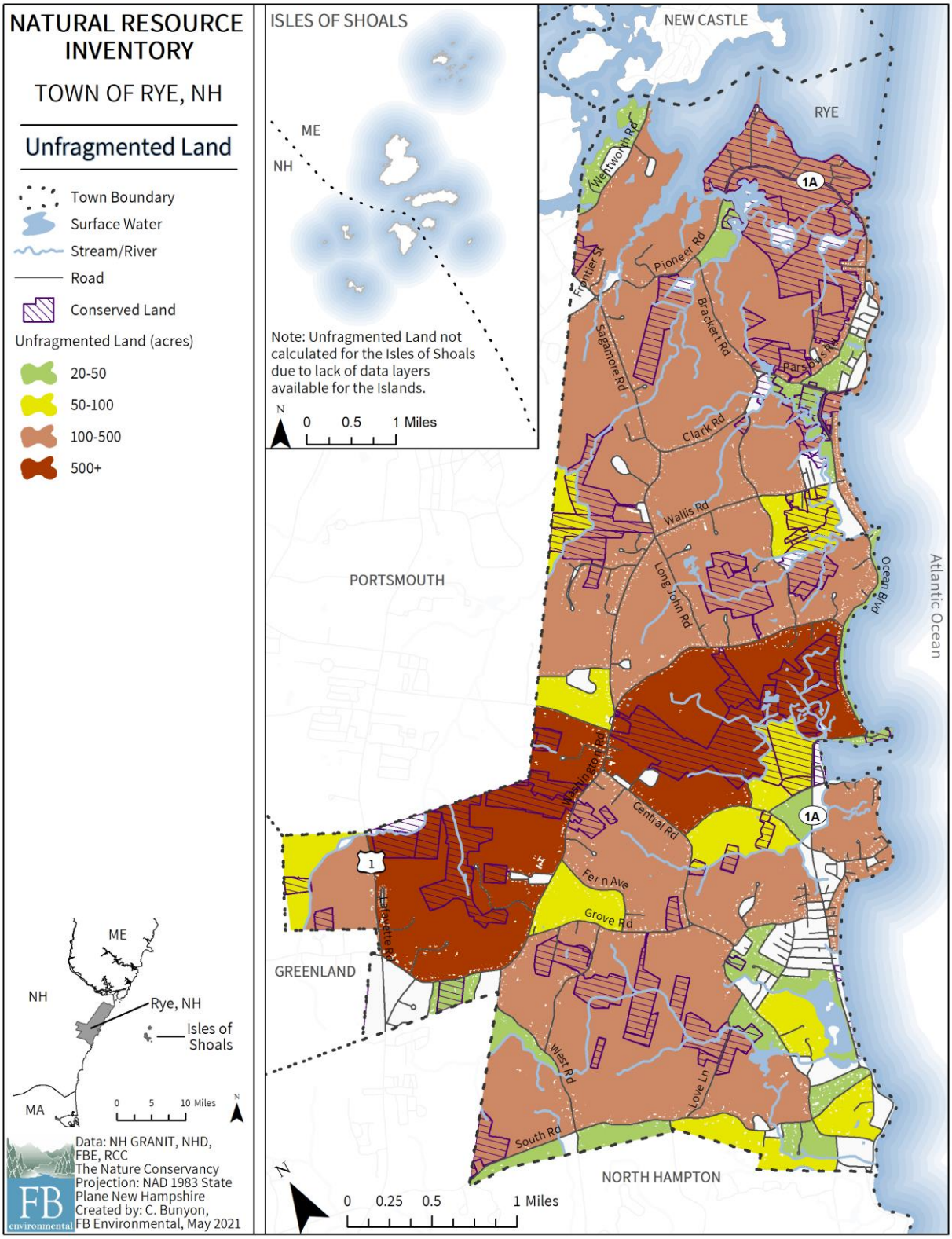
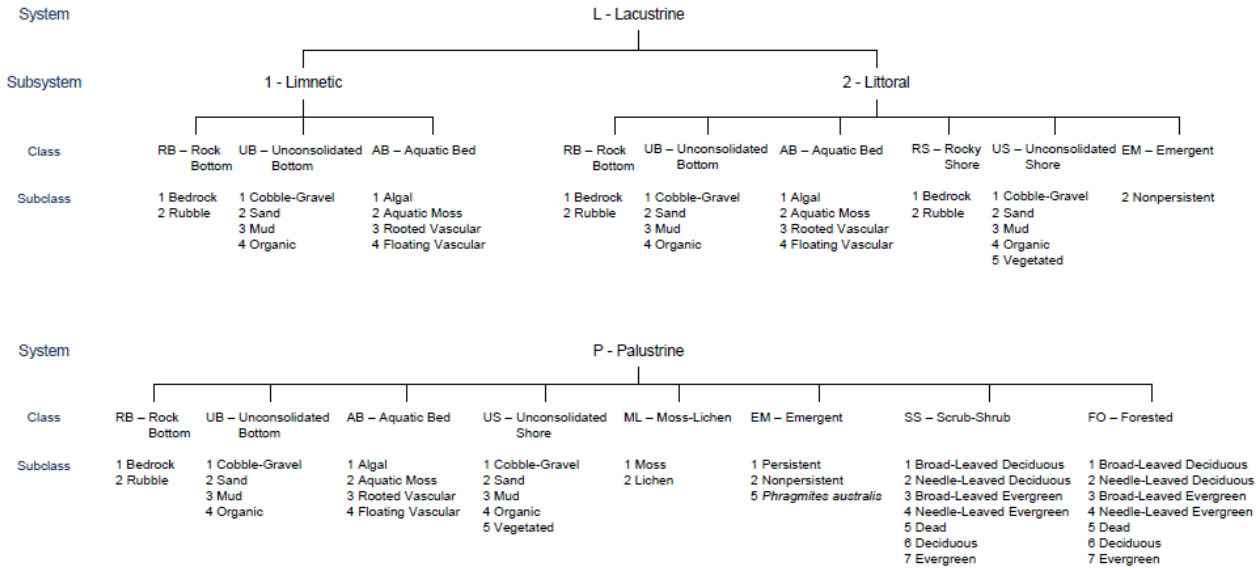
Map 15



Return to Section 7.2.

Appendix B: Cowardin et. al. (1979) Wetland and Deepwater Habitat Classification

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

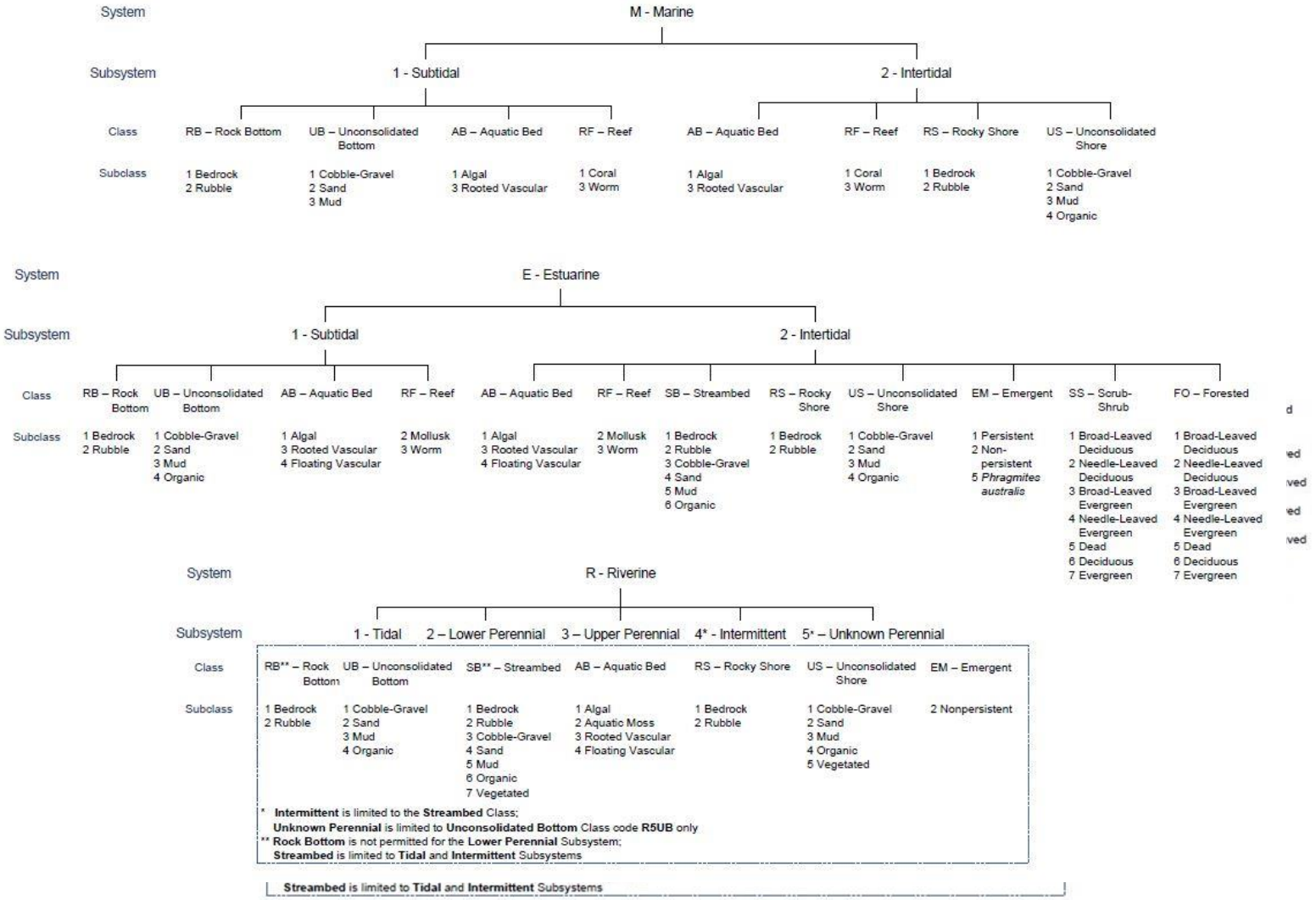


MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

Water Regime			Special Modifiers	Water Chemistry			Soil
Nontidal	**Saltwater Tidal**	**Freshwater Tidal**		**Coastal Halinity**	**Inland Salinity**	**pH Modifiers for all Fresh Water**	
A Temporarily Flooded	L Subtidal	S Temporarily Flooded-Tidal	b Beaver	1 Hyperhaline	7 Hypersaline	a Acid	g Organic
B Saturated	M Irregularly Exposed	R Seasonally Flooded-Tidal	d Partly Drained/Ditched	2 Euhaline	8 Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	T Semipermanently Flooded-Tidal	f Farmed	3 Mixohaline (Brackish)	9 Mixosaline	i Alkaline	
E Seasonally Flooded/ Saturated	P Irregularly Flooded	V Permanently Flooded-Tidal	h Diked/Impounded	4 Polyhaline	0 Fresh		
F Semipermanently Flooded			r Artificial	5 Mesohaline			
G Intermittently Exposed			s Spoil	6 Oligohaline			
H Permanently Flooded			x Excavated	0 Fresh			
J Intermittently Flooded							
K Artificially Flooded							

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION



Return to Section 2.2.2 and Section 7.3.2.

Appendix C: SLAMM Wetland Type Definitions

Source: SLAMM 6 beta Technical Documentation (May, 2010)
http://warrenpinnacle.com/prof/SLAMM6/SLAMM6_Technical_Documentation.pdf

SLAMM 6.0.1 Technical Documentation *Draft, May 2010*

Table 4: NWI Classes to SLAMM 6 Categories

		NWI code characters					
SLAMM Code	Name	System	Subsystem	Class	Subclass	Water Regime	Notes
1	Developed Dry Land (upland)	U					SLAMM assumes developed land will be defended against sea-level rise. Categories 1 & 2 need to be distinguished manually.
2	Undeveloped Dry land (upland)	U					
3	Nontidal Swamp	P	NA	FO, SS	1, 3 to 7, None	A,B,C,E,F,G,H,J,K None or U	Palustrine Forested and Scrub-Shrub (living or dead)
4	Cypress Swamp	P	NA	FO, SS	2	A,B,C,E,F,G,H,J,K None or U	Needle-leaved Deciduous forest and Scrub-Shrub (living or dead)
5	Inland Fresh Marsh	P	NA	EM, f**	All None	A,B,C,E,F,G,H,J,K None or U	Palustrine Emergents; Lacustrine and Riverine Nonpersistent Emergents
		L	2	EM	2 None	E, F, G, H, K None or U	
		R	2, 3	EM	2 None	E, F, G, H, K None or U	
6	Tidal Fresh Marsh	R	1	EM	2, None	Fresh Tidal N, T	Riverine and Palustrine Freshwater Tidal Emergents
		P	NA	EM	All, None	Fresh Tidal S, R, T	
7	Transitional Marsh / Scrub Shrub	E	2	SS, FO	1, 2, 4 to 7,None	Tidal M, N, P None or U	Estuarine Intertidal, Scrub-shrub and Forested (ALL except 3 subclass)
8	Regularly Flooded Marsh (Saltmarsh)	E	2	EM	1 None	Tidal N None or U	Only regularly flooded tidal marsh No intermittently flooded "P" water Regime
9	Mangrove **Tropical settings only, otherwise 7**	E	2	FO, SS	3	Tidal M, N, P None or U	Estuarine Intertidal Forested and Scrub-shrub, Broad-leaved Evergreen
10	Estuarine Beach old code BB and FL = US	E	2	US	1,2 Important codes	Tidal N, P	Estuarine Intertidal Unconsolidated Shores
		E	**2**	**US**	**None**	**Tidal N, P**	**Only when shores (need images or base map)**
11	Tidal Flat old code BB and FL =US	E	2	US	3,4 None	Tidal M, N None or U	Estuarine Intertidal Unconsolidated Shore (mud or organic) and Aquatic Bed; Marine Intertidal Aquatic Bed
		E	2	AB	All Except 1	Tidal M, N None or U	
		E	**2**	**AB**	**1**	**P**	**Specifically, for wind driven tides on the south coast of TX**
		M	2	AB	1, 3 None	Tidal M, N None or U	
12	Ocean Beach old code BB and FL = US	M	2	US	1,2 Important	Tidal N, P	Marine Intertidal Unconsolidated Shore, cobble-gravel, sand
		M	2	US	None	Tidal P	
13	Ocean Flat old code BB and FL = US	M	2	US	3,4 None	Tidal M, N None or U	Marine Intertidal Unconsolidated Shore, mud or organic, (low energy coastline)

Source, Bill Wilen, National Wetlands Inventory.

Also see the Excel database of NWI Codes to SLAMM Categories installed with the SLAMM 6 Installer in the directory with the SLAMM 6 Executable.

Table 4 (cont.): NWI Classes to SLAMM 6 Categories

		NWI code characters					
SLAMM Code	Name	System	Subsystem	Class	Subclass	Water Regime	Notes
14	Rocky Intertidal	M	2	RS	All None	Tidal M, N, P None or U	Marine and Estuarine Intertidal Rocky Shore and Reef
		E	2	RS	All None	Tidal M ,N, P None or U	
		E	2	RF	2, 3 None	Tidal M, N, P None or U	
		E	2	AB	1	Tidal M, N None or U	
15	Inland Open Water old code OW = UB	R	2	UB, AB	All, None	All, None	Riverine, Lacustrine, and Palustrine Unconsolidated Bottom, and Aquatic Beds
		R	3	UB, AB, RB	All, None	All, None	
		L	1, 2	UB, AB, RB	All, None	All, None	
		P	NA	UB, AB, RB	All, None	All, None	
		R	5	UB	All	Only U	
16	Riverine Tidal Open Water old code OW = UB	R	1	All **Except EM**	All None **Except 2**	Fresh Tidal S, R, T, V	Riverine Tidal Open water **R1EM2 falls under SLAMM Category 6**
17	Estuarine Open Water (no h* for diked / impounded) old code OW=UB	E	1	All	All None	Tidal L, M, N, P	Estuarine subtidal
18	Tidal Creek	E	2	SB	All, None	Tidal M, N, P Fresh Tidal R, S	Estuarine Intertidal Streambed
19	Open Ocean old code OW = UB	M	1	All	All	Tidal L, M, N, P	Marine Subtidal and Marine Intertidal Aquatic Bed and Reef
		M	2	RF	1,3, None	Tidal M, N, P None or U	
20	Irregularly Flooded Marsh	E	2	EM	1, 5 None	P	Irregularly Flooded Estuarine Intertidal Emergent marsh
		E	**2**	**US**	**2, 3, 4 None**	**P**	**Only when these salt pans are associated with E2EMN or P**
21	Not Used						
22	Inland Shore old code BB and FL = US	L	2	US, RS	All	All Nontidal	Shoreline not pre-processed using Tidal Range Elevations
		P	NA	US	All, None	All Nontidal None or U	
		R	2, 3	US, RS	All, None	All Nontidal None or U	
		R	4	SB	All, None	All Nontidal None or U	
23	Tidal Swamp	P	NA	SS, FO	All, None	Fresh Tidal R, S, T	Tidally influenced swamp

* **h=Diked/Impounded** - When it is desirable to model the protective effects of dikes, an additional raster layer must be specified.

** Farmed wetlands are coded Pf
All: valid components
None: no Subclass or Water regime listed
U: Unknown water regime
NA: Not applicable

DATE 1/14/12010

Water Regimes	
Nontidal	A, B, C, E, F,G, J, K
Saltwater Tidal	L, M, N, P
Fresh Tidal	R, S,T, V

Note: Illegal codes must be categorize by intent.
Old codes BB, FL = US
Old Code OW = UB

Source, Bill Wilen, National Wetlands Inventory

For more information on the NWI coding system see Appendix A of Dahl, Dick, Swords, and Wilen 2009.

Return to Section 2.5.2.

Appendix D: Wildlife Action Plan Habitats

Note that habitat descriptions below are excerpted from New Hampshire Fish and Game's Habitat Types and Species webpage (NHFGD, n.d. b).

Appalachian Oak-Pine Forests

Appalachian Oak-Pine forests are found mostly below 900 feet elevation in southern New Hampshire and along the Connecticut River in western New Hampshire. The nutrient-poor, dry, sandy soils and warm, dry, climate influences the typical vegetation including oak, hickory (*Carya spp.*), mountain laurel (*Kalmia latifolia*), and sugar maple (*Acer saccharum*). Many wildlife species use these forests for part or all of their life cycle including whippoorwills (*Antrostomus vociferous*), black bears, northern myotis (*Myotis septentrionalis*), and state-determined endangered eastern hognose snakes (*Heterodon platirhinos*). Traditionally, Appalachian Oak-Pine forests are influenced by frequent fires, which change the age structure of the forest. Diverse age and structure of the forest help to promote wildlife diversity. Intense development pressure, particularly in the southeast corner of New Hampshire, has dramatically reduced naturally occurring fires and increased fragmentation of this forest type. Incorporating habitat conservation into local land use planning, protecting unfragmented blocks, and adopting sustainable forestry are a few examples of conservation strategies for Appalachian Oak-Pine forests.

Hemlock Hardwood Pine Forest

Hemlock-hardwood-pine forests are comprised of mostly hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), beech (*Fagus grandifolia*), and oak (*Quercus spp.*) trees. Since this is a transitional forest, it can occur at different elevations and over different types of soil and topography, and the composition of vegetation can be variable. This forest type is the most common in New Hampshire and covers nearly 50% of the state and provides habitat for numerous wildlife species such as the cerulean warbler (*Setophaga cerulean*), eastern pipistrelle (*Perimyotis subflavus*), and bobcat (*Lynx rufus*). Many of the species that use this habitat type require large blocks of unfragmented forest such as the northern goshawk (*Accipiter gentilis*) and black bear (*Ursus americanus*). Since this forest type is so common in the state, it is sometimes overlooked in conservation efforts. Development and fragmentation are huge threats to the continued existence of hemlock-hardwood-pine forest. Some conservation strategies for hemlock-hardwood-pine forests are incorporating habitat conservation into local land use planning, protecting unfragmented blocks of land, and educating landowners.

Lowland Spruce-Fir

Lowland spruce-fir forests occur between 1,000 and 2,500 feet in elevation and are comprised of a mosaic of lowland spruce-fir forest and red spruce swamp communities. Typical vegetation includes red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), hobblebush (*Viburnum lantanoides*), and bunchberry (*Cornus canadensis*). Although lowland spruce-fir covers approximately 10% of the state, it provides habitat for over 100 vertebrate species from spruce grouse to black bear (*Ursus americanus*) to hoary bats (*Lasiurus cinereus*). Lowland spruce-fir forests also contain very important deer wintering areas. During heavy snow years, these forests provide an area for white-tailed deer (*Odocoileus virginianus*) to yard up where the conifer trees provide food and shelter from the heavy snow. The federally threatened and state endangered Canada lynx (Lynx canadensis) uses this habitat as well as two state threatened wildlife species: American three-toed woodpecker (*Picoides dorsalis*) and American marten (*Martes americana*). In some areas, forest harvesting in this habitat has resulted in trees that are less than two inches in diameter. In other areas, cutting has converted the landscape to

northern hardwood conifer forest. Some conservation strategies for lowland spruce-fir forests are to protect unfragmented blocks of land and to maintain late successional habitat.

Grasslands

Grasslands are comprised of grasses, sedges, and wildflowers with little to no shrubs and trees. The most common grassland habitats are airports, capped landfills, wet meadows, and agricultural fields such as hayfields, pastures, and fallow fields. Pre-colonial grasslands in New Hampshire were probably only maintained by beaver (*Castor canadensis*) and fires started by lightning and Native Americans. The numerous agricultural lands maintained by early European settlers provided ideal habitat for some wildlife species that need grassland habitat. As these agricultural lands were abandoned, these populations began to decline and there are now on the state endangered list such species as the eastern hognose snake, northern harrier (*Circus cyaneus*), upland sandpiper (*Bartramia longicauda*) and on the state threatened list species such as the grasshopper sparrow (*Ammodramus savannarum*). Other species such as wood turtles (*Glyptemys insculpta*) and numerous species of butterflies also benefit from these open grass fields. Development and natural forest succession have reduced grassland habitat in the state. Grasslands require maintenance and must be mowed to prevent them from becoming shrublands or forests. Only 8% of New Hampshire grasslands are currently under conservation easements. Reclaiming and maintaining grasslands are two important conservation strategies for grassland habitats. Many grassland and potential grassland habitat are on private land and landowners can help restore and conserve them.

Temperate Swamps

This habitat consists of forested wetlands found primarily in central and southern New Hampshire. Temperate peat swamps are typically found in isolated or stagnant basins with saturated, organic soils. The temperate swamps classification also includes the four known Atlantic white cedar communities in New Hampshire, and the pitch pine-heath swamp, a rare community usually associated with the Pine Barrens landscape. Most coastal conifer peat swamps occur within 30 miles of the Atlantic coast. These wetlands provide a number of functions such as flood control, pollutant filters, shoreline stabilization, sediment retention and erosion control, food web productivity, wildlife habitat, recreation, and education. Since hemlock is a common component of temperate swamps across New Hampshire, threats to this habitat include habitat degradation from insect pests such as the hemlock woolly adelgid (*Adelges tsugae*). Inputs of sedimentation, insecticides, and fertilizers are sources of pollution that threaten temperate swamp habitats. Actions to conserve temperate swamps include supporting the Division of Forests and Lands in the implementation of the hemlock woolly adelgid action plan and working with foresters to use Best Management Practices outlined in the document “Good Forestry in the Granite State”.

Wet Meadows and Shrub Wetlands

Emergent marsh and shrub swamp systems have a broad range of flood regimes, sometimes controlled by the presence or departure of beavers, but mostly controlled by groundwater. This system, which is an important food source for many species, is often grouped into three broad habitat categories: wet meadows, emergent marshes, and scrub-shrub wetlands. Marsh and shrub wetlands filter pollutants, preventing them from getting into local streams, and help hold water to reduce flooding. Many wildlife species use marsh and shrub wetlands, including common species like red-winged blackbirds (*Agelaius phoeniceus*), beavers (*Castor canadensis*), and painted turtles (*Chrysemys picta*). Marsh and shrub wetlands are also critically important for state endangered Blanding's turtles (*Emydoidea blandingii*), New England cottontails (*Sylvilagus transitionalis*), northern harriers (*Circus hudsonius*), ringed boghaunters (*Williamsonia lintneri*), and sedge wrens (*Cistothorus stellaris*) plus those on the state list of threatened wildlife: spotted turtles (*Clemmys guttata*) and pied billed grebes (*Podilymbus Podiceps*).

Development is a threat to these habitats mostly from driveways and roads that fragment wetlands or change the flow of water. The loss of an upland habitat around a marsh or shrub wetland also increases the amount of pollution and sedimentation threatening the habitat. Another constant threat to marsh and shrub wetlands is invasive plants such as purple loosestrife (*Lythrum salicaria*) and Japanese knotweed (*Reynoutria japonica*) that compete with native vegetation. Some conservation strategies for marsh and shrub wetlands are restoration and protection of these important habitats. Many marsh and shrub wetlands are on private land and landowners can help restore and conserve them.

Peatlands

Peatland habitats are extremely important for carbon sequestration on a local and global scale. The water in peatlands has low nutrient content and typically high acidity caused by limited groundwater input and surface runoff. These environmental conditions are such that plant and animal material take a very long time to decompose. This organic material contains carbon and other nutrients, storing it away and slowly releasing it into the atmosphere. Drainage and destruction of peatlands releases this carbon into the atmosphere more quickly, increasing greenhouse gases today. Conservation of the 11 different natural communities that comprise peatlands is also vital to the continued existence of many rare plant and wildlife species in New Hampshire. On the state endangered list is the ringed bog haunter (*Williamsonia lintneri*) which uses peatlands and the surrounding uplands in the southern part of the state. Also on the state list is the northern bog lemming (*Synaptomys borealis*) which inhabits burrows in the sphagnum moss and associated grasses. Typical vegetation in a peatland includes sphagnum moss, leather leaf (*Chamaedaphne calyculata*), northern white cedar (*Thuja occidentalis*), and American larch (*Larix laricina*). Threats to peatland habitats are development, altered hydrology (amount and flow of water), and unsustainable forest harvesting. Non-point source pollutants, such as road salt, lawn fertilizers, and pesticides, also threaten this habitat by altering the acidity and nutrients. Establishing buffers around this habitat is one conservation strategy that will help minimize the threats to peatland habitats.

Salt Marshes

Salt marshes are grass-dominated tidal wetlands existing in the transition zone between ocean and upland. They are among the most productive ecosystems in the world and provide great habitat for many bird species including American bittern (*Botaurus lentiginosus*), Nelson's sharp-tailed sparrow (*Ammospiza nelson*), salt marsh sharp-tailed sparrow (*Ammodramus caudacutus*), seaside sparrow (*Ammodramus maritimus*), and semipalmated sandpiper (*Calidris pusilla*). Salt marsh plants are salt-tolerant and adapted to fluctuating water levels. Nutrients that stimulate marsh plant growth are carried in with the tides, and organic matter that feeds fish and other organisms is carried out by the tides. Over time, organic matter accumulates on the marsh and forms peat. By building up more peat, salt marsh elevation can keep pace with rising sea level, unless the rate of sea-level rise becomes too great, such as is predicted from climate change. Salt marshes help protect coastal areas from storm surges, but an estimated 30-50% of New Hampshire's original salt marsh habitat has been lost to development. Some of the conservation strategies for salt marshes are restoring and protecting the remaining salt marsh habitat and surrounding upland buffer habitat.

Dunes

Coastal sand dunes are constantly changing areas of sand and gravel that are deposited by wave and wind action within a marine beach system. This habitat is important to residential and commercial buildings along the coast because it provides some shelter from storms, wind, waves, erosion, and rising sea levels. Coastal dunes are considered one of New Hampshire's most at-risk habitats and are used by many birds for breeding, migration, or wintering. Federally designated as threatened and state designated as endangered, the piping plover (*Charadrius melodus)* uses this habitat for breeding. The

semi-palmated sandpiper (*Calidris pusilla*) and horned lark (*Eremophila alpestris*) are two of the many bird species that use dune habitat during migration. New Hampshire has less than 19 miles of Atlantic coastline, of which less than two miles are dune habitat (the rest being rocky shoreline). Development has reduced the places where dunes would naturally shift, forcing this habitat to be more static or to shift into recreational areas. Other threats to this habitat are oil spills and rising sea level resulting from climate change. As beach goers we can all help by staying off dune habitats and obeying restricted area signs and fences. Habitat protection, education, and enforcing laws and regulations are a few of the conservation strategies for dunes.

Coastal Islands

Coastal islands have rocky shores, and are usually remote, undisturbed, and free of predators. As well as providing critical wildlife habitat, these islands are evidence of New Hampshire's rich and vibrant maritime past. Vegetation on these islands typically includes grasses, herbaceous plants, and shrub thickets growing among rocky outcrops, with few to no trees. New Hampshire's Isles of Shoals serve as an important site for neotropical bird migration and provide wintering habitat for land birds. Seavey and White Islands provide breeding grounds for federally designated as endangered roseate terns (*Sterna dougallii*), state designated as endangered least terns (*Sternula antillarum*), and state designated as threatened common terns (*Sterna hirundo*). In addition to birds, other wildlife species such as seals, barnacles, and monarchs (*Danaus plexippus*) use these islands. The most challenging issues facing coastal island habitat and seabird communities are over-populations of introduced predators such as gulls. Other threats include recreation and climate change. Habitat protection, controlling overpopulated predators, and preparing for oil spills are a few of the conservation strategies for coastal islands.

Developed Habitats

Residential and commercial development in New Hampshire ranges from maintained gardens and manicured lawns to multi-story buildings in city centers. Some wildlife species have learned to use these areas for things like nesting or finding food sources. For example, peregrine falcons (*Falco peregrinus*), which typically create nests on vertical cliffs to raise their young, have begun nesting in urban settings in the southeastern portion of the state. Tall buildings and similar man-made structures possess physical characteristics similar to cliffs. Another bird, the chimney swift (*Chaetura pelagica*), was once known to nest in large hollow trees in the forest, but as this resource has declined, the species now almost exclusively nests in the chimneys of buildings. Many bumble bee species can be found in crop fields, orchards, gardens, and other locations with flowering plants maintained by humans in developed areas. Although development can cause problems for wildlife, some species have figured out how to adapt to certain conditions.

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Appendix E: Species of Greatest Conservation Need by Habitat for Rye, NH

NH Fish and Game Department

DISCLAIMER:

These lists of Species of Greatest Conservation Need (SGCN) per Town represent potential occurrences of species based on known or predicted broad distributions of species within New Hampshire and are for information purposes only. They do not necessarily represent known occurrences and in some cases a species may not occur in a town even though it is listed. As such, users should evaluate whether potential habitat is present within the area of question to further assess potential of such species occurring. These species lists shall not be used for permitting purposes. For a permitting datacheck of known occurrences and/or a landowner datacheck of protected species, see: https://www.nh.gov/nhdfl/land-conservation/natural-heritage-bureau.htm

Not intended to be a substitute for required data check of NH Natural Heritage records for permit and grant applications.

https://www.nh.gov/nhdfl/land-conservation/natural-heritage-bureau.htm

RANGE TYPE

Historic only

Statewide = species may occur statewide

Throughout = species may occur throughout its range

Localized = species may occur in specific habitats within its range

Town = species may occur in or was previously documented to occur in specified town

Marine = applies only to Atlantic and Shortnose Sturgeon

Migrant = non-breeding, applies only to Golden Eagle (no current breeding records)

STATUS

ST = state-threatened

SE = state-endangered

FT = federally-threatened

FE = federally-endangered

SC = special concern in NH

SGCN = Species of Greatest Conservation Need

(i) = introduced

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Alewife	Alosa pseudoharengus	Localized	Fish	SC, SGCN	Large Warmwater Rivers, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
Alewife Floater	Anodonta implicata	Localized	Freshwater Mussels	SGCN	Large Warmwater Rivers, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
American Black Duck	Anas rubripes	Statewide	Birds	SGCN	Lakes and Ponds, Rivers and Streams, Marsh and Shrub Wetlands, Northern Swamps, Peatlands, Temperate Swamps
American Brook Lamprey	Lampetra appendix	Localized	Fish	SE, SGCN	Coldwater Rivers and Streams, Warmwater Rivers and Streams
American Bumble Bee	Bombus pensylvanicus	Statewide	Bumble Bees	SGCN	Developed Habitats, Grasslands, Shrublands
American Eel	Anguilla rostrata	Localized	Fish	SC, SGCN	Coldwater Rivers and Streams, Lakes and Ponds with Coldwater Habitats, Large Warmwater Rivers, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
American Kestrel	Falco sparverius	Statewide	Birds	SC, SGCN	Developed Habitats, Grasslands, Shrublands
American Shad	Alosa sapidissima	Localized	Fish	SC, SGCN	Estuarine, Large Warmwater Rivers, Marine
American Water Shrew (Eastern)	Sorex palustris albibarbis	Statewide	Mammals	SGCN	Northern Swamps
American Woodcock	Scolopax minor	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Hemlock Hardwood Pine Forest, Marsh and Shrub Wetlands, Northern Swamps, Shrublands, Temperate Swamps
Atlantic Sturgeon	Acipenser oxyrinchus	Localized	Fish	ST, SGCN	Estuarine, Marine
Atlantic Sturgeon	Acipenser oxyrinchus	Marine	Fish	ST, SGCN	Estuarine, Large Warmwater Rivers, Marine
Bald Eagle	Haliaeetus leucocephalus	Statewide	Birds	SC, SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, High Elevation Spruce-Fir Forest, Lakes and Ponds, Rivers and Streams, Lowland Spruce-Fir Forest, Marsh and Shrub Wetlands, Northern Hardwood-Conifer Forest
Banded Sunfish	Enneacanthus obesus	Localized	Fish	SC, SGCN	Warmwater Lakes and Ponds, Warmwater Rivers and Streams

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Bank Swallow	Riparia	Statewide	Birds	SC, SGCN	Coldwater Rivers and Streams, Grasslands, Lakes and Ponds with Coldwater Habitats, Large Warmwater Rivers, Marsh and Shrub Wetlands, Warmwater Rivers and Streams
Big Brown Bat	Eptesicus fuscus	Statewide	Mammals	SC, SGCN	Appalachian Oak-Pine Forest, Caves and Mines, Floodplain Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Black-billed Cuckoo	Coccyzus erythropthalmus	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Hemlock Hardwood Pine Forest, Pine Barrens, Shrublands
Blanding's Turtle	Emydoidea blandingii	Throughout	Amphibians and Reptiles	SE, SGCN	Floodplain Habitats, Marsh and Shrub Wetlands, Peatlands, Temperate Swamps, Vernal Pools
Blue-Spotted/Jefferson Salamander	Ambystoma pop. 3	Statewide	Amphibians and Reptiles	SC, SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Marsh and Shrub Wetlands, Northern Hardwood-Conifer Forest, Northern Swamps, Peatlands, Temperate Swamps, Vernal Pools
Blue-winged Warbler	Vermivora cyanoptera	Throughout	Birds	SC, SGCN	Pine Barrens, Shrublands
Blueback Herring	Alosa aestivalis	Localized	Fish	SC, SGCN	Estuarine, Marine, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
Bobolink	Dolichonyx oryzivorus	Statewide	Birds	SGCN	Grasslands
Brook Floater	Alasmidonta varicosa	Localized	Freshwater Mussels	SE, SGCN	Large Warmwater Rivers, Warmwater Rivers and Streams
Brown Thrasher	Toxostoma rufum	Statewide	Birds	SGCN	Pine Barrens, Shrublands
Canada Warbler	Cardellina canadensis	Statewide	Birds	SGCN	Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Chimney Swift	Chaetura pelagica	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Developed Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest
Common Gallinule	Gallinula galeata	Town	Birds	SC, SGCN	Marsh and Shrub Wetlands
Creeper	Strophitus undulatus	Statewide	Freshwater Mussels	SGCN	Coldwater Rivers and Streams, Lakes and Ponds with Coldwater Habitats, Large Warmwater Rivers, Warmwater Lakes and Ponds, Warmwater Rivers and Streams

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Eastern Box Turtle	Terrapene carolina	Localized	Amphibians and Reptiles	SE, SGCN	Appalachian Oak-Pine Forest, Grasslands, Hemlock Hardwood Pine Forest, Marsh and Shrub Wetlands, Shrublands, Temperate Swamps
Eastern Brook Trout	Salvelinus fontinalis	Localized	Fish	SGCN	Coldwater Rivers and Streams, Lakes and Ponds with Coldwater Habitats
Eastern Meadowlark	Sturnella magna	Throughout	Birds	ST, SGCN	Grasslands
Eastern Red Bat	Lasiurus borealis	Statewide	Mammals	SC, SCGN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Eastern Ribbon Snake	Thamnophis sauritus	Throughout	Amphibians and Reptiles	SGCN	Floodplain Habitats, Marsh and Shrub Wetlands, Peatlands, Vernal Pools
Eastern Small-footed Bat	Myotis leibii	Town	Mammals	SE, SGCN	Appalachian Oak-Pine Forest, Caves and Mines, Hemlock Hardwood Pine Forest, Northern Hardwood-Conifer Forest, Rocky Ridge, Cliff, and Talus
Eastern Towhee	Pipilo erythrophthalmus	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Peatlands, Pine Barrens, Rocky Ridge, Cliff, and Talus, Rocky Ridge, Cliff, and Talus, Shrublands
Field Sparrow	Spizella pusilla	Statewide	Birds	SGCN	Pine Barrens, Shrublands
Fowler's Toad	Anaxyrus fowleri	Localized	Amphibians and Reptiles	ST, SGCN	Appalachian Oak-Pine Forest, Dunes, Large Warmwater Rivers, Marsh and Shrub Wetlands, Pine Barrens, Shrublands, Vernal Pools, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
Golden Eagle	Aquila chrysaetos	Migrant	Birds	SE, SGCN	Appalachian Oak-Pine Forest, Hemlock Hardwood Pine Forest, High Elevation Spruce-Fir Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Rocky Ridge, Cliff, and Talus
Hoary Bat	Lasiurus cinereus	Statewide	Mammals	SC, SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Little Brown Myotis	Myotis lucifugus	Statewide	Mammals	SE, SGCN	Appalachian Oak-Pine Forest, Caves and Mines, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Pine Barrens, Temperate Swamps

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Lyre-tipped Spreadwing	Lestes unguiculatus	Town	Dragonflies and Damselflies	SGCN	Marsh and Shrub Wetlands, Northern Swamps, Vernal Pools
Marsh Wren	Cistothorus palustris	Throughout	Birds	SGCN	Marsh and Shrub Wetlands, Salt Marsh
Monarch Butterfly	Danaus plexippus	Statewide	Butterflies and Moths	SC	Developed Habitats, Grasslands
Moose	Alces	Localized	Mammals	SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, High Elevation Spruce-Fir Forest, Lowland Spruce-Fir Forest, Marsh and Shrub Wetlands, Northern Hardwood-Conifer Forest, Swamps, Shrublands, Lakes and Ponds
Nelson's Sparrow	Ammodramus nelsoni	Town	Birds	SC, SGCN	Salt Marsh
Northern Black Racer	Coluber constrictor	Throughout	Amphibians and Reptiles	ST, SGCN	Appalachian Oak-Pine Forest, Grasslands, Hemlock Hardwood Pine Forest, Rocky Ridge, Cliff, and Talus, Shrublands
Northern Leopard Frog	Lithobates pipiens	Localized	Amphibians and Reptiles	SC, SGCN	Coldwater Rivers and Streams, Floodplain Habitats, Grasslands, Lakes and Ponds with Coldwater Habitats, Large Warmwater Rivers, Marsh and Shrub Wetlands, Shrublands, Warmwater Rivers and Streams
Northern Long-eared Bat	Myotis septentrionalis	Statewide	Mammals	FT, SE, SGCN	Appalachian Oak-Pine Forest, Caves and Mines, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest
Prairie Warbler	Setophaga discolor	Throughout	Birds	SGCN	Pine Barrens, Shrublands
Purple Finch	Haemorhous purpureus	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, High Elevation Spruce-Fir Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps
Purple Martin	Progne subis	Town	Birds	ST, SGCN	Developed Habitats, Grasslands, Salt Marsh
Purple Sandpiper	Calidris maritima	Localized	Birds	SGCN	Coastal Islands and Rocky Shores
Red Knot	Calidris canutus	Localized	Birds	FT, ST, SGCN	Coastal Islands and Rocky Shores, Dunes, Estuarine, Salt Marsh
Redfin Pickerel	Esox americanus	Localized	Fish	SC, SGCN	Warmwater Lakes and Ponds, Warmwater Rivers and Streams

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Ruddy Turnstone	Arenaria interpres	Localized	Birds	SGCN	Coastal Islands and Rocky Shores, Dunes, Estuarine
Ruffed Grouse	Bonsai umbrellas	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Grasslands, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Marsh and Shrub Wetlands, Northern Hardwood-Conifer Forest, Shrublands
Rusty-patched Bumble Bee	Bombus affinis	Statewide	Bumble Bees	FE, SE, SGCN	Developed Habitats, Grasslands
Saltmarsh Sparrow	Ammodramus caudacutus	Town	Birds	SC, SGCN	Salt Marsh
Sanderling	Calidris alba	Localized	Birds	SGCN	Coastal Islands and Rocky Shores, Dunes, Estuarine, Salt Marsh
Scarlet Tanager	Piranga olivacea	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Hemlock Hardwood Pine Forest, Northern Hardwood-Conifer Forest
Sea Lamprey	Petromyzon marinus	Localized	Fish	SC, SGCN	Coldwater Rivers and Streams, Estuarine, Large Warmwater Rivers, Marine, Warmwater Rivers and Streams
Semipalmated Sandpiper	Charadrius semipalmatus	Localized	Birds	SGCN	Coastal Islands and Rocky Shores, Dunes, Estuarine, Salt Marsh
Shortnose Sturgeon	Acipenser brevirostrum	Localized	Fish	FE, SE, SGCN	Estuarine, Marine
Shortnose Sturgeon	Acipenser brevirostrum	Marine	Fish	FE, SE, SGCN	Estuarine, Large Warmwater Rivers, Marine
Silver-haired Bat	Lasionycteris noctivagans	Statewide	Mammals	SC, SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Smooth Green Snake	Opheodrys vernalis	Throughout	Amphibians and Reptiles	SC, SGCN	Grasslands, Marsh and Shrub Wetlands, Peatlands, Rocky Ridge, Cliff, and Talus, Rocky Ridge, Cliff, and Talus, Shrublands
Southern Bog Lemming	Synaptomys cooperi	Statewide	Mammals	SGCN	Northern Hardwood-Conifer Forest
Spotted Turtle	Clemmys guttata	Throughout	Amphibians and Reptiles	ST, SGCN	Floodplain Habitats, Marsh and Shrub Wetlands, Peatlands, Temperate Swamps, Vernal Pools

COMMON NAME	SCIENTIFIC NAME	RANGE	TAXONOMIC GROUP	SPECIES STATUS	Habitats
Triangle Floater	Alasmidonta undulata	Statewide	Freshwater Mussels	SGCN	Large Warmwater Rivers, Warmwater Lakes and Ponds, Warmwater Rivers and Streams
Tricolored Bat	Perimyotis subflavus	Statewide	Mammals	SE, SGCN	Appalachian Oak-Pine Forest, Caves and Mines, Floodplain Habitats, Hemlock Hardwood Pine Forest, Lowland Spruce-Fir Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Veery	Catharus fuscescens	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Northern Hardwood-Conifer Forest, Northern Swamps, Temperate Swamps
Whimbrel	Numenius phaeopus	Localized	Birds	SGCN	Coastal Islands and Rocky Shores, Dunes, Estuarine, Salt Marsh
Willet	Catoptrophorus semipalmatus	Town	Birds	SC, SGCN	Dunes, Estuarine, Salt Marsh
Wood Thrush	Hylocichla mustelina	Statewide	Birds	SGCN	Appalachian Oak-Pine Forest, Floodplain Habitats, Hemlock Hardwood Pine Forest, Northern Hardwood-Conifer Forest
Wood Turtle	Glyptemys insculpta	Statewide	Amphibians and Reptiles	SC, SGCN	Coldwater Rivers and Streams, Floodplain Habitats, Grasslands, Shrublands, Warmwater Rivers and Streams
Yellow-banded Bumble Bee	Bombus terricola	Statewide	Bumble Bees	SGCN	Developed Habitats, Grasslands, Shrublands
Yellow Bumble Bee	Bombus fervidus	Statewide	Bumble Bees	SGCN	Developed Habitats, Grasslands

Return to Section 3.3.

Appendix F: Point Sources of Pollution in Rye

Above and underground storage tanks: The aboveground storage tank and underground storage tank layers identify the locations of registered above- and belowground storage tanks in NH. There are currently seven aboveground storage tanks and 29 underground storage tanks in Rye. Ownership of these tanks range from commercial industries, gas stations, municipal facilities, and more.

Solid waste facilities: There are three solid waste facilities within the Town of Rye, two of which are unlined closed landfills no longer operating – the Grove Road landfill and the Breakfast Hill landfill. The third, is the Rye Transfer Station which actively operates for collection, storage, and transfer of waste and recycled materials.

Hazardous waste sites: Hazardous waste-generating facilities are identified through the United States Environmental Protection Agency's (USEPA's) Resource Conservation and Recovery Act (RCRA), which the state must apply to such facilities through either federal or state regulation. Only three of the 19 listed hazardous waste sites in Rye are active. The rest are classified as either inactive (14) or declassified (2).

Local potential contamination sources: Local potential contamination sources are sites that may represent a hazard to drinking water quality supplies due to the use, handling, or storage of hazardous substances. There may be overlap between local potential contamination sources and other PCS identified in this section. Following the procedure for "Performing an Inventory for Drinking Water" (NHDES Fact Sheet WD-DWGB 12-3), NHDES has identified 11 total potential contamination sources in Rye.

NPDES outfalls: Of the two National Pollutant Discharge Elimination System outfalls that discharge pollutants directly to a surface water within the Town of Rye, only one is actively discharging (General Permit #NH0020966), the Wallis Sands State Park Wastewater Treatment Facility (WWTF). The inactive NPDES outfall is identified as the old location- Wallis Sands State Park WWTF.

Remediation sites: The 90 remediation sites present within the Town of Rye are sites that once consisted of leaking storage facilities that contain fuel or oil, sites with chlorinated solvents and other non-petroleum products, non-hazardous and non-sanitary holding tanks, initial spill response sites, historical dump sites, previously leaking residential or commercial oil tanks for heating or motor oil tanks, historic underground injection control of wastewaters not requiring a groundwater discharge permit, unlined wastewater lagoons, or a flagged groundwater sample for contamination but with no direct connection to a source of contamination. These sites are identified as remediation sites for the source of contamination has since been eliminated (although legacy effects from the contamination site may still be present).

Return to Section 2.4.3.