Moultonborough Natural Resources Inventory

NEW HAMPSHIRE

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NATURAL RESOURCES INVENTORY

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December 2016

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EXECUTIVE SUMMARY

This Natural Resource Inventory (NRI) report was prepared by FB Environmental (FBE) for the Moultonborough Conservation Commission with the intent to provide a detailed description and analysis of the town's natural resources. It was developed to be useful to all municipal departments - not solely the Conservation Commission. It is clear from the results presented herein that Moultonborough possesses abundant and diverse natural resources that contribute significantly to both the ecological richness and health of the town, as well as socially to the community's quality of life.

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 some initial recommendations about what is important to conserve. The NRI is a baseline characterization, and a beginning in what should be an ongoing process of updates and refinements.

As part of the NRI process, FBE compiled and created relevant GIS shapefiles which provide a means to visualize and further analyze Moultonborough's natural resources information. This report and its associated shapefiles provide Moultonborough with a tool to help guide future planning and conservation efforts throughout the town.

Thirteen maps were created to illustrate the town's natural resources and character. The maps depict topography, bedrock geology, forest soils, agricultural soils, hydric soils, major watersheds, water resources, wetlands, Wildlife Action Plan habitat types, Wildlife Action Plan habitat ranks, priority conservation areas, co-occurrence of natural resources, and buildable area.

Moultonborough has experienced steady population growth and development since the 1960s. There are currently 14,100 acres of conserved land within the town. Much of this conserved land is in the higher-elevation portions of the town, namely the Ossipee Mountains and Red Hill. Conservation land is underrepresented in lower-elevation portions of the town, where development is most prominent.

FBE in consultation with the Moultonborough Conservation Commission identified areas within the town having the highest natural resource values using numerous spatial datasets. Locations within town having the largest areas of high co-occurrence values were identified as "Priority Conservation Areas". Nine contiguous priority conservation areas were identified in total: Moultonborough Neck Marsh, Moultonborough Neck, Mud Pond, Moultonborough Bay, Lee's Pond, Cross Property, Berry Pond, Balmoral, and Shannon Brook.

These Priority conservation areas represent lower-elevation portions of the town and encompass much of the town's mapped wetlands and streams, in addition to areas mapped as part of New Hampshire Fish and Game Department's Wildlife Action Plan as valuable habitat which are not already protected. In total, the nine Priority Conservation Areas cover approximately 5,174 acres (47%) of buildable land out of total 10,908 acres identified by the FBE's 2015 build-out analysis.

The greatest threat to the natural resources and ecology of Moultonborough is habitat loss/alteration resulting from poorly-planned development. It's important to note however that 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, as careful attention to growth in Moultonborough will help to ensure sound stewardship of the town's natural resources.

1.0 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 essentially 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, however, to identify 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). Such is the case with the Town of Moultonborough. An NRI was completed for the town almost ten years ago. New data has since become available, and the Town contracted FBE to provide this updated NRI report and associated spatial data (i.e., GIS shapefiles).

1.2 RATIONALE

In order 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 where resources are located, which are significant to them, and why.

The future of a natural resource base is largely dependent on land use decisions made at the local level. 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, a natural resources inventory 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.

Major accomplishments of an NRI are the creation and compilation of various maps and their associated data tables and descriptions, and a means to provide a better understanding and appreciation of the community's natural resources (Stone, 2001).

2.0 METHODS

2.1 GENERAL METHODOLGY

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 Moultonborough. Geographic Information System (GIS**)**-based data and maps related to each resource are presented. For each natural resource type included in this document, a description of the resource and its extent in the town is provided, as well as any known and/or potential threats. 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. An accompanying map set is presented in the report appendices (Appendix A).

2.2 DISCLAIMER AND DATA LIMITATIONS

Much of the data utilized in this NRI represent stock data sets obtained from the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) database. Many of these data layers were created from remotely sensed data (e.g. aerial photography, digital orthophotos, and satellite images) and large landscape-level mapping projects (e.g. Soil Units). 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 make 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.

3.0 NATURAL RESOURCES

The town of Moultonborough encompasses 75 square miles in the Lakes Region of central New Hampshire. The town's population was 4,044 at the 2010 census.

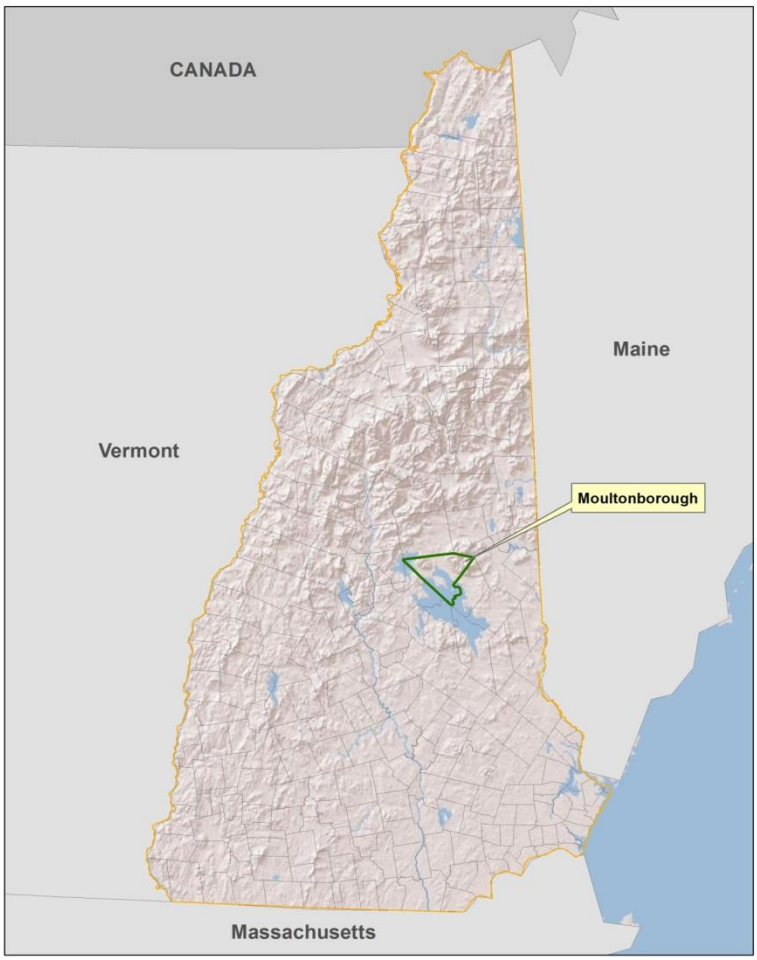


Figure 1. *Moultonborough locator map.*

Moultonborough contains the northern portion of Lake Winnipesaukee and is bound by Sandwich, Tamworth, and Ossipee to the north, Tuftonboro to the east, and Gilford, Meredith, and Center Harbor to the West.

Moultonborough is served by the east-west State Route 25 which connects Meredith and Plymouth to the west with Ossipee, New Hampshire and Portland, Maine to the east. NH Route 109 proceeds southeast towards Wolfeboro and northwest to Sandwich.

Moultonborough is fortunate to have within its boundaries a number of large waterbodies, mountains, and other natural resources. The natural beauty of Moultonborough's lakes and mountains attract many visitors and seasonal residents. As such, the town offers many recreational opportunities such as snowmobiling, boating, hiking, and cycling.

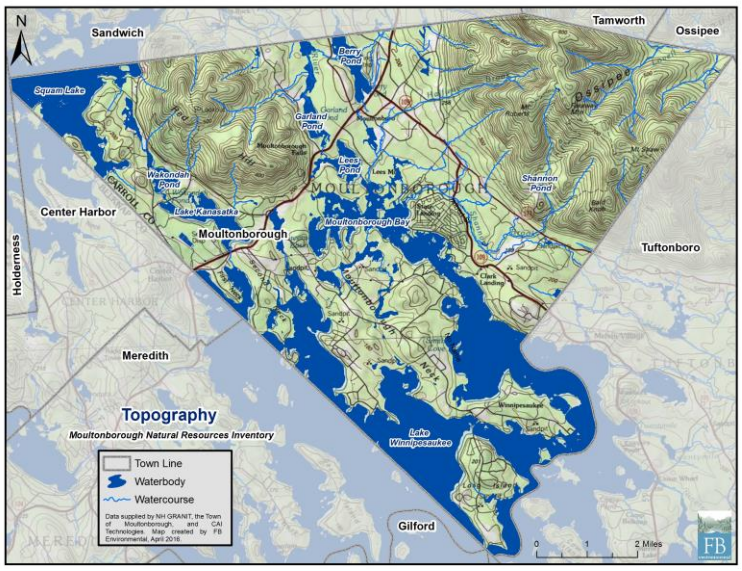
The largest waterbody in Moultonborough is Moultonborough Bay, a part of Lake Winnipesaukee, which is the largest lake in New Hampshire. Other waterbodies within the town include Squam Lake, Wakondah Pond, Lake Kanasatka, Berry Pond, Garland Pond, Lees Pond, and Shannon Pond.

Red Hill is in the northwest portion of the town. In the east is Mount Shaw (elevation 2,990 feet), which is part of the Ossipee Mountains and the highest point in Moultonborough.

3.1 TOPOGRAPHY

Identifying the physical structure and composition of a community's natural landscape is an important starting point and context for evaluating its specific natural resources. Topography provides the basic conditions for understanding how a landscape evolves into areas valuable for specific natural functions such as agriculture, forestry, hydrology, and wildlife habitat, or cultural functions such as scenic vistas.

Topography is also an important factor in the assessment of suitability of development or resource protection. Higher points on the landscape are a visual asset and as such, are vulnerable to potentially unsightly development.



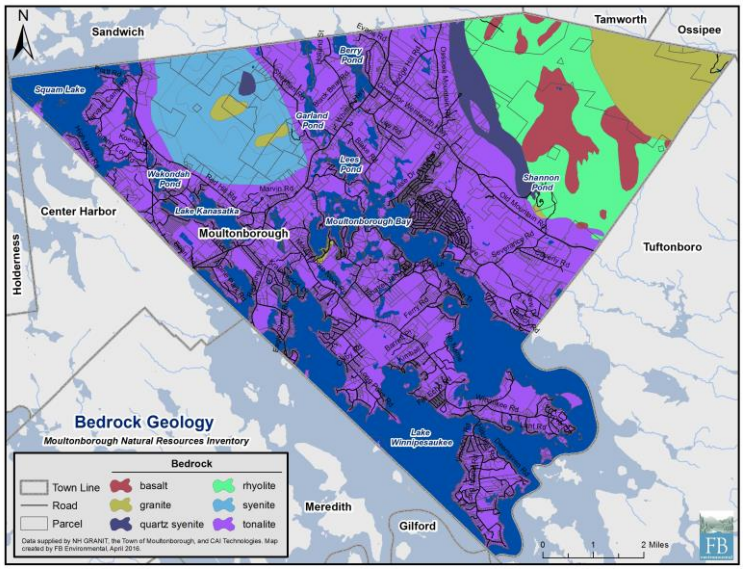
Topographical map of Moultonborough. See Appendix A, Map 1.

Moultonborough's highest elevations are located in the northwestern and northeastern portions of the town, Red Hill and the Ossipee Mountains, respectively. The highest point in the town is 2,990 feet above sea level, at the summit of Mount Shaw. Aside from the aforementioned mountainous areas, the rest town has generally flat to moderately sloping topography, dominated by low areas encompassing the town's numerous lakes and ponds.

3.2 BEDROCK GEOLOGY

About 10,000 to 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 off. Chunks of bedrock were picked up and dragged for miles, then left behind as the large glacial boulders now called erratics.

The pattern of a general southwest to northeast direction of the receding glaciers of over 12,000 years ago can be seen today in Moultonborough as well as in most of New England (Billings, 1980). This process formed the rivers, lakes, and



Map depicting Moultonborough's bedrock geology. See Appendix A, Map 2.

wetlands that we see today. The soil variations found throughout the Town of Moultonborough exist because of the parent material (or bedrock) that lies beneath the surface and the deposits of materials left by the retreating glaciers. These parent materials influence the land formations, waterbodies, and vegetation occurring above them.

The bedrock underlying Moultonborough is of an igneous origin. Igneous rocks are formed from the solidification of molten rock material. Intrusive igneous rocks (e.g., granite) crystallize below the Earth's surface. Extrusive igneous rocks (e.g., basalt, rhyolite) cooled quickly after erupting to the surface.

The vast majority of the bedrock in Moultonborough is tonalite, which corresponds with the low, relatively flat portions of the town. Higher elevation areas are containing different bedrock material. Red Hill is composed of syenite, quartz syenite, and granite while the section of the Ossipee Mountains within the town consists of rhyolite, basalt, and granite.

3.3 SURFICIAL GEOLOGY

Surficial geology describes the rocks and unconsolidated materials that lie between bedrock and the ground surface. 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. These formations contain various sized particles and are classified by the shape of formation, the thickness, and the type and size of particles found. Surficial geology is important because the characteristics of materials below the earth's surface influence the feasibility of constructing buildings and roads (Goldthwait et al., 1951).

Materials deposited by running water typically consist of sand and gravel carried into low-lying areas. These deposits formed the stratified drift aquifers (layered sand and gravel) now used for large water withdrawals and productive domestic wells. Stratified drift aquifers have been surveyed statewide by the USGS using drilling and data extrapolation methods (Mack and Lawlor, 1992).

In addition to aquifers, surficial deposits commonly determine soil composition and therefore may affect agricultural viability. Mapped data showing the surficial geology of Moultonborough was not available to incorporate into this report. However sections 3.4 (Soils of Special Importance) and 3.5 (Water Resources) provide more details on some of the natural resources in Moultonborough that are influenced by the area's surficial geology. Further details about NH geology are available at http://des.nh.gov/organization/commissioner/gsu/ and www.nhgeology.org.

3.4 SOILS OF SPECIAL IMPORTANCE

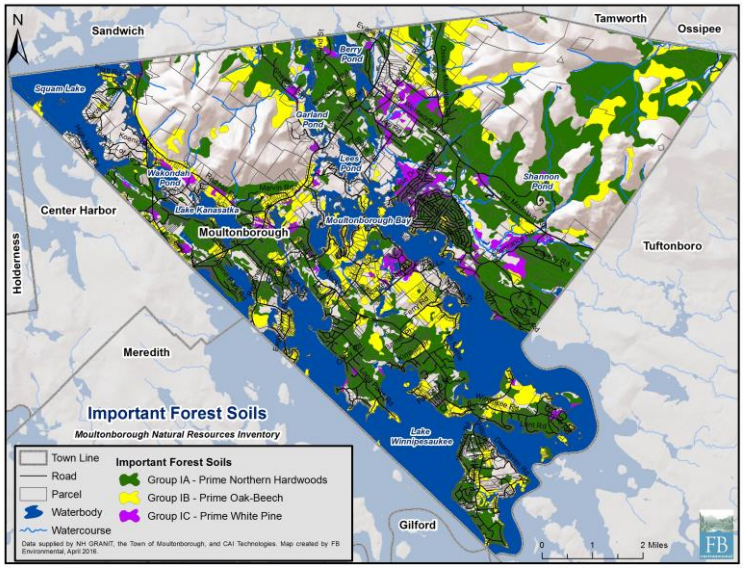
Soil is the unconsolidated mineral and organic matter on the immediate surface of the earth that serves as a natural medium for the growth of plants. Understanding the nature and properties of soils is critical to managing and conserving natural resources. Different soil types throughout the town have 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 behavior for selected land uses and highlight limitations and hazards inherent in the soil and the impact of selected land uses on the environment. The most recently published edition of the Carroll County Soil Survey dates back to 1977.The data and soils map for this inventory were derived from this 1977 survey.

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, and 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.

3.4.1 FOREST SOILS

For millions of years soils have provided the foundation for trees and forests. 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 as well as other plants and vegetation, are an important factor in the creation of new soil as leaves and other vegetation rot and decompose (fao.org, 2016).



Map depicting Moultonborough's important forest soils. See Appendix A, Map 3.

Forest soils are generally subjected to fewer disturbances than agricultural soils (e.g., they are not plowed), and the forest floor is a unique feature to them. They also typically do not receive external inputs (e.g., fertilizer, manure, herbicides, insecticides, fungicides) and instead rely on their inherent soil nutrient cycling to support plant nutritional needs (Perry and Amacher, 2007).

Disturbances to forest soils tend to be related primarily to timber harvesting. 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, including water quality and quantity (Perry and Amacher, 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 and Sundquist, 2001).

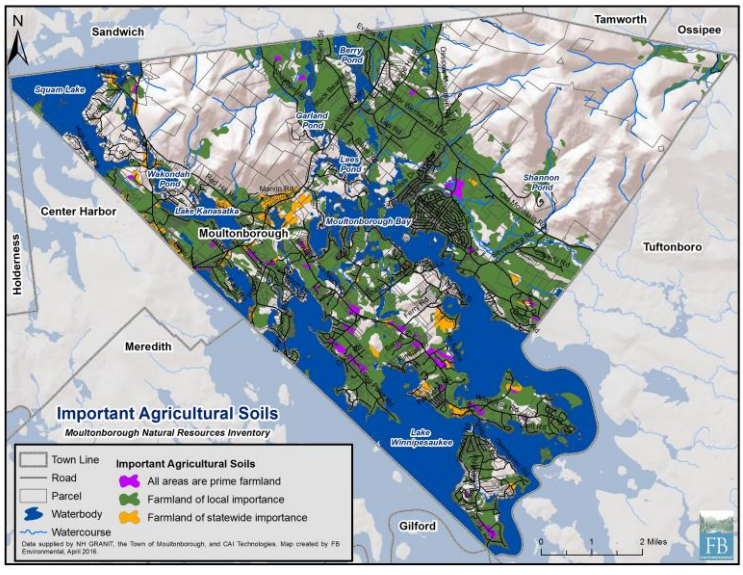
Soils mapped by the NRCS for each county soil survey have been grouped into six "Important Forest Soils Groups" based on the inter-relationship between soil characteristics including texture and moisture or wetness; inherent limitations of the soil for forest management (e.g. steep slopes, shallowness, boulders, rock outcrops); and typical forest successional trends on certain soil types (Thorne and Sundquist, 2001). The three most important forest soil groups in Moultonborough are described below.

- **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 Moultonborough, these soils account for approximately 14,452 acres or about 38% 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 5,646 (15%) 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 1,550 acres (4%) of the town's total area.

In total, approximately 21,648 acres (57%) of Moultonborough's land area is comprised of important forest soil. The majority of that that area is currently forested.

3.4.2 AGRICULTURAL SOILS

The Farmland Protection Policy Act of 1981 was established to assure that Federal programs are administered in a manner that will be 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):



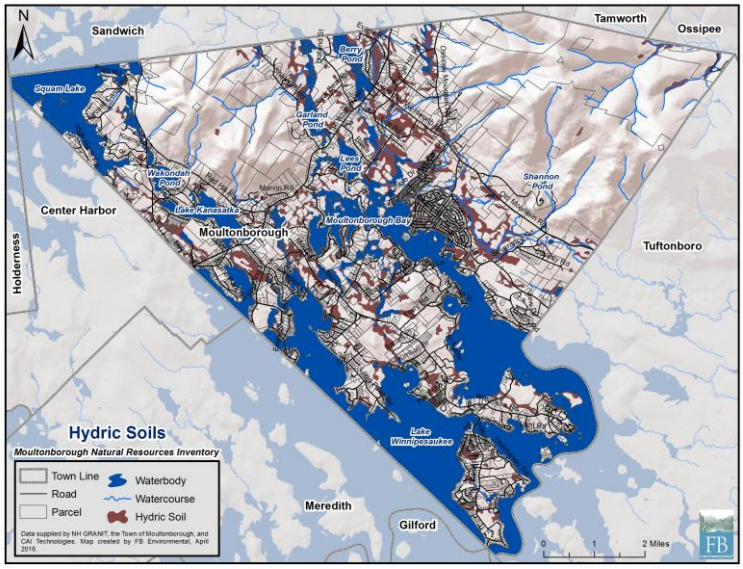
Map depicting Moultonborough's important agricultural soils. See Appendix A, Map 4.

- **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 Moultonborough, these soils account for approximately 460 acres, about 1% 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 include those areas that are nearly prime farmland and that can economically produce high yields of crops when treated and managed according to acceptable farming methods. These soils constitute about 760 acres, approximately2% 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. This is the predominant agricultural soil group in Moultonborough with over 15,427 acres, about 40% of the town's total area.

In total, approximately 16,647 acres (43%) of Moultonborough's land area is comprised of agricultural soil. The highest concentrations of these soils are found in the lower elevation sections of the town. Moultonborough's best agricultural soils, prime agricultural soils, are located sporadically in small patches throughout lower-elevation portions of the town.

3.4.3 POORLY DRAINED SOILS

Soil drainage characteristics are based on a soil's permeability - the ability of air and water to move through it. Permeability is influenced by the size, shape, and continuity of pore spaces, which is dependent on soil density, structure, and texture. Texture is one of the most important characteristics since it influences many other properties of soil such as irrigation needs, erosion potential, and fertility. Soil texture describes the proportionate distribution of different sizes of mineral particles in a soil, excluding organic matter.



Map depicting Moultonborough's hydric soils. See Appendix A, Map 5.

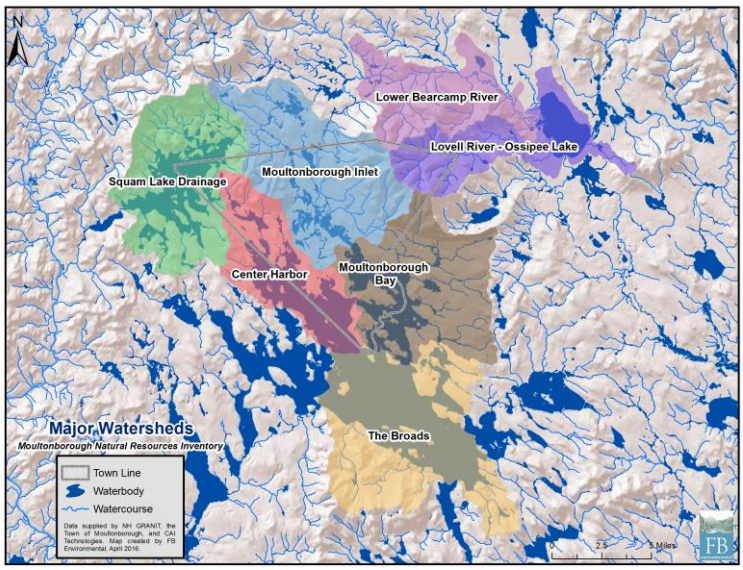
Generally, sandy soils tend to be low in organic matter content and fertility; low in ability to retain moisture and nutrients; and well-drained and therefore well suited for road foundations and building sites. Fine-textured soils are generally more fertile; contain more organic matter; and are better able to retain moisture and nutrients. When soils areas fine-textured as to be classified as clay they are somewhat difficult to manage for cultivation, and have characteristics that adversely affect their suitability at 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, and are generally not well drained. While these soils are located in lowland areas and depressions throughout Moultonborough, the highest concentration of these soils is in the central portion of the town. This part of Moultonborough has the lowest elevations, and numerous wetlands. In total there are 4,543 mapped acres hydric soils in Moultonborough, covering approximately 12% of the town.

3.5 WATER 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 in bedrock. Surface waters offer many recreational possibilities, and are key elements in the value of scenic resources. Floodplains provide fertile farming soils, and are also valuable in attenuating damaging floods. Wetlands are well-known to provide habitat for diverse array wildlife and to provide flood storage and water filtering services. These aspects of Moultonborough's water resources are discussed below.

3.5.1 MAJOR WATERSHEDS

A watershed is the area of land where all of the water that is on, over or under it drains into a given stream, river, lake or other water body. A watershed acts as a funnel, collecting all water within a drainage area and channeling it into groundwater, a stream, river or lake, and ultimately into the ocean. Watersheds are land features that can be identified by tracing a line along the highest elevations between two areas on a map, often along a ridgeline. Every piece of land is part of a watershed; therefore, everything that occurs on the land eventually has an effect on the water flowing through that watershed.



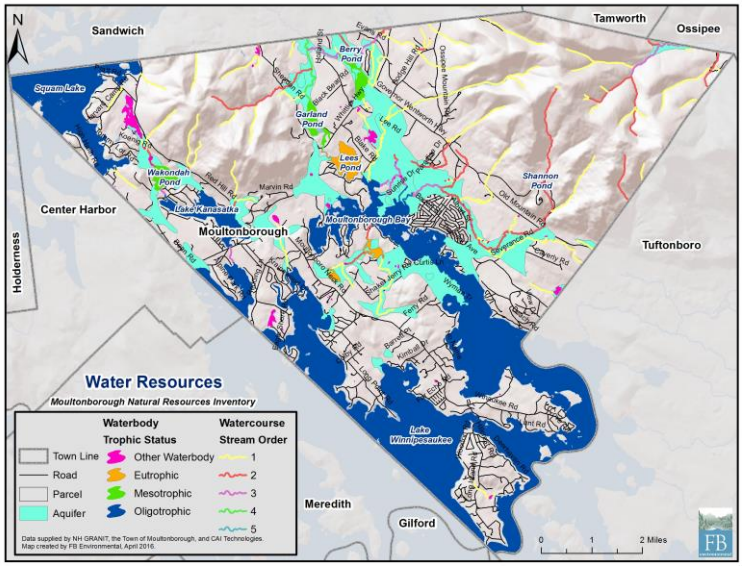
Map depicting major watersheds in Moultonborough. See Appendix A, Map 6.

The majority of Moultonborough is within the Lake Winnipesaukee drainage, which in the town has four subwatersheds: Moultonborough Inlet, Center Harbor, Moultonborough Bay, and the Broads. The three other major watersheds in the town are the Bearcamp River drainage, Ossipee Lake Drainage, and Squam River drainage. Each of these is made up of smaller sub-watersheds.

3.5.2 LAKES AND PONDS

Lakes, ponds, and reservoirs are key elements of aquatic ecosystems, and provide valuable habitat for fish, wildlife, and plants, as well as important recreational opportunities including swimming, boating, and fishing. Natural lakes and artificially impounded reservoirs may also serve as sources of drinking water.

Moultonborough is home to numerous lakes and ponds (Table 1), and contains a portion of the largest waterbody in New Hampshire, Lake Winnipesaukee, which in total encompasses 71 square miles. Collectively, lakes and ponds amount to 9,854 acres, approximately 21% of the town's total area.



Map depicting waterbodies, watercourses, and stratified drift aquifers in Moultonborough. See Appendix A, Map 7.

Lakes follow a natural aging process whereby they become nutrient enriched and gradually fill in. Under natural conditions, this aging process takes place over centuries. However, this process can be greatly accelerated by human activities. Increases in nutrients, especially phosphorus which tends to increase plant growth, which in turn impacts overall lake water quality. Lakes are classified into three trophic classes based on measurements of chlorophyll pigments, total phosphorus, and water clarity. These trophic classes provide an estimate of the lake's biological productivity, or the amount of living material supported within them, primarily in the form of algae.

Oligotrophic lakes 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 lake bottom. Eutrophic lakes have low water transparencies, high nutrient concentrations, high algae concentrations, large stands of aquatic plants, and very low dissolved oxygen concentrations near the lake bottom. Mesotrophic lakes have qualities between those of oligotrophic and eutrophic lakes. It is important to note, however, that not all eutrophic lakes are so due to human activity. Shallow waterbodies with forested watersheds with extensive wetlands, may be naturally eutrophic.

According to the NHDES Lake Trophic Surveys mapper, within Moultonborough Kanasatka Lake, Squam Lake and Lake Winnipesaukee are classified as Oligotrophic. Berry Pond, Garland Pond, and Wakondah Pond are mesotrophic, and Lees Pond, Meadow Brook Pond, and Pickering Pond are eutrophic.

Moultonborough waterbodies support both warm water and cool water fisheries (Table 1). Examples of cool water species in New Hampshire include brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), and burbot (*Lota lota*). Examples of warm water species in New Hampshire include smallmouth bass (*Micropterus dolomieu*) largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), horned pout (brown bullhead) (*Ameiurus nebulosus*) black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*) white perch (*Morone americana*) and yellow perch (*Perca flavescens*).

Table 1. Trophic status, elevation, size, depth, fishery type supported, and species occurring in named waterbodies within Moultonborough, NH. Game fish species are as follows: 1) rainbow trout; 2) salmon; 3) lake trout; 4) whitefish; 5) smallmouth bass; 6) largemouth bass; 7) chain pickerel; 8) horned pout, 9) white perch; 10) black crappie; 11) bluegill; 12) rock bass; 13) burbot (cusk), and 14) yellow perch.

Waterbody Name	NH DES Trophic Status*	Elev. (feet)	Total Acres	Acres in Moult.	Max. Depth (feet)	Fishery Type	Game Fish Species Present*
Lake Kanasatka	Oligotrophic	158	358	358	33.94	warm/cool	5,6,7,8,9
Squam Lake	Oligotrophic	170	6,791	1,321	127.15	coldwater	1,2,3,4,5,6,7,8, 9,13
Lake Winnipesaukee	Oligotrophic	153	45,654	7,506	302.23	coldwater	1,2,3,4,5,6,7,8, 9,10,11,12,13
Berry Pond	Mesotrophic	171	82	82	13.73	warm/cool	6,7,8,14
Garland Pond	Mesotrophic	160	102	102	17.85	warm/cool	7,8,14
Wakondah Pond	Mesotrophic	161	94	94	32.74	warm/cool	5,6,7,8,9,14
Lees Pond	Eutrophic	154	154	154	21.86	warm/cool	5,6,7,10,11
Meadow Brook Pond (Ledgy Pond)	Eutrophic	155	38	38	8.52	warm/cool	Info. not available
Pickering Pond	Eutrophic	162	22	22	3.17	warm/cool	Info. not available
Shannon Pond	-	374	4	4	-	warm/cool	Info. not available

*Species lists obtained from New Hampshire Fish and Game Department's (2009) *New Hampshire Freshwater Fishing Guide and from* New Hampshire Fish and Game Department bathymetry maps.

3.5.3 RIVERS AND STREAMS

Moultonborough contains 78 miles of mapped rivers and streams. Some intermittent streams, which carry water for only a portion of the year, are too small to be mapped and are not included in the above estimate. The watercourses and their adjacent riparian corridors are important habitat and travel corridors for the town's terrestrial wildlife. In addition, many bird species are attracted to water and the food sources that are located nearby. There are eleven named watercourses in Moultonborough (Table 2) and numerous miles of additional unnamed streams in the town.

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 (Figure 2).

Fourth order and higher streams are protected under the NH Comprehensive Shoreland Protection Act. Headwater Streams (first-order streams) that have a watershed area less than one square mile are considered "primary" headwater streams. The health of larger streams, rivers, and other surface waters downstream in a watershed depend in part upon an intact primary headwater stream network. Headwater streams are particularly important for maintaining water quality due to the sheer number of miles they represent in most watershed drainage systems. In Moultonborough, headwater streams account for 60% of total mapped stream miles (see Map 7 and Table 2). These areas contain especially important natural resources and provide important habitat, which are vulnerable to degradation by improper forestry practices and land use changes.

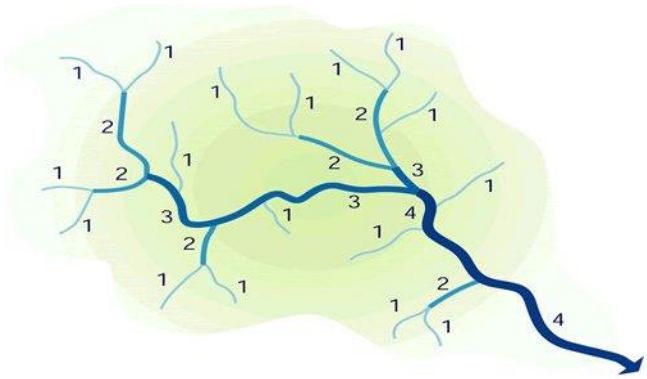


Figure 2. Illustration of the stream order system used in New Hampshire. Source: SUNY College of Environmental Science and Forestry. Fluvial Geomorphology Training Module, Section 4.viii, http://www.fgmorph.com/fg_4_8.php.

Table 2. Order, Length, and temperature class of named watercourses in Moultonborough, NH.

Watercourse Name	Stream Order	Length in Moultonborough (miles)	Temperature Class	Game Fish Species Present*
Cook Brook	1	0.76	coldwater	Info. not available
Gulf Brook	1	1.43	coldwater	Info. not available
Halfway Brook	1	5.06	coldwater	Info. not available
Jackson Brook	2	0.36	coldwater	Info. not available
Lovell River	3	2.59	coldwater	brook trout
Red Hill River	4	1.70	coldwater, warm/cool	Info. not available
Shannon Brook	2	7.73	coldwater	brook trout
Skinner Brook	1/2	1.13	coldwater	brook trout
South Brook	2	1.30	coldwater, warm/cool	Info. not available
Weed Brook	1/2/3	4.20	coldwater	brook trout
White Brook	2	0.86	coldwater	Info. not available

*Species list obtained from New Hampshire Fish and Game Department's (2009) *New Hampshire Freshwater Fishing Guide.*

The collective health and functioning of primary headwater streams have profound influences on the quality and value of larger streams, rivers and lakes. The importance and 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 in larger streams in times of drought. They are a key determinant in the overall condition of the river system (Ohio EPA, 2015).

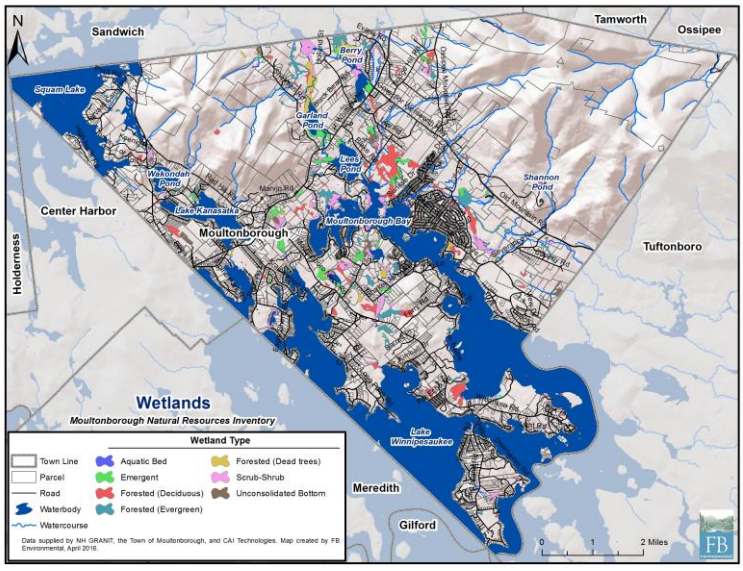
3.5.4 AQUIFERS

An aquifer is a geologic unit or formation that contains a useable supply of water. A stratified drift aquifer consists mainly of layers of sand and gravel, parts of 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 and Moore, 1995). Based on GIS data obtained from NH GRANIT, Moultonborough contains approximately 4,762 acres of stratified drift aquifer.

3.6 WETLANDS

Wetlands are an integral part of Moultonborough's natural resources. They removing 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 and add to the visual resources of the town as well.

There are a diversity of wetland types in Moultonborough, including areas of aquatic bed vegetation (i.e., water lilies, *Nymphaea odorata*), emergent vegetation [e.g., cattail (*Typha spp.*) marshes], forested wetlands [e.g., red maple (*Acer rubrum*) swamps], and scrub-shrub wetlands. The principal types of wetlands with standing water in the spring have been mapped from aerial photos by the National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service. 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. This is particularly so for small wetlands including vernal pools. Vernal pools are seasonal depressional wetlands that typically fill during the spring or fall (see following section).



Map depicting NWI-mapped wetlands in Moultonborough. See Appendix A, Map 8.

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 of the amount of wetlands in Moultonborough. While these inaccuracies are known to exist in NWI data, they nevertheless are very useful in serving as a baseline reference to locate wetlands.

Moultonborough contains approximately 2,021 acres of mapped wetlands, representing approximately 4% of the town's total area (Table 3; Appendix A, Map 8). The vast majority of these wetlands are situated outside of conserved lands.

Wetlands in the United States are typically classified using the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 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. 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 Cowardin System, Subsystem, and Class. Note however that in the section below, wetlands appearing on New Hampshire Wildlife Action Plan (WAP) maps are classified as one of five categories – Floodplain Forests, Northern Swamps, Temperate Swamps, Peatlands, Marsh and Shrub Wetlands.

Table 3. Moultonborough, NH wetlands and associated Cowardin classifications.

Cowardin Classification	Acres	Percent Total Wetland Area
Palustrine emergent (PEM)	319	16
Palustrine forested broad-leaved deciduous (PFO1)	527	26
Palustrine forested needle-leaved evergreen (PFO4)	372	18
Palustrine forested (dead trees) (PFO5)	172	8
Palustrine scrub-shrub (PSS)	482	24
Palustrine unconsolidated bottom (PUB)	150	7
Total	**2,021**	**100**

3.6.1 VERNAL POOLS

Vernal pools are defined in Calhoun and Klemens (2002) as "...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 the Region, 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 which serve as the base of the food chain. Even though vernal pools are typically small in size, 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 et al., 2012).

Vernal pools undoubtedly exist in Moultonborough. As of the writing of this report, however, there have been no formal efforts to map vernal pools throughout the town. See section 5.0 Conservation Recommendations for information regarding mapping vernal pools in Moultonborough.

3.6.2 PRIME WETLANDS

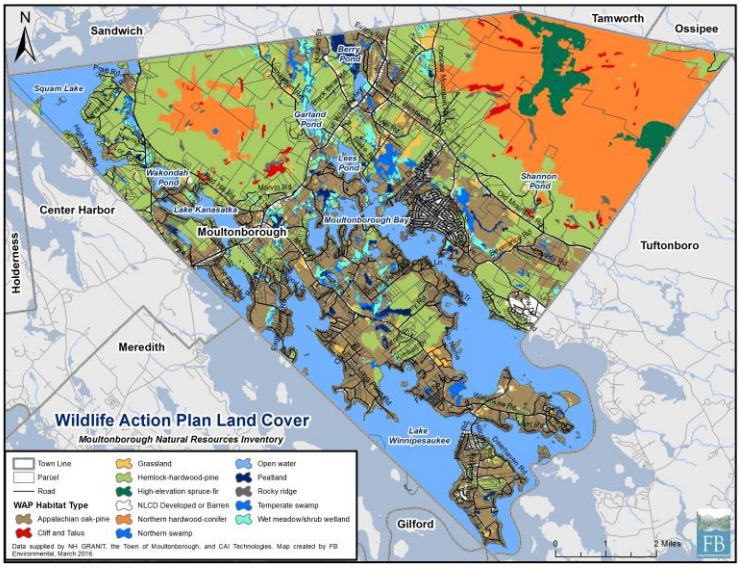
The following regarding Prime Wetlands is excerpted from NH Department of Environmental Service's Prime Wetlands in NH Communities webpage, available at: http://des.nh.gov/organization/divisions/water/wetlands/prime_wetlands.htm.

> Under 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 "desk top" 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 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 or within 100 ft of these resources.

3.7 NEW HAMPSHIRE WILDLIFE ACTION PLAN HABITAT TYPES

The New Hampshire Fish and Game Department collaborated with partners in the conservation community to create the state's first Wildlife Action Plan (WAP), completed in 2005. The plan, which was mandated and funded by the federal government through the State Wildlife Grants 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 rare(r) and more costly to protect. The Wildlife Action Plan is the most comprehensive wildlife assessment ever completed in New Hampshire. It was updated in 2015, information from which is incorporated into this report.



Map depicting New Hampshire's Wildlife Action Plan Habitat Types in Moultonborough. See Appendix A, Map 9.

The section below describes the habitat types present in Moultonborough as according to the Wildlife Action Plan (Table 4; Appendix A, Map 9). 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. The reason for this is that the modeling processes used in the Wildlife Action Plan draw on many natural resource factors – soils, slope, solar aspect, vegetation, etc. – to identify those areas with high potential to harbor the types of habitats mapped. In most cases, the natural communities indicative of the habitats will actually be found in those locations; however, the exact extent and distribution of patches may not match existing field conditions. Only careful field reconnaissance can determine the actual location and extent of natural communities and habitat features. **Note that habitat descriptions below are excerpted directly from New Hampshire Fish and Game's Habitat Types and Species webpage: http://www.wildlife.state.nh.us/habitat/types.html**.

Examination of the habitat type map illustrates that Moultonborough is primarily forested. In fact, forests cover 80 percent of the State's land area. 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 4. New Hampshire Wildlife Action Plan Habitat Type and acreage for Moultonborough, NH.

Wildlife Action Plan Habitat Type	Acres	% Total Area
Hemlock-hardwood-pine	14,003	29.14
Open water	9,553	19.88
Appalachian oak-pine	9,481	19.73
Northern hardwood-conifer	7,810	16.25
NLCD Developed Classes	2,292	4.77
Temperate swamp	1,079	2.25
High-elevation spruce-fir	1,067	2.22
Wet meadow/shrub wetland	1,033	2.15
Grassland	730	1.52
Peatland	510	1.06
Cliff and Talus	312	0.65
Rocky ridge	160	0.33
Northern swamp	15	0.03

3.7.1 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, so 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, it is sometimes overlooked in conservation efforts. Development and fragmentation is a huge threat 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.

This is also the dominant cover type in Moultonborough, covering 29% of the town. It is predominant in the foothills surrounding Red Hill and Mount Shaw.

3.7.2 APPALACHIAN OAK-PINE FOREST

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 whip-poor-wills (*Antrostomus vociferous*), black bears, northern myotis (*Myotis septentrionalis*), and state endangered eastern hognose snakes (*Heterodon platirhinos*). Traditionally, Appalachian oak-pine forests are influenced by frequent fires, which change the age structure of the forest. The

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.

This is the second most-dominant forest type in Moultonborough, covering 20% of the town's total area. It is present in the central and south-central low elevation areas of the town.

3.7.3 NORTHERN HARDWOOD-CONIFER FOREST

This habitat type is typically found between 1,400 and 2,500 feet in elevation and is usually made up of hardwood trees such as American beech, sugar maple, yellow birch (*Betula alleghaniensis*), and conifer trees such as eastern hemlock, white pine (*Pinus strobus*), and balsam fir (*Abies balsamea*). Most of northern hardwood conifer habitat occurs in central and northern New Hampshire. This transitional zone provides habitat for many wildlife species including state threatened species: bald eagle (*Haliaeetus leucocephalus*), who nest and roost near lakes and rivers, and peregrine falcons (*Falco peregrinus*) who nest on cliffs but hunt over the forest. Other typical species in this habitat include ruffed grouse (*Bonasa umbellus*), wood thrush (*Hylocichla mustelina*), and northern long-eared bat (*Myotis septentrionalis*). Development pressure is heavy within some parts of this habitat type. Forest harvesting is common in this habitat and if done sustainably produces the diversity of age classes and species which is beneficial to wildlife. Forestry also has increased this type of habitat by converting spruce-fir habitats to the more economically valuable northern hardwoods. Some conservation strategies for northern hardwood conifer forests are incorporating the habitat into local conservation planning, protecting unfragmented blocks of land, and advocating for the adoption of sustainable forestry.

This forest type is present in Moultonborough at higher elevations in the vicinity of Mount Shaw.

3.7.4 HIGH-ELEVATION SPRUCE-FIR FOREST

High-elevation spruce-fir forests can be found between 2,500 and 3,500 feet in elevation on upper mountain slopes and ridge tops. Harsh climatic extremes and highly erosive soils play a significant role in determining the vegetative species found in this habitat type, which typically includes red spruce (*Picea rubens*), balsam fir, and paper (*Betula papyrifera*) and yellow birches. High-elevation spruce-fir forest has a very limited distribution in New Hampshire, covering approximately 4% of the state's land area, and provides some of the last areas relatively free of human disturbance. The wildlife species that are found in this habitat include the federally threatened and state endangered Canada lynx (*Lynx lynx*) and the state threatened American marten (*Martes americana)*. Spruce grouse (*Falcipennis canadensis*) and Bicknell's thrush (*Catharus bicknelli*) also use this habitat. Not only do the trees at this elevation have to cope with the harsh climate, but they must also deal with the stress effects of acid deposition. The high elevation also presents another potential threat: energy and communication infrastructure. High elevation spruce-fir soils are also shallow, so forestry operations can easily

damage the fragile soils. Conservation strategies for high-elevation spruce-fir forests include habitat protection and examining potential wildlife habitat degradation from wind farm construction.

The Wildlife Action Plan identifies 1,066 acres of high-elevation spruce-fir forest in Moultonborough. All of it is found in the Ossipee Mountains.

3.7.5 GRASSLAND

There are 730 acres mapped as grassland in Moultonborough. 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 are now on the state endangered list such as the eastern hognose snake, northern harrier (*Circus cyaneus*), upland sandpiper (*Bartramia longicauda*) and on the state threatened list such as the grasshopper sparrow (*Ammodramus savannarum*). Other species also benefit from these open grass fields such as wood turtles (*Glyptemys insculpta*) and numerous species of butterflies. 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 NH 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.

Moultonborough contains 730 acres mapped as grasslands. The areas are not concentrated but rather occur in patches throughout the town.

3.7.6 ROCKY RIDGE, CLIFF AND TALUS

Rocky ridges and talus slopes are two related but distinct habitats. Talus slopes, comprised of loose or stable boulders and rocks, range from open, lichen covered talus "barrens" to closed-canopy forested talus communities. Rocky ridges generally occur on outcrops and bedrock ridges and summits below the alpine zone. Talus slopes and rocky ridges provide crucial habitat for several rare wildlife species in New Hampshire, including bobcat, state endangered timber rattlesnake (*Crotalus horridus*) and eastern small-footed bats (*Myotis leibii*), and state threatened peregrine falcon. Due to the inaccessible nature of talus slopes, human impacts exist primarily on the rocky ridge portion of this habitat, though some trails and other impacts are found on talus. Some conservation strategies for rocky ridges and talus slopes are to limit trails through high risk areas and monitoring indicator species for climate change.

Cliffs are steep, rocky outcrops greater than 65° in slope and 3 meters in height. They can be low in elevation within a forest or higher in elevation and completely exposed such as the historic location of The Old Man of the Mountain. Cliffs have sparse vegetation that is typically

restricted to cracks and crevices where soil accumulates. Depending on the type of rock that make up the cliff, different types of vegetation will grow there such as sheep laurel (*Kalmia angustifolia*) on acidic cliffs and bulblet bladder fern (*Cystopteris bulbifera*) on calcareous cliffs. Cliffs are used by several wildlife species including the state threatened peregrine falcon, state endangered timber rattlesnake, bobcat, common raven (*Corvus corax*), and long-tailed shrew (*Sorex dispar*). Although often viewed as isolated or inaccessible to people, the popularity of cliffs and cliff tops as recreational destinations for hikers and rock climbers is rapidly increasing. Another threat to the tops of these exposed habitats is energy and communication infrastructure such as cell towers and wind turbines. Some conservation strategies for cliff habitat are educating recreational users, habitat protection, and advising wind energy developers of potentially negative impacts through regulation and policy.

There are 160 acres of rocky ridge mapped in Moultonborough. Most areas are found in mountainous areas of the town.

3.7.7 TEMPERATE SWAMP

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. Threats to temperate swamps include habitat degradation from insect pests such as the hemlock woolly adelgid (*Adelges tsugae*), since hemlock is a common component of temperate swamps across NH. 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.’

The Wildlife Action Plan has mapped 1,079 acres of temperate swamp in Moultonborough. They are situated in low-elevation areas of the town and are typically embedded in Appalachian Oak-Pine Forest.

3.7.8 WET MEADOW/SHRUB WETLAND

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, 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, ringed boghaunters (*Williamsonia lintneri*), and sedge wrens (*Cistothorus platensis*) plus state threatened 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 (*Fallopia 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.

The Wildlife Action Plan identifies 1,033 acres of wet meadow/shrub wetlands in Moultonborough. The largest concentrations occur in the central portion of the town.

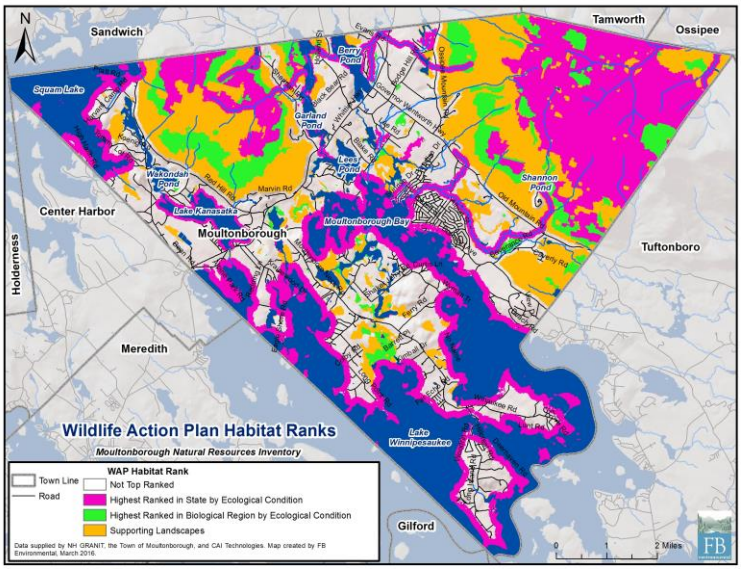
3.7.9 NORTHERN SWAMP

This habitat consists of forested wetlands found mainly in the northern half of the state, including black spruce peat swamps and forest seeps. Black spruce (*Picea mariana*) peat swamps are found in central and northern New Hampshire, typically in closed or stagnant basins with limited drainage. These swamps have a forest or woodland structure, but often surround open peatlands. Seeps occur where groundwater emerges at the soil surface and begins flowing into a stream. Despite their small size, they support a distinctive suite of plant species, and have value as wildlife habitat for some amphibians. Between 2004 and 2015, NH DES documented approximately 950 acres of wetlands lost in New Hampshire through development activities. Therefore, development of swamps, surrounding uplands, and impacts from fragmenting features like roads are all threats to this habitat. Other threats include increased temperatures that can cause changes in species composition, and eventual conversion to a different habitat type. The best action we can take to conserve swamps is to delineate forested swamps in northern New Hampshire, and add this information to the review process by the NH DES Wetlands Bureau.

There are 15 acres of northern swamp mapped in Moultonborough. The largest is approximately six acres located within Red Hill’s northern hardwood-conifer forest.

3.8 WILDLIFE ACTION PLAN HABITAT RANKS

Using habitat types mapped in the NH 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 raked 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.



Map depicting NH's Wildlife Action Plan Habitat Ranks for Moultonborough. See Appendix A, Map 10.

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 with the exception of 100% inclusion of certain rare cover types (e.g., alpine areas, dunes, salt marshes, rocky shores). Critical habitat for state-listed species is included as well (NHFG, 2016).

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 NH Natural Heritage Bureau were added to highlight the importance of plant diversity in habitat quality (NHFG, 2016).

Supporting Landscapes: 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 (NHFG, 2016).

3.8.1 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 combination with other locally-collected information on forest stand types, wildlife sightings, recreational trails, scenic views, water resources, etc. as part of the decision-making process.

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 habitat for those things are located 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).

3.8.2 A PRIMER ON HABITAT CONNECTIVITY

The major factor in the reduction and loss of biodiversity (i.e., plants, animals, and habitat types) in the Northeast is fragmentation of habitat units into smaller, isolated sub-units. This is a national phenomenon, discussed in detail by Johnson and 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're arranged in a fashion that facilitates movement of animals across the landscape (Miller et al., 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 between core areas thus enabling genetic exchange and preventing local species extirpations. These connections are typically referred to as "corridors". Note however that a corridor for wildlife is not a narrow, linear green strip between core areas. Rather, a wildlife corridor 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 between core areas (Miller et al., 2005).

It is prudent to identify where the matrix of wildlife habitat and corridors occur on a given landscape. It is insufficient to randomly protect small parcels of habitat across a region in hopes that they'll be beneficial to wildlife. Instead, it is best to discover where particular species occur and incorporate the information into future land-use decisions (Miller et al. 2005).

The Priority Conservation Areas presented below 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.

3.9 RARE PLANTS & ANIMALS AND EXEMPLARY NATURAL COMMNUNITES

Rare plant and animal species have been documented in Moultonborough; this information is maintained by New Hampshire's Division of Forests and Lands' Natural Heritage Bureau, in cooperation with the New Hampshire Fish & Game's Non-Game and Endangered Wildlife Program. Generalized information on the presence of these species and communities is available from the Natural Heritage Bureau. According to the Bureau's "Rare Plants, Rare Animals and Exemplary Natural Communities in New Hampshire Towns" (NHB, 2013) the species and natural communities/systems listed in Appendix C have been documented to exist in Moultonborough. The specific locations of rare species and communities are not available for this study due to data release policies of the NHB. As described above in Section 3.8, information on rare species and communists has been incorporated into the Wildlife Action Plan's Habitat Rank.

3.10 NON-NATIVE, INVASIVE SPECIES

Aquatic plant species: Nine non-native, invasive aquatic plant species are known to exist in New Hampshire waterbodies: variable milfoil (*Myriophyllum herterophyllum*), fanwort, (*Cabomba caroliniana*), Eurasian water-milfoil (*Myriophyllum spicatum*), Brazillian elodea (*Egeria densa*), curly-leaf pondweed (*Potamogeton crispus*), European naiad (*Najas minor*), water chestnut (*Trapa natans*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*).

These invasive aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000, cited in NHDES, 2013). They accomplish this primarily through forming dense monocultures in the waterbodies they infest. These infestations result in reduced overall species diversity in plant and animal species, diminished water quality, reduced fishing and water recreation opportunities, and reduced property values.

Variable milfoil became established in Moultonborough Bay in 1965, and is the longest standing infestation in New Hampshire. The NH Department of Environmental Service (2013) states the plants throughout the bay are mature and well-established, forming monocultures in many areas, and generally widespread in others. The plant has flowered for a number of years in some areas of the lake, which has produced substantial seed stock in the lake substrate that could germinate and perpetuate growth for many years to come.

The Town of Moultonborough has been proactive in the effort to control milfoil in infested waterbodies in town, including Moultonborough Bay. The town formed a special Milfoil Committee that operates under the Conservation Commission. The group meets regularly to discuss and strategize for milfoil control activities. The town has been successful in passing warrant articles to allocate funds for milfoil control efforts in waterbodies infested within Moultonborough town boundaries (NHDES, 2013).

Terrestrial and wetland 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 out-compete native species, and with their loss so follows the loss of their native pollinators and other dependent wildlife. Also, 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 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.

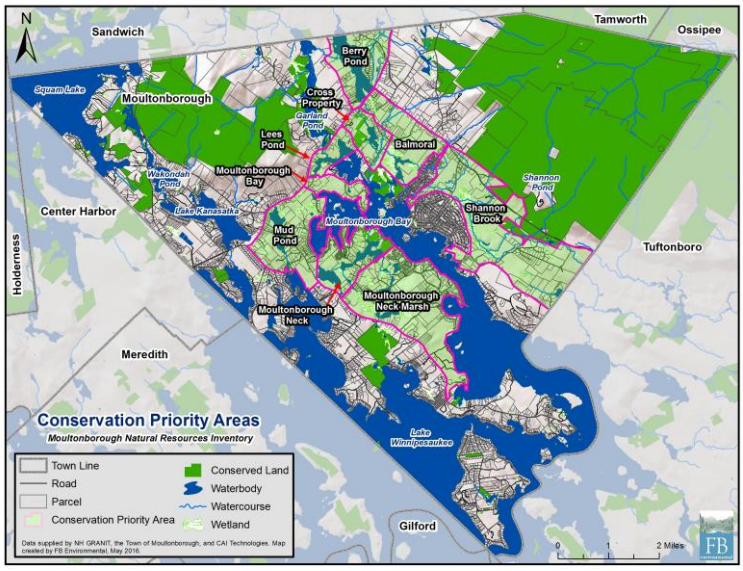
Common non-native, invasive plant species which undoubtedly occur in Moultonborough include Japanese knotweed (*Fallopia japonica*), glossy buckthorn (*Frangula alnus*), Asian bittersweet (*Celastrus orbiculatus*), honeysuckle (*Lonicera morrowii* and *L. tatarica*), autumn olive (*Elaegnus umbellata*), and multiflora rose (*Rosa multiflora*).

Invasive species pose a considerable threat in Moultonborough. Best management practices require multiple approaches including inventory and mapping, control at ecologically important or vulnerable sites, local policy, and regional partnerships. See Cygan's (2011) *New Hampshire Guide to Upland Invasive Species* for more information.

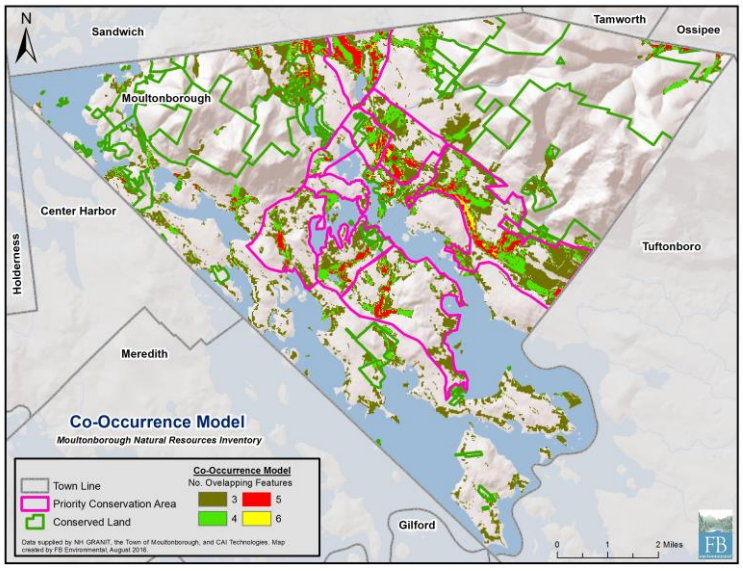
Insects: Several non-native, invasive insect species are known to occur in New Hampshire including the emerald ash borer (*Agrilus planipennis*), hemlock wooly adelgid (*Adelges tsugae*), elongate hemlock scale (*Fiorinia externa*), red pine scale (*Matsucoccus resinosae*), winter moth (*Operophtera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

4.0 PRIORITY CONSERVATION AREAS

The original 2007 Moultonborough NRI presented nine Priority Conservation Areas. These areas represent areas of the town with the highest natural resource values and were identified using a co-occurrence model developed by the New Hampshire Fish and Game Department. A co-occurrence analysis involves the overlay of raster images in a GIS. The raster images used in the original 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. NHFG has since replaced this original co-occurrence model with the New Hampshire Wildlife Action Plan Habitat Ranks (discussed in Section 3.8).



Map showing Moultonborough's Priority Conservation Areas. See Appendix A, Map 11.

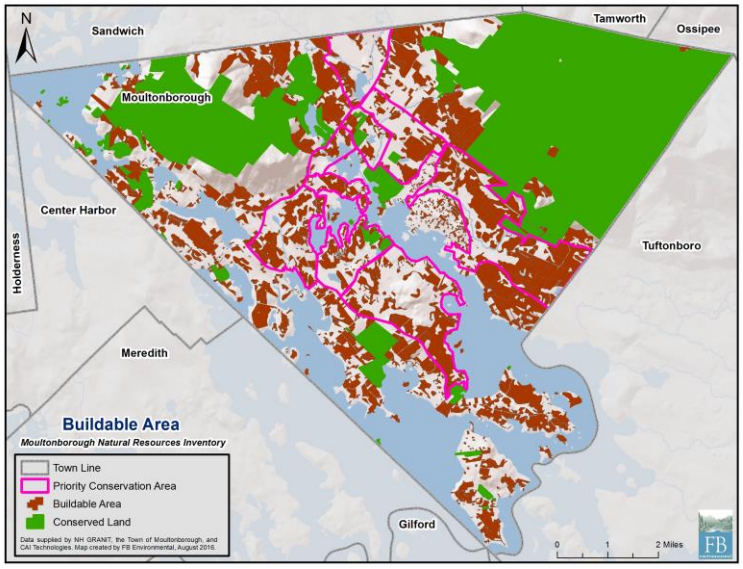


Map showing Moultonborough's Priority Conservation Areas overlaid on the results of the co-occurrence model. See Appendix A, Map 12.

For this NRI update, an additional co-occurrence model was created by overlaying rasters depicting mapped wetlands, areas ranked as greater than zero according to the Wildlife Action Plan, agricultural soil, hydric soil, aquifers, streams (and the area 350' on either side of them), and areas identified as buildable by the build-out analysis (FBE, 2015). The recent analysis matches up well with the conservation areas identified as part of the original NRI. They have been made larger, however, in part to encompass areas ranked by the Wildlife Action Plan.

Two of the areas identified in the original NRI have since been conserved. The properties surrounding Garland Pond are now under conservation easements and the Lovell River Priority Area is part of the Chocorua Forestlands.

Examination of existing conserved lands shows that low-lying areas of Moultonborough are lacking protection significantly compared to higher-elevation areas. These low lying areas also contain more overlapping features areas and as such, the Priority areas are contained within the low-lying central portion of the town. These nine areas combined form a "horseshoe" around Moultonborough Bay.



Map showing Moultonborough's Priority Conservation Areas overlaid on buildable area. See Appendix A, Map 13.

The nine Priority Conservation Areas are: Moultonborough Neck Marsh, Moultonborough Neck, Mud Pond, Moultonborough Bay, Lee's Pond, Cross Property, Berry Pond, Balmoral, and Shannon Brook. These areas encompass much of the town's mapped wetlands and streams, in addition to areas mapped as part of the Wildlife Action Plan as valuable habitat which are not already protected (Table 5). In total, the identified areas cover approximately 5,174 acres (47%) of buildable land out of total 10,908 acres identified by the build-out analysis (FBE, 2015). Descriptions of the nine priority conservation areas are below.

4.1 MOULTONBOROUGH NECK MARSH

The Moultonborough Neck Marsh Priority Area encompasses 1,988 acres located between Moultonborough Neck Road and Moultonborough Bay. The most notable feature in this area is the Moultonborough Neck Marsh, a large wetland complex hydrologically connected to Moultonborough Bay.

According to Wildlife Action Plan data the area consists of Appalachian oak pine forest (51%), hemlock-hardwood-pine forest (31%), wet meadow/shrub wetland (4%), peatland (4%), temperate swamp (3.4%), grassland (3.1%), and open water (0.3%). An additional 3.4% is classified as developed. Based on the Wildlife Action Plan habitat ranking data, 33.5% (66.4 acres) of Moultonborough Neck Marsh Priority Conservation Area is mapped as one of the top-ranked habitat categories.

Additionally, 627.5 acres (20.9%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 797.0 acres (40.1%) of the area as buildable. The greatest threat to the natural resources and ecology of the Moultonborough Neck Marsh Priority Area is habitat alteration associated with development. Initial conservation activity in this

Table 5 Summary of New Hampshire Wildlife Action Plan Habitat Types and Habitat Ranks within Moultonborough's nine Priority Conservation Areas. For Habitat Ranks 0 = Not Ranked, 1 = Highest Ranked in State by Ecological Condition, 2 = Highest Ranked in the Biological Region by Ecological Condition, 3 = Supporting Landscapes.

	Moultonborough Neck Marsh		Moultonborough Neck		Mud Pond		Moultonborough Bay		Lee's Pond		Cross Property		Berry Pond		Balmoral		Shannon Brook	
Cover Type	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Cover Type																		
Appalachian oak-pine	1,011	51%	453	58%	514	47%	246	88%	78	27%	29	7%	254	31%	180	20%	1,254	51%
Grassland	61	3%	-	0%	50	5%	3	1%	2	1%	56	14%	25	3%	111	12%	100	4%
Hemlock-hardwood-pine	616	31%	79	10%	246	22%	11	4%	78	27%	212	52%	161	19%	375	42%	721	29%
NLCD Developed Classes	67	3%	23	3%	120	11%	5	2%	39	14%	42	10%	97	12%	77	9%	159	6%
Open water	6	0%	40	5%	2	0%	0	0%	38	13%	1	0%	51	6%	0	0%	1	0%
Peatland	79	4%	14	2%	30	3%	5	2%	6	2%	3	1%	166	20%	-	0%	31	1%
Temperate swamp	67	3%	62	8%	43	4%	7	3%	8	3%	26	6%	35	4%	122	14%	133	5%
Wet meadow/shrub wetland	80	4%	115	15%	98	9%	4	1%	36	13%	41	10%	42	5%	29	3%	75	3%
Total	1,988	100%	787	100%	1,104	100%	281	100%	286	100%	410	100%	831	100%	894	100%	2,473	100%
Habitat Rank																		
0	1,322	66%	231	29%	635	58%	183	65%	212	74%	308	75%	414	50%	666	75%	971	39.3%
1	353	18%	246	31%	191	17%	88	31%	41	14%	31	8%	379	46%	44	5%	378	15.3%
2	37	2%	112	14%	60	5%	2	1%	18	6%	11	3%	7	1%	34	4%	103	4.2%
3	276	14%	199	25%	218	20%	8	3%	15	5%	60	15%	31	4%	149	17%	1020	41.2%
Total	1,988	0%	787	0%	1,104	0%	281	0%	286	0%	410	0%	831	0%	894	0%	2,473	0.0%

area should be focused around Moultonborough Neck Marsh as it contains the greatest amount of area mapped as one of the top-ranked habitat categories in the Wildlife Action Plan.

4.2 MOULTONBOROUGH NECK

Moultonborough Neck Priority Conservation Area is located between Moultonborough Neck Road and Moultonborough Bay, just northwest of the Moultonborough Neck Marsh Priority Area. As with the Moultonborough neck area, the Moultonborough Neck Priority Area also encompasses a large wetland complex hydrologically connected to Moultonborough Bay.

In total the area encompasses 787.4 acres of which 57.6% is mapped as Appalachian oak-pine forest, 10% as hemlock-hardwood-pine, 5.1% as open water, 1.8% as peatland, 7.9% as temperate swamp, and 14.6 as wet meadow/shrub wetlands. An additional 2.9% is classified as developed.

Based on the Wildlife Action Plan habitat ranking data, 70.7% of Moultonborough Neck Priority Conservation Area is mapped as one of the top-ranked habitat categories. Stratified drift aquifers comprise 22.5% (177.1 acres) of the priority conservation area. The 2015 build-out analysis classified 258.3 acres (32.8%) as buildable.

The greatest threat to the natural resources and ecology of the Moultonborough Neck Priority Area is habitat alteration associated with development. Conservation activity within this area should be focused on areas mapped as one of the top-ranked habitat categories in the Wildlife Action Plan.

4.3 MUD POND

The Mud Pond Priority Conservation Area encompasses 1,104.3 acres surrounding Mud Pond. The pond's outlet drains south into Salmon Meadow Cove. According to the Wildlife Action Plan data, the area consists of Appalachian oak pine forest (46.6%), hemlock-hardwood-pine forest (22.3%), wet meadow/shrub wetland (8.9%), grassland (4.5%), temperate swamp (3.9%), peatland (2.7%), and open water (0.2%). An additional 10.9% is classified as developed.

Based on the Wildlife Action Plan habitat ranking data, 33.5% (66.4 acres) of the Mud Pond Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 469.0 acres (4.25%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 499.7 acres (45.3%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Mud Pond Priority Area is habitat alteration associated with development. Conservation activity within this area should be focused around Mud Pond and the wetland complexes in the northeastern portion of the area.

4.4 MOULTONBOROUGH BAY

The Moultonborough Bay Priority Conservation Area encompasses 280.5 acres located east of Route 25 and West of the northern end of Moultonborough Bay. According to the Wildlife Action Plan the area is comprised mostly of Appalachian oak pine forest (87.7%), hemlock-hardwood-

pine forest (3.8%), temperate swamp (2.5%), peatland (1.8%), wet meadow/shrub wetland (1.3%), grassland (1.1%), and open water (0.1%). An additional 1.6% is classified as developed.

Based on the Wildlife Action Plan habitat ranking data, 34.9% (97.8 acres) of Moultonborough Bay Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 76.3 acres (27.2%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 136.1 acres (48.5%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Moultonborough Bay Priority Area is habitat alteration associated with development. Town parcel data shows this priority area contains a few large tracts of land that could be targeted for possible land protection efforts.

4.5 LEE'S POND

The Lee's Pond Priority Conservation Area is 285.79 acres in size and is located north and west of Lee's Pond, just southeast of Route 25. According to the Wildlife Action Plan, the area consists of Appalachian oak-pine forest (27.3%), hemlock-hardwood-pine forest (27.3%), open water (13.4%), open water (13.4%), wet meadow/shrub wetland (12.6), temperate swamp (2.9%), peatland (2.1%), and grassland (0.8%). An additional 13.7% is mapped as being developed.

Based on the Wildlife Action Plan habitat ranking data, 25.9% (73.9 acres) of Lee's Pond Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 76.3 acres (27.2%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 95.8 acres (33.5%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Lee's Pond Priority Area is habitat alteration associated with development. Conservation activity should be focused in the vicinity of Lee's Pond and the wetlands associated with it.

4.6 CROSS PROPERTY

The Cross Property Priority Conservation Area encompasses a 409.8 acre area which includes an unnamed waterbody and a stretch of Halfway Brook, a tributary to Moultonborough Bay which drains from the Ossipee Mountains and is one of the largest stream complexes in the town. The area is bordered by Route 25, Lee Road, Lees Mill Road, and Blake Road. According to the Wildlife Action Plan, the area is comprised of hemlock-hardwood-pine forest (51.8%), grassland (13.7%), wet meadow/shrub wetland (10.0%), Appalachian oak-pine forest (7.2%), temperate swamp (6.3%), peatland (0.6%), and open water (0.3%). An additional 10.2% is mapped as being developed.

Based on the Wildlife Action Plan habitat ranking data, 25.0% (102.3 acres) of Cross Property Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 76.3 acres (27.2%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 118.3 acres (28.9%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Cross Pond Priority Area is habitat alteration associated with development. Conservation activity within this area should first be focused around Halfway Brook, as the land bordering it is mapped as Highest Ranked in the State by Ecological Condition in the Wildlife Action Plan.

4.7 BERRY POND

The Berry Pond Priority Conservation Area encompasses 831.3 acres and it includes Berry Pond and a tributary to it, Weed Brook. The area is mapped as Appalachian oak-pine forest (30.6%), peatland (20.0), hemlock-hardwood-pine forest (11.7%), open water 6.15%, wet meadow/shrub wetland (5.02%), temperate swamp (4.2%), and grassland 2.95%. An additional 11.7% is mapped as being developed.

Based on the Wildlife Action Plan habitat ranking data, 50.2% (417.5 acres) of Berry Pond Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 351.8 acres (42.3%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 183.4 acres (22.1%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Berry Pond Priority Area is habitat alteration associated with development. Conservation activity within this area should first be focused around Weed Brook, as it and the land bordering it is mapped as Highest Ranked in the State by Ecological Condition in the Wildlife Action Plan.

4.8 BALMORAL

The Balmoral Priority Area encompasses 893.7 acres located northeast of Moultonborough Bay and southwest of the Governor Wentworth Highway. Present at the south end of this area is a large wetland complex adjacent to Moultonborough Bay. Halfway Brook traverses this area. The watercourse is a tributary to Moultonborough Bay which drains from the Ossipee Mountains and is one of the largest stream complexes in the town.

The Balmoral Priority Area consists of hemlock-hardwood-pine forest (42.0%), Appalachian oak-pine forest (20.1%), temperate swamp (13.7%), grassland (12.4%), and wet meadow/shrub wetland (3.2%). An additional 8.6% is classified as developed.

Based on the Wildlife Action Plan habitat ranking data, 25.4% (227.3 acres) of Balmoral Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 568.1 acres (63.6%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 331.1 acres (37.0%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Balmoral Priority Area is habitat alteration associated with development. Conservation activity within this area should first be focused around Halfway Brook and the large wetland complex at the southern end of the priority area.

4.9 SHANNON BROOK

The Shannon Brook Priority Conservation Area is 2,473.5 acres in size and is located in-between the Ossipee Mountains and Moultonborough Bay. The area is mapped as Appalachian oak-pine forest (50.7%), hemlock-hardwood-pine forest (29.2%), temperate swamp (5.4%), grassland (4.0%), wet meadow/shrub wetland (3.1%), and peatland (1.2%). An additional 6.4% is mapped as being developed.

Based on the Wildlife Action Plan habitat ranking data, 60.7% (1,501.3 acres) of Shannon Brook Priority Conservation Area is mapped as one of the top-ranked habitat categories. Additionally, 759.2 acres (30.7%) of the area is mapped as being underlain by a stratified drift aquifer. The 2015 build-out analysis identified 1,468.3 acres (59.4%) of the area as buildable.

The greatest threat to the natural resources and ecology of the Shannon Brook Priority Area is habitat alteration associated with development. Conservation activity within this area should first be focused around Shannon Brook as it and the land adjacent to it is mapped as one of the top-ranked habitat categories in the Wildlife Action Plan.

5.0 CONSERVATION RECOMMENDATIONS

A challenge that Moultonborough faces moving forward is how to achieve a better balance between prudent economic growth, land ownership, and responsible stewardship of its natural resources. A healthy functioning environment is often considered to be in opposition to economic growth and human quality of life. This is a false dilemma. Clean air, clean water, and ecosystem services provided by natural systems are essential to maintaining a high quality of human life. If comminutes 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 et al. 2012).

The following section mentions some tools and techniques that can be used to achieve a balance between development and conservation within Moultonborough. The recommendations are in part adapted from Miller and Klemens (2004), Miller et al. (2005), Klemens et al. (2012), and FBE (2016). Note that for information and recommendations regarding the water quality of Moultonborough Bay Inlet, FBE is currently developing a comprehensive Watershed Restoration Plan in cooperation with the Lake Winnipesaukee Association and the New Hampshire Department of Environmental Services.

5.1 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.

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.

5.2 RECOMMENDATIONS FOR LAND PRESERVATION

Attempt to add area via purchase or conservation easement to existing protected areas–. "The whole is greater than the sum of the parts" applies here. Adding to existing protected areas buffers those areas from externally-caused degradations (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, and predation and parasitism levels, all of which can have deleterious effects on populations of area-sensitive wildlife species. In Moultonborough, conserving land in the Shannon Brook Priority Conservation Area could effectively increase the size of the Ossipee Mountain Preserve.

Partner with local and regional land trusts and other conservation organizations to conserve land in Moultonborough–. Regional land trusts such as the Lakes Region Conservation Trust and the New Hampshire Chapter of The Nature Conservancy can be instrumental in acquiring land, holding conservation easements, and facilitating conservation projects.

5.3 RECOMMENDATIONS FOR LOCAL LAND USE PLANNING

Avoid large-lot zoning–. Increasing the size of buildable residential lots is considered by some to be a "quick fix" to sprawl-type development. This change to zoning results in a development pattern that *appears* to be "green", with fewer houses and more trees visible. In reality, this practice actually spreads 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 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.

Moultonborough's required setback of 50 feet follows the State of New Hampshire's minimum requirement, as dictated by the State Water Quality Protection Act. Some towns in NH (e.g., neighboring Sandwich) 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 et al., 2013) and it may therefore be prudent for Moultonborough to increase its setback distance.

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).

Moultonborough's zoning ordinance does contain a provision for conservation subdivisions (referred to as Multi-Family and Cluster Development in the ordinance). The town permits the clustering of housing units for the preservation of open space, to promote more efficient use of land, and to provide flexibility in subdivision design. The town does not require this type of development to take place as a result of certain circumstances; however, the provision itself is progressive in that it states that the total ground area occupied by buildings and parking areas may not exceed 20% of the total ground area of the development. Note too that conservation lands in these subdivisions should not only include steep slopes and wetlands, but also developable land that connects these constrained features. 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 mandating 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. Moultonborough can help protect water quality and wildlife habitat by mandating the use of LID in new and renovated developments.

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: www.des.state.nh.us/organization/commissioner/pip/publications/wd/documents/wd-11-11.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, they are often not adequately protected in New Hampshire, where wetlands below a certain size threshold are not regulated and those that are have inadequate buffers. (Wetland regulations are typically written to protect water quality and rarely include language to protect wildlife that require wetland areas.)

Moultonborough's ordinance specifies a 50-foot setback from wetlands and that a naturally vegetated buffer be maintained within 25 feet immediately adjacent to applicable wetlands. Moultonborough's ordinance also only applies to wetlands greater than 20,000 square feet (just

less than ½ acre) in their entirety or wetlands of any size that are contiguous to a river, brook, lake, or pond with certain other exemptions (e.g., manmade ditches, detention basins).

Moultonborough may wish to eliminate its wetland size requirement, or perhaps not disregard setback requirements if a given small wetland is functioning as a vernal pool. Vernal pools are typically very small in size, but can be enormously productive wetlands. For additional protection of wetlands and their water quality, Moultonborough might wish to increase its wetland buffers, in particular for wetlands that support a significant amount of pool-breeding wildlife.

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 Calhoun and Klemens (2002) *Best Development Practices Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States* and Calhoun and deMaynadier (2004) *Forestry Management Guidelines for Vernal Pool Wildlife*. Additional BMPs from other organizations and agencies may also prove useful.

5.4 PRIME WETLANDS

As mentioned previously, there are currently 33 towns in New Hampshire that have designated prime wetlands of which Moultonborough is not one. Prime Wetland 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 or within 100 ft of these resources.

While Prime designation does offer addional 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.

5.5 VERNAL POOLS

New Hampshire's Nongame and Endangered Wildlife Program of New Hampshire Fish and Game encourages citizens to document the locations of vernal pools using a downloadable form and/or through their NH Wildlife Sightings website, a web tool for reporting wildlife observations throughout the state. More information regarding documenting and reporting NH Vernal Pools can be found in *Identifying and documenting vernal pools in New Hampshire*, (Marchand, 2016) available at: http://www.wildlife.state.nh.us/nongame/vernal-pools.html.

While it likely NHFG may have some vernal pool information on file pertaining to Moultonborough, it is recommended that vernal pools be formally documented throughout the entire town. This does not need to be conducted by, nor is it likely economically feasible to hire consultants to document pools throughout the entire town. Rather, the work could be carried out by trained citizen scientists. This 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 citizenry 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 and Calhoun, 2012). More information regarding the use of citizen scientists to map vernal pools can be found in 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) mentions 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.

5.6 RESIDENTIAL / LANDOWNER STEWARDSHIP AND PUBLIC EDUCATION

Promote the use of native plant species in Moultonborough–. Review of development proposals should include the promotion of native plantings in landscaping plans. Educate the public about invasive species through garden clubs and other civic groups.

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

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 Moultonborough due to the presence of many headwater stream systems.

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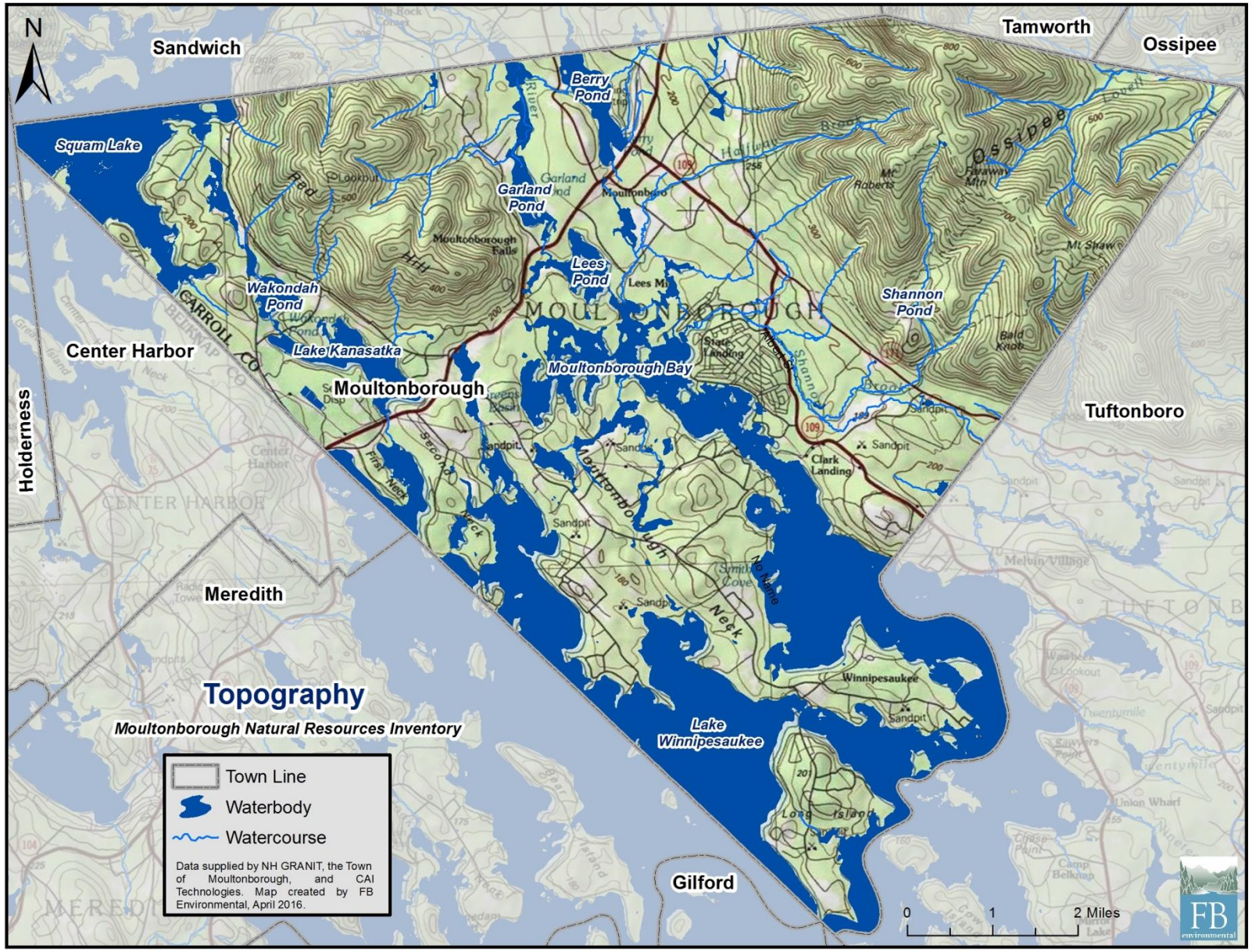
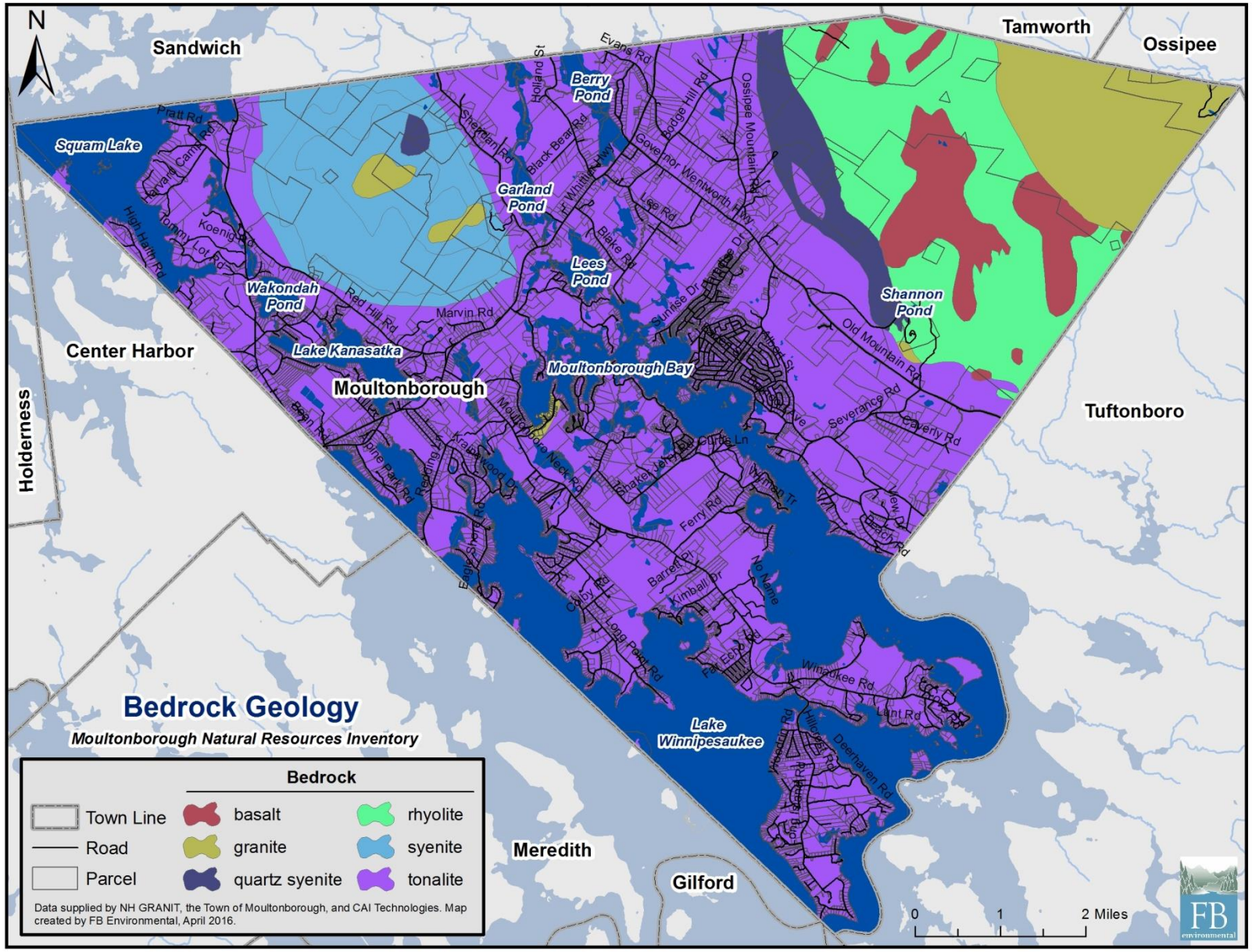
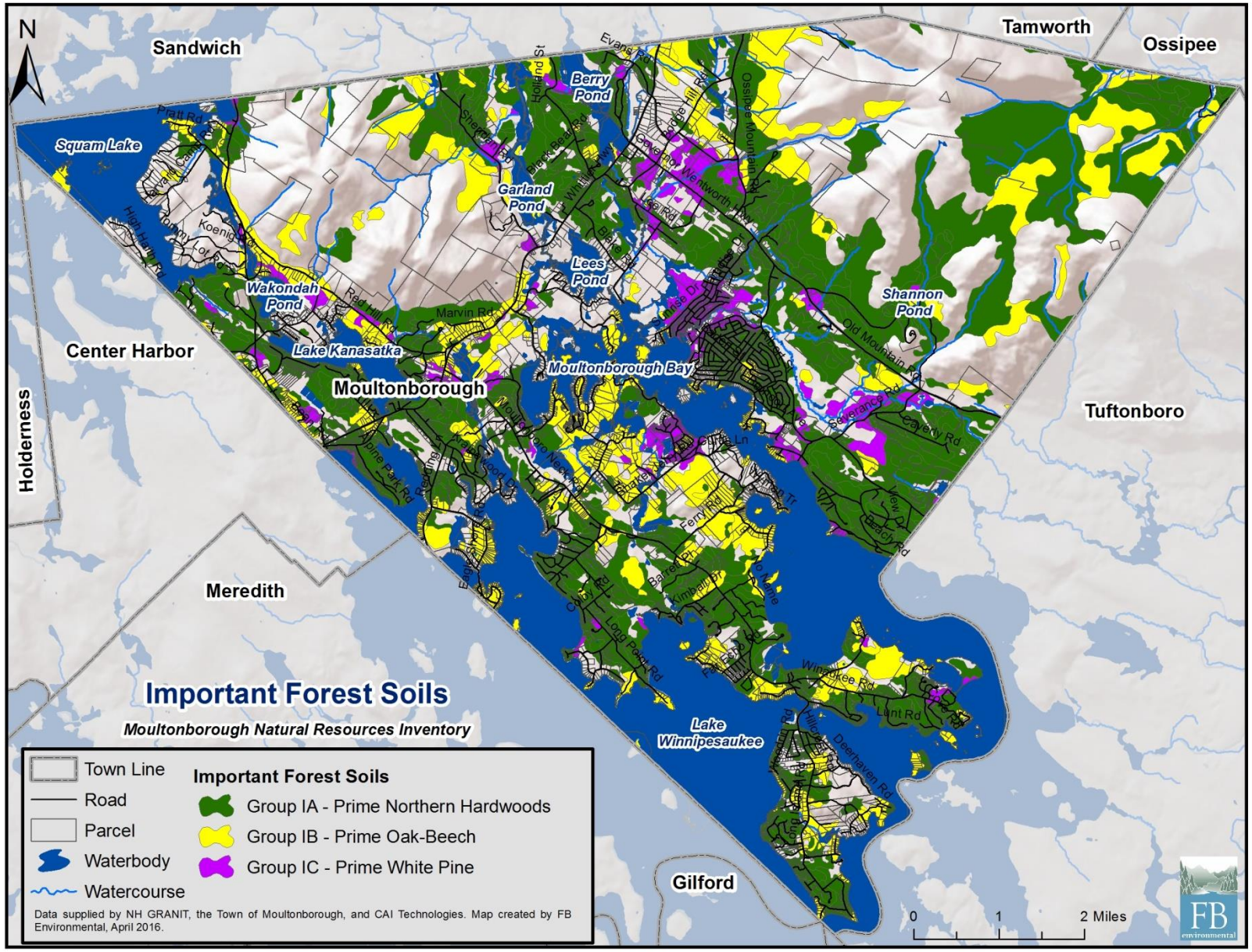
APPENDIX A. MAPS


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Lake Kanasatka
Moultonborough Bay
Shannon Pond
Center Harbor
Moultonborough
Tuftonboro
Holderness
Meredith
Gilford
Lake Winnipesaukee
Topography
Moultonborough Natural Resources Inventory
Town Line
Waterbody
Watercourse
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

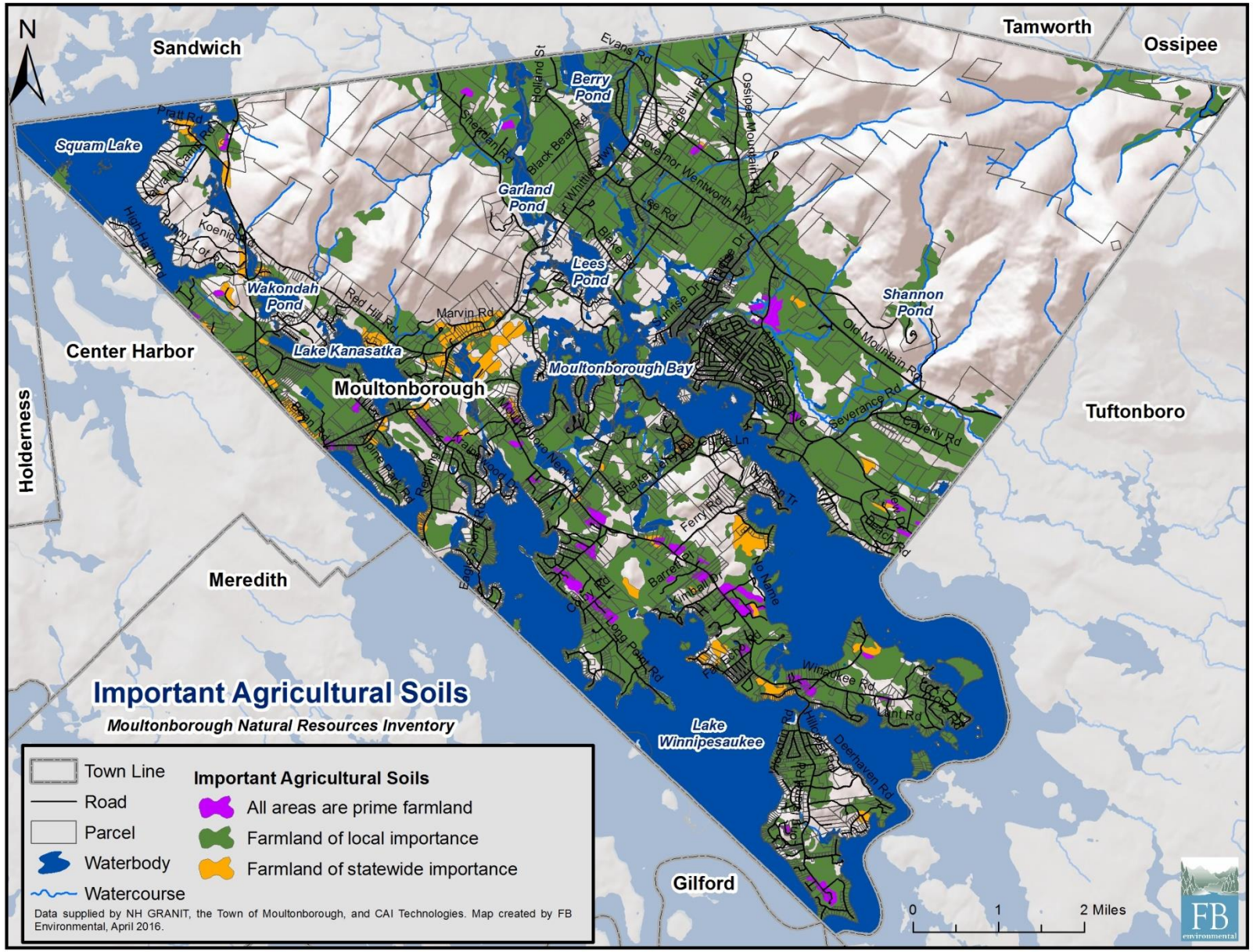
MAP 1


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Shannon Pond
Lake Kanasatka
Moultonborough Bay
Center Harbor
Moultonborough
Holderness
Tuftonboro
Meredith
Gilford
Lake Winnipesaukee
Bedrock Geology
Moultonborough Natural Resources Inventory
Bedrock
Town Line
Road
Parcel
basalt
granite
quartz syenite
rhyolite
syenite
tonalite
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

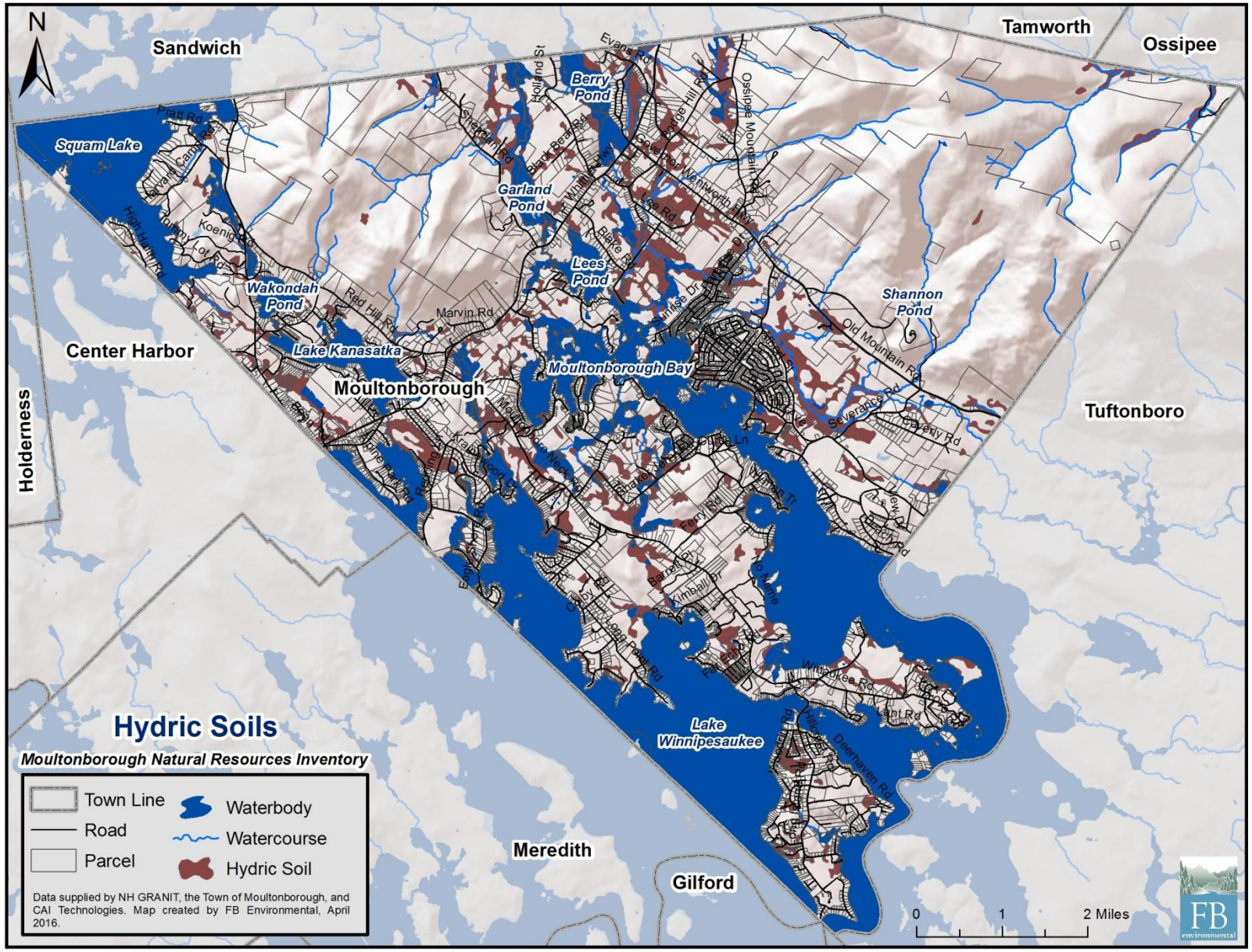
MAP 2


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Shannon Pond
Lake Kanasatka
Moultonborough Bay
Center Harbor
Moultonborough
Holderness
Tuftonboro
Meredith
Lake Winnipesaukee
Gilford
Important Forest Soils
Moultonborough Natural Resources Inventory
Town Line
Road
Parcel
Waterbody
Watercourse
Important Forest Soils
Group IA - Prime Northern Hardwoods
Group IB - Prime Oak-Beech
Group IC - Prime White Pine
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

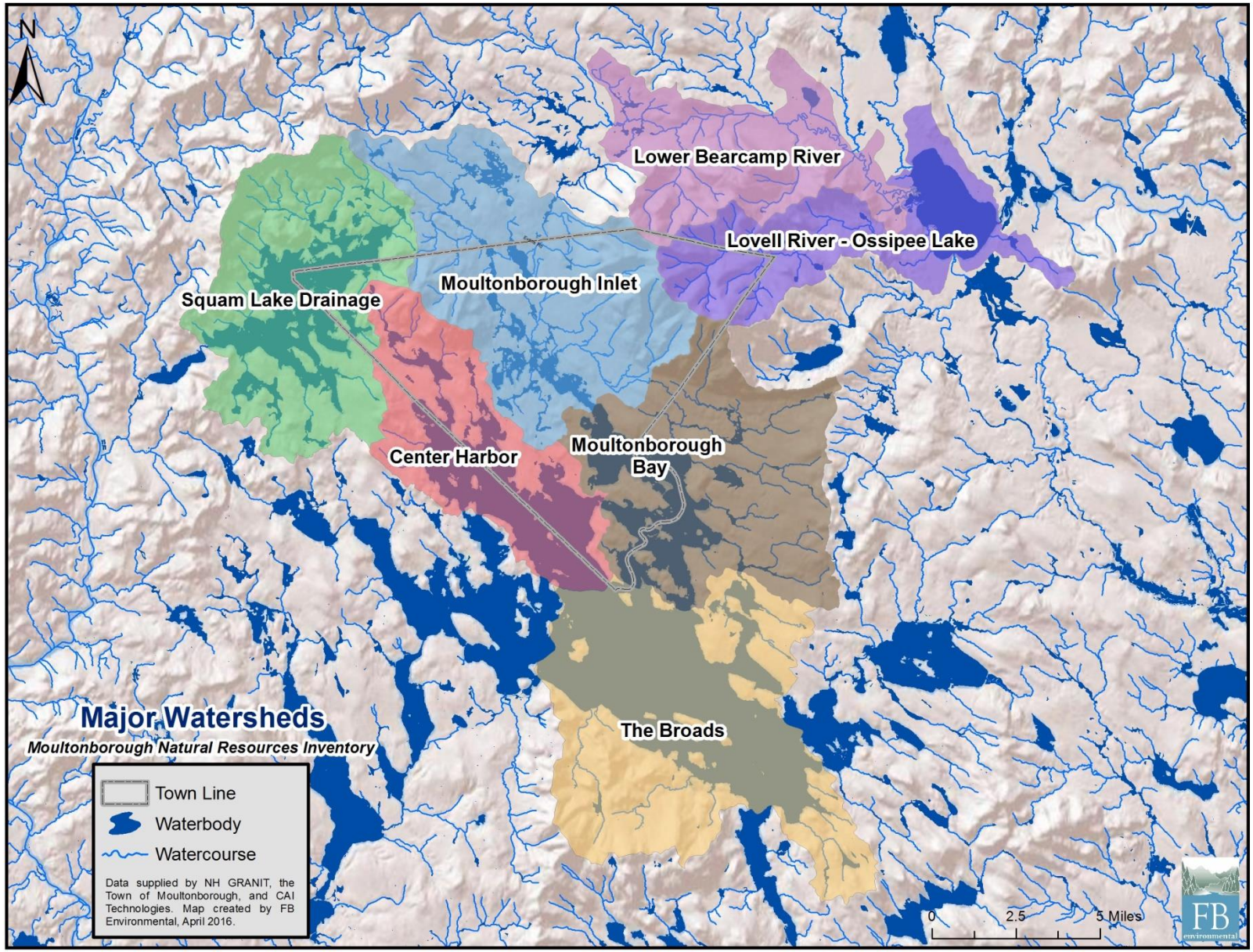
MAP 3


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Shannon Pond
Lake Kanasatka
Moultonborough Bay
Moultonborough
Center Harbor
Holderness
Tuftonboro
Meredith
Gilford
Lake Winnipesaukee
Important Agricultural Soils
Moultonborough Natural Resources Inventory
Town Line
Road
Parcel
Waterbody
Watercourse
Important Agricultural Soils
All areas are prime farmland
Farmland of local importance
Farmland of statewide importance
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

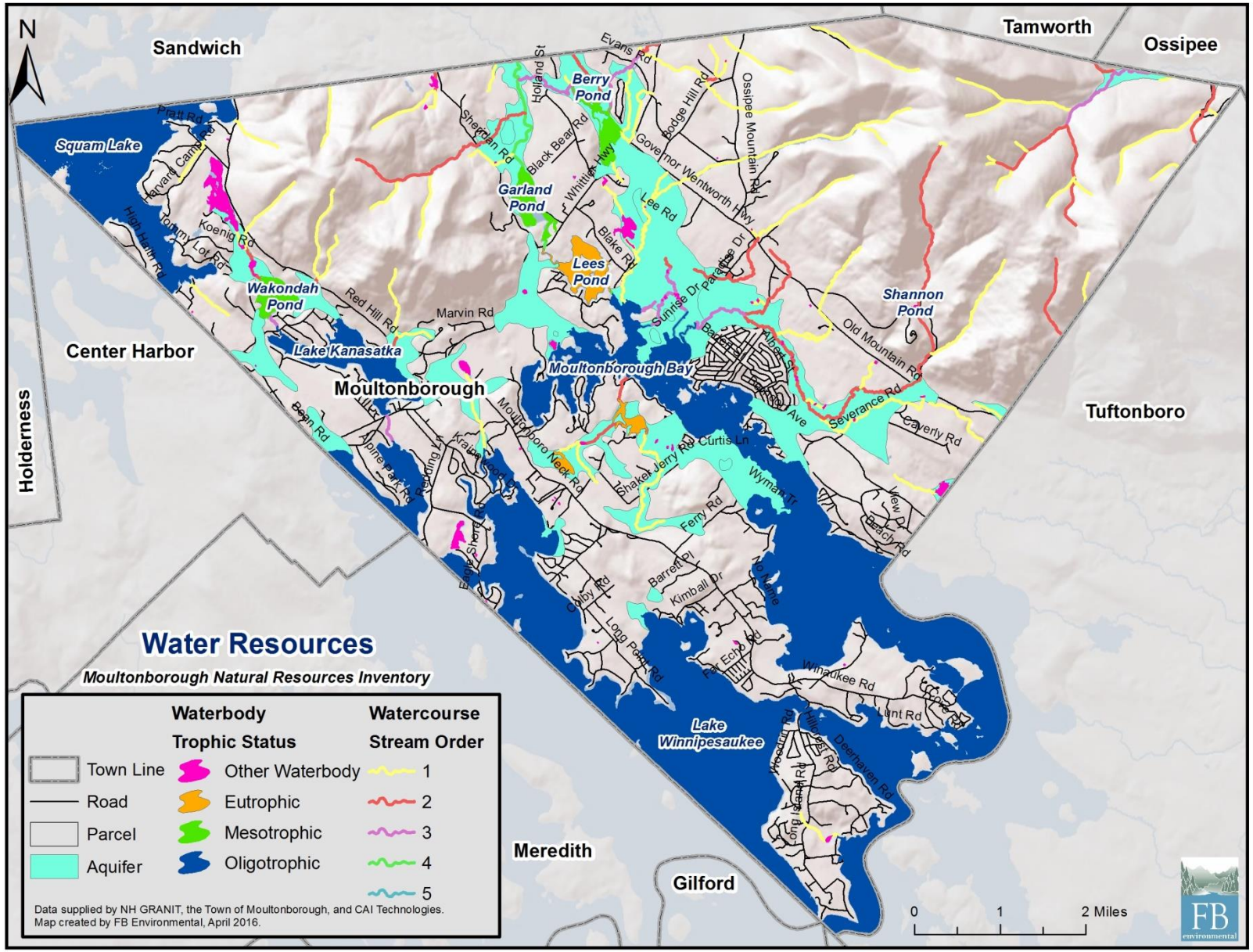
MAP 4


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Shannon Pond
Lake Kanasatka
Moultonborough Bay
Center Harbor
Moultonborough
Holderness
Tuftonboro
Meredith
Gilford
Lake Winnipesaukee
Hydric Soils
Moultonborough Natural Resources Inventory
Town Line
Road
Parcel
Waterbody
Watercourse
Hydric Soil
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

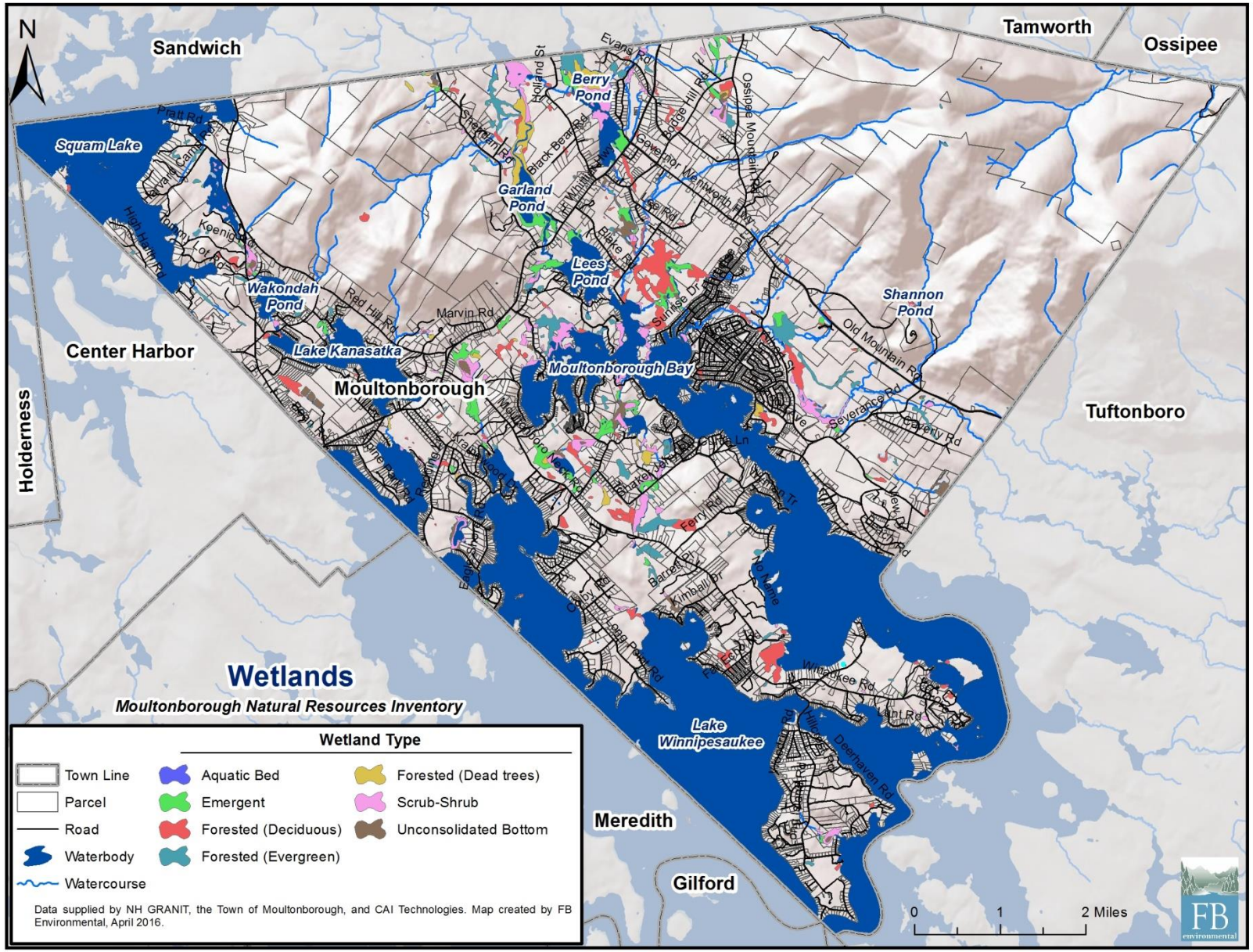
MAP 5


N
Lower Bearcamp River
Lovell River - Ossipee Lake
Moultonborough Inlet
Squam Lake Drainage
Center Harbor
Moultonborough Bay
The Broads
Major Watersheds
Moultonborough Natural Resources Inventory
Town Line
Waterbody
Watercourse
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
2.5
5 Miles
FB environmental

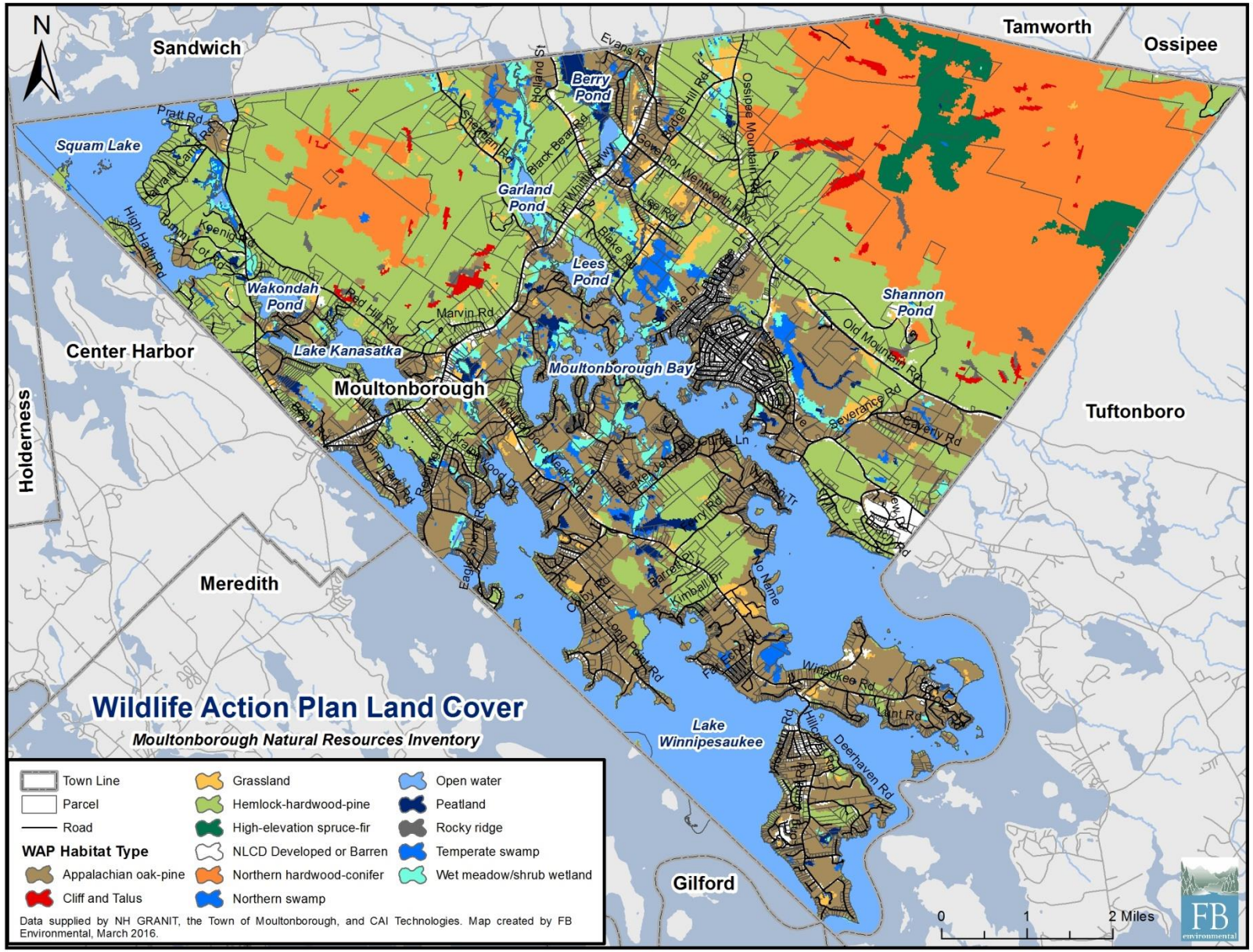
MAP 6


N
Sandwich
Tamworth
Ossipee
Tuftonboro
Center Harbor
Moultonborough
Holderness
Meredith
Gilford
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Lake Kanasatka
Moultonborough Bay
Shannon Pond
Lake Winnipesaukee
Water Resources
Moultonborough Natural Resources Inventory
Waterbody
Trophic Status
Other Waterbody
Eutrophic
Mesotrophic
Oligotrophic
Watercourse
Stream Order
1
2
3
4
5
Town Line
Road
Parcel
Aquifer
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies.
Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

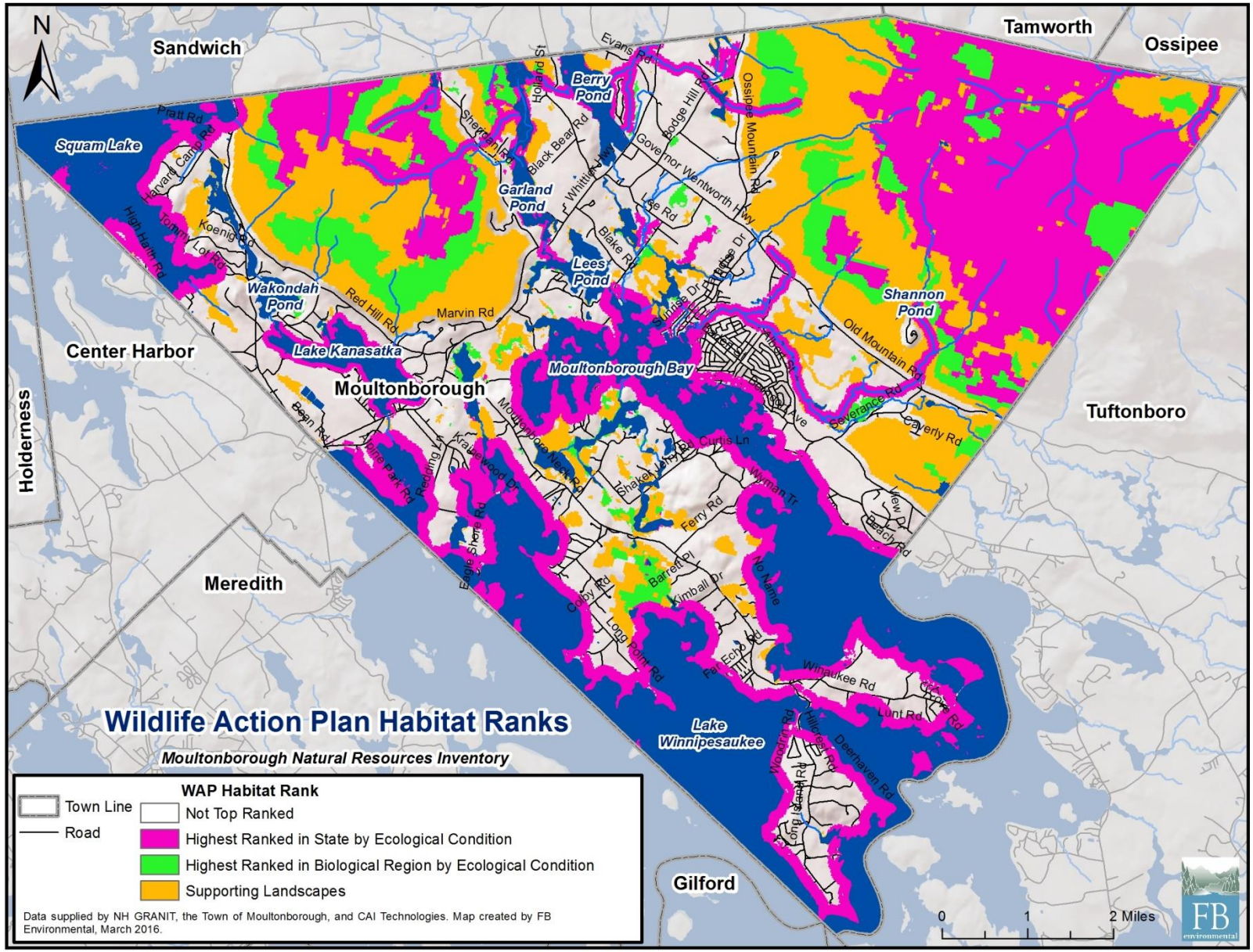
MAP 7


N
Sandwich
Tamworth
Ossipee
Tuftonboro
Center Harbor
Moultonborough
Holderness
Meredith
Gilford
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Lake Kanasatka
Moultonborough Bay
Shannon Pond
Lake Winnipesaukee
Wetlands
Moultonborough Natural Resources Inventory
Wetland Type
Town Line
Parcel
Road
Waterbody
Watercourse
Aquatic Bed
Emergent
Forested (Deciduous)
Forested (Evergreen)
Forested (Dead trees)
Scrub-Shrub
Unconsolidated Bottom
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, April 2016.
0
1
2 Miles
FB environmental

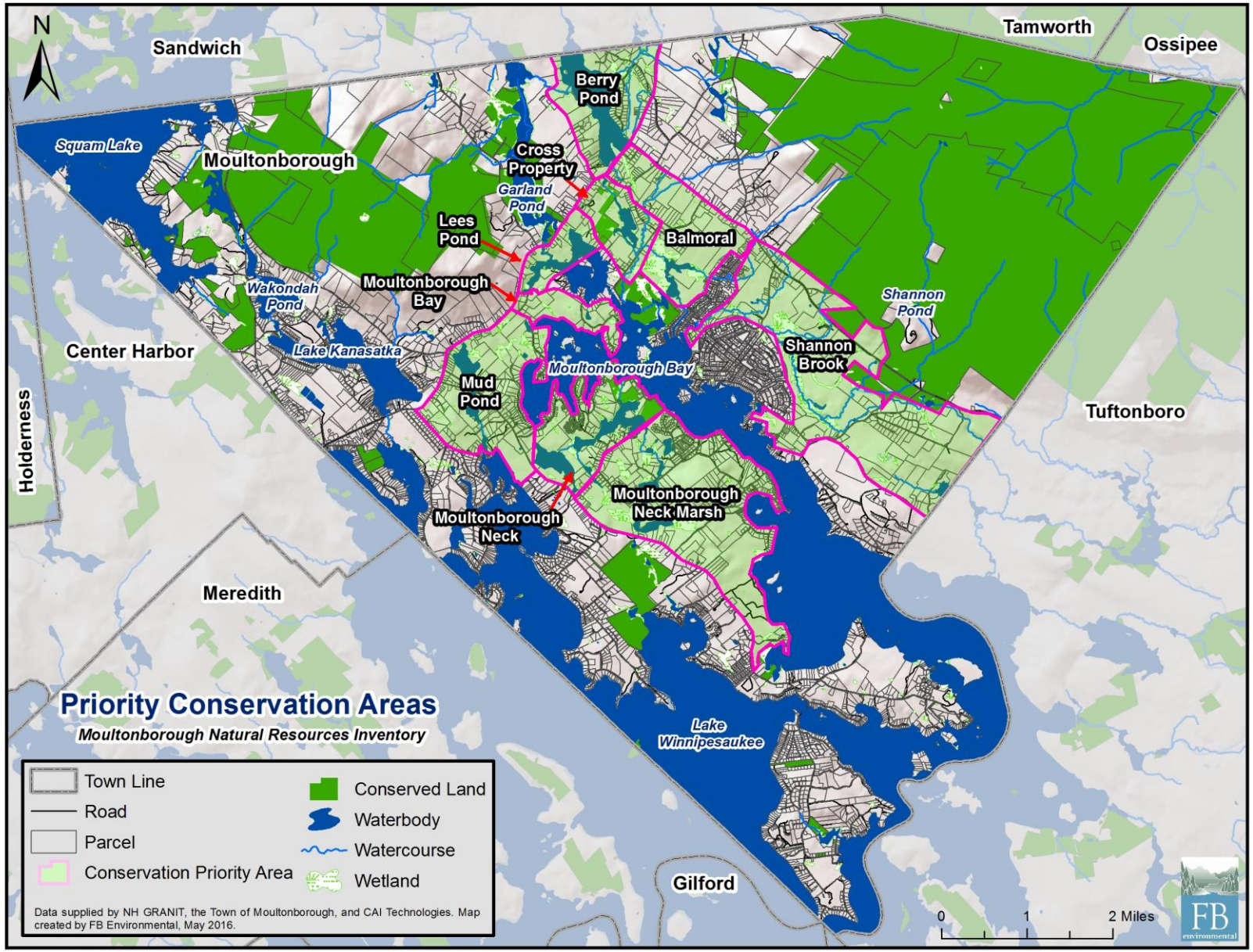
MAP 8


N
Sandwich
Tamworth
Ossipee
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Shannon Pond
Lake Kanasatka
Moultonborough Bay
Center Harbor
Moultonborough
Holderness
Tuftonboro
Meredith
Lake Winnipesaukee
Gilford
Wildlife Action Plan Land Cover
Moultonborough Natural Resources Inventory
Town Line
Parcel
Road
WAP Habitat Type
Appalachian oak-pine
Cliff and Talus
Grassland
Hemlock-hardwood-pine
High-elevation spruce-fir
NLCD Developed or Barren
Northern hardwood-conifer
Northern swamp
Open water
Peatland
Rocky ridge
Temperate swamp
Wet meadow/shrub wetland
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, March 2016.
0
1
2 Miles
FB environmental

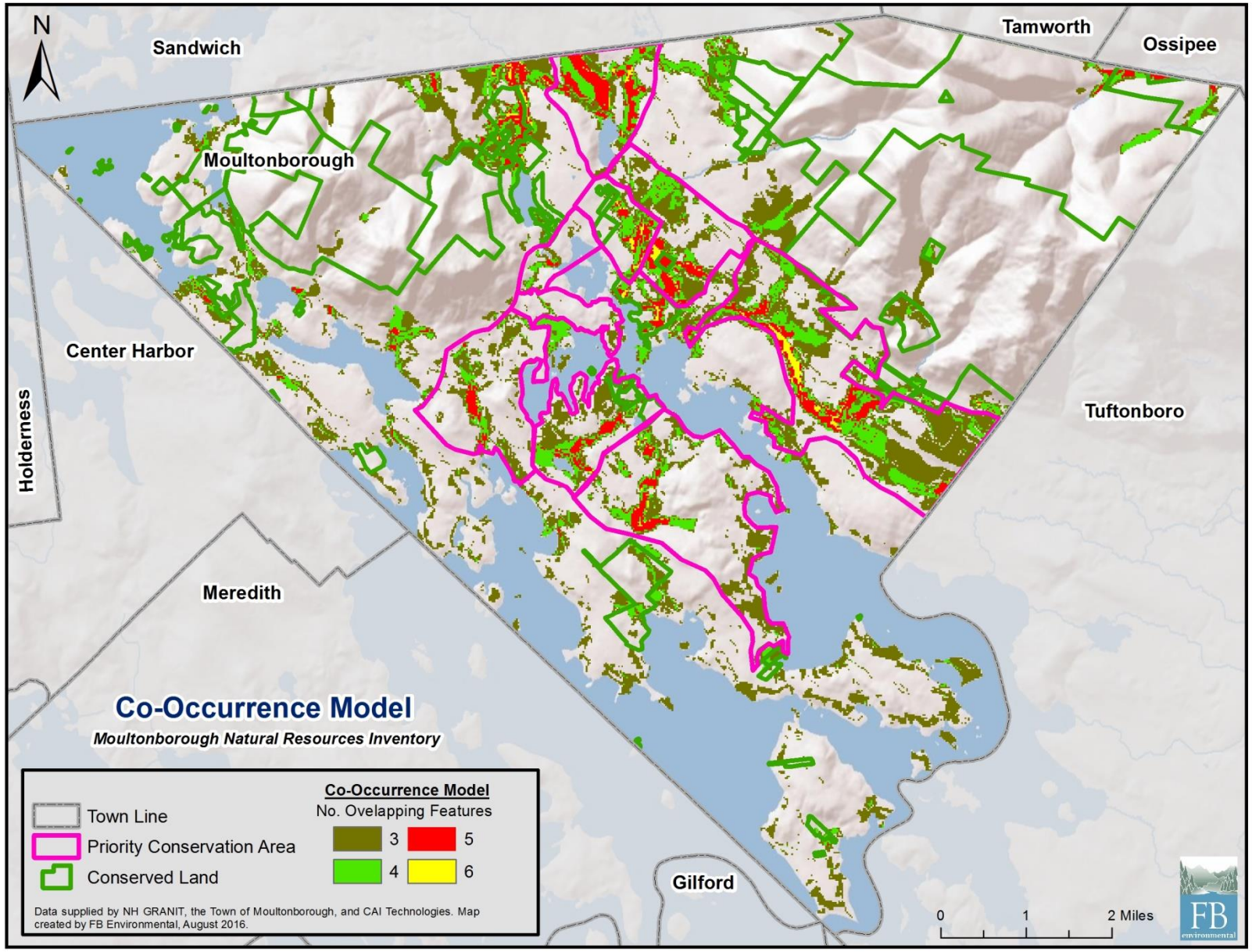
MAP 9


N
Sandwich
Tamworth
Ossipee
Tuftonboro
Center Harbor
Moultonborough
Holderness
Meredith
Gilford
Squam Lake
Berry Pond
Garland Pond
Lees Pond
Wakondah Pond
Lake Kanasatka
Moultonborough Bay
Shannon Pond
Lake Winnipesaukee
Wildlife Action Plan Habitat Ranks
Moultonborough Natural Resources Inventory
WAP Habitat Rank
Town Line
Road
Not Top Ranked
Highest Ranked in State by Ecological Condition
Highest Ranked in Biological Region by Ecological Condition
Supporting Landscapes
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, March 2016.
0
1
2 Miles
FB environmental

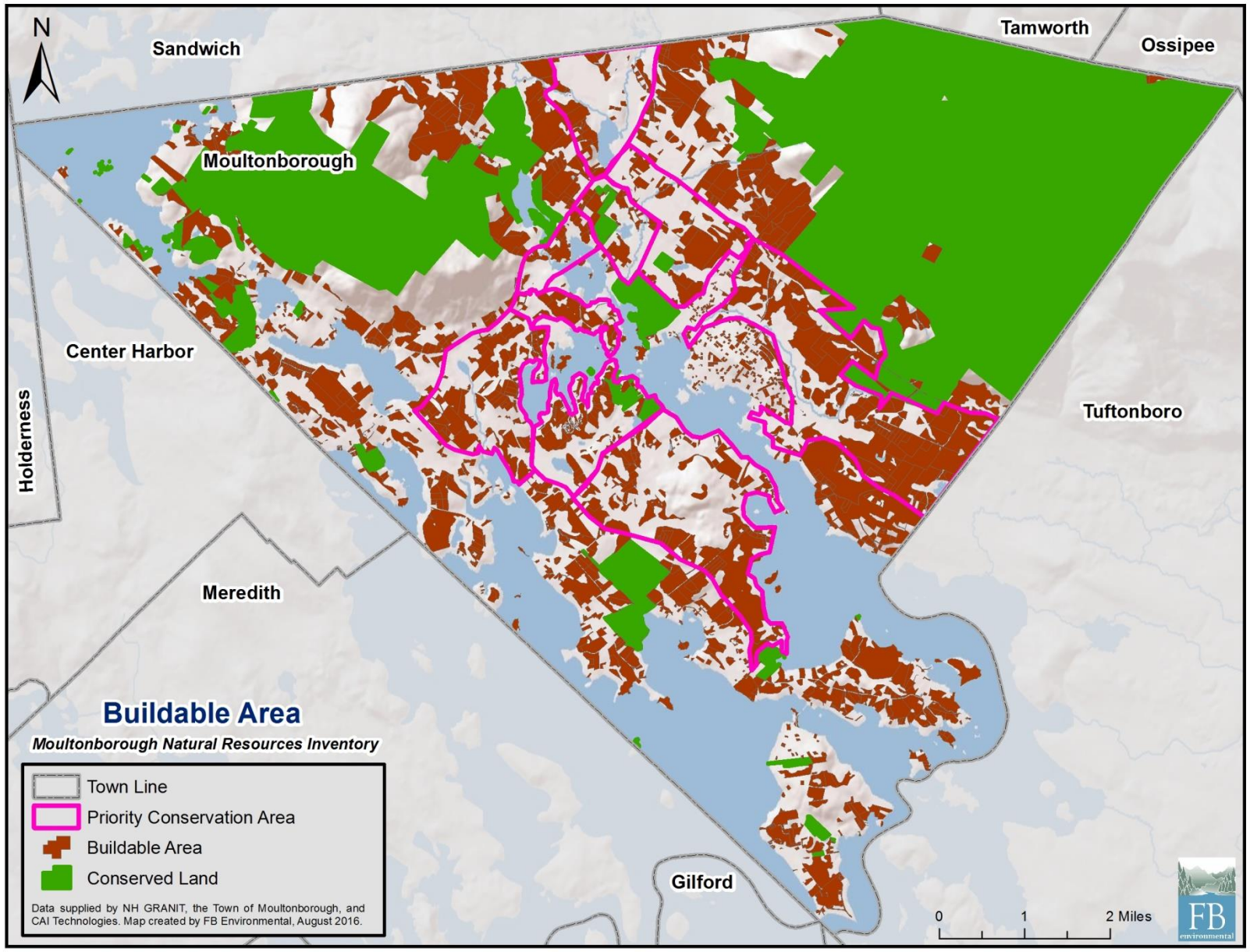
MAP 10


N
Sandwich
Tamworth
Ossipee
Berry Pond
Squam Lake
Moultonborough
Cross Property
Garland Pond
Lees Pond
Balmoral
Moultonborough Bay
Wakondah Pond
Shannon Pond
Center Harbor
Lake Kanasatka
Shannon Brook
Moultonborough Bay
Mud Pond
Tuftonboro
Holderness
Moultonborough Neck Marsh
Moultonborough Neck
Meredith
Priority Conservation Areas
Moultonborough Natural Resources Inventory
Lake Winnipesaukee
Gilford
Town Line
Road
Parcel
Conservation Priority Area
Conserved Land
Waterbody
Watercourse
Wetland
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, May 2016.
0
1
2 Miles
FB environmental

MAP 11


N
Sandwich
Tamworth
Ossipee
Moultonborough
Center Harbor
Holderness
Tuftonboro
Meredith
Gilford
Co-Occurrence Model
Moultonborough Natural Resources Inventory
Co-Occurrence Model
No. Ovelapping Features
Town Line
Priority Conservation Area
Conserved Land
3
4
5
6
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, August 2016.
0
1
2 Miles
FB
environmental

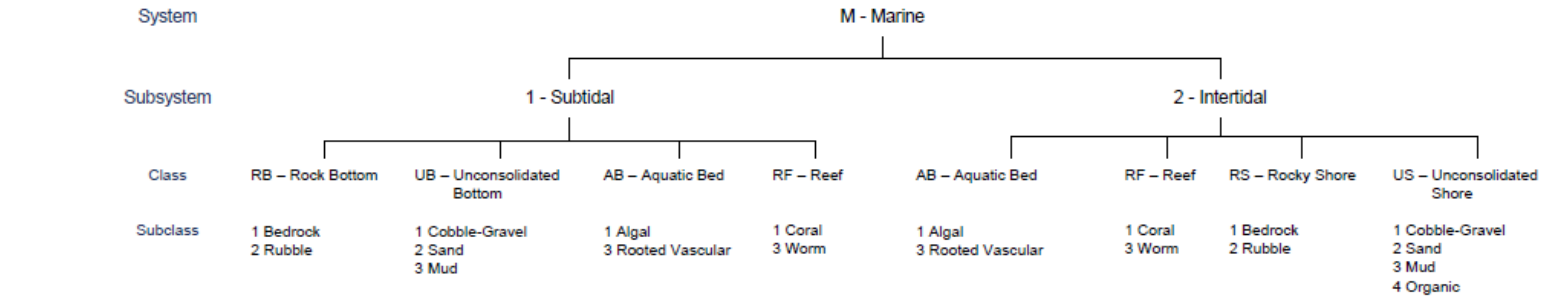
MAP 12

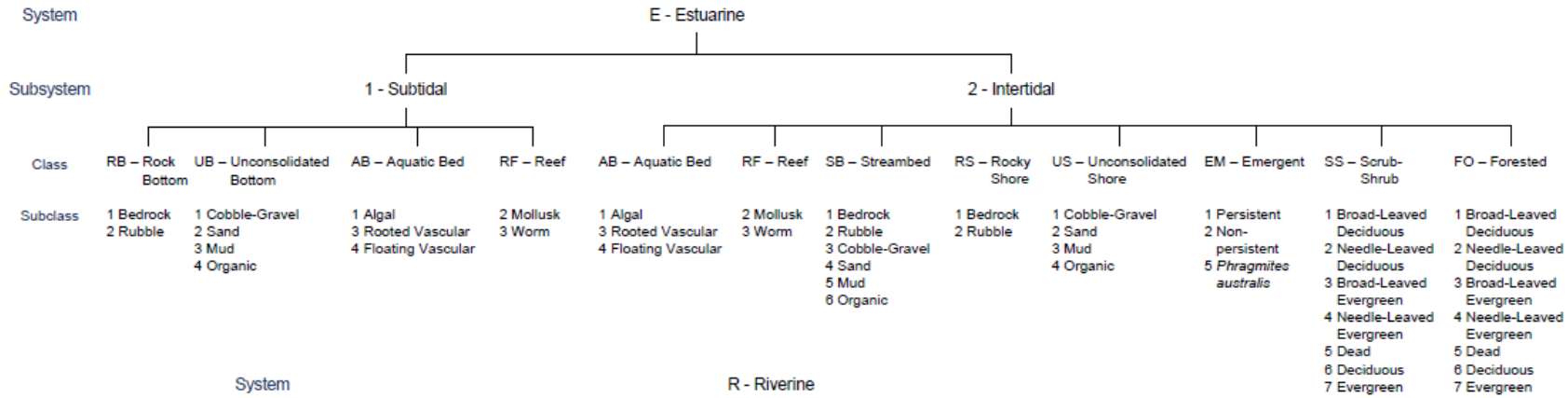

N
Sandwich
Tamworth
Ossipee
Moultonborough
Center Harbor
Holderness
Tuftonboro
Meredith
Gilford
Buildable Area
Moultonborough Natural Resources Inventory
Town Line
Priority Conservation Area
Buildable Area
Conserved Land
Data supplied by NH GRANIT, the Town of Moultonborough, and CAI Technologies. Map created by FB Environmental, August 2016.
0
1
2 Miles
FB
environmental

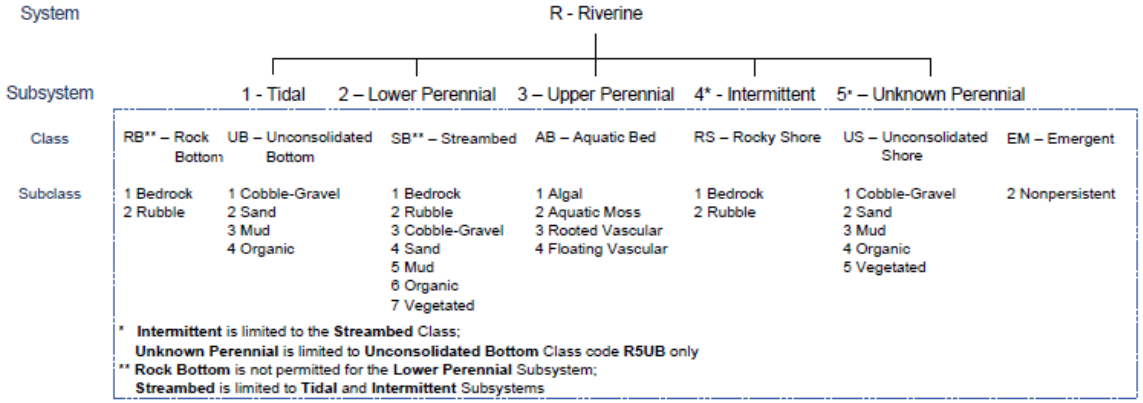
MAP 13

APPENDIX B. COWARDIN ET AL. (1979) WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

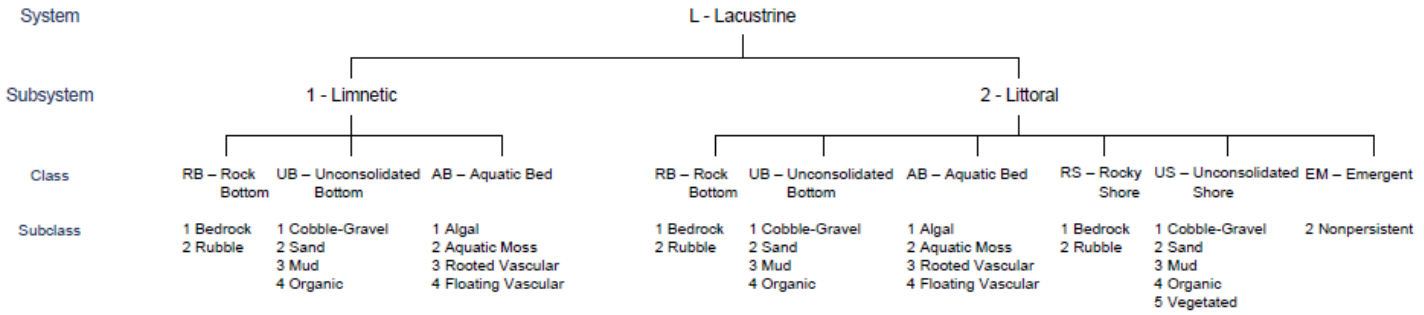


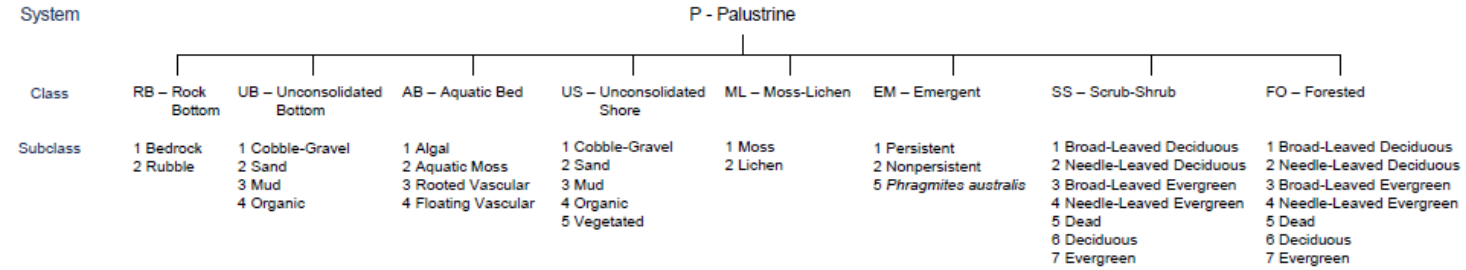




Classification of Wetlands and Deepwater Habitats of the United States, Cowardin *et al.* 1979

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							

APPENDIX C. RARE WILDLIFE AND PLANT COMMUNITIES

NH Natural Heritage Bureau

Town Flag	Species or Community Name	Listed? Federal	State	# reported last 20 yrs Town	State
Moultonborough					
	Natural Communities - Terrestrial				
**	Northern hardwood - spruce - fir forest	--	--	1	12
	Natural Communities - Palustrine				
**	Medium level fen system	--	--	1	62
**	Poor level fen/bog system	--	--	1	29
	Plants				
***	Beck's water-marigold (*Bidens beckii*)	--	T	2	12
**	bristly rose (*Rosa acicularis* ssp. *sayi*)	--	E	1	2
	Budding Pondweed (*Potamogeton gemmiparus*)	--	E	Historical	6
*	clustered sedge (*Carex cumulata*)	--	T	1	19
**	dragon's-mouth (*Arethusa bulbosa*)	--	E	2	21
**	flat-stem pondweed (*Potamogeton zosteriformis*)	--	E	2	11
***	Fogg's Goosefoot (*Chenopodium foggii*)	--	E	1	5
*	Four-leaved Milkweed (*Asclepias quadrifolia*)	--	E	1	8
	green adder's-mouth (*Malaxis unifolia*)	--	T	Historical	56
*	green rockcress (*Boechera missouriensis*)	--	T	1	14
**	hairy wood brome (*Bromus pubescens*)	--	E	1	6
**	large yellow lady's-slipper (*Cypripedium parviflorum* var. *pubescens*)	--	T	1	20
**	lesser tussock sedge (*Carex diandra*)	--	T	1	9
	long-headed windflower (*Anemone cylindrica*)	--	E	Historical	11
	northern wild senna (*Senna hebecarpa*)	--	E	Historical	10
**	purple virgin's-bower (*Clematis occidentalis*)	--	E	1	25
**	ram's-head lady's-slipper (*Cypripedium arietinum*)	--	E	1	13
	resupinate bladderwort (*Utricularia resupinata*)	--	E	Historical	15
	Sessile-fruited Arrowhead (*Sagittaria rigida*)	--	E	Historical	7
**	Silverling (*Paronychia argyrocoma*)	--	T	1	21
**	Slender Knotweed (*Polygonum tenue*)	--	E	2	5
	Three-birds Orchid (*Triphora trianthophora*)	--	T	Historical	22
**	tufted yellow-loosestrife (*Lysimachia thyrsiflora*)	--	T	1	10
	Vasey's Pondweed (*Potamogeton vaseyi*)	--	E	Historical	13
*	wild hound's-tongue (*Cynoglossum virginianum* ssp. *boreale*)	--	E	1	8
	Vertebrates - Mammals				
**	American Marten (*Martes americana*)	--	T	1	144
	Vertebrates - Birds				
**	Bald Eagle (*Haliaeetus leucocephalus*)	--	T	6	88
**	Common Loon (*Gavia immer*)	--	T	20	288
**	Osprey (*Pandion haliaetus*)	--	SC	1	103
	Pied-billed Grebe (*Podilymbus podiceps*)	--	T	Historical	28
**	Purple Martin (*Progne subis*)	--	SC	1	18
	Vertebrates - Reptiles				
	Blanding's Turtle (*Emydoidea blandingii*)	--	E	Historical	709
**	Wood Turtle (*Glyptemys insculpta*)	--	SC	1	193

Listed? E = Endangered T = Threatened SC = Special concern

Flags
**** = Highest importance
*** = Extremely high importance
** = Very high importance
* = High importance

These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact the Natural Heritage Bureau at (603) 271-2214 to learn more about approaches to setting priorities.

NH Natural Heritage Bureau

Town Flag	Species or Community Name	Listed? Federal	State	# reported last 20 yrs Town	State
	Vertebrates - Fish				
***	Bridle Shiner (*Notropis bifrenatus*)	--	T	4	22
	Lake Whitefish (*Coregonus clupeaformis*)	--	SC	Historical	8
	Invertebrates - Dragonflies & Damselflies				
***	New England Bluet (*Enallagma laterale*)	--	--	1	2
**	Subarctic Darner (*Aeshna subarctica*)	--	--	1	8

Listed? E = Endangered T = Threatened SC = Special concern

Flags
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These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact the Natural Heritage Bureau at (603) 271-2214 to learn more about approaches to setting priorities.

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