

HILLSBOROUGH NATURAL RESOURCES INVENTORY and CONSERVATION PRIORITIES PLAN

Prepared for:
Hillsborough Conservation Commission



**Jeffrey N. Littleton
Moosewood Ecological LLC
Innovative Conservation Solutions for New England
PO Box 9—Chesterfield, NH 03443
jeff@moosewoodecological.com
(603) 831-1980**

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Principal Ecologist



Moosewood Ecological LLC
*Innovative Conservation Solutions
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PO Box 9
Chesterfield, NH 03443
(603) 831-1980
Jeff@moosewoodecological.com
www.moosewoodecological.com

March 2014

Cover photograph – *Bull moose feeding in a wetland on a town-owned property.*

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INTRODUCTION

Population Growth and Development

Currently, New Hampshire's population is growing at a rate that is twofold that of the other New England states. The population has doubled in the forty years leading up to the turn of the century in 2000, and there was a rise in population of 17.2% between 1990 and 2004 alone. This rate of growth is followed by VT (10.4%), RI (7.7%), ME (7.3%), MA (6.7%), and CT (6.7%). Furthermore, it has been projected that the state will experience an increase of 23% from 1997 to 2020. New Hampshire's development pressure will tax the state's natural resources if not managed with diligence.

The bulk of population growth is in the southern half of the state; however 75% of conservation lands are located in the northern regions. This entrusts towns in the southern half of New Hampshire with the responsibility of managing their natural resources and biological diversity, and establishes citizens as stewards of the land, requiring the use of informed decision making to promote a more sustainable approach to land use planning.

Natural Resources and Land Use Planning

One of the first steps in planning for growth and development is to conduct a natural resources inventory (NRI). This effort helps to better understand what natural resources are within a town and where they are located. As such, an NRI is a list and description of the natural elements found within and adjacent to a town (or even a watershed or larger region). These can include such elements as wetlands, aquifers, ponds, rivers, forests, plants, soils, and wildlife. These data can be created from existing sources or from field-based assessments to better reflect the extent of natural resources within a community.

New Hampshire statutes mandate that communities shall create an NRI. This is generally the responsibility of the local Conservation Commission, whose purpose is "for the proper utilization and protection of natural resources and for the protection of watershed resources" of the town. In particular, RSA 36-A:2 continues to state that "Such commission shall conduct researches into its local land and water areas [and] ... shall keep an index of all open space and natural, aesthetic or ecological areas within the city

or town ... with the plan of obtaining information pertinent to the proper utilization of such areas, including lands owned by the state or lands owned by a town or city. It shall keep an index of all marshlands, swamps and all other wetlands in a like manner...”

An NRI can serve as the basis for developing innovative land use planning that can be adopted to help protect various resources, such as wetlands, wildlife habitats, and biological diversity. Biological diversity, or biodiversity, refers to the variety, variability, and complexity of life in all its forms and includes various ecological processes (for example, nutrient cycling, flooding, fires, wind events, and succession) that have helped to shape species over time.

Biodiversity includes various levels of ecological organization such as individual species and their genes that have evolved over time, as well as the many intricate plant and wildlife populations. It refers to even higher levels of organization including the assemblage of ecological communities¹ and even entire ecosystems, such as wetlands, woodlands, and rivers. Therefore, the concept of biodiversity engenders all levels of biological organization and the interactions of living organisms within their physical environments. It is at the heart of this understanding of the dynamics of biodiversity that we seek to develop protection strategies, helping to ensure a healthy environment for humans, as well as all other life forms.

Planning for the conservation of natural resources and biodiversity is not a new concept. It has helped in such efforts as the recovery of the American bald eagle; assisted in building preserves and managing other lands for species of conservation concern, as well as our most common species; aided in the identification of biodiversity hot spots; and helped to identify and protect critical wildlife habitats within our landscape. It has been a center piece for natural resources protection, restoration, and adaptive management for the past four decades.

This form of land use planning is not a static directory but one that is ever-changing. It is a vision that should be based on the principles of conservation biology and incorporates the current ecological structure of a given area (such as a town, a watershed,

¹ An ecological community is a group of two or more populations of different species found in the same place. For example, this would include the bird community of Farrar Marsh or the black gum swamp community of Fox State Forest.

or an entire region). Thus, conservation planning strives to incorporate the socio-economic fabric of our world with that of the ecological structure. This effort can help build more sustainable, more resilient New Hampshire communities far into the future as a result of implementing comprehensive land use planning that includes our natural environment and built infrastructure.

The need for this type of informed land use planning is becoming more evident. Ecosystems and their constituents have long been susceptible to long-term degradation from overexploitation and misuse of natural resources. This has led to a precipitous decline in several species, some even resulting in extinction altogether (such as the passenger pigeon and eastern elk). It has also led to the loss of critical habitats due to sprawling developments over time. While the past few decades certainly have seen a positive change in resource management and protection, there has been a distinct rise in conservation planning efforts within the 21st century, especially in New Hampshire.

Statement of Purpose

The Hillsborough Natural Resources Inventory (NRI) was initiated in April 2011. The overall scope of this project was to develop an enhanced NRI to support the Town's natural resource protection efforts and provide a basis for informed land use planning. Goals of the project were 1) to engage the community in the NRI process through community forums and a public presentation, 2) to develop a series of NRI maps designed for educational and planning purposes (see the GIS Data Disclaimer in Appendix A), 3) to refine existing data for wetlands, ponds and lakes, and grasslands, 4) to assess the presence of focal species to better understand habitat connectivity and potential wildlife corridors, 5) to refine mapping of the NH Fish and Game Wildlife Action Plan habitats, 6) to identify other significant ecological features, such as vernal pools, exemplary natural communities, and species of conservation concern, and 7) to identify conservation priorities.

To help achieve these goals observations were recorded using roadside surveys and site assessments on various private and public properties. Private properties were only entered upon where landowners provided written permission to conduct such site

assessments. Aerial photography interpretation was also conducted to refine various data noted above.

Community Outreach and Education

In cooperation with Moosewood Ecological, the Hillsborough Conservation Commission held two community forums to engage the town's residents in the public planning process. The first was held on June 4, 2011. This forum introduced the overall project background to the community, including the goals of each of the components. It also facilitated a discussion on growth and natural resources protection. This discussion focused on identifying the strengths and challenges of Hillsborough's natural resources and its working landscape, as well as began to list some of its most significant natural areas. The results of the community forum are located in Appendix B.

The second forum was held on August 6, 2011. It provided an update of the project, including the results of the first community forum. The morning then continued with the theme of growth and natural resources protection. This included discussions that centered on identifying the natural resources that are most important to Hillsborough. This discussion was then followed by an exercise that ranked natural resources for protection. The results of the ranking exercise, which can be found in Appendix C, were used in a co-occurrence analysis to assist with identifying areas for site assessments, as well as mapping ecologically significant areas.

As a final component of the NRI project, a public presentation was held on November 14, 2013, to discuss the findings of the NRI. Topics included water, ecological, agricultural, and forest resources, as well as general conservation priorities identified for Hillsborough. The many uses of an NRI were also illuminated during the presentation.

Hillsborough's Physical Landscape

Hillsborough covers approximately 45 square miles, or 28,607 acres, of mostly forested and hilly terrain (Figures 1 and 2). Its topography is highly variable, ranging in elevation from approximately 600 feet along the Contoocook River to 1,768 feet atop

Thompson Hill just south of Low State Forest. The landscape is further characterized by the rolling hills of Jones Hill, Murdough Hill, Stowe Hill, and Campbell Mountain. Major water bodies include Franklin Pierce Lake, Contention Pond, Loon Pond, Bagley Pond, Gould Pond (aka Emerald Lake), Contoocook River, North Branch River, Shedd Brook, Beard Brook, and Sand Brook. Extensive wetland systems grace many sections along rivers and streams, including the Town's largest and notably most significant Farrar Marsh. These varying landforms offer great diversity for wildlife and plant communities alike.

The most heavily developed areas can be found along Main Street and Route 149 in the southern section of Hillsborough following the course of the Contoocook River. The majority of the town is dotted with residences, which are scattered throughout. As such, Hillsborough is mostly characterized as a rural community surrounding its economic center. Conservation and town-owned lands can be found throughout Hillsborough. It is home to Fox State Forest, Low State Forest, and Farrar Marsh (NH Fish and Game Wildlife Management Area), as well as many others.

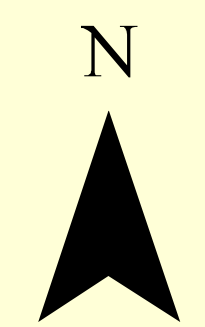
The Parcel Base map (Figure 3) provides an opportunity to better understand how Hillsborough's landscape has been parcelized or divided into separate properties. This map demonstrates the relative size and distribution of properties throughout the town. To better understand acreage and ownership, as well as tax parcel and lot number, refer to the paper maps located in the Town Office or visit the following website: <http://www.caigisonline.com/HillsboroughNH/Default.aspx?Splash=True>

Hillsborough Natural Resources Inventory Topographic Base Map

Figure 1

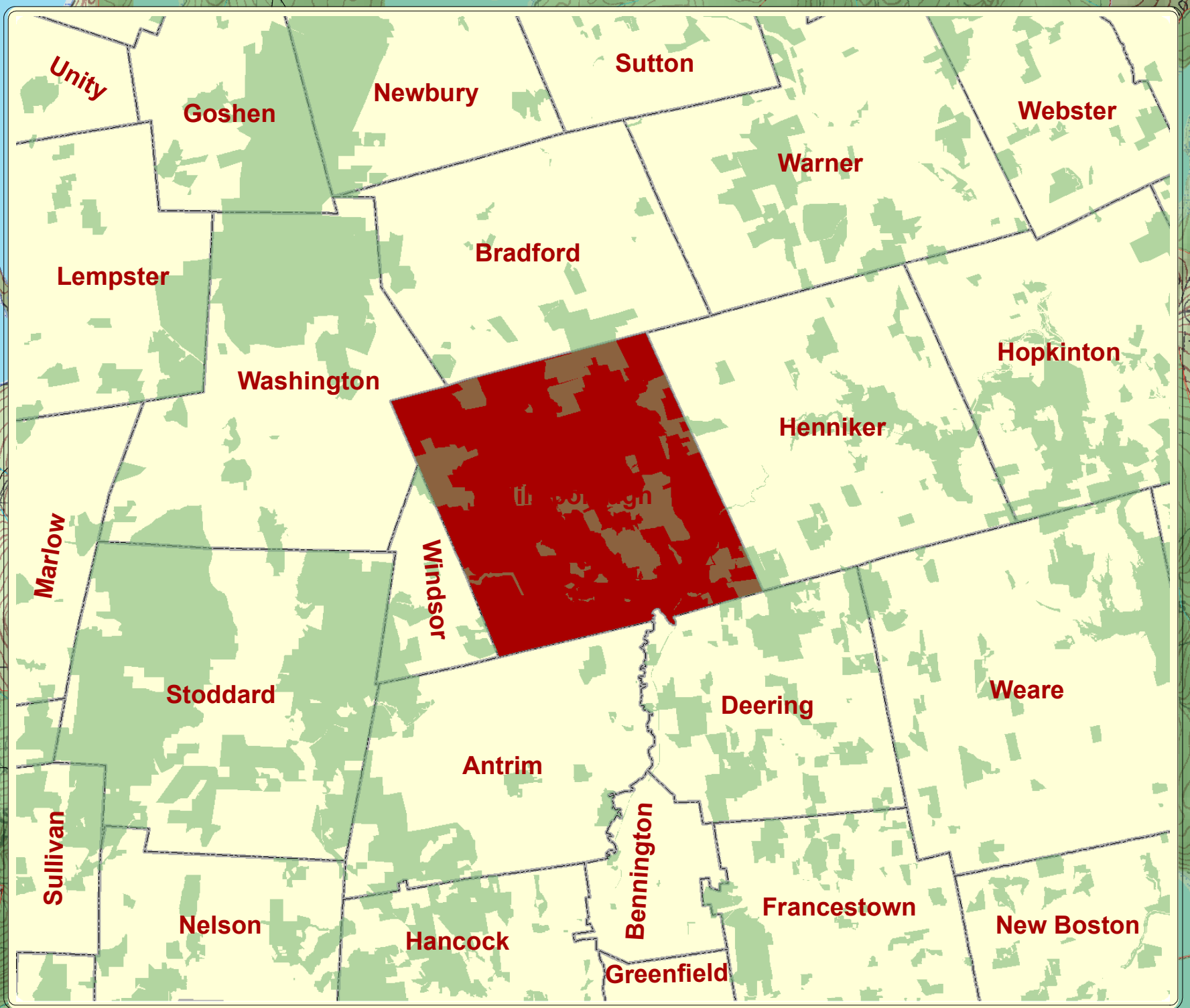
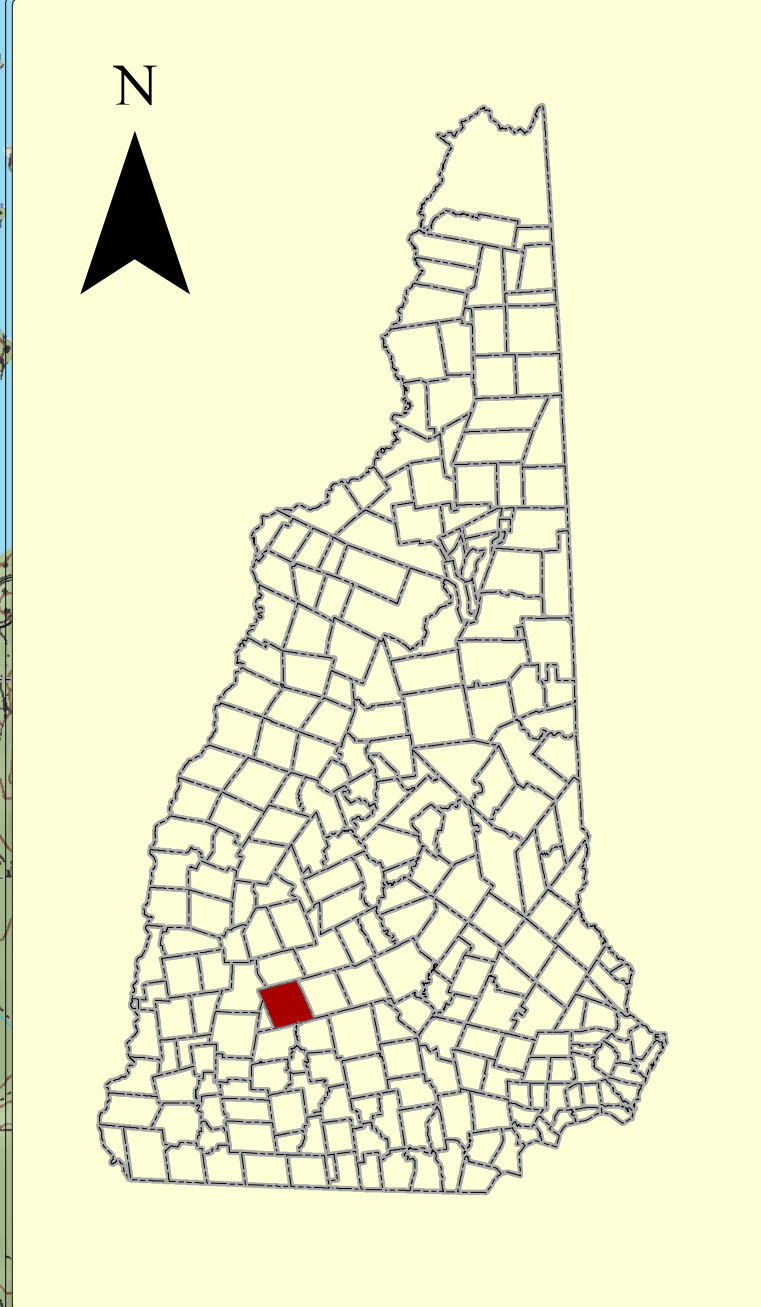
Legend



- Political Boundary
- Transmission Line
- Stream
- Major Roads
- Other Roads
- Roads Not Maintained
- Ponds and Lakes
- Wetlands
- Regional Conservation Lands
- Conservation Lands and Town-owned Lands under the auspices of the Conservation Commission



1:18,000

0 0.25 0.5 1 Mile





Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Mooswood Ecological GIS Data Disclaimer for more information on its use and purpose. All data from NH GRANIT, Mooswood Ecological, and Town of Hillsborough, NH.

Jeffrey N. Littleton, M.S.
Conservation Ecologist
(603) 881-1896
Mooswood Ecological LLC
Innovative Conservation Solutions for New England

Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,250.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Feet US

Date: Feb 24, 2014

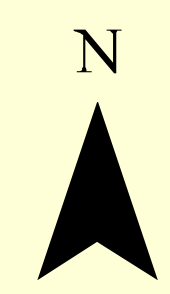
Figure 2

Hillsborough Natural Resources Inventory

Aerial Base Map (2010 Photo)

Legend

- Transmission Line
- Major Roads
- Other Roads
- Roads Not Maintained
- Ponds and Lakes
- Political Boundary
- Wetlands
- Stream
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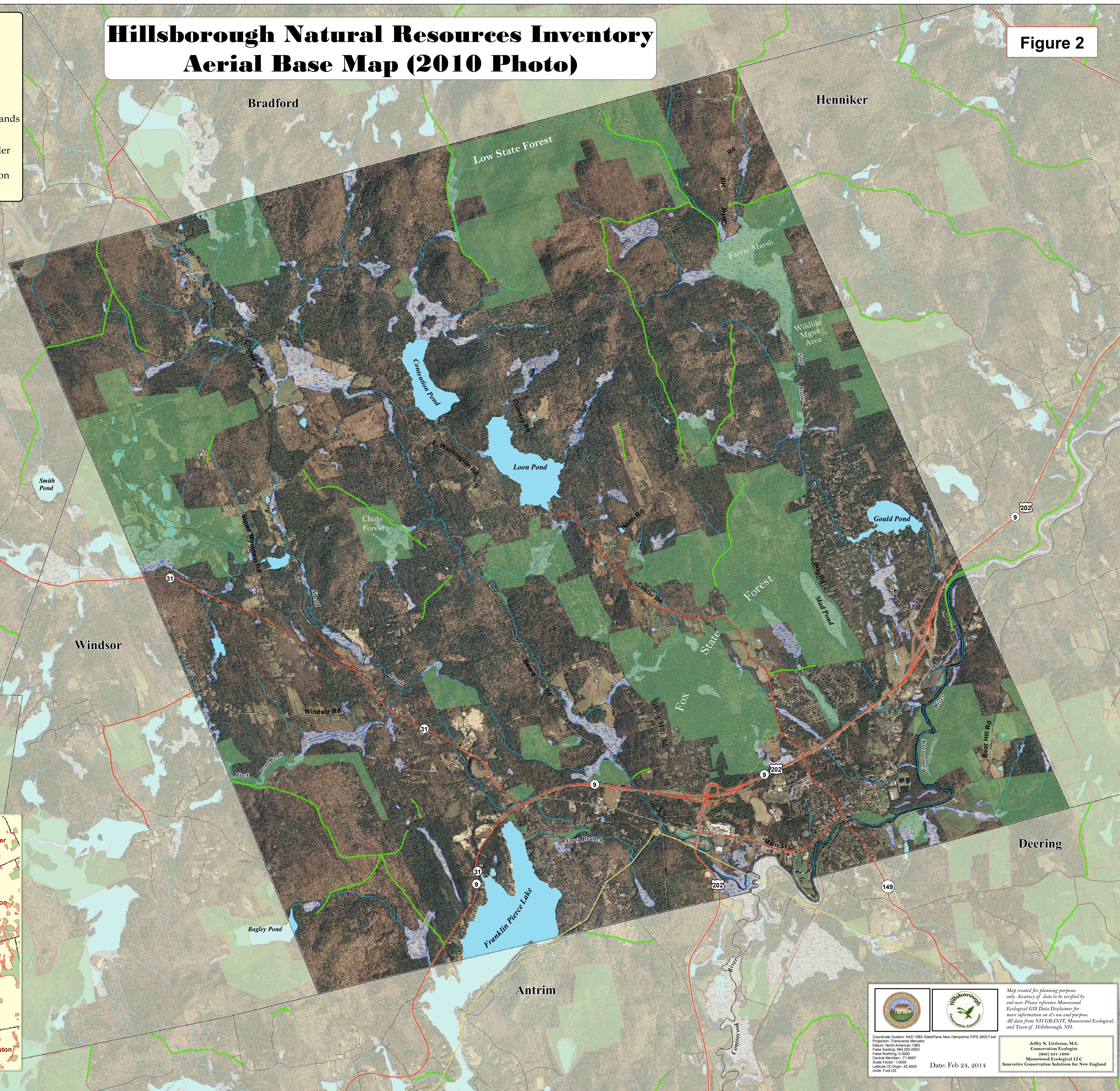
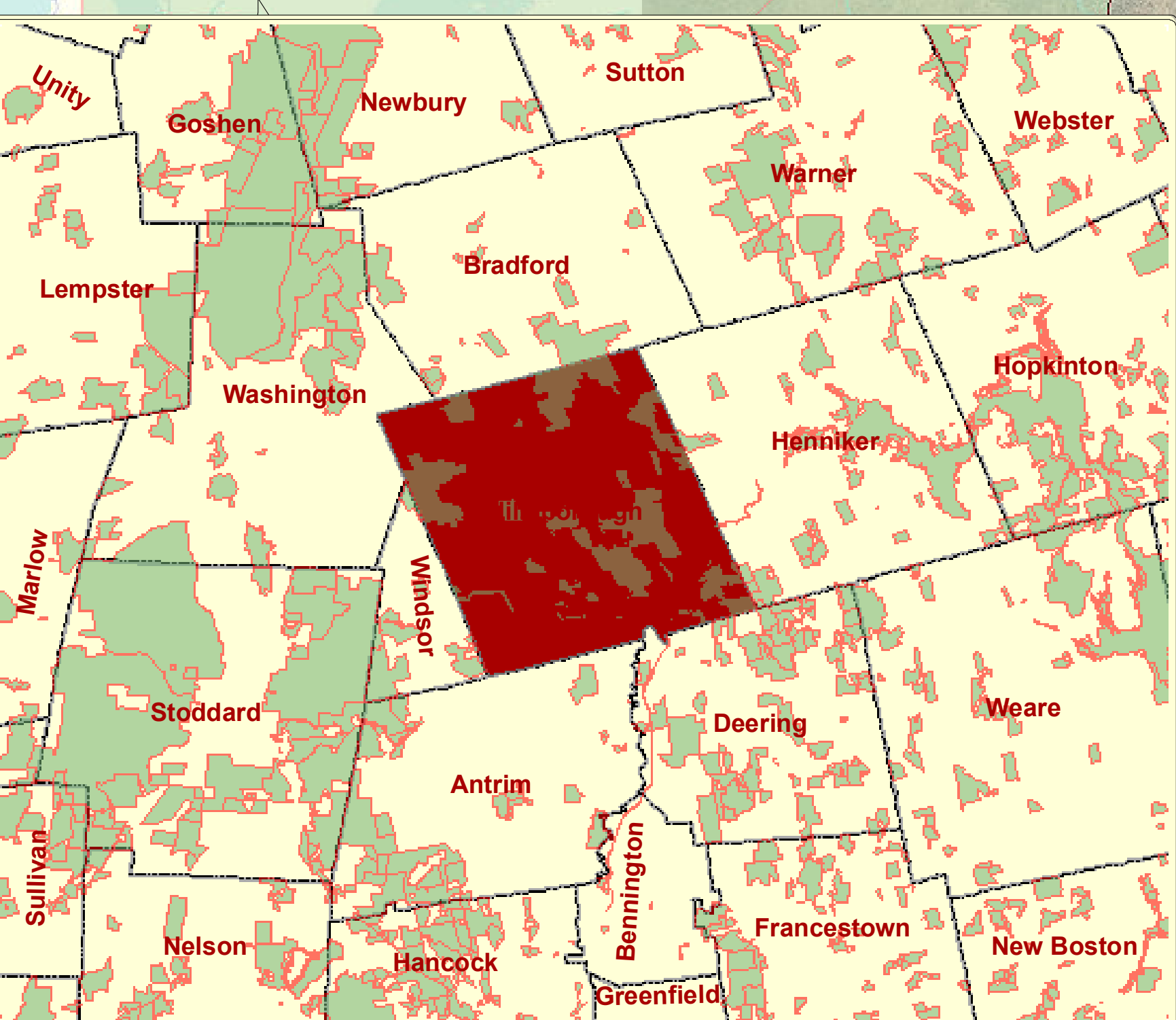


Figure 3

Hillsborough Natural Resources Inventory Parcel Base Map

Legend

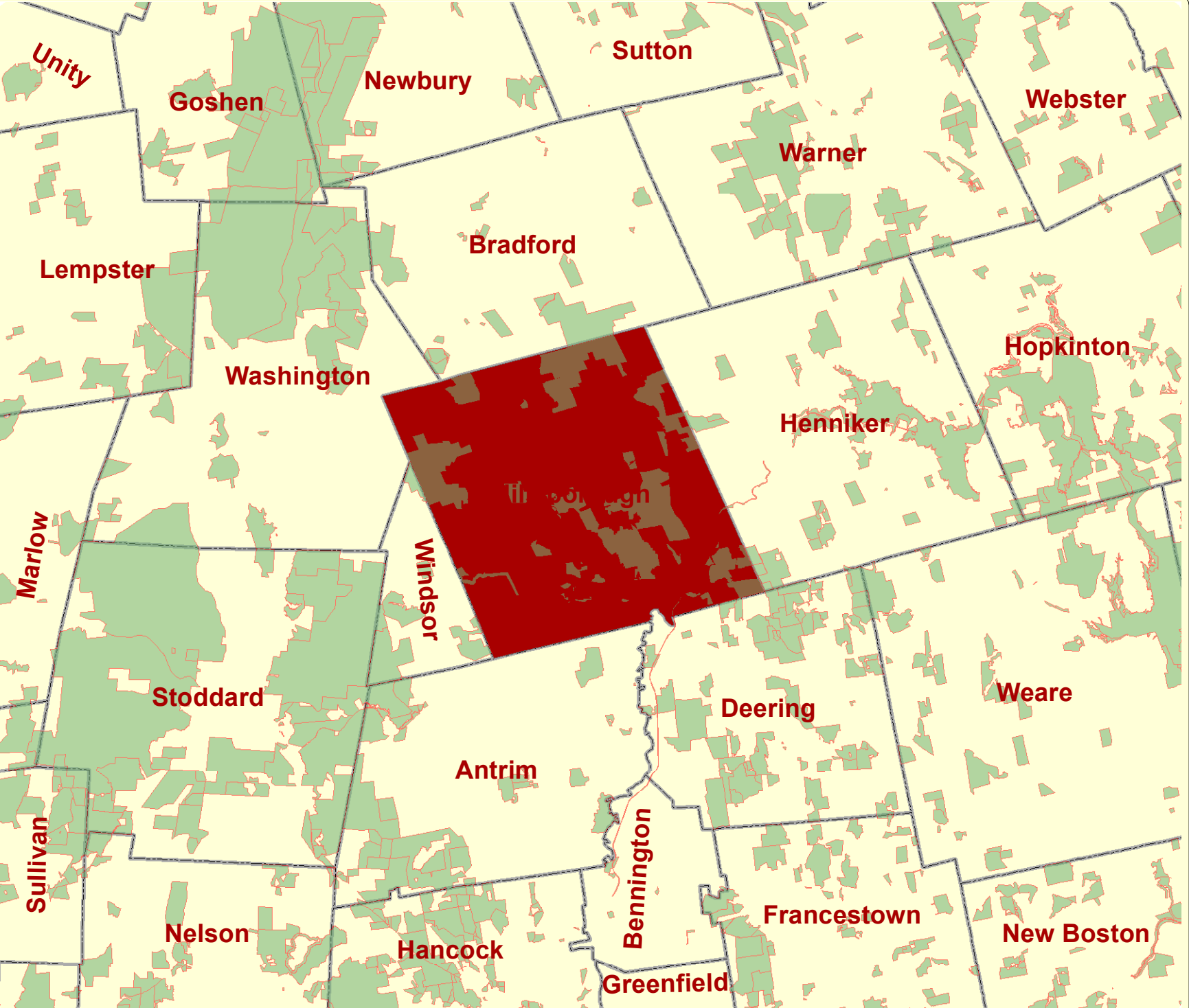
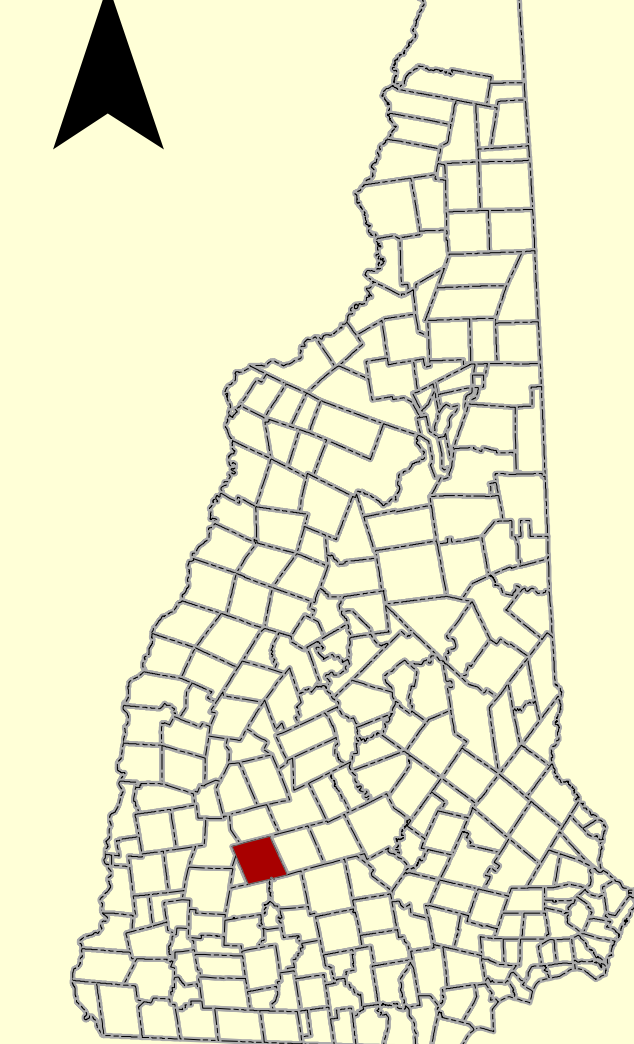
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N

1:18,000

0 0.25 0.5 1 Mile

N



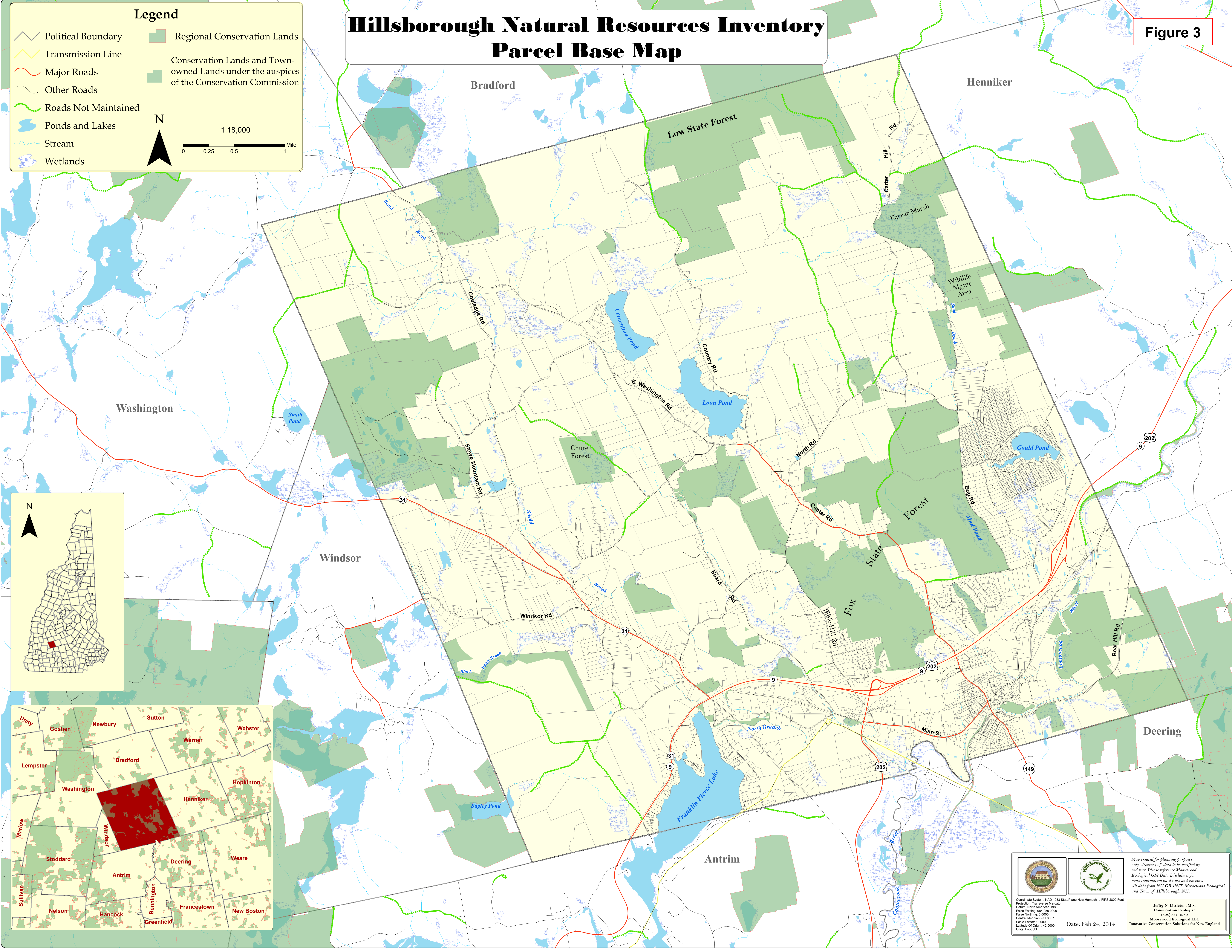


Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Moosewood Ecological GIS Data Disclaimer for more information on it's use and purpose. All data from NH GRANT, Moosewood Ecological, and Town of Hillsborough, NH.

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Jeffrey N. Littleton, M.S.
Conservation Ecologist
(603) 931-1869
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

Date: Feb 24, 2014



WATER RESOURCES

Water resources represent some of our most fragile ecosystems and are particularly sensitive to certain types of land use. Water resources comprise a variety of natural features, which include both surface water and groundwater resources. Such features include our streams and rivers, ponds and reservoirs, wetlands, and aquifers. In terms of their importance, these resources provide a variety of ecological functions and societal values, including:

- Water quality maintenance
- Flood control
- Wildlife and fisheries habitat
- Drinking water sources
- Recreation
- Visual quality and aesthetics
- Rare and endangered species habitat and natural communities
- Groundwater recharge and discharge
- Shoreline stabilization
- Educational and scientific value
- Overall biological diversity of Hillsborough and the planet

Surface Water Bodies

Hillsborough contains a variety of surface water bodies, including rivers, streams, ponds, and lakes, that are distributed throughout the Town (Figure 4). Not only do water bodies provide a multitude of human benefits such as fishing, hunting, boating, swimming, and nature watching, they are also extremely significant for diverse wildlife and plants that depend upon these resources for part or all of their life cycle needs. Generally, major threats to water resources include potential water quality degradation and habitat loss due to surrounding land uses, including unsustainable forestry and agricultural practices and land conversion associated with various types of developments.

Lakes and ponds in Hillsborough cover approximately 777 acres, ranging in size from 0.1 acre to 303.1 acres (Table 1). These have been recognized and labeled as such by the NH Dept. of Environmental Services and/or the US Geological Survey. Seven lakes and ponds are included on the NH Dept. of Environmental Services Consolidated List of Water Bodies subject to the Shoreland Water Quality Protection Act under RSA 483-B. An additional 75 ponds, totaling 42.7 acres, have also been identified through refined mapping efforts. These are rather small waterbodies, ranging in size from 0.1 acres to 8.1 acres.

Table 1. Summary of lakes and ponds in Hillsborough.

Lakes and Ponds	Size (acres)
Franklin Pierce Lake	520*
Loon Pond	155.1
Contention Pond	93.7
Gould Pond (Emerald Lake)	59.4
Bagley Pond	32.5^
Sand Brook Marsh (Farrar Marsh)	98.5
Possa Nissen Pond (Girls Camp Pond)	20
Other Ponds	42.7

SOURCE: USGS topography, GRANIT hydrography datasets, NH DES RSA 483-B, and Moosewood Ecological LLC.

Lakes and ponds in **bold type** are jurisdictional designations by NH DES and subject to the Shoreland Water Quality Protection Act under RSA 483-B.

* = 303.1 acres are located within Hillsborough

^ = 4.7 acres are located within Hillsborough

Approximately 97.6 miles of rivers and streams have been mapped in Hillsborough (Table 2). Seven of these have been identified by the U.S. Geological Survey by name. Of the many rivers and streams, five are included on the NH DES Consolidated List of Water Bodies subject to the Shoreland Water Quality Protection Act under RSA 483-B.

Table 2. Summary of rivers and streams in Hillsborough.

Streams	Length (miles)	Stream Order
Contoocook River	10.9	7th
North Branch River	2.9	6th
Beard Brook	9.4	5th
Shedd Brook	6.3	5th
Black Pond Brook	2.3	4th
Sand Brook	6.7	3rd
Nelson Brook	1.7	2nd
Other Streams	57.4	1st-2nd

SOURCE: USGS topography, GRANIT hydrography datasets, NH DES RSA 483-B, and Moosewood Ecological LLC.

Streams in **bold type** are jurisdictional designations by NH DES and subject to the Shoreland Water Quality Protection Act under RSA 483-B.

The Shoreland Water Quality Protection Act (RSA 483-B) is a state statute that was prepared to protect water quality for designated public waters. The Act establishes minimum standards for various setbacks from the reference line based on land use within the designated 250-foot buffer. For most new construction, as well as land excavating and filling, a state permit may be required (certain exemptions apply). As such, all great ponds (>10 acres), fourth order streams² or higher, and state-designated rivers have been identified by the NH Dept. of Environmental Services as those water bodies that are subject to the Act.

For more details on the Act, as well as certified administrative rules, refer to the NH DES at <http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm>

² Stream ordering is a hierarchy used to define the size of a stream. The smaller the stream order the smaller the stream. First order streams include the “starter” streams that can be found along the steep slopes of Hillsborough. When two first order streams meet they form a second order stream, and so on.

Wetlands

Wetlands generally include familiar places such as marshes, wet meadows, beaver impoundments, swamps, fens, bogs, and other surface water bodies. As noted above, they perform a variety of ecological functions and values, such as providing significant habitats for wildlife and plants, maintaining good water quality, providing storage during a flood event, and sources for recreation. In New Hampshire, wetlands are defined by RSA 482-A:2 as “an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soils conditions.” As such, wetlands are regulated by the NH Dept. of Environmental Services Wetlands Bureau as defined by RSA 482-A:2.

The US Fish and Wildlife Service’s National Wetlands Inventory (NWI) and US Department of Agriculture’s (USDA) Natural Resources Conservation Service (NRCS) hydric soils were mapped to better understand the extent of wetlands within Hillsborough. These combined datasets provide for a more balanced approach at wetlands mapping.

The NWI is a hierarchal system of classification that was designed to map wetlands throughout the United States. The purpose was to determine wetlands loss over time. It also serves as a systematic method for comparing wetlands within a defined geographic location (i.e., town or watershed). The NWI provides some very useful information including the type of wetland as well as its hydrology, associated plant communities, water chemistry, and other modifiers such as human dams and beaver influence.

Hillsborough is estimated to have roughly 1,586 acres of wetlands dispersed throughout the Town (Figure 4). The largest and most extensive wetlands can be found along the various streams and rivers. However, the landscape provides small pockets of isolated wetlands as well.

To gain a better sense of the true extent of wetlands it is important to also consider hydric soils. Essentially, these are wetland soils, and include poorly drained and very poorly drained soil types. These have been mapped by the USDA Natural Resources

Conservation Service. Poorly drained soils are estimated to cover about 1,709 acres while very poorly drained soils cover 1,163 acres. These are estimates and field checking is needed when appropriate.

Watersheds

All of the previously discussed water resources reside in a particular watershed. A watershed is the area that drains to a common water resource. This may be a wetland, stream, or lake, and the land use within a particular watershed can have a direct effect on the quality and quantity of surface waters and the underlying aquifers. Land use planning that uses a watershed approach can have a great impact on a town's water resources. This is important since we all depend upon clean water to help sustain life. Hillsborough is divided into 6 major watersheds (Table 3 and Figure 4).

Table 3. Summary of major watersheds in Hillsborough.

Watershed	Total Area (acres)	Area in Hillsborough (acres)
Sand Brook	15,731.5	9,715.9
Beard Brook	21,911.0	11,222.7
Shedd Brook	14,026.4	4,401.0
Franklin Pierce Lake	22,959.1	3,063.1
Great Brook	23,721.7	50.3
Hopkinton Lake	16,703.4	153.7

SOURCE: USGS HUC 12 watersheds from GRANIT.

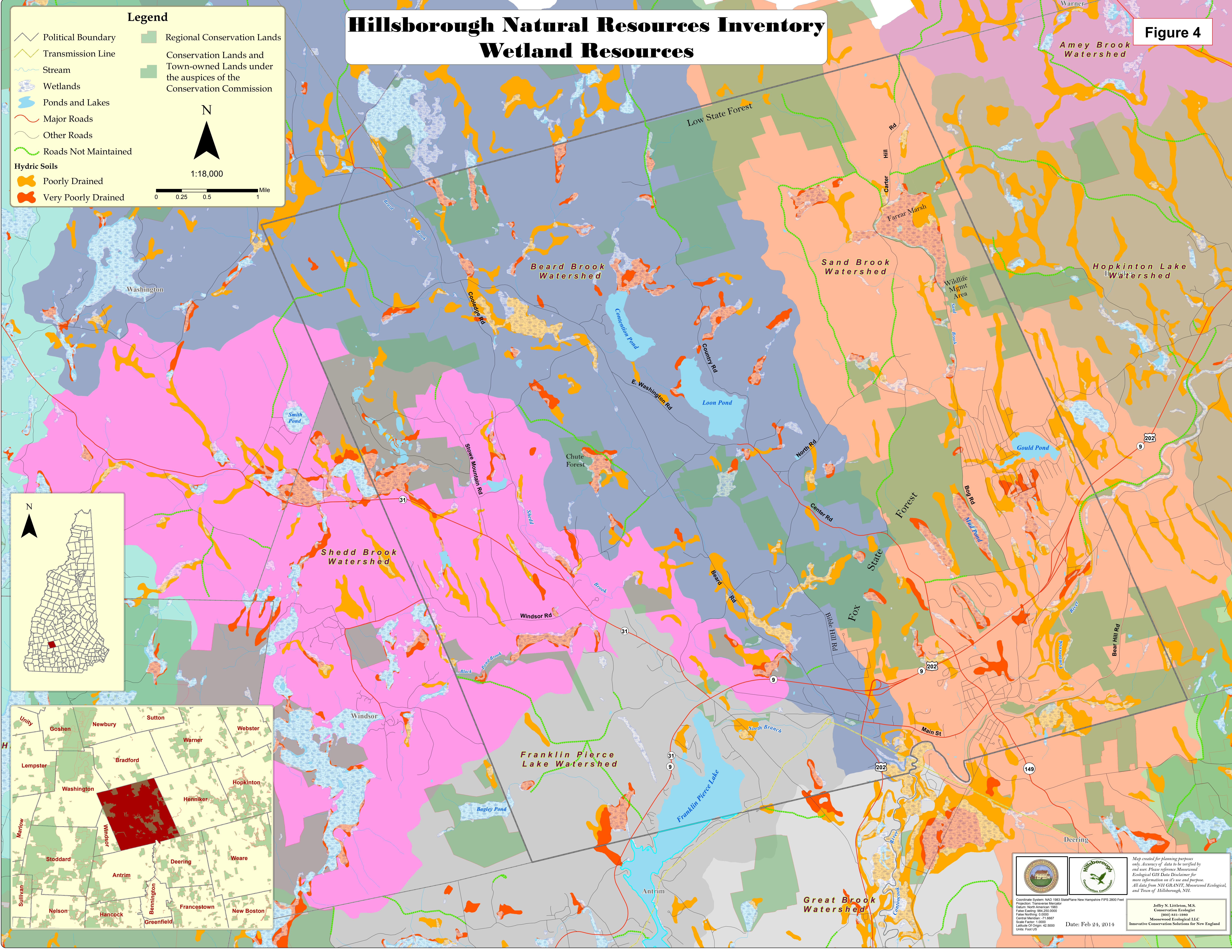


Farrar Marsh is a large wetland located in the northeast part of Hillsborough. It is one of the most significant wetlands in town.

Hillsborough Natural Resources Inventory

Wetland Resources

Figure 4



Groundwater Resources - Stratified Drift Aquifers

Groundwater resources are stored in two main types of aquifers and can serve as sources for drinking water. Aquifers can be located within saturated areas of sand and gravel deposits or in fractured bedrock. In the past as glaciers melted they left behind layers of coarse sediments including sand and gravel. The space between these sediments provides opportunity for groundwater storage and flow. Groundwater stored in *stratified drift aquifers* of this kind can serve as an excellent source for drinking water. Locating and protecting these geologic features can help to ensure a supply of clean drinking water for the community as these areas are vulnerable to contamination.

Hillsborough contains approximately 3,721 acres of stratified drift aquifers (Table 4 and Figure 5). The largest and most significant aquifers are located along the Contoocook River, Shedd Brook, and Beard Brook. Smaller aquifers are associated with Gould Pond, Contention Pond, and the wetland complex north of Route 31 along the western town boundary.

Aquifers are divided into categories based on *transmissivity*, or the rate at which water moves through an aquifer and is measured in square feet per day (ft²/day). Therefore, higher rates of transmissivity correspond to a potentially higher yield of groundwater. Most of the aquifers in Hillsborough have a transmissivity rate of 1,000ft²/day or less, which corresponds to a potential yield of less than 75 gallons per minute. However, a few smaller areas are predicted to have a much higher yield.

While transmissivity takes into account the quantity of water moving through an aquifer system it does not reflect the quality of the source. To assist in addressing this issue and to identify potential future public water supplies for communities, the NH Dept. of Environmental Services and the Society for the Protection of NH Forests prepared a Potential Favorable Gravel Well Analysis (PFGWA). This technique analyzed stratified drift aquifers, affording the opportunity for town planners and water suppliers to determine quantity and quality constraints on aquifers. In doing so, the PFGWA creates buffers to eliminate all known and potential contamination sources and examines potential well yield to identify the most suitable areas for potential community wells. In effect, this effort is encouraging communities to take proactive measures at protecting

their most significant groundwater resources. As such, the higher yielding aquifers along the Contoocook River, Shedd Brook, and Beard Brook have been identified by the PFGWA. It was estimated that these sites could produce more than 75 gallons per minute with a few sites potentially producing more than 300 gallons per minute.

Table 4. Summary of aquifers and favorable gravel well analysis in Hillsborough.

Groundwater Attribute	Size (acres)
<i>Stratified Drift Aquifer Transmissivity Rates</i>	
<2,000 feet ² /day	3,490.2
2,000-4,000 feet ² /day	135.4
>4,000 feet ² /day	95.0
<i>Favorable Gravel Well Analysis</i>	
>75 Gallons/Minute	154.7

Source: USGS stratified drift aquifers (GRANIT 2000) and NH DES favorable gravel well analysis (2011).



The Contoocook River is associated with some of the most important aquifers in Hillsborough.

Figure 5

Hillsborough Natural Resources Inventory

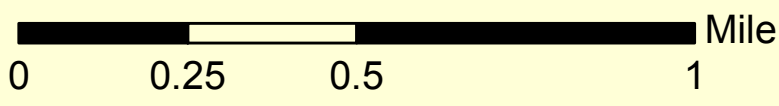
Groundwater Resources

Legend

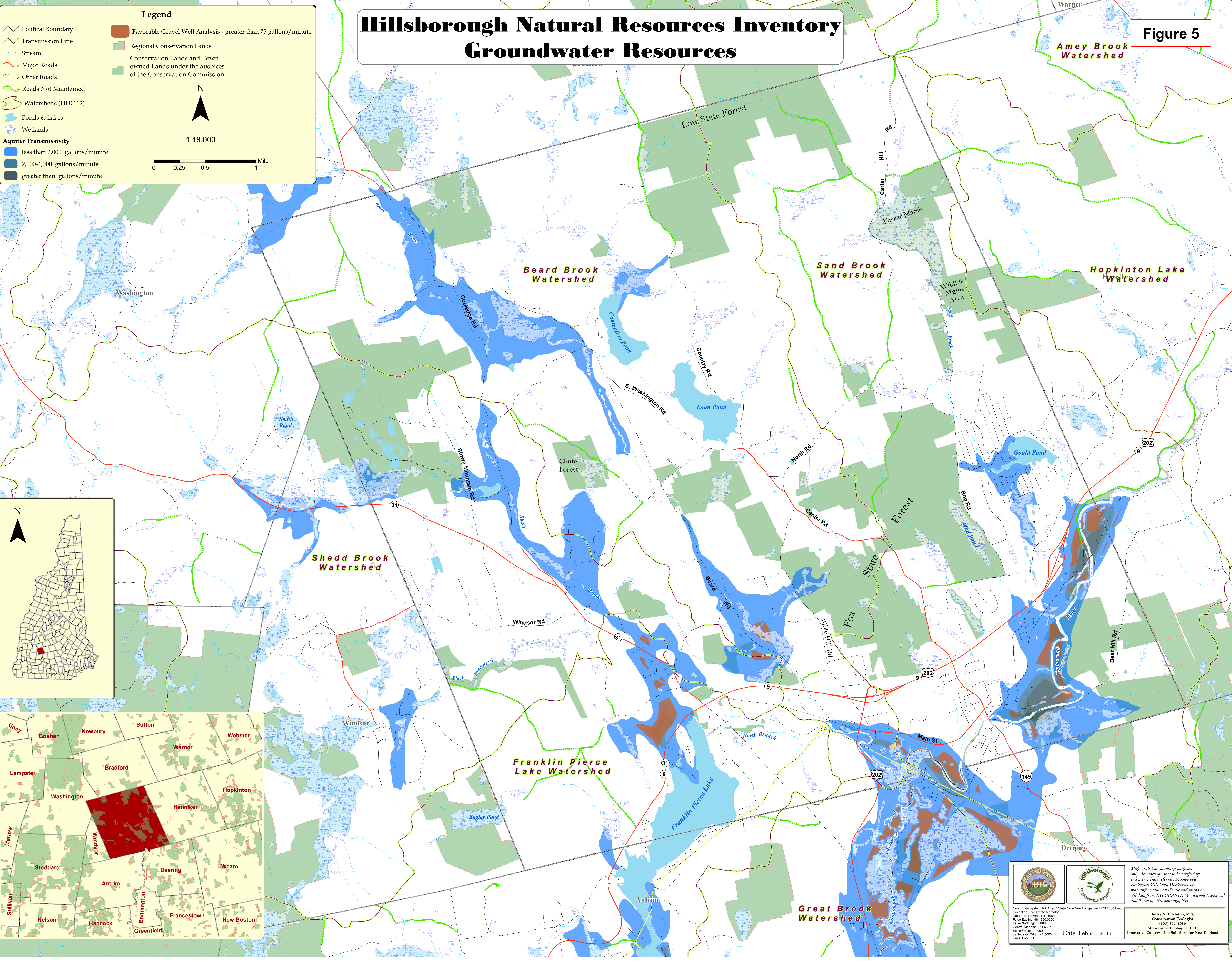
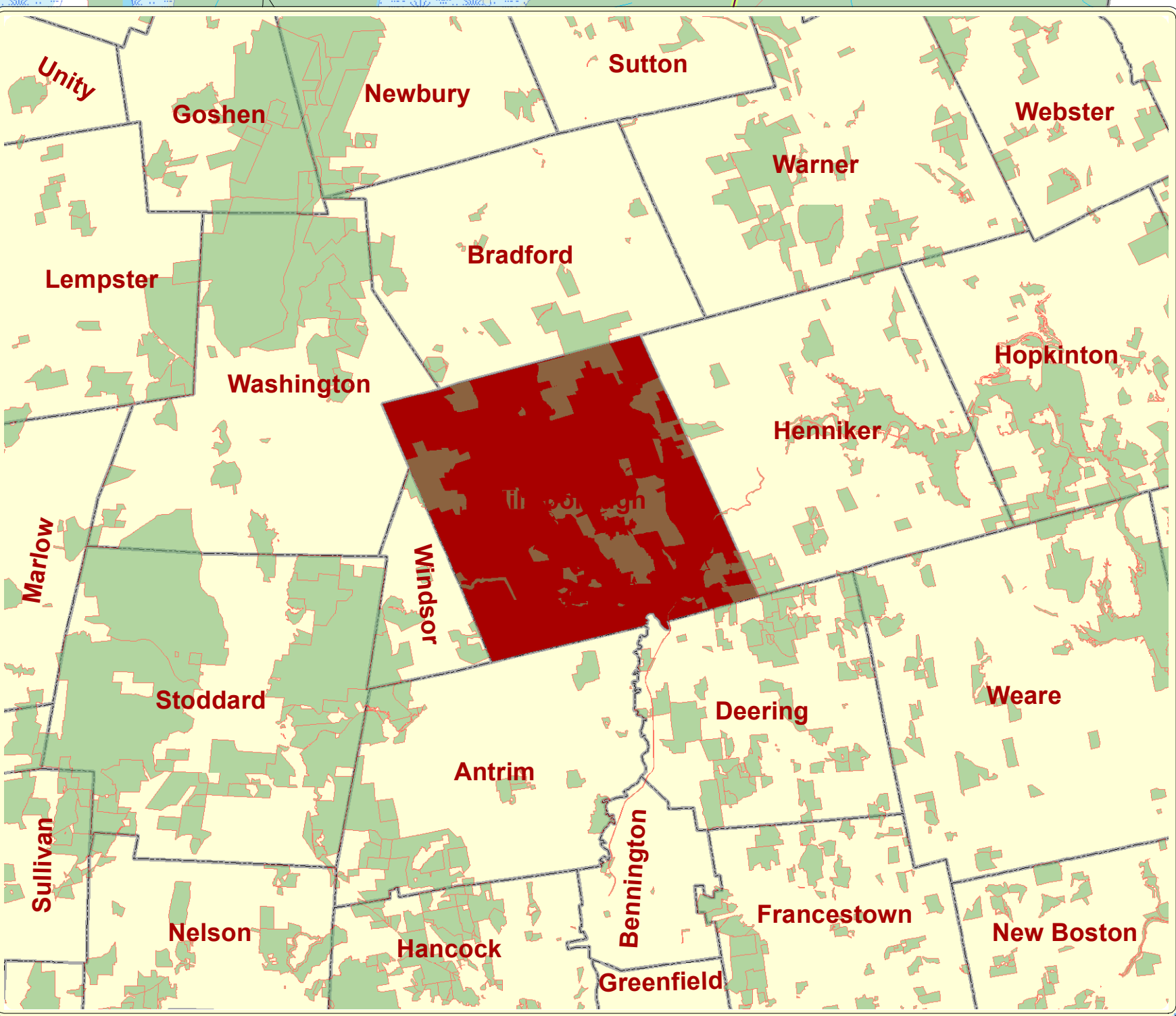
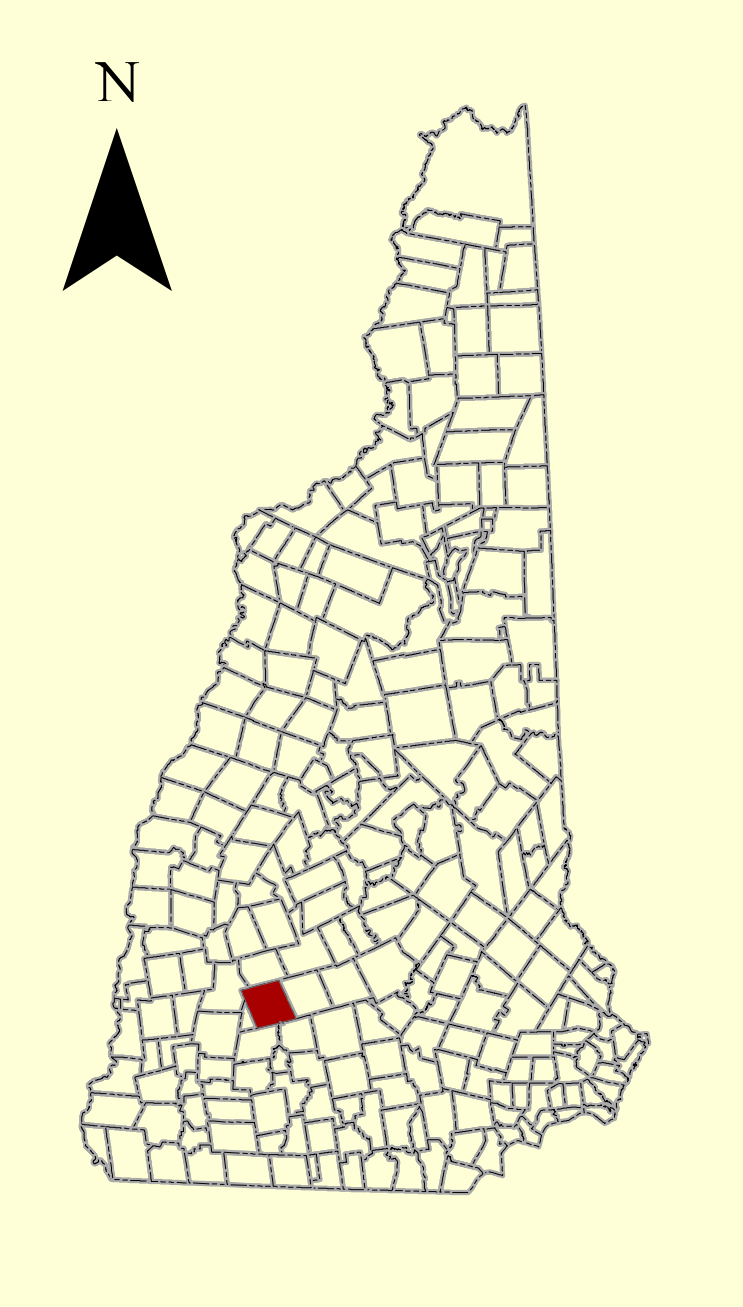
- Favorable Gravel Well Analysis - greater than 75 gallons/minute
- Regional Conservation Lands
- Conservation Lands and Town-owned Lands under the auspices of the Conservation Commission


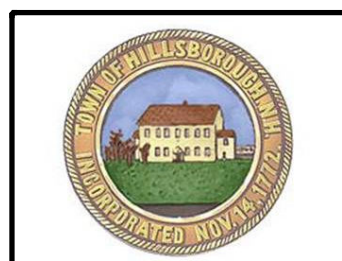


1:18,000



- Political Boundary
- Transmission Line
- Stream
- Major Roads
- Other Roads
- Roads Not Maintained
- Watersheds (HUC 12)
- Ponds & Lakes
- Wetlands
- Aquifer Transmissivity
 - less than 2,000 gallons/minute
 - 2,000-4,000 gallons/minute
 - greater than 4,000 gallons/minute





Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Mooswood Ecological GIS Data Disclaimer for more information on it's use and purpose. All data from NH GLINT, Mooswood Ecological, and Town of Hillsborough, NH.

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Conservation Ecologist
(603) 851-1800
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ECOLOGICAL RESOURCES

Wildlife Habitats

The NH Fish and Game Department, in cooperation with other agencies, organizations, and individuals, produced the NH Wildlife Action Plan (WAP) in 2005 (habitats revised 2010). This document was designed as a planning and educational tool for federal, state, and municipal governing bodies, conservation commissions, land trusts and other conservation organizations, and private landowners, as well as the general public, to promote the conservation and management of NH's biological diversity. The WAP provides a resource for developing informed land use decisions and land management planning. The intent was to ensure an adequate representation of various wildlife habitats are maintained across our landscape, keeping common species common in NH and working to prevent the loss of our rare and endangered species.

A total of eight wildlife habitats as recognized by the WAP were mapped for Hillsborough (Table 5 and Figure 6). These habitats were refined based on 2010 aerial photography interpretation in combination with roadside surveys and site assessments. The WAP predicted that Appalachian oak-pine forests were scattered throughout Hillsborough. However, evidence of this forest type was not observed and is most likely less abundant than predicted. Additional site investigations within the predicted areas would need to be performed to confirm its presence or absence.



Heron rookeries provide important breeding habitats for great blue herons.

Table 5. Summary of wildlife habitats in Hillsborough.

Wildlife Habitat Type	Size/Count	% of Town
Marsh and Shrub Wetlands	910.9 acres	3.2
Peatlands	160.6 acres	0.6
Forested Wetlands (Swamps)	538.1 acres	1.9
Vernal Pools	116 pools	n/a
Floodplain Forests	1,387.3 acres	4.9
Ponds and Reservoirs	702.2 acres	2.5
Streams	102.8 miles	n/a
Riparian Buffer	8,758.6 acres	30.6
Steep, South-facing Slopes	456.2 acres	1.6
Lowland Spruce-Fir Forests	503.5 acres	1.8
Northern Hardwood-Conifer Forests	516.7 acres	1.8
Hemlock-Hardwood-Pine Forests	21,037.3 acres	73.5
Appalachian Oak-Pine Forests	1,368 acres	4.8
Deer Wintering Areas	95.7 acres	0.3
Shrublands	30.3 acres	0.1
Grasslands	1,104 acres	3.9

Source: Refined wildlife habitats by Moosewood Ecological (2013) using Wildlife Action Plan data (2010), aerial photography (2010) interpretation, National Wetlands Inventory (2001), NH Fish and Game deer wintering areas (2004), and ground-truthing; NH hydrography data (2006), Wildlife Action Plan data (2010), aerial photography (2010), and National Wetlands Inventory (2001) from GRANIT .

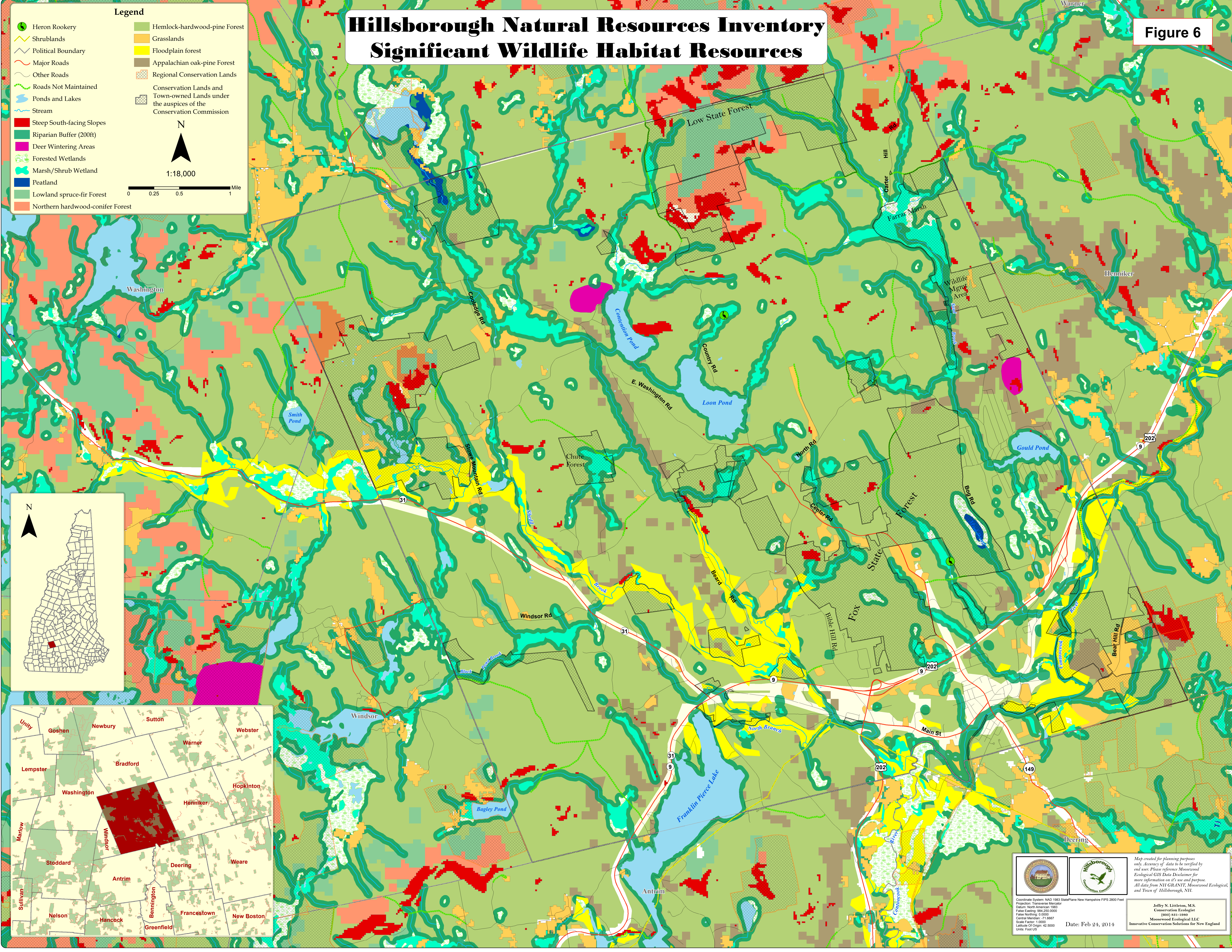


Vernal pools are critical for the long term survival of obligate species such as spotted salamanders and wood frogs.

Hillsborough Natural Resources Inventory

Significant Wildlife Habitat Resources

Figure 6



An additional habitat that was recognized, but not mapped, in the WAP included vernal pools. Approximately 119 vernal pools have been observed in Hillsborough (Figure 7). These pools were mapped during field work in 2012, as well as from 1992 to 2001 by Marion Baker while working with the Harris Center for Conservation (Hancock, NH). Of the 119 vernal pools, 59 were confirmed based on the presence of obligate species, including wood frogs and spotted salamanders that depend upon these habitats for long term survival. The remaining 60 vernal pools are potential sites for critical breeding sites for many wildlife species.

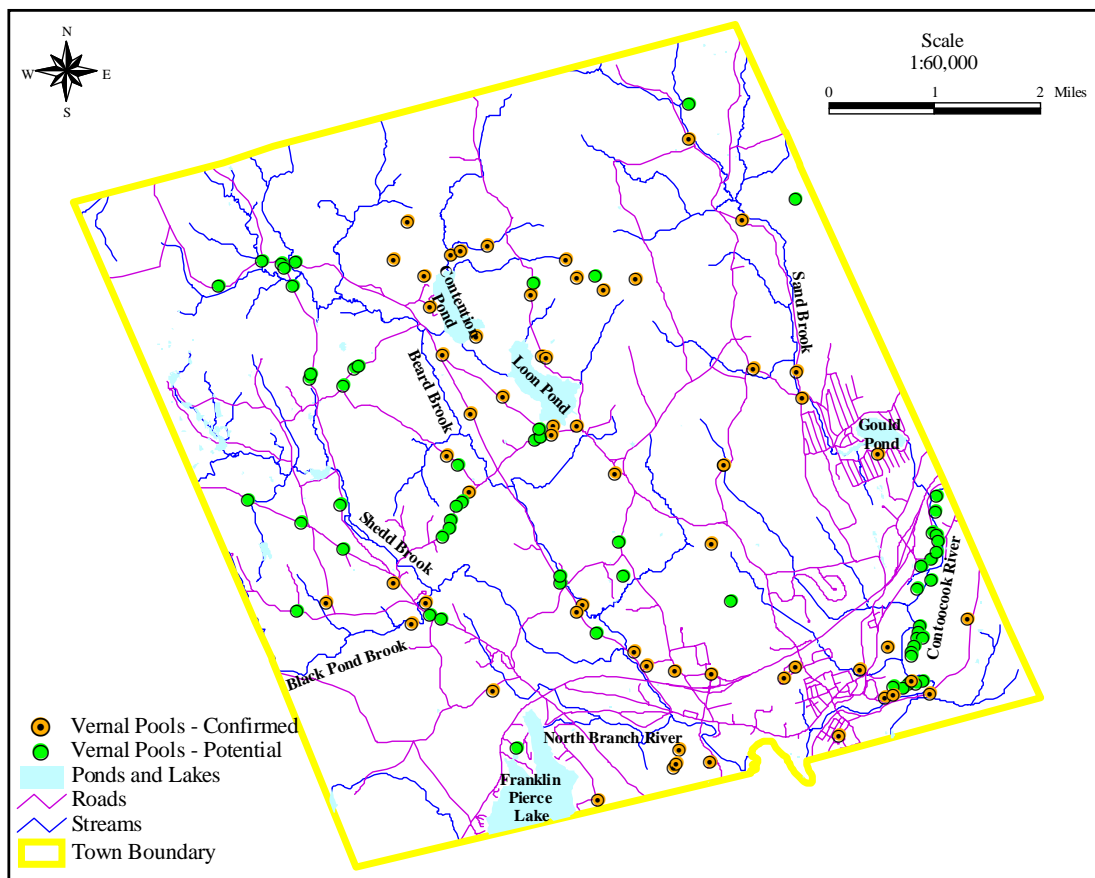


Figure 7 Distribution of confirmed and potential vernal pools in Hillsborough. This map depicts the approximate location of vernal pools that we identified by aerial photography interpretation, site assessments, and/or roadside surveys. Data sources: Moosewood Ecological LLC (2012) and Marion Baker (1992-2001)

Focal Species Assessment

Focal species assessments were conducted on public properties, as well as private properties whose landowners provided written permission for access. Roadside surveys were conducted as well. These assessments focused on species of conservation concern and various mammals, including black bear, bobcat, moose, river otter, mink, and beaver. These species were identified to act as surrogates to better understand habitat connectivity and quality, as well as long-term viability of wildlife habitats in light of the effects of fragmentation and land use patterns. These help to get a sense of the relative ecological integrity, or health, within Hillsborough.

A total of nine focal wildlife species were observed throughout Hillsborough (Figure 8). These included black bear, moose, river otter, mink, bobcat, beaver, red-shouldered hawk, osprey, and bobolink. Of these, sign of moose, black bear, and bobolink were the most frequently documented.

Sign of moose was observed throughout Hillsborough. Sign was most abundant north of Loon Pond on town-owned property (Hillsborough Water and Sewer land) and on Thompson Hill, as well as in the southeast corner adjacent to the Contoocook River. In fact, a cow and her calf as well as a bull moose were seen on the town-owned property in the same day! These areas are located within large unfragmented blocks in the region. The area in the northern part of town is located within a very large forested block of 22,000 acres. Moose require large, remote forests with embedded wetlands and can travel long distances in search of food. The northern half of Hillsborough provides the best, high quality habitat and connectivity for moose with its intact forest communities and diverse concentration of numerous wetlands.

Like moose, black bear require large areas of intact forests with diverse wetland complexes. They can serve as an umbrella species, since protecting prime black bear habitat will also protect habitat for a wide variety of species. Bear sign was most abundant in the northern half of Hillsborough, which provides excellent habitat and a multitude of food sources. Bear sign can be easily observed while traveling along the more remote roads, such as Cooledge Road and Sleeper Road. Bear-bitten utility poles are easily recognized in these areas.

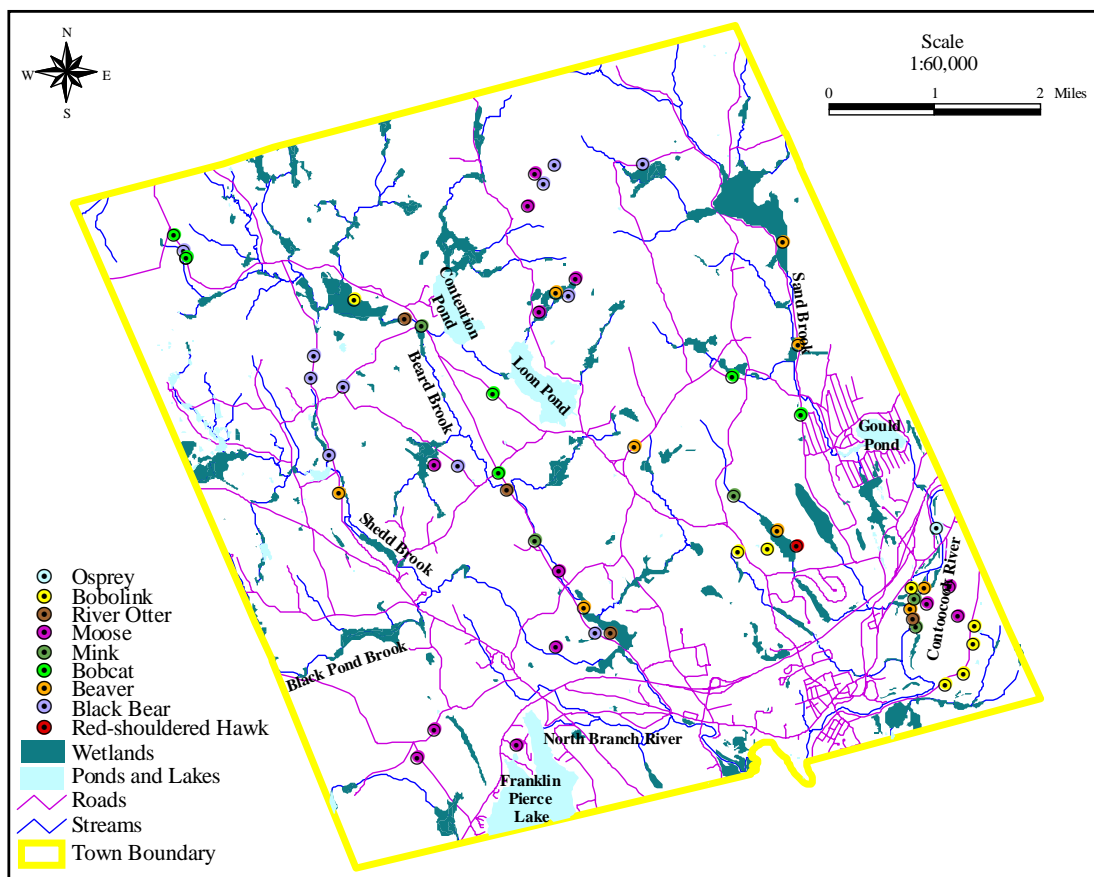


Figure 8 Distribution of focal species observed in Hillsborough. This map depicts the approximate location of focal species that we identified by site assessments and roadside surveys. Data sources: Moosewood Ecological LLC (2012)

River otter was observed in several locations along Beard Brook and Contoocook River. It is suspected that this species is more widespread in Hillsborough, especially in the more remote areas. Unlike mink, river otters prefer habitats with little to no human presence, particularly intact riparian buffers. They are strongly associated with active beaver ponds, which provide perfect habitat for otters. A total of seven active beaver sites were observed throughout Hillsborough. Presence of beaver is used as an indicator of good water quality and forage habitat. Not only do beaver provide great habitat for otter but they have a great affect on increasing biodiversity in an area, including waterfowl, amphibians, reptiles, and aquatic insects.

American mink are more tolerable of humans than river otter. Similar to otter distribution, mink tracks were observed along Beard Brook and Contoocook River, as well as Fox State Forest. If an adequate supply of aquatic wildlife is present mink are expected to be found in most parts of Hillsborough, especially along well-shaded streams with intact riparian areas.

Bobcat sign was observed on two separate occasions during winter mammal tracking surveys. Tracks were observed crossing several roads in the northern half of Hillsborough, including Sleeper Rd., East Washington Rd., Beard Rd., Flint Rd., and Bog Rd. Bobcats are considered a species of conservation concern in New Hampshire. This was mainly due to unregulated harvests in the 1800s and most of the 1900s. Maturing forests and decline of shrubby habitat also played a part in their decline. However, it seems that the population has begun to rebound over the past 20 years but remains a species of concern.

Typically, bobcats are associated with dense vegetation and rugged terrain with rocky outcrops within large unfragmented forest blocks, which is most notable in the northern part of Hillsborough. Like many large roaming mammals, continued human development and fragmentation is expected to negatively impact bobcat populations.

Two additional species of conservation concern were observed. Osprey was observed fishing along the Contoocook River. It was recently down-listed as state threatened but is still a concern during its recovery. Osprey indicates good water quality as well as an abundant food source. Red-shouldered hawk was observed in Fox State Forest near the heron rookery. Like osprey, this species is a top predator and is indicative of good habitat and adequate food sources. Finally, bobolinks were observed in several locations throughout Hillsborough. They were very common in the fields along Bear Hill Road, East Washington Road, and at Intrepid Farm. These grassland birds have declined due to reduced habitat associated with development, as well as field abandonment that has resulted in fields being reverted back into forests.

Other species of conservation concern have been previously documented in Hillsborough (Table 6). These included plants as well as animals that have been reported to the NH Natural Heritage Bureau. There were no plants of conservation concern

observed during site assessments. In addition, a variety of exemplary natural communities have also been previously documented, as well as observed during site assessments. The black gum swamp can be found on the western portion of Fox State Forest. The silver maple floodplain forest is located along the Contoocook River and includes a variety of vernal pools.

Table 6. Rare species and exemplary natural communities in Hillsborough.

Rare Elemental Occurrence	Rarity Rank
Exemplary Natural Communities	
Black gum swamp**	
Medium level fen system**	
Poor level fen/bog system**	
Circumneutral riverbank outcrop**	
Silver maple-false nettle-sensitive fern floodplain forest**	
Plants	
American ginseng**	T
Sand blackberry*	E
Birds	
Common Loon**	T
Reptiles	
Eastern smooth green snake**	SC
Wood Turtle**	SC
Invertebrates - Dragonflies and Damselflies	
Pygmy snaketail***	

Source: NH Natural Heritage Bureau database (2013) and Moosewood Ecological LLC (2012).

E - Endangered

T - Threatened

SC - Special Concern

* - High Importance

** - Very High Importance

*** - Extremely High Importance

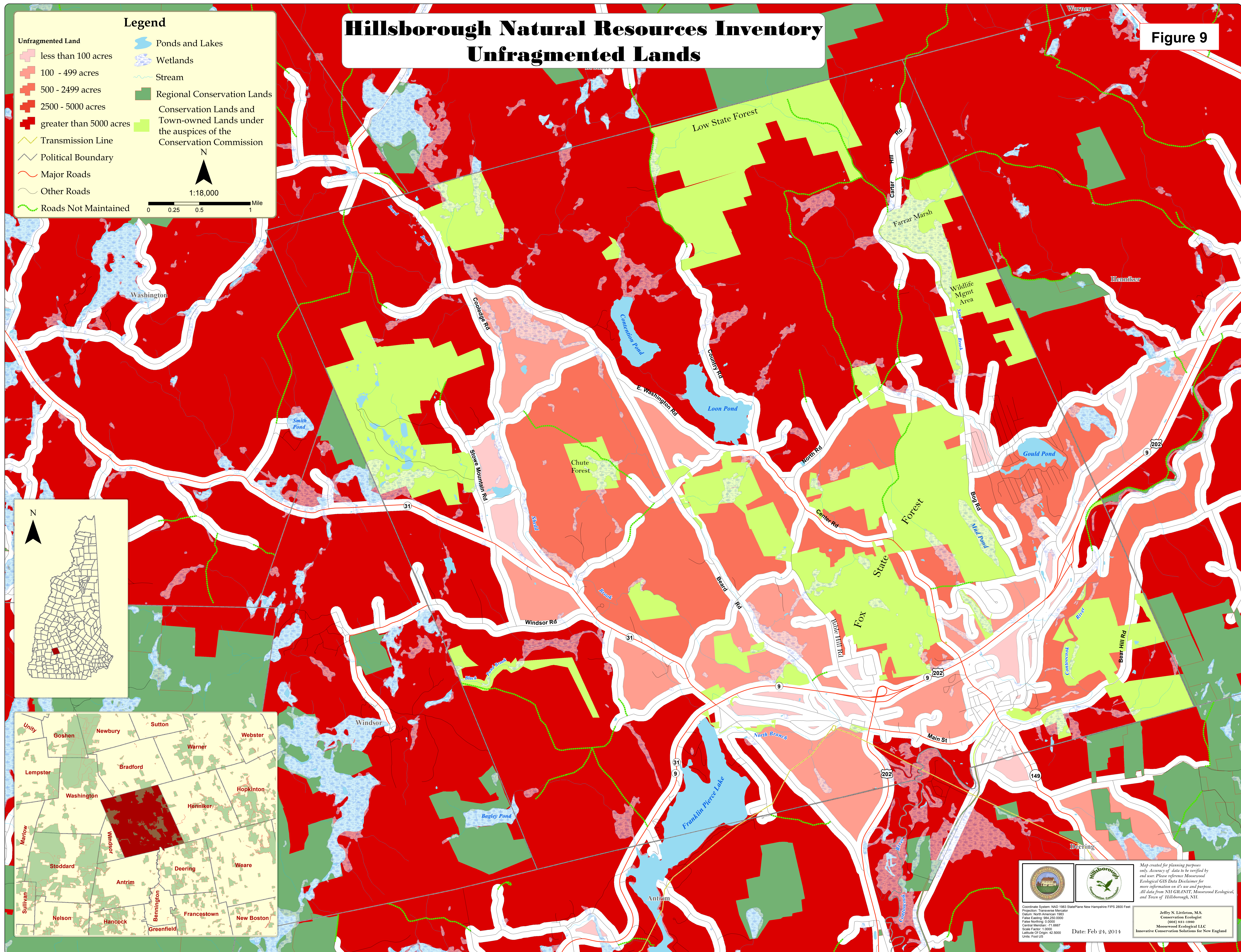
Unfragmented Lands and Habitat Connectivity

Unfragmented lands are defined by the surrounding human infrastructure (roads and developed areas). Fragmentation of land can negatively affect species survival rates by increasing mortality, lowering breeding success, or causing species loss altogether. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented blocks, the species or community in question, the extent of loss of natural habitats, intensity of human use, and colonization of invasive species.

The NH Wildlife Action Plan (WAP) developed an unfragmented lands analysis. However, this data layer has inherent errors. As such, the unfragmented lands were revised to more accurately reflect Hillsborough's landscape (Figure 9). For the purposes of this project, fragmenting features were defined as 500 feet on either side of existing roadways, including all state and town roads but excluding Class VI roads and trails, as well as private driveways. It is this area within 500 feet of roadways that most developments occur. Unfragmented blocks of land include a variety of natural habitats such as forests, wetlands, streams, and ponds but also can include human-modified areas such as agricultural lands and shrublands.

Large blocks of unfragmented areas are widely known to support greater biodiversity than smaller blocks. As forest blocks become smaller due to the construction of roadways and developments their biodiversity will generally be reduced. This fragmentation affect has less immediate impact on generalist species or those with small home ranges (such as gray squirrels, raccoon, many amphibians, and small rodents) while affecting and potentially eliminating area-sensitive specialists that need large forested blocks in order to maintain their home ranges and for long-term survival (such as bear, bobcat, moose, some reptiles, wood thrush, and goshawk). Appendix D provides a general list for habitat block size requirements for wildlife to help illustrate this point.

Figure 9





Moose require large blocks of unfragmented forests and wetlands for survival.

Large landscapes also provide for wildlife movement and habitat connectivity. By maintaining connectivity between critical habitats it may be possible to provide permanent wildlife corridors within the built environment. Wildlife travel corridors function as areas that one or many species may use to move from one habitat to another. This movement can be based on traveling to various areas for feeding, breeding, nesting, or shelter. Wildlife must be able to travel safely throughout the landscape in order to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These may include features such as riparian zones of wetlands, ponds and streams, ridgelines, utility right-of-ways, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, muskrat, fox, coyote, bobcat, deer, moose, fisher, mink, and bear.

Wildlife corridors are not only significant for mammals but equally as important for amphibians, reptiles and migratory birds. Both amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of suitable habitats. This affect can often be exacerbated as the same individuals must return back to their wintering habitats. Thus, there is a great significance in maintaining habitat connectivity, as well as understanding where these patterns of movement are taking place. This latter point can be a very important

educational tool for community education and awareness about corridors across roadways. It can provide a means to adjust transportation patterns to help eliminate potential road mortality.

To better assist with understanding habitat connectivity in Hillsborough, wildlife road crossings were recorded (Figure 10). Roadside snow tracking was used to determine where areas of wildlife crossings were concentrated. Based on the assessment of focal species, wildlife crossings, and unfragmented lands, the northern half of Hillsborough provides the most impressive, high quality habitats to support a wide diversity of wildlife. Abundant observations of black bear, moose, bobcat, otter, mink, and beaver reinforce this point. It is suspected that additional focal species are likely present in this area, including wood turtle, American woodcock, wood thrush, and northern goshawk.

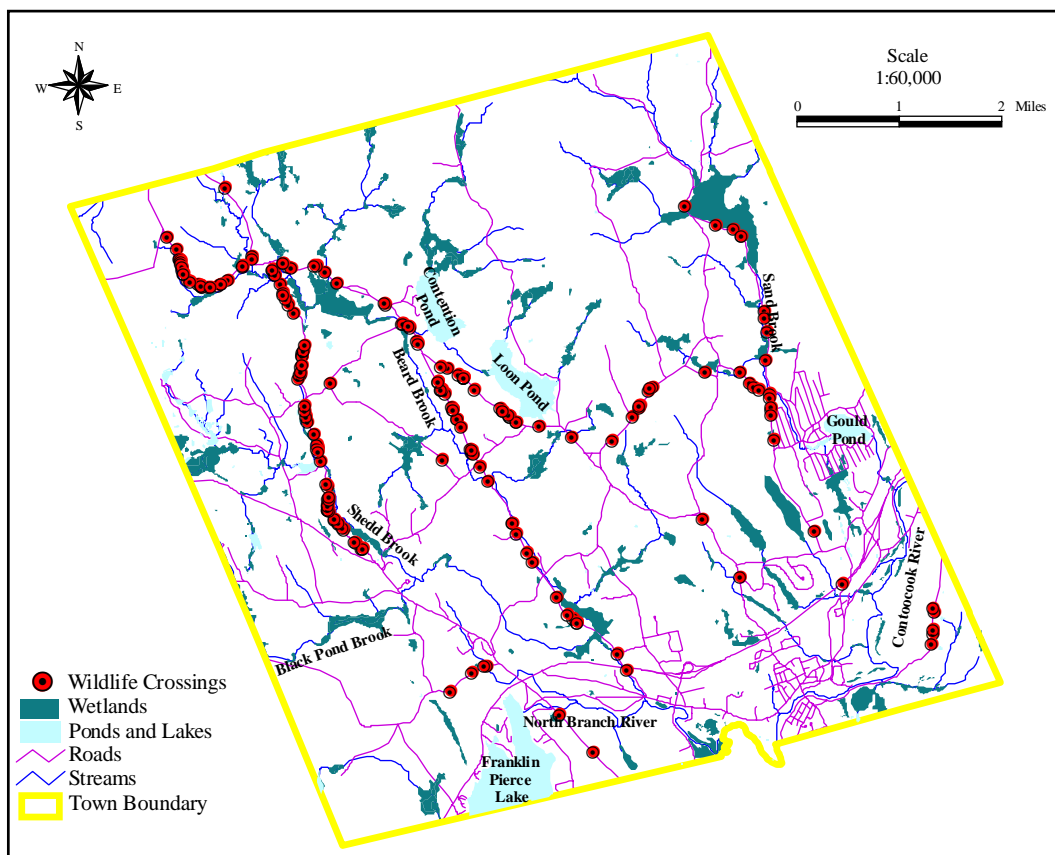


Figure 10 Distribution of wildlife crossings in Hillsborough. This map depicts the approximate locations where wildlife were observed to have crossed the roadway during snow tracking surveys. Data sources: Moosewood Ecological LLC (2012)

Land use that continues to fragment Hillsborough's landscape, especially those on the outskirts of town decreases quality, connectivity and long term viability of wildlife habitats and natural communities. Concentrating developments within the built environment and maintaining large unfragmented blocks can help to maintain connectivity, allowing species to continue to travel from habitat to habitat to meet their life cycle needs. Likewise, the use of appropriate culverts at stream crossings can help to maintain connectivity for aquatic-related species such as otter, mink, turtles, and fish.

The urban areas of Hillsborough and NH Routes 9/202 act as major barriers for wildlife movement, inhibiting connectivity for many species from north to south. Route 31 also appears to act as a fragmenting feature that can disrupt wildlife movement. However, the more rural areas of these roads most likely allow for habitat connectivity although they also contribute to road mortality.

In general, the southern part of Hillsborough, particularly south of Route 9/202, is prohibitive for wildlife movement due to the sheer number of roadways, smaller unfragmented blocks, and dense development. Thus, habitat connectivity in this area has been negatively impacted. As noted above, this does not suggest that wildlife can't travel through parts of this area, but the long term viability and quality of habitats have been degraded. However, there are some places that still provide connectivity. The area along and south of Contoocook River in the southeast part of Hillsborough provides connectivity to the south and east of the river. Also, the area where Beard Brook and the North Branch River meet provides critical north-south connectivity. A female bear and its three cubs were videotaped by a resident. They were travelling through the area.

Major wildlife movement was associated with Shedd Brook, Beard Brook, and Sand Brook. It is in these locations where the most concentrated road crossings occurred. Wildlife movement was also noted running in parallel to these streams, helping to facilitate movement throughout the Hillsborough landscape. The majority of the crossings included deer, coyote, and red fox, which are rather abundant throughout the state. However, species that need large, unfragmented blocks, such as black bear and bobcat, were also observed in these areas.

AGRICULTURAL AND FOREST RESOURCES

Hillsborough is rich with important soils for both forest management and agriculture. These areas represent some of the best soils for the production of forest products and food, feed, and fiber from farming. These natural resources can help provide us with insight into the potential production within the working landscape.

Important Agricultural Soils

In response to the Farmland Protection Policy Act of 1981³, agricultural soils were mapped by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Based on a variety of physical and chemical properties (i.e., drainage, texture, hydric regime, pH, erodibility factor), these soils have been identified as being among the most productive lands for many types of farming practices. These include prime farmland soils, farmland soils of statewide significance, and farmland soils of local significance. Each is defined below by the USDA NRCS:

Prime Farmland

- ◆ Soils that have an aquic or udic moisture regime and sufficient available water capacity within a depth of 40 inches to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- ◆ Soils that are in the frigid or mesic temperature regime.
- ◆ Soils that have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches.
- ◆ Soils that have either no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to New Hampshire to be grown.
- ◆ Soils that have a saturation extract less than 4 mmhoc/cm and the exchangeable sodium percentage is less than 15 in all horizons within a depth of 40 inches.

³ As defined by the USDA NRCS: “The Farmland Protection Policy Act of 1981 was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses.

- ◆ Soils that are not frequently flooded during the growing season (less than a 50% chance in any year or the soil floods less than 50 years out of 100.)
- ◆ The product of the erodibility factor times the percent slope is less than 2.0 and the product of soil erodibility and the climate factor does not exceed 60.
- ◆ Soils that have a permeability rate of at least 0.06 inches per hour in the upper 20 inches.
- ◆ Soils that have less than 10 percent of the upper 6 inches consisting of rock fragments larger than 3 inches in diameter.

Farmland of Statewide Importance

These soils refer to land that is not prime or unique but is considered farmland of statewide importance for the production of food, feed, fiber, forage and oilseed crops. Criteria for defining and delineating farmland of statewide importance are determined by a state committee chaired by the Commissioner, New Hampshire Department of Agriculture, Markets and Food, with members representing the University of New Hampshire Cooperative Extension, New Hampshire Association of Conservation Districts and the New Hampshire Office of State Planning. The NRCS State Soil Scientist serves on this committee in an advisory capacity. The original criteria were established on June 20, 1983. It was updated on December 7, 2000.

Soils of statewide importance are soils that are not prime or unique and:

- ◆ Have slopes of less than 15 percent
- ◆ Are not stony, very stony or bouldery
- ◆ Are not somewhat poorly, poorly or very poorly drained
- ◆ Includes soil complexes comprised of less than 30 percent shallow soils and rock outcrop and slopes do not exceed 8 percent.
- ◆ Are not excessively drained soils developed in stratified glacial drift, generally having low available water holding capacity.

Farmland of Local Importance

Farmland of local importance is farmland that is not prime, unique or of statewide importance, but has local significance for the production of food, feed, fiber and forage. Criteria for the identification and delineation of local farmland are determined on a county-wide basis by the individual County Conservation District Boards. The original criteria were established on June 20, 1983. Updates are noted according to the county initiating the update. The criteria for soils of local importance in Hillsborough are as follows:

- ◆ Soils that are poorly drained, have artificial drainage established and are being farmed.
- ◆ Specific soil map units identified from the NRCS county soil survey legend, as determined by the Conservation District Board.

Important agricultural soils cover approximately 9,018 acres, or roughly 32% of Hillsborough (Table 7 and Figure 11). These soils are widely distributed throughout the town. Prime farmland soils make up about 4.7% of the total acreage of agricultural soils while farmlands of local and statewide significance represent 95.3% of these soils.

Table 7. Summary of important soils for farm production in Hillsborough.

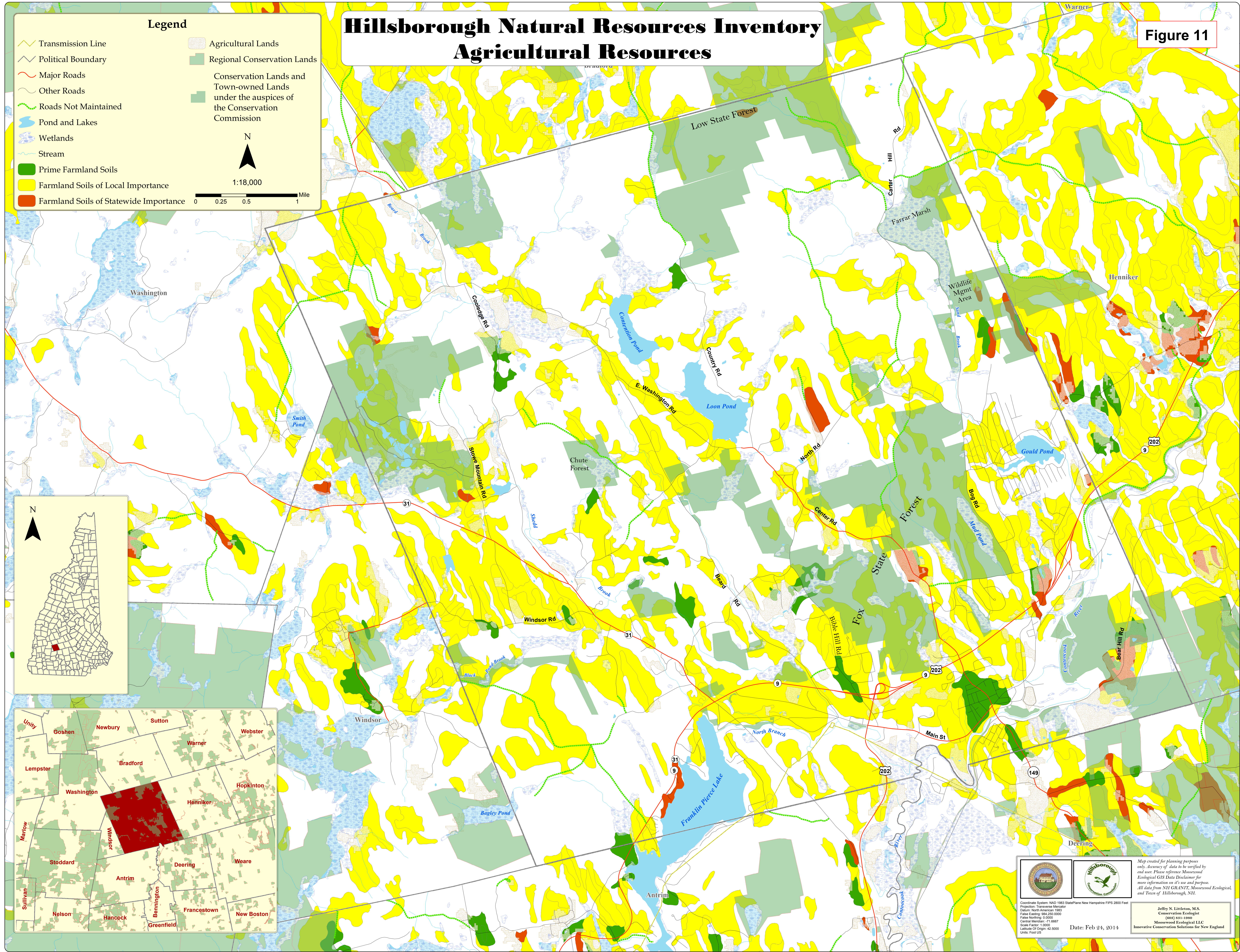
Important Soil Type	Size (acres)	% of Town
Prime Farmland Soils	420.7	1.5
Farmland Soils of Statewide Significance	274.6	1.0
Farmland Soils of Local Significance	8,322.9	29.1

SOURCE: GIS Analysis (Moosewood Ecological 2012) of USDA Natural Resources Conservation Service soils.

Hillsborough Natural Resources Inventory

Agricultural Resources

Figure 11



Important Forest Soils

Forest resources within New Hampshire are significant for many reasons. They provide sources of employment, a multitude of forest products, promote local economies, recreation and tourism, provide clean air, help sequester carbon, and provide substantial habitats for wildlife and plants, as well as diverse ecological functions (such as nutrient cycling, carbon sequestration, water quality maintenance through sediment trapping). For these reasons, it is important to maintain large tracts of forest lands and to better understand where important forest soils exist in Hillsborough.

The USDA Natural Resources Conservation Service has mapped the distribution of important forest soils and has classified them according to their capacity to grow trees. These soils signify areas as providing the most productive lands for timber production. The NRCS has identified three soils groups within this category and have described each as follows:

Forest Soil Class IA

This group consists of the deeper, loamy textured, moderately well, and well-drained soils. Generally, these soils are more fertile and have the most favorable soil moisture relationships. The successional trends on these soils are toward stands of shade tolerant hardwoods, i.e., beech and sugar maple. Successional stands frequently contain a variety of hardwoods such as red oak, beech, sugar maple, red maple, white birch, yellow birch, aspen, and white ash in varying combinations with red spruce, hemlock, and white pine. Hardwood competition is severe on these soils. Softwood regeneration is usually dependent upon persistent hardwood control efforts.

Forest Soil Class IB

The soils in this group are generally sandy or loamy over sandy textures and slightly less fertile than those in group IA. These soils are moderately well and well drained. Soil moisture is adequate for good tree growth, but may not be quite as abundant as in group IA soils. Soils in this group have successional trends toward a climax of tolerant hardwoods, predominantly beech. Successional stands, especially

those which are heavily cutover, are commonly composed of a variety of hardwood species such as red oak, red maple, aspen, paper birch, yellow birch, sugar maple, and beech, in combinations with white pine, red spruce, balsam fir, and hemlock. Hardwood competition is moderate to severe on these soils. Successful softwood regeneration is dependent upon hardwood control.

Forest Soil Class IC

The soils in this group are outwash sands and gravels. Soil drainage is somewhat excessively to excessively drained and moderately well drained. Soil moisture is adequate for good softwood growth, but is limited for hardwoods. White pine, red maple, aspen, and paper birch are common in early and mid-successional stands. Successional trends on these coarse textured, somewhat droughty and less fertile soils are toward stands of shade tolerant softwoods, i.e., hemlock and red spruce. Hardwood competition is moderate to slight on these soils. Due to less hardwood competition, these soils are ideally suited for softwood production. With modest levels of management, white pine can be maintained and reproduced on these soils. Because these soils are highly responsive to softwood production, especially white pine, they are ideally suited for forest management.

Important forest soils represent nearly 16,000 acres, or approximately 57% of Hillsborough (Table 8 and Figure 12). Forest soil groups IA and IB make up the majority of this resource and are most ideally suited for hardwood production. Soil group IC appears to be more restricted to stream drainages where outwash sands and gravels were deposited by glacial activity about 11,000 years ago. Group IC soils types are suited for softwood production, mainly white pine.

Table 8. Summary of important forest soils for timber production in Hillsborough.

Important Soil Type	Size (acres)	% of Town
Hardwood Production (Groups IA and IB)	16,486.1	57.6
Softwood Production (Group IC)	1,767.4	6.2

SOURCE: GIS Analysis (Moosewood Ecological 2012) of USDA Natural Resources Conservation Service soils.

Hillsborough Natural Resources Inventory

Forest Resources

Figure 12

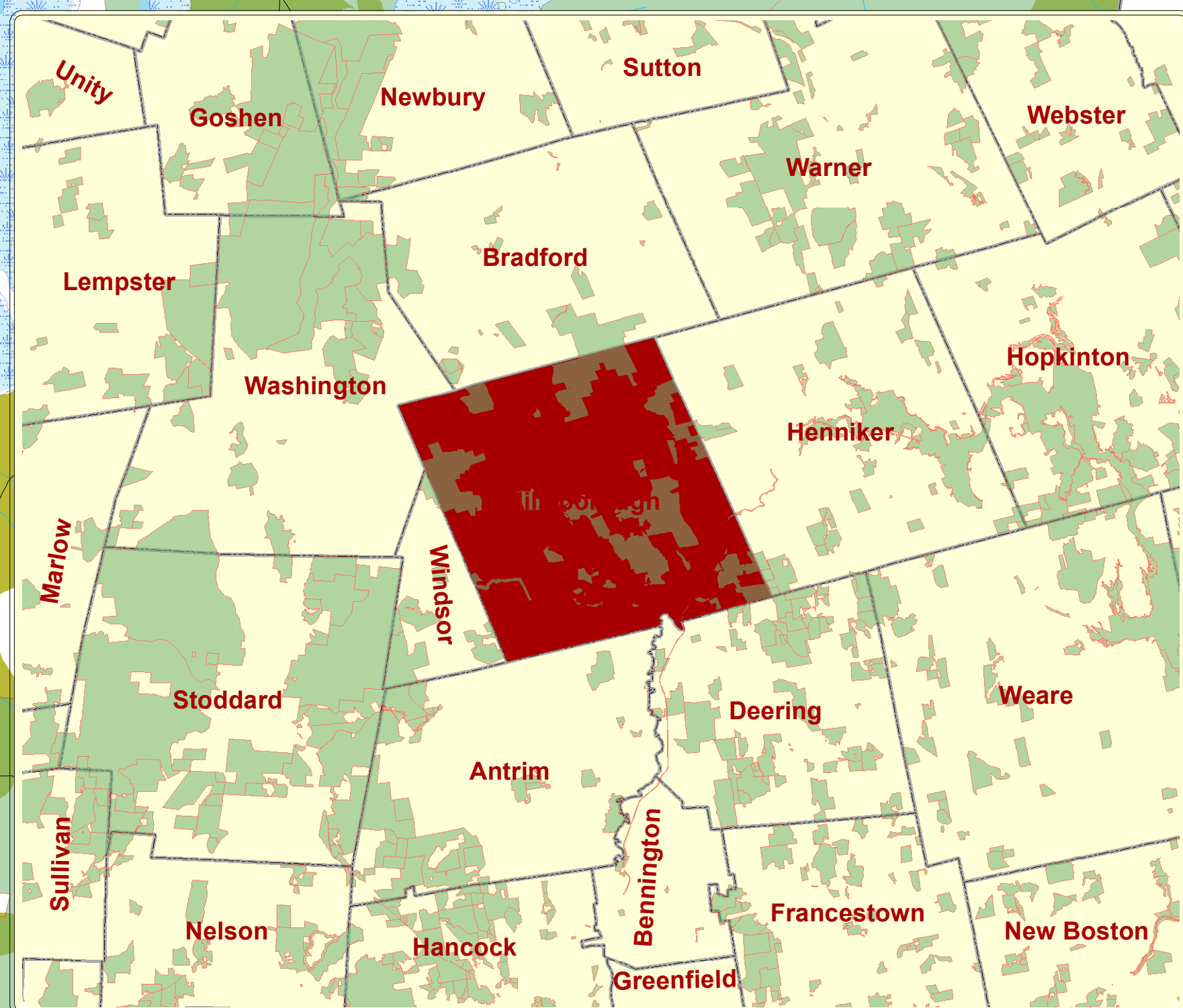
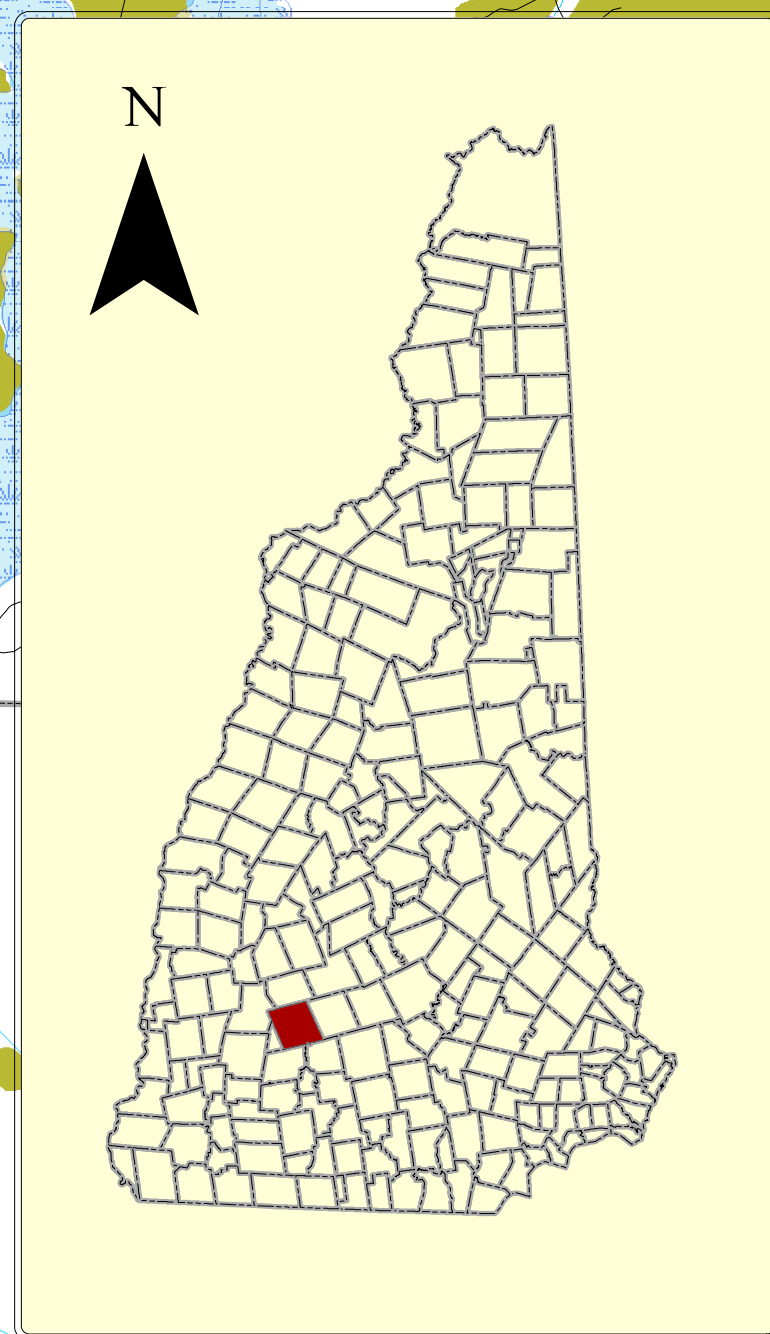
Legend



- Transmission Line
- Regional Conservation Lands
- Conservation Lands and Town-owned Lands under the auspices of the Conservation Commission
- Stream
- Political Boundary
- Major Roads
- Other Roads
- Roads Not Maintained
- Ponds and Lakes
- Wetlands
- Forest Soils
 - Group IA and Group IB
 - Group IC



1:18,000

0 0.25 0.5 1 Mile





Map created for planning purposes only. Accuracy of data to be verified by end user. Please reference Mooswood Ecological GIS Data Disclaimer for more information on it's use and purpose. All data from NH GRANIT, Mooswood Ecological, and Town of Hillsborough, NH.

Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 984,200.0000
False Northing: 0.0000
Central Meridian: -71.6667
Scale Factor: 1.0000
Latitude Of Origin: 42.5000
Units: Foot US

Jeffrey N. Littleton, M.S.
Conservation Ecologist
(603) 851-1860
Mooswood Ecological LLC
Innovative Conservation Solutions for New England

Date: Feb 24, 2014

CONSERVATION LANDS

There are approximately 5,831 acres of conservation and town-owned lands in Hillsborough (Table 9 and Figure 13). The majority of these lands are privately owned and protected by conservation easements. The Society for the Protection of NH Forests holds conservation easements on the largest acreage of protected lands. This is in contrast to protected public lands owned by the State of NH, including Low State Forest, Fox State Forest, and Farrar Marsh Wildlife Management Area, and protected lands owned by the Town of Hillsborough, which are managed under the auspices of the Hillsborough Conservation Commission.

Table 9. Conservation lands and town-owned lands under the auspices of the Hillsborough Conservation Commission.

Primary Protecting Agency	Acres	Land Ownership
NH Dept. of Resources and Economic Development	2176.8	Public
NH Dept. of Transportation	80.7	Private
NH Fish and Game	484.5	Public
Five Rivers Conservation Trust	168.1	Private
Society for the Protection of NH Forests	2486.3	Private
The Nature Conservancy	67.2	Private
Town of Hillsborough	367.4	Public

SOURCE: GRANIT Conservation Lands database (2013) and Hillsborough Conservation Commission (2013).

Hillsborough Natural Resources Inventory

Conservation Lands

Figure 13

Legend

- Regional Conservation Lands
- Transmission Line
- Political Boundary
- Major Roads
- Other Roads
- Roads Not Maintained
- Ponds and Lakes
- Stream

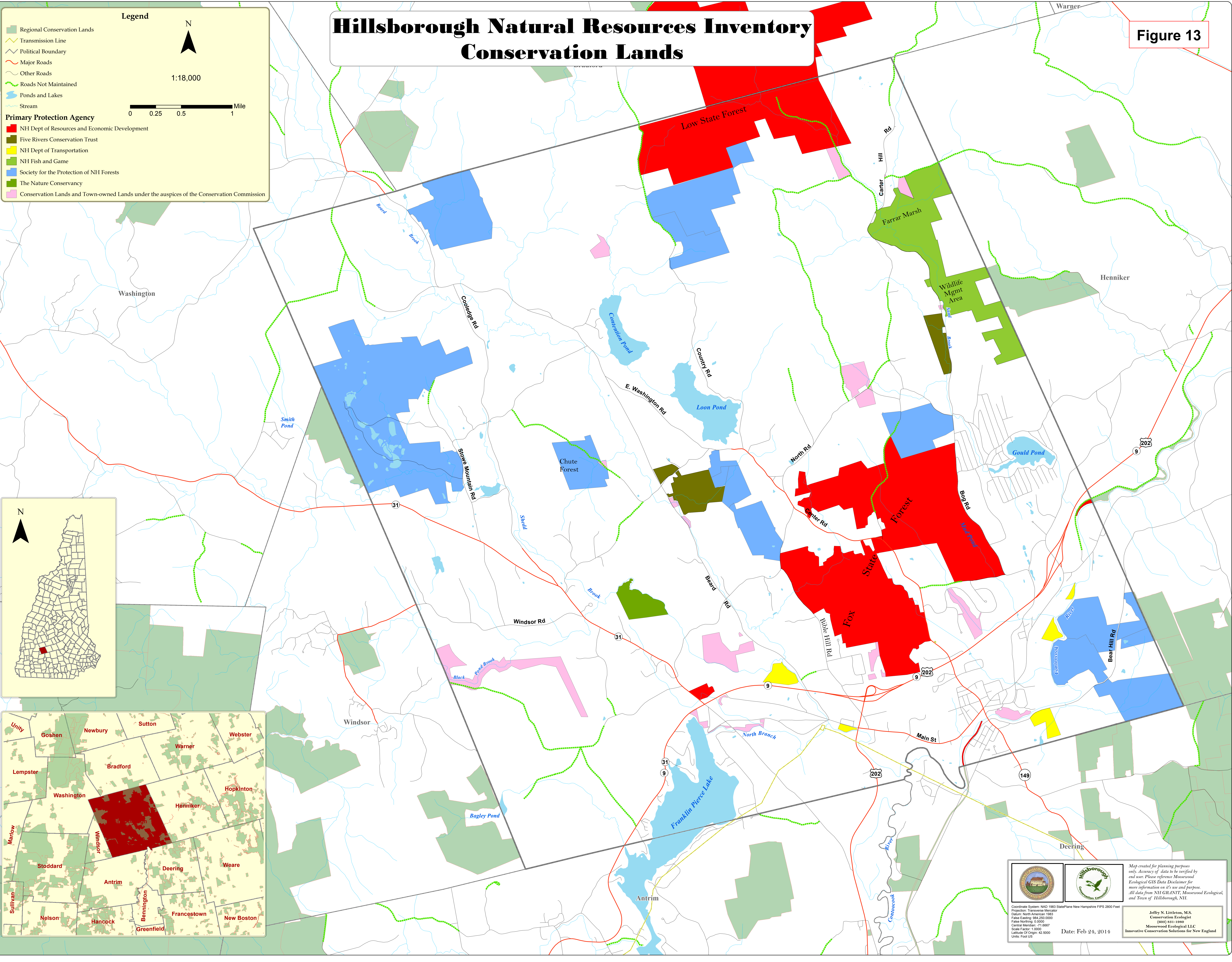
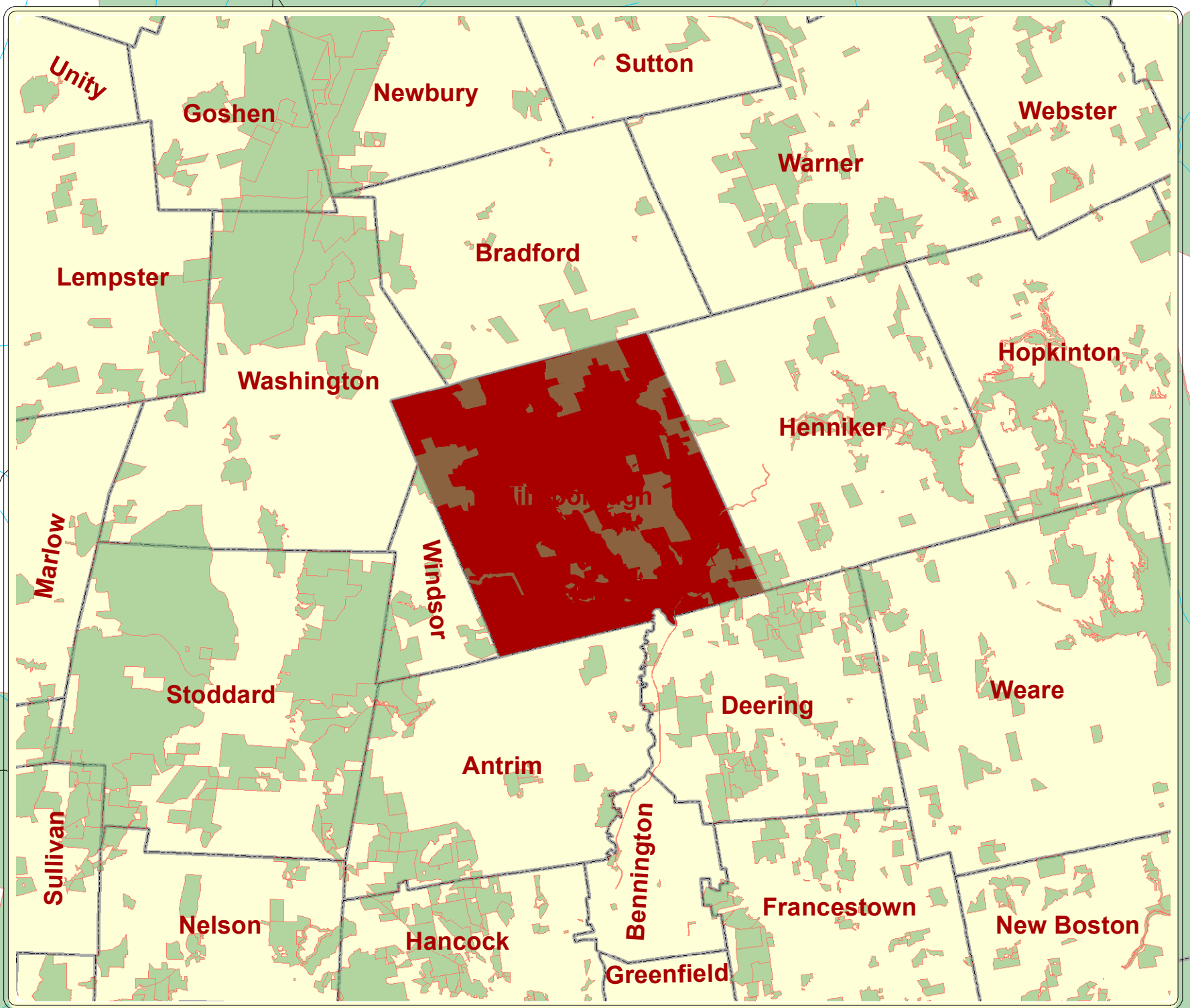
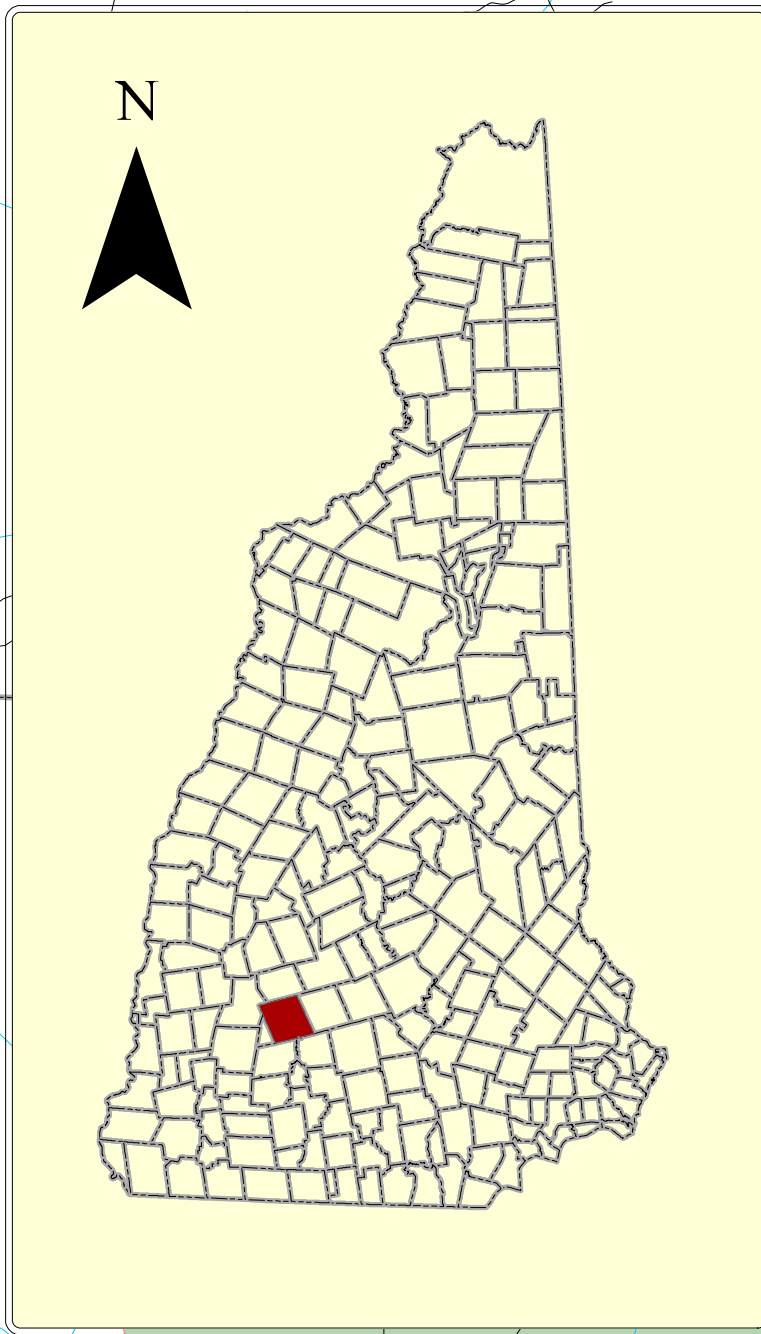
Primary Protection Agency

- NH Dept of Resources and Economic Development
- Five Rivers Conservation Trust
- NH Dept of Transportation
- NH Fish and Game
- Society for the Protection of NH Forests
- The Nature Conservancy
- Conservation Lands and Town-owned Lands under the auspices of the Conservation Commission

N

1:18,000

0 0.25 0.5 1 Mile



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CONSERVATION PRIORITIES PLAN

The final outcome of an NRI should identify high quality natural resources within the community based on the overall assessment. These areas reflect hotspots or priorities for conservation in Hillsborough. These conservation priorities are areas that exhibit unique characteristics, deserving special attention in terms of land use and management. This further provides a basis for informed land use planning, recognizing that some areas have higher value based on the various natural resources present.

The Conservation Priorities Plan was prepared for Hillsborough to provide guidance into the identification and protection of open space for significant natural resources. The Hillsborough Conservation Commission's (HCC) purpose was to focus on four major natural resource themes: water resources, ecological resources, agricultural resources, and forest resources. This Plan is intended to serve as a planning tool for the HCC, Planning Board, Select Board, schools, residents, and the state of New Hampshire.

The following maps identify high quality natural resources based on the four major themes. These can be used for community planning, education, and prioritizing areas for conservation.

Water Resources

In 2009, a report was prepared that summarized the results of a comparative wetlands evaluation in Hillsborough (Scully, 2009). This evaluation followed the protocol established in the Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire (Ammann and Stone, 1991). This project originally identified 128 wetlands in Hillsborough, of which 32 wetlands were included in the final evaluation. The evaluation criteria included wetlands greater than 10 acres and those having at least 50% of very poorly drained soils (as mapped by the US Dept. of Agriculture).

As a result, a total of 12 wetlands were ranked as having a high value, which was followed by 20 wetlands having a medium value for protection (Figure 14). These wetlands have the most desirable characteristics for protection. These include healthy and productive wildlife habitats with relatively good water quality, as well as good flood control, great sites for educational and scenic value, and ecological uniqueness.

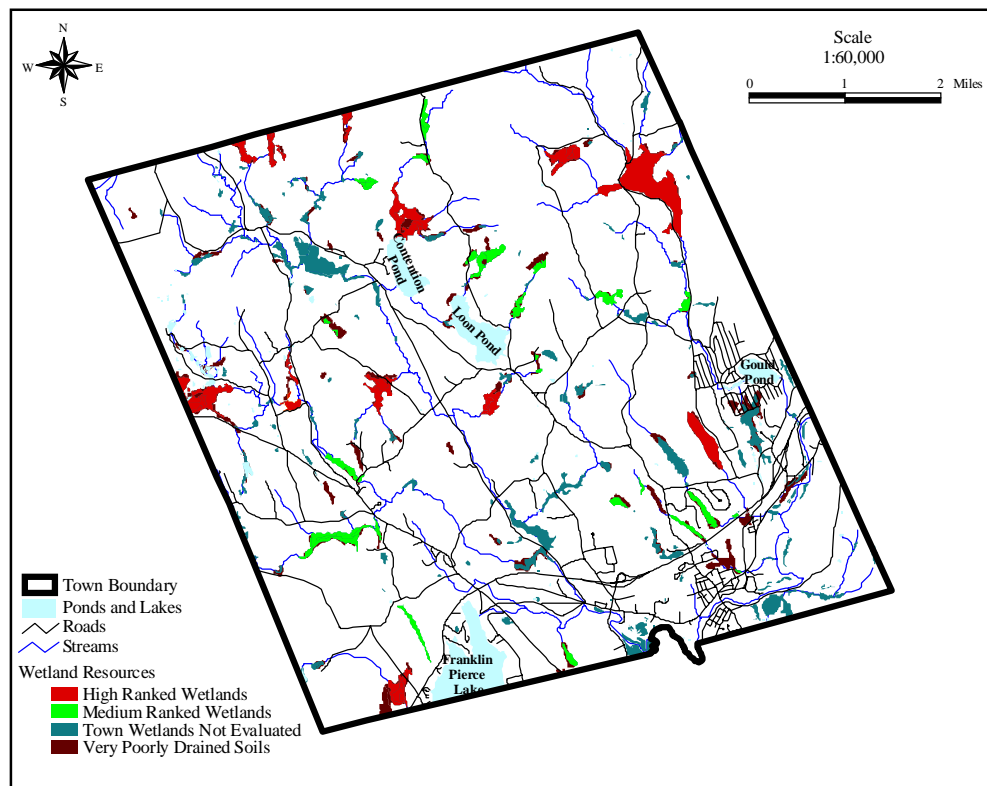


Figure 14 Highest quality wetland resources in Hillsborough. This map was developed from the wetlands evaluation final report produced in 2009. It demonstrates the top ranked wetlands from this study. This map represents wetland resources that have the highest priority for protection. Data sources: Moosewood Ecological LLC (2012), USDA soils (2009), and Scully (2009)

Agricultural Resources

Protection of agricultural resources begins with mapping important farmland soils. This included agricultural soils of significance. Combining this information with areas maintained as grasslands, hayfields, and pastures provides a strong sense for agricultural preservation. It is the overlap of these resources that was used to identify high quality agricultural lands (Figure 15). Energy has already been expended to maintain them as open, productive land, and they include soils that are most productive for agricultural purposes.

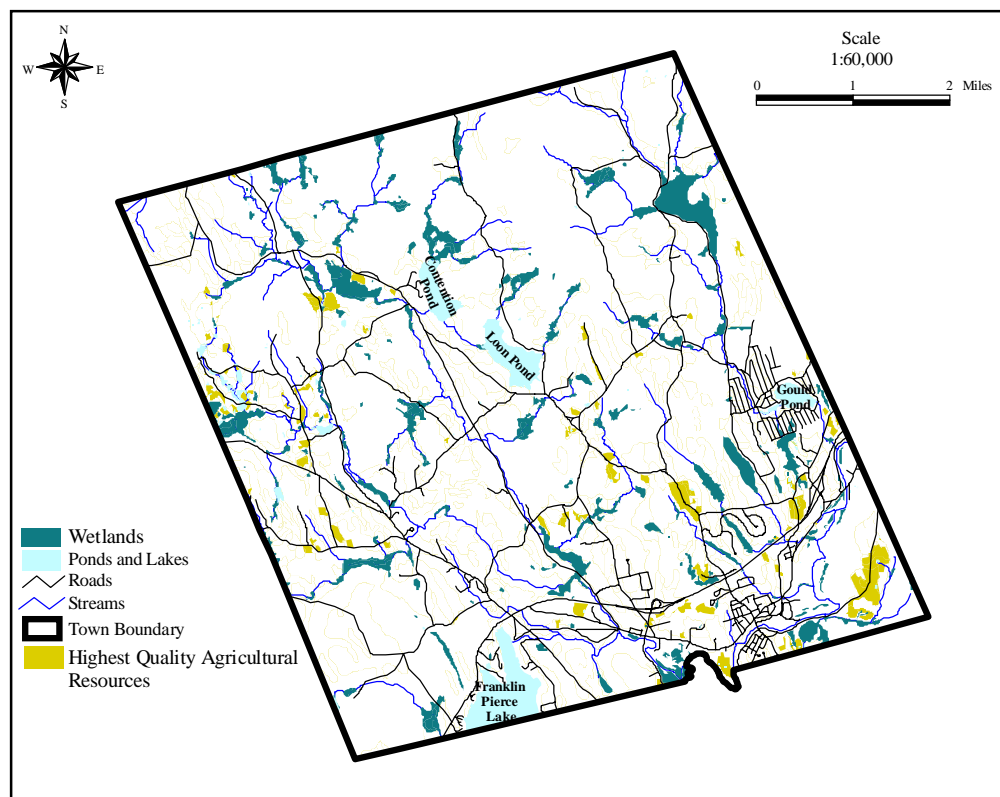


Figure 15 Highest quality agricultural resources in Hillsborough. This map shows where active farmlands and grasslands overlap with farmland soils of significance. This overlap represents the areas that have the highest priority for protecting agricultural resources. Data sources: Moosewood Ecological LLC (2012) and USDA soils (2009)

Forest Resources

The distribution of significant forest soils was a starting point to map high quality forest lands for Hillsborough. This was combined with unique forest types observed during field assessments and unfragmented lands. This afforded the opportunity to identify conservation priorities for forest lands (Figure 16). This map demonstrates the location of forests within the unfragmented landscape that have some of the most productive soils for growing trees and unique forests, such as exemplary floodplain forests and enriched forests. These areas were then further refined based on 2010 aerial photography to account for developed areas. The more remote sites would have higher priority than those located within or adjacent to heavily developed areas. It is assumed that heavily developed areas are associated with an increased risk of invasive plants, pollution, and possible misuse of resources.

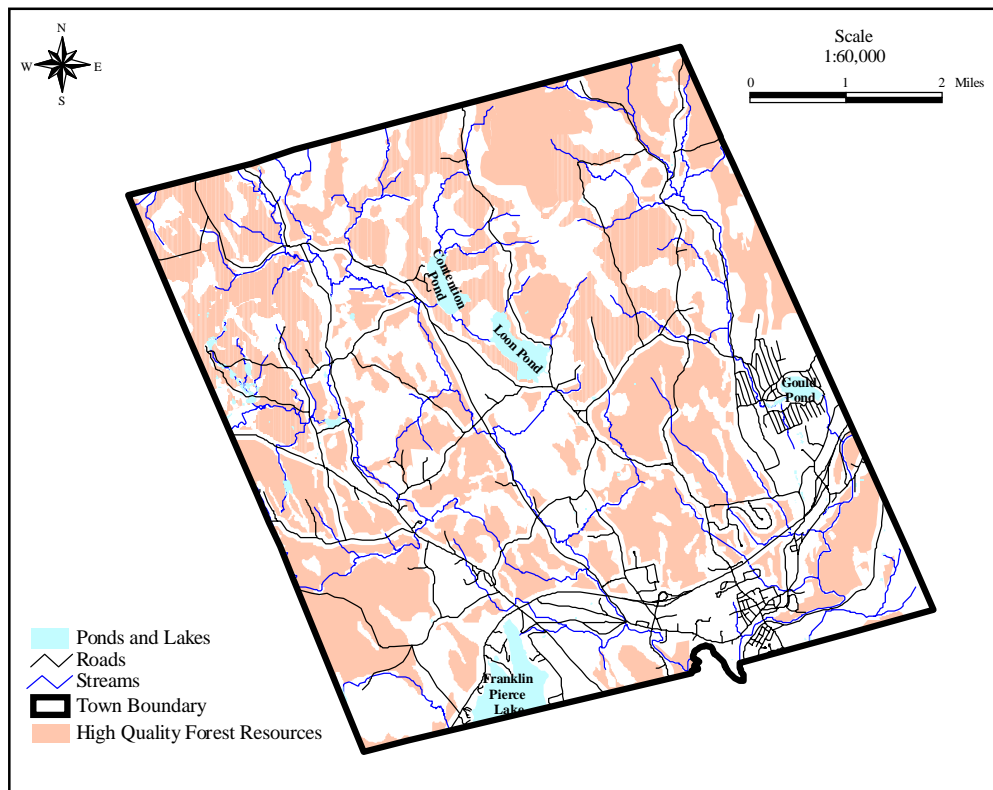


Figure 16 Highest quality forest resources in Hillsborough. This map was developed from a combination of best forest soil types within the unfragmented landscape, and unique forest types. This map represents areas that have the highest priority for protecting forest resources. Data sources: Moosewood Ecological LLC (2012), USDA soils (2009), 2010 aerial photography, and refined Wildlife Action Plan unfragmented forest blocks (2010).

Ecologically Significant Areas

Ecologically Significant Areas (ESAs) were identified using a multitude of factors. These included a combination of unfragmented lands, wildlife movement and habitat connectivity, clustering effect of significant habitats that occur in close proximity to one another, presence and distribution of focal species, wetlands of high value, presence and distribution of exemplary natural communities, priorities for conservation developed by the NH Fish and Game Wildlife Action Plan, as well as predicted high quality habitats, and a co-occurrence analysis of natural resources. These landscape-level considerations aid in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the built and natural environments.

Six ESAs have been identified in Hillsborough (Figure 17). These ESAs can serve as a starting point for identifying overall conservation priorities within Hillsborough. In addition, the Quabbin to Cardigan conservation initiative identifies most of the northern half of town as a core conservation focus area. Below is a brief explanation of the special ecological attributes associated with each ESA.

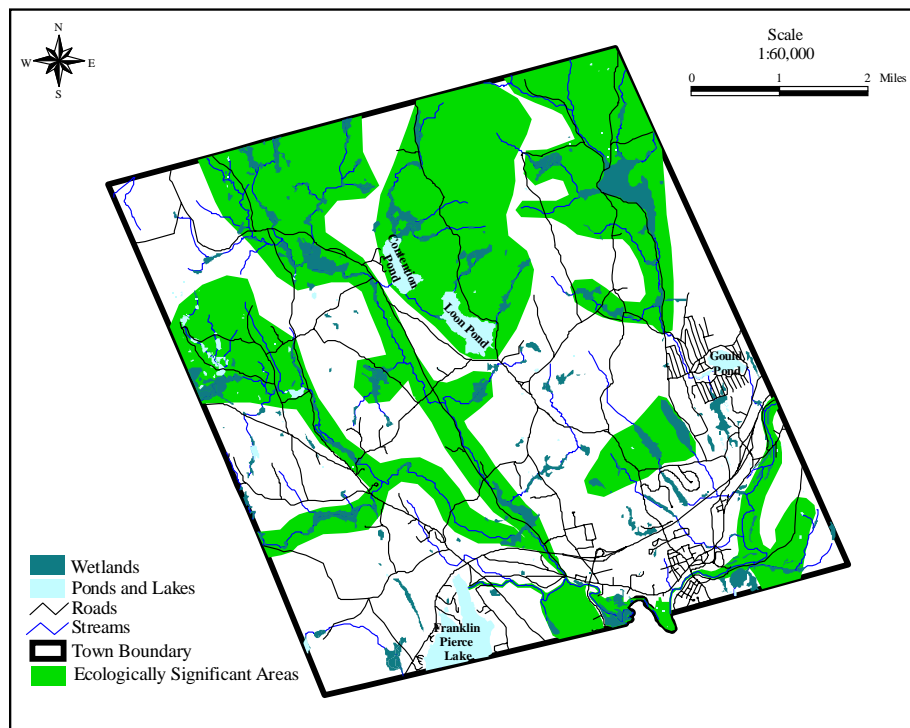


Figure 17 Highest quality ecological resources in Hillsborough. This map was developed from a variety of data sources, including site assessments. This map represents areas that have the highest priority for protecting ecological resources. Data sources: Moosewood Ecological LLC (2012).

Ecologically Significant Area A – Shedd Brook and Black Pond Brook Vicinity

This ESA focuses on Shedd Brook and Black Pond Brook and its associated upland and floodplain forests, as well as the Stowe Hill area. Below is a list of factors that were used to distinguish this area as an ESA.

- While many of the sections of Shedd Brook are associated with relatively smaller blocks of unfragmented lands, there are two sections that are relatively larger. The Black Pond Brook section is part of a 14,700-acre block of unfragmented forest and wetlands that extends westward. Likewise, the Stowe Hill area off of Stowe Mountain Road is associated with a 4,770-acre unfragmented block of land. Although these two blocks are located on the fringe of these unfragmented areas they serve as important buffers from the adjacent roadways and developments. This area also contains diverse habitats, including Shedd Brook and Black Pond Brook, floodplains, marshes, peatlands, swamps, grasslands, vernal pools, and a mixture of different forest ecosystems.
- Shedd Brook maintains habitat connectivity for wildlife. Tracks of many species were observed moving along Shedd Brook, as well as crossing Cooledge Road. Coyotes were most abundant followed by deer, but other species were also noted, such as red fox, bear, and fisher. It is suspected that other focal species, such as otter and mink, are also present in this area. Route 31 appears to be a major obstacle for mammal movement as there was a significant lack of mammal crossings. Route 31 is most likely associated with high rates of wildlife mortality due to its heavy use.
- Shedd Brook, Black Pond Brook, and their tributaries are among some of the highest ranked habitats in New Hampshire. Significant floodplains line various stretches along Shedd Brook and two large marshes have been identified as top-ranked habitats, as well as several tributaries. These include the Shedd Brook marsh along the western town boundary and the one located along Black Pond Brook. These floodplains and marshes have been identified by the NH Wildlife Action Plan as highest ranked habitat for the biological region. This ESA

contains a few confirmed and potential vernal pools. These pools support obligate species (such as spotted salamanders, wood frogs, and fairy shrimp) that need these habitats in order for long-term survival.

- Two focal species were observed, including bear and beaver. As mentioned above, it is suspected that otter and mink are using the streams in this ESA.
- This ESA contains four significant wetlands, including two high-valued wetlands and two medium-valued wetlands.
- The majority of the area has some of the best forest soils for growing hardwood forests. However, smaller stretches along Shedd Brook contain great soils for growing white pine. There are also several patches of high quality agricultural resources scattered around the Stowe Hill area.
- This ESA contains some sites with high rates of co-occurrence of natural resources within Hillsborough, ranging 11-16 natural resources co-occurring together. This analysis was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).

Ecologically Significant Area B – Beard Brook Vicinity

This ESA focuses on Beard Brook and its associated wetlands and floodplain forests, as well as its major tributaries. Below is a list of factors that were used to distinguish this area as an ESA.

- This ESA is associated with several unfragmented blocks. Smaller blocks can be found in the southern section associated with a greater density of developments, while the northern section is associated with much larger blocks, ranging in size from 2,100 acres to over 22,000 acres. Although they are located on the fringe of these unfragmented areas they serve as important buffers from the adjacent roadways and developments. This area also contains diverse habitats,

including Beard Brook and its tributaries, floodplains, marshes, peatlands, swamps, grasslands, vernal pools, and a diversity of upland forests.

- Beard Brook maintains habitat connectivity for wildlife. Tracks of many species were observed moving along Beard Brook, as well as crossing Beard Road and East Washington Road. Deer and coyote were most abundant but other species were also noted, such as gray fox, bear, moose, bobcat, mink, otter and hare. The presence of Route 9 across Beard Brook most likely does not significantly impede wildlife movement, especially since it spans all of Beard Brook and some of the adjacent forest. However, Main Street, just north of Contoocook River, most likely presents some challenges for wildlife movement mainly due to lack of significant habitat cover and potential for road mortality.
- Beard Brook and its tributaries are among some of the highest ranked habitats in New Hampshire. This area also includes significant floodplains along Beard Brook in the southern section of the ESA. The large wetland off East Washington Road was identified as having the highest ranked habitat in the biological region. Other areas within this ESA were also noted as having the highest ranking for the biological region. This ESA contains a few confirmed and potential vernal pools. These pools support obligate species (such as spotted salamanders, wood frogs, and fairy shrimp) that need these habitats in order for long-term survival.
- Several focal species were observed, including bear, beaver, bobcat, moose, mink, otter, and bobolink.
- Six significant wetlands have been identified in this area. Five of these include wetlands of high value in Hillsborough.
- While no rare species or natural communities were observed, one species of conservation concern, the bobcat, was recorded.
- More than half of this ESA is noted as having some of the highest quality soils for timber production for both hardwoods and white pine. It also has a few locations of the highest quality agricultural resources.

- This ESA has one of the highest rates of co-occurrence of natural resources within Hillsborough, ranging from high (11-16 natural resources co-occurring together) to very high (17-23 natural resources co-occurring together). This analysis was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).
- The southern section of this ESA is associated with a fairly large aquifer, parts of which have been identified as significant due to its relatively high yield and good water quality which is valuable as a potential future drinking water supply.

Ecologically Significant Area C – Contention Pond-Loon Pond Vicinity

This ESA focuses on Contention Pond and Loon Pond, as well as areas to the north. Below is a list of factors that were used to distinguish this area as an ESA.

- This area is part of an extensive 21,842-acre block of unfragmented forest and is Hillsborough's largest unfragmented block. It is home to a wide variety of habitats, including vernal pools, marshes, peatlands, swamps, streams, south-facing slopes, open waterbodies, and a variety of upland forest ecosystems.
- This area helps to maintain wildlife connectivity to the south, as well as to the east and west. Its rural and remote nature within a large unfragmented block of diverse habitats supports wildlife movement throughout the area.
- Portions of this ESA are among some of the highest ranked habitats in New Hampshire. Contention Pond, Loon Pond, and their adjacent uplands, tributaries, and wetlands are identified as significant habitats by the NH Wildlife Action Plan. This area also includes scattered vernal pools, a heron rookery, and a diversity of upland forests types.
- Thompson Hill and a few other areas have steep, south-facing slopes. These areas may provide good opportunities for den sites, unusual forest communities, and good bobcat habitat.

- Common loon has been documented to nest around Loon Pond. This is a species listed as threatened on the NH state list.
- Four focal species were associated with this ESA, including moose, bobcat, black bear, and beaver. Actually, three moose were observed on the town-owned property within this area on the same day, including a bull moose feeding in the wetland and a cow and its calf in the adjacent forest. Given the remote nature of this area it is expected that additional focal species are using this area throughout the year.
- This ESA contains several significant wetlands, including one high value wetland adjacent to Contention Pond, and five medium valued wetlands (one of which is located on a town-owned property).
- A large portion of this area has some of the highest ranked habitats in NH as defined by the NH Wildlife Action Plan, including several significant wetlands as noted above, riparian areas, and important open water bodies (Loon Pond and Contention Pond).
- Extensive areas are associated with some of the best forest soils for hardwood production, while a small area is great for white pine.
- Scattered areas within this ESA had high rates of co-occurrence of natural resources, ranging from 11-16 different natural resources co-occurring in the same place. This was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).

Ecologically Significant Area D – Farrar Marsh-Sand Brook Vicinity

This ESA focuses on Sand Brook and Farrar Marsh vicinity, including significant wetland and upland habitats, as well as some headwater streams of Sand Brook. Below is a list of factors that were used to distinguish this area as an ESA.

- The Farrar Marsh-Sand Brook ESA is located within Hillsborough's largest unfragmented block of land, extending into Bradford and Henniker and

covering nearly 22,000 acres. This area also contains diverse habitats, including Sand Brook and its tributaries, Farrar Marsh, other marshes, open water, swamps, vernal pools, and a diversity of upland forests.

- A variety of tracks and other signs were observed in parallel with Sand Brook, as well as along and crossing Bog Road, Flint Road, Colby Road, and Dean Hill Road. Coyote was the most abundant but focal species such as bobcat and bear were also observed. Like much of the northern half of Hillsborough this area provides good connectivity to many significant habitats in the surrounding area with minor impediments for movement. Its rural and remote nature within a very large unfragmented block of diverse habitats supports wildlife movement.
- Most of the wetlands within this ESA were top-ranked for the biological region by the NH Fish and Game Wildlife Action Plan. This in combination with the very large unfragmented block resulted in areas to the west and north of, and including, Farrar Marsh as being among the top-ranked in the state and biological region.
- There are at least five verified and two potential vernal pools known to exist within this ESA. These pools support obligate species (such as spotted salamanders, wood frogs, and fairy shrimp) that need these habitats in order for long-term survival.
- Some areas north of Farrar Marsh have steep, south-facing slopes. These areas may provide good opportunities for den sites, unusual forest communities, and good bobcat habitat.
- Beaver, black bear, otter, and bobcat were focal species observed within this area. Bobcat was noted crossing roadways in the southern section of this area. Based on habitat availability and diversity, it is expected that other focal species are using this area such as mink and moose.
- This ESA has four significant wetlands, including two ranked as high value (including Farrar Marsh) and two ranked as medium value.

- While no rare species or natural communities were observed there was one species of conservation concern, the bobcat, which was recorded just south of this area.
- Over half of this area has significant soils for timber production, most of which are well-suited for hardwood production.
- Wetlands within this area (including Farrar Marsh) were ranked as having a high rate of co-occurrence of natural resources (11-16 natural resources co-occurring together). This analysis was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).

Ecologically Significant Area E – Fox State Forest Vicinity

This ESA focuses on the middle sections of Fox State Forest on either side of Center Road and grasslands in between these forested areas. It also focuses on two significant wetlands. Below is a list of factors that were used to distinguish this area as an ESA.

- This ESA is associated with two fairly large-sized blocks of unfragmented lands (933 acres and 1,515 acres). These areas are surrounded by roadways and residential developments. This area also contains diverse habitats, including a heron rookery, marshes, peatlands, swamps, streams, vernal pools, grasslands, and upland forests with a diversity of age classes including some old trees.
- While deer and coyote were abundant in Fox State Forest, the only evidence of wildlife crossing Center Road was red fox tracks located just north of the ESA. Since this area is surrounded by roadways and associated residential development (heavy in some places), it is suspected that this area maintains connectivity for wildlife (those with smaller home ranges or those accustomed to humans) such as fox, skunk, raccoon, coyote, and deer.
- One of the wetlands serves as a significant feeding habitat for herons, as well as a rookery for both great blue herons and green herons.

- The grasslands/hayfields provide significant habitat for grasslands birds, including bobolinks.
- Three focal species were observed in this area, including bobolink, red-shouldered hawk, and beaver. Mink tracks were observed along the stream that feeds the heron rookery and they are suspected to be present within the ESA.
- This ESA has three significant wetlands, including one ranked as high value (Mud Pond) and two ranked as medium value.
- Two exemplary natural communities are located within this ESA, including a red maple-black ash swamp on the western side of Fox State Forest and a poor level fen/bog system located in Mud Pond. These are considered to be of very high importance for protection by the NH Natural Heritage Bureau. Historically, this ESA was known for six rare species but these observations dated back from 1936-1983 and need confirmation of their current existence.
- The grasslands/hayfields associated with the bobolinks have some of the highest quality agricultural resources in Hillsborough. The majority of the ESA has significant soils for hardwood production.
- A couple of small areas were noted to have a relatively high co-occurrence of natural resources (11-16 natural resources co-occurring together). This analysis was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).

Ecologically Significant Area F – Contoocook River-North Branch River-Bear Hill Road Grasslands

This ESA focuses on the entire stretch of the Contoocook River, the North Branch River and their associated upland and floodplain forests, as well as the significant grasslands and pastures along Bear Hill Road. Below is a list of factors that were used to distinguish this area as an ESA.

- The western section of this ESA is part of a 3,056-acre block of unfragmented forest with a diversity of habitats, including the Contoocook River (a significant NH Designated River) and portions of its tributaries, unique floodplain forests, abundant vernal pools, upland forests, and important grasslands. The western half is associated with smaller unfragmented blocks and more developments. However, the Contoocook River and The North Branch are both NH Designated Rivers. Also, there is a significant array of diverse habitats, including floodplains, wetlands, and grasslands, at the confluence of the Contoocook River and the North Branch River.
- The forests and fields southwest of the Contoocook River are most likely serving as a conduit for wildlife movement to and from the river. Based on limited site visits it appears that the eastern part of the Contoocook River and adjacent forests also allow fairly unobstructed movement for wildlife such as mammals, birds, amphibians, and reptiles. Aquatic wildlife movement is largely available east (or upstream) of the dam at Bridge Street, which serves as a major obstacle for aquatic species movement.
- Significant floodplains grace various stretches along the Contoocook River, rich in habitat and species diversity. These floodplains have been identified by the NH Wildlife Action Plan as highest ranked habitat for the state and the biological region.
- The grasslands and pastures along Bear Hill Road function as significant habitat for bobolinks, hosting the largest population of this focal species in Hillsborough. These grasslands and pastures have been identified by the NH Wildlife Action Plan as highest ranked habitat for the biological region.
- The eastern half of this ESA has a very high density of confirmed and potential vernal pools along the Contoocook River. These pools support obligate species (such as spotted salamanders, wood frogs, and fairy shrimp) that need these habitats in order for long-term survival.
- There was a relatively high density of focal species within the eastern section, including moose, mink, beaver, otter, osprey, and bobolink.

- An exemplary floodplain forest is located within the eastern section of this ESA. The silver maple-false nettle-sensitive fern floodplain forest was noted by the NH Natural Heritage Bureau to be of very high importance for conservation.
- The majority of the eastern stretch along the Contoocook River has some of the best forest soils for growing hardwood forests. These soils are also present at the confluence of the Contoocook River and the North Branch River.
- This ESA contains the largest contiguous block (greater than 110 acres) of highest quality agricultural resources in Hillsborough. Another significant area can be found just east of the confluence of the Contoocook River and the North Branch River.
- It has some of the highest rates of co-occurrence of natural resources within Hillsborough, ranging from high (11-16 natural resources co-occurring together) to very high (17-23 natural resources co-occurring together). This analysis was based on the greatest possibility of 23 different natural resources that could occur together in the same place (see Appendix E for a list of these natural resources).
- This area contains some of the most significant stratified drift aquifers in Hillsborough. It has been identified as having some of the best spots for potential future drinking water sources based on water quantity and quality.

Recommendations

The information provided herein, including the various maps, can be used when considering the adoption of various land use planning techniques or when working with willing landowners on resource protection efforts. The data used to develop such information represents the most current, readily available data to better understand Hillsborough's natural resources. As such, there are some basic guidelines that the town can use to promote innovative and informed land use planning.

- protect large unfragmented blocks, especially those with high quality habitats located within close proximity of one another and with limited barriers for wildlife movement;
- protect known rare species populations;
- protect representative examples of critical habitats for known rare species;
- protect rare and representative examples of natural communities;
- protect intact wetland and stream riparian buffers and promote the restoration of degraded areas;
- support voluntary and regulatory approaches at natural resources protection;
- build upon existing contiguous protected lands;
- connect protected lands and other critical habitats with upland, aquatic, and/or riparian corridors;
- better understand wildlife movement patterns to identify and design the most effective conservation corridors; and
- promote community education and outreach regarding Hillsborough's biodiversity and the importance of long-term protection strategies.

The following general recommendations have been provided based on the findings of the project. These are considered as the next actions steps that Hillsborough could consider as the Town proceeds with community land use planning and education.

1. Consider establishing an Open Space Committee as part of the Conservation Commission to help oversee conservation planning efforts.
2. Use the above conservation priorities maps to guide specific or general conservation planning efforts. This could include regulatory or voluntary methods. The Town might consider developing innovative land use techniques to help protect natural features, including rare species, critical habitats, rare natural communities, and large unfragmented lands. *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* (NH Dept. of

Environmental Services 2008) was designed to provide examples of various types of zoning regulations that could be implemented to promote more sustainable land use, including protective measures for various ecological attributes. This publication was developed for New Hampshire communities by the NH Department of Environmental Services in partnership with NH Association of Regional Planning Commissions, NH Office of Energy and Planning, and NH Local Government Center. It provides examples for various multi-density zoning options (i.e., density transfer credit, agricultural incentive zoning, and infill development), environmental characteristics zoning (i.e., permanent stormwater management, habitat protection, riparian protection) and site-level design (i.e., landscaping). Voluntary protection efforts could focus on working with willing landowners within ESAs as a way to maximize the results of natural resources protection.

3. Incorporate the Hillsborough NRI and Conservation Priorities Plan into the town's Master Plan. This provides a vision for the town from which adaptive land use planning can be adopted. Build public support of the NRI and Conservation Plan through informational sessions, published materials, and other means of community education and outreach. This will help to inform the community about its natural resources and future planning.
4. Conduct an audit of current zoning regulations to better understand if and how they protect critical natural resources. This effort can illuminate certain land use planning techniques that Hillsborough might want to consider adopting in an effort to develop informed land use decisions for a more sustainable future. This could identify ways to use land more efficiently, encourage more compact development, and allocate specific areas for conservation and development.
5. Continue to work with adjacent communities on similar conservation initiatives of common interest. It would be helpful to meet annually with the Conservation

Commission within each of the adjacent communities to build strong relationships and create open lines of communication, as well as to inform these communities about Hillsborough conservation planning efforts.

6. Continue with community outreach and landowner education regarding Hillsborough's natural resources and conservation planning. This can be accomplished in many ways, including workshops, hikes, printed materials such as brochures, water resource protection, and development of a citizen science program to monitor important natural resources (such as amphibian road crossings to vernal pools, culvert assessment to better understand issues with aquatic connectivity, invasive species management).

Hillsborough has a wide range of natural resources that host a diversity of species. These include ecologically significant areas such as high quality and unique examples of wildlife habitats, exemplary natural communities, rare species habitats, and Hillsborough's large unfragmented forests. Hillsborough also boasts significant natural resources that are vital for the working landscape. These include active farmlands and important soils, which signify specific areas as providing the most productive lands for agriculture and timber production. As such, this document was created to better understand where these significant natural resources are located and to devise a list of significant areas to help guide conservation planning efforts.

Planning for the protection of biological diversity is an ongoing process as more is learned from scientific research and the effects of land use. Fortunately today, land use planners are better equipped with various tools to assist with informed decision making. One such tool is the Hillsborough NRI and Conservation Priorities Plan. This report should be viewed as a work in progress. It should be reviewed and updated every 5-10 years to reflect new data, including on-site assessments, additional conservation lands, new regulatory policies, and regional conservation priorities as the natural and developed landscape evolves over time.

LITERATURE RESOURCES

- Ammann, A.P. and A.L. Stone. 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. NH Dept. of Environmental Services. Concord, NH.
- Brown, R. 2007. A Layperson's Guide to New Hampshire Current Use. Statewide Program of Action to Conserve Our Environment (SPACE), Concord, NH.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Dept. of Interior, Fish and Wildlife Service, Washington D.C. 131 pp.
- Dahl, T.E. 1990. Wetlands losses in the United States 1780s to 1980s. Department of the Interior, U.S. Fish and Wildlife Service, Washington, D.C. 21 p.
- New Hampshire Department of Environmental Services. 2008. Innovative Land Use Planning Techniques: A Handbook for Sustainable Development. New Hampshire Department of Environmental Services, Concord, New Hampshire.
- New Hampshire Fish and Game Department. 2005. New Hampshire Wildlife Action Plan. New Hampshire Fish and Game Department, Concord, New Hampshire.
- New Hampshire Natural Heritage Bureau. 2013. Rare Plants, Rare Animals, and Exemplary Natural Communities in New Hampshire Towns. Concord, NH.
- New Hampshire Office of Energy and Planning. 1998. Population Estimates and Projections database. Concord, NH.
- Society for the Protection of New Hampshire Forests. 2005. New Hampshire's Changing Landscape - Population Growth and Land Use Changes: What They Mean for the Granite State. SPNHF, Concord, NH.
- Scully, C. 2009. Inventory of Wetlands in Hillsborough, NH, and Recommendations for Designation of Prime Wetlands.
- Sperduto, D.D. 2005. Natural Community Systems of New Hampshire. New Hampshire Natural Heritage Bureau, Concord, New Hampshire.
- Sperduto, D.D. and William F. Nichols. 2004. Natural Communities of New Hampshire. UNH Cooperative Extension, Durham, New Hampshire.
- Stone, A.J.L. 2001. Natural Resources Inventory – A Guide for New Hampshire Communities and Conservation Groups. UNH Cooperative Extension, Durham, New Hampshire.

APPENDIX A

MOOSEWOOD ECOLOGICAL GIS DATA DISCLAIMER

Moosewood Ecological LLC GIS Data Disclaimer

A variety of existing and newly created data layers were used to prepare the Natural Resources Inventory (NRI) maps. These existing data have been developed by numerous government agencies and other sources. They have been produced specifically for the town, the state of New Hampshire, or the entire United States using *remote data*. These sources of remote data were developed from the interpretation of satellite imagery and aerial photography. The data were produced at various scales and therefore, represent different degrees of errors, omissions, and inaccuracies.

The NRI maps are for education and planning purposes only. They are suitable for general land use planning. However, they are not suitable for detailed site planning and design, including wetlands delineations and other jurisdictional determinations. As such, boundaries of all habitats, including wetlands, and parcels are approximate locations and should be field verified. The accuracy of the data is the end user's responsibility, and Moosewood Ecological LLC cannot be responsible for the accuracy and completeness of the data. Moosewood Ecological LLC makes no warranty, expressed or implied, as to the accuracy or completeness of the data. Furthermore, Moosewood Ecological LLC shall assume no responsibility for any errors, omissions, or inaccuracies in the information provided.

APPENDIX B

COMMUNITY FORUM I

RESULTS



Hillsborough Natural Resources Inventory Forum I Activity Results

**June 4, 2011
Baldwin Center at Fox Forest
Hillsborough, NH**

Activity 1 - Strengths and Challenges Discussion

Guiding Questions:

- 1.) What are the strengths of Hillsborough's natural resources and working lands (forestry and agriculture)?
- 2.) What are some of the challenges and concerns facing these resources?

For both questions consider the social, political and physical characteristics of Hillsborough

Results:

Strengths

- Large tracts of protected lands (both state-owned and private)
- Beautiful existing tracts of farmland
- Water resources
- Varying topography
- Current Use tax structure
- Diverse wildlife and their habitats
- Hiking trails system/old roads for recreation
- Large blocks of unfragmented lands remaining (i.e., Sulfur Hill to southwest, large forested block to the north including watershed to Loon Pond)
- Town beach areas
- Rural character of town and surrounding towns
- Cottage industry/crafts

Challenges and Concerns

- Bypass and Main Street acting as a barrier for wildlife movement
- Unmanaged forestry

- Out of town ownership
- Fragmentation
- Town located between major populated areas, including Concord, Keene, and Peterborough
- Uncontrolled recreational use resulting in land degradation
- Development pressures
- Coordination and conflicting interests between town boards
- Lack of community interest/awareness of natural resources and their importance
- Current zoning
- Expanding current conservation lands
- Logging pressure
- Trying to boost business development despite topographical challenges; puts pressure on floodplain development
- High poverty rate
- Identification of local farms and promoting local agriculture (localvore)
- Current economic climate
- Industry for tax revenue versus additional population
- “Individual versus Community” priorities
- Lack of community gardens/small farms

Activity 2 - Hillsborough’s Significant Natural Areas

Guiding Question:

1.) What are some of Hillsborough’s most significant cultural and natural areas?

Results:

- Fox State Forest (especially since it is located in the middle of town)
- Contoocook River and North Branch, including their associated wetlands/oxbows
- Lowe State Forest
- Bear Hill (recreation: hiking, snowmobiling, state trails, near downtown)
- Beard Brook and its watershed
- Natural water supplies for wildlife and recreation
- Loon Pond, Contention Pond, Pierce Lake
- Gleason Falls
- Farrar Marsh and Sand Brook
- Heron rookery on Mud Pond and another in wetland northeast of Loon Pond
- Kimball Hill
- Lou Jones’ land – 1,000 acres of protected area
- Northern border with Bradford
- “High Peaks” in town (i.e., Bear Hill, Stowe Hill, Jones Hill, Kimball Hill, Thompson Hill) acting as cultural resources for scenic vistas, hiking, and wilderness feel of unbroken woods attracts people and engages interest in Hillsborough ecological landscape
- Unfragmented block north of Fox Forest extending into Bradford and Henniker
- Significant cultural aspects include stone bridges, Grimes field, big farms along Center Road, Franklin Pierce homestead, Hillsborough Center

APPENDIX C

COMMUNITY FORUM II

RESULTS

Natural resources ranking for co-occurrence analysis for Hillsborough.

Natural Resources Datalayer	Ranking
Surface Waters (ponds, lakes, streams)	1
Wetlands (NWI and hydric soils composite)	2
Stratified Drift Aquifers	1
WAP habitats (incl. refined grasslands layer)	2
200-foot Stream Buffer	2
Heron rookery	2
South-facing slopes	2
Forested wetlands	2
Deer wintering areas	2
Orchards	2
Shrublands	2
Unfragmented Lands (>500 acres)	2
Unfragmented Lands (500-2,499 acres)	3
Unfragmented Lands (>=2,500 acres)	4
Prime Farmland Soils	3
Farmland of Local Importance	2
Farmland of Statewide Importance	2
Active agriculture	2
Important Forest Soils (IA, IB, IC)	1

APPENDIX D

HABITAT BLOCK SIZE REQUIREMENTS FOR WILDLIFE

1-19 Acres	20-99 Acres	100-499 Acres	500-2,500 Acres	>2,500 Acres
raccoon	raccoon hare	raccoon hare	raccoon hare	raccoon hare coyote
small rodent	small rodent porcupine	small rodent porcupine	small rodent porcupine	small rodent porcupine bobcat
cottontail	cottontail beaver	cottontail beaver	cottontail beaver	cottontail beaver black bear
squirrel	squirrel weasel	squirrel weasel mink	squirrel weasel mink	squirrel weasel mink fisher woodchuck
	woodchuck	woodchuck deer	woodchuck deer	woodchuck deer
muskrat	muskrat	muskrat	muskrat moose	muskrat moose
red fox	red fox	red fox	red fox	red fox
songbirds	songbirds	songbirds sharp-shinned hawk	songbirds sharp-shinned hawk bald eagle	songbirds sharp-shinned hawk bald eagle
skunk	skunk	skunk Cooper's hawk harrier broad-winged hawk kestrel great-horned owl barred owl osprey turkey vulture turkey	skunk Cooper's hawk harrier broad-winged hawk goshawk kestrel red-tailed hawk great-horned owl raven barred owl osprey turkey vulture turkey	skunk Cooper's hawk harrier broad-winged hawk goshawk kestrel red-tailed hawk great-horned owl raven barred owl osprey turkey vulture turkey
most reptiles	most reptiles garter snake ring-necked snake	reptiles garter snake ring-necked snake	reptiles garter snake ring-necked snake	reptiles garter snake ring-necked snake
most amphibians	most amphibians	most amphibians wood frog	amphibians wood frog	amphibians wood frog

APPENDIX E

LIST OF NATURAL RESOURCES USED IN THE CO-OCCURRENCE ANALYSIS

A co-occurrence model is an analytical tool that uses digital data to determine where various levels of natural resources occur in unison, or where they overlap. This analysis, in its simplest form, shows locations of co-occurring resources to assist in the identification of ecologically significant areas (ESA). While the co-occurrence model is an effective tool for an initial analysis it should be used in combination with various ecological data to determine ESAs. Below is a list of data used in the co-occurrence model.

1. Streams/rivers
2. Ponds/lakes
3. Hydric soils
4. Aquifers
5. Favorable Gravel Well Analysis
6. Hemlock-hardwood-pine forests
7. Appalachian oak-pine forests
8. Lowland spruce-fir forests
9. Northern hardwood forests
10. Grasslands
11. Floodplains
12. Deer wintering areas
13. Steep, south-facing slopes
14. Peatlands
15. Marshes
16. Forested swamps
17. Unfragmented lands
18. Prime farmland soils
19. Farmland soils of statewide significance
20. Farmland soils of local significance
21. Forest soils group IA
22. Forest soils group IB
23. Forest soils group IC