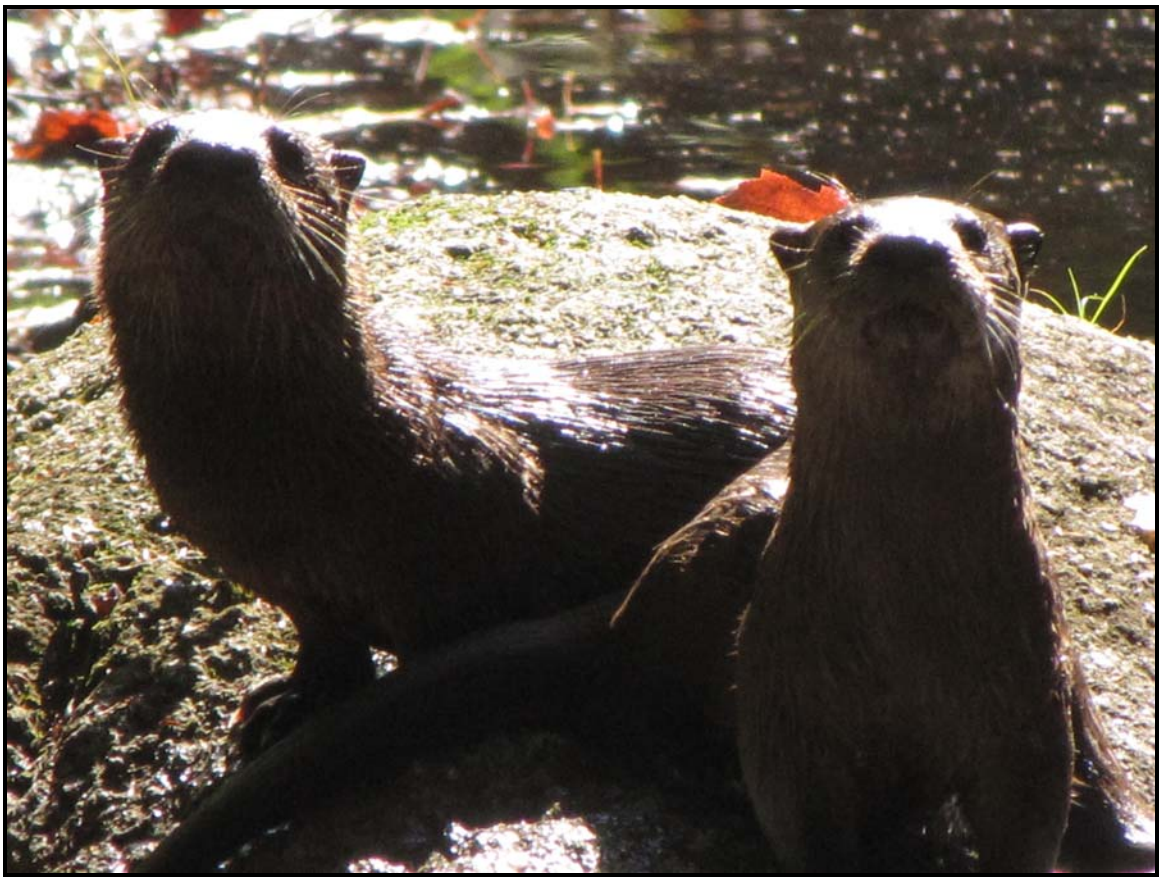
TOWN OF CHESTERFIELD
NATURAL RESOURCES INVENTORY
AND
CONSERVATION PRIORITIES

Wetlands, Wildlife, and the Working Landscape

Prepared for:
Town of Chesterfield Conservation Commission



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Cover photograph – Juvenile otters observed in the California Brook Natural Area (CBNA).

EXECUTIVE SUMMARY

The Chesterfield Natural Resources Inventory (NRI) and Conservation Priorities project was initiated in September 2008. The Chesterfield Conservation Commission contracted with Moosewood Ecological LLC to conduct the NRI. This project included a more detailed approach at creating a fine-scale NRI based on existing mapping efforts. These efforts are typically developed at a much larger scale and the accuracy of such information ultimately warrants verification. Therefore, the need exists to collect site-specific information to refine natural resources data at the local level, hence the current project.

The Wildlife Action Plan (WAP), published by the NH Fish and Game Department in 2005 and updated in 2010, represents a large-scale mapping effort to identify important wildlife habitats state-wide. While these data provide good information on the different types and distribution of habitats it is essential that they are verified through site-specific investigations. This is especially true since smaller critical habitats, such as vernal pools, heron rookeries, and rare natural communities, were not mapped as part of the WAP and can only be accurately mapped at the site-specific level.

Based on the WAP habitats and their perceived ecological conditions, highest ranked habitats have been identified throughout the state. These highest ranked habitats serve as a basis for large-scale conservation planning efforts at the state and regional levels. They also can serve as priorities for field verification on a town-level. However, these WAP state rankings should be used as only a guide while incorporating detailed site-specific data that identifies conservation focus areas at the town-level. This is because at the town-level one can incorporate more specific data that might not have otherwise been considered for the state rankings. As such, this mapping was used as a basis for conducting the fine-scale NRI in Chesterfield (see *2010 Highest Ranked Wildlife Habitats* map, p.viii).

The overall scope of this project was to develop an enhanced natural resource inventory based on wildlife habitats, natural communities, wetland functions and values, and high quality forest and agricultural lands. The purpose was to provide a long-term ecological vision for the town. Results of the project can serve as a guide to help determine where the town should prioritize its conservation efforts, as well as to promote informed land use planning and education. In particular, the goals and objectives of the project were outlined as follows:

GOAL 1 – Perform community outreach and education to foster participation by Chesterfield residents

Objective 1A – Conduct a community forum to solicit input regarding Chesterfield's natural resources and engage residents as volunteers

Objective 1B – Prepare an informational packet to assist volunteers in recording natural resources data

Objective 1C – Conduct a series of workshops to train and educate volunteers

Objective 1D – Conduct a public presentation on the findings of the project

GOAL 2 – Develop a fine-scale assessment of various natural resources in Chesterfield

Objective 2A – Map and evaluate wetlands using the Comparative Evaluation of Non-tidal Wetlands in New Hampshire (Amman and Stone 1991)

Objective 2B – Refine wildlife habitats/natural communities as mapped as part of the New Hampshire Wildlife Action Plan (NH Fish and Game 2010) and map additional on-site habitats and rare natural communities

Objective 2C – Record incidental observations of species of greatest conservation concern

Objective 2D – Map high quality agricultural resources

Objective 2E – Map high quality forest lands

Objective 2F – Develop a co-occurrence analysis[1] to help identify Conservation Focus Areas

Objective 2G – Prepare a final report on the findings of the project, including basic recommendations for future conservation planning initiatives

In cooperation with Moosewood Ecological LLC and the Cheshire County Conservation District, the Chesterfield Conservation Commission held a community forum on November 19, 2008, to engage the town's residents in the public planning process. This forum introduced the overall project background, including its goals and objectives. This was followed by a discussion on growth and natural resources protection in town. Participants identified the strengths and challenges of Chesterfield's natural resources and its working landscape, as well as began to list some of Chesterfield's most significant natural areas.

The evening also introduced the wetlands evaluation process. Participants prioritized those functional values (such as ecological health, wildlife habitat, water quality, and flood control) that were most important in Chesterfield. In addition, volunteers were solicited to help gather natural resources information on their own properties, as well as public lands (such as Pisgah State Forest, Friedsam Town Forest, and Wantastiquet State Forest). Additional properties were only assessed by the principal investigator and his field assistant. Landowners of these properties provided written permission to enter their land for natural resource assessments. To ensure the quality of the data collected, an informational packet was prepared to assist volunteers in the collection and documentation of data.

In a continued effort to solicit volunteers for the project and provide educational opportunities to residents, the Chesterfield Conservation Commission, in cooperation with Moosewood Ecological LLC and the Cheshire County Cooperative Extension, sponsored a Global Position System (GPS) workshop on April 16, 2009. The workshop trained volunteers on how to use GPS units to collect locational data for various natural resources on participant-owned lands or public properties. GPS units were provided by Cooperative Extension for volunteer use during April and May.

A second workshop sponsored by the Chesterfield Conservation Commission, in cooperation with Moosewood Ecological LLC, was held on May 3, 2009. Vernal pool

[1] Co-occurrence analysis is a computer-generated model that identifies where valuable natural resources overlap or co-occur. This analysis helps to identify areas of higher conservation value.

ecology was the theme of this event, which explored common and rare species of vernal pools. Other aspects discussed during the field outing included how to distinguish vernal pools from other smaller wetlands, how to identify egg masses, ecological functions of vernal pools, and the significance of these ecosystems for biodiversity.

On December 9, 2009, a public presentation was held to discuss the findings of the NRI. Topics included the results of the community forum, comparative wetlands evaluation, significant wildlife habitats and natural communities, species of greatest conservation concern, agricultural resources, and forest resources, as well as general Conservation Focus Areas. The many uses of an NRI were also illuminated during the presentation.

This project incorporated ground-truthing evaluations on public lands and, as mentioned, private properties by permission from landowners, as well as seen from along roadsides. Private landowners representing 129 parcels and approximately 8,092 acres provided permission for the principle investigator and field assistant to enter their properties for the purposes of evaluating wetlands, as well as assessing wildlife and their habitats. This acreage of privately-owned lands in combination with public lands totaled approximately 10,180 acres or roughly 40% of the total area of Chesterfield, excluding Pisgah State Park. No land was entered upon for data collection purposes where the landowner did not provide permission for access.

A total of 55 wetlands were chosen for the comparative evaluation. This level of effort represented nearly 80% of the wetlands in Chesterfield. These wetlands represented a subset of those found within the town, which included wetlands larger than two acres, and was based on landowner permissions to access private properties. Rivers, streams, and lakes were not evaluated. In addition, wetlands located within Pisgah State Park and Wantastiquet State Forest were not evaluated since they are located on state property.

Based on the evaluation, wetlands were ranked into three tiers, whereas tier one represents the upper one-third of wetlands with the highest functional value (see *Top Ranked Evaluated Wetlands* map, p.26). As a result, tier one wetlands perform the best ecological services, holding the greatest value for conservation efforts. Nearly one-half of the tier one wetlands are located within the California Brook Natural Area, a prime link between Pisgah State Park and the conserved area of West Hill in Keene. The California Brook Natural Area has been a major focus for conservation efforts by the Conservation Commission.

Chesterfield has numerous ecologically significant habitats (ESH). These habitats include various *important wildlife habitats* and *exemplary natural communities*[2]. ESH's function as 1) habitats for rare species and other species of conservation concern; 2) rare or declining habitats and natural communities in New Hampshire; and 3) connectivity to other habitats within a largely undisturbed forested landscape. For the purposes of this report, the following ESH's were considered as critically important for the protection and maintenance of biodiversity in Chesterfield:

[2] Exemplary natural communities include almost all rare types of natural communities, as well as high quality examples of those that are more common in the state. The NH NHB regards exemplary natural communities as priorities for conservation.

1. Important wildlife habitats mapped by the NH Fish and Game Wildlife Action Plan;
2. Additional important wildlife habitats mapped as part of site assessments;
3. Rare and uncommon natural communities;
4. Large unfragmented forest blocks; and
5. Habitats that support known rare species

A total of 19 important wildlife habitat types have been identified and mapped in Chesterfield (see *Ecologically Significant Habitats* map, p.47). These include various habitats such as vernal pools, floodplain forests, heron rookeries, deeryards, grasslands, and unique wetland and forest types. Both Spofford Lake and the Connecticut River serve as critical habitat for migratory waterfowl. In addition, there are at least six exemplary natural communities that are known to exist in Chesterfield. These include woodlands and forests, as well as wetlands. They carry great natural resource significance for conservation, especially in terms of their rare occurrence in the state and associated rare species.

During 2008-2010 a total of 169 species of wildlife were documented, including 115 birds, 14 amphibians, 8 reptiles, and 32 mammals. Of the documented wildlife, 25 species have been noted as species of greatest conservation concern. These include 15 birds, 2 amphibians, 2 reptiles, 2 fish, and 4 mammals (see table below).

List of known wildlife of greatest conservation concern in Chesterfield.

Birds	
Common loon	Osprey
Pied-billed grebe	American kestrel
American black duck	Wood thrush
American woodcock	Veery
Wild turkey	Canada warbler
Ruffed grouse	Cerulean warbler
Northern harrier	Eastern towhee
American bald eagle	
Amphibians	
Jefferson salamander	Northern leopard frog
Reptiles	
Wood turtle	Eastern ribbon snake
Fish	
Eastern brook trout	Slimy sculpin
Mammals	
Black bear	Moose
Bobcat	White-tailed deer

Source: Moosewood Ecological (2008-2010); Brown (2010); Klapper (2009); Peterson (2009); NH Fish and Game (2009), and NH Natural Heritage Bureau database (January 2010)

Nine rare plants have been documented by the NH Natural Heritage Bureau to occur in Chesterfield (see table below). Six species are considered as historical observations since the latest record was more than 20 years ago. However, it is likely that these species still remain and additional rare plants exist in Chesterfield. The downy false foxglove, fern-leaved false foxglove, and the Guadalupe waternymph are regarded as having very high importance for conservation.

List of known rare plants in Chesterfield.

Species	**Rarity Rank**
Appalachian filmy fern (*Trichomanes intricatum*)*	S1
Butterfly weed (*Acslepias tuberosa*)*	S1
Downy false-foxglove (*Aureolaria virginica)*	S1
Hairy stargrass (*Hypoxis hirsuta)**	S1
Incurved umbrella sedge (*Cyperus squarrosus*)*	S1
Short-fruited rush (*Juncus brachycephalus)**	S1
Wild senna (*Senna hebecarpa*)*	S1
Fern-leaved false foxglove (*Aureolaria pedicularia var. intercedens intercedens*)	S2
Guadalupe waternymph (*Najas guadalupensis*)	

Source: NH Natural Heritage Bureau database (January 2010)

***Indicates historical observation of greater than 20 years.
S1 - State Endangered
S2 - State Threatened

Chesterfield is characterized by a variety unfragmented blocks of land, ranging in size from 14 acres to nearly 11,000. Unfragmented blocks are relatively free of roads with regular vehicular traffic, which divides the landscape into small blocks of land. In general, larger unfragmented blocks are associated with greater biodiversity. Due to its rural nature, Chesterfield has some substantial unfragmented blocks larger than 500 acres. The largest block is associated with Pisgah State Park and the California Brook Natural Area. This area in Chesterfield is approximately 11,000 but continues into Keene, Swanzey, and Winchester where it reaches over 28,000 acres of unbroken forests and embedded wetlands. Due to the shear size and diversity of its habitats this unfragmented block is the most significant in Chesterfield.

Important agricultural soils cover approximately 5,605 acres, or roughly 18% of Chesterfield (see *Agricultural Resources* map p.59). Prime farmland soils make up about 19% of the total acreage of agricultural soils while farmlands of local and statewide significance total approximately 81% of these soils. These data, especially when combined with active farmlands, can provide a first phase in developing agriculturally-based land use planning.

It was estimated that Chesterfield currently has approximately 3,154 acres of relatively high quality interior forestlands (see *High Quality Forestlands* map, p.63). These represent some of the best forested areas associated with the most productive forest soils in town and were perceived to have relatively high ecological health.

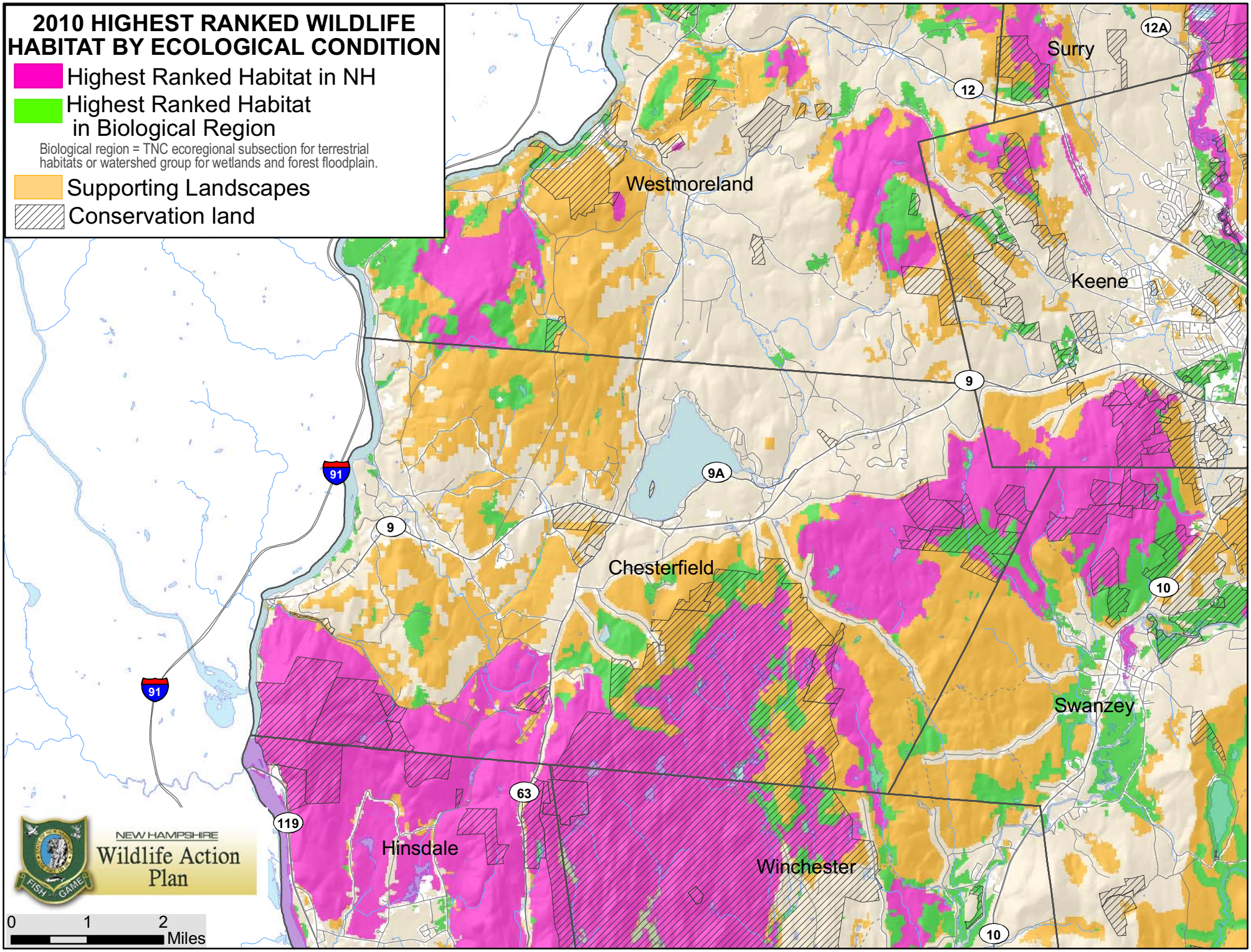
Based on the results of the NRI, a co-occurrence model was prepared to assist in identifying the most significant areas in Chesterfield (see *Co-occurrence Analysis* map, p.70). A co-occurrence model is an analytical tool to determine where various natural resources occur in unison, or where they overlap. The darkest reds note higher levels of overlap, whereas the lighter areas represent fewer natural resources overlapping. Hence, the darker the red color the higher the ecological significance and conservation value. This analysis is a first phase in helping to identify "hotspots" for conservation.

Next, the co-occurrence model was used to identify Conservation Focus Areas (CFAs). A total of five CFAs have been identified as having high priorities for conservation, which is also supported by the WAP state rankings.

- California Brook Natural Area
- Spofford Lake watershed
- Gulf Brook watershed
- Hubbard Brook and Catsbane Brook watersheds (especially south of Route 101)
- Connecticut River riparian corridor

Based on the findings of this project a variety of general recommendations have been suggested. These are considered as the next actions steps that Chesterfield could consider as they proceed with community land use planning. Some of the more immediate action steps include the development of an Open Space Committee as part of the Conservation Commission. Their general role would be to help oversee conservation planning efforts in the Town. This can be an effective approach at conservation planning, especially in light of the Conservation Commission's current substantial workload. Other immediate steps that could be acted upon in the near future includes the develop of a comprehensive Conservation Plan, incorporating the NRI into the Master Plan by the Planning Board, and the development of a parcel-based ecological assessment to help guide the Planning Board's land use and conservation planning efforts. This assessment provides an efficient approach at land conservation by assigning priorities for protection at the parcel-level. This tool can be used as the Conservation Commission works with willing landowners.

The Chesterfield NRI and Conservation Priorities document is meant to be used for educational and town planning purposes. It was prepared for use by landowners, town boards and committees, as well as the residents of Chesterfield. Landowners can use the document and associated data to better understand the ecological attributes of their properties to help develop land management planning options. Residents of Chesterfield can use the document to learn more about the town's natural resources and what makes them so special. Town boards and committees can use the findings herein to promote and encourage informed land use planning. By understanding Chesterfield's most significant natural resources the town is better prepared to adopt a variety of appropriate land use planning techniques that encourage the wise use of our natural resources. This can, in turn, promote a healthy environment that all residents deserve and encourage a more sustainable approach at community development.


2010 HIGHEST RANKED WILDLIFE HABITAT BY ECOLOGICAL CONDITION
Highest Ranked Habitat in NH
Highest Ranked Habitat in Biological Region
Biological region = TNC ecoregional subsection for terrestrial habitats or watershed group for wetlands and forest floodplain.
Supporting Landscapes
Conservation land
Surry
12A
12
Westmoreland
Keene
9
9A
91
9
Chesterfield
10
91
Swanzey
63
119
Hinsdale
Winchester
10
NEW HAMPSHIRE
Wildlife Action Plan
FISH & GAME
0
1
2
Miles

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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 third 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 a great responsibility with managing its natural resources and biological diversity, and establishes citizens as stewards of the land if we are to use informed decision making to promote a more sustainable approach at land use planning.

Natural Resources and Conservation 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, lakes, rivers, forests, wildlife, plants, and soils. These data can be created from existing sources or from more detailed studies that have been developed over time.

New Hampshire statues mandate that communities shall create an NRI. This is generally the responsibility of 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 a conservation plan from which innovative land use planning can be adopted for the protection of various resources, including 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 communities[1] 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 (such as bedrock, soil, and water). 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 altogether. 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 Spofford Lake or the plant community of Friedsam Town 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 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. It has also led to the loss of critical habitats. 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 Chesterfield Natural Resources Inventory (NRI) and Conservation Priorities project was initiated in September 2008. The overall scope of this project was to develop an enhanced natural resource inventory based an on wildlife habitats, natural communities, wetland functions and values, and high quality forest and agricultural lands. The purpose is to provide a long-term ecological vision for the town. Results of the project can then serve as a guide to help determine where the town should prioritize its conservation efforts, as well as to promote informed land use planning and education. In particular, the goals and objectives of the project were outlined as follows:

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Objective 2D – Map high quality agricultural resources

Objective 2E – Map high quality forest lands

Objective 2F – Develop a co-occurrence analysis to help identify Conservation Focus Areas

Objective 2G – Prepare a final report on the findings of the project, including basic recommendations for future conservation planning initiatives

Community Outreach and Education

In cooperation with Moosewood Ecological LLC and the Cheshire County Conservation District, the Chesterfield Conservation Commission held a community forum on November 19, 2008, to engage the town's residents into the public planning process. This forum introduced the overall project background to participants, including the goals and objectives. This was followed by a discussion on growth and natural resources protection in town. Participants identified the strengths and challenges of Chesterfield's natural resources and its working landscape, as well as began to list some of Chesterfield's most significant natural areas. The evening also introduced the wetland evaluation process and participants prioritized those functional values that were most important in Chesterfield. Finally, volunteers were solicited to help gather natural resources information on their own properties, as well as public lands. An informational

packet was prepared to assist volunteers collect and document data. The results of this community forum can be found in Appendix A (p.79).

In a continued effort to solicit volunteers for the project and provide educational opportunities to residents, the Chesterfield Conservation Commission, in cooperation with Moosewood Ecological LLC and the Cheshire County Cooperative Extension, sponsored a Global Position System (GPS) workshop on April 16, 2009. The workshop trained volunteers on how to use GPS units to collect locational data for various natural resources on participant-owned lands or public properties. GPS units were provided by Cooperative Extension for volunteer use during April and May.

A second workshop sponsored by the Chesterfield Conservation Commission, in cooperation with Moosewood Ecological LLC, was held on May 3, 2009. Vernal pool ecology was the theme of this event, which explored common and rare obligate species of vernal pools, as well as other species that use them for critical habitats (such as breeding and feeding). Other aspects discussed during the field outing included how to distinguish vernal pools from other smaller wetlands, species identification from egg masses, ecological functions of vernal pools, and the significance of these ecosystems for biodiversity.

To assist in finalizing the project, a public presentation was held on December 9, 2009, to discuss the findings of the NRI. Topics included the results of the community forum, comparative wetlands evaluation, significant wildlife habitats and natural communities, species of greatest conservation concern, agricultural resources, and forest resources, as well as general Conservation Focus Areas. The many uses of an NRI were also illuminated during the presentation.

Chesterfield's Physical Landscape Setting

Chesterfield is located within the Northern Connecticut River Valley and the Hillsboro Inland Hills and Plains ecoregional subsections (Figure 1, p.6). These subsections are part of the U.S. Forest Service's Vermont-New Hampshire Upland ecoregion that spans the western portion of New Hampshire and continues into Vermont. This ecoregional classification system is based on natural divisions defined by physical

(climate and landforms) and biological characteristics. The natural divisions that define ecoregions and their associated subsections are useful in synthesizing information regarding plant distributions and ecosystems. Simply stated, it represents a systematic approach of understanding and classifying the ecological structure of our landscape on a large scale.

The Hillsboro Hills and Plains subsection is typically associated with shallow and stony soils, and are characterized as foothills of the White Mountains. Narrow valley streams and small waterbodies are numerous throughout. Bedrock geology that typifies these subsections mostly includes granite. However, small intrusions of more calcium-rich areas can exist as well. In contrast, the Northern Connecticut River Valley is generally less stony with stratified sands and gravel deposits along with glacial lake bed sediments. It is associated with a variety of floodplains and older river terraces. This subsection is also associated with soils of a higher nutrient content, which Chesterfield demonstrates in its western portion.

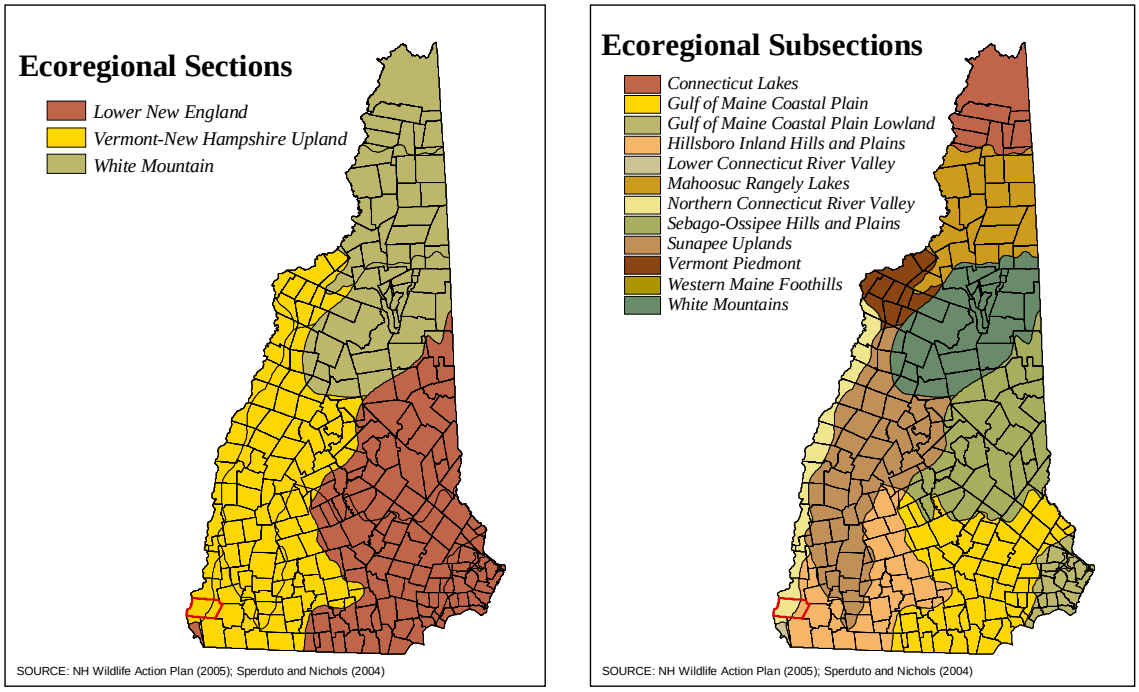


Figure 1. Ecoregions of New Hampshire. These maps show the distribution of ecoregional sections (*left*) and subsections (*right*) and how the town of Chesterfield (outlined in red) fits into this big picture. Moosewood Ecological LLC.

The town of Chesterfield can be viewed from a watershed perspective as well. It lies within the greater Connecticut River basin. This large watershed has been divided into two distinct units by the NH Fish and Game Wildlife Action Plan, including the Connecticut River mainstem watershed associated with Chesterfield (Figure 2, p.7). These watersheds provide a broad-scale, comprehensive approach for the protection of aquatic ecosystems and were used in developing the New Hampshire Wildlife Action Plan (2005). These watersheds will be refined into smaller units in the Wetland Comparative Evaluation section below.

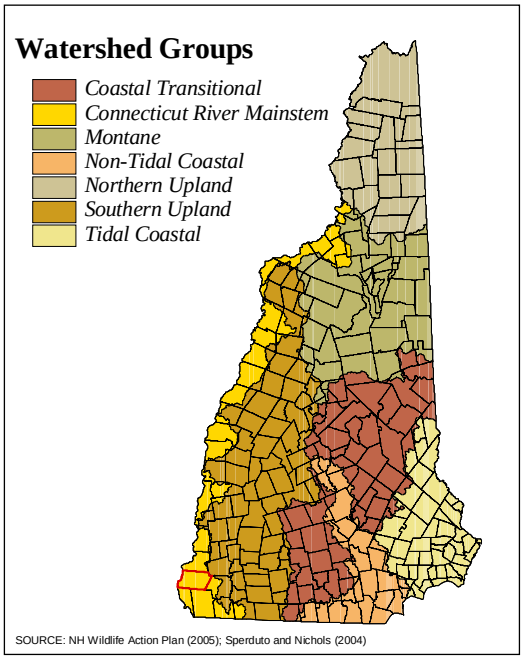


Figure 2. Major watershed units of New Hampshire. This map shows the distribution of major watershed groups and Chesterfield's relationship to the Connecticut River Mainstem watershed. Moosewood Ecological LLC.

Chesterfield covers approximately 47.5 square miles, or 30,428 acres, of mostly forested and hilly terrain (Figure 3, p. 9 and Figure 4, p.10). Its topography is highly variable, ranging from approximately 200 feet along the Connecticut River to nearly 1,365 feet atop Wantastiquet Mountain near Mine Ledge on the Madame Sherri Forest in the southwestern corner. The most densely populated centers are found in the three villages – Spofford, Chesterfield center, and West Chesterfield.

As such, the landscape is further characterized by lowland river floodplains and older river terraces along the Connecticut River and rolling hills of Davis Hill, Hubbard Hill, Bald Hill, Sargent Hill, Streeter Hill, Pistereen Mountain Daniels Mountain, and Wantastiquet Mountain. Extensive wetland systems grace sections along Wheelock Brook, California Brook, Broad Brook, Hubbard Brook, Rixford Brook, and Partridge Brook. Chesterfield is also home to Spofford Lake, the largest lake in Cheshire County at approximately 736 acres, which is known to boast impressive numbers of migratory waterbirds during fall migration (Brown 2010). These varying landforms offer great diversity for wildlife and plant communities alike.

Chesterfield has been divided into approximately 2,524 parcels (Figure 5, p.11), and has been characterized into six zoning districts. The parcel base map demonstrates the relative size and distribution of parcels throughout the town. This data can be very informative when helping to identify conservation focus areas (CFAs). To better understand acreage and ownership, as well as tax parcel and lot number, see the paper maps located in the Town Office.

Chesterfield NRI and Conservation Priorities
Topography

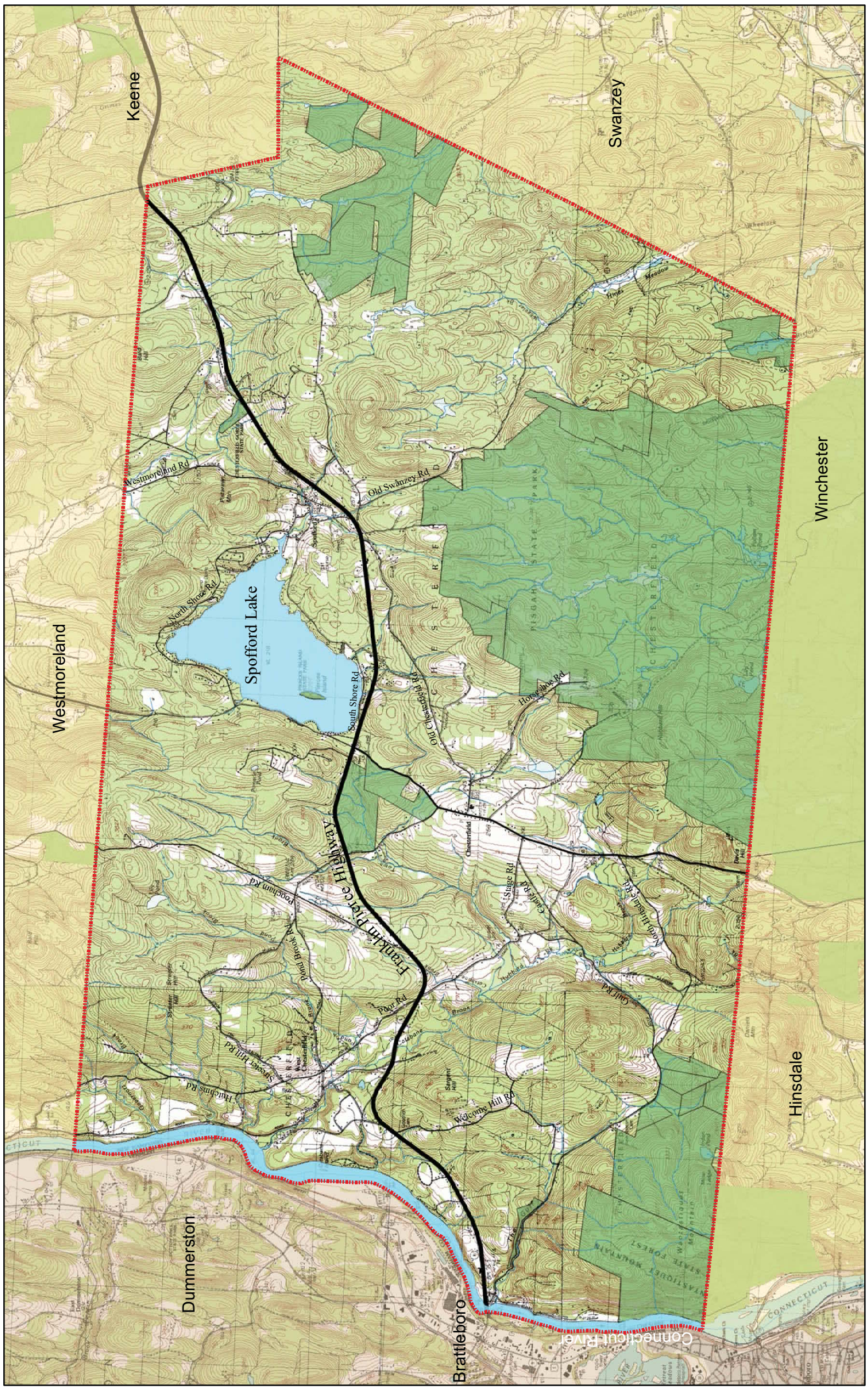


Figure 3. U.S. Geological Survey topological map (2004) of Chesterfield, NH. This map demonstrates the general topography and general land use, including the distribution of transportation systems, general developed areas, conserved lands (green shading), ponds, lakes, streams and larger wetland systems. Moosewood Ecological LLC

Chesterfield NRI and Conservation Priorities
Aerial Base Map (NAIP 2003)

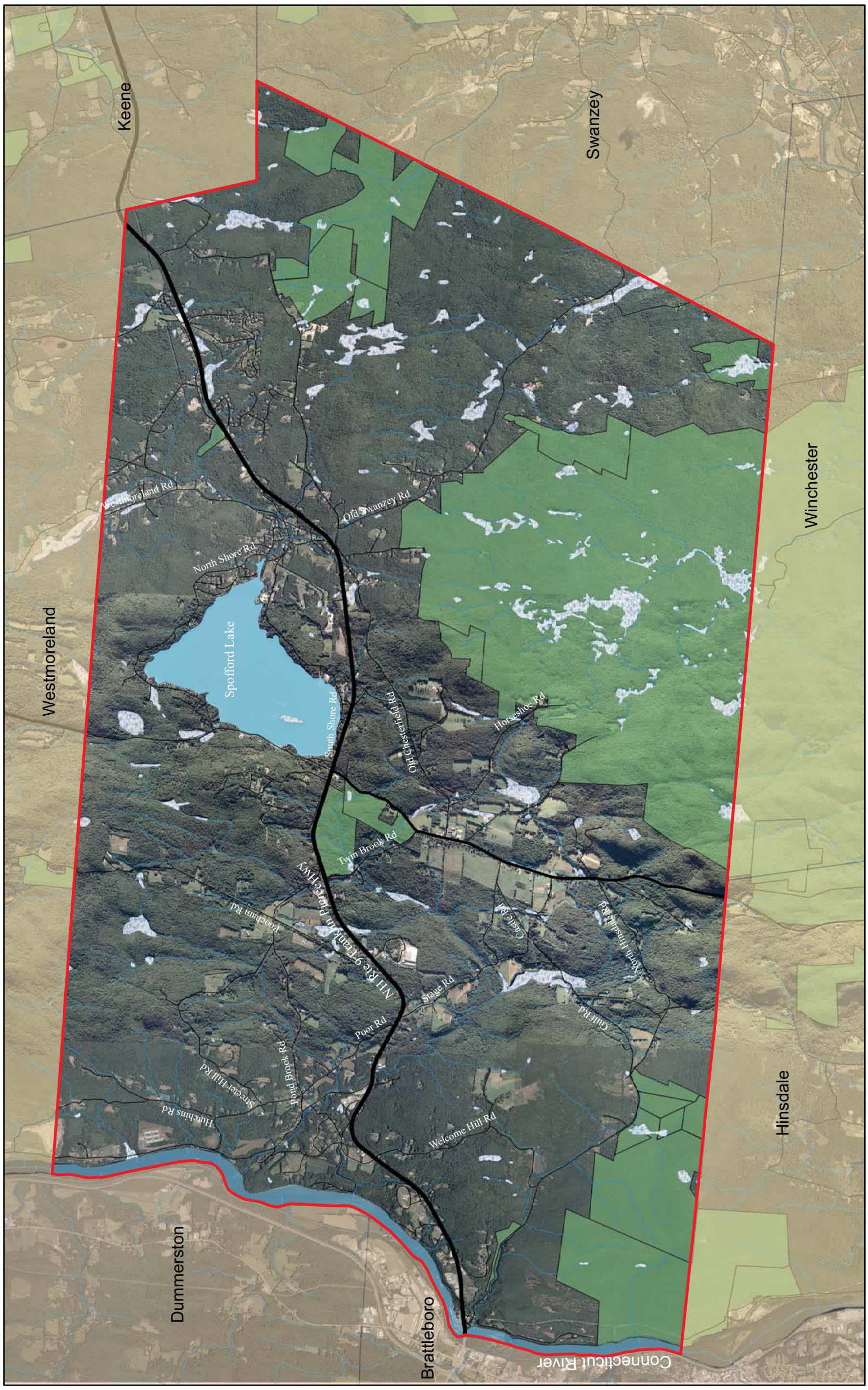


Figure 4. Aerial photography (2003) of Chesterfield, NH. This map demonstrates the basic land use, including the distribution of transportation systems, developed areas, conserved lands (green shading), fields, forested areas, ponds, lakes streams and larger wetland systems.
Moosewood Ecological LLC

Chesterfield NRI and Conservation Priorities
Parcel Base Map

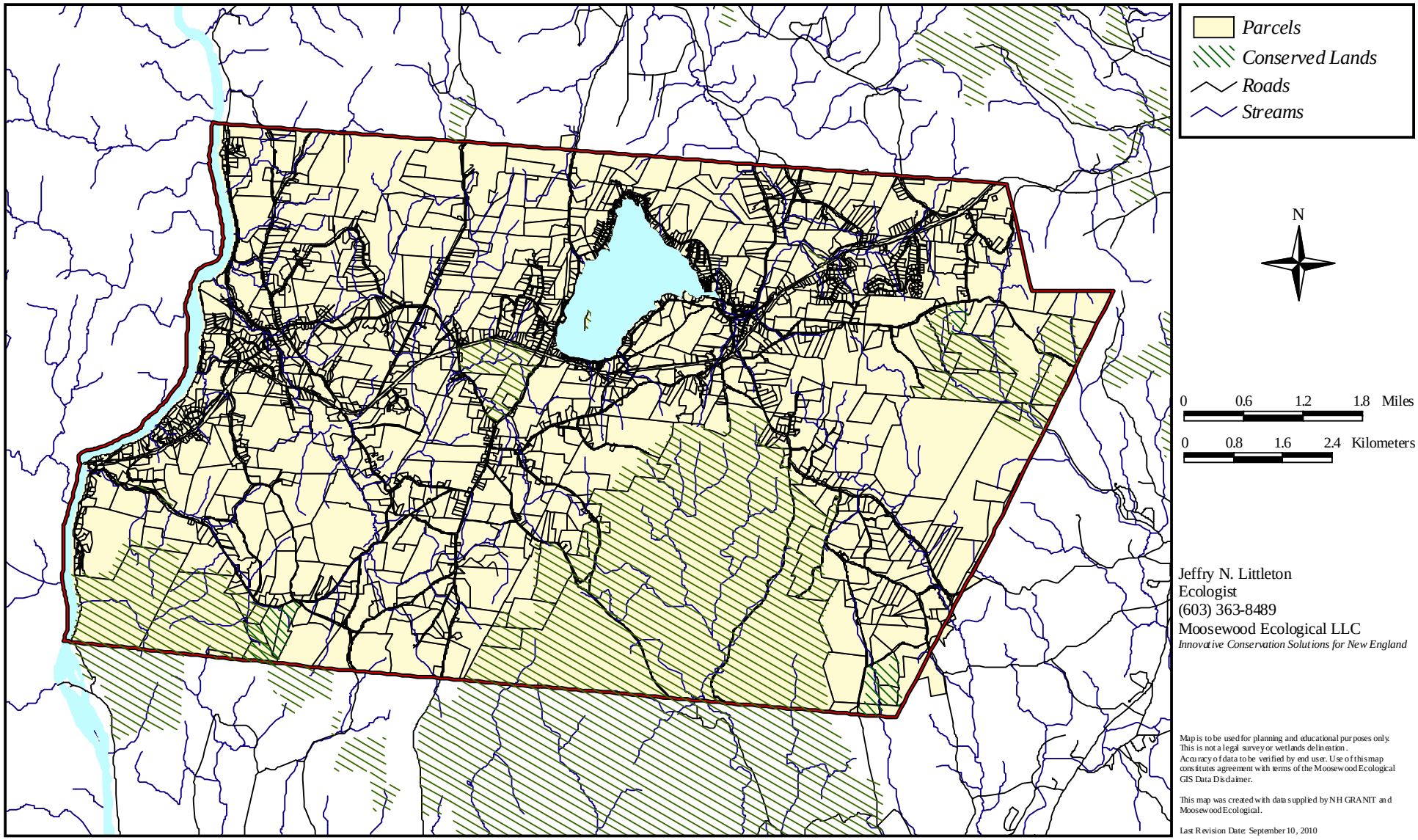


Figure 5. Tax parcel base map of Chesterfield, NH. This map demonstrates the general location and relative size of tax parcels. Moosewood Ecological LLC

Landowner Contact and Permission to Enter Properties

This project incorporated ground-truthing evaluations on public lands and private properties by permission from landowners, as well as along roadsides. Private landowners representing 129 parcels and approximately 8,092 acres provided permission for the principle investigator and field assistant to enter their properties for the purposes of evaluating wetlands, as well as assessing wildlife and their habitats. This acreage of privately-owned lands in combination with public lands totaled approximately 10,180 acres or roughly 40% of the total area of Chesterfield, excluding Pisgah State Park. No land was entered upon for data collection purposes where the landowner did not provide permission for access.

Limitations of Data and GIS Disclaimer

A variety of existing and newly created data layers were used to prepare the natural resources maps found herein (Appendix B, p.81). These existing data have been developed by numerous governmental 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 remote data were developed from satellite imagery and aerial photography. These data were produced at various scales and therefore represent different degrees of errors, omissions, and inaccuracies.

While these limitations do represent some uncertainties, this type of research is the first step, and the most cost-effective, in developing an understanding of Chesterfield's natural resources. In the ideal world, all data would be accurate, precise, and up-to-date. However, to produce such a level of accuracy and precision would be grossly time-consuming and ultimately very costly. Therefore, the data used do contain inaccuracies and further research is warranted.

Moosewood Ecological refined some existing data and developed new data based on aerial photography interpretation, site visits, and roadside surveys. Areas assessed represent only a sample of the town and do not represent a comprehensive ecological inventory and should not be construed as such. Additional ecological inventories and

biological monitoring efforts in the future should be conducted to build upon the collective knowledge gathered at this time.

The maps contained herein 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, are approximate locations and should therefore be field verified. The accuracy of the data is the end user's responsibility, and Moosewood Ecological or the Town of Chesterfield can not be responsible for the accuracy and completeness of GIS data. Moosewood Ecological and the Town of Chesterfield make no warranty, expressed or implied, as to the accuracy or completeness of the GIS data. Furthermore, Moosewood Ecological and the Town of Chesterfield shall assume no responsibility for any errors, omissions, or inaccuracies in the information provided.

RESULTS AND DISCUSSION

Wetlands Comparative Evaluation

Wetland resources represent some of our most fragile ecosystems and are particularly sensitive to certain types of adjacent land use that can cause degradation over time. These resources comprise a variety of natural features, including our streams and rivers, ponds and lakes, and vegetated wetlands that are generally referred to as marshes, swamps, wet meadows, vernal pools, and peatlands. In terms of their importance for conservation, these resources provide a variety of ecological functions and societal values, including water quality maintenance, flood control, wildlife and fisheries habitat, recreation, groundwater recharge and discharge, educational and scientific value, as well as contributing to the overall biological diversity of Chesterfield.

To better understand the distribution of wetlands and the functional roles that they perform in our society a town-wide wetlands comparative evaluation was conducted. The method that was used was the Comparative Evaluation of Non-tidal Wetlands in New Hampshire (Ammann and Stone 1991), also referred to as the "NH Method," which was published by the New Hampshire Department of Environmental Services. The general

approach of this method is to evaluate wetlands on the basis of their *functional value*, that is, the value that they hold for human society in improving and maintaining quality of life.

The overall purpose of this evaluation was to provide a clearer picture of both the location and the characteristics of the wetlands in and across the watersheds within Chesterfield. The fact that a *comparative* method was employed suggests that the reader has great latitude in placing a higher or lower value on a particular wetland under scrutiny. As is described below, the intention is to allow for a comparison of wetland *functions*, and not an overall value that a wetland received as a whole. This report serves to engender an understanding of the reasons *why* a particular wetland can serve a particular function better than others, as well as what it uniquely contributes to a given area of town.

The NH Method (Ammann and Stone 1991) arose out of an increasing need to adequately understand and evaluate wetland resources in the state of New Hampshire. Adopted from the Method for Evaluation of Inland Wetlands in Connecticut developed by Al Levere and Alan Ammann, it was initiated and supported by the Wetlands Studies Project of the Audubon Society of New Hampshire under the guidance of Amanda Lindley Stone. A tremendous amount of research and field testing went into both the parent edition in Connecticut, as well as the current methodology used in New Hampshire. The primary objective of the written work was that it be understandable by the general public; however, contrary to many of the current methods of wetland evaluation available to consulting scientists and researchers, this guide has successfully provided a manual of broad appeal for the lay person.

The fundamental tenet of this methodology is that it identifies various functions of wetlands and assigns a value to those functions. For the purpose of this work, a "function" is defined as what the wetland does (e.g., provides wildlife habitat, improves water quality) and a "value" is the evaluation of how important a particular function is. The NH Method is a rapid assessment method that asks a set of questions that are responded to observing natural attributes as one walks around a wetland. The accuracy of

the assessment is dependent on the theoretical knowledge of the observers regarding the abiotic and biotic factors that influence the "field indicators" observed.

The NH Method identifies fourteen functions associated with wetlands. Each of these particular wetland qualities performs a specific purpose for the benefit of humanity, and thus is considered valuable to retain. With little exception, all of the functions have been long recognized as major contributors to the economic, social, scientific and psychological well-being of society. In order of their placement in the method, they are as follows:

1. **Ecological Integrity**
2. **Wetland Wildlife**
3. **Finfish Habitat (rivers & streams and lakes and ponds)**
4. **Educational Potential**
5. **Visual/Aesthetic**
6. Water-based Recreation
7. **Flood Storage Potential**
8. **Groundwater Use**
9. **Sediment Trapping**
10. **Nutrient Attenuation**
11. Shoreline Anchoring and Dissipation of Erosive Forces
12. Urban Quality of Life
13. **Historic Potential**
14. **Noteworthiness**

Of the 14 functions listed above 11 were used in this evaluation (noted in **bold**). These were identified based on the desires set forth by the Chesterfield Conservation Commission and in consultation with Moosewood Ecological LLC. For specific descriptions of each of the functions, as well as the way in which they are computed, please consult the NH Method (Ammann and Stone 1991).

For the evaluation, a series of questions are asked about each wetland of concern for each function. Answers to these questions are given a value on the basis of a simple 0-1 scale, with 0 or 0.1 (depending on the function) being the lowest value choice for a given question, and 1.0 being the highest value. Then, these values are averaged for each function and related as the *Functional Value Index* (or FVI). A summary sheet compiles the overall FVI's for a given wetland, and allows for the computation of a *Wetland Valuation Unit* (or WVU). The NH Method calculates this WVU by using a multiplier for the size of the wetland in question (i.e., FVI times the wetland size in acres). This approach places greater importance on wetlands of a larger size; note, however, that through the "Noteworthiness" function, small, unique wetlands can receive a high overall rating as well.

Clearly the greatest benefit of the NH Method is in its educational potential as a planning tool. Through the use of simple and very direct questions about each wetland it provides a ready window on the world of wetland benefits for non-technical readers. It was developed for local municipalities and their governing bodies whose tasks lie in the proper governance of local and state regulations regarding growth and development. It sought to balance the need for commercial and residential expansion with natural resource conservation by providing clear examples of how different wetland characteristics operate on the landscape. By becoming more familiar with the functions that wetlands contain for the betterment of human life, it was thought that better, more accurate planning could be accomplished by local officials. Moreover, with a very easy, step-by-step approach to wetland evaluation, it was thought that a greater number of interested citizens in a given town could and would become involved in this planning process.

Over thirty-two towns in the State have utilized the NH Method as a part of their local wetland conservation efforts. Either in whole or in part, this guide has allowed many of these towns to better understand the long-range values that their wetland base serves and plan accordingly for future development in their community. For example, as a part of the overall plan of the NH Department of Environmental Services, this method

was developed to augment the designation of 'prime wetlands[1]' in a given town. Under Chapter Wt 700 administrative rules, the very same functional values identified in this guide are required to be recognized in order to petition the state to place certain wetlands under prime wetland status. However, it also can guide a town where to possibly develop wetland overlay districts, which requires more extensive parcel assessment and design considerations. It can also inform planning efforts in determining how specific development regulations may be developed or amended based on the ranking of wetlands for specific values. Another significant outcome of this evaluation is that it can provide specific information for landowners to use in their land management planning. At a minimum, the results provide a set of baseline data with which to compare current and future evaluations of one or several wetlands in a given area.

Wetland resources, as with all natural resources, do not adhere to political units, such as parcels, towns, and state boundaries. Instead, they are dictated by the physical features of our landscape that form watersheds. Watersheds can be mapped at various scales and are dependant upon the stream or drainage basin that is in question. These can include large rivers such as the Connecticut River basin down to even the smallest tributary. As such, one can create a series of nested subwatersheds that express various scales of information found within each. For example, the small stream on the east side of Wantastiquet Mountain that drains into the wetland on Madame Sherri forms its own subwatershed. This small stream is contained within The Gulf subwatershed, a brook that flows northwesterly along Gulf Road. In turn, The Gulf is a subwatershed of the larger Connecticut River watershed that covers many towns in western New Hampshire and eastern Vermont, as well as other states to the south.

Watersheds typically form reasonable ecological units from which land use planning and management can be most beneficial. They can be very effective in better understanding land use impacts on our natural resources, including water quality and quantity, flooding, soil erosion, wildlife habitats, natural communities, rare species, and

[1] Prime wetlands is defined by the State of NH as "any areas falling within the jurisdictional definitions of RSA 482-A:3 and RSA 482-A:4 that possess one or more of the values set forth in RSA 482-A:1 and that, because of their size, unspoiled character, fragile condition, or other relevant factors, make them of substantial significance."

aquatic wildlife, including fisheries. As such, they form easily identifiable units that can be used in various types of conservation planning efforts.

Watersheds have been classified by their Hydrologic Unit Code (HUC), as defined by the U.S. Geological Survey. These are codes given to a particular hydrologic unit, or watershed, and identify the scale at which it was mapped. The higher the HUC number the smaller the watershed unit and hence represents a finer scale of mapping. For example HUC 12 has been mapped at a finer scale than HUC 6. The USDA Natural Resources and Conservation Service and the NH Department of Environmental Services have mapped the hydrologic units for New Hampshire, including HUC 6 (Figure 2, p.7) and HUC 12 watersheds (Figure 6, p.25 and Table 1, p.18).

Table 1. Summary of HUC 12 watersheds.

HUC 12 Watersheds	Area in Chesterfield (acres)
Chesterfield Tributaries	13,567.1
Hinsdale Tributaries	558.1
Hinsdale-Winchester Tributaries	4,487.2
Keene Tributaries	26.5
Partridge Brook	6,390.9
Winchester-Swanzey Tributaries	5,398.0
	30,428

SOURCE: USDA Natural Resources Conservation Service and NH Department of Environmental Services HUC 12 watersheds from GRANIT.

Wetlands generally include familiar places such as marshes, wet meadows, beaver impoundments, swamps, fens, bogs, streams, rivers, ponds, and lakes. As noted above, they perform a variety of ecological functions and values that benefit humans. They also serve as ecologically significant habitats for wildlife and plants, which is discussed in the *Wildlife Habitats and Natural Communities* section below. 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." They are further defined by three particular elements, including

hydrophytic vegetation[2], hydric soils[3], and wetlands hydrology[4]. As such, wetlands are regulated by the New Hampshire Department of Environmental Services' Wetlands Bureau as defined in 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 potential extent of wetlands within Chesterfield (Figure 6, p.25). 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 conterminous United States as a means 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.

Chesterfield contains three main wetland ecosystems mapped by the NWI, covering approximately 1,984 acres or nearly 7% of Chesterfield. These include lacustrine, riverine, and palustrine wetlands (Table 2, p.20). Lacustrine wetlands generally refer to ponds and lakes greater than 20 acres that are located in a topographic depression (with or without an existing dam) or along a dammed river. These wetland systems lack a substantial cover (<30%) of trees, shrubs, and herbaceous plants (i.e., grasses, sedges, and wildflowers). Lacustrine systems may include other smaller waterbodies if the shoreline is formed by wave action or lined with bedrock, or if the water depth exceeds 6.6 feet. Chesterfield's lacustrine wetland was estimated to cover approximately 736 acres and includes Spofford Lake.

Riverine wetlands generally include small streams to large rivers that are confined with a channel, including the Connecticut River. Chesterfield's riverine wetland was

[2] Hydrophytic vegetation means water-loving plants that are associated with wetlands.
[3] Hydric soils are types of wetlands soils that have developed special properties as a result of being inundated or saturated with water for an extended period of time.
[4] Wetlands hydrology considers the movement of water within the wetland and is often noted by various field indicators.

estimated by the NWI to cover approximately 374 acres and includes the Connecticut River. This estimate would be much greater if the acreage of the smaller riverine systems were included. However, the NWI has only mapped larger riverine systems.

Palustrine systems make up the majority of wetlands distributed throughout New Hampshire. As such, Chesterfield typifies this general trend in the northeast. Palustrine systems are primarily wetlands that are dominated by vegetation and do not meet the criteria as a lacustrine or riverine system. These are, for practical purposes, wetlands that most people recognize as marshes, swamps, beaver impoundments, and bogs. These can even include vernal pool complexes.

Table 2. Summary of National Wetlands Inventory and hydric soils.

Wetlands Description		**Size (acres)**
National Wetlands Inventory		
Palustrine Emergent Marsh		101.3
Palustrine Scrub-Shrub Swamp		268.2
Palustrine Forested Swamp		313.3
Palustrine Unconsolidated Bottom		191.2
Riverine		373.6
Lacustrine		736.4
	Total	*1,984.0*
Hydric Soils		
Very Poorly Drained		419.1
Poorly Drained		1,906.6
	Total	*2,325.7*
Wetlands Composite		
NWI and Hydric Soils		*3,832.1**

SOURCE: USDA Natural Resources Conservation Service soils and US Fish and Wildife Service National Wetlands Inventory datasets from GRANIT

*Total estimated acreage of wetlands when combining hydric soils and National Wetlands Inventory together into one data layer.

Four main classes of palustrine wetlands are located in Chesterfield. These include:

1. *emergent marshes* - dominated by herbaceous plants such as grasses, sedges, rushes, and wildflowers;
2. *scrub-shrub swamps* - dominated by shrubs such as highbush blueberry, winterberry, northern wild raisin, arrowood, and alder as well as small trees;
3. *forested swamps* - dominated by mature trees such as red maple, hemlock, spruce, and fir; and
4. *unconsolidated bottom* - open waterbodies with mucky or sandy substrates and less than 30% vegetative cover.

Palustrine systems comprised approximately 874 acres or 44% of NWI in Chesterfield. The majority of the palustrine wetlands were represented by forested swamps (36%) followed by scrub-shrub swamps (31%), unconsolidated bottom (22%), and emergent marshes (11%). The largest and most structurally diverse wetland complexes can be found along the various stream drainages, including California Brook, Wheelock Brook, Hubbard Brook, Partridge Brook, and Broad Brook. However, many smaller wetlands were found in isolated basins and may represent some unique plant communities and wildlife assemblages.

Hydric soils are essentially wetland-related soil types and represent those that take on anaerobic (oxygen-deprived) conditions as a result of seasonal saturation, flooding, or ponded water. These have been mapped by the USDA NRCS and when combined with the NWI provide a more complete perspective of the potential array of wetlands in Chesterfield. Included are poorly drained soils and very poorly drained soils.

Poorly drained soils are those that drain water very slowly. For this reason the soil is wet for extended lengths of time and is periodically saturated during the growing season. Poorly drained soils are not always associated with jurisdictional wetlands[5] and

[5] Jurisdictional wetlands refer to wetlands that possess all three criteria (wetland soils, wetland plants, and hydrology) that define wetlands and are regulated by the NH Department of Environmental Services under RSA 482-A.

need field verification. In comparison, very poorly drained soils include soils that also drain water very slowly, but result in free water at or on the surface during the majority of the growing season. Generally, very poorly drained soils are associated with jurisdictional wetlands of the state. It is important to display both NWI and hydric soils data to help understand potential gaps that may exist, especially as it pertains to forested wetlands that can be difficult to map using aerial photography interpretation alone.

Hydric soils were widely distributed throughout Chesterfield, accounting for approximately 2,326 acres or 8% of the town (Table 2, p.20). Very poorly drained soils comprised nearly 18% of hydric soils. These were mostly found in association with palustrine wetlands and as a result were mapped beneath the NWI. In contrast, poorly drained soils represented about 82% of the hydric soils in Chesterfield. They were mostly found in association with palustrine wetlands, extending into areas of slow drainage due to broad topographic relief.

When these two wetland datasets were combined into a single wetland composite, it was estimated that Chesterfield contains approximately 3,832 acres of wetlands, or 13% of the town. This estimate provides a better representation of wetlands coverage across the town. However, it should be noted that NWI can typically underestimate wetlands acreage while hydric soils, and in particular poorly drained soils, can tend to overestimate total coverage.

A total of 70 palustrine wetlands were considered for the comparative wetlands evaluation. This represented approximately 541.3 acres within Chesterfield. Of these, a total of 55 wetlands, or approximately 462.1 acres, were chosen for the evaluation based on landowner permissions to access private properties. This level of effort represented nearly 80% of the total number of wetlands, and 85% of the total acreage of wetlands that have been mapped by the NWI.

These wetlands represented a subset of the entire stock of wetlands within Chesterfield, were two acres or larger, and were those that were adjacent to stream corridors or found isolated within the uplands. Riverine wetlands (Connecticut River) were not evaluated. In addition, wetlands located within Pisgah State Park and Wantastiquet State Forest were not evaluated.

Appendix C (p.83) provides a summary of the findings of the comparative wetlands evaluation. This includes an overall map of wetlands that were evaluated, maps of wetland codes by watershed, and a table of Wetland Valuation Unit (WVU) scores for each. These scores have incorporated the acreage of each wetland.

The table in Appendix C highlights three different tiers (top 1/3, middle 1/3, and lower 1/3) based on overall WVU scores within each functional value. This tiered system affords the opportunity to compare some of the most significant wetlands within each function. For instance, one can examine the overall top 5% of wetlands within each functional value for the entire town (Table 3, p.23).

Table 3. Top 5% of ranked wetlands within each functional value in Chesterfield.

FV1 Ecological Integrity	FV2 Wetland Wildife	FV3a Finfish: Streams	FV3b Finfish: Ponds	FV4 Education Potential	FV5 Aesthetics Quality
CB2	CB2	GB1	TB9	CB2	PB2
HB1	HB1	WB12	PB2	PB2	CB2
WB4	WB4	HB1	RB4	RB4	RB4

FV7 Flood Control	FV8 Groundwater Use	FV9 Sediment Trapping	FV10 Nutrient Attenuation	FV13 Historic Potential	FV14 Note-worthiness
CB2	PTB1	WB12	WB4	MS1	CB2
HB1	PTB4	HB1	WB12	PTB3	HB1
WB4	HB1	WB4	HB1	WB1	WB4

Another approach to help tease out some of the most overall significant wetlands, those that have the highest values among selected functions, is to prioritize the functions that are most important to a community. This was achieved during the community forum in November 2008. As noted in Appendix A (p.79), the protection of wildlife habitat, ecological integrity, and water quality (sediment trapping and nutrient attenuation) have the greatest priority for protection.

Based on the scoring of these functions, wetlands have been mapped on a first, second, and third tier system, whereas the first tier represents wetlands that have the

highest scores among the prioritized functions (Figure 7, p.26). These results can be used by town of Chesterfield to prioritize conservation efforts, as well as to consider regulatory and voluntary options for wetlands protection.

Spofford Lake was also evaluated but was not compared to the other wetlands since it is a different type of wetland system altogether. It is classified as a lacustrine wetland, whereas the other wetlands are considered as palustrine. This fact creates a challenge when trying to compare these two types of wetland systems, especially since they can have drastically different functions. Also, at 736 acres Spofford Lake is over 14 times greater in size than the largest palustrine wetland. Since size of the wetland was a factor in computing the Wetland Valuation Unit this would put the other wetlands at a great disadvantage if they were compared directly.

In light of these challenges Spofford Lake offers many unique ecological functions and values to humans. These include:

- high functionality for flood control
- high functionality for habitat for rare species, including the bald eagle, osprey, and common loon
- significant habitat for migratory waterfowl
- largest lake in Cheshire County
- high functionality for water-based recreation
- mid-level functionality for the other functions including ecological integrity, wildlife habitat, fish habitat, educational potential, visual/aesthetic quality, and nutrient attenuation
- strong level of commitment from the Spofford Lake Association in sampling for water quality, helping to prevent water quality degradation, and helping to limit the spread of aquatic invasive plants
- exceptional water clarity and low *E. coli* counts

Chesterfield NRI and Conservation Priorities
Wetland Resources Map

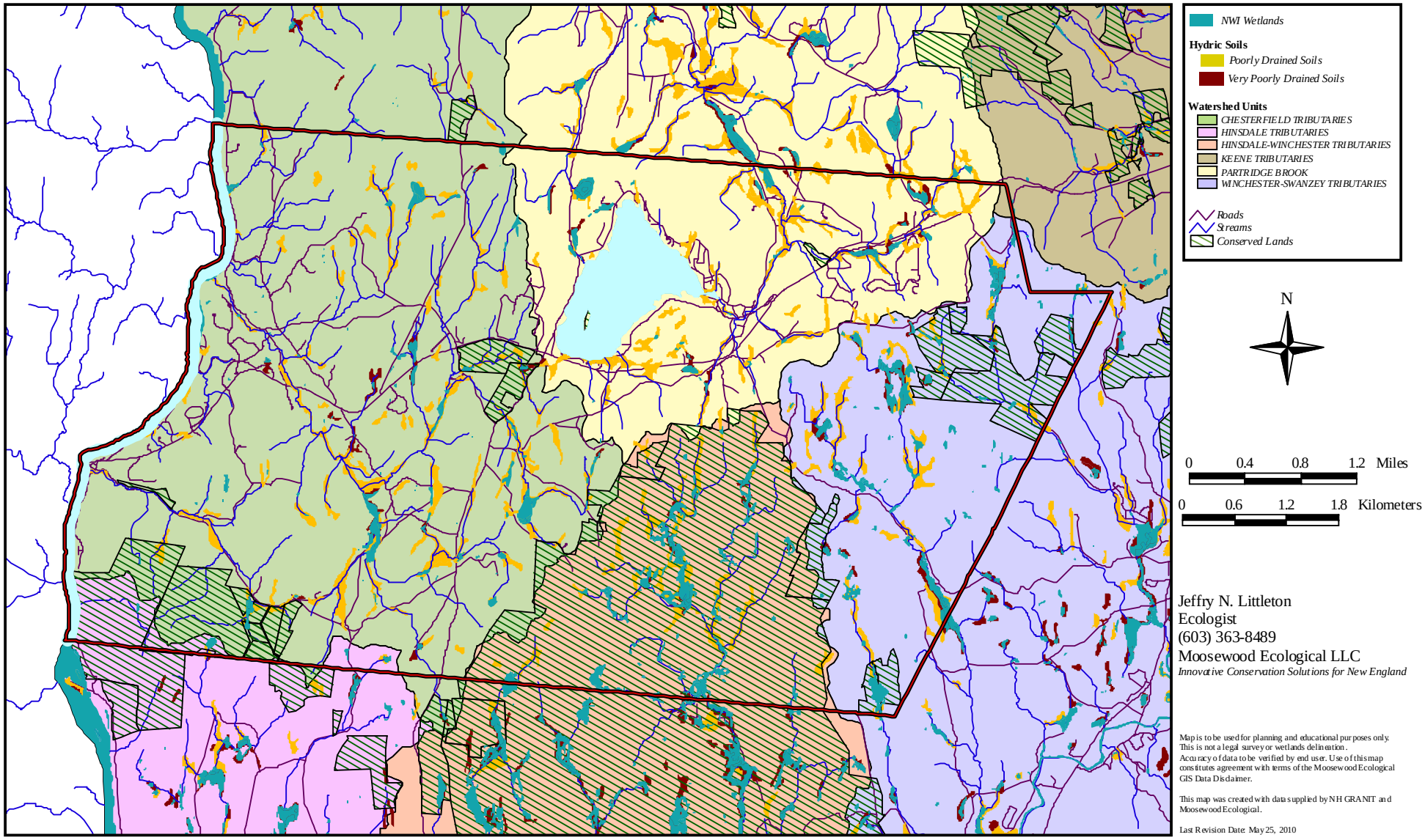


Figure 6. Wetlands of Chesterfield, NH. This map demonstrates the distribution of wetlands (National Wetlands Inventory and hydric soils) and HUC 12 watersheds, as well as those areas that are conserved. Moosewood Ecological LLC

Chesterfield NRI and Conservation Priorities
Top-Ranked Evaluated Wetlands

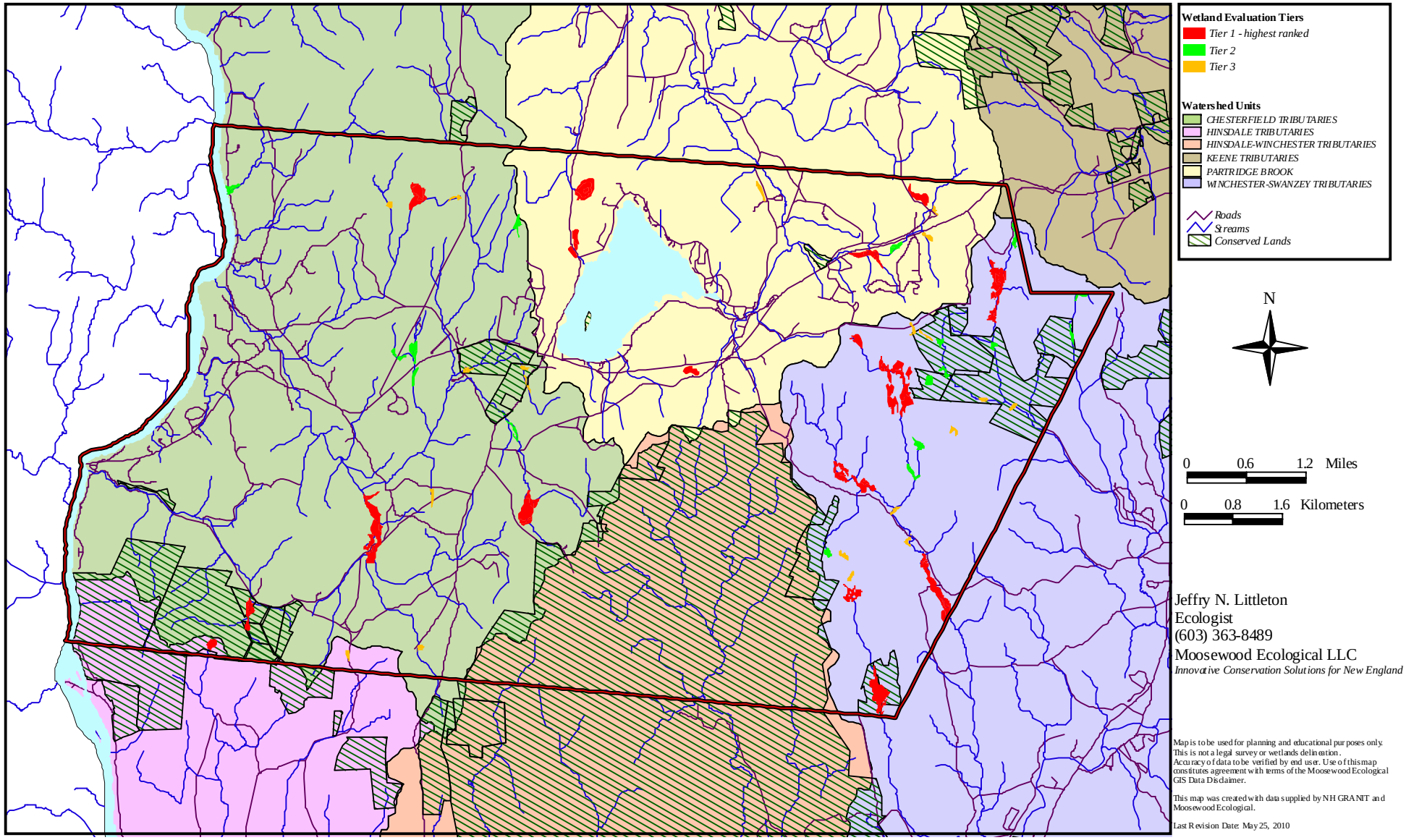


Figure 7. Top-ranked wetlands in Chesterfield, NH. This map demonstrates the distribution and ranking of wetlands based on priorities set forth at the November 2008 community forum. Moosewood Ecological LLC

Wildlife Habitats and Natural Communities

In general, ecology is the field of science that studies organisms and their environments. Ecology includes interactions within and between species, within habitats (such as habitats for mating, breeding, and feeding) and even at the cellular level. Therefore, developing a better understanding of ecological resources is accomplished on several levels, or scales. These include genes, species, populations, communities, ecosystems, and even the larger landscape that includes human land use within the natural environment.

For effective conservation planning and protection of human health and welfare, it is essential to better understand the distribution, composition, structure and function of ecological attributes on these many scales. Having this foundation of knowledge can greatly inform us on how land use may affect our natural resources and better prepare us for a more sustainable style of community planning. This section attempts to develop a basic understanding of these concepts in relation to Chesterfield and builds upon the current foundation of knowledge on *important wildlife habitats*, *exemplary natural communities*, *rare species*, and the *unfragmented landscape*.

Chesterfield's diverse terrain is characterized by a variety of ecologically significant habitats (ESH's) that reflect the town's biodiversity. This diverse landscape supports a wide range of wildlife and plants, including common and infrequent species and a variety of those considered as a conservation concern, as well as significant types of habitats.

ESH's include *important wildlife habitats* and *exemplary natural communities*. These two elements are defined and discussed below. ESH's function as 1) habitats for rare species and other species of conservation concern; 2) rare or declining habitats and natural communities in New Hampshire; and 3) connectivity to other habitats within a largely undisturbed forested landscape. For the purposes of this report, the following ESH's were considered as critically important for the protection and maintenance of biodiversity in Chesterfield:

1. Wildlife habitats as mapped by the NH Fish and Game Wildlife Action Plan, including marshes, peatlands, open waterbodies, grasslands, floodplain forests, hemlock-hardwood-pine forests, Appalachian oak-pine forests, northern hardwood-conifer forests, lowland spruce-fir forests, and rocky ridge/talus slopes;
2. Additional significant wildlife habitats observed and mapped for Chesterfield, including riparian areas, heron rookeries, deer wintering areas, forested swamps, vernal pools, woodland seeps, shrublands, and steep south-facing slopes;
3. Rare and uncommon natural communities as defined by the NH Natural Heritage Bureau;
4. Large unfragmented forest blocks with embedded wetlands and other habitats lumped in close proximity to one another; and
5. Habitats that support known rare species

Important 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. 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.

The following accounts provide a description of each of the 19 important wildlife habitats that were identified in Chesterfield (Figure 8, p.47 and Table 4, p.46). These habitats were broad in scope as mapped by the WAP (noted with an asterisk*) and were confirmed to the extent possible by on-site observations. Site assessments and spatial

analyses aided in mapping other fine-scale important wildlife habitats. Species in **bold** type have been identified by the WAP as species of conservation concern.

Marsh and Shrub Wetlands*

The marsh and shrub wetlands comprise approximately 673 acres in Chesterfield, according to the WAP. These wetland complexes are composed of four main wetland classes originally mapped by the U.S. Fish and Wildlife Service National Wetlands Inventory. These wetland classes include emergent marshes, aquatic beds (pond lilies), unconsolidated bottoms (open water), and shrub swamps. Each of these wetland classes are dictated by topographic setting, hydrologic regimes, soil development, nutrient availability, wildlife influence (such as beaver damming), and plant community composition. The only major wetlands not included in this habitat type are peatlands and forested swamps, which are described below as their own distinct habitat types.

Marsh and shrub wetlands offer dramatic variations in plant community structure. Various grasses, sedges, rushes, ferns, dwarf shrubs, pond lilies, pickerel weed, wild flowers, and other herbaceous plants, as well as open water, typify Chesterfield's marshes. In contrast, shrub wetlands are dominated by shrubs such as speckled alder, highbush blueberry, maleberry, winterberry, mountain holly, wild raison, arrowood, and chokeberry. They will usually also contain a mixture of herbaceous plants and sparse sapling trees, depending upon the density of the shrub layer and degree of wetness.

Both habitats perform significant ecological functions and hold great value to humans and wildlife alike. Ecological functions include storing floodwaters, providing wildlife habitats, maintaining good water quality of surface and groundwater resources, trapping sediments, reducing impacts of excess nutrients and toxicants, stabilizing shorelines, controlling erosion, and supporting rare species and natural communities. These wetlands also have significant societal values such as education and scientific research, visual aesthetics, recreation (fishing, hunting, and boating), and historical value.

Wetlands are widely known to have diverse plant and animal communities. This is mainly due to the fact that wetland ecosystems contain a wide variety of smaller habitats. The availability of multiple habitats provides many organisms with all or part of

their life cycle needs. Robust bird communities can be found in marsh and shrub wetlands. Waterfowl (such as wood duck, **American black duck**, mallard, common merganser, and Canada goose), **American bittern**, **great blue heron**, red-winged blackbird, northern kingbird, tree swallow, belted kingfisher, song sparrow, swamp sparrow, gray catbird, and common grackle, as well as various warblers (common yellowthroat and yellow warbler) commonly breed and nest in wetlands or along the wetland edge. Many waterfowl also depend on wetlands and open waterbodies during spring and fall migration. Other birds of conservation concern associated with marsh and shrub wetlands include **American woodcock**, and **least bittern**.

Mammals, including river otter, mink, beaver, and muskrat, rely heavily upon marsh and shrub wetlands for feeding and denning sites within or adjacent to the wetland. Other mammals known to use these wetlands include raccoon, state endangered **New England cottontail**, ermine, long-tailed weasel, **bobcat**, white-tail deer, moose, and bear. Many frogs and amphibians are common to marsh and shrub wetlands. Green frog, bullfrog, pickerel frog, spring peeper, wood frog as well as the American toad and red-spotted newt, were frequently observed in Chesterfield. **Northern leopard frog**, **Jefferson salamander** and spotted salamander are also associated with these habitats. Painted and snapping turtles were observed as well.

Marsh and shrub wetlands also provide critical habitat for more secretive and less abundant species such as the state endangered **Blanding's turtle**, **spotted turtle**, **ribbon snake**, **eastern smooth green snake**, and northern water snake. Aquatic wildlife such as fish and macroinvertebrates are also integral to and dependant upon these wetland ecosystems, representing a significant part of the complex food cycle.

The interface between wetlands and their adjacent uplands form the riparian zone, which further adds complexity and diversity to the ecological structure and composition. The riparian zone is used by a wide range of semi-aquatic and terrestrial species for breeding, nesting, and feeding, or as connectivity to other significant habitats. The riparian zone is also very beneficial for aquatic species (such as fish and macroinvertebrates) that benefit from the shading of overhanging tree canopies. These

trees help to maintain cooler streams temperatures for long term survival of many species, including the brook trout.

It was estimated that approximately 53% of wetland acreage in the contiguous forty eight states was lost between 1780 and 1980[1]. The widespread devastation of loss and conversion has left a substantial mark; 117 million acres were filled, drained, or flooded. New Hampshire is fortunate to have a conservative history of wetland loss. Between 1780 and 1980 it was estimated that approximately nine percent of the state's wetlands were lost through destruction and/or alteration; the second lowest of the fifty states. However, marsh and shrub wetlands are still vulnerable to human alterations through direct disturbance within the wetland or more often within the adjacent uplands. Threats include habitat loss and conversion, fragmentation, effects of stormwater, introduction of invasive plants, haphazard use of off-highway recreational vehicles (OHRV), and compromised water quality due to ineffective riparian buffers.

Forested Swamps

Forested swamps represent another major class of wetland habitats, covering approximately 313 acres in Chesterfield. Forested swamps are hydrologically connected to marsh and shrub wetlands or exist as isolated basin swamps. In Chesterfield, these are commonly found as red maple- or hemlock-dominated swamps. However, locally significant and uncommon types have been observed, including black gum-red maple basin swamp and red maple-black ash-swamp saxifrage swamp.

Forested swamps were not mapped as part of the WAP but are considered as ecologically significant due to their close relationships with marsh and shrub wetlands and associated wildlife. Some forested swamps function as vernal pools, providing critical habitat for such obligate species such as wood frogs, spotted salamander, **Jefferson's salamander**, and invertebrates such as fingernail clams, caddis fly, and other aquatic insects. Other species that use forested swamps for feeding and nesting are **red-shouldered hawk**, Cooper's hawk, barred owl, northern waterthrush, and **Canada warbler**.

[1] Dahl (1990). Wetlands losses in the U.S. from 1780-1980.

Forested wetlands face many of the same threats associated with other wetland habitats. These include habitat loss and conversion, fragmentation, effects of stormwater, introduction of invasive plants, haphazard use of off-highway recreational vehicles (OHRV), and compromised water quality due to ineffective riparian buffers.

Peatlands*

In general, wetlands can be lumped into two different categories: peatlands and non-peatlands. The previously discussed wetland habitats are considered non-peatlands. Peatlands and non-peatlands can often be part of the same mosaic of plant communities within large wetland complexes, especially those associated with slow moving streams. Peatlands are considered as a distinct wetland habitat type due to the unique species composition, sensitivities to changes in pH (level of acidity), and potential to contain rare species and natural communities.

Peatlands are characterized by acidic conditions with little groundwater input and limited nutrients. This condition dramatically slows down decomposition rates of plant material. This slow decomposition results in the accumulation of peat over time. Peatlands are classified into three wetland classes, including open emergent peatlands, shrub thickets, and forested wetlands. The WAP has estimated that approximately 50 acres of peatlands are found throughout Chesterfield.

Peatlands are considered significant due to their rare plants and unique natural communities. However, the state endangered **ringed boghaunter**, a type of dragonfly, is strongly associated with peatland habitats. Many of the same species that use the marsh and shrub wetlands can also be found in association with open and shrub peatlands, including **eastern smooth green snake**, **ribbon snake**, **Jefferson's salamander**, **northern leopard frog**, state endangered **New England cottontail**, and **bobcat**.

Peatlands are sensitive to excessive loading of nutrients, sedimentation, and toxicants from adjacent land uses as they can change the water chemistry, altering both plant and animal communities. Excess flooding as a result of incompatible adjacent land use planning, as well as damming by beavers, can also dramatically alter peatland habitats. In summary, threats to these habitats include fragmentation, habitat loss and

conversion, altered hydrology, nonpoint source pollution, unsustainable forestry practices, haphazard use of off-highway recreational vehicles (OHRV), and introduction of invasive plants.

Floodplain Forests*

According to the WAP, floodplain forests were estimated to cover approximately 62 acres in Chesterfield. These floodplains were scattered along the Connecticut River and in some cases, were associated with the mouth, or confluence, of tributaries. Additional floodplains can be found along other streams in Chesterfield. Small examples of the rare sycamore floodplain forest were observed along the Catsbane Brook near the Connecticut River.

Floodplain forests perform a variety of significant ecological functions. They assist storing floodwaters and reducing overall flow rates that help reduce potential flooding downstream. They maintain water quality by buffering adjacent land uses associated with excess nutrients, sedimentation, and toxicants. They also control erosion.

Floodplains are a mosaic of habitats that can greatly vary in structure, owing to its rich biological makeup. They can include both upland and wetland habitats such as forests and less dense open woodlands, meadows, oxbow marshes, shrub thickets, vernal pools, and seeps. This interaction between wetland and upland communities forms the riparian zone. These collective habitats in turn support wonderfully diverse wildlife communities for breeding, nesting, feeding, and migration.

Floodplain forests provide habitat for many migratory and year-round resident birds. Waterfowl (such as wood ducks and mallards using vernal pools), American redstart, Baltimore oriole, **red-shouldered hawk**, Cooper's hawk, **American woodcock**, **veery**, and **wood thrush** use these dynamic habitats. Amphibians include spring peeper, wood frog, spotted salamander, green frog, pickerel frog, gray tree frog, and American toad. More importantly, floodplains are critical for **Jefferson's salamanders** and **northern leopard frog**, as well as some reptiles considered as species of conservation concern, including the state endangered **Blanding's turtle**, **wood turtle**, **spotted turtle**, and **ribbon snake**. Semi-aquatic mammals using river systems readily depend upon these

riparian forests and signs of river otter, muskrat, beaver, and mink can typically be observed using intact floodplain forests.

In the past, many of New Hampshire's major and minor floodplain forests have been converted to other land uses such as agriculture or residential, commercial, and industrial developments. This fact exemplifies the great significance of protecting the remaining intact examples if we are going to conserve the wildlife and plant communities that reside within these habitats. Threats to the long term stability and ecological integrity of floodplains include fragmentation, habitat loss and conversion, altered natural disturbance due to damming, and the introduction of invasive plants that can out-compete native species, potentially altering wildlife communities.

Open Waterbodies*/Rivers and Streams

Open waterbodies include rivers, smaller streams, lakes, and ponds. These natural resources have great significance for providing critical habitats for diverse wildlife. Open waterbodies of the Connecticut River mainstem watersheds provide habitats for both cold and warm water species. The Connecticut River itself has been recognized as a large river system than can support a wide range of diadromous fish, including the rare **Atlantic salmon**, American eel, and river herring. It supports the federally endangered **dwarf wedge mussel** and the state endangered **cobblestone tiger beetle**. The Connecticut River is also a recognized flyway for migratory birds. Other important wildlife found within the Connecticut River mainstem watersheds include **American eel**, **American shad**, state threatened **bald eagle**, **blueback herring**, **burbot**, **common loon**, **eastern brook trout**, **eastern pond mussel**, **northern leopard frog**, **osprey**, **sea lamprey**, **tessellated darter**, **wood turtle**, and migrating and wintering birds.

The smaller streams of Chesterfield are significant for both warm water and cold water fish. Species observed by the NH Fish and Game Department include brown bullhead, blacknose dace, common white sucker, **eastern brook trout**, chain pickerel, fallfish, **slimy sculpin**, and spottail shiner.

Spofford Lake is considered as both warm water and cold water fisheries. Known species include banded killifish, rock bass, blue gill, common sunfish, white perch,

yellow perch, yellow bullhead, rainbow trout, smallmouth bass, largemouth bass, pickerel, horned pout, and northern pike. Spofford Lake is known as a significant habitat and hotspot for fall migrating waterfowl (Brown 2010). Horned, pied-billed, and red-necked grebes, common and hooded mergansers, bufflehead, common goldeneye, long-tailed duck, mallard, and black duck are commonly seen in the fall. Large flocks of scoters (up to 600) have been observed as well. Spofford Lake is also considered a significant habitat for species of conservation concern, including the **bald eagle**, **osprey**, and **common loon**, which have been observed using the lake during the breeding season.

Threats to the open waterbodies of the Connecticut River mainstem watersheds generally include altered natural flow regimes as a result of dams that can inhibit migration of semi-aquatic and aquatic species (particularly fish), nonpoint source pollution (especially sedimentation and stormwater runoff) from land development and unsustainable forestry and agricultural practices within or adjacent to the resources, and the spread of invasive species.

Heron Rookeries

Beaver impoundments and other wetlands can provide critical nesting habitat for **great blue herons**, which typically nest in colonies referred to as heron rookeries. Nests are generally found in dead trees (or snags) within or adjacent to the wetland. However, live white pines along the edge of wetlands are known to provide nesting sites as well. Great blue heron habitats can also function as breeding and nesting habitat for **osprey**.

Five heron rookeries were observed in Chesterfield. Nesting adults and/or fledglings were observed in four of the rookeries in 2009 and 2010. The only location that was inactive was the rookery in the beaver pond along Winchester Road. However, nests still remain as testament that it was once serving as a heron rookery.

Herons are known to exhibit sensitivities to habitat loss and disturbance, especially during the breeding and nesting season. The loss of nesting sites in dead flooded trees is often the reason for inactivity. New beaver flooding is a prime and related activity. Also, maintaining a buffer of pines along ponds is a good forestry practice.

Other major threats to heron rookery health include those cited for the marsh and shrub wetland habitat discussed above.

Vernal Pools

Vernal pools are listed in the WAP as a critical habitat type but have not been mapped at the state level. The recognition of vernal pools as a critical wildlife habitat is relatively recent. Due to their small size often on-site evaluation is the only indication they exist. Therefore, these habitats are more easily mapped at the town or site-specific level. The vernal pools in Chesterfield were mapped using on site assessments and roadside surveys. A total of 84 potential and confirmed vernal pools were recorded, including 45 pools previously observed in Pisgah State Park[2].

Vernal pools are typically temporary or seasonal woodland pools that are found within upland or floodplain forests. These woodland pools fill with water in the spring and fall, and generally dry partially or even completely in the summer. They are isolated in small basins and are not associated with a permanent inflow or outflow of water. Additionally, they are devoid of fish populations.

Vernal pools are critical for the long-term survival of many obligate species of amphibians, reptiles, and macroinvertebrates. Species considered as obligate or strongly associated with vernal pools include the state endangered **Blanding's turtle**, **spotted turtle**, **ribbon snake**, **Jefferson's salamander**, **blue-spotted salamander**, spotted salamander, state endangered **marbled salamander**, wood frog, fingernail clams, and fairy shrimp. **Bobcat** and state endangered **New England cottontail** can also be found using this habitat for feeding and/or cover from predation.

The main threats to vernal pools are associated with residential, commercial, and industrial development activities within and adjacent to this habitat, resulting in habitat loss and conversion. Fragmentation created by roadways can bisect a complex of vernal pools within close proximity from one another. This effect can result in high road mortality and lower genetic diversity, essentially isolating populations of amphibians. Forestry practices adjacent to vernal pools can have negative effects within upland

[2] Dexter (2008)

habitats, as well as alterations in hydrology from removing the forest canopy that covers the pools. Increased rates of evaporation can cause the pools to dry out more rapidly and consequently desiccating egg masses before they can fully develop to maturity. In addition, the adjacent woodland is home to the wood frogs and salamanders that use the vernal pool for breeding.

Woodland Seeps

Woodland seeps are basically small swamps that are fed by groundwater and generally less than an acre in size. Seeps are found in a variety of physical settings, including upland forests and riparian zones associated with streams and wetlands. Plant species composition within seeps can be highly variable, depending upon specific site conditions.

Unless impacted by human land use, seeps are generally covered by continuous forest cover except when a tree is blown down during a storm. These blowdowns are ecologically significant as they provide a source of coarse woody debris that is important for a variety of ecological processes such as nutrient exchange and soil development through decomposition, as well as a microhabitat for a variety of amphibians, insects, microorganisms, and fungi.

Woodland seeps function as refugia for a variety of plants and animals, serving a critical ecological role during the driest months of the year. Frogs, salamanders, and newts will typically use seeps when moving between other habitats. Seeps also function as an early spring food source for bear, turkey, deer, and moose, as well as a good source of oxygenated water when they are connected with streams.

Threats to this habitat type include logging and filling associated with development activities. Adjacent developments may have negative effects on groundwater quality and quantity, whereby reducing the functionality of seeps.

Riparian Areas

Riparian areas form the interface between uplands and wetlands, including ponds rivers, and streams. They provide a wide range of natural services that are essential in maintaining biodiversity and proper ecological functions. These include services such as:

- various biogeochemical processes that result in the breakdown of living and non-living materials that support a thriving soil community, providing food web support and nutrients for plant growth;
- buffering properties for point and nonpoint source pollution (i.e., sedimentation, excess nutrients, toxicants) from upland land use;
- providing optimal shading by the tree canopy that is required for streams to maintain cold temperatures needed by fish and aquatic macroinvertebrates (large water bugs);
- contribution of organic debris (i.e., large woody debris or downed trees, smaller woody limbs and twigs, and leaf litter) within the riparian area and adjacent wetland ecosystems;
- reducing the effects of downstream flooding by storing rising water levels in floodplains;
- wildlife corridors for safe movement between various habitats for mammals, birds, reptiles, and amphibians; and
- important breeding, feeding, and nesting habitats for terrestrial, aquatic, and semi-aquatic wildlife.

Riparian areas have been mapped using a 200-foot buffer around all intermittent and perennial streams, as well as wetlands and open waterbodies. The total riparian area of Chesterfield was estimated to be 6,956 acres, or nearly 23% of the town. This estimate provides insights into the distribution and coverage that this critical area represents in Chesterfield.

Hemlock-Hardwood-Pine Forest*

The hemlock-hardwood-pine forest ecosystem is often considered to be a northern transitional hardwood forest situated between the northern hardwood-conifer forests typical of the northern half of New Hampshire and the Appalachian oak-pine forests that reside in the southern most portion of the state. Coniferous and mixed forests typify this ecosystem and are composed of various mixtures of eastern hemlock, American beech, red oak, white pine, and red maple. Other hardwoods are present but less abundant include sugar maple, white ash, hop-hornbeam, hickory, basswood, and black cherry.

According to the WAP, the hemlock-hardwood-pine forest consists of approximately 20,743 acres, or roughly 68% of Chesterfield. This estimate appears to be lower than what actually exists. Site visits confirm that the hemlock-hardwood-pine forest is more extensive, especially in the eastern half of Chesterfield.

Species diversity for the hemlock-hardwood-pine forests in New Hampshire totals 140 vertebrates throughout New Hampshire, including 15 amphibians, 73 birds, 39 mammals, and 13 reptiles. These include a variety of important wildlife such as **American woodcock**, state threatened **bald eagle**, **northern goshawk**, **Canada warbler**, **cerulean warbler**, Cooper's hawk, **eastern towhee**, **purple finch**, **red-shouldered hawk**, **ruffed grouse**, **veery**, **wood thrush**, **blue-spotted salamander**, **Jefferson's salamander**, **ribbon snake**, **smooth green snake**, **wood turtle**, **eastern pipistrelle**, **eastern red bat**, **northern myotis**, **silver-haired bat**, **bear**, **moose**, and **bobcat,** as well as many migratory and wintering birds.

Some of the major direct threats to these forests include the construction of new roadways that fragment the remaining forested blocks, exposing wildlife to increased road mortality and decreasing core forest habitat needed by certain area sensitive species, such as **bobcat**, ovenbird, scarlet tanager, and some raptors. Other threats are associated with habitat loss and conversion due to land use planning, leading to new roadways and associated forest fragmentation. These elements also lend themselves to exposure pathways for the colonization of non-native, invasive plants that can alter species composition and diversity of native trees, shrubs, and other plants. Lastly, non-native

forest pests such as the hemlock wooly adelgid and the Asian long-horned beetle poses serious risks to forest health as can other introduced pathogens.

Northern Hardwood-Conifer Forest*

The northern hardwood-conifer forests stretches from the Monadnock highlands through the foothills of the White Mountains and beyond, increasing in distribution as one moves north in the state. Only one location was predicted in Chesterfield by the WAP. It was estimated to be about 20 acres and was located between Route 63 and Pisgah State Park along the southern boundary line of Chesterfield.

Species diversity for the northern hardwood-conifer forest in New Hampshire is very similar to the hemlock-hardwood-pine forest, totaling 137 vertebrates throughout New Hampshire, including 14 amphibians, 73 birds, 42 mammals, and 8 reptiles. These include a variety of important wildlife such as **American woodcock**, state threatened **bald eagle**, **northern goshawk**, **Canada warbler**, **cerulean warbler**, Cooper's hawk, **purple finch**, **red-shouldered hawk**, **ruffed grouse**, **veery**, **wood thrush**, **blue-spotted salamander**, **Jefferson's salamander**, **ribbon snake**, **smooth green snake**, **wood turtle**, **eastern pipistrelle**, **eastern red bat**, **northern myotis**, **silver-haired bat**, **bear**, **moose**, **bobcat**, and state endangered/federally threatened **Canada lynx,** as well as many migratory and wintering birds.

The same threats listed for the hemlock-hardwood-pine forests also apply to the northern hardwood-conifer forests.

Appalachian Oak-Pine Forest*

According to the WAP, the Appalachian oak-pine forest represents the second largest forest type. It was estimated to be approximately 6,429 acres, or about 21% of Chesterfield. However, based on site visits this estimate appears to be an overestimate. This is especially true for the eastern half of town where this forest type was mostly absent.

The Appalachian oak-pine forest is characterized mainly as hardwood and hardwood-dominated mixed forest types. Common hardwood species include white oak,

black oak, red oak, hickories, and red maple. Other hardwoods present but less abundant may include sugar maple, white ash, hop-hornbeam, American chestnut, and chestnut oak. Coniferous species usually include white pine with some occasional eastern hemlock and even less abundant pitch pine.

Species diversity for the Appalachian oak-pine forest in New Hampshire accounts for approximately 104 vertebrates. These include 8 amphibians, 67 birds, 17 mammals, and 12 reptiles. Diverse wildlife communities can be observed in these upland forests. Typical birds include many species of raptors such as red-tailed hawk, **red-shoulder hawk**, Cooper's hawk, broad-winged hawk, **northern goshawk**, and barred owl, as well as many Neotropical migratory birds (i.e., scarlet tanager, **veery**, ovenbird, black-throated green warbler) and other resident songbirds. Mammals can include **deer**, **moose**, **bear**, **bobcat**, coyote, fox, fisher, snowshoe hare, eastern cottontail, red and gray squirrels, as well as other smaller members of the rodent family.

Other rare and important wildlife that may also exist in these upland forests includes **American woodcock**, state threatened **bald eagle**, state threatened **black racer**, state endangered **Blanding's turtle**, **blue-spotted salamander, Canada warbler, cerulean warbler, Eastern box turtle,** state threatened **eastern hognose snake, eastern pipistrelle, Eastern towhee, Jefferson's salamander, marbles salamander,** state endangered **New England cottontail, northern myotis, ribbon snake, ruffed grouse, silver-haired bat, smooth green snake, spotted turtle,** state endangered **timber rattlesnake, wild turkey, veery, whip-poor-will, wood thrush** and **wood turtle**.

The same threats listed for the hemlock-hardwood-pine forests also apply to the Appalachian oak-pine forests.

Lowland Spruce-Fir Forest*

Lowland spruce-fir forests have a similar range in New Hampshire as the northern hardwood-conifer forests. They can represent upland forests with well-drained soils or forested spruce swamps. According to the WAP, lowland spruce-fir forests cover approximately 239 acres in Chesterfield. However, site visits confirm that this is an overestimation of distribution. Many of the potential spruce-fir forests did not actually

exist but rather dominated by hemlocks. Lowland spruce-fir forests more than likely cover one-quarter or less than the original estimate.

Species diversity for the northern hardwood-conifer forest is very similar to the two previously described forest types, totaling 101 vertebrates throughout New Hampshire, including 9 amphibians, 53 birds, 37 mammals, and 2 reptiles. These include a variety of important species such as state threatened **bald eagle**, **bay-breasted warbler**, **northern goshawk**, **Canada warbler**, Cooper's hawk, **purple finch**, **wood turtle**, **hoary bat**, state threatened **American marten**, **bear**, **moose**, **bobcat**, and state endangered/federally threatened **Canada lynx,** as well as many migratory and wintering birds.

The same threats listed for the hemlock-hardwood-pine forests also apply to the northern hardwood-conifer forests.

Deer Wintering Areas

During the winter months, deer congregate in wintering areas known as deer yards. These wintering areas are critical for deer survival as they provide areas of reduced snow cover on the ground, as well as protection from wind and storms. Usually a food source close by is an added benefit. These factors are crucial for reducing the amount of energy expended during the winter months when food supplies are scarce.

Deer yards are usually found within hemlock forests but can be found in a variety of other dense coniferous dominated forests as well, including spruce-fir forests and densely populated white pine stands. When heavy snow cover exists, deer will tend to stay confined to wintering areas and compact the snow for ease in traveling. Also, as a result of scarce food supplies deer will bark conifer saplings, and when present they seem to prefer hemlocks over other conifers. This involves using their bottom incisors to scrape or strip the bark and inner tissue for food. The compacted trails from high traffic, numerous bedding sites, and tree barking can help to confirm a deer wintering area.

In the 1980's, NH Fish and Game Department (NHFGD) mapped deer wintering areas using aerial photography interpretation and ground surveys. These data are not complete for the state and some towns have been updated over the years. As such, the

deer wintering areas data should not be construed as current or complete. However, it does provide a base line effort of mapping potential deer wintering areas that can be refined over time. According to the NHFGD, there were a total of 21 potential sites that total 6,621 acres.

Major threats to this critical habitat include habitat loss from development and forestry. However, forestry projects can greatly enhance deer yards by creating much needed food sources adjacent to the habitat and by promoting regeneration of softwoods. Deer yards are also sensitive to continuous human disturbance during the winter months when they are actively used by deer.

Ridge/Talus Slopes* and Steep South-facing Slopes

Rocky ridges can be found along outcroppings associated with ridgelines and summits. Talus slopes are often associated with cliffs and steep slopes of mountains. These two habitats have been lumped together into one data layer by the WAP. These habitats can be found in Chesterfield along Wantastiquet Mountain and total roughly 140 acres. Steep south-facing slopes were also analyzed to expand the potential locations of smaller talus slopes with southern exposures. These habitats are widely distributed throughout Chesterfield and cover approximately 244 acres.

Ridges, talus slopes, and other south-facing slopes can serve as primary habitat as snake hibernacula for species such as the state endangered **timber rattlesnake** and state threatened **black racer**. They can also serve as critical habitat for **bobcat, bear,** and state endangered **common nighthawk.** These areas are known to support various unique natural communities that are uncommon in the Monadnock region or rare in the state.

Grasslands*

According to the WAP, grasslands were estimated to account for approximately 2,319 acres in Chesterfield. These upland habitats include hayfields, pastures, cropland, and other types of open fields (such as athletic fields). Wet meadows (or beaver meadows) can also function as critical grassland habitats.

Typical plant composition for upland grasslands includes various grasses and sedges, goldenrods, asters, meadowsweet, and milkweeds. Medium- to large-sized shrubs and young trees may also be present but are not common. Management within each type of grassland habitat varies depending upon the type of land use but all should be maintained in a fashion that prevents the establishment of shrubs and trees. If not by human intervention grasslands will naturally succeed into shrublands, and eventually develop into a forest.

Grasslands provide critical open habitat for wildlife that greatly contributes to Chesterfield's diversity, specifically that of birds, insects, and reptiles. Species of conservation concern associated with grassland habitats include **eastern meadowlark**, **vesper sparrow**, state threatened **grasshopper sparrow**, **northern harrier**, **American kestrel**, **American woodcock**, **upland sandpiper**, **horned lark**, **wood turtle**, and state threatened **northern black racer,** and **eastern smooth green snake**. Also associated with grasslands is the **northern leopard frog**, especially grasslands in close proximity with floodplain forest complexes.

Grasslands and their associated wildlife have been in decline due to the mass abandonment of agriculture within the last 100-150 years. When farming and open land was more prevalent grassland species thrived in the state. However, grassland bird populations are declining more rapidly than any others in the northeast[3] and are in clear decline in New Hampshire[4]. Other threats to grasslands are habitat loss and conversion due to land use. Without the presence of grassland habitats some species would not remain a part of Chesterfield's landscape, resulting in lower biodiversity overall.

Shrublands

Shrublands are typically characterized by a combination of shrubs and young shrub-like trees that dominate this habitat. Mixed grasses, sedges, and forbs are generally present and interspersed throughout but less abundant overall. Chesterfield's shrublands may include utility right-of-ways, reverting sand and gravel pits, old farmlands, and patch cuts created during forestry projects. Certain shrub swamps (such as those in association

[3] Sauer et al. (2003)
[4] Hunt (2009)

with Hubbard Brook along Gulf Road and Partridge Brook along Route 9) may also function as important shrubland habitat for a subset of wildlife. As noted above, grasslands will naturally succeed into shrublands if not maintained, and likewise, shrublands will eventually revert to forests. Each of these areas (except shrub swamps) must be managed appropriately in order to maintain this habitat type and support its various wildlife communities.

Upland shrubland habitats are significant for many birds and reptiles. They serve as primary and secondary habitats for breeding, nesting, and feeding. Species of conservation concern that use shrublands include **eastern smooth green snake**, state threatened **northern black racer**, state endangered **eastern hognose snake**, **eastern towhee**, **ruffed grouse**, **whip-poor-will**, **American woodcock**, **wood turtle**, **bobcat**, and the state endangered **New England cottontail**. The latter four species can also be associated with certain shrub swamps as well. Common wildlife that was observed in these habitats included common yellowthroat, song sparrow, gray catbird, white-tailed deer, moose, and garter snake.

Shrubland habitats have been declining in the state. During the abandonment of farms, grasslands succeeded into shrublands and were once widespread throughout the state. Most of these shrublands have succeeded into forests, rapidly reducing the size and distribution of this critical habitat and negatively impacting wildlife that requires this habitat. Other threats to this habitat type include fragmentation, habitat loss and habitat conversion, haphazard use of off-highway recreational vehicle (OHRV) activities, and establishment of invasive plants, including honeysuckles, buckthorn, autumn olive, Asian bittersweet, and swalloworts. Invasive species can be quite aggressive; resulting in a change in plant composition from native species to one dominated more with invasive species.

Table 4. Summary of important wildlife habitats of Chesterfield.

Wildife Habitat Type	Size	% of Town
Marsh and Shrub Wetlands*	673 acres	2.2
Forested Swamps	313 acres	1.0
Peatlands*	50 acres	0.2
Floodplain Forests*	62 acres	0.2
Open Waterbodies*^^	954 acres	3.1
Rivers and Streams*	136 miles	n/a
Heron Rookeries	5 locations	n/a
Vernal Pools	84 locations	n/a
Woodland Seeps	various locations	n/a
Riparian Areas	6,956 acres	22.9
Hemlock-Hardwood-Pine Forests*	20,743 acres	68.2
Northern Hardwood-Conifer Forests*	20 acres	<0.1
Appalachian-Oak-Pine Forests*	6,429 acres	21.1
Lowland Spruce-Fir Forests*	239 acres	0.8
Deer Wintering Areas	6,221 acres	20.4
Rocky Ridge or Talus Slopes*	140 acres	0.5
Steep South-facing Slopes	244 acres	0.8
Shrublands	various locations	n/a
Grasslands*^	2,319 acres	7.6

Source: GIS Slope and Riparian Buffer Analysis (Moosewood Ecological 2009); NH Fish and Game Department Wildlife Action Plan (2005); USGS topography, NH hydrography and US Fish and Wildife Service National Wetlands Inventory datasets from GRANIT.

*Wildlife habitats mapped as part of the NH Fish and Game Wildlife Action Plan (2005).
^Grasslands include hayfields, pastures, croplands, and orchards, as well as other open maintained fields.
^^Waterbodies include Spofford Lake, Connecticut River, ponds, and other open waterbodies.

While this represents a fairly comprehensive list of significant wildlife habitats some types may be even more abundant throughout Chesterfield. This is particularly true for forest seeps and vernal pools since they are generally found in small isolated areas that can occur in a variety of forested and residential settings, and are only now considered important enough to search out and record. Other types of smaller but significant habitats may also be found scattered throughout Chesterfield, including turtle nesting areas and hard mast forests. More detailed investigations would need to be conducted to better understand where these types of localized habitats exist.

Chesterfield NRI and Conservation Priorities
Ecologically Significant Habitats

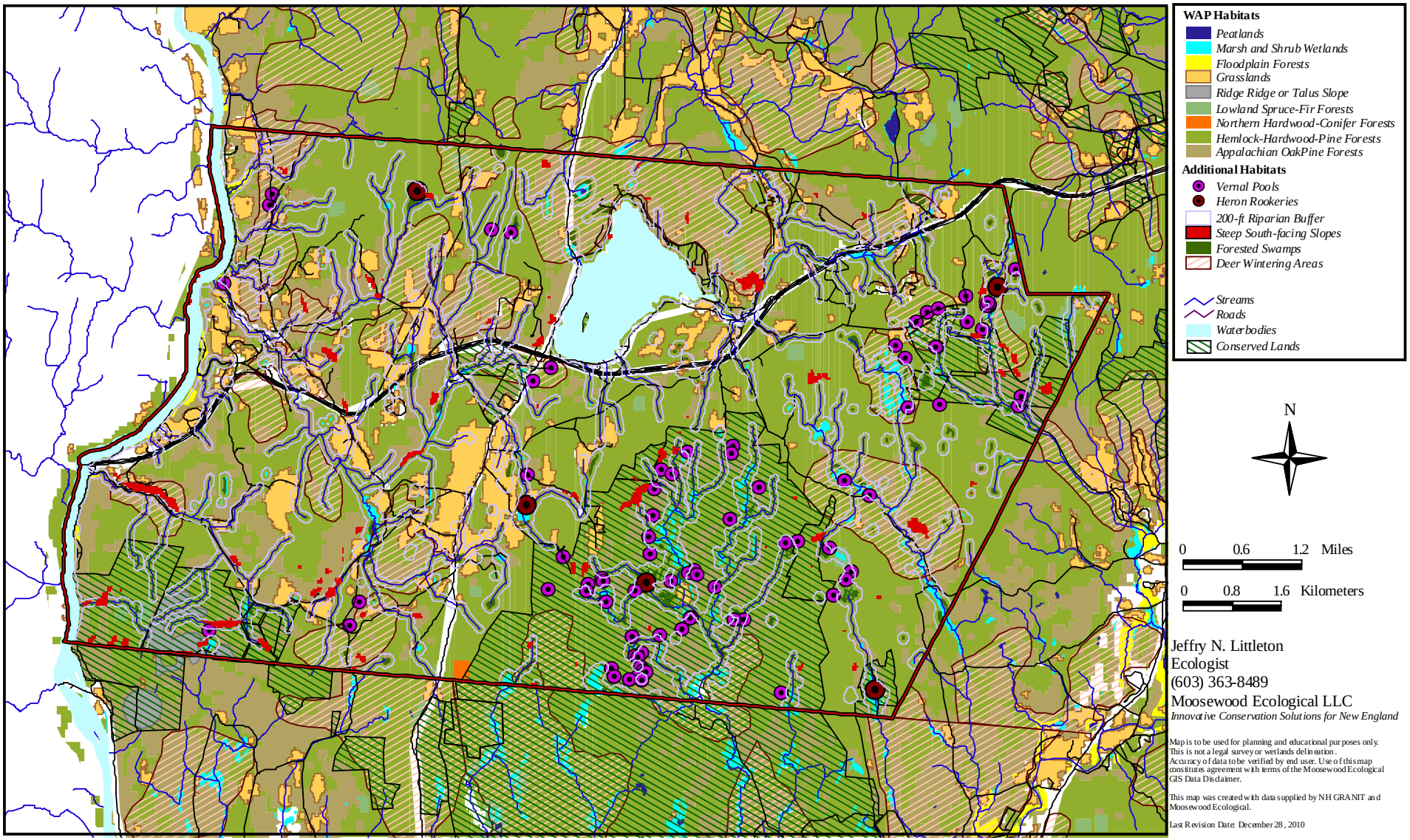


Figure 8. Ecologically significant habitats of Chesterfield, NH. This map demonstrates the distribution of upland and wetland habitats that express especially high and/or unique biodiversity attributes, including rare or declining habitats. Moosewood Ecological LLC

Exemplary Natural Communities

Natural communities are defined by three features: 1) distinct plant assemblages, 2) their physical environments, and 3) the ecological processes that affect them. Essentially, they are ecological units that can be delineated throughout the landscape. Natural communities include both uplands and wetlands such as forests and woodlands, talus slopes, shorelines, marshes, forested swamps, peatlands, floodplains, and aquatic systems. Natural communities can be thought of as habitats for plants and provide a complimentary perspective to the previous section on *Important Wildlife Habitats*. Natural community classification and mapping is a way of providing more detail regarding the various plant communities that form a broader habitat type (for example, many types of natural communities can make up the marsh and shrub wetland habitat).

Natural communities provide scientists and resource managers with an ecological understanding of the land and its inhabitants to make informed decisions regarding land management options. Therefore, natural community classifications provide a powerful tool to guide strategic land use planning. Equally as important, they provide a basis from which inventory and monitoring programs can be developed, and a means to document and track rare species and exemplary natural communities.

The NH Natural Heritage Bureau (NH NHB), a bureau within the Department of Resource and Economic Development's Division of Forest and Lands, is responsible for locating, tracking, and facilitating the protection of rare and imperiled plants and exemplary natural communities. NH NHB has developed an extensive classification system for natural communities in New Hampshire. This classification system was the basis from which the various forest and wetland communities of Chesterfield were identified.

The NH NHB has documented six exemplary[1] natural community types for Chesterfield (Table 5, p.49). These included five upland forest communities and one wetland system. All upland forests except the hemlock-hardwood pine forest system can be found on Wantastiquet Mountain. The hemlock-hardwood pine forest and emergent

[1] Exemplary natural communities include almost all rare types of natural communities, as well as high quality examples of those that are more common in the state. The NH NHB regards exemplary natural communities as priorities for conservation.

marsh-shrub swamp were observed in Pisgah State Park. Another representative site supporting an exemplary emergent marsh-shrub swamp was previously recorded in the California Brook Natural Area.

This list of exemplary natural communities has been cross-referenced to their associated critical wildlife habitat for direct comparisons. This affords the opportunity to view Chesterfield in a more ecological perspective, integrating biological diversity and conservation planning with considerations for both wildlife habitats and natural communities that together form ecologically significant habitats (ESH's). In addition, this is not a comprehensive list of exemplary natural communities that can be found in Chesterfield. It only represents those that have been observed and documented by the NH NHB. It is extremely likely that Chesterfield contains many other exemplary communities. For example, during this project a sycamore floodplain forest was observed off Main Street along the lower section of Catsbane Brook. This natural community is considered as extremely rare in New Hampshire. Documentation of this floodplain forest will be submitted to the NH Natural Heritage Bureau for review.

Table 5. List of known exemplary natural communities in Chesterfield.

Natural Community Types	Associated Wildlife Habitat
Wooded Uplands	
Spruce-fir zone	
Spruce-birch-moutain maple wooded talus	Appalachian oak-pine forest
Northern and transition hardwood - conifer zone	
Hemlock-hardwood-pine forest system	Hemlock hardwood pine forest
Oak-pine zone	
Appalachian oak-pine rocky ridge	Appalachian oak-pine forest
Dry Appalachian oak-hickory forest	Appalachian oak-pine forest
Red oak-hickory wooded talus	Appalachian oak-pine forest
Open Wetlands and Riparian Communities	
Open emergent marshes, shrub thickets, and aquatic beds	
Emergent marsh-shrub swamp system	Marsh and shrub wetlands

Source: Sperduto and Nichols (2004); NHNHB (2010)

Wildlife Species

During 2008-2010 a total of 169 species of wildlife were documented, including 115 birds, 14 amphibians, 8 reptiles, and 32 mammals (Appendix D, p.90). This effort did not include a comprehensive survey of wildlife nor do the lists intend to suggest that other species are not present. Birds that were documented include year-round residents and migratory observed during the breeding season, as well as spring and fall migration. Of the documented wildlife, 25 species have been noted as species of greatest conservation concern (NH WAP 2005, Hunt 2007). These include 15 birds, 2 amphibians, 2 reptiles, 2 fish, and 4 mammals (Table 6, p.50).

Table 6. List of known wildlife of greatest conservation concern in Chesterfield.

Birds	
Common loon	Osprey
Pied-billed grebe	American kestrel
American black duck	Wood thrush
American woodcock	Veery
Wild turkey	Canada warbler
Ruffed grouse	Cerulean warbler
Northern harrier	Eastern towhee
American bald eagle	
Amphibians	
Jefferson salamander	Northern leopard frog
Reptiles	
Wood turtle	Eastern ribbon snake
Fish	
Eastern brook trout	Slimy sculpin
Mammals	
Black bear	Moose
Bobcat	White-tailed deer

Source: Moosewood Ecological (2008-2010); Brown (2010); Klapper (2009); Peterson (2009); NH Fish and Game (2009), and NH Natural Heritage Bureau database (January 2010)

Rare Plant Species

Nine rare plants have been documented by the NH NHB to occur in Chesterfield (Table 7, p.51). Six species are considered as historical observations since the latest record was more than 20 years ago. However, it is likely that these species still remain and additional rare plants exist in Chesterfield. The downy false foxglove, fern-leaved false foxglove, and the Guadalupe waternymph were regarded by the NH NHB as having very high importance for conservation.

Table 7. List of known rare plants in Chesterfield.

Species	Rarity Rank
Appalachian filmy fern (*Trichomanes intricatum*)*	S1
Butterfly weed (*Acslepias tuberosa*)*	S1
Downy false-foxglove (*Aureolaria virginica)*	S1
Hairy stargrass (*Hypoxis hirsuta)**	S1
Incurved umbrella sedge (*Cyperus squarrosus*)*	S1
Short-fruited rush (*Juncus brachycephalus)**	S1
Wild senna (*Senna hebecarpa*)*	S1
Fern-leaved false foxglove (*Aureolaria pedicularia var. intercedens intercedens*)	S2
Guadalupe waternymph (*Najas guadalupensis*)	

Source: NH Natural Heritage Bureau database (January 2010)

*****Indicates historical observation of greater than 20 years.
S1 - State Endangered
S2 - State Threatened

Unfragmented Landscape

Fragmentation is an effect of human land use that divides our landscape into discrete blocks of land. This division of land occurs when roadways are created to support our built infrastructure (such as residential, commercial, and industrial developments). The continuous development of new roadways and fragmentation into large forested blocks can eventually create a mosaic of smaller unfragmented forest blocks that can no longer support robust wildlife and plant populations. Furthermore, many types of wildlife need large unfragmented lands in order to survive and successfully reproduce, including bear, bobcat, and even small warblers such as the ovenbird.

When discussing fragmentation it is important to look at the big picture. Since natural resources do not observe our political boundaries we must take into account the pattern and distribution of unfragmented blocks within Chesterfield, as well as the adjacent communities. This approach provides a better perspective for understanding species presence and ecological integrity of our landscape in light of our development patterns.

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. This is the area where most developments occur in relation to roadways. Unfragmented blocks of land includes 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.

Chesterfield is characterized by a variety unfragmented blocks of land, ranging in size from 14 acres to nearly 11,000 (Figure 9, p.53). Due to its rural nature, Chesterfield has some substantial unfragmented blocks larger than 500 acres. The largest block is associated with Pisgah State Park and the California Brook Natural Area. This area in Chesterfield is approximately 11,000 but continues into Keene, Swanzey, and Winchester where it reaches over 28,000 acres of unbroken forests and embedded wetlands. Due to the shear size and diversity of its habitats this unfragmented block is the most significant in Chesterfield.

To better understand the significance of the unfragmented landscape and associated wildlife, see Appendix E (p.97). This chart lists the habitat requirements of different wildlife species, as well as what you could expect to find within certain size ranges. This is an important tool to understand potential species of Chesterfield and how fragmentation can impact species composition.

Chesterfield NRI and Conservation Priorities
Unfragmented Lands Map

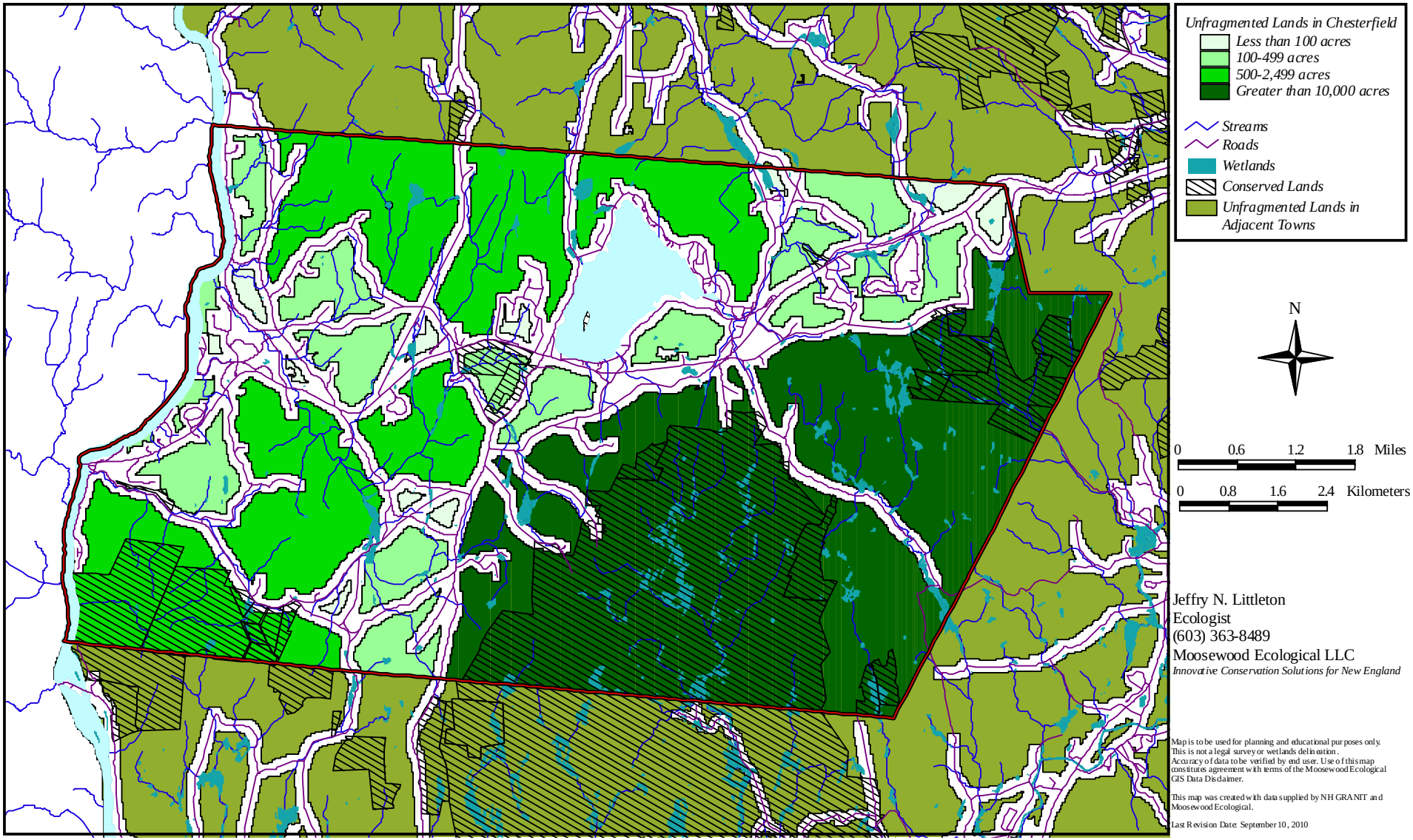


Figure 9. Unfragmented lands of Chesterfield, NH. This map shows the distribution and size range of unfragmented, contiguous forest patches with embedded wetlands. Roads, excluding Class VI, and private driveways serve as fragmenting features. Moosewood Ecological LLC

Agricultural Resources

Agricultural resources included active farmland and important farmland soils. Not only are these resources important for food production, but they can function as critical wildlife habitats as well. Active farmlands also provide an aesthetic quality that helps to define the rural character of New Hampshire; a characteristic that many communities revere and seek to preserve.

These elements have been recently reinforced with the local foods movement across America that seeks to promote and support local farming activities. One such effort that has been underway for the past two years is the Monadnock Farm and Community Connection (MFCC), a program that is administered by the Cheshire County Conservation District. This program seeks to increase community awareness about the importance of local agriculture, which can in turn stimulate agricultural production in the region. To this end MFCC has engaged community volunteers, farmers, service providers and other professionals to better understand the mechanisms needed to help achieve this vision. One method in which this is being accomplished is through the volunteer-based work of three committees, including the Agricultural Inventory Committee, Infrastructure Committee, and Education Committee, that are working together with the MFCC Steering Committee.

In particular, the Agricultural Inventory Committee (AIC) has been working to gather baseline documentation on Cheshire County's existing and potential agriculturally-based activities using existing coarse-filter data. The Agricultural Resources and Land Use Mapping project was designed to better understand the distribution and type of current farmlands in Cheshire County, as well as areas of productive farmland soils and their current land use (such as active farmland, fallow farmland, managed grassland, forested, developed, and protected open space). As such, this effort has focused on maintaining an ongoing list of active farms in each of the 23 towns in Cheshire County. The results of this work may be used in a variety of formats, including:

- assisting towns and Agricultural Commissions with town-specific farmland data;
- informing our regional community on where to purchase local farm-related products;
- prioritizing the best agricultural lands on a town- and county-wide basis for conservation;
- incorporating agricultural information into the master planning process; and
- developing innovative land use planning techniques for agricultural lands on a local level.

According to the 2001 land cover data set, Chesterfield has roughly 1,865 acres of active farmland classified into three broad categories: pastures/hayfields, row crops, and orchards (Figure 10, p.59 and Table 8, p.58). This is no means an exhaustive list of current agricultural-based land uses. Therefore, this data should be further refined in conjunction with the MFCC AIC and other interested town boards and community members.

In response to the Farmland Protection Policy Act of 1981[1], 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:

[1] 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, and to assure that Federal programs are administered in a manner that, to the extent practicable, will be compatible with state, unit of local government, and private programs and policies to protect farmland."

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.
- 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

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 Cheshire County 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 5,605 acres, or roughly 18% of Chesterfield (Figure 10, p.57 and Table 8, p.56). These soils are widely distributed throughout the town. Prime farmland soils make up about 19% of the total acreage of agricultural soils while farmlands of local and statewide significance total approximately 81% of these soils. These data, especially when combined with active farmlands, can provide a first phase in developing agriculturally-based land use planning.

Table 8. Summary of significant agricultural resources in Chesterfield.

Agricultural Resource Type	Size	% of Town
Agricultural Soils		
Prime Farmlands	1,069 acres	3.5
Farmlands of Statewide Signficance	1,333 acres	4.4
Farmlands of Local Signficance	3,203 acres	10.5
Agricultural Land Use		
Pastures and Hayfields	1,767 acres	5.8
Orchards	13 acres	<0.1
Row Crops	85 acres	0.3

SOURCE: GIS Analysis (Moosewood Ecological 2010) of USDA Natural Resources Conservation Service soils, Land Cover, and NH Wildlife Action Plan grasslands datasets from GRANIT

Chesterfield NRI and Conservation Priorities
Agricultural Resources Map

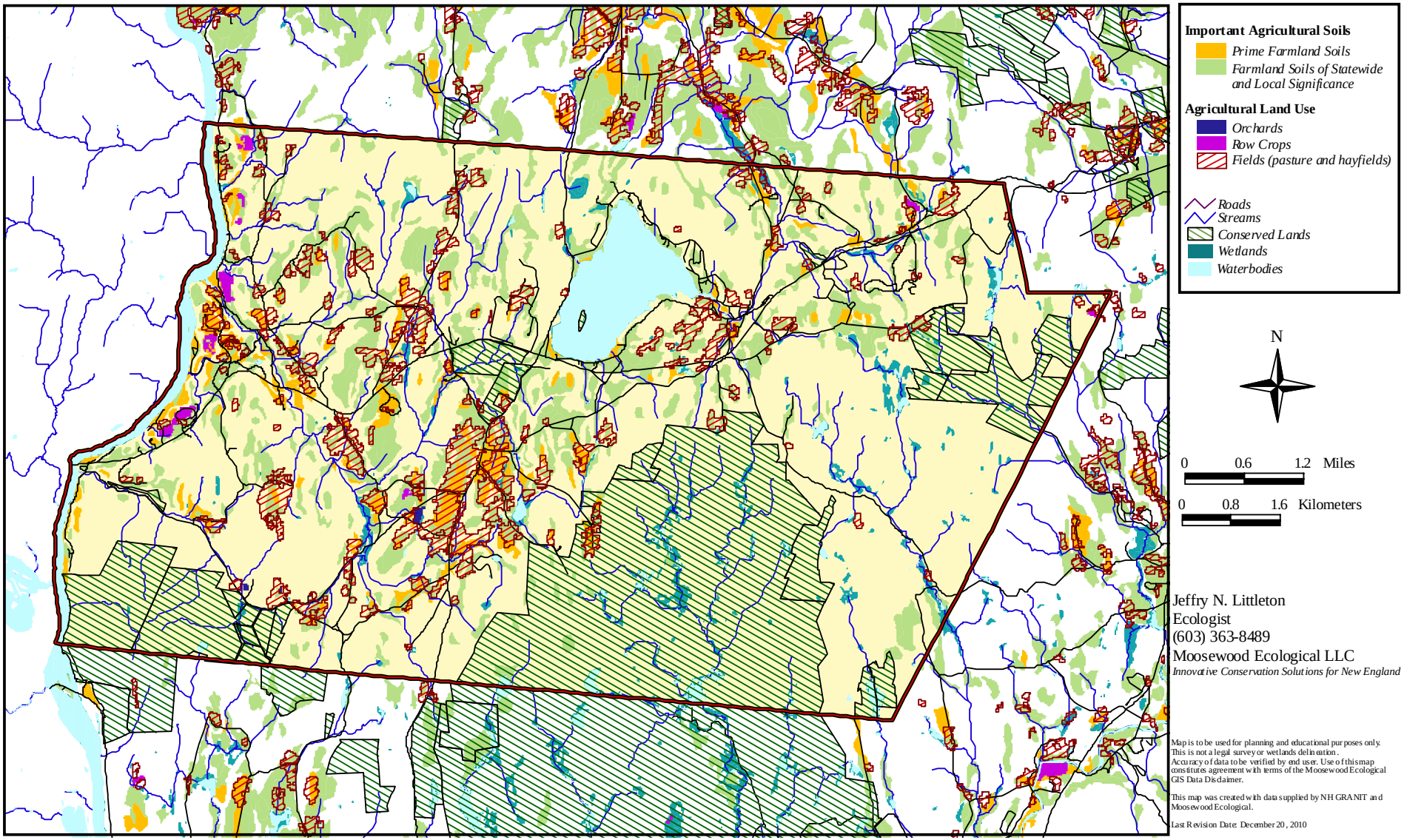


Figure 10. Significant agricultural resources of Chesterfield, NH. This map shows the distribution of prime farmland soils and other significant farmland soils, current farmlands, and which of these resources are currently conserved. Moosewood Ecological LLC

Forest Resources

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, 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 Chesterfield.

The USDA NRCS has mapped the distribution of important forest soils and have 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 cover approximately 9,889 acres, or 33% of Chesterfield (Table 9, p.62). Groups IA and IB make up the majority of the area (95%) and are most ideally suited for hardwoods. Group IC appear to be more restricted to stream drainages where outwash sands and gravels were deposited by glacial activity about 11,000 years ago. These areas include patches along the corridors of Hubbard Brook, Catsbane Brook, and the Connecticut River. Group IC soils types are suited for softwood production, mainly white pine.

Table 9. Summary of significant forest soil resources in Chesterfield.

Forest Soil Type	Size	% of Town	Primary Productivity
Group IA	8,651 acres	28.4	northern hardwoods
Group IB	999 acres	3.3	hardwoods
Group IC	239 acres	0.8	pine, spruce, and hemlock

SOURCE: GIS Analysis (Moosewood Ecological 2010) of USDA Natural Resources Conservation Service soils dataset from GRANIT

In order to derive at a baseline documentation of the highest quality forestlands a few more attributes have been considered. This process eliminated lands that were currently not in a forested state (such as fields and developed areas). It also includes taking into account forest fragmentation, which also considers edge effects that encourage the spread of invasive plants. Invasive plants can greatly influence species composition within forests, especially at the detriment to native trees, shrubs, and herbaceous plants.

Once these factors are taken into account it was calculated that Chesterfield has approximately 3,154 acres of relatively high quality, interior forestlands (Figure 11, p.63). These represent some of the best forested areas associated with the most productive forest soils and were perceived to have relatively high ecological integrity.

Chesterfield NRI and Conservation Priorities
High Quality Forestlands Map

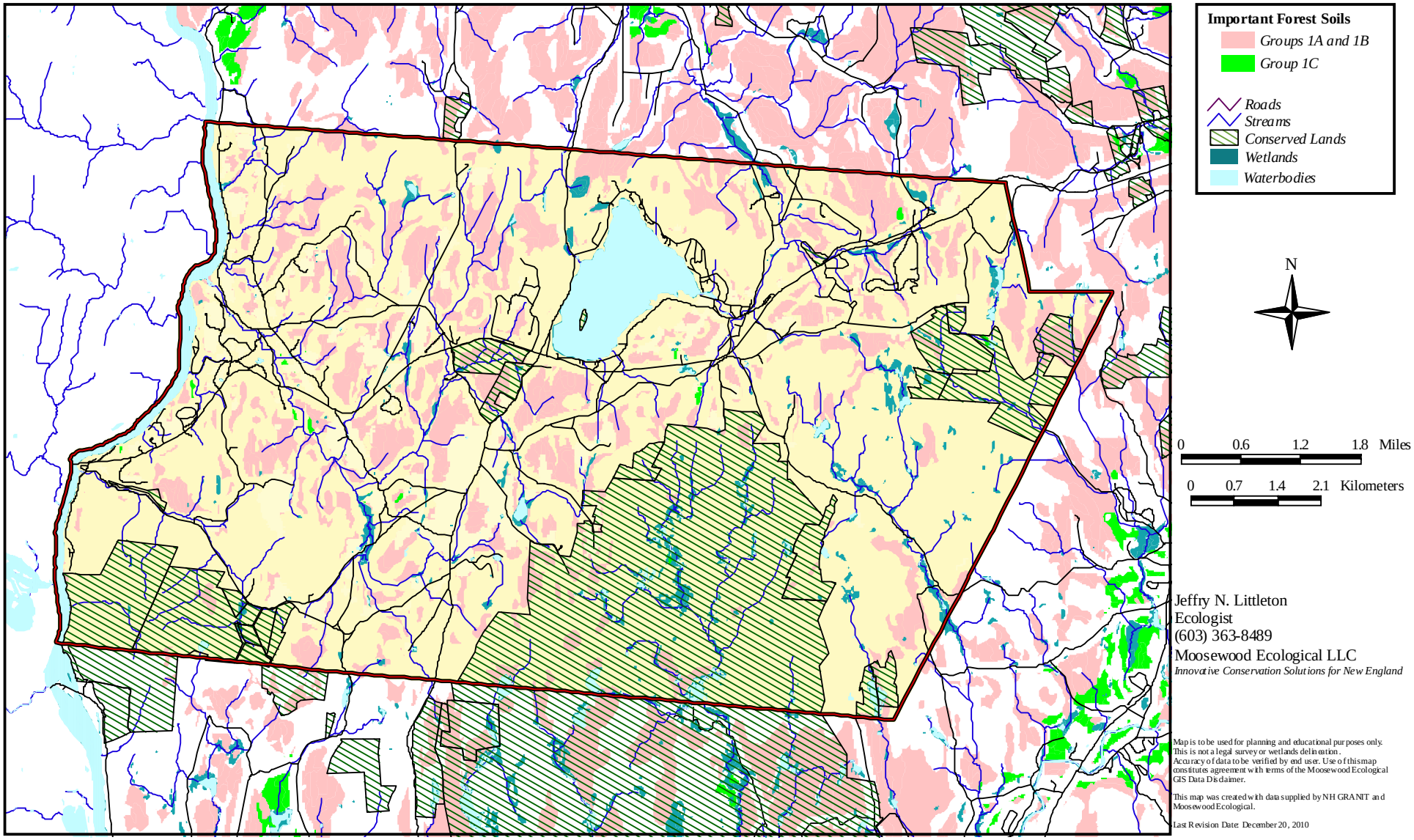


Figure 11. High quality forestlands of Chesterfield, NH. This map shows the distribution of important forest soils that are currently in a forested condition and within the unfragmented landscape. Moosewood Ecological LLC

Conservation Lands

Chesterfield has a total of 16 permanently conserved tracts of land that total 6,941.7 acres, or approximately 23% of the town (Table 10, p.65 and Figure 12, p.66). At an estimated 4,665 acres, Pisgah State Park represents by far the largest tract of conserved lands in Chesterfield. However, Pisgah State Park totals more than 13,600 acres as it extends into Hinsdale and Winchester.

The next largest block of conserved lands in Chesterfield is located in the southwestern corner of town. It includes the Wantastiquet Mountain Natural Area, Madame Sherri Forest, Stokes' Lot, O'Neil Forest, and the Daly Easement, totaling nearly 1,153 acres. This area is further exemplified by adjacent protected lands that extend into Hinsdale, including the Wantastiquet Mountain Natural Area and Daniels Mountain. Altogether, this conserved block is roughly 1,700 acres.

Another large conservation area is located in the eastern part of Chesterfield. These tracts of land are part of the California Brook Natural Area that the Monadnock Conservancy has been working on and in conjunction with the Chesterfield Conservation Commission. It is part of a larger effort to connect the West Hill conservation lands in Keene and Swanzey with Pisgah State Park. So far, this effort has conserved nearly 880 acres in Chesterfield.

The Friedsham Town Forest is yet another significantly large block of protected land, which totals nearly 210 acres. It is located southwest of Spofford Lake along Routes 9 and 63 and Twin Brook Road.

Table 10. Summary of conserved lands in Chesterfield.

Conservation Lands	Acres in Chesterfield	Total Acreage	Primary Protecting Agency	Agency Type	Protection Level	Protection Type
Wantastiquet Mtn. Natural Area	514.8	884.8	DRED	State	Permanent Conservation Land	FO
Madame Sherri Forest	479.5	488.1	SPNHF	Private	Permanent Conservation Land	FO
Stokes Lot	24.3	24.3	TNC	Private	Permanent Conservation Land	CE
O'Neil Forest	95.7	95.7	Town of Chesterfield	Municipal	Permanent Conservation Land	FO
Greenbelt Area	16.5	16.5	Town of Chesterfield	Municipal	Permanent Conservation Land	FO
Daly Easement	38.5	38.5	Town of Chesterfield	Municipal	Permanent Conservation Land	CE
Friedsham Town Forest	209.4	209.4	Town of Chesterfield	Municipal	Permanent Conservation Land	FO
Pierce Island State Park	5.5	5.5	DRED	State	Permanent Conservation Land	FO
Pisgah State Park	4,664.9	13,668.2	DRED	State	Permanent Conservation Land	CE/FO
Chesterfield Gorge Natural Area	15.8	15.8	DRED	State	Permanent Conservation Land	FO
Flethcher-Doyle Easement	114.6	114.6	MC	Private	Permanent Conservation Land	CE
Haley Easement	33.8	33.8	MC	Private	Permanent Conservation Land	CE
Forecastle Easement	386.7	386.7	MC	Private	Permanent Conservation Land	CE
Hanna Easement	96.6	96.6	MC	Private	Permanent Conservation Land	CE
Houghton Easement	191.5	191.5	MC	Private	Permanent Conservation Land	CE
Trask Easement	53.6	53.6	MC	Private	Permanent Conservation Land	CE

SOURCE: GRANIT Conservation Lands database (2010).

SPNHF = Society for the Protection of New Hampshire's Forests (a.k.a., the Forest Society)
TNC = The Nature Conservancy
DRED = NH Department of Resources and Economic Development
MC = Monadnock Conservancy

CE = Conservation Easement
FO = Fee Ownership

Chesterfield NRI and Conservation Priorities
Conservation Lands Map

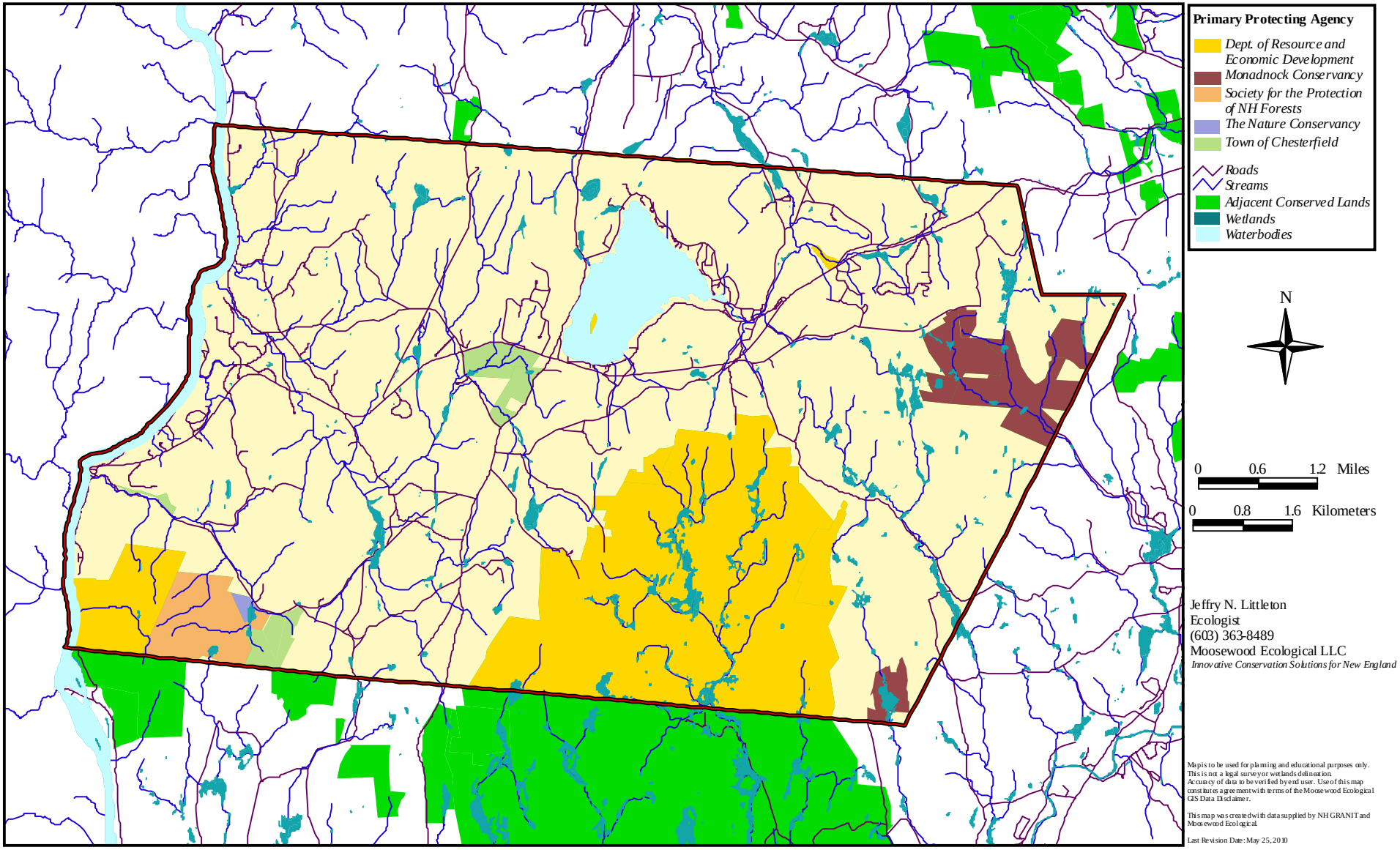


Figure 12. Conservation lands of Chesterfield, NH. This map shows the distribution of permanently conserved lands by ownership. Moosewood Ecological LLC

Priorities for Conservation

Co-occurrence Analysis and Landscape-level Considerations

To continue the process of identifying Chesterfield's most significant areas in town, a co-occurrence model was generated in a GIS (Figure 13, p.70). A co-occurrence model is an analytical tool that uses spatial data to determine where various levels of natural resources occur in unison, or where they overlap. This analysis, in its simplest form, demonstrates low, medium, and high levels of co-occurring resources to assist in the identification of "hotspots" for conservation. Essentially, it helps to prioritize conservation planning efforts to help maximize economic, social, and ecological benefits.

While the co-occurrence model is an effective tool for an initial analysis it should be used in combination with an ecological interpretation of Chesterfield's landscape to aid in the identification of conservation focus areas (CFAs). It should consider many landscape-level attributes, including wildlife movement and habitat connectivity, ecological reserve design and proximity to protected lands, unfragmented lands, development pressure, land parcelization, and current land use, as well as the presence and distribution of rare species and clustering effect of ecologically significant habitats (ESHs) that occur in close proximity to one another.

These landscape-level considerations aid in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the built and natural environments. When these elements are considered in combination with the distribution of currently protected lands then a more successful conservation plan can be prepared that incorporates the concepts of biological conservation and ecosystem reserve design to help maximize and sustain biodiversity protection for the long-term.

One major landscape-level consideration includes the size and distribution of unfragmented lands in Chesterfield (Figure 9, p.53). These areas are defined by the surrounding human infrastructure (roads and developed areas) and can negatively affect species survival rates, including mortality, lowered rates of breeding success, or species loss altogether. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented block, the species or community in question, the

extent of loss of natural habitats, intensity of human use, and colonization of invasive species.

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 reptiles, 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 E (p. 97) provides a general list for habitat block size requirements for wildlife to help illustrate this point.

Another function of large landscapes considers 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, beaver, and bear.

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.

Another consideration to take into account when developing priorities for conservation is the distribution of currently protected lands (Figure 12, p.66). This affords the opportunity to understand how various fine- and large-scale ecological attributes are arranged on the landscape and how they coincide with protected areas to best prioritize for conservation initiatives. This conservation planning effort helps to determine how Chesterfield can link significant areas with those parcels that have high ecological value to create larger reserves. These are the basic ideas of ecological reserve design that helps to maximize conservation values and ensure that representative ecologically significant habitats (ESHs) are included for protection strategies.

Chesterfield NRI and Conservation Priorities
Co-occurrence Analysis

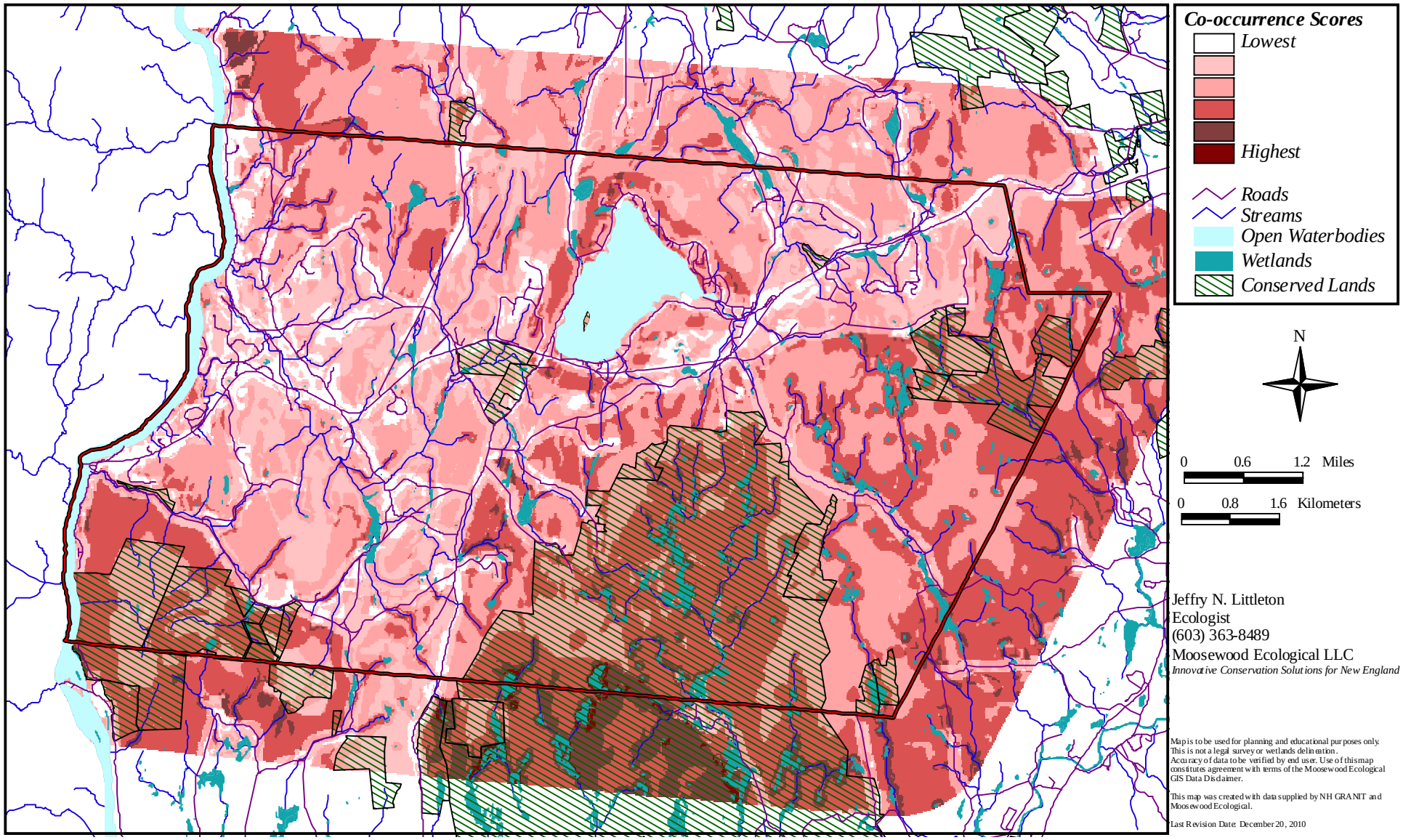


Figure 13. Co-occurrence analysis of ecological data for Chesterfield, NH. This map shows hotspots where ecological attributes overlap. The darker red coloration indicates greater overlap, or co-occurrence, of these resources. Conversely, the lighter the shade of red indicates fewer co-occurrences. Moosewood Ecological LLC

Conservation Focus Areas

In consideration of the co-occurrence analysis, clustering effect of diverse habitats, and other landscape-level attributes of Chesterfield, a total of five large-scale Conservation Focus Areas (CFAs) have been identified as having high priorities for conservation. Through this analysis, these CFAs represent some of the best areas to expand upon conservation initiatives in Chesterfield due to their associated natural resources and contributions to biological diversity. The five CFAs include:

- California Brook Natural Area
- Spofford Lake watershed
- Gulf Brook watershed
- Hubbard Brook and Catsbane Brook watersheds (especially south of Route 101)
- Connecticut River riparian corridor

The identification of these areas as having the highest priorities for conservation is also supported by the WAP state rankings. These rankings have identified priorities for conservation on a state-wide scale and are applicable for regional conservation planning as well. They are also helpful in town-wide planning but should be used as a guide while incorporating co-occurrence analyses, important landscape attributes, and site-specific assessments. This is because at the town-level one can incorporate more specific and detailed data that might not have otherwise been considered for the state rankings.

It should not be construed that these are the only areas worthy for natural resources protection. Many other areas in town, especially those that may contain rare species and habitats, as well as high valued wetlands, also deserve attention. Rather, these CFAs represent some of the best places to further conservation efforts on a large scale. It is also believed that these CFAs may offer the best economic return in terms of natural services supplied, such as maintaining clean water, reducing flood hazards, and providing exceptional wildlife habitat. Refined analyses and on-site ecological investigations may provide data that can identify future priorities in Chesterfield. As such, identifying priorities for conservation is a continual process that should be refined over time.

RECOMMENDATIONS

The information provided herein, including the various maps, should be used when considering the adoption of various land use planning techniques. The data used to develop such information represents the most current, readily available data to better understand Chesterfield'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 Chesterfield'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 Chesterfield could consider as they proceed with community land use planning.

1. Consider establishing an Open Space Committee as part of the Conservation Commission to help oversee conservation planning efforts in the Town

2. Prepare a parcel-based GIS ecological assessment model to rank parcels according to their natural resource values. This affords the opportunity to better understand and compare the conservation value of individual parcels throughout the town.

3. Develop a comprehensive Biodiversity Conservation Plan that incorporates recommendations for land conservation, regulatory and voluntary actions, community outreach and education, financial planning, and conservation strategies for ecologically significant habitats and species of greatest conservation concern. This plan should build upon the priorities described above while incorporating more detailed and refined data, such as the parcel assessment model. The plan should incorporate several avenues for biodiversity conservation and not just land protection alone. For example, it should identify opportunities for long-term monitoring of and land management strategies for species of conservation concern, as well as potential restoration of degraded habitats. Finally, an action plan should be included that identifies what should be addressed, by whom, when and how for the next five and ten years.

4. Incorporate the Chesterfield NRI and Conservation Priorities into the town's Master Plan. This provides a vision for the town from which adaptive land use planning can be adopted.

5. 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 the Town 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.

6. Continue to work with adjacent communities on similar conservation initiatives of common interest. It would be helpful to meet 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 Chesterfield's conservation planning efforts.

7. Continue with community outreach and landowner education regarding Chesterfield's natural resources and conservation planning.

CONCLUSIONS

Chesterfield has a wide range of natural resources that host a diversity of wildlife and plants. These include ecologically significant areas such as high quality and unique examples of wildlife habitats, exemplary natural communities, rare and endangered species habitats, and Chesterfield's large unfragmented forests and wetlands. Chesterfield's 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, the Chesterfield NRI and Conservation Priorities was created to better understand where these significant natural resources are located and to devise a list of Conservation Focus Areas to help guide conservation planning efforts.

The Chesterfield NRI and Conservation Priorities document is meant to be used for educational and town planning purposes. It was prepared for use by landowners, town boards and committees, as well as the residents of Chesterfield. Landowners can use the document to better understand the significance of their properties in order to help develop land management planning options. Residents of Chesterfield can use the document to learn more about the town's natural resources and what makes them so special. Town boards and committees can use the findings herein to promote informed land use

planning. By understanding Chesterfield's most significant natural resources the town is better prepared to adopt a variety of appropriate land use planning techniques that encourage the wise use of our natural resources. This can, in turn, promote a healthy environment that all residents deserve. It can also promote a more sustainable approach at community development.

The Chesterfield NRI and Conservation Priorities can serve as an ecological vision of how the town can incorporate biodiversity planning into its current land use and zoning. This report can be used for many purposes, including:

- Promoting the conservation of Chesterfield's most important working lands for agriculture and forestry, as well as ecologically significant areas, including important wildlife habitats and wetlands with high functional values
- Helping to direct development projects to areas with less critical natural resources, including areas of degraded habitats and other major human alterations to the landscape
- Recommending on-site natural resource assessments for ecologically significant areas and rare species
- Guiding voluntary conservation planning efforts
- Identifying potential areas for possible compensatory mitigation[1] should the need arise
- Recommending policies in Chesterfield's Master Plan
- Identifying areas and/or specific natural resources from which innovative land use planning techniques[2] may be applied
- Promoting education for the residents and town officials of Chesterfield
- Supporting grant applications for future funding of land conservation, restoration, land management planning, and additional natural resources inventories

[1] Compensatory mitigation can be used to help replace the loss of certain ecological functions of a natural resource due to land development or alterations. This is generally applied to impacts to wetland resources. General methods of compensatory mitigation include natural resource restoration, creation, enhancement, and preservation.
[2] See Innovative Land Use Planning Techniques: A Handbook for Sustainable Development (2008) developed by the NH Dept. of Environmental Services.

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 Chesterfield NRI and Conservation Priorities. As such, 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.

RESOURCES

Ammann, A.P. and A.L. Stone. 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. NH Department of Environmental Services, Concord, NH.

Brown, P. 2010. New Hampshire Bird Records – Fall 2010: Fall Migration on the Monadnock Region's Lakes and Ponds. New Hampshire Audubon, Concord, NH.

Brunkhurst, E. 2009. Personal communications. Conservation Biologist, NH Fish and Game, Concord, New Hampshire.

Coppola, M.L. 2009. Request for rare elemental occurrences on conservation lands. Environmental Information Specialist, NH Natural Heritage Bureau, Concord, New Hampshire.

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.

Dexter, T. 2008. Vernal pools surveys. Antioch University graduate student. Keene, NH.

Gries, G. 2009. Personal communications. Fisheries Biologist, NH Fish and Game Department, Region 4, Keene, NH.

Hunt, P. 2009. Personal communications. Senior Conservation Biologist, NH Audubon Society, Concord, NH.

Hunt, P. 2007. Endangered and Threatened Species List Revision Summaries including Threatened x Responsibility Table. New Hampshire Audubon. Prepared under contract for the NH Fish and Game Department.

Klapper, K. 2009. Personal observations.

Marchand, M. 2009. Personal communications. Conservation Biologist, NH Fish and Game Department, Concord, New Hampshire.

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. 2009. 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.

Peterson, H. 2009. Personal observations.

Rosenberg, G.L. 1989. Soil Survey of Cheshire County, NH. U.S. Department of Agriculture Natural Resources Conservation Service in cooperation with NH Agricultural Experiment Station.

Society for the Protection of New Hampshire Forests. 2009. Madame Sherri Forest Summary. SPNHF, 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.

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. NH Natural Heritage Bureau, Concord, NH. Pub. UNH Cooperative Extension, Durham, New Hampshire.

Stone, A.J.L. 2001. Natural Resources Inventory – A Guide for New Hampshire Communities and Conservation Groups. University of NH Cooperative Extension.

APPENDIX A

COMMUNITY FORUM RESULTS

Chesterfield Conservation and Community Planning Forum November 2008

Attendees: ~40

<u>Wetland Function & Values</u>
as prioritized by forum attendees of the town of Chesterfield

- Ecological Integrity 8,7,8; total: 23; priority: 2
- Wildlife Habitat 10,8,7; total: 25; priority: 1
- Water Quality 8,7,7; total: 22; priority: 3
- Flood Control 0,1,3; total: 4
- Groundwater Use 5,0,2; total: 7
- Erosion Control 0,1,1; total: 2
- Recreation 1,3,1; total: 5
- Social Significance 1,3,1; total: 5

<u>Natural Resources Strengths and Challenges for the town of Chesterfield</u>
As identified by forum attendees of the town of Chesterfield

Strengths

- Willing to support conservation (great Conservation Commission)*
- Innate Beauty & Rural Quality*
- Zoning Board
- Great CCC
- Spofford Lake (aesthetic, tax base)
- Pisgah Park & other Public Lands*
- Trail System
- Planning Board ?
- Wildlife
- Spofford Lake
- Unfragmented Land*
- Madame Sherri Forest
- Pisgah Park
- Cooperative citizen leaders and volunteers*
- Connecticut River
- Views – Scenic
- Open Spaces
- Much protected land*
- Lack of major auto routes
- Darkness
- Open farmlands*
- Aesthetics

- Pisgah/Gorge*
- Proximity to Pisgah
- Good soils
- Lake H_2O quality*
- Route 9
- Tonight: people and planning
- Conservation Commission*
- Tourism

Challenges

- Light pollution
- Losing farm land
- Climate change (warming, acid rain)*
- Drinking water
- Unchecked development (Route 9, farmland)*
- Losing dirt roads
- Losing rural quality*
- Housing pressure on lake
- Protecting wetlands
- Roads shared with other towns
- Town border sharing issues
- Lake pollution issues *
- Cluster Development *
- Lack of ground water*
- Ensure migratory corridors
- Effect of global warming
- Light pollution – artificial lights
- Spider driveways use much land
- Noisy boats
- Millfoil and invasive plants
- ATV pollution and noise
- Limited commercial land limits tax revenues*
- Protecting hills and ridges from development*
- Lake H_20 quality
- Retain agricultural lands
- Cluster development
- Legislation and regulation (no Act 250) *
- Route 9*
- Openness to innovative development
- Education *

*** denotes the top strengths or challenges as identified during the natural resources group activity by town of Chesterfield attendees**

APPENDIX B

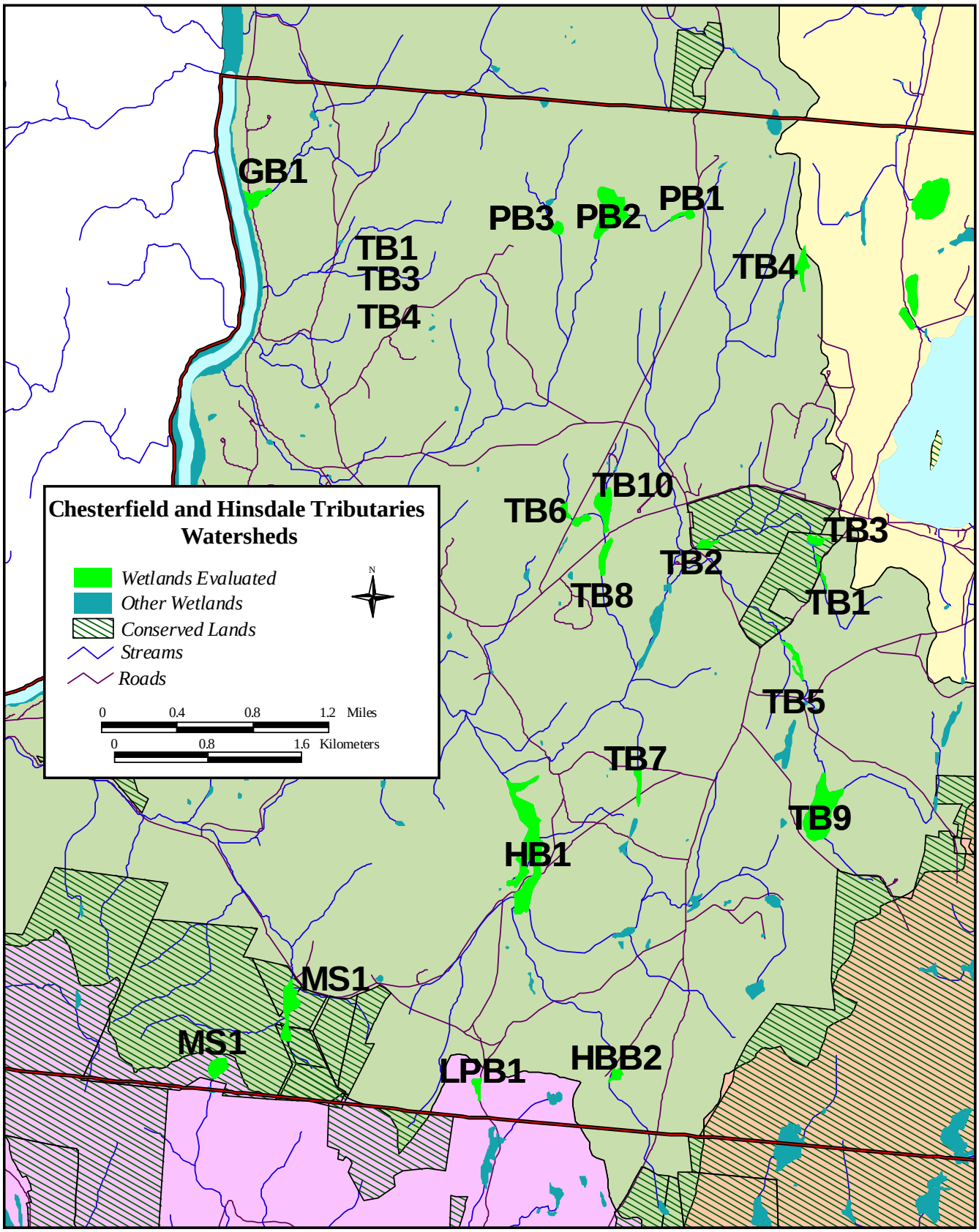
GIS DATA SOURCES

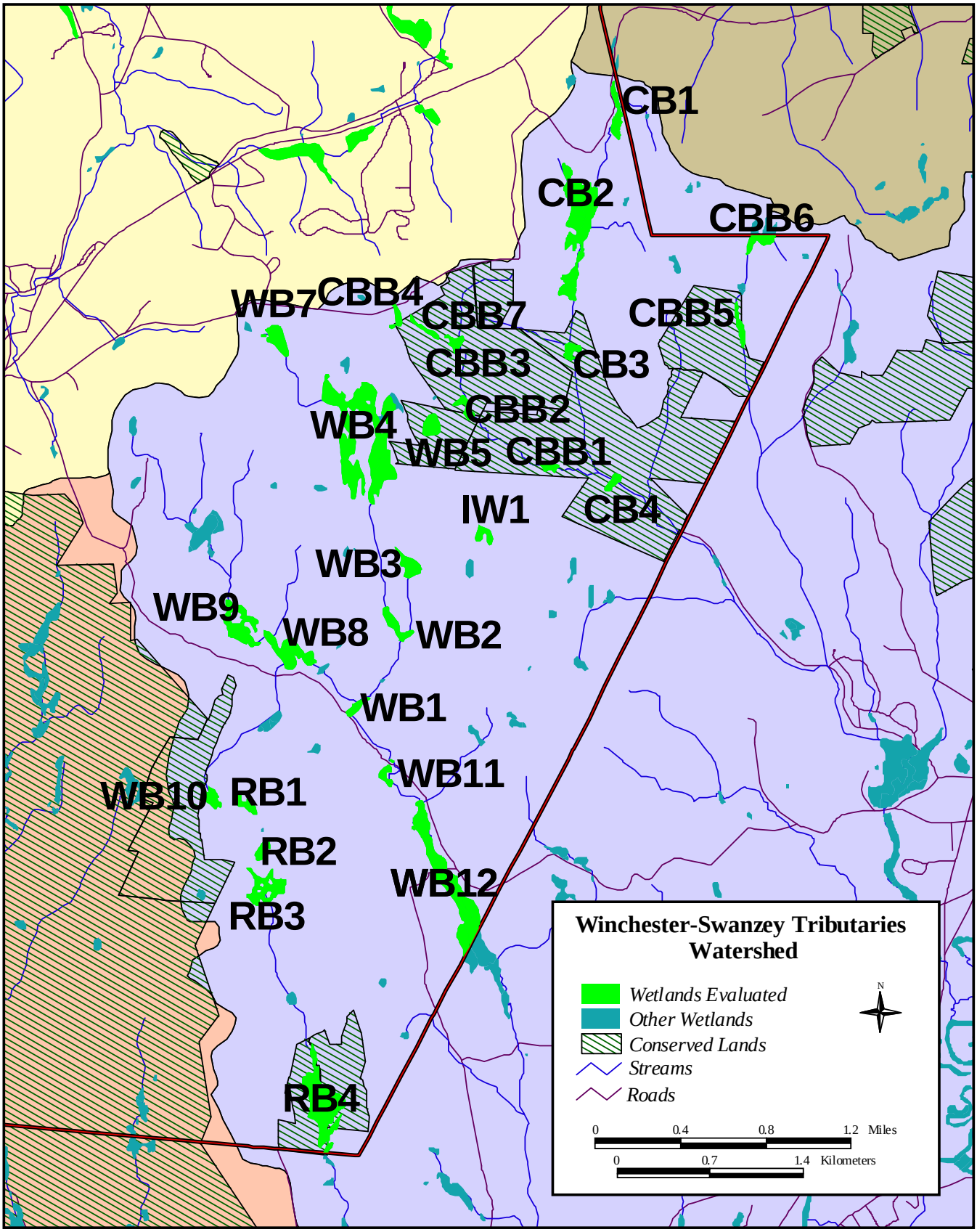
Appendix B. Basic GIS Data and Sources for Chesterfield NRI Maps.

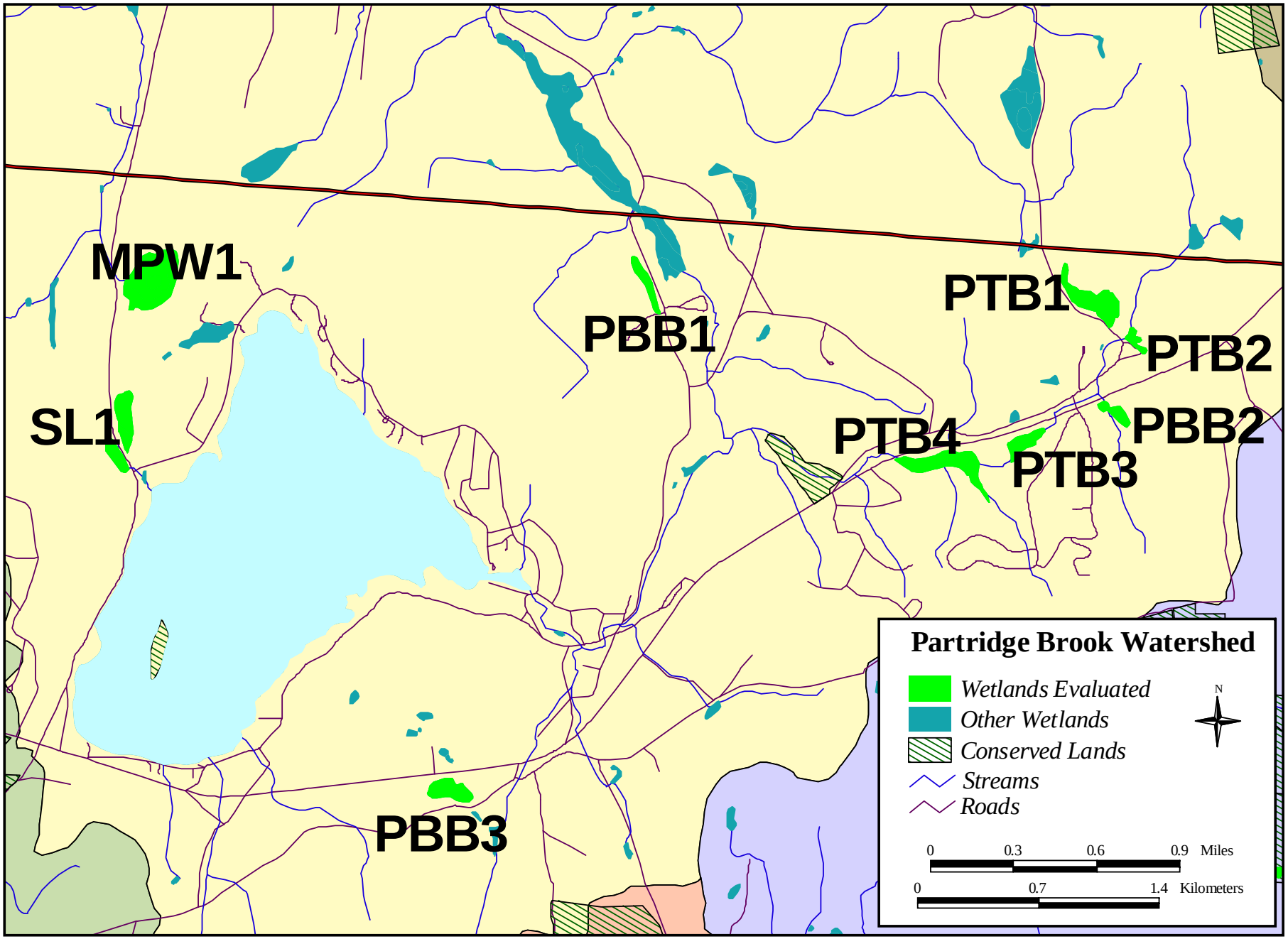
Basic Data Layer	**Source(s)**
Town Boundaries	United States Geological Survey
Roads	NH Deptartment of Transportation
Conservation Lands	Society for the Protection of NH Forests and Moosewood Ecological
Watersheds (HUC 6 and HUC 12)	US Dept. of Agriculture Natural Resources Conservation Service and NH Dept. of Environmental Services
Surface Waters (ponds and streams)	United States Geological Survey
National Wetlands Inventory (NWI)	US Fish and Wildlife Service
Hydric Soils	US Dept. of Agriculture Natural Resources Conservation Service
Stratified Drift Aquifers	United States Geological Survey
Potentially Favorable Gravel Well Analysis	NH Dept. of Environmental Services
WAP Wildlife Habitats	NH Fish and Game Dept.
Deer Wintering Areas	NH Fish and Game Dept.
Riparian Areas	Moosewood Ecological
Steep, South-facing Slopes	Moosewood Ecological
Vernal Pools	Moosewood Ecological and Dexter (2008)
Heron Rookeries	Moosewood Ecological
Rare Species and Natural Communities	NH Natural Heritage Bureau and Moosewood Ecological
Unfragmented Lands	NH Fish and Game Dept.
Agricultural Soils	US Dept. of Agriculture Natural Resources Conservation Service
Forest Soils	US Dept. of Agriculture Natural Resources Conservation Service

APPENDIX C

WETLANDS COMPARATIVE EVALUATION MAPS AND DATA SUMMARY


Chesterfield and Hinsdale Tributaries Watersheds
Wetlands Evaluated
Other Wetlands
Conserved Lands
Streams
Roads
N
0 0.4 0.8 1.2 Miles
0 0.8 1.6 Kilometers
GB1
PB3
PB2
PB1
TB1
TB3
TB4
TB4
TB10
TB6
TB3
TB2
TB8
TB1
TB5
TB7
TB9
HB1
MS1
MS1
LPB1
HBB2


CB1
CB2
CBB6
WB7
CBB4
CBB7
CBB5
CBB3
CB3
CBB2
WB4
WB5
CBB1
IW1
CB4
WB3
WB9
WB8
WB2
WB1
WB11
WB10
RB1
RB2
WB12
RB3
RB4
Winchester-Swanzey Tributaries Watershed
Wetlands Evaluated
Other Wetlands
Conserved Lands
Streams
Roads
N
0
0.4
0.8
1.2
Miles
0
0.7
1.4
Kilometers


MPW1
SL1
PBB1
PBB3
PTB1
PTB2
PTB4
PTB3
PBB2
Partridge Brook Watershed
Wetlands Evaluated
Other Wetlands
Conserved Lands
Streams
Roads
N
0
0.3
0.6
0.9
Miles
0
0.7
1.4
Kilometers

APPENDIX C. Wetland Valuation Unit (WVU) scores.

Wetland Code	Acres	FV1 Ecological Integrity	FV2 Wetland Wildife	FV3a Finfish: Streams	FV3b Finfish: Ponds	FV4 Educational Potential	FV5 Aesthetics Quality	FV7 Flood Control	FV8 Ground-water Use	FV9 Sediment Trapping	FV10 Nutrient Attenuation	FV14 Note-worthiness	Watershed Group
CB1	4.9	3.1	3.5	0.1		2.3	1.1	2.5		1.3	2.1		CB
CB2	32.2	30.9	30.5		7.2	11.6	16.5	29.0		25.4	13.8	32.2	CB
CB3	2.9	2.9	2.6			1.4	1.5	0.6		1.6	1.7		CB
CB4	2.2	2.0	2.0			0.5	0.6	0.7		0.9	1.0		CB
CBB1	2.0	2.0	1.7		0.4	0.6	0.8	0.0		0.3	0.8		CB
CBB2	3.0	2.8	2.4		0.2	0.4	0.5	1.8		1.9	2.0		CB
CBB3	2.8	2.8	2.3			1.0	1.2	0.6		1.6	1.5		CB
CBB4	2.4	1.9	2.0		0.3	0.3	0.4	1.2		1.3	1.7		CB
CBB5	3.1	3.1	2.7		1.0	0.8	1.0	0.6		0.9	1.6		CB
CBB6	3.5	3.5	3.0		0.9	0.7	0.8	0.0		0.9	1.8		CB
CBB7	0.7	1.7	1.8		0.3	1.6	0.8	1.2		1.5	1.8		CB
IW1	2.9	2.9	2.2			0.1	1.9	2.6		1.0	1.3	2.9	CB
GB1	5.2	3.3	3.1	0.1		0.7	0.6	3.6	4.6	2.0	2.9	5.2	GB
HB1	40.5	33.8	32.1	0.4		1.4	1.3	36.5	31.4	27.9	27.5	40.5	HB
HBB2	2.2	1.7	1.7		0.4	0.8	0.8	0.0		1.0	1.4		HB
LPB1	2.9	2.3	2.3			0.4	0.4	1.5		0.8	1.2		LPB
MPW1	20.7	16.4	13.2			9.2	9.0	20.7		9.3	9.7	20.7	SL
SL1	10.0	6.4	5.8			5.2	4.4	10.0		5.9	6.8	10.0	SL
MS1	12.1	9.2	9.5		1.8	2.0	2.0	6.1		7.4	8.0	12.1	TG
MS2	5.3	5.3	4.6		2.3	3.9	4.5	3.2		2.9	3.1	5.3	TG
PB1	2.7	2.1	2.0		0.5	1.7	2.0	0.8		1.4	1.8	2.7	PB
PB2	18.1	18.1	17.2		11.2	13.0	15.4	14.5		10.7	10.9	18.1	PB
PB3	2.2	2.2	1.7		1.2	1.6	1.7	0.2		0.8	1.2		PB
PBB1	4.0	2.4	2.1			0.1	0.1	1.2	3.0	0.9	1.9		PTB
PBB2	3.1	1.9	2.0			0.4	0.4	2.5	2.3	1.0	1.4		PTB
PBB3	6.1	3.7	3.3		2.7	3.5	3.5	1.8		3.2	4.0		PTB
PTB1	10.9	7.7	6.4		1.0	1.0	1.3	10.9	8.2	7.2	7.0	10.9	PTB
PTB2	2.0	1.2	1.2	0.1		0.4	0.5	1.4	1.5	1.6	1.5		PTB
PTB3	4.8	3.2	2.6			0.7	0.9	4.8	4.2	3.5	2.8	4.8	PTB
PTB4	12.3	7.0	7.1			0.9	0.1	12.3	10.8	7.7	6.9	12.3	PTB

Tier 1 within each functional value
Tier 2 within each functional value
Tier 3 within each functional value

Wetland Code	Acres	FV1 Ecological Integrity	FV2 Wetland Wildife	FV3a Finfish: Streams	FV3b Finfish: Ponds	FV4 Educational Potential	FV5 Aesthetics Quality	FV7 Flood Control	FV8 Ground-water Use	FV9 Sediment Trapping	FV10 Nutrient Attenuation	FV14 Note-worthiness	Watershed Group
RB1	2.9	2.9	2.2			0.4	0.6	0.9		1.2	1.3		RB
RB2	2.5	2.4	2.0			0.4	0.5	2.0		1.3	1.2		RB
RB3	10.6	9.8	9.5		1.1	2.4	4.8	8.5		6.3	6.4		RB
RB4	26.1	25.0	23.6		17.5	17.2	22.2	7.8		11.5	17.2	26.1	RB
TB1	5.3	5.3	4.2		1.2	2.9	3.0	2.7		3.0	3.3		TB
TB2	2.5	1.7	1.9	0.2		0.5	0.5	0.8		1.5	1.4		TB
TB3	2.3	1.4	1.5			0.5	0.6	0.2		1.3	1.1		TB
TB4	2.0	1.2	1.4	0.2		1.3	0.9	1.0		0.9	0.9		TB
TB5	3.9	2.6	2.5	0.1		1.0	1.0	0.4		2.3	2.5		TB
TB6	4.0	1.8	2.4		0.2	0.4	0.4	1.2		2.1	2.7		TB
TB7	3.1	1.8	1.8			0.1	0.1	2.8	2.7	1.5	1.7		TB
TB8	4.3	2.7	2.9			0.1	0.1	0.4		1.2	2.7	4.3	TB
TB9	24.7	17.5	18.1		8.2	11.0	13.6	14.8		15.6	16.4	24.7	TB
TB10	7.9	4.5	4.5			0.1	0.1	7.9		2.9	4.4		TB
WB1	2.5	2.5	2.0		0.3	0.4	0.4	1.8		1.4	1.2	2.5	WB
WB2	4.7	4.5	4.0	1.5		0.5	0.5	1.9		1.2	2.0		WB
WB3	4.9	4.5	4.2		0.8	0.2	0.2	4.4		3.1	2.9	4.9	WB
WB4	51.1	49.0	46.3	0.4	7.0	10.5	13.9	51.1		38.8	19.9	51.1	WB
WB5	4.4	4.4	3.8			0.1	0.2	0.4		0.8	1.8	4.4	WB
WB7	5.9	5.2	5.0		0.8	2.6	3.0	3.0		4.2	3.7		WB
WB8	11.3	10.4	8.9		1.1	1.0	1.2	10.2		6.9	6.9		WB
WB9	11.9	10.9	9.5	0.3		0.6	0.7	6.0		5.4	5.6	11.9	WB
WB10	3.4	3.1	2.9		1.8	2.2	2.5	0.0		1.5	1.9		WB
WB11	2.6	1.9	2.0	0.2		0.4	0.4	1.3		1.4	1.3		WB
WB12	31.5	22.6	24.3	0.2		3.5	4.1	28.4		26.1	21.7	31.5	WB

Tier 1 within each functional value
Tier 2 within each functional value
Tier 3 within each functional value

APPENDIX D

WILDLIFE SPECIES LISTS

Birds of Chesterfield, NH.

SCIENTIFIC	COMMON
Gavia immer	**Common loon (T)**
Podiceps auritus	Horned grebe
Podiceps grisegena	Red-necked grebe
Podilymbus podiceps	**Pied-billed grebe (T)**
Branta canadensis	Canada goose
Aix sponsa	Wood duck
Anas platyrhynchos	Mallard
Anas rubripes	**American black duck**
Anas crecca	Green-winged teal
Melanitta fusca	White-winged scoter
Melanitta nigra	Black scoter
Aythya marila	Greater scaup
Clangula hyemalis	Long-tailed duck
Bucephala albeola	Bufflehead
Bucephala clangula	Common goldeneye
Mergus merganser	Common merganser
Lophodytes cucullatus	Hooded merganser
Larus marinus	Great black-backed gull
Ardea herodias	Great blue heron
Ardea alba	Great egret
Charadrius vociferus	Killdeer
Scolopax minor	**American woodcock**
Actitis macularia	Spotted sandpiper
Meleagris gallopavo	**Wild turkey (BGP)**
Bonasa umbellus	**Ruffed grouse**
Circus cyaneus	**Northern harrier (E)**
Accipiter striatus	Sharp-shinned hawk
Accipiter cooperii	Cooper's hawk
Buteo lineatus	Red-shouldered hawk
Buteo platypterus	Broad-winged hawk
Buteo jamaicensis	Red-tailed hawk
Haliaeetus leucocephalus	**American bald eagle (T)**
Pandion haliaetus	**Osprey (SC)**
Cathartes aura	Turkey vulture
Falco sparverius	**American kestrel (SC)**

SCIENTIFIC	**COMMON**
Falco columbarius	Merlin
Aegolius acadicus	Northern saw-whet owl
Bubo virginianus	Great horned owl
Strix varia	Barred owl
Zenaida macroura	Mourning dove
Columba livia	Rock pigeon
Coccyzus americanus	Yellow-billed cuckoo
Archilochus colubris	Ruby-throated hummingbird
Ceryle alcyon	Belted kingfisher
Melanerpes carolinus	Red-bellied woodpecker
Sphyrapicus varius	Yellow-bellied sapsucker
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker
Colaptes auratus	Northern flicker
Dryocopus pileatus	Pileated woodpecker
Cantopus virens	Eastern wood-peewee
Empidonax alnorum	Alder flycatcher
Sayornis phoebe	Eastern phoebe
Myiarchus crinitus	Great-crested flycatcher
Tyrannus tyrannus	Eastern kingbird
Vireo olivaceus	Red-eyed vireo
Vireo gilvus	Warbling vireo
Vireo solitarius	Blue-headed vireo
Cyanocitta cristata	Blue jay
Corvus corax	Common raven
Corvus brachyrhynchos	American crow
Tachycineta bicolor	Tree swallow
Hirundo rustica	Barn swallow
Baeolophus bicolor	Tufted titmouse
Poecile atricapilla	Black-capped chickadee
Sitta carolinensis	White-breasted nuthatch
Sitta canadensis	Red-breasted nuthatch
Certhia americana	Brown creeper
Troglodytes troglodytes	Winter wren
Troglodytes aedon	House wren
Regulus satrapa	Golden-crowned kinglet

SCIENTIFIC	COMMON
Sialia sialis	Eastern bluebird
Turdus migratorius	American robin
Hylocichla mustelina	**Wood thrush**
Catharus fuscescens	**Veery**
Catharus guttatus	Hermit thrush
Dumetella carolinensis	Gray catbird
Mimus polyglottos	Northern mockingbird
Bombycilla cedrorum	Cedar waxwing
Vermivora ruficapilla	Nashville warbler
Dendroica pensylvanica	Chestnut-sided warbler
Dendroica magnolia	Magnolia warbler
Dendroica caerulescens	Black-throated blue warbler
Dendroica fusca	Blackburnian warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica virens	Black-throated green warbler
Parula americana	Northern parula warbler
Wilsonia canadensis	**Canada warbler (RC)**
Dendroica cerulea	**Cerulean warbler (RC, SC)**
Dendroica petechia	Yellow warbler
Dendroica striata	Blackpoll warbler
Dendroica palmarum	Palm warbler
Dendroica pinus	Pine warbler
Mniotilta varia	Black-and-white warbler
Seiurus aurocapillus	Ovenbird
Geothlypis trichas	Common yellowthroat
Piranga olivacea	Scarlet tanager
Cardinalis cardinalis	Northern cardinal
Carpodacus mexicanus	House finch
Pheucticus ludovicianus	Rose-breasted grosbeak
Coccothraustes vespertinus	Evening grosbeak
Pipilo erythrophthalmus	**Eastern towhee**
Spizella passerina	Chipping sparrow
Zonotrichia albicollis	White-throated sparrow
Melospiza melodia	Song sparrow
Melospiza georgiana	Swamp sparrow

SCIENTIFIC	**COMMON**
Passer domesticus	House sparrow
Passerella iliaca	Fox sparrow
Junco hyemalis	Dark-eyed junco
Agelaius phoeniceus	Red-winged blackbird
Molothrus ater	Brown-headed cowbird
Quiscalus quiscula	Common grackle
Sturnus vulgaris	European starling
Icterus galbula	Baltimore oriole
Carduelis tristis	American goldfinch

Bold = species of greatest conservation concern
E = NH endagered, T = NH threatened, SC = NH species of special concern, RC = Regional conservation concern, FE = Federally endangered, FT = Federally threatened, BGP = Only included in the NH Big Game Management Plan

SOURCE: Moosewood Ecological (2008-2010); Klapper (2009); Brown (2009-2010); Peterson (2009); NH Natural Heritage Bureau (2010); Society for the Protection of NH Forests (2009); NH Wildife Action Plan (2005)

Amphibians of Chesterfield, NH.

SCIENTIFIC	COMMON
Ambystoma maculatum	Spotted salamander
Ambystome jeffersonianum	**Jefferson salamander (SC)**
Desmognathus f. fuscus	Northern dusky salamander
Eurycea bislineata	Northern two-lined salamander
Plethodon cinereus	Redback salamander
Notophthalmus v. viridescens	Red-spotted newt
Bufo americanus	American toad
Hyla versicolor	Gray tree frog
Pseduacris crucifer	Spring peeper
Rana catesbeiana	Bullfrog
Rana clamitans	Green frog
Rana palustris	Pickerel frog
Rana pipiens	**Northern leopard frog (SC)**
Rana sylvatica	Wood frog

Reptiles of Chesterfield, NH.

SCIENTIFIC	COMMON
Chelydra serpentina	Common snapping turtle
Chrysemys p. picta	Eastern painted turtle
Clemmys insculpta	**Wood turtle (SC, RC)**
Crotalus horridus	**Timber rattkesnake (E)***
Nerodia s. sipedon	Northern water snake
Storeria o. occipitomaculata	Northern red-bellied snake
Thamnophis s. sauritus	**Eastern ribbon snake (RC)**
Thamnophis s. sirtalis	Eastern garter snake

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*** =historic hibernaculum**

SOURCE: Moosewood Ecological (2008-2010); Society for the Protection of NH Forests (2009); NH Wildife Action Plan (2005)

Mammals of Chesterfield, NH.

SCIENTIFIC	COMMON
Didelphis virginiana	Virginia opossum
Canis latrans var.	Eastern coyote
Urocyon cinereoargenteus	Gray fox
Vulpes vulpes	Red fox
Castor canadiensis	American beaver
Alces alces	**Moose (BGP)**
Odocoileus virginianus	**White-tailed deer (BGP)**
Myodes gapperi	Southern red-backed vole
Microtus pennsylvanicus	Meadow vole
Felis rufus	**Bobcat (SC)**
Lepus americanus	Snowshoe hare
Sylvilagus floridanus	Eastern cottontail
Lutra canadensis	River otter
Martes pennanti	Fisher
Mustela vison	Mink
Mustela erminea	Ermine (short-tailed weasel)
Erethizon dorsatum	North American porcupine
Ondatra zibethicus	Muskrat
Peromyscus spp.	Deer or White-footed mouse
Napaeozapus insignis	Woodland jumping mouse
Zapus hudsonius	Meadow jumping mouse
Sciurus carolinensis	Gray squirrel
Tamias striatus	Eastern chipmunk
Tamiasciurus hudsonicus	Red squirrel
Glaucomys sabrinus	Northern flying squirrel
Marmota monax	Woodchuck
Blarina brevicauda	Northern short-tailed shrew
Scalopus aquaticus	Eastern mole
Condylura cristata	Star-nosed mole
Ursus americanus	**Black bear (BGP)**
Procyon lotor	Racoon
Mephitis mephitis	Striped skunk

Bold = species of greatest conservation concern
E = NH endagered, T = NH threatened, SC = NH species of special concern, RC = Regional conservation concern,
FE = Federally endangered, FT = Federally threatened, BGP = Only included in the NH Big Game Management Plan

SOURCE: Moosewood Ecological (2008-2010); NH Fish and Game Wildife Action Plan (2005)

APPENDIX E

HABITAT BLOCK SIZE REQUIREMENTS FOR WILDLIFE

Habitat Block Size Requirements For Wildlife

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