HILLS, WOODS, AND SWEEPING VALES

A Natural Resources Inventory of
Lyndeborough, New Hampshire

Prepared for the
Lyndeborough Conservation Commission
February, 2009

by

Joseph M. Trudeau
Preserve Land Works
Hancock, NH

To the mountain-
My being, values, habits, and memories; founded in the land,
in countless days of childhood hikes and hunts, of boiling sap and berry topped hills,
of bicycle rides through forest tunnels; coming to know the earth, my self, and others.

Insight gained from the room to roam, the space to expand in,
and mystery enough to beckon a return, time and time again; my father the same, and his before.

May the liberty of land remain for the next generation, for it to soften a child's heart,
callous his hand, tune his vision, and unwrap his mind,
with discovery, distance, and depth.

Joe Trudeau, Hancock, NH, January 2009

"*The mountain, yonder is the same; the hills which I used to climb are the same. The rocks are still here, and many as huge as ever. I find the same narrow valleys and winding roads. From the hilltops are the same wide views and charming prospects of nature*."

-Daniel Putnam, 1889, on his homecoming to
Lyndeborough at its 150th anniversary celebration

The title for this report, *Hills, Woods, and Sweeping Vales* is an adaptation of text within the *Physical Features* chapter of the "History of Lyndeborough, N.H., 1735-1905, v. 1," by the Reverend D. Donovan and Jacob A. Woodward.

Cover photos, clockwise from upper left: long beech fern (*Phegopteris connectilis*); black gum foliage (*Nyssa sylvatica*); ice encrusted branches; Littleton Formation schist

Following page: The view north from Winn Mountain, past Rose Mountain, Crotched Mountain, the Contoocook Valley, and to Mount Kearsarge.

This page: Lyndeborough Mountain from Ted's Trail, North Pack Monadnock, Greenfield, NH

All photos in this report by Joe Trudeau unless otherwise noted

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Lyndeborough, New Hampshire

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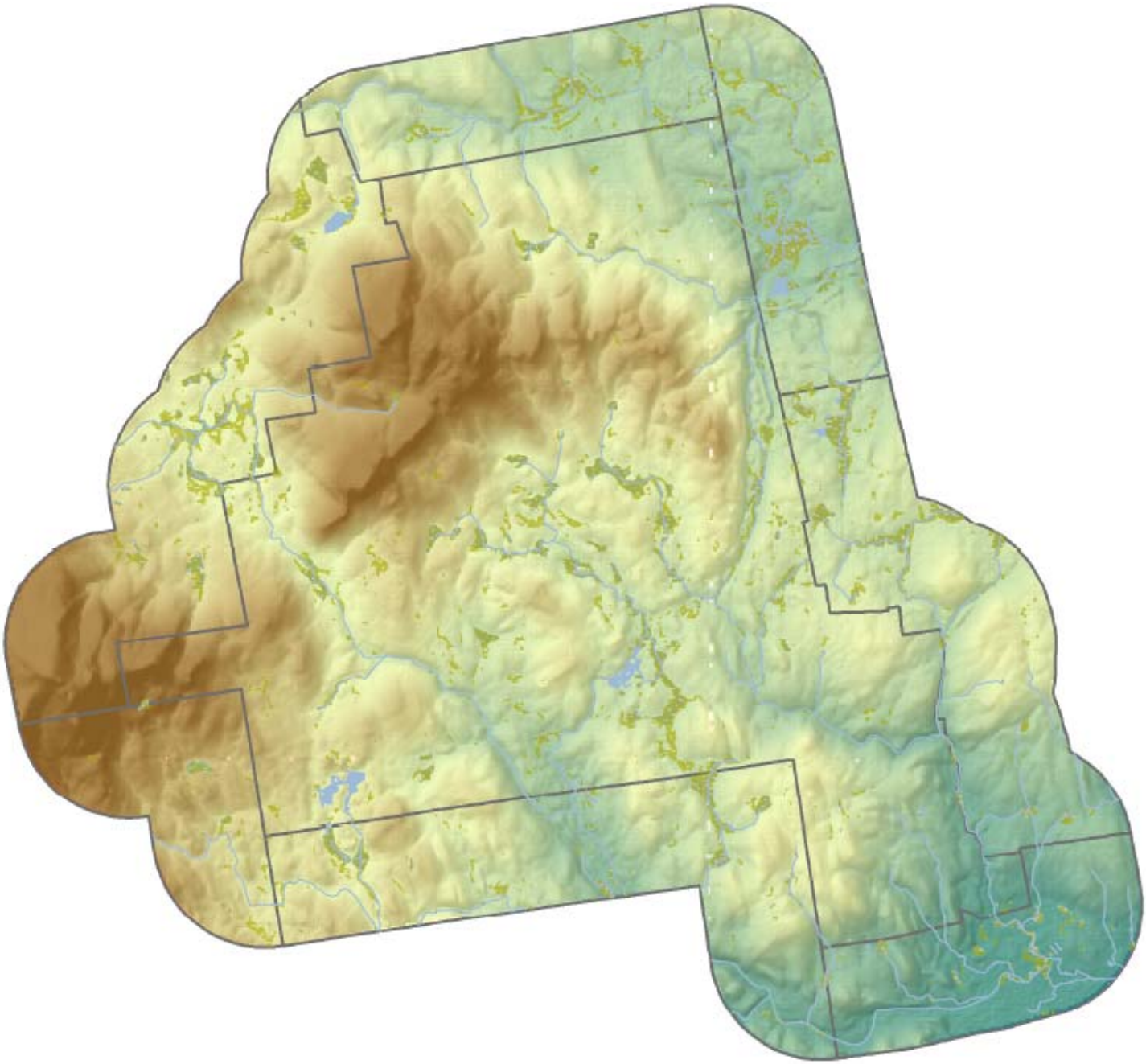
Conservation Science

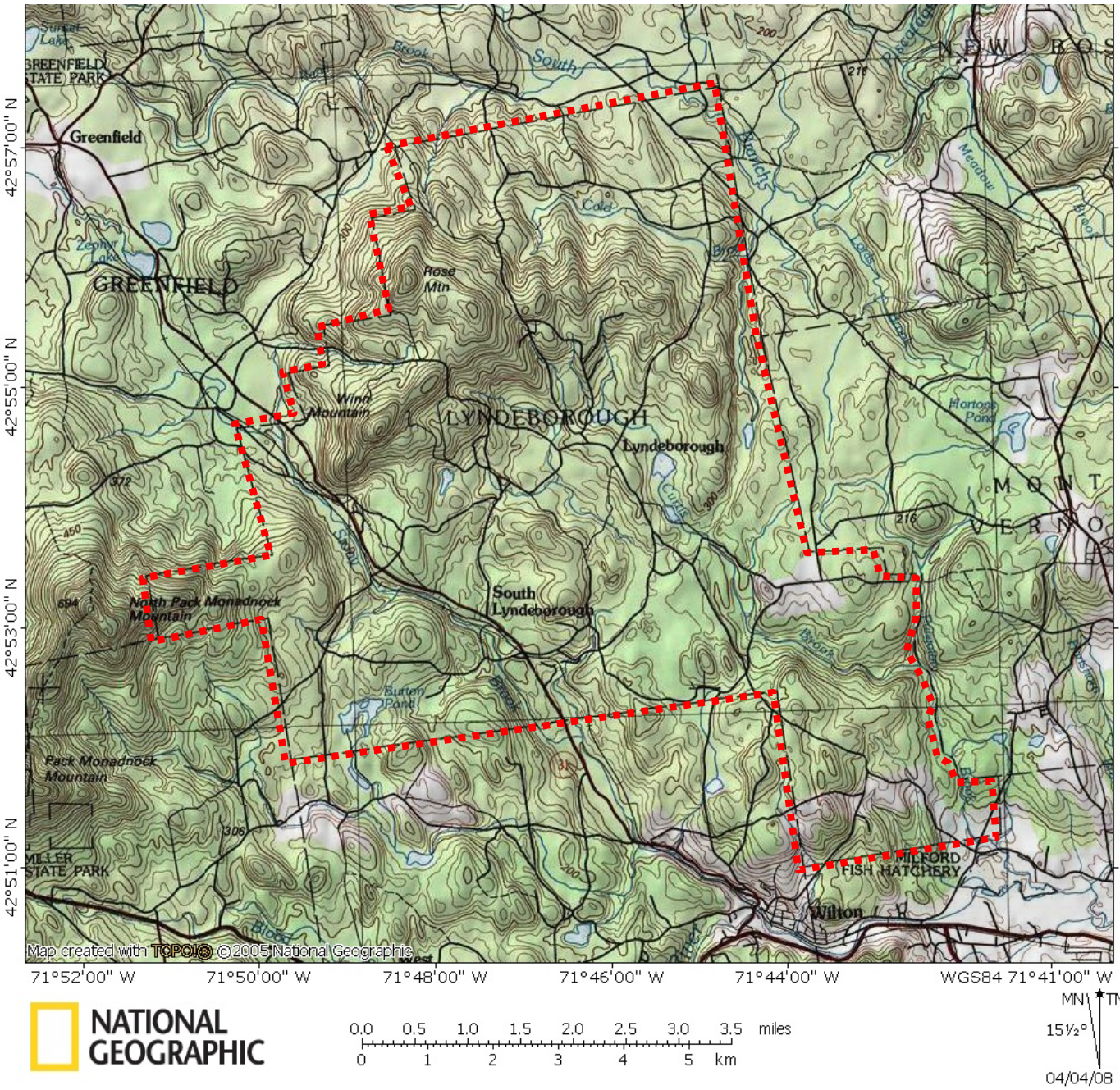
Ecological Forestry

Environmental Education

LYNDEBOROUGH, NEW HAMPSHIRE

& 1 mile buffer in
SHADED RELIEF
showing
STREAMS, PONDS & WETLANDS





Map created with National Geographic TOPO! software

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ALL PHOTOGRAPHS BY JOE TRUDEAU UNLESS OTHERWISE NOTED

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Chapter 1
Purpose & Scope

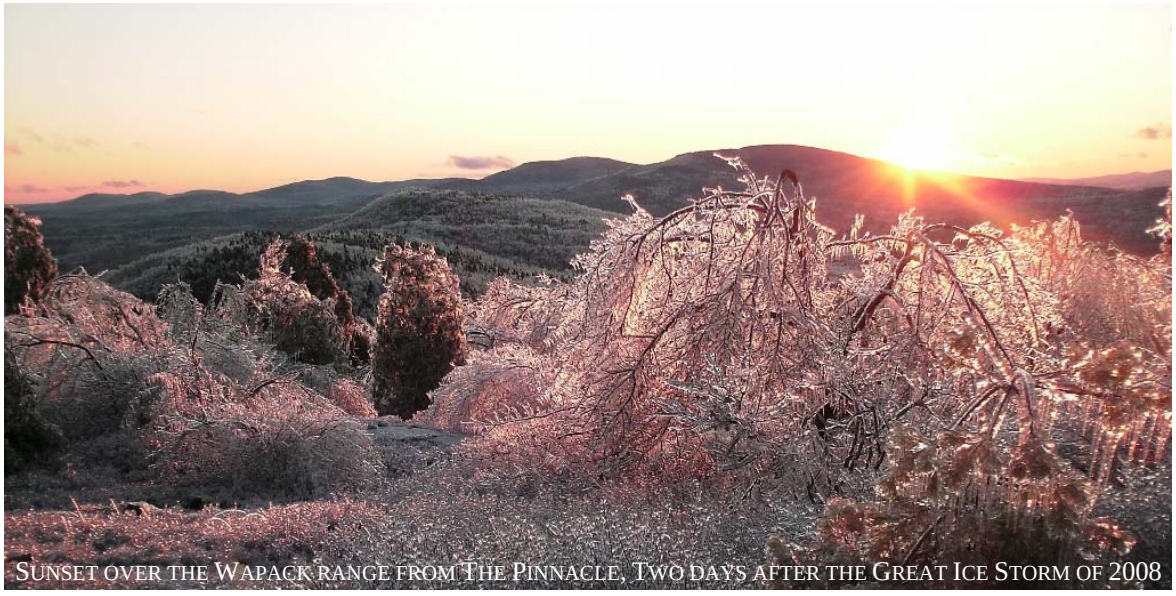
"Natural resources and wild areas define the character of Lyndeborough to a greater degree than perhaps any other town in the Nashua region. Lyndeborough's extensive forested hillsides, wetlands, and agricultural areas form the ever-present background for the community's quality of life."
-Master Plan, 2002

There is something very special about Lyndeborough, New Hampshire. Why, amidst all the hustle and bustle of this fast paced computer-driven millennium, has this little pocket of woods and wetlands remained so quiet, relaxed, and at times, just plain old-fashioned? Rugged hills, strong zoning ordinances, and maybe even luck have contributed to the still-rural nature of Lyndeborough. You could walk all day on dirt roads in north Lyndeborough, and if you saw anyone at all, for certain they'd smile and wave. You could fish for hornpout all day at Putnam Pond, and if you saw anyone at all, for certain they share a story. You could hunt, hike, and pick berries all season in the mountains, and you might not see anyone at all.

This has been changing slowly, but measurably, as change and growth comes to all communities. Only 50 miles from Boston, Lyndeborough has become in some ways a 'bedroom community'; a place for urban commuters to call home. This is a residential pattern that is relatively new to Lyndeborough, and comes with some associated risks. Until the recent and ongoing housing and economic recession, one of the most aggressive building booms this country has seen spread like wildfire through southern New Hampshire. Hundreds, then thousands, of homes were built quickly with little regard for environmental concerns, and quite often built for families who would not remain in the community. Between 1970 and 2006, the population of Hillsborough County nearly doubled; in the same time Lyndeborough's population grew by 225% (NH Dept. Employment Security, 2008). Such rapid development provides instant housing to meet demands, but also detracts from the character of small towns and their unique natural environments. Often, the pace of development surpasses the ability of a community to adequately plan for water protection, open space conservation, and other important

resource protection efforts that maintain the integrity of the community. That Lyndeborough escaped most of this pressure is much appreciated by conservationists, hunters, recreationists, and farmers. The current period of stalled growth gives an opportunity to take a measured, science-based look at how Lyndeborough can meet future periods of growth with smart development tactics that consider wildlife habitat, water quality protection, flood mitigation, aesthetics, and small town, rural character. This NRI is a powerful tool to help inform those decisions now, and into the future.

The people of Lyndeborough know how special their home is, and they appreciate it. The *Community Profile* project managed by University of New Hampshire in 2001 gathered together around 100 residents for a weekend of brainstorming about what Lyndeborough is to them and what they want it to be in the future. The results – the actual words spoken by Lyndeboroughs sons and daughters – speak volumes as to why this is such a special town; the most rural, rugged, and pleasant place to be in the entire Nashua Region. Out of 48 responses to the question *"What is Lyndeborough today?"* 16 (33%) were directly related to the wild, rural character of the town. Statements like "lots of land between houses," "undeveloped mountain tops," "lots of wetlands," "and many dirt roads" were common. When asked *"What we want in the future"* 28 out of 64 responses (44%) described preservation of this character. Statements like "healthy & diverse wildlife," "very slow growth," "strong support for agriculture," and "preservation of Lyndeborough's mountains" sum up the sentiment that *Lyndeborough is great the way it is, Nature here is beautiful; let's do our best to protect that which we love.*



SUNSET OVER THE WAPACK RANGE FROM THE PINNACLE, TWO DAYS AFTER THE GREAT ICE STORM OF 2008

The *Community Profile* process resulted in six key issues that the people of Lyndeborough felt the town (both the government and the community members) needed to work on. These were:

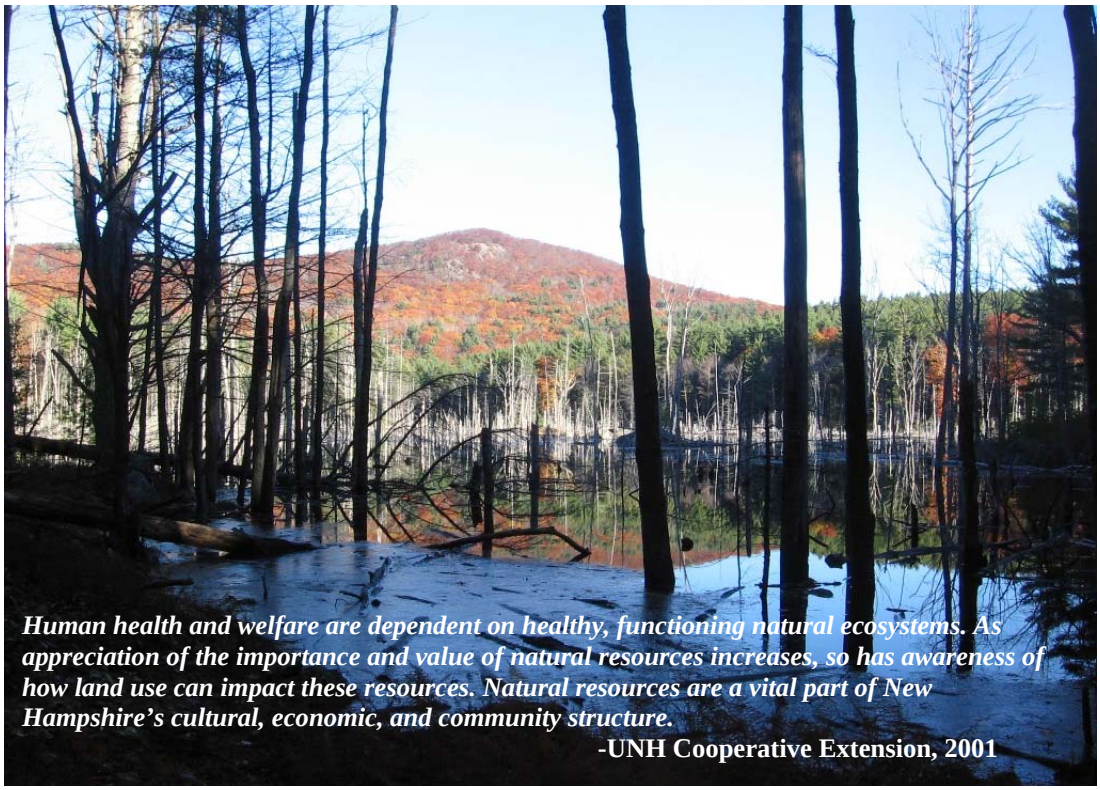
Citizen Engagement
Preservation of Rural Character
Communication
Infrastructure
Caring for our Citizens
Creating an Identity and Sense of Place

In addition to Preservation of Rural Character, two of these, Citizen Engagement and Identity/Sense of Place, are strongly tied to the health, extent, & availability of open space lands, wild forests, wetlands, and natural character. Lyndeborough's identity is already correlated to Nature; hayfields, blueberries, hunting, fishing, snowshoeing, hiking, horses, apples, and farming were all listed as elements of identity that people recognized. The sense of place one has after coming to know Lyndeborough is based largely on these aspects of living a country life. By capitalizing on this existing perception of what Lyndeborough "is", I believe that the citizenry can become engaged to protect those elements that they feel strongest about. This is an experience that has occurred in many towns, villages, Native American Reservations and distant countries. This is what conservationist Peter Forbes calls "the Great Remembering;" it is when people come together around a commonly accepted notion that the land and culture that sustains them needs to be protected, to ensure that future generations can have the same opportunities to explore, learn, get dirty, and grow in the presence of a vibrant living Earth. Communities must grow, populations will expand, and changes will come; but the traditions that define the ethics, values, and lifestyles of a place should not suffer for the sake of tax revenue or progress.

Preservation of Rural Character, a key issue emerging from the *Community Profile*, can be a catalyst for promoting the principles of the remaining issues. According to the participants, some of Lyndeboroughs strengths are its mountain ranges, substantial undeveloped areas, varied wildlife, great hiking, blueberries, old bridges, vistas, clean rivers, wetlands, orchards, and farms. To meet the threats to those strengths they called for the development of an enhanced understanding of Lyndeboroughs environment; habitat maps, conservation overlays, and ultimately, a Natural Resources Inventory. The next year, the Lyndeborough Master Plan echoed the call for a Natural Resources Inventory. Seven years later, those calls have been answered.

New Hampshire is the fastest growing state in the northeast, and within the next 40 years 85% of new growth is expected to occur in the southeastern portion of the state (Forest Society, 2001). Lyndeborough will absorb some of this development, which is not to say that it is all 'bad'. The culture and lifestyle of semi-rural New Hampshire depends on fairly dense population; many small towns in close proximity, many different people to share ideas, recipes, and good times. But, further fragmentation of wild forests, encroachment on wetlands, disruption of habitat, and destruction of native ecosystems will ultimately have long-term devastating affects on the qualities that people value today, and wish to see in the future.

This document is not a guide to "smart-growth" principles or practices, but it provides the basis for making decisions that minimize some of the negative impacts of human activity on the ecology and environment of Lyndeborough. Our dependence on Nature for clean air, clean & abundant water, reliable crop pollination, effective pollution filtration & flood control, healthy food & durable fiber, and of course spiritual rejuvenation, cannot be understated. This Natural Resources Inventory presents an account of these resources in Lyndeborough with the objective of protecting them, and in turn protecting ourselves and our community. Furthermore, this report should be heralded as a celebration of the rich and diverse wildlife and landscapes of this unique town, documented now in greater detail than at any time before.



Human health and welfare are dependent on healthy, functioning natural ecosystems. As appreciation of the importance and value of natural resources increases, so has awareness of how land use can impact these resources. Natural resources are a vital part of New Hampshire's cultural, economic, and community structure.

-UNH Cooperative Extension, 2001

ELEMENTS OF THIS NATURAL RESOURCES INVENTORY

This Natural Resources Inventory (hereafter NRI) is a compilation of existing natural resources information, documentation of new and unknown natural resource values, analysis of these data, and identification of the most important areas in Lyndeborough to maintain or conserve in order to meet human and natural resource needs. This NRI includes the following three main components as suggested by the UNH Cooperative Extension in *Natural Resource Inventories: A Guide for New Hampshire Communities and Conservation Groups* (2001):

1) Inventory maps that show the location and extent of resources
2) Associated data and information sources
3) Written report that describes in detail the methods, objectives, scope, findings, and any other information generated during the study period

Herein, I provide these plus an exhaustive analysis of wildlife habitat, wetland systems, ecosystems, and ecosystem services. Detailed mapping was completed with the most modern Geographic Information System (GIS) software, and hundreds of hours of field inventory substantiate, support, and expand on the data portrayed on the maps. An extensive, though not comprehensive, cataloging of the plants, animals, birds, habitats, and natural communities provides a ground-based scientific background for assessment and analysis. The details included here should serve as a foundation for future studies in natural history and ecology, and stand as a potent educational asset to develop a deeper understanding and appreciation for the natural world among Lyndeboroughs residents, governing citizens, and students. The following chapters are presented in a hierarchical format, building from the ground up.

Chapter 2, Geography & Landscape Features, provides a summary of the lay of the land; the mountains, hills, valleys, streams, ponds, cultural centers, and other features that need to be reviewed to help the reader visualize where they are as they read the rest of the report.

Chapter 3, Geology & Soils, discusses the incredible story of the building of New England 400 million years ago, the rise and fall of great mountain ranges, the spread of the glaciers, and the development and nature of surficial features and soils. Agricultural soils and aquifers are discussed here.

Chapter 4, Land Cover & Vegetation, describes the systems used to classify land cover at landscape scales, the characteristics of the various land cover types in Lyndeborough, the natural communities found in our forests, the plants and mushrooms documented during field inventory work, invasive species, and a discussion of wetland species diversity.

Chapter 5, Wetlands & Water Resources, discusses the streams, ponds, marshes, swamps, and other wetlands that occur, the typical vegetation, hydrologic patterns, functional values, habitat values, and community types.

Chapter 6, Wildlife, discusses the birds, mammals, fish, reptiles and amphibians of Lyndeborough, the habitats they utilize and need to survive, as well as an analysis of the most important habitats and areas in town.

Chapter 7, Conservation Lands, reviews the lands currently permanently protected, the mechanisms used to conserve them, the values they protect, and the entities that we have entrusted with these lands.

Chapter 8, Co-occurrence Mapping of Conservation Priorities, describes the process, rationale, and results of co-occurrence analysis: the process that identified the priority areas for enhanced land conservation to meet wildlife, agricultural, water, recreation, and other resource demands.

Chapter 9, Conclusion & Recommendations, summarizes the NRI process and results, and suggests important steps to meet the needs of present and future generations.

Throughout the report and following the text in plastic sleeves are detailed maps to show the spatial arrangement of natural resources, topography & terrain, and patterns in human & natural systems.

HOW THE NRI CAN BE USED

This NRI has already provided significant benefits to the town. A GIS dataset has been compiled that will provide most of the planning data that the town will need to make decisions related to water protection, wetlands, forest fragmentation, road layout, conservation plans, wildlife habitat, flood planning, and many more concerns. This data exceeds the quality available from NH GRANIT, the states official data source, or the regional planning commission. Some significant improvements to the data include:

- the physical shape of Lyndeborough has been corrected to match tax parcel GIS data created for the town by Cartographic Associates
- roads were adjusted to match right of way corridors on tax parcel maps
- conservation areas were adjusted to match tax parcel data, and questionable boundaries were verified at the County Registry of Deeds
- additional conservation lands were added that were never reported to NH GRANIT

• certain streams and wetlands were adjusted to match tax parcel map data and 2008 aerial photographs

• ponds were refined to represent those actual bodies of water as of summer 2008

• custom generated layers developed through extensive field inventory were developed, including rare plant locations, potential vernal pool locations, recreational trails, beaver dams, and unfragmented forest blocks

• maps of co-occurring resources were produced with an understanding of the resources being mapped that could only have grown from extensive field work and personal knowledge developed through years of exploring the towns forests and wetlands

Just having this database is an exceptional tool for the town, but there is as much or more additional information within this report. Detailed accounts of geology, vegetation, and wildlife including the relative 'commonness' of these resources provides a perspective of the sensitivity of certain attributes of the environment to degradation. For example, each plant documented in this report (almost 300 species) has been ranked with a number (1-5) that estimates its commonness in Lyndeborough. If a subdivision were to be submitted for review, and a site walk ensued wherein a Conservation Commission member noticed a certain flower or fern that appeared unusual, they could identify it in the appropriate field guide, look it up in this NRI, see that it was ranked 1, which means it is locally rare or uncommon, and then suggest a more in-depth review of the proposal to be sure that rare, unique, or special habitats were not going to be destroyed. Another example could be this: a landowner offers a 'bargain sale' of her 40 acres of forest to a land trust for $25,000. The land trust asks that the town kick in $15,000, which is half of the towns available conservation funds. The town can now look at the properties location in relation to wetlands, existing conservation lands, and its ranking on any of the three included co-occurrence maps, and determine whether the money will be well spent. Additionally, a site-specific NRI or a site walk by botanists could be commissioned that would identify features that are very common to Lyndeborough, or as yet undocumented. In this case, if the forest is ranked very low on the habitat, agriculture, and conservation priorities maps, and the site walk reveals plants and birds that I have determined common and widespread, then the town may decide to save its limited funds for future projects with higher impact. These are just a couple examples of the many ways that this information can be used to support informed decision making in the planning process.

The primary ways an NRI is used, according to UNH Cooperative Extension (2001) are:

- Document current conditions so changes over time can be assessed
- Develop a conservation plan
- Educate local officials and the public about natural resources
- Initiate and support land protection efforts
- Provide a basis for land use planning efforts
- Develop or update the natural resources section of the municipal master plan
- Evaluate the effects of proposed land use and zoning changes
- Develop amendments to existing zoning ordinances
- Screen development proposals

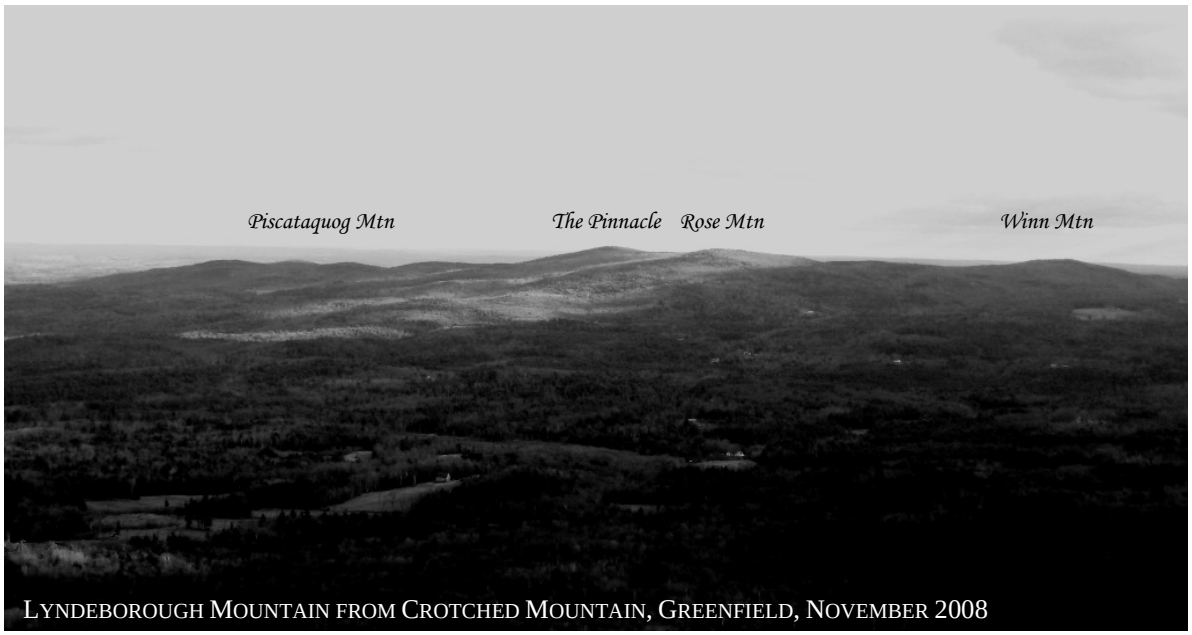
This NRI is adequate to use for any and all of these purposes and can and should be amended as new information becomes available, land-use patterns change, and time reworks the face of Nature to the point that the information needs updating.

SHORTFALLS AND AREAS NEEDING IMPROVEMENT

Geospatial data has its limitations, to be sure. Several layers are not as accurate as they should be and it was determined that correcting them was beyond the scope of this project. The most significant data shortfall is the classification of wetlands in the National Wetlands Inventory (NWI) data layer available from NH GRANIT. In the 1990's the US Fish & Wildlife Service mapped and classified the wetlands of New Hampshire according to the Cowardin *et al.* (1979) scheme; this is the standard hierarchy for wetlands classification in the United States. The imagery used was 1:58,000 color aerial infrared photography taken between 1985-1987 (Tiner, 2007). The bottom line is that many of these wetlands, while still in fact wetlands, are no longer the same type as they were 25 years ago. For example, a pine forest flooded in 1983 by beaver would by 1985 be classified as a semi-permanent beaver-flooded dead forest. By the mid-1990's when the data was analyzed and classified, the beaver had abandoned the pond because of resource depletion, and it would have already changed to a seasonally flooded persistent mucky pond/emergent marsh. By 2008 when I compiled this report, the marsh had mostly filled in with sediment, a distinct stream channel had been re-established, shrubs had overtaken the grasses, and it should be re-classified as a seasonally flooded deciduous shrub swamp. Not every wetland has changed to this degree, but enough have that I suggest a future reclassification project. This could take shape as a Prime Wetland Analysis, a simple aerial photo interpretation, a 'windshield survey', or some other scheme. Regardless, the data was left

mostly the way it came. Some wetlands shapes were adjusted to match major changes in extent, and some reclassifications were made to very large wetland units that would, if not fixed, have resulted in less accurate results from the co-occurrence analysis.

Other GIS data layers that are incomplete are those developed during field inventory. They, obviously, only reflect my personal observations and do not include, for example, vernal pools or black gum swamps that I did not locate. This should be considered whenever interpreting the data. Land cover data, including the 2001 Landsat Thematic Mapper satellite imagery (which was taken in the 1990's) and the Wildlife Action Plan habitat types were developed at the scale of the entire state of New Hampshire and do not necessarily reflect true conditions on the ground in Lyndeborough. For example, about ¼ of the cells classified as Spruce – Fir by the 2001 Landcover Assessment were actually very dense hemlock. This data cannot be changed, but this point should be considered when interpreting the data. Tables in the appendices list the layers in the GIS database along with important accompanying information.



LYNDEBOROUGH MOUNTAIN FROM CROTCHED MOUNTAIN, GREENFIELD, NOVEMBER 2008

PUBLIC INVOLVEMENT, OUTREACH, AND PRESS

A goal of this project was to capitalize on and expand the natural resource knowledge of Lyndeboroughs residents, landowners, students and others. An informational poster was put on display at Citizens Hall for the March 2008 town meeting and was left up for the remainder of the project. Slips were provided for interested parties to leave their contact information so I could reach out to them for participation. A rather disappointing three slips were filled out for the entire one-year duration of the project. Rather than this symbolizing peoples disinterest in the project, I suspect that the method of outreach was simply not a favorable one. Despite this low rate of inquiry, a total of 26 people (besides Conservation Commission members during meeting times) participated in various ways. Lyndeborough residents Leo & Amy Trudeau, Karen & Walter Holland, Jessie Salisbury, Liz Lorvig, Helen Van Ham, Mike Decubelis, Pauline & Bill Ball, Julie Zebuhr, Sharon Slater, Phil & Virginia Brooks, Robin Arnold, Ron & Sally Curran, and Lois Kennick participated by supplying natural resources information, joining me in field work, going on walks, permitting use of their property for guided hikes, and providing good conversation. Non-resident landowners Armand Poirier, Ian Law, and Francie Von Mertens provided information and joined me to hike their property. Field assistance from Amber Fields (Hancock), Eric Aldrich (Hancock), Barbara Grise (Rindge), and Patrick Scanlon (high school student from Bow who was doing a career study project) made inventory work even more enjoyable. Pete Gallagher of Milford provided interesting wildlife accounts and stories from his 20+ years of hunting on Piscataquog Mountain. Finally, sponsorship of three hikes was offered by the Conservation Commission and the Harris Center for Conservation Education in Hancock:

May 24, 2008:	Cold Brook, from Senters Falls to Whittemere Meadow	4 hikers
June 28, 2008:	Rose Mountain forestry tour from Greenfield side	8 hikers
July 20, 2008:	Geology hike up Winn Mountain from Rt. 31	5 hikers

In addition, I led two field trips for the Lyndeborough Central School; I took the 1st grade class out on a plant tour on the schools and Mr. Wally Holts property, and I took the 6th grade class on an ecology tour to the Furnace Brook ravine and Putnam Pond Conservation Area. I had a wonderful time with the attentive and involved students and deeply appreciate the opportunity to collaborate with the staff of LCS. The following pages include copies of the press and publications during this project, including the three articles I wrote for *Lyndeborough Views*. Certainly others participated in less formal ways and I have forgotten the time, place, and person; to those who offered help and knowledge who have not been mentioned here, I apologize.

LYNDEBOROUGH Monadnock Ledger-Transcript Tuesday February 19, 2008

Town to inventory natural resources

LYNDEBOROUGH — Thoreau said, "Nature will bear the closest inspection. She invites us to lay our eye level with her smallest leaf, and take an insect view of its plain." Over the next year, Joe Trudeau will make that inspection for the town of Lyndeborough.

At a Conservation Commission meeting Thursday, the commission unanimously voted that Trudeau conduct a Natural Resource Inventory of the town, a process of gathering information about natural resources in a place and mapping them out in a report.

Conservation Commission member Pauline Ball said Monday that the issue had been before the commission for a number of years and the town needed to have an inventory done.

"We can see what we have as far as resources and how we can protect them in our planning for the town," she said.

Trudeau said Friday that there are many reasons why a town would want to get a Natural Resource Inventory done.

"It can be a powerful took in a variety of management actions. It can inform and guide the Master Plan. It can inform amendments to zoning board ordinances, and as the region grows, it can be used to develop conservation plans, wildlife habitats and recreation areas," he said.

He said Lyndeborough has a particular interest to get this done because the Planning Board is currently revising its master plan, and is about to begin the section on natural resources.

According to Trudeau, towns are supposed to keep a current Natural Resource Inventory by New Hampshire State law, but few do because the law does not provide for enforcement. Trudeau said roughly a quarter of New Hampshire towns are up to date.

Trudeau said he has been doing similar work for five years, but this project in Lyndeborough has special meaning for him.

"I am interested in the process for very personal reasons. I've spent much of my life in Lyndeborough and my father still lives there. I grew up spending time in the forest making maple syrup there. With this particular project, I want to go the extra mile," he said.

Trudeau said the beginning of the process involves less fieldwork and more research. He said he will begin by gathering data and maps that have already been generated at the state level.

"We don't want to reinvent the wheel, and we do want to give credence to the people who have done work before us," he said.

He said a lot of this information is available to the public at a website maintained by the University of New Hampshire and the Office of State Planning at www.granit.unh.edu. Where the fieldwork comes in, he said, is that these maps are constructed at the state level, and he must verify the accuracy when "zoomed in" at the scale of the town.

According to Trudeau, he will look at where geographic features are located. He will determine what the town's water resources are, which he said can have applications from protecting drinking supplies to harnessing opportunities for hydro-electric power.

He will look at recreational resources, such as what trails people use, where people go boating, where are the scenic roads. He will study biological resources like biodiversity, and what sort of forest communities, wetlands and river systems are in town.

He will also compile a town species list, which he said will represent everything he encounters in the process.

"We can discover plants that nobody knew were there. We can understand how the environment functions that can help our lives," he said.

Trudeau said he is taking longer to make the Natural Resource Inventory than most, a full year, because he wants to give ample opportunities for community involvement.

"We really want to involve the public and get information from the residents of Lyndeborough. The people who have lived there for generations know a lot about the environment there," he said.

Other advantages to taking the full year, he said, are to get information throughout all the seasons and providing an opportunity to take classes from local schools into the field for hands-on science education.

"I personally resolve to try and involve the schools to help students develop a sense of place which is largely lacking in a lot of places," he said.

Trudeau moved from New Hampshire to Arizona in 2001, where he said he got to do natural resource projects covering large areas. He returned to New Hampshire in 2006 and decided to bring his expertise in natural resources to his hometown. He proposed a Natural Resource Inventory to the conservation commission last March.

"I felt it was something I wanted to pursue," he said, "but I knew it would take some leadership."

LYNDEBOROUGH Monadnock Ledger-Transcript May 20, 2008

Taking a resources inventory

By Dave Eisenstadter
Monadnock Ledger-Transcript Staff

LYNDEBOROUGH — In his dual efforts to include educational and community involvement components while performing a natural resources inventory of town, Joe Trudeau took a local student with him into the field Thursday.

Bow High School Student Patrick Scanlan said job shadowing Trudeau served as a graduation requirement.

"We need to have 20 hours of job shadowing in our four years," Scanlan said, "and Joe has a cool job."

Scanlan met Trudeau on a 10-day guided class trip Trudeau led through the wilderness. Scanlan, who's currently looking at colleges, said he hoped to have a career to satisfy his interests in environmental studies and outdoor adventures.

"I always was outside as a kid," Scanlan said. "Places like this are serene and relaxing. You don't have to think about what's going on at school or anything."

Trudeau led the way around the half-mile Senters Falls Trail that passed by a stream on the 16-acre Alan and Edgar Rice Natural Area in Lyndeborough. He called the land, owned by a land trust, private land for public use.

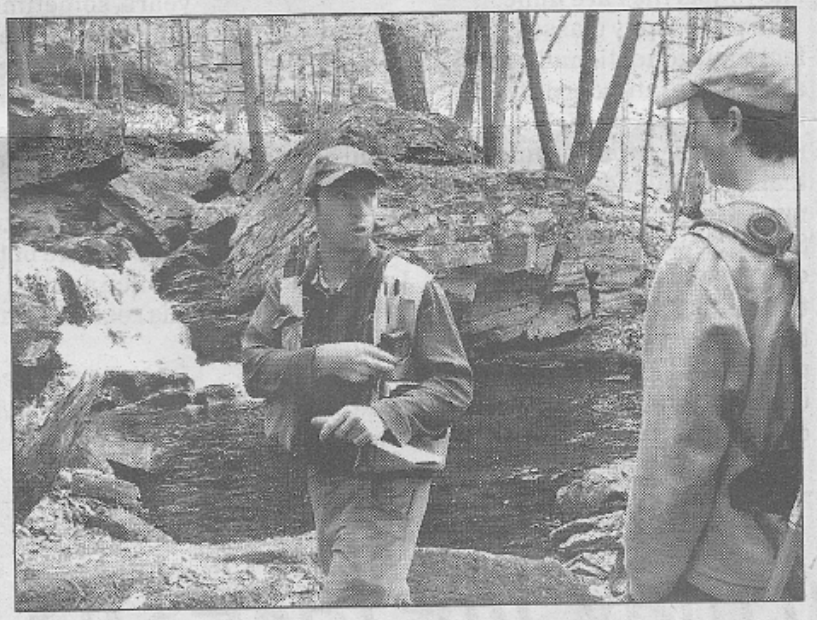
"The threat always stands that someone can buy land and post it 'no trespassing' and then people can't see their favorite falls," Trudeau said. "As long as a land trust owns it, it will be protected."

Trudeau identified plants and geographic features along the trail as a part of a Natural Resource Inventory for Lyndeborough's Conservation Commission. The yearlong process began in February, and he said he is taking a year to get as much community involvement as possible.

Trudeau pointed out beech trees and black birch along the way, explaining the significance of each species for the forest.

"Black birch used to be common in old growth forests," Trudeau said. "It's nice to see them still in Lyndeborough."

Trudeau said other members of the community could get involved in a number of ways, sharing knowledge and anecdotes about wildlife in the area with him or going through their land with him identifying former land uses and natural communities. For questions or comments about the process, call Trudeau at 562 6226.



Staff Photo by Dave Eisenstadter

Joe Trudeau, left, talks to high-school student Patrick Scanlan, who was participating in a job-shadowing program, next to a stream at the Alan and Edgar Rice Natural Area in Lyndeborough Thursday.

What's on the land?

Area man keeps a close eye on Lyndeborough's environment

By Jessie Salisbury
Correspondent

LYNDEBOROUGH — During a two-hour stroll along Furnace Brook, Cider Mill, Cemetery, and Furnace Hill roads, Joe Trudeau found a number of interesting things.

While the side of Cemetery Road was harboring the invasive plant Tatarian honeysuckle (which he removed), there were also a number of young native chestnut trees. He pointed out how they were shoots growing out of an old stump, a tree that had succumbed to the chestnut blight.

And then there were the ferns: wood ferns, Christmas fern, bracken, interrupted, cinnamon, and lady ferns. He agreed that it is not always easy to tell them apart, "but ferns are sure neat."

He spoke of other, less common trees: witch hazel, bass wood, hop hornbeam.

It is the type of walk he would like to make this fall with small groups of students from the Central School.

By state statute, each town's conservation commission is required to conduct an environmental resource study — compile a comprehensive list of what is out there: the kinds of animals, birds, trees, plants, biospheres, ecological niches, and all of the other interesting natural tidbits that make up the diverse ecology of a town.

'I'm spending time in the woods with folks describing all the wonderful attributes of Lyndeborough. I hope (my report) reflects the knowledge of the people of the town.'
Joe Trudeau

Last year, Trudeau, of Hancock, began doing that for Lyndeborough. On a recent sunny morning he walked along Furnace Brook, an area he was familiar with from his childhood when he went fishing with friends and cousins, but had not visited recently.

"I'm spending time in the woods with folks describing all the wonderful attributes of Lyndeborough," he said. "I hope (my report) reflects the knowledge of the people of the town."

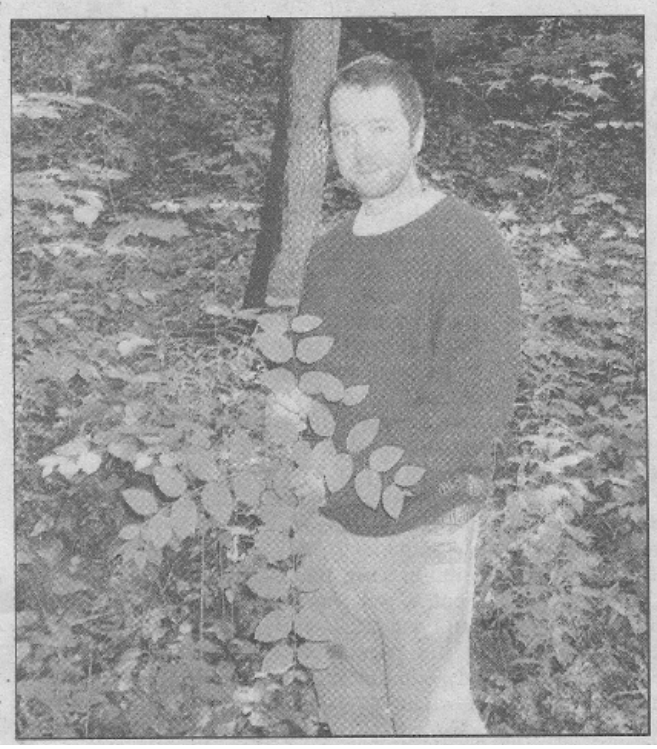
He also hopes the report "doesn't end up another report on a shelf," but will be used by the planning board as well as the conservation commission.

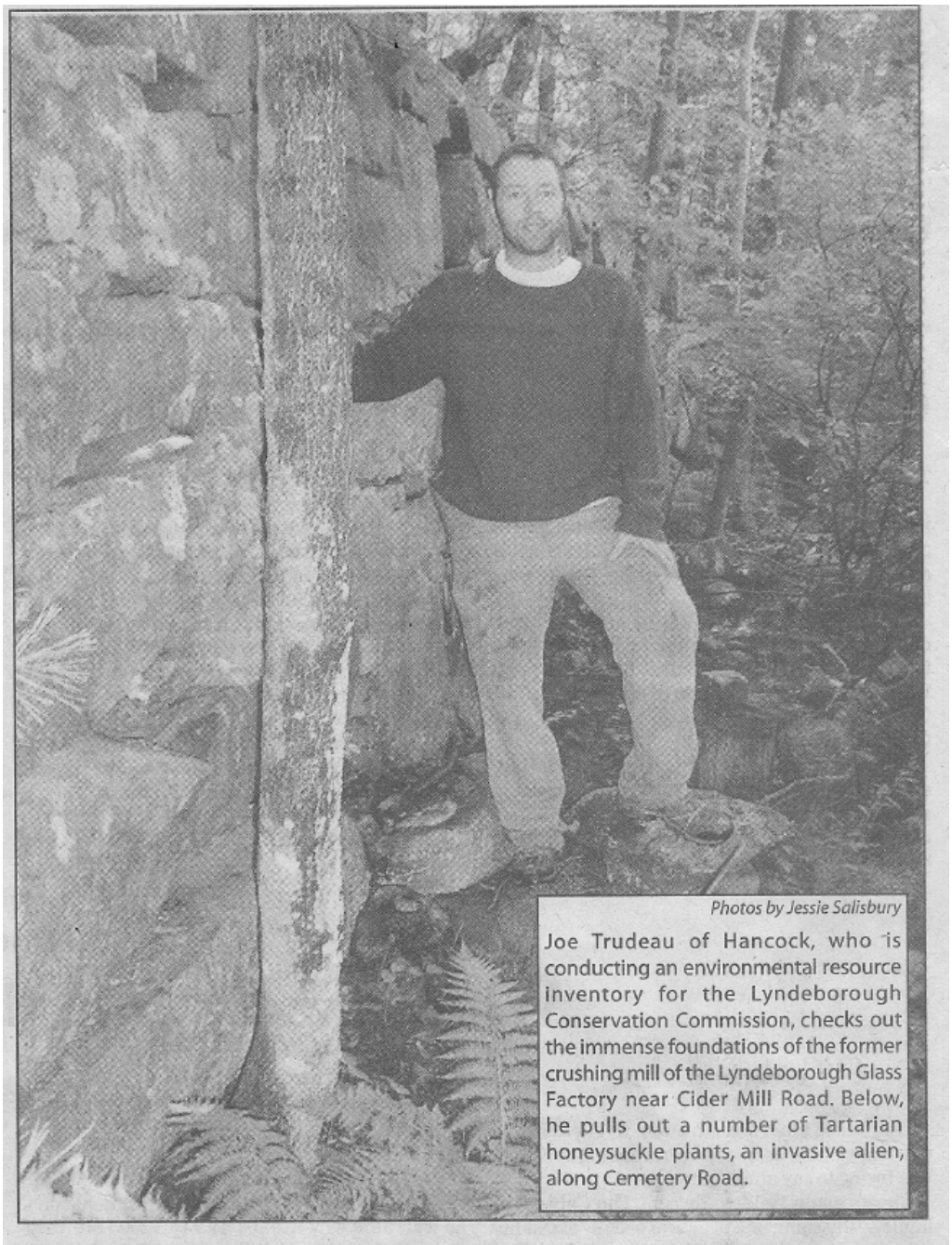
Trudeau, 28, grew up in Amherst and is a graduate of Northern Arizona University in Flagstaff with a degree in parks and recreation management. He is the owner of Preserve Land Works of Hancock and is an ecosystem management consultant. He has worked with several towns and with non-profits, he said.

The conservation commission is financing his study of the town.

"I'm trying to find better ways to live with the land," he said.

The walk downstream ended at the massive stone foundations of the former crushing





Photos by Jessie Salisbury

Joe Trudeau of Hancock, who is conducting an environmental resource inventory for the Lyndeborough Conservation Commission, checks out the immense foundations of the former crushing mill of the Lyndeborough Glass Factory near Cider Mill Road. Below, he pulls out a number of Tartarian honeysuckle plants, an invasive alien, along Cemetery Road.

mill for the Lyndeborough Glass Company, located off Cider Mill Road. He noted a stand of the shrub spicebush, which he later said he had not encountered before in town.

He also noted a collection of trash, including a refrigerator just downstream from the dam site, and the usual cans and bottles. The site is popular with glass hunters because the glass factory dumped their slag there.

The area would make a "great conservation area," he said, considering the history. He also recommended that the steep ravine between the dam and Cemetery Road be considered for a possible conservation easement in the future.

"It is a unique area," he said.

What he does, Trudeau said, "is roadside botany." He pointed out grape vines, herb Robert (a kind of wild geranium), false Solomon's seal, and noted he had seen the "true" version earlier. The very pretty white multiflora rose is very invasive, he said, "choking out the native shrubs."

He usually spends two days a week in town and expects the report and accompanying maps to be ready to present to the town in February.

He can be reached at joe@preservelandworks.com.

More information can be found at his website, www.preservelandworks.com.

Volume 8, Issue 2 "To Educate and Inform the Citizens of Lyndeborough" June, July, Aug. 2008

Mapping Lyndeborough's Natural Resources

By Joe Trudeau

During the next year, I will be completing a Natural Resources Inventory, or "NRI", for the town of Lyndeborough. An NRI lists, describes, and maps components of the natural and human environment that exist within a given locality. For this project, things such as plants, geology, soils, wetlands, recreational and scenic areas, important wildlife habitat, conservation land and agricultural lands will be identified and described for Lyndeborough and its immediate surroundings. For more than 25 years, I have been privileged to spend much of my time in Lyndeborough, as a visitor and a resident, and I am very excited to see this project develop.

Why inventory natural resources?

The New Hampshire State Law (RSA 36-A:2) that established Conservation Commissions states that a Commission shall "...conduct research into its local land and water areas," and "...keep an index of all open space and natural, aesthetic or ecological areas, with the plan of obtaining information pertinent to proper utilization of such areas, including lands owned by the state or lands owned by a town or city." The index referred to is a Natural Resources Inventory.

Just as important, human health and well-being, the economy, and society are dependent on healthy, well functioning natural ecosystems. As southern New Hampshire's population grows and once rural towns become rapidly fragmented, towns are forced to confront difficult land use decisions regarding resource conservation, open space development, and access to public land. A NRI provides a detailed information source for Master Plans, Conservation Plans, or as the basis for sustainable development projects. It can also serve as an educational tool for school science classes or others interested in the rich natural world that Lyndeborough offers.

What is the NRI Process?

Over the next year, existing information and maps will be compiled, new information and data will be gathered in the field, and final maps and an accompanying report will be generated. Existing conservation lands will be inventoried to evaluate currently protected natural resources. Public participation will help provide important information that will ultimately describe and display Lyndeborough's natural resources in a depth not yet available. The final product will reflect

(Continued on page 7)

Natural Resources.....

(Continued from page 1)

the inventorying work that has occurred in the past as well as new research that includes public scoping and participation, ecological surveys, and state-of-the-art map and database creation.

How can you get involved?

Public involvement is critical in putting together a NRI that reflects the knowledge and sentiment of residents, is easily accepted as a planning tool, and builds a sense of community around a common resource: The land. I bring a decade of experience in natural resource management and study to this project, but I still am looking for some help from people whose eyes and ears have been on the ground for many years. I invite your participation in any way you are comfortable; sharing your knowledge of a certain piece of land, stories about how things have changed, or hosting a survey of your own property.

If you are interested, I will gladly take phone calls at 562-6226, or emails at joe@preservelandworks.com. Also, feel free to stop by the town offices and see a color wall poster I drafted for Town Meeting. I hope to see you around!

Natural Resources Inventory Proceeds with Exciting Discoveries

Submitted by Joe Trudeau

Now that the Natural Resources Inventory process is halfway through, I'd like to provide a progress report to readers of Lyndeborough Views and share with you some of the interesting observations I've made. Since late winter I've spent 22 days in the field, walked over 100 miles across 2,000 acres of conservation and public lands, made observations along more than 40 miles of road, met with 10 interested residents and landowners, and slogged through more than anyone's share of swamp, marsh, muck, and mire. This project has acquainted me with areas of Lyndeborough I haven't visited since I was a very young boy, and areas I never thought to visit before.

Coming into this I had a goal of identifying 200 species of plants. Well, that might just turn out to be the beginning! Already, I've reached about 225, and every time I go out I find more. As for wildflowers, I've documented 115 species, 23 of which are introduced, and 92 native. The most common forest flowers are Wintergreen, Partridgeberry, and Canada Mayflower. My most exciting finds are the endangered Fern-Leaved False Foxglove on Piscataquog Mountain, Foamflower in a unique nutrient rich seep along Cold Brook, and the elegant Pale Corydalis tucked into a boulder field on Winn Mountain. The most abundant family is the Composites, or Asters, followed by Lilies and Roses. I've found 16 species of ferns, including the threatened Goldies Fern, and some uncommon species such as the ledge loving Rusty Woodsia on Winn Mountain, and the nutrient-rich soil loving Maidenhair Fern in a sugar maple grove in north Lyndeborough.

I've documented an astonishing 46 shrub species, of which 6 are exotic invasives that deserve some attention. Areas of the highest diversity of shrubs are old blueberry fields and certain wetlands. The shrubs are fairly evenly distributed along moisture gradients, with sixteen of these species considered by wetland scientists to occur more than 67% in wetlands, thirteen to occur in uplands more than 67% of the time, and the remaining third commonly found in both environments or are unrated by the U.S. Army Corps of Engineers. Thirty-four tree species have been observed, including some unique occurrences, such as a Douglas fir (native to the western mountain ranges) on the roadside at Hunters Cot, and the lovely Catalpa in front of the Congregational Church in South Lyndeborough. Besides these, dozens of species of grasses, sedges, rushes, mosses, club-mosses, and vines have been observed in a variety of habitats.

Old growth forest in Lyndeborough

Lyndeborough is graced by some lovely natural areas that I urge anyone interested in nature to visit. Of surprising diversity is the Curtiss Dogwood State Botanical Area on Perham Corner Road, where I was delighted to discover several species of dogwood, and a rich forest floor of flowers, grasses, and low shrubs (including a scary amount of poison ivy!). Other highlights so far have been the discovery of three previously undocumented Black Gum swamps on Piscataquog Mountain. These are very rare communities in New Hampshire and fortunately these occurrences are already protected by a Conservation Easement. The oldest known deciduous tree in the east is a Black Gum in Hillsborough County estimated at almost 700 years old! Summer is nearly over and soon the season for discovering our natural heritage will have passed, but I'm planning on spending another 10 or 15 days in the field or on the water before I consign myself to the computer for data analysis and report writing for a few months. Again, anyone is welcome to participate in the exciting project and can reach me at 562-L6226, or joe@preservelandworks.com.

Windows into Winter

By Joe Trudeau

Winter is a great time to get outside and see the natural world in a new way. While it is tempting to settle in by the woodstove for the next 4-6 months, a few trips into the wild will be worth the effort in terms of good exercise and the ability to see some things much more clearly than when the greenery of summer has turned most of the woods into an indiscernible confusion of leaves.

Unlike me, you probably do not spend a whole lot of time walking through marshes and swamps. Winter is a great time to do this once temperatures have stayed cold enough to permit the shallows to freeze, which will happen before the deeper areas of moving water. While you're out in a wetland this winter, look for a shrub with many bright red berries; you have time as they will remain on the bush for several more months. This shrub, one of 46 wild-growing shrubs I have documented in Lyndeborough, is winterberry holly (*Ilex verticillata*). This is an important food source for winter resident birds. An average shrub wetland, like what you will see at the Badger Pond culvert on New Road, might have 10 different shrub species, many of which look very similar until you learn some little clues to help you identify the variations, like the long-lasting red berries.

Wetlands are some of the most important habitats in New Hampshire. The steep mountains of Lyndeborough give rise to several important streams that are graced by beautiful and extensive wetlands along their courses. Furnace Brook, which drains the southern face of Winn Mountain and much of central Lyndeborough, consists of numerous beaver-created meadows and ponds interspersed with stretches of steep cascading brook. This winter, try to take a trip to Putnam Pond Conservation Area on Cemetery Road. The pond and fringe wetlands were formed when Furnace Brook was dammed as part of a state flood control project. Visit early or late in the winter when ice is thin or mushy and you might catch a view of some common pond characters. Beaver are active all winter and will maintain openings at the edge of the pond as long as they can defeat the ice. Also, otter will maintain some openings from which they will rise to eat the fish, snakes, or frogs they catch in the muddy pond bottoms. This summer I found fresh otter scat on the west side of the pond with an intact 18" long water snake in it! If you see some openings in the ice this winter, sit back and wait because there is a good chance you will catch these critters in action.

On a recent fall day Joe Trudeau and the LCS Sixth Grade took a trip outdoors to learn about ecology and conservation.

If you are not much of a swamp walker and you would rather head for the hills, there are a few things up high you only get to see in winter. Many of the steep hillsides in Lyndeborough have extensive talus slopes that you might find on your way to the top. Talus is broken fragments of bedrock that have fallen from cliffs and ledges over millennia. These areas are favorite haunts for porcupines. These odd creatures are active all winter, and if you find a talus field you might see numerous well-packed paths worn into the snow from the Earth's third-largest rodent waddling along en route to their favorite feeding tree, which is probably a stubby hemlock that has been the brunt of the porcupines gnawing for several generations. Some snake species use talus as hibernacula (a shelter for a hibernating animal), including the Northern ringneck snake (*Diadophis punctatus edwardsii*), Northern black racer (*Coluber constrictor constrictor*), and the timber rattlesnake (*Crotalus horridus*). While none of these three species have been documented in Lyndeborough, it is certainly possible they could be hiding in the dark corners of our semi-wild mountains, so keep your eyes open and report any sightings to New Hampshire Fish and Game. Whether you choose to forge a path into a marsh or to an open mountain top, you will certainly see some things that disappear into the mass of color and action in summer. These hardy survivors depend on protected habitat for their survival.

For more information on these species, Lyndeborough's habitats, or land conservation, contact the Conservation Commission on the second Thursday of each month, 7:30 pm at Citizens Hall. Happy wanderings!

Town Website

CHECK IT OUT!!

Check the Lyndeborough Town Web site for information about department meetings, other events, and to see the Lyndeborough Views in color.

www.http://town.lyndeborough.nh.us

Insert in Monadnock Ledger-Transcript
"SAU 63 Spotlight"

Central School

SUSAN TUSSING
Principal

Lyndeborough Central School is located in a rural area with many ponds, streams, meadows, and forested hills. It has long been my desire for our students to explore the environment of the surrounding area. This wonderful resource, right at our doorstep, offers many natural science opportunities.

This fall, we were approached by Joseph Trudeau of Preserve Land Works, who is currently mapping ecosystems for the Lyndeborough Conservation Commission. He asked if he could lead some student field trips in the area, to share what he is learning about our wetlands, watersheds, and streams. Joe led our first graders on a couple of walking tours of the land surrounding our school. He took the sixth graders to Putnam Pond Conservation Area, and showed them how to bore for soil samples, to test the soil Ph, and many other aspects of forest life. We are hoping to maintain this relationship as an exciting real life view of environmental science.

CHAPTER 2
GEOGRAPHY & LANDSCAPE FEATURES

"This township of Salem-Canada was emphatically a land of mountains, hills, and valleys, and figuratively speaking, there were few places in it where a wagon would stand without 'trigging the wheels.' It was a well watered, attractive country, sightly and healthful."

J.A. Woodward, 1906.

THE SHIFTING FACE OF LYNDEBOROUGH

In the passing of the last two-hundred and seventy five years, the face of Lyndeborough has seen great change. Prior to it's granting as Salem-Canada to the province of Massachusetts in 1735, it was a well used territory of the Native Americans. Abenaki and Penacook peoples occupied the land in relative abundance. The Souhegan River was well stocked with anadromous fish; tribes would convene annually despite their grudges and fish for salmon and alewife using systems of weirs and long handspun nets. As a child, watching my father and grandfather clear the forest and strip the soil from my native floodplains of Amherst to make way for homes, we would find pits, ten feet round, a couple feet deep, filled with charcoal, and buried by 200 years of forest litter. These were the smoking pits where the winter's stores would be dried and preserved. A major Indian trail passed from the Souhegan through Lyndeborough, following Stony Brook upstream to Russell Station and continuing on through the Monadnock Region and converging with a major trail along the Contoocook River (Goodby, 2006).

They were fishing people, and deer hunting people. Lowland forests were burned regularly to make hunting easy, and to create a forest rich in grasses and shrubs where the wildlife would flourish. The pine plains of sandy lowlands are the result of thousands of years of Native influence on the landscape. These were scarce in Lyndeborough, restricted to a patch north of the mountains (Woodward, 1906) where some stately pitch pines still grow at the Deland Forest. Lyndeborough probably represents the northern limit of this land management technique, which was fairly widespread in Massachusetts and areas south, and also common in

New Hampshire at Ossipee, Concord, and Merrimack. These pitch pine barrens, scarce in Lyndeborough, were abundant just a few miles west.

> *"In the cabin the blazing logs furnished light as well as heat and were probably supplemented at night by a knot of brightly burning pitch pine propped in front of the fireplace. This pitch pine which grew abundantly on the plains between Sunset and Otter Lakes was the object of yearly journeys made by the earlier settlers from the surrounding towns."*
>
> -Hopkins, 1977: History of Greenfield, NH

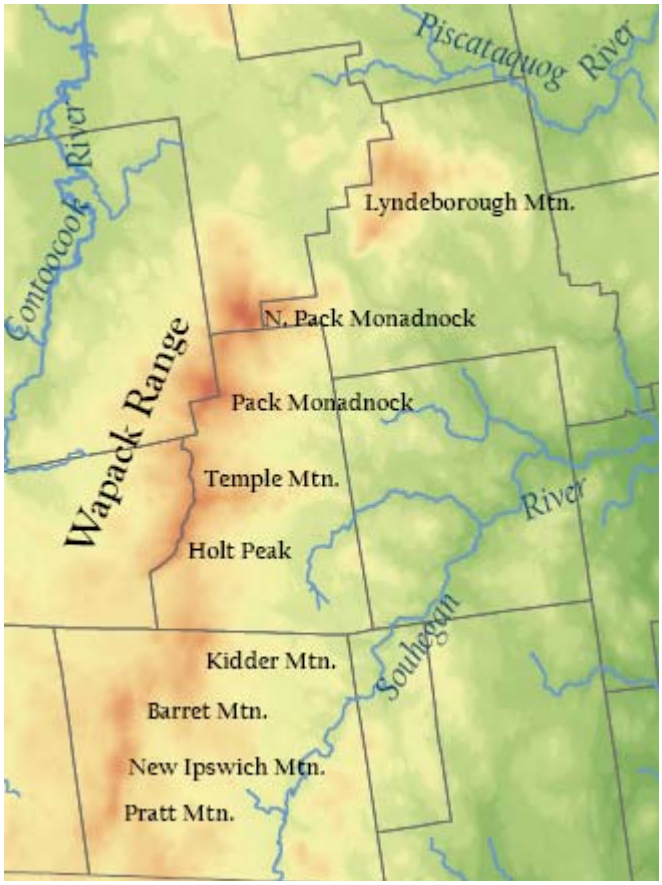
The Native people settled in the broad, low river valleys, and traveled to the high country in search of game, medicinal plants, and spiritual experiences. One must ask, when sitting on the cliffs of Winn Mountain, overlooking the Souhegan valley and the long, low plains that stretch to the sea, *how many have come before me, to this mountain top, to squint at a ridge in the distant summer haze, to watch ravens tumble over currants of rising heat, and to rest at ease in this lucid moment?*

In Lyndeborough, wolves, cougar, lynx, bobcat, moose, and bear may have owned the hills, and they roamed them knowing no limits of roads or spaces where wooden homes had stolen the earth from beneath their paws. The wilderness of New Hampshire then, though feared as a dark place of evil haunts by the settlers at the coast, was ripe with great timber, open land with no border to the limit of extent, and soils that seemed rich with the hope of supporting farms. We will never know exactly what Lyndeborough was like in 1736, when the first road was carved into the land to the new town center at Putnam Hill. The next 100 years set about the most devastating era of forest loss the world has seen. Entire mountain sides were felled in great chopping sprees enjoyed with party-like atmosphere; stands of virgin timber were felled into piles and burnt just to clear room for homesteads and fields. Whole forests were laid to waste in the hope that the soils would prop up a wealthy new society. By the 1830's, the dream had been abandoned as more fertile lands opened up in Ohio and places west. The forest began to return, but in a far different form. Roads had been established, the rail had carved a bench along the deep gorge of Stony Brook, fields had leveled areas of hillside, stone walls had cleared the forest floor of much of its unevenness, and the soil had been pillaged of its hard-won nutrition that had established in the 15,000 years since the retreat of the glaciers. The 200 foot tall kings pines, ancient groves of fire-scarred oak, and luxuriant "open, green, grassy meadows…like oases of beauty in the dense forests" (Cochran, 1895) had all been destroyed. The path to recovery for

our forests, wetlands, and meadows will be long, and will probably never fully occur because of pollution, frequent logging, climate change, habitat loss, and fragmentation. The trees have grown back, but surely without the vigor and stature of those that grew on the ancient soils now long washed away by "sudden and violent freshets; the cutting away of the forests; the drying of the streams in summer" (Woodward, 1906).

A Geography of Resilience: The Lay of the Land

As the drama of settlement, farm abandonment, and now suburbanization has unfolded, the physical land has remained much the same. Except for several large gravel pits, some attempts at mining silver, and the damming of streams, the hills and valleys remain mostly unchanged as they have for millennia.



Mountains

Lyndeborough is split by the graceful, arching spine of Lyndeborough Mountain, the northern terminus of the Wapack Range, separated from the ranges second-highest peak, North Pack Monadnock (2,276'), by the valley of Stony Brook. Lyndeborough Mountain is not often considered part of the Wapack as we know it today; the name Wapack grew from the trail that runs from Mt. Watatic in Ashburnham, Massachusetts to North Pack in Greenfield. Historically, however, it has been considered as part of the Pack Monadnock range (Woodward, 1905). Furthermore, Lyndeboroughs hills have until recent times been considered part of the Monadnock Region. Lyndeborough is currently more often considered part of the Nashua Region, but from a landscape perspective is much more strongly associated with the mountainous terrain to the west. These mountains serve as an influential cultural and environmental division that is understood by many who live in and around them.

Lyndeborough Mountain is collectively formed by the individual summits of Winn Mountain (1,676'), Rose Mountain (1,725'), The Pinnacle (1,686'), and Piscataquog Mountain (1,282') which curve in a unique arch formed by an erosion-resistant uplifted geologic base that resisted the grinding action of glaciers during the last ice age. Piscataquog Mountain is the whole eastern arm of this arch, and consists of several distinct summits. Throughout this report, when I reference Piscataquog Mountain I am referencing the easternmost summit (1,155') and its slopes because that is where I did substantial field work, and it is this point that I, and others, grew up calling Piscataquog Mountain. It would be a worthwhile effort to convene a citizen's coalition to name all of the distinct summits in order to more fairly describe the area.

The northeast ridge of North Pack Monadnock (2,276') is the highest point in Lyndeborough; 1,820' at the town border with Greenfield. The lowest point is at Purgatory Brook where it crosses the Milford town line (261'). Several small hills sit in the cup formed by this arch, including Stimson Hill (1,000') which is the high point of a mostly undeveloped tract of wild forest and wetland; and Putnam Hill (883') which is where the original town center is located along Center Road. Others hills dot the landscape which may or may not have names. The average elevation of the entire town is around 800'.

Streams

Four major streams drain these mountains. Flowing southeast into the Souhegan River, from west to east, are Stony, Furnace, and Curtis Brooks. Stony Brook is distinct in its deep gorge alongside State Route 31. Furnace Brook is distinct in its high density of unfragmented marsh, shrub, and forested wetlands and ponds along its course. Curtis Brook is variable along its course, including areas of large unbroken wetlands, and steep, deep valleys. Cold Brook drains a major portion of the northern flank of the mountains, along with the lesser streams French and Schoolhouse Brooks. These brooks are distinct from the brooks of the southern flank in that they flow through much larger tracts of unbroken forest, have generally steeper gradients, and tend to have clearer, colder water. Purgatory Brook receives the flow of Curtis Brook and forms much of the southeastern border of the town as it courses through a deep ravine broken by stretches of marsh and pond. Many small seasonal streams drain the dozens of steep drainages that descend from the ridges and hilltops.

Ponds

Lyndeborough has never been a place of swimming lakes, a fact lamented in the 2001 *Community Profile.* Three major ponds occur in Lyndeborough. Burton Pond (~37 acres) was formed by a 160 foot long earthen dam built in 1846 and drains south into Wilton. Badger Pond (~9 acres) is a part of an extensive wetlands system along Curtis Brook. Putnam Pond (~21 acres) was formed when the Lucas Flats section of Furnace Brook below the Pinnacle Mountain Fish & Game Club was impounded by a flood control dam built in 1977. Other significant ponds include a ~16 acre beaver pond along Center Road just north of State Route 31 (Forest Road), a ~17 acre beaver pond north of Winn Road, and Swartz Pond (~9 acres) which was formed by a 300 foot long earthen dam built in 1930 and is part of the upper reaches of Furnace Brook. These are all shallow ponds between 3-6 feet in depth, with gravelly to mucky bottoms.

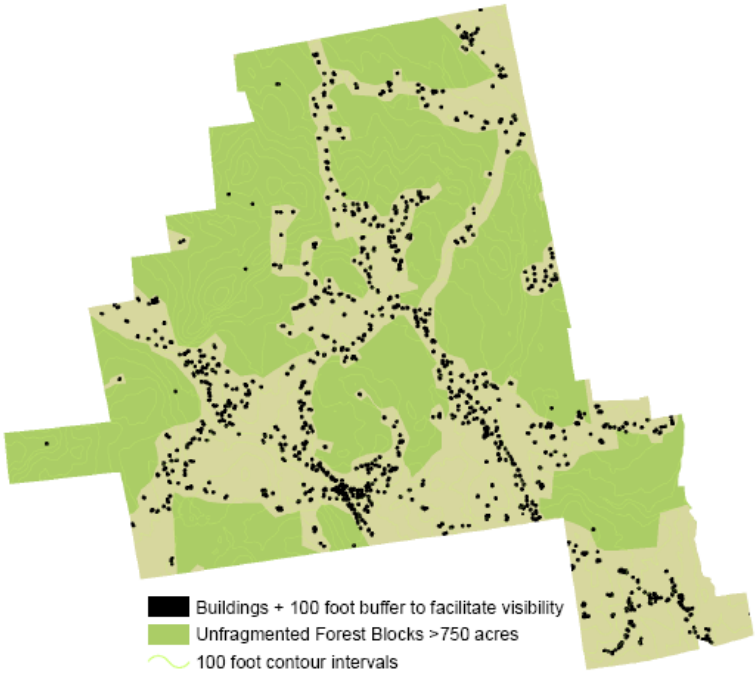
BASE MAP INTERPRETATION

The BASE MAP shows major cultural and natural features that are important to understand as you read and use this report. Almost all foldout maps use a 1 mile buffer around Lyndeborough to show neighboring natural resources and infrastructure elements that are important to the wise use, stewardship, and planning for Lyndeborough's natural resource assets.

Where a buffer is not used an explanation is provided. All public and selected private roads are labeled to reflect the currently used names. Names are not provided on subsequent maps in order to reduce clutter. Tax parcels are shown and are accurate as of 2008 when the data was made available. They are not shown on every map but are in the GIS so they can be overlaid on any data layer.

To the out-of-town traveler and perhaps some of Lyndeboroughs residents, the center of town is at South Lyndeborough. In terms of commerce and communication, this is true. The Village Store, the Congregational Church, the Post Office, Citizens Hall, and the town's highest density housing are located here. The original town center is at the junction of Center and New Roads atop Putnam Hill. Housing is relatively low density here. Other areas of high-density housing are along the Rt. 31 corridor at South Lyndeborough and at Temple Road, Center Road, the Johnsons Corner area, and Mountain Road south of its high point at the shoulder of The Pinnacle. Keep in mind that the buildings layer does not differentiate between residential and agriculture or utility structures.

GENERALIZED POPULATION DISTRIBUTION BY BUILDING DENSITY



Topics Addressed In This Chapter:

- Formation of the New England region of pre-historic North America
- The foundations of New Hampshire's distinct mountainous landscape
- The composition and organization of Lyndeborough's rocks
- The process of glaciation
- Surficial features of glacial origin
- Soil maps and agricultural soils analysis

INTRODUCTION

The physical foundation for the ecological and cultural landscape of Lyndeborough is the underlying rocks and their history. All aspects of the regions geology have contributed to the landscape structure and composition as we know it, as well as having affects on land-use both historically and in the modern era. This chapter provides a simplified review of the complicated geologic history of Lyndeborough through an introduction to the processes and events that formed the landscape over the last half-billion years. Bedrock features in Lyndeborough give one the opportunity to study the deeply eroded core of a mountain range that formed about 400 million years ago, and was at least one mile higher than the land we see today. Surficial features allow us to peer into the age of glaciers, before ice polished smooth the rock slabs of the hilltops and redistributed boulders and sand over the land.

The science and findings within the field of geology are much disputed. New ideas are periodically being proposed and old ideas discarded or changed as new techniques refine our ability to detect patterns and analyze minerals, physical structure, and processes. The difficulty in understanding the causes and effects of phenomena that occurred prior to any form of terrestrial life should not be understated. What can be grasped, however, are the ways in which the physical form of the Earth has affected human settlement, resource use and allocation, biological patterns, and hydrologic function. This chapter serves as the primary foundation to build a greater understanding of Lyndeborough, both as a living landscape and as the place you

call home. This Natural Resources Inventory would be incomplete without such a detailed discussion of geology. In fact, the depth of this discussion probably exceeds that found in other reports of this nature.

The "Geology of New Hampshire" series, published in three volumes by the Department of Resources and Economic Development between 1951 and 1977, were instrumental in writing this chapter (see Billings, 1956; Goldthwait *et al.*, 1951; and Meyers & Stewart, 1977). These, as well as Raymo & Raymo (2001), so influenced this chapter that instead of citing the respective source of general geologic information, here I direct the reader to these works for more information. This will keep this text relatively uncluttered. Several other important sources are cited however, as the information gleaned from them is more specific.

THE BUILDING OF NEW ENGLAND

What we now know to be the northeastern United States is in fact the aggregate result of four distinct periods of mountain building, or orogenies, spanning a half-billion year period. As continental tectonic plates repeatedly shifted position over the Earth, collisions occurred between these proto-continents. Each orogeny was forced by the collision of the proto-continents of Europe, Africa, and South America against the ancestral North American continent called Laurentia. These extended periods of collision and upheaval crushed, pressurized, baked, and rearranged the sediments and bedrocks into new rock types: the process of metamorphism. Tremendous mountain ranges rose along these contact zones, laying the foundations for New England's unique mountainous topography. The massive, multi-millennial periods of collision were followed by periods of rifting and separation when Oceans formed between the continents and erosional forces wore away the newly formed mountains. These eras of erosion provided the sediments for the sandstones, shales, and mudstones of Vermont and New York, and the schists and conglomerates of New Hampshire and Maine. The meta-sedimentary rocks of most of New Hampshire were shed from mountains to the west, except for the Littleton Formation rocks which were likely formed from sediments that came from the east (Dorais, 2003).

Three main periods of mountain building are responsible for 'creating' New England:

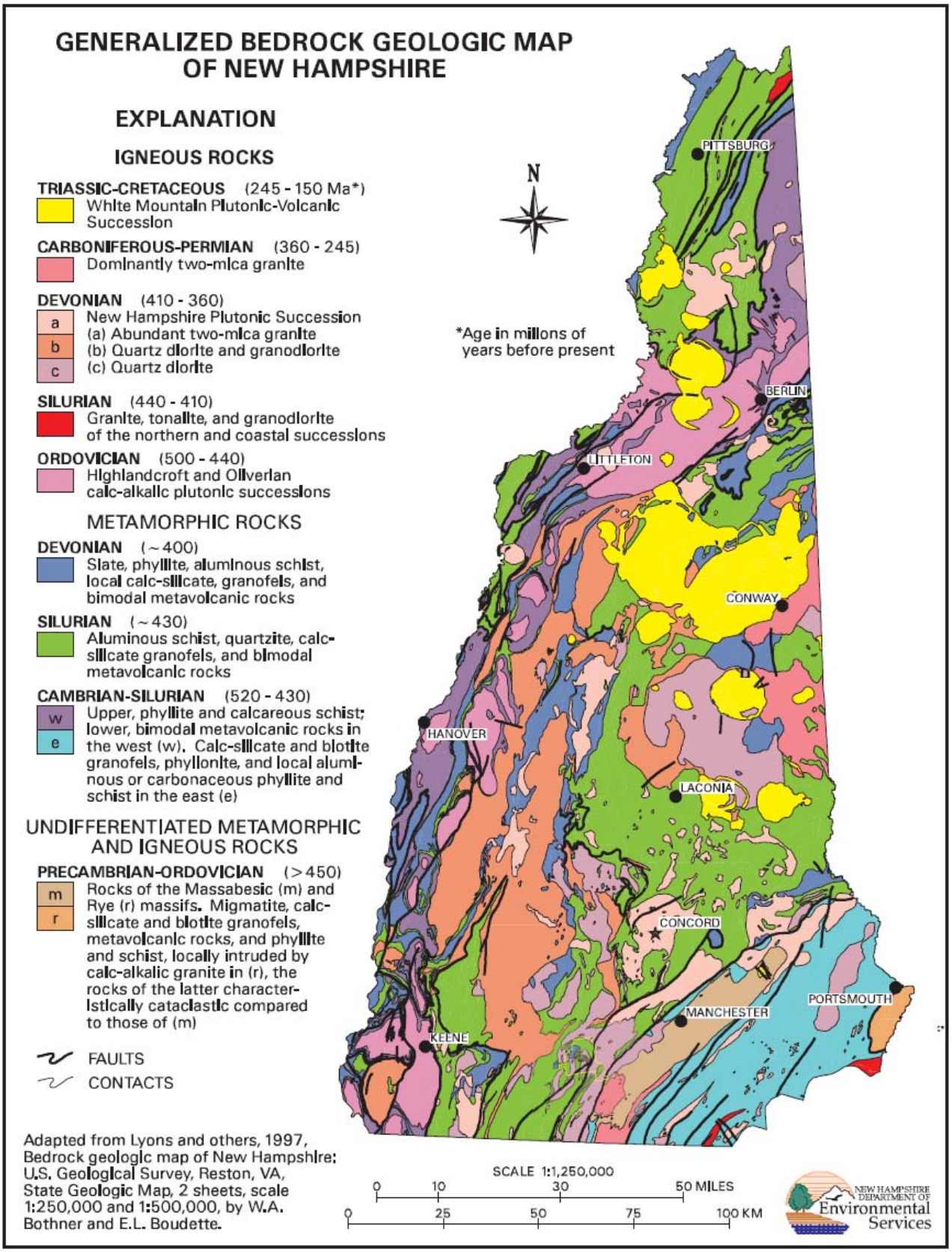
1) the *Taconic Orogeny*, wherein the basis of what is now much of western Massachusetts and Vermont's Taconic and Green Mountains was formed: ~ 500 million years ago (mya);

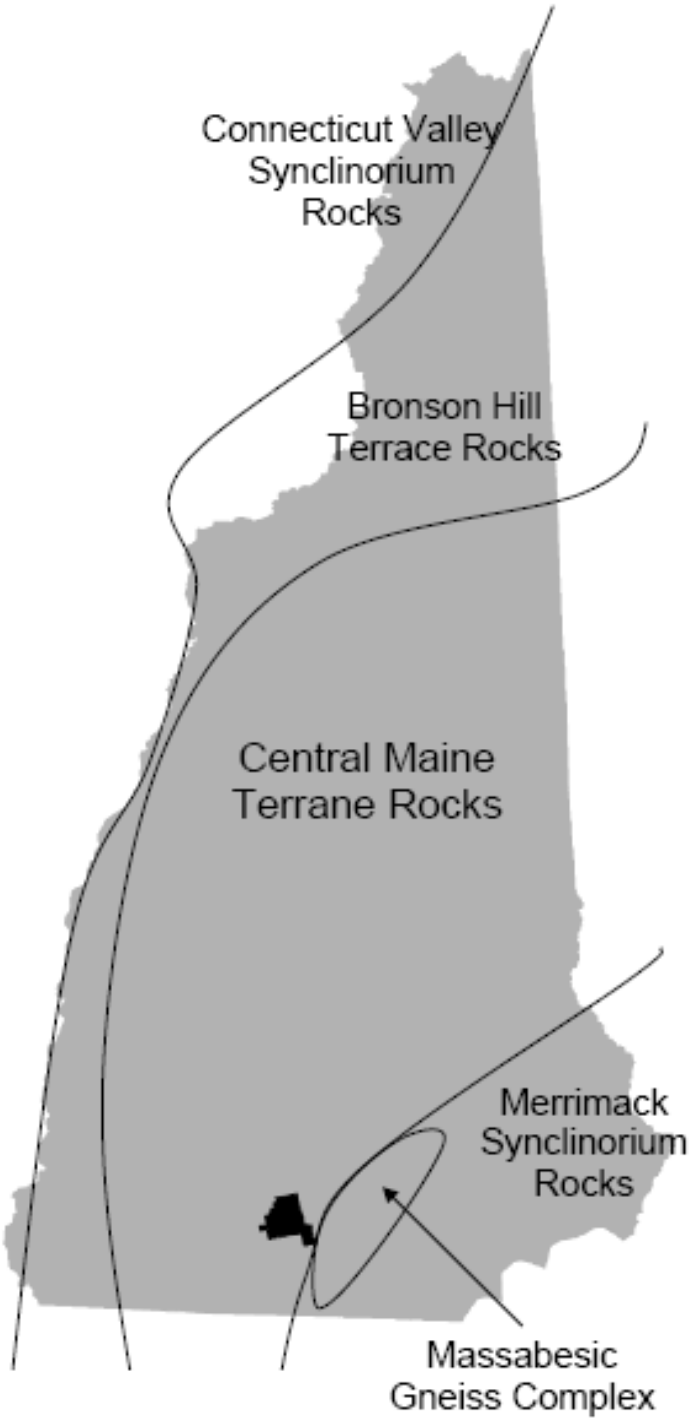
2) the *Acadian Orogeny*, wherein most of New Hampshire and Maine were formed: ~ 400 mya;

3) the *Alleghenian Orogeny*, wherein areas mostly south of New Hampshire were formed: ~300 mya.

Each of these collisions cemented additional rock groups called terranes to the growing eastern margin of Laurentia, which would be subjected to enhanced mountain-building when the next collision would occur. During each period of rifting, parts of the exotic terranes remained adhered to Laurentia, thus building New England in subsequent events. The rocks that comprised the terranes represented the rocks of their parent continents, but they were greatly affected by metamorphism, erosion, and intrusion of igneous granites and volcanoes such that they no longer resemble their former character. The Generalized Bedrock Geologic Map of New Hampshire (page 28; N.H. Department of Environmental Services, 1997) is the result of decades of mapping bedrock exposures, interpreting drilling and mining results, and tracing landforms and faults. Lyndeborough is outlined in light yellow, showing its position on a complex swirl of metamorphic and igneous rock groups and significant faults. The geology, and in turn the ecological landscape, to the east and south is wholly different, whereas Lyndeborough is quite similar to areas west.

New Hampshire is primarily composed of Acadian origin rocks in four bands, or lithotectonic zones. The map on page 29 shows these four zones. From west to east are the Connecticut Valley Synclinorium, Bronson Hill Terrace, Central Maine Terrane, and Merrimack Synclinorium rock groups (based on Dorais *et al*., 2001). Each zone is unique in terms of its rock types & ages, metamorphic history, mineral composition, and intrusive igneous members; therefore each zone is unique in its landforms, mountains, valleys, hydrology and ecology. Think about that as you look at the zones; Southeastern New Hampshire is quite different from the bulk of the state where Lyndeborough is located; the Connecticut River Valley is indeed unique; and the North Country of Pittsburg is a geographic region all its own. Lyndeborough sits entirely within, but right on the edge of the Central Maine Terrane rocks, which comprises much of New Hampshire and Maine's jumbled mountainous terrain. Characteristics common to the Central Maine Terrane are variably metamorphosed sedimentary rocks with many complex folds, periodically intruded by igneous rocks. The meta-sediments that formed the Monadnock Region were extensively deformed by at least three phases of folding, ultimately resulting in tight folds with a northeastern trending axis, the dominant structural grain of the regions geology.


GENERALIZED BEDROCK GEOLOGIC MAP OF NEW HAMPSHIRE
EXPLANATION
IGNEOUS ROCKS
TRIASSIC-CRETACEOUS (245 - 150 Ma*)
White Mountain Plutonic-Volcanic Succession
CARBONIFEROUS-PERMIAN (360 - 245)
Dominantly two-mica granite
DEVONIAN (410 - 360)
a
b
c
New Hampshire Plutonic Succession
(a) Abundant two-mica granite
(b) Quartz diorite and granodiorite
(c) Quartz diorite
SILURIAN (440 - 410)
Granite, tonalite, and granodiorite of the northern and coastal successions
ORDOVICIAN (500 - 440)
Highlandcroft and Ollverian calc-alkalic plutonic successions
METAMORPHIC ROCKS
DEVONIAN (~400)
Slate, phyllite, aluminous schist, local calc-silicate, granofels, and bimodal metavolcanic rocks
SILURIAN (~430)
Aluminous schist, quartzite, calc-silicate granofels, and bimodal metavolcanic rocks
CAMBRIAN-SILURIAN (520 - 430)
w
e
Upper, phyllite and calcareous schist; lower, bimodal metavolcanic rocks in the west (w). Calc-silicate and biotite granofels, phyllonite, and local aluminous or carbonaceous phyllite and schist in the east (e)
UNDIFFERENTIATED METAMORPHIC AND IGNEOUS ROCKS
PRECAMBRIAN-ORDOVICIAN (>450)
m
r
Rocks of the Massabesic (m) and Rye (r) massifs. Migmatite, calc-silicate and biotite granofels, metavolcanic rocks, and phyllite and schist, locally intruded by calc-alkalic granite in (r), the rocks of the latter characteristically cataclastic compared to those of (m)
FAULTS
CONTACTS
Adapted from Lyons and others, 1997, Bedrock geologic map of New Hampshire: U.S. Geological Survey, Reston, VA, State Geologic Map, 2 sheets, scale 1:250,000 and 1:500,000, by W.A. Bothner and E.L. Boudette.
N
*Age in millions of years before present
PITTSBURG
BERLIN
LITTLETON
CONWAY
HANOVER
LACONIA
CONCORD
PORTSMOUTH
MANCHESTER
KEENE
SCALE 1:1,250,000
0 10 30 50 MILES
0 25 50 75 100 KM
NEW HAMPSHIRE DEPARTMENT OF Environmental Services

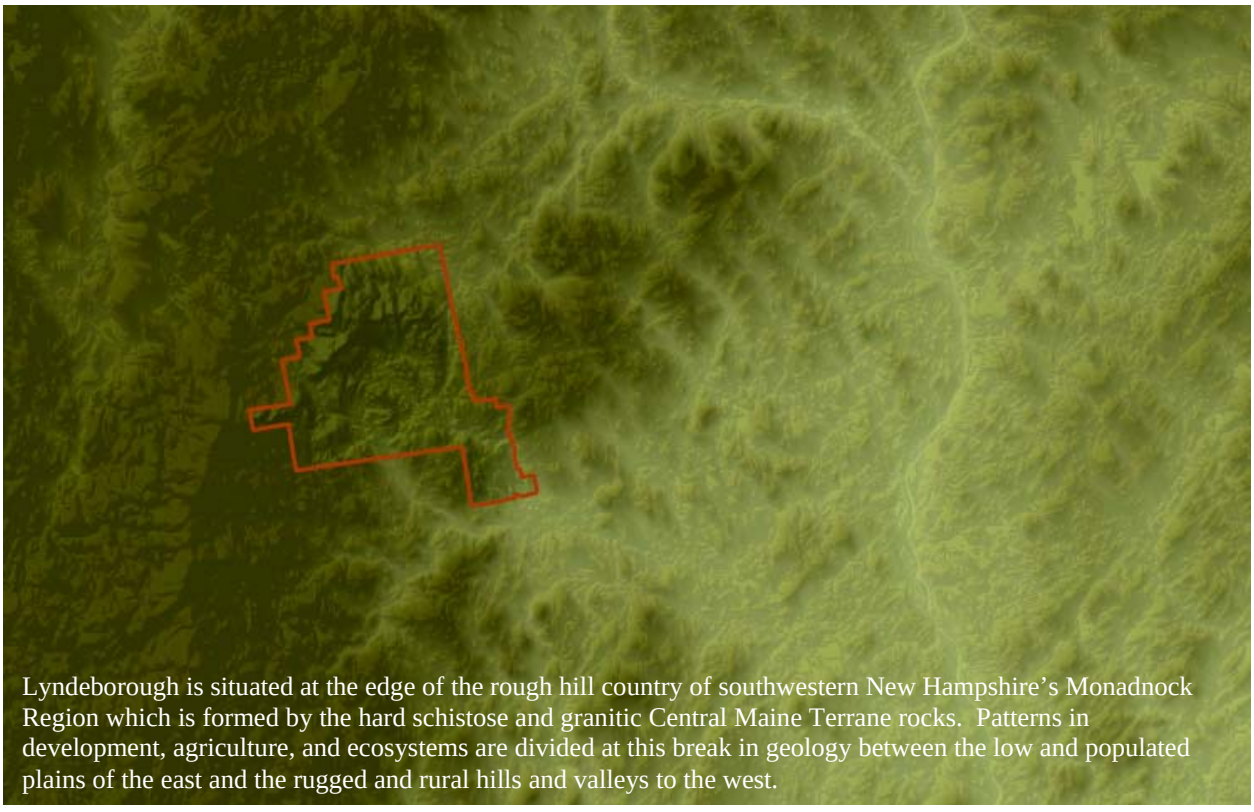


Lithotectonic Zones of New Hampshire

Generalized geologic map based on Dorais *et al.*, 2001 after Zartman, 1988

These rocks belong to the upper sillimanite metamorphic zone, marked by the absence of staurolite and comprised chiefly by a sillimanite-muscovite-biotite-quartz-garnet-plagioclase mineral structure (Chamberlain & Lyons, 1983).

Bedrock in Lyndeborough shares many similarities with distant areas such as New Hampshire's Presidential Range and Maine's Katahdin Area. Additionally, the higher terrain of Rose Mountain, Winn Mountain, and The Pinnacle are the same very resistant rock type as Mount Monadnock, *The Littleton Formation*. The map below provides a shaded relief perspective of how Lyndeborough is situated at this upland edge with lower and less dramatic features to the south and east. Southeastern New Hampshire, beginning immediately east of Lyndeborough is comprised of rocks from the Merrimack group, which in places is actually an entirely different terrane that is responsible for building much of eastern North America, from Massachusetts south. The difference in underlying geology can easily be seen across the landscape when one compares the relatively flat and low-lying areas east of Lyndeborough to the higher and hillier terrain to the west. Furthermore, this geologic basement has profound effects on regional ecological patterns and plant community structure; this will be discussed in the next chapter.



Lyndeborough is situated at the edge of the rough hill country of southwestern New Hampshire's Monadnock Region which is formed by the hard schistose and granitic Central Maine Terrane rocks. Patterns in development, agriculture, and ecosystems are divided at this break in geology between the low and populated plains of the east and the rugged and rural hills and valleys to the west.

Lyndeborough shares strong enough geologic resemblance to the area west of it that it truly should be considered part of the Monadnock Region. The hills and mountains of the Monadnock Region are indeed distinctive; schist, gneiss, and granite ridges and ravines; domed, balded summits worn smooth by glaciation; and boulder strewn woods and talus fields. This jumbled landscape where streams flow in every direction, and the adage *"you can't get there from here"* is the result of metamorphosis of the Acadian Orogeny ~400 million years ago and the intrusions of igneous rocks in following periods.

LYNDEBOROUGHS ROCKS

Analyzing the geology of the whole region or of the entire Central Maine Trough is well beyond the scope of this NRI, but it is worthwhile to take a close look at Lyndeboroughs specific rocks and their history. The GEOLOGY map shows the bedrock geology of the area as mapped by state geologists and researchers. In the field, many of these rocks look very similar. It takes a trained eye with knowledge of mineral identification, structure, and interpretation of metamorphosis to identify a specific type. The rocks shown on the map are described below, in order of their dominance on the landscape. For each, I provide information on the rocks distribution in the region and state, where it is found in Lyndeborough, where it can be seen in bedrock exposures, a description of the mineralogy, structure, and character, and its age.
Also shown are the two major faults that break the southeastern portion of Lyndeborough from the western portion, the Spofford Gap and Pinnacle Faults. Areas of till, alluvium, outwash, and drumlins are shown as well. Additional jointing and fracturing is not shown since it has not been mapped by geologists. The southeast face of Winn Mountain is a very broken series of ledges and talus fields and may be a significant fracture/joint zone. This would be a worthwhile area to investigate for potential minor fault activity which could affect the types of development that are suitable for that area.

LYNDEBOROUGHS ROCKS

Spaulding Tonalite (*Spaulding Quartz Diorite*) ~48% of Lyndeborough (~9500 acres)

A member of the New Hampshire Plutonic Suite. These intrusive igneous rocks were injected into the Central Maine meta-sediments during the waning stages of the Acadian Orogeny
It is a sheet-like pluton no more than 2.5km thick (Chamberlain & Lyons, 1983).

LOCATION: Widespread throughout Lyndeborough at low to mid elevations, generally below 1000ft. Much of the town underlain by this rock is low to mid slopes, with few areas exceeding 20%. Most of the lowest lying areas of glacial outwash both within and outside Lyndeborough sit atop this layer. Similarly, most of the ponds in Lyndeborough sit atop this layer. Exposures are uncommon except in ravines such as below Purgatory Falls, Furnace Brook along Cider Mill Road, and Stony Brook below Old Temple Road West. The New Hampshire Plutonic Series rocks (Bethlehem Granodiorite, Kinsman Granodiorite, Spaulding Tonalite, and Concord Granite) are widespread throughout the central and southwestern parts of the state and are only rare in Coos County.

DESCRIPTION: The New Hampshire Series rocks are generally gray in color, with biotite being a principal dark mineral. Light colored quartz is also dominant, and pegmatites are usually white. The Spaulding Tonalite, which is named for its type location at Spaulding Hill, 3 miles east of Marlborough is the common granitic rock of the Monadnock Region. Eleven bodies of it are found northwest, south, and east of Mount Monadnock. It is a weakly to non-foliated massive structure. Much of the agricultural land in Lyndeborough is found on this rock.

AGE: Early Devonian. ~390 mya.

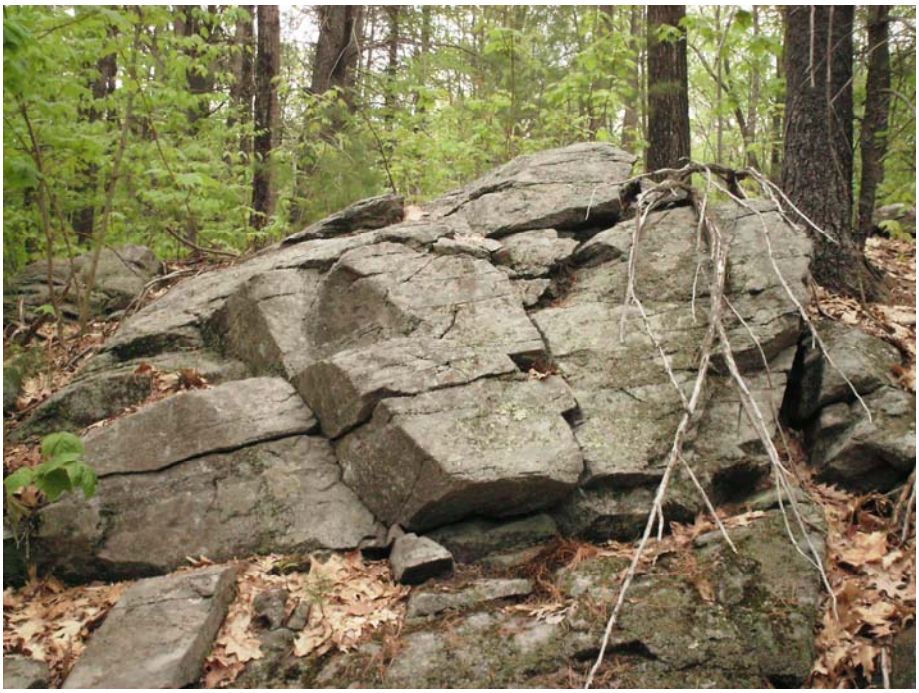
Perry Mountain Formation ~27% of Lyndeborough (~5300 acres)

A widespread metasediment of the Central Maine Terrane.

LOCATION: This rock is widespread in all but southeastern Lyndeborough. It is generally found at slightly higher locations than the Spaulding Tonalite. The three principal locations are the east-west trending ridge between Mountain and New Roads, and the eastern ridge of North Pack Monadnock, and a mostly mid elevation area of central Lyndeborough where it is intermixed with the Spaulding Tonalite.

DESCRIPTION: The Perry Mountain Formation consists mainly of sandstones rich in quartz, resulting from the end stages of the erosion of the Taconic Mountains. Beds with sharp sandy bases grade up into shales that were deposited in a distal marine environment. Sharply interbedded quartzites, light gray nongraphitic meta-pelites, and meta-turbidites. The graded beds likely resulted from deposition by slurries of sediment moving downslope due to gravity in deep water. The metamorphic minerals biotite and staurolite are common (Moench, 1971). Interestingly, the majority of rare Black Gum swamps in Lyndeborough occur on this rock.

AGE: Middle to Lower Silurian



Rangeley Formation ~16% of Lyndeborough (~2000 acres)

A widespread meta-sediment of the Central Maine Terrane; divided into three units in our area.

LOCATION: The Rangeley Formation is separated into three units on the geologic map. A wide band of the formation stretches southwest-northeast in the vicinity of Curtis and Purgatory Brooks. The Upper Unit is found in thin bands in southern Lyndeborough and an arching band on the north and east slopes of Lyndeborough Mountain in the Cold Brook watershed. The bulk of Piscataquog Mountain consists of this upper unit. The steep escarpment on the east face of this mountain is a good location to view exposures of this rock. Ledges along Cold Brook, such as Senters Falls, also provide good exposures. The Lower Unit is shown on the map at one very small location in Wilton off Route 31; because it is of little concern to this report I will not describe it in detail.

DESCRIPTION: The Rangeley Formation is a rusty weathering metamorphosed sandstone, shale, and conglomerate with a coarse grain. The meta-sandstones and meta-conglomerates are interpreted to have been deposited in a proximal marine setting (Moench, 1971). Calc-silicate pods are common which could have localized affects on soil chemistry and ecology such as areas of soil enrichment. This could be an important determinant in the abundance of prime soils, enriched forests, and sugar maple stands along Mountain Road and elsewhere in North Lyndeborough.

AGE: Lower Silurian

Littleton Formation ~8% of Lyndeborough (~1500 acres)

LOCATION: Littleton Formation rocks are found at higher elevations, generally above 1000ft. Winn & Rose Mountains and The Pinnacle in Lyndeborough, and the summit of North Pack Monadnock in Greenfield feature extensive exposures of this rock. Open slabs and fractured ledges are common at these sites. Mounts Monadnock and Washington are both comprised of Littleton Formation rocks. In the Monadnock Region the formation is around 16,000 feet thick.

DESCRIPTION: A very hard, resistant meta-sedimentary bedrock layer, widespread in New Hampshire, extending north-northeast from Massachusetts to Maine. It is a complex formation composed of clay sediments, volcanics, quartzites, and impure dolomites, and variably metamorphosed from the chlorite to the sillimanite zones. In this region, the formation is in the sillimanite zone; composed of chiefly shale and argillaceous sandstone sediments. Gray mica schists are the most commonly observed rock forms. The commonest minerals are quartz, muscovite, and biotite, with garnet, sillimanite, staurolite, and andalusite. Rocks can vary from schistose to massive, and interbedding of differing concentrations of quartz is common. Lime-silicate rocks of dolomite origin have been mapped in some areas of the Monadnock region, but not in Lyndeborough. Detailed inspection of the Littleton Formation at Pawtuckaway State Park found that it consists originally of sandstone, shaly sandstone, and shale that were metamorphosed to quartzite, mica-schist, mica-garnet schist, mica-staurolite schist, and mica-sillimanite schist (Freedman, 1950). Though a similar inspection of Lyndeborough has not been done by a state geologist, my observations suggest that this rock, where it surfaces at higher elevations, is characteristic of this formation.

AGE: Lower Devonian. Approximately 400 mya. This formation has been dated by uncommon occurrences of fossils. Most fossil beds in these ancient sea floor sediments were destroyed during metamorphosis but good sites remain on Mount Moosilauke and near the town of Littleton, New Hampshire where the rock was first identified and thus named (Boucet, 1980).

LITTLETON FORMATION ROCKS

Smalls Falls Formation ~1.5% of Lyndeborough (~300 acres)

Locally mapped as Francestown Formation of Nielson (1981) in southern New Hampshire

LOCATION: Very limited distribution at high elevations in Lyndeborough. Found only in thin layers underlying the Littleton Formation and above the Perry Mountain Formation. Exposures can be observed at a series of beautiful cascades along Duncklee Brooks' steep descent off of Lyndeborough Mountain near the Greenfield border, and steep ledges that can be found on the south side of French Road. The waterfalls of Duncklee Brook owe their existence to this very hard rock.

DESCRIPTION: This is primarily a rusty weathering black schist with thin layers of light brown quartzite. The schist contains abundant pyrrhotite (an iron sulfide mineral), along with lesser amounts of other sulfide minerals, that result in the distinctive rusty weathering. Graphite (carbon) is abundant in this rock as well and gives it the dark black color on fresh surfaces. Guidotti and Van Baalen (2001) chemically analyzed some samples of the Smalls Falls Formation in Maine and found concentrations of metals such as lead, zinc, chromium, vanadium, nickel, arsenic, and others. An environmental consequence of the abundance of metallic sulfide minerals is that ground water in this formation can be highly acidic and contain toxic metals. The limited distribution and high landscape position suggests that this may not be a widespread concern for Lyndeboroughs water supply, but may affect soil chemistry & ecology at specific sites or specific water wells at Mountain Road homes.

AGE: Upper to Middle Silurian. ~430 mya.

Massabesic Gneiss Complex <1% of Lyndeborough (~20 acres)

Most likely a member of the Avalon Terrane, completely unrelated to rocks of the Central Maine Terrane.

LOCATION: Found only in the farthest southeastern corner of Lyndeborough in the vicinity of Fitch's Corner.

DESCRIPTION: Pink, foliated biotite granite very closely intruding gneiss and granulose meta-sedimentary and meta-volcanic rocks.

AGE: Pre-Cambrian to Ordovician

Gray Biotite Granite *None in Lyndeborough*

LOCATION: None in Lyndeborough; shown on the map in Milford. Found in small bodies throughout southeastern New Hampshire.

DESCRIPTION: Most of the granites in southeastern New Hampshire are similar in that they are light-gray to white, medium-grained binary granite and quartz-monzonite. They may be foliated, but bodies around Milford tend to be massive in structure. This is the granite that has been quarried extensively in the Milford area.

AGE: Permian; Pennsylvanian or Mississippian. The massive granites may be older than those well-foliated.

GLACIATION & GLACIAL FEATURES

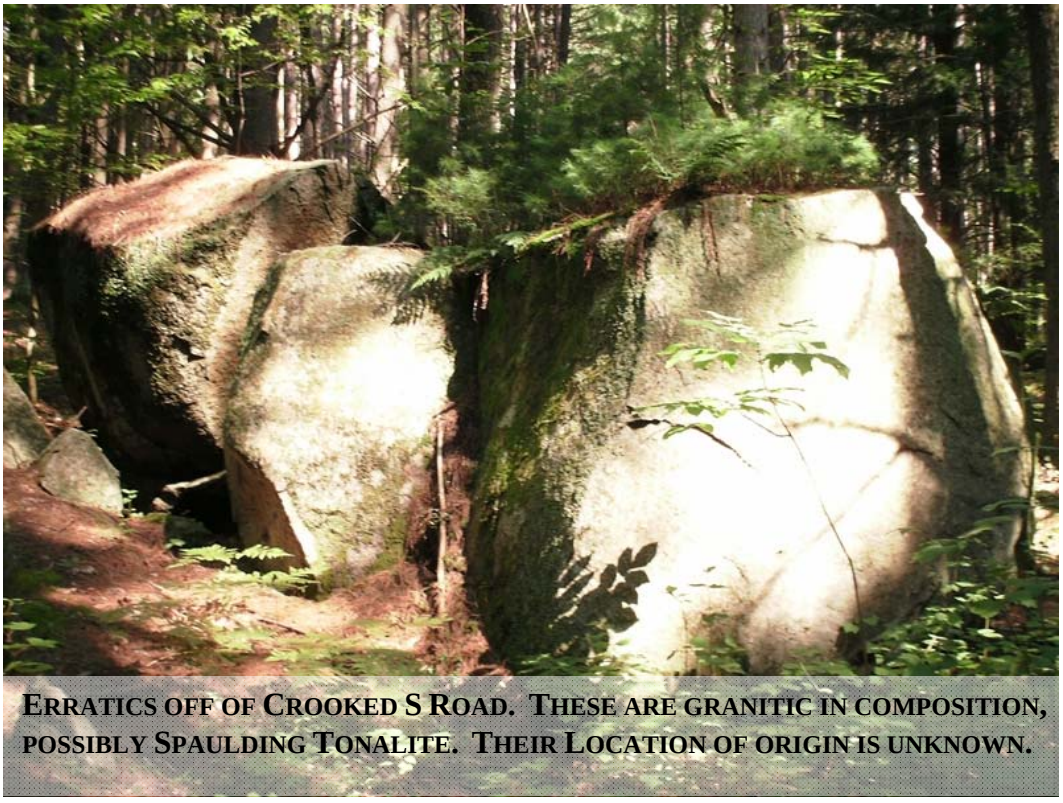
The past one million years have been a relatively cold period for Earth. Between one million and about fourteen thousand years ago numerous periods of glaciation occurred where massive sheets of ice crept south from the arctic region and consumed the North American and European continents. Most of the evidence of these is irretrievable because the most recent period, the *Wisconsin Glacial Stage*, destroyed previous evidence with its colossal reshaping of the Earths surface. The Wisconsin Glaciation lasted from about 100,000 to 14,000 years ago, and reached its peak in New England about 20,000 years ago just before it began to melt and recede into Canada; at this time the ice was one to two miles thick. This continental glacier reached as far south as New York. Long Island, Nantucket, Martha's Vineyard, Block Island, and Cape Cod are the remains of the massive pile of sand, gravel, and shattered rock that the edge of the glacier was pushing; this is the glaciers *terminal moraine.*

The pressure, friction, and scouring of the Wisconsin Glacial Era removed less rock than one might think; only about 20 feet of solid rock was scoured off of the surface, and most of this was rotten, weak, and exposed points. It was the previous periods, and especially the several hundred million years of erosion following the last great orogeny that really defined the landscape-scale topography of the region. The rock that was removed was generally moved five miles or less, and deposited in either till, talus, or erratics. Glacial *till* is composed of fragments of rock of all sizes that were moved by the glacier and smeared over the surface by the weight of the glacier. The GEOLOGY map shows till overlaying the bedrock as a grey stone-shaped pattern. Most of Lyndeborough is overlain by this till which averages in New Hampshire ~20 feet thick on hilltops, and ~14 feet thick on slopes and in valleys.

Talus is shattered fragments of rock torn from ledges and mountain tops and deposited directly below the cliffs and ledges. It was either moved during glaciation or has separated from the cliffs by freeze/thaw cycles over the last 14,000 years. Significant talus slopes are found on the southeast face of Winn Mountain and various patches of other steep southeast slopes below higher points. These areas support unique vegetational communities, provide abundant high quality wildlife habitat because of many denning areas, and may harbor relic old-growth forest communities because of the difficulty in harvesting timber from these areas. Also mapped with talus on the GEOLOGY map are rocky ridges and slabs. In Lyndeborough, slabs are generally

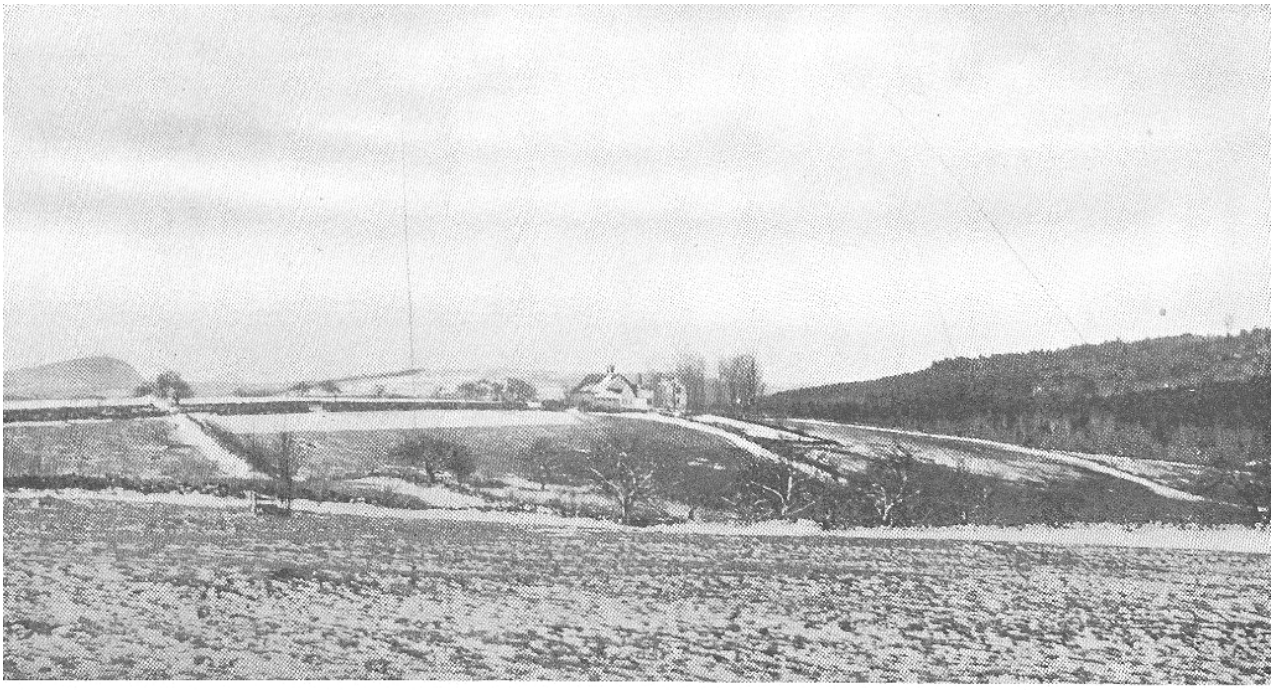
the exposed summits of the higher mountains where the glaciers impact was the greatest. Following the retreat of the glaciers, these areas were completely exposed polished surfaces. Since then soil development has been slow. Clearing, burning, and livestock grazing during the nineteenth century removed much of the little soil that had developed and reverted these summits towards their condition several thousand years ago. The thin soils, dry conditions, exposed windy environment, and history of heavy disturbance makes these areas similarly important as talus ecologically, but in entirely different ways. Their significance is discussed at length in the next chapter. Rocky ridges are areas of slab, talus, or exposed till that have developed more soil and tend to support open-canopy forests of oak or spruce.

Erratics are boulders, at times huge, that have been carried up to 30 or 40 miles from their parent hills by the glacier and then deposited on top of a till surface. New Hampshire is particularly noted for its immense and abundant Erratics since they often form from granites, which due to their massive structure can withstand the rolling and grinding action of the glacier. Relatively few Erratics occur in Lyndeborough compared to incredible concentrations in Hancock, Peterborough, and Harrisville that form 'trains' several miles long. Often, these solitary boulders are covered by foliose and crustose lichens, ferns, tree seedlings, and grasses.



ERRATICS OFF OF CROOKED S ROAD. THESE ARE GRANITIC IN COMPOSITION, POSSIBLY SPAULDING TONALITE. THEIR LOCATION OF ORIGIN IS UNKNOWN.

Also molded during the period of glacial action were *drumlins.* These are lenticular hills of loose till over low rounded bedrock domes oriented with the direction of ice flow which was south-southeast. They formed when the pressure under the glacier was relatively low as it was melting at its terminal edge. These moraine-like deposits were later shaped by slightly heavier and higher-pressure conditions into the smooth hills we see today. The weight of the ice could not be too great however, because the till would be scraped away. Drumlins reach a very high abundance in southern New Hampshire, and are nearly absent to the north. The GEOLOGY map shows Lyndeborough's drumlins in green dashed outlines. Important drumlins in Lyndeborough are those north of Lyndeborough Mountain where prime farm soils occur, and Putnam Hill where Lyndeborough Center was settled in 1736.



LENTICULAR HILLS AT NORTH LYNDEBOROUGH; WHITTEMORE HOMESTEAD.

The image above is borrowed from the 1906 History of Lyndeborough (Donovan & Woodward, 1906, p.104). The view is of the Whittemore Farm on Mountain Road in North Lyndeborough. In the distance on the left is Joe English Hill of New Boston, and the broad ridge where Mont Vernon's Lamson Farm is located. The long, low, lenticular shape of the drumlin is evident in this photograph. The photographer was located in the vicinity of the intersection of Mountain and Warner Roads. The forest has now grown back, but the stone walls and apple trees still exist, albeit in poor condition. The Whittemore home was moved 200 feet north and turned 90 degrees to the west by the late Mr. Lem Bolles between 2002 and 2004 with the assistance of this author and his father, Mr. Leo Trudeau, and others; at that time a new timber framed barn was erected.

The period of fairly rapid melting of the glaciers produced limited but unique features in Lyndeborough that are of particular importance as natural resources: *outwash, eskers,* and *meltwater channels & potholes. Outwash plains* are flat areas of sand and gravel where meltwater streams deposited sediments in deep and broad horizontal layers. These plains are most common in southeastern New Hampshire but occur in the Monadnock region as well. The Contoocook and Ashuelot River valleys have extensive outwash deposits. Few exist in Lyndeborough because it is generally a headwaters region where streams maintained high velocity through steep valleys. Outwash deposits in Lyndeborough include the vicinity of Putnam Pond, the vicinity of Old Temple Road West and Route 31, Route 31 at the Greenfield border, and fairly extensive areas in extreme northeastern Lyndeborough associated with the broad South Branch Piscataquog River valley. Outwash is an important resource for water supply purposes because it is associated with stratified drift aquifers. Only 8% of Lyndeborough is underlain by these aquifers, and only a few places the depth exceeds 10 feet. These aquifers in Lyndeborough are apparently incapable of yielding significant water supplies for more than residential uses (Master Plan, 2002).

Eskers are sinuous ridges of sand and gravel that were deposited by subglacial meltwater rivers. As rivers tunneled below the ice, they deposited sediments along their course in steep, sharp-crested ridges up to 100 feet high and many miles long. A significant esker sits at the base of the steep east face of Piscataquog Mountain. For years it has been actively mined for its high quality sand and gravel by a concrete company. The scarcity of these features makes them unique and thus a target for land conservation, but in this case conservation is unlikely given the industrial use of this esker.

Meltwater channels are deep gorges that are relatively straight in course, suggesting they were carved in a short period by a very high velocity stream. Stony Brooks deep gorge west of South Lyndeborough may be an example of this phenomenon as a post glacial meltwater torrent escaped Glacial Lake Contoocook to the west. In similar fashion, the nature of Purgatory Chasm suggests rapid downcutting by a high velocity stream. *Potholes* and waterfalls at Upper Purgatory Falls reinforce this hypothesis of rapid erosion in an extended flood-like scenario. Once carved into their respective gorges, streams naturally maintained these channels, although examples exist of meltwater channel abandonment as at Pulpit Rock in Bedford.

At Purgatory Falls, the stream drops 30 feet in a rapid down-cutting that created a beautiful polished groove for 50 feet above the waterfall. This feature was formed during torrential post-glacial periods of meltwater flooding. The severity of the erosion and bedrock sculpting does not typically occur with average flows; a major, prolonged flooding of high velocity, high turbidity, and high sediment discharge is required. Sediment-laden floods following a catastrophic release of a glacial lake may have played a role in the carving of these falls and the chasm below, as well the gorge through which Stony Brook flows upstream of South Lyndeborough. Purgatory Falls are permanently protected by the town of Lyndeborough. Recently acquired were the lower falls several miles downstream. The Purgatory Brook corridor is a conservation focus area for the town of Mont Vernon and several conservation groups. In this NRI, I have identified it as one of the five most important conservation priorities in Lyndeborough.

SOILS

Soils have been mapped by the USDA Natural Resource Conservation Service for eastern and western Hillsborough County. Lyndeborough is included in the western portion which comprises soil groups in the frigid temperature regime. Soils to the east, including the neighboring towns of Francestown, New Boston, Mont Vernon and Milford are classified in the mesic regime and thus are not correlative with those of Lyndeborough. Because of this the soils analysis for this NRI examines only the soils of Lyndeborough.

Field inventory did not account for soil influence on ecological, vegetative, or hydrologic systems, patterns, or processes. Soil pits were not dug nor examined to assess the accuracy of the NRCS mapping. Map units are only as accurate as the level of detail of the original mapping. Details can be found in the Hillsborough County West Soil Survey (Soil Conservation Service, 1985) and at the NRCS Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).

Twenty nine soil series are mapped for Lyndeborough. Three series are not soil types (*water, gravel pit, rock outcrop*) so there are really 26 series. These are further divided by eight slope categories (0-3%, 0-5%, 0-8%, 3-8%, 8-15%, 15-25%, 15-35%, and 15-50%) which results in 44 soil types for Lyndeborough. The SOILS foldout map shows each soil unit in Lyndeborough, its Unit Number, its full name, and its slope. Additionally, there is a chart which displays the abundance of the soil series. The major soil types of Lyndeborough are the Monadnock stony fine sandy loam (33% of town), the Lyman-Turnbridge rock outcrop complex (26% of town), and the Marlow stony loam (14% of town). Together these three series comprise 73% of Lyndeborough's soils. Mapped units correlate to the Hillsborough County West Soil Survey where soil series descriptions can be found. Also, the Soils GIS data contains abundant data on use limitations, farm uses, extractable resources, drainage and hydric classes, and more.

NRCS AGRICULTURAL SOIL DESCRIPTIONS & STATISTICS

The Lyndeborough Master Plan (2002) and the Community Profile (2001) discuss the importance of agriculture to Lyndeboroughs economy, quality of life, and identity. Preservation of farmlands is a critical aspect of conservation, especially as mass-produced foods and fibers have become less safe, more unsustainable, and more expensive to produce and distribute. The identification of farmable soils is an important part of an NRI. Agricultural soils and currently farmed areas are mapped here to aid in the identification and understanding of Lyndeborough's agricultural characteristics. Natural Resource Conservation Service soil descriptions for classified farm soils are listed below, followed by an analysis of agricultural soil area and utilization in Lyndeborough based of NRCS soil data and the 2001 Landcover Assessment:

Prime Farmland - These lands are best suited for producing food, feed, forage, and fiber or soil seed crops. Their soil quality, growing season, and moisture supply make them suitable for producing sustained high yields of crops economically when treated and managed according to modern farming methods. They can be farmed continuously without degrading the environment, and usually require little investment and energy for maintaining their productivity. These soils are rated among the best in the country for farming uses. The SCS has included the following soil types as constituting Prime Farmland: Groveton (27B); Madawaska (28B); Becket (56B); Marlow (76B); Peru (78B); Ondawa (101; Podunk (104); Monadnock (142B); and, Skerry (558B).

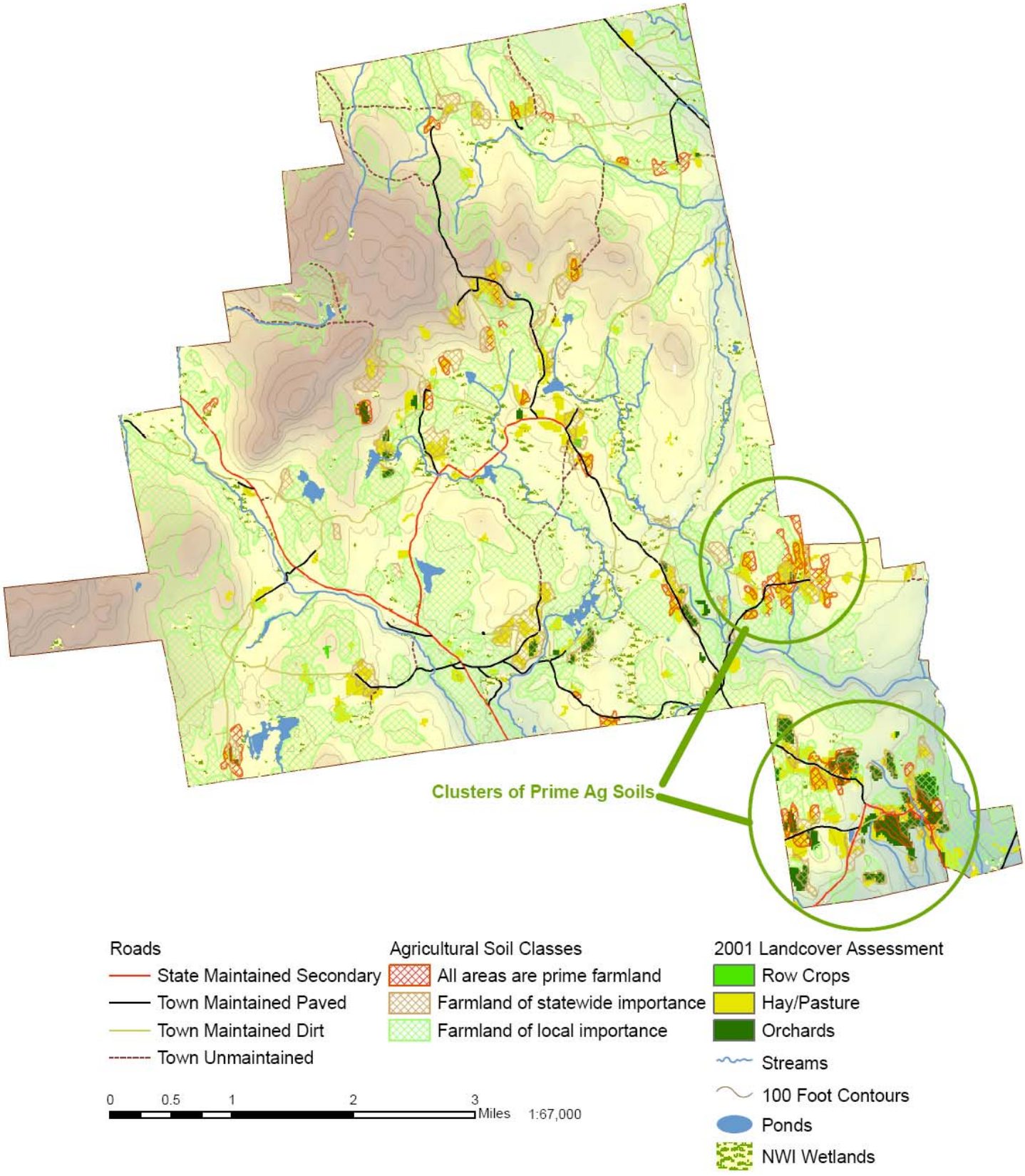
Farmlands of Statewide Importance - These lands are rated as being of Statewide importance for the production of food, feed, fiber, forage, and oilseed crops. They are important to agriculture in New Hampshire but exhibit some properties which exclude them from Prime Farmland status (such as erodibility or droughtiness). They can be farmed satisfactorily by greater input of fertilizer and erosion control practices, and will produce fair to good crop yields when managed properly. The SCS has included the following soil types as constituting farmlands of Statewide importance: Becket (56C); Marlow (76C); and, Monadnock (142C).

Farmlands of Local Importance - These lands are rated as having local importance because they are already being actively farmed. Since they are now under active farm management, they are important to the role agriculture plays in the Town's economic, cultural, and conservation picture. The SCS has included the following soil types as farmlands of local importance: Adams (36A, 36B); Becket (57B, 57C); Marlow (77B, 77C); Peru (79B); Rumney (105); Monadnock (143B, 143C); Skerry (559B); and, Croghan (613A, 613B).

LYNDEBOROUGH, NEW HAMPSHIRE
AGRICULTURAL SOILS: EXTENT AND UTILIZATION (PER 2001 LANDCOVER ASSESSMENT)

NRCS Soil Class	Total Acreage	Average Unit Area in acres	Acres in use as Pastures in 2001	Acres in use as Orchards in 2001	Acres in use for Row Crops in 2001
Prime Farmland	350	8	135	65	0
Statewide Importance	750	14	235	110	1.5
Local Importance	5,950	37	135	30	0
Not Prime Farmland	12,450	33	400	65	3.5
TOTAL	**19,500**		**905**	**270**	**5**

LYNDEBOROUGH, NEW HAMPSHIRE
NATURAL RESOURCES INVENTORY - AGRICULTURAL SOILS



CHAPTER 4
LAND COVER & VEGETATION

Topics addressed in this chapter

- •Lyndeborough's unique biogeographic position
- •Classification of land cover types
- •Characteristics of vegetation types
- •Natural communities & ecological systems
- •Plant species inventory

INTRODUCTION

The broad range of elevation in Lyndeborough, from 261 feet near Fitch's corner to 1820 feet on the slopes of North Pack Monadnock Mountain, provides the geographic foundation for a diverse mosaic of vegetation. The ridges and summits that form the arching spine of Lyndeborough Mountain, the northern terminus of the Wapack Range, are the principal headwaters for four significant stream systems: Stony Brook, Furnace Brook, Curtis Brook, and Cold Brook. Other brooks, like Rand and Purgatory, also receive considerable volume from these hills. The interaction between this elevational gradient and the complex drainage systems formed by over 40 miles of streams, compounded by a dramatic land use history of farming, controlled fire, damming streams and harvesting timber has resulted in a variety of forests, meadows, swamps, shrublands, and farmscapes where well over 300 species of wild plants, several hundred species of fungi, and 200+ birds, mammals, amphibians and reptiles exist.

This richness is made more possible by Lyndeborough's unique position straddling the zone of tension between two major ecological zones (Bailey, 1980). From the mountains and north, and on into Canada, is classified as the *New England – Adirondack Ecological Province*. This region is characterized by subdued glaciated mountains covered with a layer of till, cut by streams coursing through deep valleys, and clothed with a forest transitional between the immense and homogenous Boreal forests of Canada and the rich hardwood forests of the Appalachian Mountains. From Lyndeborough Mountain to the south and east through southern New England is the *Eastern Broadleaf Forest Ecological Province*, a highly variable landscape

of minimally or unglaciated hills, plains, and plateaus, where large rivers twist through broad valleys, and the forests are dominated by oaks, hickories, and pines. Lyndeborough sits, literally, right on the boundary that ecologists have applied to this division, and it shares characteristics in flora, fauna, and ecological processes of both ecoregions. Because of the tension between these two very different zones, unique species assemblages and patterns occur that would not a few towns to the north or to the south. As an example, on a 300-yard walk from the north aspects of Lyndeborough Mountain over the barren ridgeline to the southern slopes, you would encounter plant species and communities that you might see on a walk from southern portions of the White Mountains to coastal Connecticut. Along with the array of plant communities and wetland systems comes the variety of fungi, birds and other animals that require those niches. These patterns are what ecologists refer to as biogeography, or how the biology of a place is inseparable from its position geographically.

The numerous plant species and species groups that occur in Lyndeborough, of which I estimate only 1/2 of which were documented during field work for this NRI[1], are organized into patterns across the landscape based on the specific needs and abilities of each species, the history of each site, and climatic factors. The potential for a completely haphazard arrangement exists, and in some ways appears to be evident as many species were recorded only once during field work, although their required habitat is abundant. Regardless of the mystery of why many plants, fungi, and other biota appear where and when they do, strong patterns do exist, and vegetation can be organized under different hierarchies.

Throughout this chapter, I present an analysis of vegetational patterns in Lyndeborough according to some of these schemes. At the largest scale, I have briefly discussed the effects of continental scale ecoregional patterns. Moving in to the scale of New Hampshire, we have the ability to interpret satellite imagery that classifies 30 meter blocks according to the dominant cover type. And at the finest scale I have identified individual plant communities which must be determined by compiling species lists and observing patterns of association. Furthermore, there are several levels of classification spanning the scales between those. This chapter provides an

[1] Winchester (1991) reported ~410 species of flowering herbs and shrubs in Greenfield following decades of field work. This NRI documented ~200 such species in under six months. It is probable that a similar magnitude of species occurs in Lyndeborough as in Greenfield. Also, 454 plant species have been reported for the New Boston Air Force Station (Lyndeborough Master Plan, 2002). These tallies, in conjunction with the rate of new species discovery I was experiencing even at the end of the field work period, suggest that ~50% of Lyndeboroughs plant diversity was encountered during this NRI. Additional plants will likely be recorded with each additional field survey.

overview of the general patterns of land cover within differing hierarchies, characteristics of ecosystem types within those broad cover types, descriptions of some specific natural communities and ecosystems, and ultimately a full accounting of the plant and fungi species documented in the town of Lyndeborough during the duration of this project. Again, the patterns and processes in vegetated systems are shaped by geology, land use history, contemporary land use, climate, and other factors. Where important, these factors will be discussed. Brief mention is made of wetland and aquatic systems and wildlife habitat as more details are provided in following chapters.

Fern-leaved false foxglove
Aureolaria pedicularia var. *intercedens*

A rare species documented in
Lyndeborough at 6 or more locations

Thanks to Francie Von Mertens for helping
get this incredible high definition photograph.

2001 LAND COVER CLASSIFICATION

In 2001, the NH GRANIT staff at the University of New Hampshire Complex Systems Research Center, in partnership with seven other agencies and organizations, released the NH Statewide Landcover Assessment, a digital, statewide, 23 class land cover data set developed with Landsat Thematic Mapper satellite imagery acquired between 1990-1999 (see Justice *et al*., 2002 for details on data acquisition, processing, and ground-truthing). This data set has classified the entire state based on 30 meter blocks; each block was assigned one of 23 land cover types based on the dominant land cover within that block. This is a useful tool for visualizing land cover at state, town, and regional scales, but begins to lose its effectiveness at scales under several hundred acres. It is a useful tool for describing the land cover for Lyndeborough, and analyzing patterns within areas of town, but it should not be used to determine the trees you will see in your own backyard. The table below summarizes Lyndeborough's land cover based on this data. Percentages were rounded to the nearest whole number because of the relative inaccuracy of the data. For comparison, figures for the entire state of New Hampshire are provided as well from Justice *et al*. (2002).

Land Cover	Acres	% Cover	% of NH
Forests			
Mixed Forest	6905	35%	33.9%
Beech-Oak	5625	29%	18.5%
White-Red Pine	2135	11%	9.6%
Hemlock	1250	6%	4.6%
Other Hardwoods	570	3%	18.5%
Paper Birch-Aspen	390	2%	5.3%
Spruce-Fir	187	<1%	9.2%
	17062	**87%**	**77.6%**
Agriculture			
Hay-Pasture	905	4%	
Orchards	270	1%	
Row Crops	5	<1%	
	1180	**5-6%**	**4.1%**

Land Cover	Acres	% Cover	% of NH
Wetlands			
Open Water	211	1%	4.4%
Open Wetland	266	1%	3.1%
Forested Wetland	40	<1%	combined
	481	**2-3%**	**7.5%**
Development			
Transportation	406	2%	
Developed	60	<1%	
Disturbed Land	20	<1%	
	486	**3%**	**4.4%**
Other Cleared Land*	**497**	**2%**	**6.4%**

* in the case of Lyndeborough, this category includes some old gravel pits, and some very heavily logged forest lands, and old agricultural lands reverting to forest.

According to the 2001 Land Cover data, Lyndeborough is 87% forested which is higher than the state total of 77.6% Lyndeborough also has more agricultural land than the state average, but fewer wetlands, ponds & lakes, and development. These figures should come as no surprise as many regard Lyndeborough as a forested, mountainous town with a strong agricultural legacy, and not as an urban center or destination for water lovers. The abundance of

different forest types in Lyndeborough generally reflects the towns location in southern New Hampshire. Spruce-Fir, Birch-Aspen, and Other Hardwoods types common to northern areas cover less of the land by percent than across the state, and Beech-Oak, White-Red Pine, and Hemlock, which are common southern New Hampshire forest types, cover more land by percent in Lyndeborough than across the state. The Other Hardwoods class is generally what is considered "northern hardwoods" by foresters or ecologists: forests dominated by maples, beech, and birch.

The data's detection of wetlands falls far short of those identified in the National Wetlands Inventory (NWI; see Tiner, 2007) which classifies just over 1000 acres in Lyndeborough as wetland. An additional 1000 acres are classified as hydric soils by the Natural Resource Conservation Service (NRCS) in the Hillsborough County Soil Survey, though not 100% of these polygons may actually be wetlands. Furthermore, many smaller wetlands exist that were not detected by the NWI or are smaller than NRCS mapable units. The 2001 Landcover Assessment data, then, shows as wetlands those that are largest and most obvious, while many smaller wetlands exist within the forest matrix. (See chapter on Wetlands & Water Resources for more detail). For this reason, the LAND COVER & VEGETATION Map shows NWI wetlands over the background 2001 Landcover layer, as the NWI data is most representative of actual, on-the-ground wetlands.

WILDLIFE ACTION PLAN HABITAT TYPES

The New Hampshire Fish & Game Department Wildlife Action Plan (WAP) reclassified much of New Hampshire into broad habitat types that would help them better analyze the conservation needs of New Hampshire's wildlife species. They refined the background data from the 2001 Landcover Assessment by filtering areas by elevation, soil type, Ecological Land Units, known extent of examples of habitat types, input from professional scientists, and other filters. The result of this process is data layers for the predicted extent of important habitat types. The types that were used in this NRI and their extents are listed below:

WILDLIFE ACTION PLAN HABITAT COVER TYPES USED IN THIS NRI

Habitat Type	Acres	% Cover	% of NH
Hemlock-Hardwood-Pine	12595	65%	45%
Appalachian Oak-Pine	3639	19%	7%
Lowland Spruce-Fir	210	<1%	13%
Northern Hardwood-Conifer	908	<1%	18%
Talus Slopes & Rocky Ridges	126	<1%	<1%
Floodplains	67	<1%	2%

The four forest types were selected for use in this NRI because they offer an alternative view to the classification of Lyndeboroughs vegetation. The Talus Slopes & Rocky Ridges data was chosen because field work confirmed the high importance of these communities for habitat, species diversity, and other natural resource values in Lyndeborough. Also, this layer was amended during the NRI, adding areas on Rose, Winn, Piscataquog, and Pinnacle Mountains that showed exposures of rocky ledges and slabs on aerial photos. Floodplains are minimally represented in Lyndeborough, but a very large complex is found just to the north in Francestown. Habitat types represented in Lyndeborough but were not used include Grasslands, Peatlands, and Marsh & Shrub Wetlands. The Grassland data was not used because the 2001 Landcover data provided a higher level of detail, and the detail offered by NWI data exceeds that of both the Peatlands and the Marsh & Shrub Wetlands data.

Hemlock-Hardwood-Pine forests are the most widespread cover type in Lyndeborough and New Hampshire. The percent cover in Lyndeborough is higher than the state because of this cover types general restriction to central and southern parts of the state. Appalachian Oak-Pine forests are found predominantly below 900 feet elevation in southern and central New Hampshire and have a relatively low distribution across only 7% of the state. The WAP data predicts that up to 19% of Lyndeborough is classified as this habitat type, suggesting a higher than normal abundance. Qualitative observations during field work suggest that this prediction is a bit high, and some of these areas should be considered more like the Hemlock-Hardwood-Pine habitats.

VEGETATION TYPES & NATURAL COMMUNITY DESCRIPTIONS

The two systems summarized above provide a scheme for classifying large areas into few relatively homogenous categories. Within those categories a tremendous range of diversity occurs along numerous gradients and scales. For example, one 30 meter block classified as White-Red Pine may have several tree species and dozens of shrubs and herbs organized into a

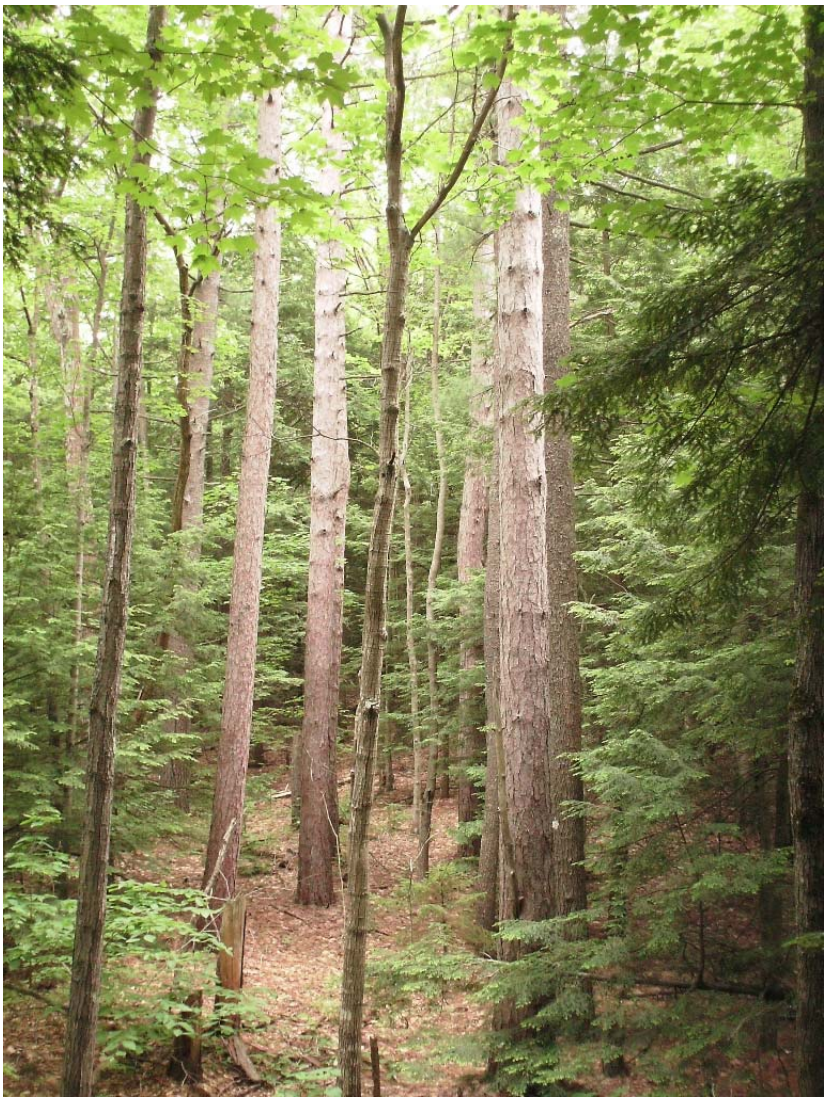
few natural communities based on soil wetness, disturbance history, or other factors. In this section I provide more detail into the organization of vegetative communities in Lyndeborough within the structure of the 2001 Landcover Assessment and further refined based on the Natural Communities of New Hampshire hierarchy developed by the NH Natural Heritage Bureau (Sperduto & Nichols, 2004).

Because of the incredibly complex mosaic of Lyndeboroughs ecosystems along structural, functional, compositional, temporal, and spatial scales, along with the limitation of the 30 meter analysis area, there is no way to positively identify a suite of species that will only occur within one cover type, and not in others. Many species and associations of species are common and widespread, and many more might only have a few locations in Lyndeborough because of limitations in seed distribution, habitat needs, or disturbance history. Additionally, Natural Communities, in the strictest sense, are associations between plants and their environment that occur without the interruption of human action, and within the context of their 'natural' successional pathway. In that sense, many areas cannot be described according to the Natural Community hierarchy because they have been too deeply affected by logging, farming, development, water impoundment, fire suppression, or other human activities. It is possible, at times, for a trained ecologist to 'read between the lines' of a vegetation community, and see what it might be in the absence of these human-caused stressors. Other times, human intervention has so impacted a site that there are few clues to allow classification at this scale. Regardless of this, most areas can still be classified at a higher level in the hierarchy if not down to the community level. The vegetation type descriptions below are organized by land cover type according to the 2001 Landcover classes, but not all communities or ecosystems will neatly fall into one of these categories. Those unique, uncommon, or hard to classify communities are described within the class most strongly associated with it ecologically and not necessarily according to where it occurs spatially on the LAND COVER & VEGETATION MAP. In many cases, widespread forest community types could be found within any 2001 Landcover forest type. Conservation rankings signify its status in New Hampshire:

S1 – Critically imperiled; extremely rare (1-5 occurrences); highly vulnerable to extinction
S2 – Imperiled; rare (6-20 occurrences); fairly vulnerable to extinction
S3 – Very rare and localized (21-100 occurrences); restricted range; somewhat vulnerable to extinction
S4 – Apparently widespread and secure although it may be rare at its periphery
S5 – Demonstrably widespread and secure although it may be rare at its periphery

MIXED FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES



Hemlock-beech-oak-pine forest
Dry red oak-white pine forest
Dry Appalachian oak-hickory forest
Appalachian oak-mountain laurel forest
Appalachian oak-pine forest

Mixed Forest ~6,905 acres ~35% of Lyndeborough

General Description

This is the matrix forest of Lyndeborough, and indeed much of the region. It is classified as being a mixture of hardwoods and softwood, with softwoods representing between 25-65% of basal area.

Trees: These forests are dominated by red oak, white pine, red pine, beech, hemlock, red maple, black birch, and white birch. Occasionally sugar maple, yellow birch, white ash, red spruce, hop-hornbeam or others will occur in small amounts. Shagbark hickory occurs on dry, southern facing slopes and sites with a possible fire history. This type corresponds strongly with the Hemlock-Hardwood-Pine type of the Wildlife Action Plan.

Shrubs: Generally, these forests have few shrubs because of a relatively dense canopy which limits the amount of sunlight that reaches the forest floor. Most shrub diversity in Lyndeborough is found in wetlands or dry mountain ridges, but several are common in the mixed forest, including witch hazel, striped maple, beaked hazelnut, lowbush blueberry, highbush blueberry, mapleleaf viburnum and hobblebush. Occasionally relics of the pre-1900's forest will be seen in low stump sprouts of American chestnut, which was decimated by blight a century ago. Slightly wetter areas not mapped as wetlands will have a much higher richness of shrubs, as well as herbs and ferns discussed below.

Herbs: Several herbs are very common in these forests. In spring, twisted stalk and sessile bellwort are common. All year, it is common to see large areas covered with a carpet of some low ground covers like partridgeberry, wintergreen, dewberry, starflower, or Canada mayflower. Indian pipe is common under pine, and wild sarsaparilla is generally common in high abundance under hardwoods. In areas of beech dominance, expect to see the parasite beech drops.

Ferns: Some upland ferns that are common in mixed woods include hay-scented fern, New York fern, evergreen wood fern, marginal wood-fern, and rock polypody on rocks and stumps. Common clubmosses include northern ground cedar and princess pine.

Fungi: Some mushrooms found in mixed woods include fragrant armillaria, Russell's bolete, spindle yellow coral, giant clitocybe, tinder polypore, thick-stalked false morel, white helvella, shingled hedgehog, several waxy caps, red cap scaber stalk, several amanitas, and the gilled bolete.

Mixed Forest ~6,905 acres ~35% of Lyndeborough

Natural Communities often found in Mixed Forests

TRANSITION HARDWOOD – CONIFER ZONE FORESTS
ACIDIC, PRIMARILY NUTRIENT POOR FORESTS

Hemlock-beech-oak-pine forest (S5)

Schoolhouse Brook

A very common, broadly defined, and very variable community found on glacial till in low-mid elevations in central and southern New Hampshire. It is transitional between northern hardwood forests and Appalachian oak-hickory forests. Single tree windthrow is the dominant natural disturbance, and beech bark disease has diminished the quality of beech in these communities.

This is the dominant natural community in Lyndeborough across a broad range of elevations, soil types, bedrocks, and disturbance regimes. Usually it is found on acidic soils of metamorphic parent material, which most of Lyndeborough consists of. It is in some ways a 'default' state for much of Lyndeboroughs forests. In the absence of soil nutrient enhancement, unique site conditions, unique disturbance history, or other specialized site factors, many forests will trend in the direction of this common type.

On drier soils and southern aspects, this community will grade into an oak-pine forest, and on more mesic soils or northern aspects it will grade into northern hardwood types, though sugar maple and yellow birch are consistently of low importance. These forests are important for forestry, and because of their wide range and prominence, very important for habitat, biodiversity, and water quality protection. In Lyndeborough, birch-aspen cover types are most often early successional states of this community.

Mixed Forest ~6,905 acres ~35% of Lyndeborough

Natural Communities often found in Mixed Forests

TRANSITION HARDWOOD – CONIFER ZONE FORESTS
ACIDIC, PRIMARILY NUTRIENT POOR FORESTS

Dry red oak-white pine forest (S3S4)

Southern slopes of Piscataquog Mountain

Forests dominated by red oak and white pine are very common in the region, and often reflect the land use history of central and southern New England. These species commonly regenerate following timber harvesting, and require disturbance to maintain dominance. In Lyndeborough, excessively well drained soils, steep slopes, or areas that have been affected by fire tend to be dominated by these two species almost to the exclusion of others.

Typically, these forests are open, with wide spacing between trees which allows for development of understory flowers, shrubs, and mosses. Lowbush blueberry, cow-wheat, and reindeer lichen are common, as are beech and hemlock saplings. In the absence of repeated disturbance it is likely that these stands would eventually succeed to these two tree species.

Forestry activities are difficult in these forests because of the slow growth rates, generally shorter maximum heights, steep slopes, and low stocking levels. Prescribed fire is possibly a necessary tool to maintain the quality of these stands and to prevent them from succeeding into denser stands with diminished shrub and herb layers.

Mixed Forest ~6,905 acres ~35% of Lyndeborough

Natural Communities often found in Mixed Forests

OAK – PINE ZONE FORESTS
DRY FORESTS AND WOODLANDS

Dry Appalachian oak-hickory forest (S1S3)

Curtis Dogwood State Botanical Park

These forests are apparently limited to the extreme southeastern portion of Lyndeborough where some species are at the northern limit of their range, and are probably more common further down the Souhegan River valley and certainly more common in areas to the east and south.

The one example of this community that was documented is at Curtis Dogwood State Botanical Park near the Wilton border. A unique history led to the growth of a very interesting forest dominated by shagbark hickory, red oak, bigtooth aspen, white pine, and occasional red and sugar maple. Flowering dogwood dominates the shrub-heavy midstory along with mountain laurel, hobblebush, maple-leaved viburnum, witch hazel, round leaved dogwood, staghorn sumac, and alternate leaved dogwood. High forb diversity includes heart-leaved aster, false Solomon's seal, Virginia creeper, whorled aster, Jack-in-the-pulpit, and common speedwell. Several plants were observed here but nowhere else in Lyndeborough, including poke milkweed and sweet-scented bedstraw. It is likely that fire had a strong affect on the creation of this natural community, and without it the overall diversity and the flowering dogwood will be lost. The dogwood is already declining to the point of nearing its loss from this location.

Mixed Forest ~6,905 acres ~35% of Lyndeborough

Natural Communities often found in Mixed Forests

OAK-PINE ZONE FORESTS

MESIC AND DRY-MESIC NUTRIENT-POOR FORESTS AND WOODLANDS

Appalachian oak-mountain laurel forest (S3)

Flats south of Winn Mountain

This community, which is most common in southwestern New Hampshire, is dominated by red or white oak, red maple, and white pine, and a thick, sometimes impenetrable shrub layer of mountain laurel. The dense shrub layer provides cover habitat for wildlife, especially deer. Selective harvesting of hardwood trees can lead to the increase in the density of the shrub layer which can limit tree regeneration.

Typically, herbs are sparse to nonexistent, but may include common species like starflower, Canada mayflower, trailing arbutus, and partridgeberry. Large whorled pogonia (*Isotria verticillata*), a rare species, has been documented in this community type, though not yet in Lyndeborough.

Mixed Forests 6,905 acres ~35% of Lyndeborough

Other unique forests not classified as Natural Communities

Appalachian oak-pine forest

Southern slopes of Piscataquog Mountain

The southern and eastern slopes of Piscataquog Mountain are covered by perhaps 100 acres of classic Appalachian Oak-Pine Forest, where red, black and white oaks, white, pitch, and red pines, and scattered hemlocks and maples form open, park-like stands with rich shrub and grass understory layers. These communities may be the result of past forest fires, and without similar disturbance will probably succeed to a more common type.

BEECH-OAK FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES

Red oak-pine rocky ridge
Red spruce-heath-cinquefoil rocky ridge
Red oak-black birch wooded talus
Beech forest
White oak-beech forest

Beech-Oak Forests ~5,625 acres ~29% of Lyndeborough

General Description

The Beech-Oak forest is a common, widespread forest type through much of southern New Hampshire, and is similar to Mixed Forests in many ways. The most important difference is a generally lower prominence of pine and hemlock. Beech and oak must comprise at least 30% of a 30 meter block by basal area.

Trees: Red oak and American beech are the dominant species, with red maple, white birch, and black birch following in importance. Suppressed and overtopped white pine and hemlock are common, as well as scattered individuals of well-formed white pine, red pine, hemlock, and sugar maple. Drier sites will have higher amounts of white oak or shagbark hickory, particularly in southern and eastern portions of Lyndeborough; these trees almost disappear just a few miles west of Lyndeborough, reflecting its position along the margin of ecological zones.

Shrubs: Witch hazel and mountain laurel are widespread and at times abundant, particularly following timber harvesting. In areas of closed canopy, shrubs are very uncommon. In open areas shrub diversity can be quite high, particularly in areas affected by fire within the past several decades. Highbush and lowbush blueberry, black huckleberry, sweetfern, creeping juniper, black chokeberry and sheep laurel are common in these dry openings. Red elderberry and mountain maple are often found in areas of broken talus or broken ledge.

Herbs: Dense canopy conditions limit abundance of forest floor species other than wild sarsaparilla, but recently harvested areas, areas affected by fire, and other open, sunny areas provide habitat for a wide range of herbs and sub-shrubs, including common speedwell, cow-wheat, downy goldenrod, gall of the earth, panicled hawkweed, smaller pussytoes, Pennsylvania sedge, wood sorrel, and the endangered fern-leaved false foxglove. Talus and ledge areas harbor limited patches of herb-Robert, sheep sorrel, pale corydalis, plaintain-leaved pussytoes, and common hair-grass.

Ferns: A similar variety of ferns is found in these forests as Mixed Forests, with hay-scented fern, wood ferns, bracken fern, and rock polypody being most common. Slightly wetter areas support cinnamon fern and New York fern. Rusty woodsia is an uncommon fern found on dry ledges.

Fungi: Some fungi commonly found in these forests include variable russula, firm russula, sharp-scaly pholiota, yellow morel, chicken mushroom, purple-gilled laccaria, lion's mane, bluing bolete, thick-maze oak polypore, oak loving colybia, funnel clitocybe, Frost's bolete and several amanitas,

Beech-Oak Forests ~5,625 acres ~29% of Lyndeborough

Natural Communities often found in Beech-Oak Forests

OAK – PINE ZONE FORESTS
DRY FORESTS AND WOODLANDS

Red oak-pine rocky ridge (S3S4) / Red spruce-heath-cinquefoil rocky ridge (S3S4)

Western slope of Rose Mountain

Two community types are listed to classify these limited areas in Lyndeborough. Hague (2005) classified them at the latter, but because of the prevalence of some southern species it is a prime example of a transitional community between the two.

Scattered, stunted red oak, white pine, red pine, and red spruce are characteristic of these communities restricted to the highest elevation mountain tops that were frequently burned to promote blueberry production in past decades. Pitch pine is occasional, as is red maple, pin cherry, and paper birch. These communities are most common in central and southern portions of New Hampshire between 1000-1800 feet in elevation.

Low tree canopy cover (25-60%) permits development of diverse shrub, grass, and lichen dominated glades. Highbush and lowbush blueberry, black huckleberry, sweetfern, creeping juniper, black chokeberry, mountain ash, smooth sumac, Bartram's serviceberry, and sheep laurel are common shrubs. Bristly sarsaparilla, stiff aster, three-toothed cinquefoil, common hair-grass, and sheep sorrel are common herbs. Rock polypody, lichens, and mosses are common on exposed bedrock which is abundant.

Beech-Oak Forests ~5,625 acres ~29% of Lyndeborough

Natural Communities often found in Beech-Oak Forests

OAK-PINE ZONE FORESTS

MESIC AND DRY-MESIC NUTRIENT-POOR FORESTS AND WOODLANDS

Red oak-black birch wooded talus (S3S4)

Cold Brook watershed

This community occurs in limited distribution in Lyndeborough on acidic talus slopes and areas with broken bedrock ledge. It ranges from 500-1800 feet in elevation in central and southern New Hampshire. The Littleton Formation is known for producing these communities, as well as other acidic to intermediate quartzites and granites. Tree composition is classically red oak, black birch, sugar maple, beech, and hophornbeam, though other hardwood species may be present. Despite the nutrient poor status of these bedrocks, talus areas tend to be slightly more enriched than surrounding slopes due to the broken rock fragments that can leech nutrients.

Red berried elder, striped maple, raspberries, and other shrubs may occur but usually not in abundance. The vines fringed bindweed and Virginia creeper are common and may spread vigorously. Rock polypody and marginal wood fern are often present. Common and widespread herbs such as Canada mayflower, wild sarsaparilla, and starflower will commonly occur as well.

Talus areas are difficult to harvest timber from, so they are often dominated by very large, old trees. The oak in the center of the above photo is over 3 feet in diameter; probably well over 200 years old. The old nature of these forests provide exceptional wildlife habitat for species that require tree cavities and downed woody debris.

Beech-Oak Forests ~5,625 acres ~29% of Lyndeborough

Natural Communities often found in Beech-Oak Forests

TRANSITION HARDWOOD – CONIFER ZONE FORESTS
ACIDIC, PRIMARILY NUTRIENT POOR FORESTS

Beech forest (S4)

Putnam Pond Conservation Area

Beech forests usually occur on well-drained, coarse till soils at low to mid elevations, and often form pure stands that exclude most other species. Beech is evolved to dominate areas where it occurs, as it readily sends out hundreds of stump sprouts and root suckers when it dies or a disturbance creates a nearby opening. In Lyndeborough, however, pure stands are generally small (<5 acres) which may be a result of land use history. Cogbill *et al*. (2002) reported that >25% of Lyndeborough may have been beech forest at the time of European settlement, which suggests that historically Lyndeborough may have been more ecologically similar to areas north and west as opposed to areas south and east. The era of agriculture, followed by continuous timber harvesting, has allowed pines and oaks to dominate the contemporary forest, which they found to cover only 7.5% and 6.8% of Lyndeborough at that time, respectively.

Beech forests tend to have few, if any understory plants present, except for the parasite beech drops, which feeds on beech roots. Beech bark disease (*Nectria*) has greatly diminished the presence of mature beech in the region, but the trees have responded by sending out numerous root suckers. In areas these suckers are so thick that they make travel difficult. Whether these suckers grow into mature trees or succumb to the disease before then remains to be seen. What is sure, though, is that the extensive, pure beech forests that the first settlers of Lyndeborough found have long since disappeared, with negative impacts on wildlife and scenery.

Beech-Oak Forests ~5,625 acres ~29% of Lyndeborough

Other unique forests not classified as Natural Communities

White oak-beech forest
Putnam Pond Conservation Area

An interesting mixture of beech and white oak occurs only at Putnam Pond Conservation Area, on the hill west of Putnam Pond. Like pure beech forest, few understory plants exist under the dense canopy. The co-occurence of these trees together is an example of the unique communities that can occur at the zone of tension between major ecological zones and physiographic regions.

WHITE-RED PINE FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES

White Pine Forests

White-Red Pine Forests ~2,135 acres ~11% of Lyndeborough

General Description

Because pure forests of white and red pine are almost always the result of agricultural abandonment and likely would not persist indefinitely in the absence of human management, the Natural Heritage Bureau has not classified them as natural communities. Significant acreage is covered by these forests though, which can be taken as a clue into the history of our use of the land. Abandoned fields quickly become filled with white pine primarily, with scattered red pine throughout, and the decline of farming a century ago has yielded extensive stands of these trees today. These stands are very important for forestry.

Trees: White pine and red pine dominate. Pitch pine often occurs on the lowest and warmest sites; the recently harvested Deland Forest on New Road is a good example of one of these sites. White birch, black birch, and hemlock often occupy canopy gaps. It is typical for these stands to regenerate hardwoods, mostly red oak, beech, and red maple, following timber harvests.

Shrubs: Blueberries, witch hazel, and sometimes hobblebush abound, but often the thick acidic bed of needles on the forest floor hinders shrub development.

Herbs: The herbs common to most forests, like partridgeberry, wintergreen, Canada Mayflower and starflower, are also found here. Acid-tolerant species such as pyrolas, pipsissewa, bluets, and plantains thrive in these shaded woods. Pink lady's-slipper is exclusive to these forests.

Ferns: Dry, acidic, low-light conditions and sandy soils favor evergreen and marginal wood ferns, and bracken fern.

Fungi: Many mushrooms of the genera *Amanita*, *Boletus*, *Suillus* and *Lactarius* are common in pine forests. Also often found are chanterelle, fat-footed clitocybe, Matsutake, and lobster mushroom.

White-Red Pine Forests ~2,135 acres ~11% of Lyndeborough

Unclassified communities

White pine forest
Off Crooked S Road

Pure stands of white pine are common on sandy soils and low slopes in Lyndeborough. Often, these stands established following abandonment of farms and pastures, and hemlock seedlings in the shaded understory hint of their future state when the pine begins to die. Fairly rich flora commonly includes bracken fern, Pennsylvania sedge, bunchberry, lowbush blueberry, partridgeberry, wintergreen, pyrolas, pipsissewa, and downy rattlesnake plantain.

HEMLOCK FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES

Hemlock forest
Hemlock-white pine forest

Hemlock Forests ~1,250 acres ~6% of Lyndeborough

General Description

Hemlock forests are typically pure or almost pure hemlock, and distinctively lack in shrub, herb, and fern species. The tree can grow extremely slow, and live up to and beyond 500 years in New England. Cogbill *et al.* (2002) reported that hemlock dominated around 20% of Lyndeborough at the time of European settlement. Similarly, Orwig & D'Amato (2007) found that old growth forests in northern Massachusetts were dominated by hemlock. These trees and the natural communities found in these forests, often occur in the absence of human intervention over fairly long periods, and may perpetuate for long periods into the future.

Trees: Hemlock is the obvious dominant species, often to the exclusion of others. White pine, red oak, red spruce, and black birch often associate with it, and can subsist as individuals in otherwise pure stands. White and gray birch may colonize canopy gaps. Yellow birch is a common associate in hydric soils and hemlock-dominated forested wetlands. Black gum commonly associates with hemlock in certain forested swamps.

Shrubs: Few shrubs can tolerate the low-light conditions of a hemlock forest. Hemlock regeneration can persist in shrub form for decades, and even close to a century (Abrams & Orwig, 1996). Hemlock 'saplings' cut and ring-counted in the vicinity of Schoolhouse Brook aged ~80 years old at 1-2" diameter. Openings and canopy gaps may support sparse individuals of high bush blueberry, black huckleberry, or hobblebush.

Herbs: Often, the ground is devoid of plants other than hemlock recruitment, but with adequate light partridgeberry, wintergreen, starflower, Canada Mayflower, or dewberry may occur. Indian Cucumber root also occurs occasionally.

Ferns: Often absent, but wood ferns do occur. Hydric soils and wet sites support cinnamon fern, royal fern, and New York fern.

Fungi: Common mushrooms in hemlock forests include lilac-brown bolete, dotted stalk suillus, variegated milky, hemlock varnish shelf, chanterelle, and black trumpet.

Hemlock Forests ~1,250 acres ~6% of Lyndeborough

Natural Communities often found in Hemlock Forests

TRANSITION HARDWOOD – CONIFER ZONE
ACIDIC, PRIMARILY NUTRIENT POOR FORESTS

Hemlock-white pine forest (S4)

Western slopes of Piscataquog Mountain

Hemlock forest (S4)

Northwestern Slope of Winn Mountain

These forests generally appear to be old and slow growing, and often are located in areas that may be difficult to operate timber harvests in. Similar stands in Antrim, NH revealed tree cores that aged 16" diameter trees at ~200 years old (personal records). These stands are valuable for forestry, but require extended periods of time to regrow, if at all. The relative scarcity of these forests suggest they be conserved for old growth reserves and winter deer habitat.

These forests often occur in deep ravines or along streams. Prime examples of this have been observed along Cold Brook at Senters Falls, Purgatory Brook below upper falls, Schoolhouse Brook, Rand Brook, and in Furnace Brook in the ravine aside Cider Mill Road. In these situations the proximity to wetland soils allows numerous mosses, ground covers, and ferns to persist. In several such locations the uncommon shrub spicebush was documented, though it is not partial to hemlock forests.

OTHER HARDWOOD FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES

Hemlock-beech-northern hardwood forest
Semi-rich mesic sugar maple forest
Rich mesic forest
Rich red oak rocky woods

Other Hardwoods Forests ~570 acres ~3% of Lyndeborough

General Description

A small but important portion of Lyndeborough is dominated by hardwoods other than oaks, beech, and birches. In scattered patches on northern aspects of higher elevation hillsides are groves of sugar maple, white ash and others. These are often the sugarbushes that have been tapped for centuries. Quite widespread in northern New Hampshire, this cover type is near its southern limit in the Monadnock Region.

Trees: Sugar maple, red maple, beech, white ash, and yellow birch are the most indicative species for this type. Red oak, hemlock, and white pine are often scattered within these forests, but are not dominant. Cooler landscape position, coarser soil textures, and possibly enriched soil conditions at some sites give the advantage to these northerly forests. In the most enriched soil conditions, scattered butternut and basswood may occur.

Shrubs: Striped maple and hobblebush are the most common, but shrubs seldom play major roles in these forests.

Herbs: Jack-in-the-pulpit, blue-bead lily, trilliums, red raspberry, wood sorrel, Solomon's seal, false Solomon's seal, poison ivy, and dwarf ginseng are common in these forests, but usually not in abundance. Isolated patches of spring wildflowers with hundreds of individuals do occur. Many of these plants can only be seen in flower in early spring before full leaf-out limits sunshine.

Ferns: Maidenhair fern and Christmas fern are strongly associated with these forests. Widespread ferns like evergreen and marginal wood ferns, and clubmosses such as bristly clubmoss and shining firmoss are common.

Fungi: Honey mushroom, several boletes & russulas, Berkeley's polypore, small chanterelle, northern tooth, bracelet cort, red-belted polypore, artist's conk, reishi, ash heart rot, sharp-scaly pholiota, and dryad's saddle are found in these forests.

Other Hardwoods Forests ~570 acres ~3% of Lyndeborough

Natural Communities often found in Other Hardwoods Forests

TRANSITION HARDWOOD – CONIFER FORESTS
ACIDIC, PRIMARILY NUTRIENT POOR FORESTS

Hemlock-beech-northern hardwood forest (S4)

Northern slopes of Pinnacle Mountain

Maples birches, beech, and scattered hemlock are the primary late successional trees in these communities, often on poor, acidic soils. Occasional red spruce on dry, thin soils, and balsam fir in cool, wet pockets remind that these forests are truly of northern affinity. Indian cucumber, goldthread, and partridgeberry are the most common herbs, but few plants other than trees are ever abundant. Unlike many of the natural communities discussed earlier, these forests have not been shaped by or are they reliant on recurring fire. Moose prefer these areas for winter habitat, and their location, generally in unfragmented forest blocks, suggest them to be important habitat for a wide variety of forest interior species. Other than beech dominated areas, these forests were probably never widespread in Lyndeborough. The work of Cogbill *et al*. (2002) suggests that maples and birches accounted for less 1/4 of Lyndeboroughs forests.

These species ability to stump sprout and root sucker, as well as their high seed production, allows these stands to be harvested for timber with little risk for impeding their persistence. Beech bark disease, maple decline, hemlock wooly adelgid, and other potentially destructive insect pests like Asian long-horned beetle and emerald ash borer, and especially climate change do threaten the integrity of these forests. Their minimal extent, characteristic deep-woods locations, and sensitivity to these threats make their conservation and sound management important.

Other Hardwoods Forests ~570 acres ~3% of Lyndeborough

Natural Communities often found in Other Hardwoods Forests

TRANSITION HARDWOOD – CONIFER FORESTS
ENRICHED FORESTS

Semi-rich mesic sugar maple forest (S3S4)

Near Badger Pond

These forests, which are very limited in Lyndeborough, tend to be positioned in colluvial positions (toes of slopes or low areas where nutrients accumulate). Sugar maple dominates the overstory, with beech and white ash secondary in importance. Soils tend to be loamy or fine sandy loams, and have a more developed layer of organic material. Most sugarbushes are located in these forests. In several areas I observed these forests transitioning away from sugar maple dominance, and trending towards hemlock-black birch dominance. This may be a result of decreased maintenance of sugarbushes found around old cellar holes. Another important factor is 'sugar maple decline'; a not yet fully understood phenomenon that may be related to long-term soil-calcium depletion caused by acid rain.

Lady fern, Christmas fern, and maidenhair fern are common in these forests, along with jack-in-the-pulpit, trilliums, and hophornbeam. The exotic orchid *Epipactis helleborine* was found in these forests in several locations, but never posing a threat to native diversity. The valuable wood and productive soils in these sites make them important for forestry, despite their limited extent.

Other Hardwoods Forests ~570 acres ~3% of Lyndeborough

Natural Communities often found in Other Hardwoods Forests

TRANSITION HARDWOOD – CONIFER FORESTS
ENRICHED FORESTS

Rich-mesic forest (S3)

Below Winn Mountain Orchards

The most fertile soils, high in calcium and with high nitrogen availability support rich-mesic forests, which are indicated by certain plants that require such fertile conditions. These forests generally occur in colluvial positions, in rocky headwaters drainages, and in areas with fractured bedrock yielding nutrients. Sugar maple, white ash, beech, basswood, and butternut overstory, with hophornbeam in the midstory, and potentially a very rich variety of herbs make these some of the most productive and diverse forests in Lyndeborough. Few shrubs are common in these forests, but spicebush was observed at some wet sites, such as the one pictured above.

Typically, the potential for floral richness is not met, however. This is a widespread concern in New England, wherein land use patterns involving destruction of the primeval rich-mesic forests destroyed the seed bank for the dozens of unique flowers that require these environments. As the forests grew back, the rich understory plants were no longer around to supply seed for renewal (Bellemare *et al*., 2002). Effective conservation of these forests should include restoration programs designed to reintroduce specialized rich-site plants. Some scattered examples of these plants documented during NRI field work include wide-leaved sedges (*Carex platyphylla, C. plantaginea*), other sedges (*C. leptonervia,* & *C. rosea*), purple-flowering raspberry, and maidenhair fern. All of these species were observed only one or two times in small populations.

Other Hardwoods Forests ~570 acres ~3% of Lyndeborough

Natural Communities often found in Other Hardwoods Forests

OAK-PINE ZONE FORESTS
ENRICHED FORESTS AND WOODLANDS

Rich red oak rocky woods (S2S3)

These small natural communities may be found in either oak-beech or other hardwoods forest types. Almost always lacking conifers, these talus slope communities are dominated by red oak, sugar maple, black birch, white ash, beech, and yellow birch. They are most often found in colluvial talus positions on southern to eastern slopes of the major mountains in the area. Their abundance on the base of the steepest slopes on Winn Mountain may indicate bedrock enrichment with intermediate to basic geochemistry resulting from hydrologic activity during metamorphosis.

Rich soils combined with dry conditions interact to create unique and highly diverse plant communities sharing elements of rich-mesic forests, dry oak-pine ridges, and enriched forested wetlands. Inaccessibility, remoteness, and other factors have protected many of these forests from timber harvesting. Old growth characteristics such as diverse tree composition, coarse woody debris accumulation, uneven aged structure, and very old trees are common in these communities. Exceptional examples are found in currently protected lands on Winn Mountain. Their age, diversity, rarity, and habitat elements make them a conservation priority.

LOWLAND SPRUCE-FIR FORESTS

DESCRIPTIONS AND NATURAL COMMUNITIES

HEMLOCK-SPRUCE-NORTHERN HARDWOOD FOREST

Spruce-Fir Forests ~187 acres <1% of Lyndeborough

General Description

Very uncommon in southern New Hampshire, but present occasionally in Lyndeborough almost exclusively on northern ridges above 1400 feet, red spruce stands illustrate the aspects of northern forests that just barely creep into the region. Technically not spruce-fir forests because balsam fir is almost completely lacking in all but the lowest, wettest sites, these isolated fragments still have qualities of more northern ecosystems.

Trees: Red spruce, hemlock, and red maple are typically dominant. White birch and white pine often colonize canopy gaps, and black birch, red oak, and other northern hardwoods are scattered throughout.

Shrubs: Bartram's serviceberry, highbush and lowbush blueberry, common juniper, maleberry, and mountain ash are found throughout, but never in abundance.

Herbs: Bunchberry is present in cool, wet locations along with mosses like *Polytrichum communum, Pluerezium schreberi* & *Luecobryum glaucum*. Dry site species like common hair-grass, starflower, and Pennsylvania sedge occupy patches with thin soil development.

Ferns: Hay-scented fern and evergreen wood fern were documented here.

Fungi: Fungi of the genera *Suillus* and *Lactarius*, as well as snowbank false morel, scaly-vase chanterelle, late fall oyster, and red gilled cort are associated with spruce.

Spruce-Fir Forests ~187 acres <1% of Lyndeborough

Natural Communities often found in Spruce-Fir Forests

NORTHERN AND TRANSITION HARDWOOD-CONIFER ZONE FORESTS
ACIDIC, PRIMARILY NUTRIENT-POOR FORESTS

Hemlock – spruce – northern hardwood forest (S3S4)

North ridge of Rose Mountain

Hague (2005) describes this community on the north ridge of Rose Mountain, and suggests that because of its scarcity it is a major conservation priority. This and other examples in Lyndeborough illustrate the oddities of the towns' unique biogeographic position. Spruce dominance in the canopy indicates a northern forest community type, which is confirmed by presence of red raspberry and *Sphagnum* mosses, but other ground flora is associated with oak-pine forests, such as hay-scented fern, lowbush blueberry, evergreen wood fern, and common hair-grass. Slow decomposition and acidic soils contribute to development of complex coarse woody debris habitats, and proximity to ledges, talus and shrub communities further increase habitat value. Because of their limited distribution at the southern extent of its range, these communities would probably not re-establish if harvested. Little to no spruce regeneration, but adequate hemlock, white pine, and birch regeneration, is occurring in canopy gaps suggesting that these stands may be a relict of agricultural abandonment and will not likely persist.

OPEN, SUCCESSIONAL, & AGRICULTURAL LANDS

DESCRIPTIONS

HAYFIELDS & PASTURES
EARLY SUCCESSIONAL FOREST

Open, successional, & agricultural lands ~1,434 acres ~7% of Lyndeborough

Many of these habitats are not considered natural communities because of their dependence on persistent human interaction to maintain them and stall succession. Some examples of early successional forests and shrublands, like abandoned beaver ponds, are represented by natural communities described in the Wetlands & Water Resources chapter. Despite these being 'anthropogenic' landscapes, they are of the highest significance for wildlife habitat for common, declining, and rare species (Kanter *et al.*, 2001; NH Ecological Reserve Advisory Group, 1988).

Hayfields & Pastures

Putnam Pond Conservation Area

Approximately 905 acres are classified as hayfield and pasture by the 2001 Landcover Assessment. Some of these areas may be lawns, fields at the Central School, or other grassy land not used for agriculture, but much of it is open field used by horses, cows, or for hay production. Vegetation communities in these fields vary along moisture gradients. The driest fields may consist mainly of non-native grasses like Timothy, Kentucky bluegrass, orchard grass, and annual ryegrass. The wettest fields, which may at times technically be considered wetlands but are still mowed at least semi-annually, will support sensitive fern, sedges, rushes, steeplebush, Joe-pye weeds, and other wetland edge species. Mosses like hair-cap moss, horsetails, and tree seedlings also commonly occur in field settings.

These areas are vital for the preservation of many birds, such as bobolink, meadowlark, and horned lark, and are critical for insects, some frogs, and many mammals. Asters, goldenrods, cinquefoils, and dozens of other species were documented in these habitats. Field edges provide significant shrub habitats, often with chokecherry, aspen, staghorn sumac, hardwood tree saplings, and numerous invasive shrubs, including Japanese barberry, autumn olive, buckthorns, and multiflora rose. Despite the high value of these shrubs to wildlife, they threaten the viability of native ecosystems and should be eradicated where possible.

Open, successional, & agricultural lands ~1,434 acres ~7% of Lyndeborough

Early successional forest

Forest Society harvest on Piscataquog Mountain

Young forests, those developing following timber harvests, forest fires, and abandonment of beaver ponds or agriculture develop species groups based on available seed sources from adjacent forests, as well as along traditional successional pathways dominated by 'early succesional' plants. Commonly after a disturbance ferns, goldenrods, asters, sedges, and shrubs will colonize a site. Shrubs, like highbush blueberry, winterberry, juniper, and some invasive species will tend to dominate the site for a decade or two as aspen, white pine, red oak, white and gray birch, and red maple establish. These trees will eventually overtop the shrubs, and within two to three decades have become a young forest. The ~30 year process of development from a scarred site back to a forest is among the most important and underappreciated habitats in Lyndeborough.

The value of forestry activities, and especially small clear-cuts (0.5-3 acres), is often not acknowledged by the layperson when considering 'good' wildlife habitat. In fact, harvested areas support many species that cannot survive in unbroken tracts of mature forest. An exact number cannot be given to describe the area in Lyndeborough in these transient states. The 2001 Landcover Assessment classified 497 acres as "Other Cleared" which is typically early successional areas. Those data are now 10-20 years old and may not be accurate regarding this cover type. However, much land clearing, logging, and farm abandonment has occurred since then, so the number could near that. The ephemeral nature of these habitats, the difficulty in inventorying them across multiple land ownerships, and the varying degrees of disturbance make them difficult to map, but incredibly important to recognize.

PLANT SPECIES INVENTORY

A comprehensive vegetation inventory would be a remarkable addition to a Natural Resource Inventory, but to be complete would require years of effort. This NRI does provide a solid base that deserves to be amended in future field seasons. The species I catalogued were those positively identified between February, 2008 and October, 2009 at sites I visited. Plots and specific studies were never completed, but rather an opportunistic sampling of all plants encountered was employed. Specific areas deserve closer inspection, specifically marsh wetlands, talus slopes, fields, and agricultural lands. Yards and wooded areas near homes that are strongly affected by human activity were largely excluded from this inventory. A horticultural inventory would require similar effort and yield similarly high species richness, although weighted towards non-native species. Species groups that need further research include violets (*Viola* species) of which I positively identified zero species; grasses, sedges, & rushes; mosses & liverworts; and aquatic emergent & submerged vegetation.

Despite the weaknesses addressed above, a relatively high number of species were recorded. In sum, 36 species of trees, 51 species of shrubs, 149 herbs & wildflowers, 5 vines, 23 ferns and fern allies, 11 grasses, 9 sedges, 1 rush, and several common moss species were positively identified by the author during the 2008 field season. The following texts were used for identification:

Newcomb's Wildflower Guide, by Lawrence Newcomb. Little-Brown, and Company, New York, NY. 1977

Wildflowers: Northeastern/North-central North America, by Roger Tory Peterson & Margaret McKenney. Houghton Mifflin Company, New York, NY. 1996.

Trees and Shrubs, by George A. Petrides. Houghton Mifflin Company, New York, NY. 1972.

Ferns of Northeastern and Central North America, by Boughton Cobb, Cheryl Lowe, and Elizabeth Farnsworth. Houghton Mifflin Company, New York, NY. 2005.

Field Guide to the Grasses, Sedges, and Rushes of the United States, by Edward Knobel. Second revised edition by Mildred E. Faust. Dover Publications, Incorporated, New York, NY. 1977.

Flora of the Northeast: A manual of the vascular flora of New England and adjacent New York, by Dennis W. Magee and Harry E. Ahles. University of Massachusetts Press, Amherst, MA. 2007.

Additional refinement and clarification was made using the USDA Natural Resources Conservation Service Plants Database, online at http://plants.usda.gov/. Rare plant identification was facilitated with assistance from botanists with the NH Natural Heritage Bureau. A list of fungi and their associated habitats was furnished by Lyndeborough resident Robin Arnold, probably the most knowledgeable mycophile in Lyndeborough. The following pages provide lists of the species catalogued for this NRI, including several reported by Hague (2005) from her NRI of the Rose Mountain Area; these may or may not have been observed in Lyndeborough. Nomenclature follows USDA Plants database. Wetland Status is described on page 106.

Sheep laurel & hay-scented fern in July

TREES OF LYNDEBOROUGH

Maple Family (*Aceraceae*)	Red maple	*Acer rubrum*
	Sugar maple	*Acer saccharum*
Birch Family (*Betulaceae*)	Yellow birch	*Betula allegheniensis*
	Gray birch	*Betula cordifolia*
	Black birch	*Betula lenta*
	White birch	*Betula papyrifera*
	Hophornbeam	*Ostrya virginiana*
Dogwood Family (*Cornaceae*)	Flowering dogwood	*Cornus florida*
	Blackgum	*Nyssa sylvatica*
Pea Family (*Fabaceae*)	Black locust	*Robinia pseudoacacia*
Oak Family (*Fagaceae*)	American beech	*Fagus grandifolia*
	White oak	*Quercus alba*
	Red oak	*Quercus rubra*
	Black oak	*Quercus velutina*
Walnut Family (*Juglandaceae*)	Shagbark hickory	*Carya ovata*
	Butternut	*Juglans cinerea*
Laurel Family (*Lauraceae*)	Sassafras	*Sassafras albidum*
Olive Family (*Oleaceae*)	White ash	*Fraxinus americanus*
Pine Family (*Pinaceae*)	Balsam fir	*Abies balsamea*
	Eastern red-cedar	*Juniperus virginiana*
	Red spruce	*Picea rubra*
	Red pine	*Pinus resinosa*
	Pitch pine	*Pinus rigida*
	White pine	*Pinus strobus*
	Douglas-fir	*Pseudotsuga menziesii*
	Eastern hemlock	*Tsuga canadensis*
	Tamarack	*Larix laricina*
	Black spruce	*Picea mariana*
Willow Family (*Salicaceae*)	Bigtooth aspen	*Populus grandidentata*
	Quaking aspen	*Populus tremuloides*
	Weeping willow	*Salix ×sepulcralis*
	Ward willow	*Salix caroliniana*
Rose Family (*Rosaceae*)	Black cherry	*Prunus serotina*
Basswood Family (*Tiliaceae*)	Basswood	*Tilia americana*
Elm Famliy (*Ulmaceae*)	American elm	*Ulmus americana*
	Slippery elm	*Ulmus rubra*

SHRUBS OF LYNDEBOROUGH (1 OF 2)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Freq Index	Native Status	Wetland indicator
Japanese barberry	*Berberis thunbergii*	*Berberidaceae*	Old fields; mixed woods	2	Exotic	FACU
Sweetfern	*Comptonia peregrina*	*Myricaeae*	Roadsides; disturbed areas; dry soil	2	Native	
Sweet gale	*Myrica gale*	*Myricaeae*	Swamps	1	Native	OBL
Northern bayberry	*Myrica pensylvanica*	*Myricaeae*	Dry upland woods	1	Native	FAC
American chestnut	*Castanea dentata*	*Fagaceae*	Dry woods	2	Native	
Speckled alder	*Alnus rugosa*	*Betulaceae*	Wetland thickets	3	Native	FACW+
Beaked hazelnut	*Corylus cornuta*	*Betulaceae*	Hardwood forests	1	Native	FACU-
Common buckthorn	*Rhamnus cathartica*	*Rhamnaceae*	Homestead sites and cellar holes	1	Exotic	UPL
Broad-leaved cat-tail	*Typha latifolia*	*Typhaceae*	Wetlands	3	Native	OBL
Alternate-leaved dogwood	*Cornus alternifolia*	*Cornaceae*	Rich upland woods	3	Native	
Silky dogwood	*Cornus amomum*	*Cornaceae*	Wetlands	2	Native	FACW
Round-leaved dogwood	*Cornus rugosa*	*Cornaceae*	Mixed woods; dry enriched talus	2	Native	
Red osier dogwood	*Cornus sericea*	*Cornaceae*	Wet areas; roadsides	2	Native	FACW+
American elm	*Ulmus americana*	*Ulmaceae*	Stream sides, road sides, wetland edges	4	Native	FACW-
Sheep laurel	*Kalmia angustifolia*	*Ericaceae*	Dry shrublands in mountains	3	Native	FAC
Mountain laurel	*Kalmia latifolia*	*Ericaceae*	Dry to wet woods; lower elevations	3	Native	FACU
Maleberry	*Lyonia ligustrina*	*Ericaceae*	Wetlands to uplands	4	Native	FACW
Low bush blueberry	*Vaccinium angustifolium*	*Ericaceae*	Dry woods; exposed rocky hilltops	5	Native	FACU-
High bush blueberry	*Vaccinium corymbosum*	*Ericaceae*	Widespread from wetlands to dry woods	4	Native	FACW-
Leatherleaf	*Chamaedaphne calyculata*	*Ericaceae*	Peatlands	1	Native	OBL
Mountain holly	*Ilex mucronata*	*Aquifoliaceae*	Forested wetlands	2	Native	OBL
Winterberry	*Ilex verticillata*	*Aquifoliaceae*	Scrub/shrub wetlands; pond edges	4	Native	FACW+
Tartarian honeysuckle	*Lonicera tatarica*	*Caprifoliaceae*	Old fields; homesteads; mixed woods	3	Exotic	FACU
Common elderberry	*Sambucus canadensis*	*Caprifoliaceae*	Wetland edges, moist openings	3	Native	FACW-
Red elderberry	*Sambucus racemosa*	*Caprifoliaceae*	Edges and openings; talus	3	Native	FACU
Snowberry	*Symphoricarpos albus*	*Caprifoliaceae*	Dry shrublands in mountains	2	Native	FACU-
Maple-leaf viburnum	*Viburnum acerifolium*	*Caprifoliaceae*	Upland forests; shade tolerant	3	Native	UPL
Hobblebush	*Viburnum lantanoides*	*Caprifoliaceae*	Moist lowlands; riparian; forested wetlands; cool shaded upland forests	3	Native	FAC

SHRUBS OF LYNDEBOROUGH (2 OF 2)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Freq Index	Native Status	Wetland indicator
Nannyberry	*Viburnum lentago*	*Caprifoliaceae*	Wetland edges; uplands	2	Native	FAC
Northern arrowwood	*Viburnum recognitum*	*Caprifoliaceae*	Forested wetlands	3	Native	FACW-
Spicebush	*Lindera benzoin*	*Laurel*	Shrub wetland thickets; enriched moist uplands; shaded streams	2	Native	FACW-
Buttonbush	*Cephalanthus occidentalis*	*Rubiaceae*	Scrub/shrub wetlands; pond edges	3	Native	OBL
Striped maple	*Acer pensylvanicum*	*Aceraceae*	Shaded mixed woods; regeneration	3	Native	FACU
Mountain maple	*Acer spicatum*	*Aceraceae*	Shaded mature forest and talus	1	Native	FACU-
Autumn olive	*Elaeagnus umbellata*	*Elaeagnaceae*	Old fields; mixed woods; roadsides	3	Exotic	
Dwarf juniper	*Juniperus communis*	*Pinaceae*	Old fields; thin soils; ledges	3	Native	
Canada yew	*Taxus canadensis*	*Taxaceae*	Damp coniferous woods	1	Native	
Smooth Juneberry	*Amelanchier laevis*	*Rosaceae*	Dry shrublands in mountains	1	Native	
Bartrams serviceberry	*Amelanchier bartramiana*	*Rosaceae*	Dry shrublands in mountains; spruce	1		
Red chokeberry	*Aronia arbutifolia*	*Rosaceae*	Shrub wetlands	1	Native	FACW
Black chokeberry	*Aronia melanocarpa*	*Rosaceae*	Dry shrublands in mountains	4	Native	FAC
Chokecherry	*Prunus virginiana*	*Rosaceae*	Field edges; open areas; roadsides	3	Native	FACU
Multiflora rose	*Rosa multiflora*	*Rosaceae*	Roadsides; thickets; wetland edges	3	Exotic	FACU
Swamp rose	*Rosa palustris*	*Rosaceae*	Wetlands	1	Native	OBL
Smooth sumac	*Rhus glabra*	*Anacardiaceae*	Dry shrublands in mountains	2	Native	
Staghorn sumac	*Rhus typhina*	*Anacardiaceae*	Roadsides; old fields; dry soils; shrubby openings	4	Native	
Poison sumac	*Rhus vernix*	*Anacardiaceae*	Shrub/scrub swamps	1	Native	OBL
Silky willow	*Salix sericea*	*Salicaceae*	Stream margins, shrub wetlands	2	Native	OBL
Shining willow	*Salix lucida*	*Salicaceae*	Shrub/scrub swamps	1	Native	FACW
Pussy willow	*Salix discolor*	*Salicaceae*	Shrub/scrub swamps	2	Native	FACW
Witch-hazel	*Hamamelis virginiana*	*Hamamelidaceae*	Mixed woods	4	Native	FAC-
Pin Cherry	*Prunus pensylvanica*	*Rosaceae*	Dry shrublands	2	Native	FACU-
Pink azalea	*Rhododendron nudiflorum*	NH Endangered species reported by Hague (2005) for Rose Mountain Area				

- Habitats are those where I observed the species; they may occur in areas not specified.
- Frequency Index (based on my observations):
  - 1 = small chance of seeing it in preferred habitat, rare in Lyndeborough
  - 2 = will sometimes see in preferred habitat, uncommon in Lyndeborough
  - 3 = will often see in preferred habitat, relatively common in Lyndeborough
  - 4 = will almost certainly see in suitable habitats
  - 5 = extremely common in many habitats

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (1 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Whorled aster	*Aster acuminatus*	*Asteraceae*	Mixed woods; roadsides	Summer	5	Native	
Oxeye daisy	*Chrysanthemum leucanthemum*	*Asteraceae*	Roadsides; meadows; open places	Spring-summer	4	Exotic	
Beechdrops	*Epifagus virginiana*	*Orobanchaceae*	Beech forests	Summer	4	Native	
Wintergreen	*Gaultheria procumbens*	*Ericaceae*	Common; mixed, open woods	Early Summer	5	Native	FACU
Canada mayflower	*Maianthemum canadense*	*Liliaceae*	Widespread, common; abundant in pine woods	Early spring	5	Native	FAC-
Partridgeberry	*Mitchella repens*	*Rubiaceae*	Common; mixed woods	Summer	5	Native	FACU
Yellow pond lily	*Nuphar lutea*	*Nymphaceae*	Ponds	Summer	5	Native	OBL
Pickerelweed	*Pontederia cordata*	*Pontederiaceae*	Shallow ponds; marshes	Summer	5	Native	OBL
Common yarrow	*Achillea millefolium*	*Asteraceae*	Roadsides; meadows; open places	Late spring	4	Exotic	FACU
Ragweed	*Ambrosia artemesiifolia*	*Asteraceae*	Roadsides; fields; yards	Late Summer	4	Native	FACU
Sarsaparilla	*Aralia nudicaulis*	*Araliaceae*	Widespread; mixed woods	Late spring	4	Native	FACU
Common milkweed	*Asclepias syriaca*	*Asclepidaceae*	Fields; roadsides	Summer	4	Native	
Swamp beggar's tick	*Bidens connata*	*Asteraceae*	Wetlands	Summer	4	Native	FACW+
Queen Anne's lace	*Daucus carota*	*Apiaceae*	Roadsides; fields; meadows	Summer	4	Exotic	
Common marsh bedstraw	*Galium palustre*	*Rubiaceae*	Open wetlands; marshes	Summer	4	Native	OBL
Wild lettuce	*Lactuca canadensis*	*Asteraceae*	Roadsides	Summer	4	Native	FACU-
Yellow loosestrife	*Lysimachia terrestris*	*Primulaceae*	Open wetlands; marshes	Summer	4	Native	OBL
Indian cucumber	*Medeola virginiana*	*Liliaceae*	Conifer woods; widespread	Late spring	4	Native	
Cow-wheat	*Melampyrum lineare*	*Scrophulariaceae*	Dry oak-pine woodlands	June-July	4	Native	FACU
Common plantain	*Plantago major*	*Plantaginaceae*	Roadsides; fields; yards	Summer	4	Exotic	FACU
Nodding smartweed	*Polygonum lapathifolium*	*Polygonaceae*	Pond edges; marshes; wet roadsides	Summer	4	Native	FACW+
Black-eyed Susan	*Rudbeckia serotina*	*Asteraceae*	Fields, roadsides	Summer	4	Exotic	FACU-
Common arrowhead	*Sagittaria latifolia*	*Alismataceae*	Open wetlands; marshes	Summer	4	Native	OBL
Tall goldenrod	*Solidago canadensis*	*Asteraceae*	Roadsides; fields	Summer	4	Native	FACU
Grass-leaved goldenrod	*Solidago graminifolia*	*Asteraceae*	Roadsides; fields	Summer	4	Native	FAC
Twisted stalk	*Streptopus amplexifolius*	*Liliaceae*	Mixed woods, widespread	Spring	4	Native	FAC+

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (2 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Poison ivy	*Toxicodendron radicans*	*Anacardiaceae*	Roadsides; rich woods; stream sides	Summer	4	Native	FAC
Starflower	*Trientalis borealis*	*Primulaceae*	Widespread; mixed woods	Spring	4	Native	FAC
Red clover	*Trifolium pratense*	*Fabaceae*	Roadsides; fields; yards	Summer	4	Exotic	FACU-
Cow vetch	*Vicia cracca*	*Fabaceae*	Fields; roadsides	Summer	4	Exotic	
Spreading dogbane	*Apocynum androsaemifolium*	*Apocynaceae*	Roadsides	Summer	3	Native	
Jack-in-the-pulpit	*Arisaema atrorubens*	*Araceae*	Rich hardwoods, damp soils	Early spring	3	Native	FACW-
Heart-leaved aster	*Aster cordifolius*	*Asteraceae*	Mixed woods; roadsides	Late summer	3	Native	
Small white aster	*Aster vimineus*	*Asteraceae*	Roadsides; fields; meadows	Summer	3	Native	FACW-
Goldthread	*Coptis groenlandica*	*Ranunculaceae*	Acidic woods; damp; coniferous	Early spring	3	Native	FACW
Bunchberry	*Cornus canadensis*	*Cornaceae*	Damp coniferous woods	Late spring	3	Native	FAC-
Showy tick-trefoil	*Desmodium canadense*	*Fabaceae*	Mixed, dry woods; roadsides	Late Summer	3	Native	FAC
Spotted Joe-pye weed	*Eupatorium maculatum*	*Asteraceae*	Open wetland edges; wet roadsides	Summer	3	Native	FACW
Boneset	*Eupatorium perfoliatum*	*Asteraceae*	Marshes; wet roadsides	Summer	3	Native	FACW+
Large leaved aster	*Eurybia macrophylla*	*Asteraceae*	Roadsides	Summer	3	Native	
Common strawberry	*Fragaria virginiana*	*Rosaceae*	Fields, open thickets & woods	Spring	3	Native	FACU
Herb Robert	*Geranium robertianum*	*Geraniaceae*	Rich, rocky hardwoods; rich oak talus slopes	Early summer	3	Native/Introduced	
Day lily	*Hemerocallis fulva*	*Liliaceae*	Roadsides; fields; yards	Summer	3	Exotic	
Panicled hawkweed	*Hieracium paniculatum*	*Asteraceae*	Roadsides; fields; dry open woods	July	3	Native	
Field hawkweed	*Hieracium pratense*	*Asteraceae*	Roadsides; meadows; open places	Late spring/summer	3	Exotic	
Jewelweed	*Impatiens capensis*	*Balsaminaceae*	Wet soils, wetland edges, roadsides	Summer	3	Native	FACW
Blue flag iris	*Iris versicolor*	*Iridaceae*	Sunny wetlands	June-July	3	Native	OBL
Whorled loosestrife	*Lysimachia quadrifolia*	*Primulaceae*	Roadsides; wetland edges	Summer	3	Native	FACU-
Purple loosestrife	*Lythrum salicaria*	*Lythraceae*	Marshes and wet roadsides	Summer	3	Exotic	FACW+

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (3 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Alfalfa	*Medicago sativa*	*Fabaceae*	Fields	Summer	3	Exotic	
Sweetclover	*Melilotus alba*	*Fabaceae*	Roadsides	Summer	3	Exotic	FACU-
White water lily	*Nymphaea odorata*	*Nymphaceae*	Ponds	Summer	3	Native	OBL
Common evening primrose	*Oenothera biennis*	*Onagraceae*	Roadsides; fields	Summer	3	Native	FACU-
Arrowleaf Tearthumb	*Polygonum sagittatum*	*Polygonaceae*	Wet meadows; marshes; pond edges	Summer	3	Native	OBL
Dwarf cinquefoil	*Potentilla canadensis*	*Rosaceae*	Mixed, dry woods	Late spring	3	Native	
Gall of the Earth	*Prenanthes trifoliata*	*Asteraceae*	Roadsides; Mixed, dry woods	Summer	3	Native	
Selfheal	*Prunella vulgaris*	*Lamiaceae*	Woods roads, roadsides	Summer	3	Native	FACU+
Dewberry	*Rubus flagellaris*	*Rosaceae*	Upland mixed forests	Summer	3	Native	UPL
Bitter dock	*Rumex obtusifolius*	*Polygonaceae*	Roadsides	Summer	3	Exotic	FACU-
False solomons-seal	*Smilacina racemosa*	*Liliaceae*	Roadsides; rich woods; stream sides	Spring	3	Native	FACU-
Early goldenrod	*Solidago juncea*	*Asteraceae*	Roadsides; fields	Summer	3	Native	
Branching bur reed	*Sparganium androcladum*	*Sparganiaceae*	Shallow ponds; marshes	Summer	3	Native	OBL
Meadowsweet	*Spiraea latifolia*	*Rosaceae*	Meadows; wetlands; roadsides	Summer	3	Native	FACW+
Steeplebuch	*Spiraea tomentosa*	*Asteraceae*	Meadows; marsh edges	Summer	3	Native	FACW
Hop clover	*Trifolium agrarium*	*Fabaceae*	Fields, roadsides	Summer	3	Exotic	
Alsike clover	*Trifolium hybridum*	*Fabaceae*	Fields	Spring-summer	3	Exotic	FACU-
Sessile bellwort	*Uvularia sessilifolia*	*Liliaceae*	Hardwoods, roadsides, moist soils	Early spring	3	Native	FACU-
Mullein	*Verbascum thapsus*	*Scrophulariaceae*	Fields; disturbed areas	Summer	3	Exotic	
Periwinkle	*Vinca minor*	*Apocynaceae*	Roadsides; cellar holes; homesteads	Early spring	3	Exotic	
Bristly sarsaparilla	*Aralia hispida*	*Araliaceae*	Dry woods & shrublands; fields;	Summer	2	Native	
Bushy aster	*Aster dumosus*	*Asteraceae*	Roadsides; fields	Summer	2	Native	FAC
New England aster	*Aster nova-angliae*	*Asteraceae*	Roadsides; meadows; open places	Spring-summer	2	Native	FACW-
Pipsissewa	*Chimaphila umbellata*	*Pyrolaceae*	Acid woods	Early summer	2	Native	

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (4 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Bulb bearing water hemlock	*Cicuta bulbifera*	*Apiaceae*	Swamps; pond edges; forested wetlands	Summer	2	Native	OBL
Water hemlock	*Cicuta maculata*	*Apiaceae*	Wetlands	Summer	2	Native	OBL
Blue-bead lily	*Clintonia borealis*	*Liliaceae*	Cool, conifer woods	Spring	2	Native	FAC
Trailing arbutus	*Epigaea repens*	*Ericaceae*	Compacted soils; sides of woods roads, trails	Spring	2	Native	
Helleborine	*Epipactis helleborine*	*Orchidaceae*	Uncommon, but in a variety of habitats	Early summer	2	Exotic	
Sweet scented bedstraw	*Galium triflorum*	*Rubiaceae*	Mixed, dry woods	Late spring	2	Native	FACU
Downy rattlesnake plantain	*Goodyera pubescens*	*Orchidaceae*	Shaded coniferous woods	Summer	2	Native	FACU-
Bluets	*Houstonia caerulea*	*Rubiaceae*	Mixed, dry woods	Spring	2	Native	FACU
Common St. Johnswort	*Hypericum perforatum*	*Clusiaceae*	Fields, roadsides, yards	Summer	2	Exotic	
Indian pipe	*Monotropa uniflora*	*Monotropaceae*	Shaded woods; parasitic	Summer	2	Native	FACU-
Pokeweed	*Phytolacca americana*	*Phytolaccaceae*	Roadsides; fields	Summer	2	Native	FACU+
Solomons seal	*Polygonatum biflorum*	*Liliaceae*	Rich and semi-rich upland forests	Early summer	2	Native	FACU
Japanese knotweed	*Polygonum cuspidatum*	*Polygonaceae*	Roadsides	Summer	2	Exotic	FACU-
Mild water pepper	*Polygonum hydropiperoides*	*Polygonaceae*	Ponds; marshes	Summer	2	Native	OBL
Common cinquefoil	*Potentilla simplex*	*Rosaceae*	Roadsides; fields	Spring	2	Native	FACU-
Dewberry	*Rubus hispidus*	*Rosaceae*	Wet forests, wetland edges	Summer	2	Native	FACW
Flowering raspberry	*Rubus odoratus*	*Rosaceae*	Thickets, streamsides	Summer	2	Native	
Sheep sorrel	*Rumex acetosella*	*Polygonaceae*	Roadsides and jeep trails; summits	June-July	2	Exotic	UPL
Marsh skullcap	*Scutellaria epilobiifolia*	*Lamiaceae*	Marshes; wet roadsides	Summer	2	Native	OBL
Mad dog skullcap	*Scutellaria lateriflora*	*Lamiaceae*	Forested wetlands	Early summer	2	Native	FACW+
Water parsnip	*Sium suave*	*Apiaceae*	Swamps; pond edges	Summer	2	Native	OBL
Giant goldenrod	*Solidago gigantea*	*Asteraceae*	Roadsides; fields; meadows; wet areas	Summer	2	Native	FACW
Skunk cabbage	*Symplocarpus foetidus*	*Araceae*	Forested wetlands, red maple	Summer	2	Native	OBL

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (5 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Early meadow-rue	*Thalictrum dioicum*	*Ranunculaceae*	Stream sides; wet places	Spring	2	Native	FAC
Painted trillium	*Trillium undulatum*	*Liliaceae*	Cool, slightly acid woods	Early spring	2	Native	
Indian poke	*Veratrum viride*	*Liliaceae*	Stream sides; forested wetlands	Summer	2	Native	FACW+
Common speedwell	*Veronica officianalis*	*Scrophulariaceae*	Dry woods	Spring	2	Exotic	FACU-
Wood anemone	*Anemone quinquefolia*	*Ranunculaceae*	Stream sides	Spring	1	Native	FACU
Smaller pussytoes	*Antennaria howellii*	*Asteraceae*	Dry, open woods	Summer	1	Native	
Plantain leaved pussytoes	*Antennaria plantaginifolia*	*Asteraceae*	Moist talus slopes	Summer	1	Native	
Indian hemp	*Apocynum cannabinum*	*Apocynaceae*	Meadows	Summer	1	Native	FACU
Poke milkweed	*Asclepias exaltata*	*Asclepidaceae*	Rich woods	Early summer	1	Native	FACU
Swamp milkweed	*Asclepias incarnata*	*Asclepidaceae*	Wetlands	Summer	1	Native	OBL
Stiff aster	*Aster linariifolius*	*Asteraceae*	Summits	Late Summer	1	Native	
Heath aster	*Aster pilosus*	*Asteraceae*	Roadsides; meadows; open places	Summer	1	Native	
Fern leaved false foxglove	*Aureolaria pedicularia var. intercedens*	*Scrophulariaceae*	Dry, open oak-pine woodlands	Mid-late summer	1	Native	
Enchanters nightshade	*Circaea quadrisulcata var. canadensis*	*Onagraceae*	Moist hardwood talus slopes	July	1	Native	FACU
Poison hemlock	*Conium maculatum*	*Apiaceae*	Roadsides; forested wetlands	Summer	1	Exotic	FACW
Pale corydalis	*Corydalis sempervirens*	*Fumariaceae*	Talus slopes	July	1	Native	
Pink lady's slipper	*Cypripedium acaule*	*Orchidaceae*	Under white pine; bog margins	Late spring	1	Native	FACU
Dew drop	*Dalibarda repens*	*Rosaceae*	Wet forests	Summer	1	Native	FAC
Swamp loosestrife	*Decodon verticillatus*	*Lythraceae*	Ponds	Summer	1	Native	OBL
Pointedleaf tick-trefoil	*Desmodium glutinosum*	*Fabaceae*	Roadsides	Summer	1	Native	
Prostrate tick-trefoil*	*Desmodium rotundifolium**	*Fabaceae*	Rich dry woods	Late Summer	1	Native	
Round-leaved sundew	*Drosera rotundifolia*	*Droseraceae*	Acid wetlands; peatlands	Summer	1	Native	OBL

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (6 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Narrow leaved gentian	*Gentiana linearis*	*Gentianaceae*	Pond edges; forested wetlands	Late summer	1	Native	OBL
Canada hawkweed	*Hieracium canadense*	*Asteraceae*	Roadsides	Summer	1	Native	
Rough hawkweed	*Hieracium scabrum*	*Asteraceae*	Fields; meadows	Summer	1	Native	
Pale St. Johnswort	*Hypericum ellipticum*	*Clusiaceae*	Wetlands	Early summer	1	Native	OBL
Yellow Iris	*Iris pseudacorus*	*Iridaceae*	Wetlands; stream sides	Spring	1	Exotic	OBL
Bush clover	*Lespedeza violacea*	*Fabaceae*	Dry sandy open area	Summer	1	Native	
Butter-and-eggs	*Linaria vulgaris*	*Scrophulariaceae*	Roadsides; disturbed areas	Summer	1	Exotic	
Cardinal flower	*Lobelia cardinalis*	*Campanulaceae*	Stream edges	Summer	1	Native	FACW+
Indian tobacco	*Lobelia inflata*	*Campanulaceae*	Open woods	Summer	1	Native	FACU
Ragged robin	*Lychnis flos-cuculi*	*Caryophllyaceae*	Fields	Summer	1	Exotic	FACU
Northern bugleweed	*Lycopus uniflorus*	*Lamiaceae*	Wooded swamps	Mid-late summer	1	Native	OBL
Pinesap	*Monotropa hypopithys*	*Monotropaceae*	Shaded woods; parasitic	Summer	1	Native	
Wood-sorrel	*Oxalis europaea*	*Oxalidaceae*	Mixed, dry woods	Late spring	1	Native	UPL
Wood-sorrel	*Oxalis montana*	*Oxalidaceae*	Moist, shaded woods	Spring	1	Native	FAC-
Dwarf ginseng	*Panax trifolius*	*Araliaceae*	Rich, moist woods; stream sides	Early spring	1	Native	
Coastal jointweed	*Polygonella articulata*	*Polygonaceae*	Dry, open sandy soils; roadsides	Summer	1	Native	
Carey's knotweed	*Polygonum careyi*	*Polygonaceae*	Roadsides	Summer	1	Native	FACW
Sulpher cinquefoil	*Potentilla recta*	*Rosaceae*	Roadsides	Summer	1	Exotic	
Three-toothed cinquefoil	*Potentilla tridentata*	*Rosaceae*	Barren summits	June-July	4	Native	
White lettuce	*Prenanthes alba*	*Asteraceae*	Rich woods	Early summer	1	Native	FACU
Short tooth mountain mint	*Pycnanthemum muticum*	*Lamiaceae*	Roadsides	Summer	1	Native	FACW
Round leaved pyrola	*Pyrola rotundifolia*	*Pyrolaceae*	Coniferous woods	Summer	1	Native	FAC
Greenish-flowered pyrola	*Pyrola virens*	*Pyrolaceae*	Mixed, acidic woods	Early Summer	1	Native	UPL
Red raspberry	*Rubus idaeus*	*Rosaceae*	Cool, shaded woods; thickets	Early summer	1	Native/Introduced	FAC-
Downy goldenrod	*Solidago puberula*	*Asteraceae*	Dry woodland openings; shrublands	Summer	1	Native	FACU-

WILDFLOWERS, FORBS, & HERBS OF LYNDEBOROUGH (7 OF 7)

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Season in flower	Freq Index	Native Status	Wetland indicator
Rough goldenrod	*Solidago rugosa*	*Asteraceae*	Roadsides; meadows; open places	Summer	4	Native	FAC
Foamflower	*Tiarella cordifolia*	*Saxifragaceae*	Rich; wet woods	Spring	1	Native	FAC-
Red trillium	*Trillium erectum*	*Liliaceae*	Moist, open, rich woods	Spring	2	Native	FACU-
Inflated bladderwort	*Utricularia inflata*	*Lentibulariaceae*	Ponds	Summer	2	Native	OBL
Swamp verbena	*Verbena hastata*	*Verbenaceae*	Marshes and open swamps	Summer	1	Native	FACW+
Marsh speedwell	*Veronica scutellata*	*Scrophulariaceae*	Marshes	Early Summer	1	Native	OBL

Wildflowers reported by Hague (2005) for the Rose Mountain Area:

Arrow arum	*Peltandra virginica*
Monkey flower	*Mimulus rigens*
False nettle	*Boehmaria cylindrical*
Nodding ladies tresses	*Spiranthes cernua*
Giant burr reed	*Sparganium eurycarpum*
Turtlehead	*Chelone glabra*

FOREST VINES OF LYNDEBOROUGH

Common Hop	*Humulus lupulus*	*Cannabaceae*	Rich thickets	1	Exotic	
Asiatic bittersweet	*Celastrus orbiculatus*	*Celastraceae*	Widespread in thickets, disturbed areas, roadsides	4	Exotic	UPL
Virginia creeper	*Parthenocissus quinquefolia*	*Vitaceae*	Rich woods and talus; homesteads	3	Native	FACU
Fringed bindweed	*Polygonum cilinode*	*Polygonaceae*	Rich wooded talus slopes	3	Native	
Bittersweet nightshade	*Solanum dulcamara*	*Solanaceae*	Roadsides; wetlands	3	Exotic	

FERNS OF LYNDEBOROUGH

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Freq Index	Wetland indicator
Hay-scented fern	*Dennstaedtia punctilobula*	*Dennstaedtiaceae*	Common in woods & fields	5	
Bracken fern	*Pteridium aquilinum*	*Dennstaedtiaceae*	Common in dry woods and clearings	4	FACU
Maidenhair fern	*Adiantum pedatum*	*Pteridaceae*	Rich mesic northern hardwoods	1	FAC-
Long beech fern	*Phegopteris connectilis*	*Thelypteridaceae*	Rich, moist woods	1	
New York fern	*Thelypteris noveboracensis*	*Thelypteridaceae*	Widespread, common in damp woods	4	FAC
Marsh fern	*Thelypteris palustris*	*Thelypteridaceae*	Small wooded upland swamps	1	
Rock polypody	*Polypodium virginianum*	*Polypodiaceae*	On boulders, cliffs, ledges, talus	4	
Interrupted fern	*Osmunda clintoniana*	*Osmundaceae*	Roadsides, ditches, wetland edges	2	FACU-
Royal-fern	*Osmunda regalis*	*Osmundaceae*	Forested wetlands, roadsides	3	OBL
Cinnamon fern	*Osmunda cinnamomea*	*Osmundaceae*	Widespread; roadsides; wetlands	4	FACW
Marginal wood-fern	*Dryopteris marginalis*	*Dryopteridaceae*	Dry to moist woods, uplands	4	FACU-
Sensitive fern	*Onoclea sensibilis*	*Dryopteridaceae*	Wet fields, wetlands, swamps	4	FACW
Spinulose wood-fern	*Dryopteris carthiusiana*	*Dryopteridaceae*	Wetland edges	2	FAC+
Goldies fern*	*Dryopteris goldiana**	*Dryopteridaceae*	Wetland edges	1	FAC+
Christmas fern	*Polystichum acrostichoides*	*Dryopteridaceae*	Rich, rocky woods	2	FACU
Rusty woodsia	*Woodsia ilvensis*	*Dryopteridaceae*	Ledges in rocky oak woodlands	1	
Crested wood fern	*Dryopteris cristata*	*Dryopteridaceae*	Wooded swamps	1	FACW+
Evergreen wood-fern	*Dryopteris intermedia*	*Dryopteridaceae*	Mixed woods	4	
Ostrich fern	*Matteuccia struthiopteris*	* reported by Hague (2005) for the Rose Mountain Area			

CLUB-MOSSES OF LYNDEBOROUGH

Northern ground cedar	*Diphasiastrum complanatum*	*Lycopodiaceae*	Mature mixed woods	2	FACU-
Princess pine	*Dendrolycopodium obscurum*	*Lycopodiaceae*	Common in most woods	4	FACU
Bristley club-moss	*Spinulum annotinum*	*Lycopodiaceae*	Openings in northern hardwoods	2	FAC
Shining firmoss	*Huperzia lucidula*	*Lycopodiaceae*	Rich mature hardwoods	1	
Running club-moss	*Lycopodium clavatum*	*Lycopodiaceae*	Dry oak-pine woods	1	FAC

GRASSES, SEDGES & RUSHES OF LYNDEBOROUGH

Common Name	*Scientific Name*	*Family (latin)*	Habitats	Freq Index	Wetland indicator
Canada bluejoint	*Calamagrostis canadensis*	*Poaceae*	Marshes; wet fields; streamsides	3	FACW+
Tall oatgrass	*Arrhenatherum elatius*	*Poaceae*	Orchards	1	FACU
Common hair-grass	*Deschampsia flexuosa*	*Poaceae*	Dry, open oak woodlands; rocky ledges	4	
Velvet panicum	*Panicum scoparium*	*Poaceae*	Roadsides; fields; meadows	3	FACW
Little bluestem	*Schizachyrium scoparium*	*Poaceae*	Roadsides; fields; dry openings	2	FACU-
Kentucky bluegrass	*Poa pratensis*	*Poaceae*	Fields; yards; open woods	3	FACU
Rice cutgrass	*Leersia oryzoides*	*Poaceae*	Emergent marshes	5	OBL
Orchard grass	*Dactylis glomerata*	*Poaceae*	Fields	4	FACU
Timothy	*Phleum pratense*	*Poaceae*	Fields	3	FACU
Mountain wavy hairgrass	*Deschampsia flexuosa Var. montana*	*Poaceae*	Dry, open oak woodlands; rocky ledges	1	
Long-awned wood grass	*Brachyelytrum aristosum*	*Poaceae*	Patches in mixed woods; roadsides	3	
Fine nerved sedge	*Carex leptonervia*	*Cyperaceae*	Rich deciduous upland woods	1	FACW
Rosy sedge	*Carex rosea*	*Cyperaceae*	Rich deciduous upland woods	2	
Tussock sedge	*Carex stricta*	*Cyperaceae*	Forested wetland; flood prone marshes	3	OBL
Fringed sedge	*Carex crinita*	*Cyperaceae*	Open wetlands	3	OBL
Inflated sedge	*Carex intumescens*	*Cyperaceae*	Wooded wetlands, marsh edges	3	FACW+
Pennsylvania sedge	*Carex pensylvanica*	*Cyperaceae*	Dry, open oak/pine woodlands	4	
Broadleaved sedge	*Carex platyphylla*	*Cyperaceae*	Rich talus slopes	1	
Three way sedge	*Dulichium arundinaceum*	*Cyperaceae*	Wetlands	3	OBL
Woolgrass	*Scirpus cyperinus*	*Cyperaceae*	Marshes	4	FACW+
Common Rush	*Juncus effusus*	*Juncaceae*	Wetlands and open hydric areas	3	FACW+

MUSHROOMS: THE MACROFUNGI OF LYNDEBOROUGH'S FORESTS

Contributed by Robin Arnold and edited by J. Trudeau

Mushrooms play a critical role in ecosystem structure, function, and composition. They are a vital component in the life cycle and health of a forest. Organic materials are broken down and decomposed so surrounding plant life and other organisms present in the habitat can more readily utilize the nutrients. Mushrooms also provide food for many forest wildlife including deer, squirrels, chipmunks, bear, and many insects. Some form a relationship with certain plants, called mycorrhizae, and provide the host plant with enhanced nutrient & water uptake and pathogen resistance abilities in exchange for the plants carbon and other minerals. It has also been proven that toxins are removed from soils in which mushrooms are growing

They form a network of "roots" called mycelium, which is the vegetative growth from which the fruiting body (mushroom) grows. It is the same idea as an apple tree to an apple; the mushroom being the fruit of the underground tree. Mycelium grows almost everywhere; under the bark of trees, into the heartwood of trees, under the ground or into rotting wood, even in the cracks of rocks. Saprophytic and parasitic types (see below for descriptions) rapidly perform their individual tasks as part of the forest cycle taking as little as 2 or 3 years to infest and break down dead or dying trees.

Lyndeborough's forests, wetlands, and fields depend on fungi as part of the intricate web of ecology. Equally, these mushrooms depend on their specific habitats. Maintaining a diverse, healthy environment for fungi maintains the health of all organisms; plants, animals, insects, and humans.

Below is a list of many that we have discovered in Lyndeborough, their habitat, and relationship to the substrate.

Latin Name – **Common Name** – Habitat Found - (S), (P), (M)

(S) =Saprophytic – Feeds on dead and/or decaying debris, breaks it down to more easily absorbed matter and nutrients for forest flora.
(P) = Parasitic – Causing damage or killing its host.
(M) = Mycorrhizal – Has a symbiotic relationship with its host, creating more nutrients and moisture, therefore healthier, more disease resistant trees.
Ones growing in grassy places (pastures, lawns etc…) may be mycorrhizal.
Sclerotia = Knot or "tuber" growing underground which when conditions are correct produces the fruiting body (mushroom).

1. *Agaricus arvensis* – **Horse Mushroom** – Meadows, grassy waste areas
2. *Agaricus campestris* – **Meadow Mushroom** – Grassy areas

3. *Agrocybe praecox* – **Spring Agrocybe** – Sawdust, leaf litter, rotting wood – (S)
4. *Aleuria aurantia* – **Orange Peel** – **hard soil, disturbed places – (S)**
5. *Amanita caesarea* **– Caesar's Mushroom** – Associated with pine - (M)
6. *Amanita muscaria* – **Fly Agaric** – Associated with pine – (M)
7. *Amanita muscaria v. formosa* – **Yellow Fly Agaric** - Associated with pine – (M)
8. *Amanita phalloides* – **Death Cap** – Associated with pine and oak – (M)
9. *Amanita rubescens* – **The Blusher** - Associated with pine and oak – (M)
10. *Amanita verosa* – **Destroying Angel** – Associated with pine and oak – (M)
11. *Armillaria caligata* – **Fragrant Armillaria** – In mixed woods – (S)
12. *Armillariella mellea sp.* – **Honey Mushroom** – Around stumps, bases of hardwoods – (S) (P)
13. *Boletinellus meruliodes* – **Ash Tree Bolete** – Associated with ash – (M)
14. *Boletus affinis* – **Spotted Bolete** – Under deciduous trees – (M)
15. *Boletus bicolor* – **Two-Colored Bolete** – Under oak and pine – (M)
16. *Boletus edulis* – **King Bolete, Cepe** – Under pine – (M)
17. *Boletus frostii* – **Frost's Bolete** – Associated with oak – (M)
18. *Boletus palidus* – N/A – Under hardwoods – (M)
19. *Boletus parasiticus* – **Parasitic Bolete** – Host is the Pigskin Puffball
20. *Boletus russellii* – **Russell's Bolete** – In mixed woods – (M)
21. *Boletus subglabripes* – N/A – Associated with birch and beech – (M)
22. *Boletus variipes* – N/A– Associated with hardwoods – (M)
23. *Bondarzewa berkeleyi* – **Berkeley's Polypore** – Base of large maple or oak – (P)
24. *Bulgaria inquinans* – **Black Jelly Drops** – On dead hardwood – (S)
25. *Calvatia gigantia* – **Giant Puffball** – Grassy areas
26. *Cantharellula umbonata* – **Grayling** – Associated with Hair-Cap moss – (M?)
27. *Cantharellus cibarius* – **Chanterelle** – Associated with hemlock and pine – (M)
28. *Cantharellus cinnabarinus* - **Cinnabar-red Chanterelle** – Edges of woods, in mossy areas – (S), (M)
29. *Cantharellus minor* – **Small Chanterelle** – Damp woods, beech and maple - (S), (M)
30. *Cantharellus tubaeformis* – **Trumpet Chanterelle** – Grows in decayed conifer wood – (S)
31. *Chlorociboria aeruginascens* – **Green Stain** – On rotting wood – (S)
32. *Christiansenia mycetophila* – **Collybia Jelly** – Attacks Collybia dryophila - (P)
33. *Clavicorona pyxidata* – **Crown-Tip Coral** – On rotting deciduous wood – (S)
34. *Clavulina amethystina* – **Violet-Branched Coral** – Deciduous woods – (S)
35. *Clavulinopsis fusiformis* **– Spindle Yellow Coral** – Moist mixed woods – (S)
36. *Climacodon septentrionale* – **Northern Tooth** – Wounds of hardwood, mostly maple – (P)
37. *Clitocybe clavipes* – **Fat-Footed Clitocybe** – Under white pine
38. *Clitocybe dealbata* – **Sweating Mushroom** – Grassy areas
39. *Clitocybe gibba* – **Funnel Clitocybe** – Oak woods – (S)
40. *Clitocybe gigantia* – **Giant Clitocybe** – Mixed wood debris – (S)
41. *Clitocybe odora* – **Anise Mushroom** – In mixed woods – (S)
42. *Clitopilus prunulus* – **Sweatbread Mushroom** – Open woods, under oak or pine
43. *Collybia dryophila* – **Oak Loving Colybia** – Under oak, in debris – (S)
44. *Coltricia cinnamomea* – **Fairy Stool** – Along paths, clearings, roadsides – (S)
45. *Coprinus atramentarius* – **Alcohol Inky** – Wood debris – (S)
46. *Coprinus comatus* – **Shaggy Mane** – Under deciduous trees – (S)
47. *Coprinus micaceus* – **Mica Cap** – Base of hardwoods, wood debris – (S)
48. *Cordyceps capitata* – **Headlike Cordyceps** – Grows off Deer Truffle (*Elaphomyces*)
49. *Cordyceps ophioglossoides* – **Goldenthread Cordyceps** – same as above
50. *Cortinarius armillatus* – **Bracelet Cort** – Associated with birch – (M)
51. *Cortinarius iodes* – **Viscid-violet Cort** – Deciduous woods – (M)
52. *Cortinarius sanguineus* – **Red Gilled Cort** – Moss under conifers – (M)
53. *Craterellus fallax* – **Black Trumpet** – Deciduous leaf litter – (S)
54. *Daedalea quercina* – **Thick-maze Oak Polypore** – On dead oak – (S)
55. *Daldinia concentrica* – **Crampball, Carbon Balls** – Dead hardwood branches – (S)
56. *Dentinum albidum* – N/A – Mixed woods – (S)
57. *Dentinum repandum* – **Sweet Tooth** – Under conifers and deciduous trees – (S)
58. *Entoloma abortivum* – **Aborted Entoloma** – Leaf litter, rotten wood – (S)

59. *Favolus alveolaris* – **Hexagonal-pored Polypore** – On dead deciduous wood – (S)
60. *Fomes fomentarius* – **Tinder Polypore** – Deciduous trees – (S), (P)
61. *Fomitopsis pinnicola* – **Red-Belted Polypore** – Birch trees – (S)
62. *Ganoderma applanatum* – **Artist's Conk** – Maples – (S), (P)
63. *Ganoderma lucidum* – **Reishi** – Maples - (S), (P)
64. *Ganoderma tsugae* – **Hemlock Varnish Shelf** – Hemlocks – (S), (P)
65. *Gomphus floccosus* – **Scaly-Vase Chanterelle** – Under conifers – (M)
66. *Grifola frondosa* – **Hen of the Woods, Maitake** – Base of old oaks, stumps – (S, (P)
67. *Gyromitra esculenta* – **False Morel** – Under conifers – (S)
68. *Gyromitra fastigiata* – **Thick-Stalked False Morel** – Mixed woods – (S)
69. *Gyromitra gigas* – **Snowbank False Morel** – Under conifers – (S)
70. *Gyroporus castaneus* – **Chestnut Bolete** – Under hardwoods
71. *Gyroporus cyanescens* – **Bluing Bolete** – Beech woods
72. *Helvella crispa* – **White Helvella** – Open, mixed woods – (S)
73. *Hericium erinaceus* – **Lion's Mane** – Beech trees, sometimes maple – (S)
74. *Hericium coralloides* – **Comb tooth** – same as above – (S)
75. *Hydnum imbricatum* – **Shingled Hedgehog** – Mixed woods – (S)
76. *Hygrophoropsis aurantiaca* – **False Chanterelle** – Decaying conifer matter – (S)
77. *Hygrophorus calophyllus* – N/A – Mixed woods – (S)
78. *Hygrophorus coccineus* – **Scarlet Waxy** – Mixed woods – (S)
79. *Hygrophorus flavescens* – **Golden Waxy Cap** – Mixed woods, mossy areas – (S)
80. *Hygrophorus flavidiscus* – **Yellow Centered Waxy** – Mixed woods, mossy areas – (S)
81. *Hygrophorus psittacinus* – **Parrot Mushroom** – Mixed woods – (S)
82. *Hypomyces lactifluorum* – **Lobster Mushroom** – Is parasitic to the genera Lactarius and Russula.
83. *Hypomyces hyalinas* – N/A – Is parasitic to species of Amanita.
84. *Inonotus obliquus* – **Birch Canker, Chaga** – Wounds of various birch species – (P)
85. *Laccaria amethystina* – **Amethyst Laccaria** – On edges and in mixed woods – (S)
86. *Laccaria laccata* – **Common Laccaria** – Poor soil, disturbed places – (S)
87. *Laccaria ochropurpurea* – **Purple-Gilled Laccaria** – Open oak woods – (S)
88. *Lactarius deliciosus* – **Orange Latex Milky** – Under pine – (M)
89. *Lactarius fragilis* – **Candy Cap** – Mixed woods – (M)
90. *Lactarius gerardii* – **Gerard's Milky** – Mixed woods – (M)
91. *Lactarius hygrophoroides* – **Hygrophorus Milky** - Edges of woods, disturbed places – (M)
92. *Lactarius paradoxus* **– Silvery-Blue Milky** – Grassy, open areas
93. *Lactarius piperatus* – **Peppery Milky** – Pine, mixed woods – (M)
94. *Lactarius subpurpureus* – **Variegated Milky** – Under Hemlock – (M)
95. *Lactarius vinaceorufescens* – **Yellow-latex Milky** – Under pine – (M)
96. *Lactarius volemus* – **Voluminous Milky** – Under conifers – (M)
97. *Laetiporus sulphureus* – **Chicken Mushroom** – Deciduous trees – (P)
98. *Laetiporus sulphureus v. semialbinus* – N/A - Deciduous trees – (P)
99. *Leccinum aurantiacum* – **Red Cap Scaber Stalk** – Mixed woods – (M)
100. *Leccinum holopsus* – N/A – Under birch trees – (M)
101. *Leccinum scabrum* – **Common Scaber Stalk** – Under birch trees – (M)
102. *Lentia lubrica* – **Ochre Jelly Club** – Mixed woods – (S)
103. *Lentia viscosa* – **Green-headed Jelly Club** – Mixed woods – (S)
104. *Lepiota americana* – **Reddening Lepiota** – Sawdust piles, waste areas – (S)
105. *Lepista nuda* – **Blewit** – Wood debris – (S)
106. *Lycoperdon perlatum* – **Gem-Studded Puffball** – Grassy, open places
107. *Lycoperdum pyriforme* – **Pear-Shaped Puffball** – Rotting, buried wood – (S)
108. *Macrolepiota procera* – **Parasol Mushroom** – Grassy areas
109. *Marasmius oreades* – **Fairy Ring** – Grassy areas
110. *Marasmius rotula* – **Pinwheel Marasmius** – Rotting debris, stumps – (S)
111. *Marasmius scorodonius* – **Garlic Marasmius** – Wood debris – (S)
112. *Morchella sp.* – **Small, Dark Grayish Morel** – Mixed woods, burned matter - Grows from sclerotia.
113. *Morchella esculenta* – **Yellow Morel** – Old apple orchards, beech woods etc… - Grows from sclerotia.
114. *Mycena haematopus* – **Bleeding Mycena** – On rotting wood – (S)

115. *Naematoloma fasciculare* – **Sulphur Tuft** – Rotting logs, stumps – (S)
116. *Naematoloma sublateritium* – **Brick Tops** – Rotting logs, stumps – (S)
117. *Omphalotus illudens* – **Jack-O-Lantern** – Base of stumps or on buried roots of hardwoods – (S)
118. *Oudemansiella radicata* – **Rooted Oudi** – Around deciduous stumps, esp. beech
119. *Panaeolus campanulatus* – **Bell Cap Panaeolus** – Cow dung – (S)
120. *Panellus serotinus* – **Late Fall Oyster** – On conifers or hardwood – (S)
121. *Paxillus atrotomentosus* – **Velvet-Footed Pax** – Stumps, buried wood – (S)
122. *Paxillus involutus* – **Poison Pax** – Mixed woods – (S)
123. *Perenniporia fraxinophila* – **Ash Heart Rot** – Ash trees (P)
124. *Peziza badio*-confusa – **Common Brown Cup** – On ground, mixed woods – (S)
125. *Phallus ravenelii* – **Ravenel's Stinkhorn** – Wood debris – (S)
126. *Pholiota squarrosoides* – **Sharp-Scaly Pholiota** – Beech, birch or maple trees – (P)
127. *Phylloporus rhodoxanthus* – **Gilled Bolete** – Mixed woods – (S)
128. *Phyllotopsis nidulans* – **Orange Mock Oyster** – On conifers and hardwoods – (S)
129. *Piptoporus betulinus* – Birch Polypore – On white birch trees – (S), (P)
130. *Pleurocybella porrigens* – **Angel Wings** – Rotting stumps – (S)
131. *Pleurotus ostreatus* – **Oyster Mushroom** – Living or dead hardwoods – (S), (P)
132. *Pluteus cervinus* – **Fawn Mushroom** – On wood, sawdust piles – (S)
133. *Polyporus brumalis* – **Winter Polypore** – Dead deciduous wood – (S)
134. *Polyporus squamosus* – **Dryad's Saddle** – Maple trees – (P)
135. *Polyporus umbellatus* – **Umbrella Polypore** – Base of deciduous trees – Grows from sclerotia
136. *Psathyrella candolleana* – **Common Psathrella** – Rotting wood debris – (S)
137. *Psathyrella foenisecii* – **Lawn Mower's Mushroom** – Grassy areas
138. *Psathyrella velutina* – **Velvet Psath** – Open grassy areas
139. *Pseudocolus schellenbergiae* – **Stinky Squid** – Wood borders, gardens – (S)
140. *Pseudohydnum gelatinosum* – **Jelly Tooth** – On rotting conifer – (S)
141. *Psilocbe coprophila* – **Dung Loving Psilocybe** – Horse manure – (S)
142. *Pycnoporus cinnabarinus* – **Cinnabar-red Polypore** – Dead hardwood – (S)
143. *Ramaria aurea* - **Yellow Coral** – Mixed woods – (S)
144. *Ramaria botrytis* – **Clustered Coral** – Under conifers – (S)
145. *Ramaria stricta* – **Straight Branched Coral** – On Logs and stumps – (S)
146. *Rozites caperata* – **The Gypsy** – Mixed woods
147. *Russula aeruginea* – **Tacky Green Russula** – Mixed woods – (M)
148. *Russula compacta* – **Firm Russula** – Beech and maple woods – (M)
149. *Russula crustosa* – **Green Quilt Russula** – Mixed woods – (M)
150. *Russula emetica* - **Emetic Russula** – Mixed woods – (M)
151. *Russula mariae* – **Purple Bloom Russula** – Oak woods – (M)
152. *Russula variata* – **Variable Russula** – Deciduous woods – (M)
153. Scleroderma citrinum – **Pigs Skin Poison Puffball** – Wood debris in sandy soil – (S*)*
154. *Scizophyllum commune* – **Split Gill** – Dead branches of hardwood trees – (S)
155. *Sparassis herbstii* – **Eastern Cauliflower Mushroom** – Base of conifers – (P)
156. *Spathularia velutipes* – **Velvety Fairy Fan** – Rotting hardwood – (S)
157. *Stereum ostrea* – **False Turkey Tail** – Hardwood logs and stumps – (S)
158. *Stropharia rugoso-annulata* – **Wine Cap** – Wood debris, sawdust – (S)
159. *Strombilomyces flocopus* – **Old Man of the Woods** – Mixed woods – (S)
160. *Suillus americanus* – **Chicken Fat Suillus** – Associated with Eastern white pine – (M)
161. *Suillus granulatus* - **Dotted Stalk Suillus** – Under pine, spruce or hemlock – (M)
162. *Suillus leuteus* – **Slippery Jack** – Under Scots or red pine – (M)
163. *Suillus placidus* – **White Suillu**s – Associated with Eastern white pine – (M)
164. *Trametes versicolor* – **Turkey Tail** – Logs and stumps of hardwoods – (S)
165. *Tremella foliacea* – **Jelly Leaf** – On stumps, logs, branches of deciduous trees – (S)
166. *Tremella mesenterica* – **Witches' Butter** – Logs, sticks and stumps of hardwood – (S)
167. *Trichaptum biformis* – **Violet Toothed Polypore** – On dead deciduous wood – (S)
168. *Tricholoma magnivelare* – **Matsutake –** In pine forests (M)
169. *Tricholomopsis platyphylla* – **Platterful Mushroom** – Around stumps, wood debris – (S)
170. *Tylopilus chromapes* – **Chrome Footed Bolete** – Mixed woods – (M)

171. *Tylopilus eximius* – **Lilac-Brown Bolete** – Associated with hemlock – (M)
172. *Tylopilus felleus* – **Bitter Bolete** – Mixed woods – (M)
173. *Tylopilus gracilis* – **Graceful Bolete** – Mixed woods – (M)
174. *Volvariella bombycina* – **Tree Volvariella** – Wounds of hardwoods – (S), (P)

PLANT SPECIES ANALYSIS

Total Plant & Mushroom Species Positively Identified

Trees	Shrubs	Herbs & Vines	Ferns & Club-mosses	Grasses & Relatives	Macrofungi
36	51	154	23	21	174

Native/Exotic Status

	Native Species	Exotic Species
Trees	33 (92%)	3 (8%)
Shrubs	46 (90%)	5 (10%)
Herbs & Vines	124 (81%)	30 (19%)
Ferns & Club-mosses	23 (100%)	0 (0%)
Grasses & Relatives	17 (81%)	4 (19%)
Total	**243 (85%)**	**42 (15%)**

Prohibited Invasive Species in Lyndeborough

Autumn olive	*Elaeagnus umbellata*	Common in old fields & roadsides
Common buckthorn	*Rhamnus cathartica*	Uncommon, cellar holes, roadsides
Asiatic bittersweet	*Celastrus orbiculatus*	Very common, roadsides, tree canopies
Tartarian honeysuckle	*Lonicera tatarica*	Common in old fields & roadsides
Purple loosestrife	*Lythrum salicaria*	Widespread in marshes
Japanese knotweed	*Polygonum cuspidatum*	Locally common on roadsides
Common buckthorn	*Rhamnus cathartica*	Uncommon, cellar holes, roadsides
Multiflora rose	*Rosa multiflora*	Uncommon, roadsides & old fields
Japanese barberry	*Berberis thunbergii*	Uncommon to severe in old fields

Roadsides and farm fields host the most significant outbreaks of these species. The shrubs were seldom encountered in the forest, except for occasional individuals at cellar holes, and in forest areas close to densely populated areas. Purple loosestrife, however, occurs in high density and abundance in several marsh wetlands. The map on the following page identifies significant invasion sites, and species details can be found within the GIS metadata.

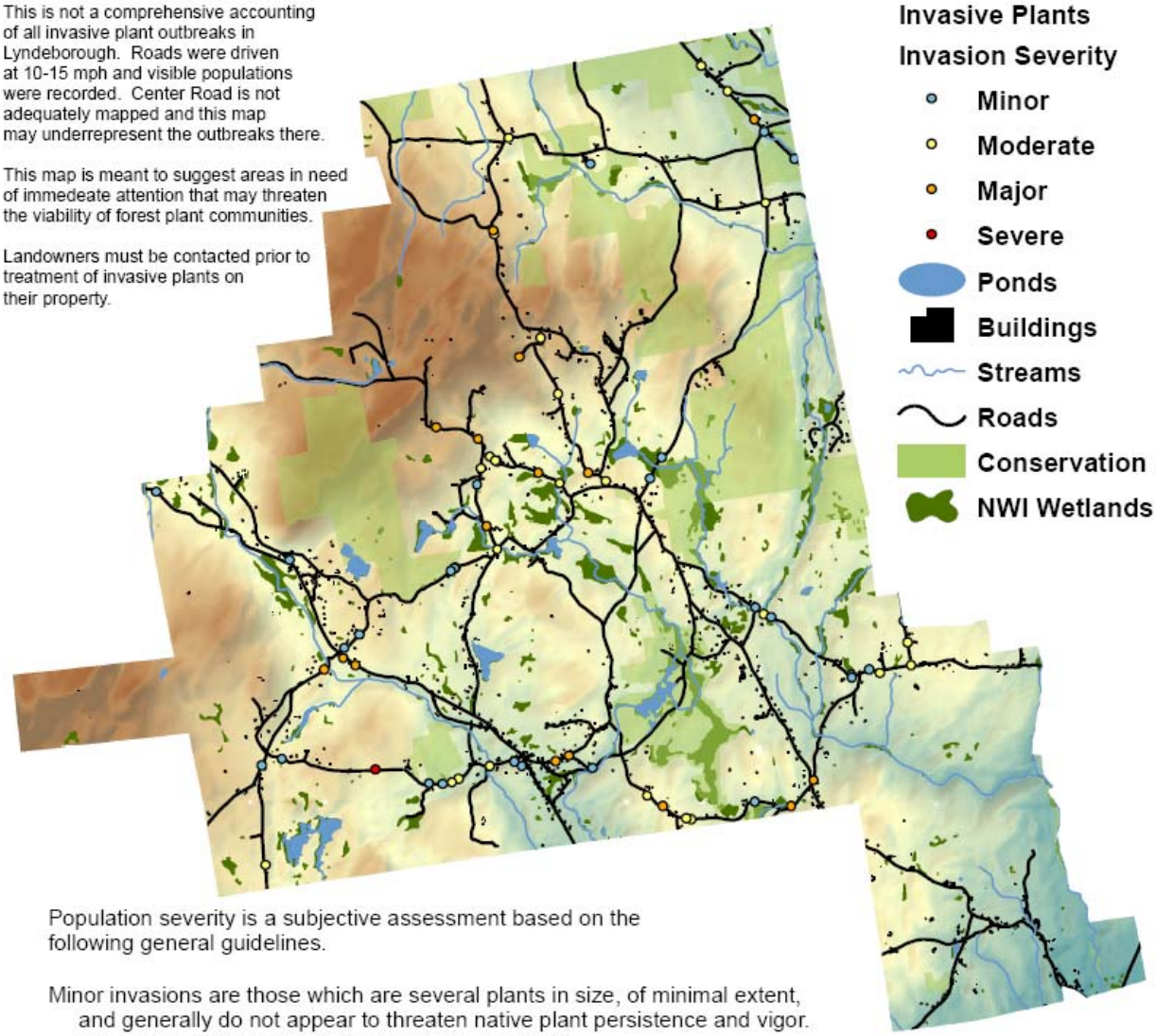
Significant Invasive Plant Populations

Each point may have one to several species present.
This information is included in the GIS layer metadata.

This is not a comprehensive accounting of all invasive plant outbreaks in Lyndeborough. Roads were driven at 10-15 mph and visible populations were recorded. Center Road is not adequately mapped and this map may underrepresent the outbreaks there.

This map is meant to suggest areas in need of immedeate attention that may threaten the viability of forest plant communities.

Landowners must be contacted prior to treatment of invasive plants on their property.



Population severity is a subjective assessment based on the following general guidelines.

Minor invasions are those which are several plants in size, of minimal extent, and generally do not appear to threaten native plant persistence and vigor. These populations are relatively easy to eradicate.

Moderate invasions appear to be populations of several to a couple dozen individuals that are beginning to reduce native species dominance. Moderately difficult to eradicate.

Major invasions have spread to many dozens of individuals over a larger area that have significantly impacted native species. Marks on the map may indicate extensive stretches of roadside affect by these species. Very difficult to eradicate, will require years of effort.

Severe invasions are those that completly dominate the ecology of an area to the near total exclusion of native species. These may be impossible to eradicate without intensive applications of chemicals in repeated treatments.

1:75,000

0 1 2 4 Miles

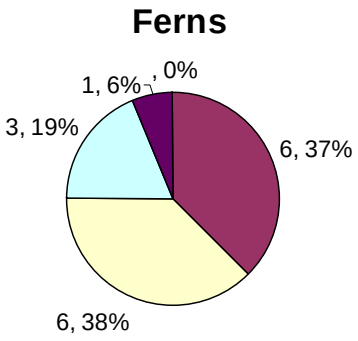
N
W E
S

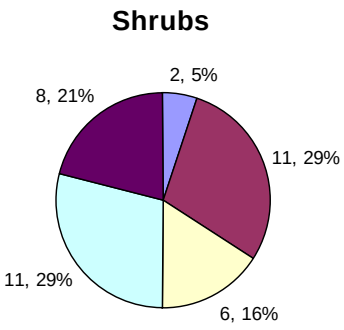
PLANT SPECIES ANALYSIS: WETLAND INDICATOR STATUS

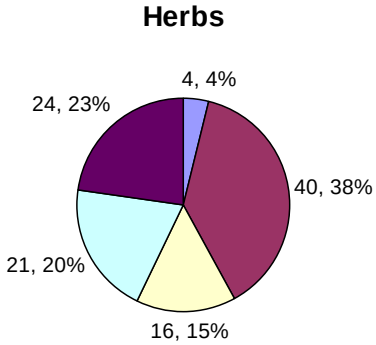
Many plant species have been classified as wetland and/or upland indicators according to the US Fish & Wildlife Service (1988; 1992). Each plant identified, except trees, during this NRI has a status according to the table below or is considered a non-indicator. These data can be used to assist conservation or planning efforts, sites walks, and development proposals. The charts below illustrate the habitat preferences of Lyndeboroughs plants based on wetland indicator status. The results indicate that wetlands are disproportionately important for plant diversity versus upland habitats based on their limited extent in Lyndeborough.

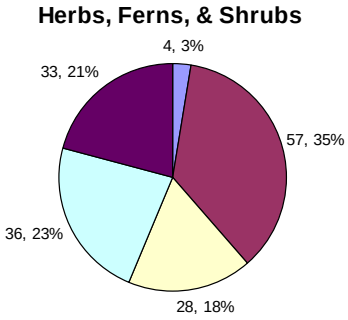
Indicator categories

Indicator Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.









Significant Observations of Lyndeborough's Flora

- A small portion of Lyndeborough's plants are strictly upland plants (3%).
- A substantial portion of the plants are strictly wetland plants (21%)
- Fern species are the most tolerant of a broad range of soil wetness, but most species prefer upland sites or have a tolerance for both
- Wetlands generally support more shrub species than uplands as 50% are OBL or FACW
- Overall, most species (56%) prefer uplands but will tolerate wetlands
- Taking total area of wetlands (5-10% of Lyndeborough) versus uplands into consideration, wetlands support a hugely disproportionate amount of plant diversity (40-60% of species commonly occur in wetlands)

Chapter 5
Wetlands & Water Resources

Topics Addressed In This Chapter:

- What are wetlands?
- Functional values of wetlands
- Wetland classification according to the US Fish & Wildlife Service
- Types of wetlands in Lyndeborough
- Wetland natural communities, with in-depth discussion of Black Gum Swamps
- Analyses of significant wetland complexes & HUC 12 watersheds

What are wetlands?

The definition of a wetland has been widely debated in the scientific community for decades (Tiner, 2007). For years, different countries, states, towns, and individuals have defined the parameters of wetlands according to different scales and schemes. The last 25 years has seen a growing consensus in wetland definition and delineation, led by cooperative teams assembled under the US Army Corps of Engineers. The national definition reached by consensus and adopted by all federal agencies as well as the state of New Hampshire is:

> *"Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."*
>
> -Wetlands Training Institute, 1995

This definition, and basic field delineation, relies on indicator plants to identify the line where the upland ends and the wetland begins (indicator plants were discussed at the end of chapter 4). Along with wetland plants, or *hydrophytic vegetation,* wetlands also have two other important features: *hydric soils* and *hydrology*. Entire college degrees can be spent on defining and identifying hydric soils, so I will not go into detail here. Typically, they are soils that are saturated enough during the growing season to promote reduced conditions caused from the lack

of oxygen. All wetlands feature hydric soils, but not all hydric soils may be wetlands. If there are a majority of upland plants and few to no wetland plants, that feature will trump the hydric soil property. Water is the dominant force in wetlands, thus *hydrology* is a critical component of a wetland. Signs of water such as ponding, pooling, scouring, staining, and others suggest the influence of water in an environment.

WETLAND FUNCTIONAL VALUES

Wetlands are highly valuable to society for many reasons. For centuries they were regarded as waste places, and were drained and filled to make way for farms and, now, urban sprawl. As much as 54% of the wetlands in the United States have been destroyed in the last two centuries. Their significance to humans and wildlife has been increasingly acknowledged over the past few decades and they are now considered conservation priorities by almost all agencies, organizations and individuals in the conservation field. Wetlands provide many useful functions and benefits, including:

- Reduction in flood damage by storing flood waters, then releasing them slowly, thus reducing the flashy nature of floods and slowing the velocity of the water
- Improving water quality by filtering excess nutrients from fields, farms, roadsides, and other waste sources
- Trapping pollutants in agricultural, industrial, and residential runoff and storing and eliminating them through biochemical processes
- Reducing sediment loads from upland sediment sources such as roads, fields, and logging operations
- Providing groundwater recharging services by allowing water to slow down and percolate into the soil rather than rush downstream
- Buffering shorelines against erosion
- Providing food and cover for numerous wildlife species including many rare species
- Providing spawning grounds for shellfish and commercial fish species
- Providing valuable aesthetic, educational, and recreational opportunities

US FISH & WILDLIFE SERVICE WETLANDS CLASSIFICATION

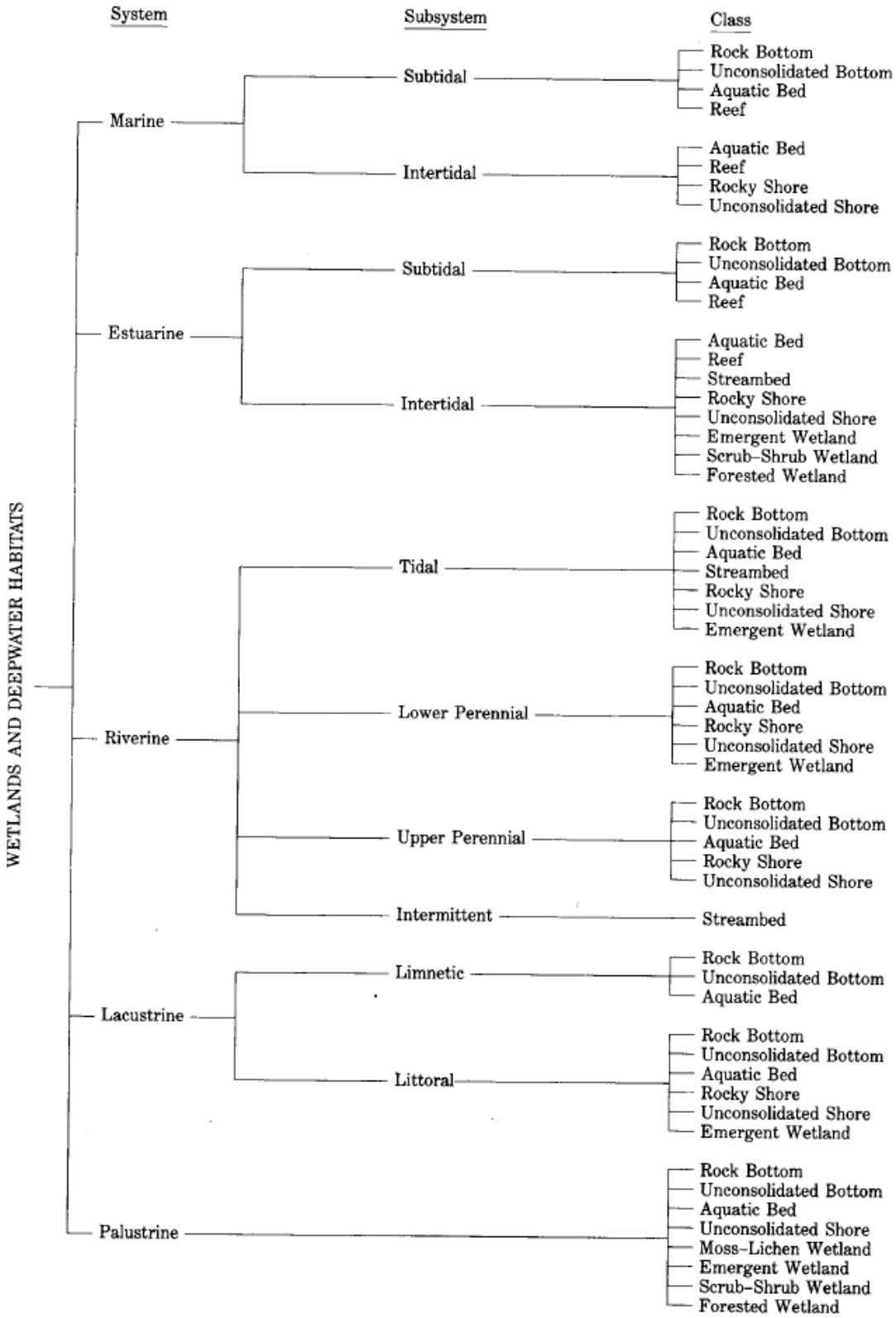
Cowardin *et al.* (1979) developed a format for classifying wetlands according to plants, soils, and frequency of flooding. This serves as the national standard for wetlands classification, and is the basis for the National Wetlands Inventory (NWI) data used for this NRI. In this system wetlands are defined as:

> *"Wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytic vegetation; (2) the substrate is predominantly poorly, or very poorly drained hydric soil; (3) and the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season."*

Five major systems are described under this format, but two are of importance to this NRI:

Lacustrine Wetlands: all open water greater than 20 acres and deeper than 2 meters
Palustrine Wetlands: all freshwater wetlands dominated by trees, shrubs, and emergent plants

The majority of Lyndeborough's wetlands are palustrine wetlands, including marshes, shrub-scrub swamps, forested wetlands, peat mats, and aquatic beds or shallow ponds. Some larger bodies of water such as Putnam and Burton Ponds are classified as Lacustrine by the NWI. On the WETLANDS & WATER RESOURCES map they are shown as ponds along with all other bodies of water that were present in the summer of 2008. Only 3 acres in Lyndeborough are classified as Riverine; a section of Stony Brook along Gulf Road. This section is mapped as Swampy Forest because it appears in aerial photos to be a riverside red maple swamp. The charts on the next two pages will be useful in interpreting the wetland codes used in the NWI GIS data.



from: Cowardin *et al.* (1979)

From: Tiner (2007)

WETLAND MAPPING UNITS USED IN THIS NRI
(all acreage values are for Lyndeborough and do not account for areas within the 1 mile buffer)

NWI wetlands shown on the WETLANDS & WATER RESOURCES MAP are labeled as the following ecotypes:

Emergent Marshes: those ~160 acres of wet meadow, cattail, and other herbaceous-dominated open wetlands

Shrub Swamps: those ~162 acres of marsh and swamp habitats dominated by woody shrubs or shrub trees

Swampy Forests: those ~360 acres of forested wetlands

Unconsolidated Bottom: those ~170 acres of mucky shallow ponds and aquatic beds that are not mapped as 'Ponds'

Unclassified Wetlands: those 11 acres that were not classified by the NWI

In addition to the NWI data, other wetlands mapped on the WETLANDS & WATER RESOURCES map include:

NRCS Hydric Soils: those 113 soil units covering ~1370 acres that are ranked as hydric in the GIS data. Approximately 300 acres of hydric soils are classified as NWI wetlands and are mapped as such

Streams: those streams in the New Hampshire Hydrography Dataset + those streams added during NRI mapping totaling ~ 41 miles

Ponds: those 26 bodies of water visible on the 2008 summer Color Aerial Photography (1 meter resolution) totaling ~150 acres

Vernal Pools: those ecological features that I documented in the field that may be vernal pools. To be positively identified as such they will require annual spring inventory to document indicator species such as wood frogs, spotted salamanders, and fairy shrimp. The features I have identified as vernal pools either did have these indicators present (1 example), had two of the three (several examples), or appeared to be adequate habitat and have a high probability of supporting these species.

Black Gum Swamps: those wetlands identified in the field that were forested or shrub wetlands with a significant overstory tree component of black gum. Some of these are NWI mapped, and others were not detected in their mapping.

Characteristics of these wetland types are found in the brief summaries of swampy forests, shrub swamps, and emergent marshes and in the Natural Community Descriptions later in this chapter.

Other Features mapped on the WETLANDS & WATER RESOURCES map include:
(all acreage values are for Lyndeborough and do not account for areas within the 1 mile buffer)

Watersheds: Four Hydrologic Unit Code (HUC) Level 12 watersheds split Lyndeborough into two HUC Level 10 watersheds:

Southeast into the Souhegan River

Purgatory Brook Watershed (~5,250 acres or 27% of Lyndeborough)
- → Curtis and Purgatory Brooks & tributaries
- → 11 miles of stream and 230 acres NWI Wetlands in 29 types
- → 590 acres of conservation land
  (6% of watershed; 19% of all conservation land)
- → 2,325 acres in Forest Blocks >750 acres
  (44% of watershed; 22% of all Forest Blocks)

Stony Brook Watershed (9,740 acres or 50% of Lyndeborough)
- → Duncklee, Frye, Beasom, Stony, Furnace, Herrick, Poor Farm and Brandy Brooks & tributaries
- → 15 miles of stream and 595 acres of NWI wetlands in 41 types
- → 1,170 acres conservation land
  (12% of watershed; 38% of all conservation land)
- → 5,050 acres in Forest Blocks >750 acres
  (52% of watershed; 47% of all Forest Blocks)

Northeast into the Piscataquog River

Rand Brook Watershed (1,070 acres or 5% of Lyndeborough)
- → French, Schoolhouse, and an unnamed brook & tributaries
- → 5 miles of stream and 7 acres of NWI Wetlands in 4 types
- → 95 acres of conservation land
  (9% of watershed; 3% of all conservation land)
- → 955 acres in Forest Blocks >750 acres
  (89% of watershed; 9% of all Forest Blocks)

South Branch Piscataquog River Watershed (3,500 acres or 18% of Lyndeborough)
- → Cold, Scataquog, and Silver Mine Brooks & tributaries
- → 10 miles of stream and 125 acres of NWI Wetlands in 24 types
- → 1,250 acres of conservation land
  (36% of watershed; 40% of all conservation land)
- → 2,375 acres in Forest Blocks >750 acres
  (68% of watershed; 22% of all Forest Blocks)

Other Features mapped on the WETLANDS & WATER RESOURCES map include:
(all acreage values are for Lyndeborough and do not account for areas within the 1 mile buffer)

Beaver Dams: those dams which I encountered during field inventory work, or saw from roadsides

Dams & Impoundments: those man-made structures reported to and regulated by NH Department of Environmental Services

Public Water Supplies: those well used for public purposes and regulated by NH Department of Environmental Services

WETLAND DISTANCES TO MAINTAINED PUBLIC ROADS & ALL BUILDINGS

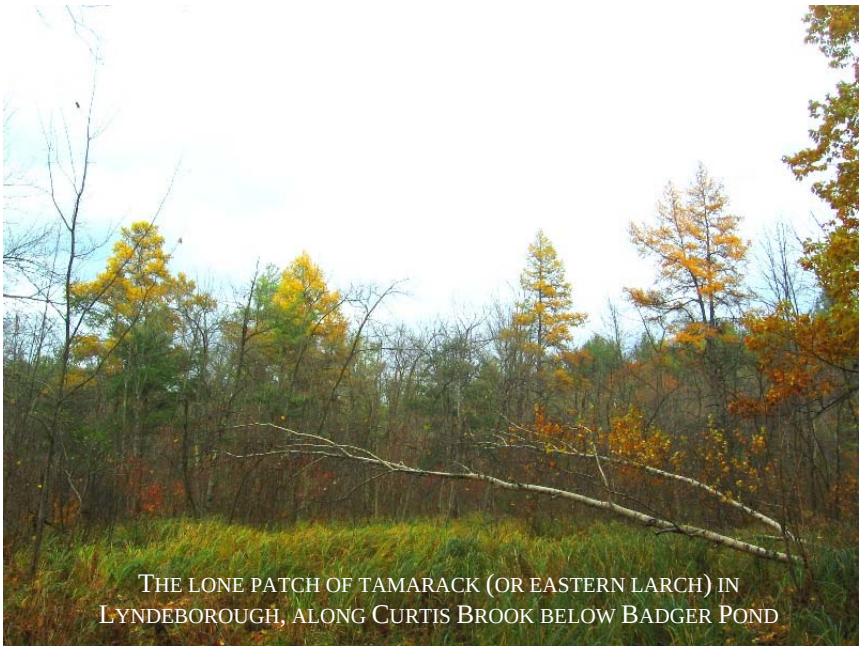
Roads affect wetlands by acting as a source of sediment and pollutants, as a danger to passing wildlife, and as a disturbance in natural water flow and hydrology. Roads can in turn be affected by flooding, freeze-thaw cycles, and motorists risk injury when avoiding wildlife at crossings. The analysis below looks at the acreage of NWI Wetlands within distances from maintained public roads. Class VI and private roads are excluded from this analysis. Also, an analysis of distance from buildings is provided as buildings are also sources of pollution, disturbance, and other factors that threaten wetland integrity.

Proximity to Infrastructure	Area of NWI Wetland
within100 feet of road	30 acres (3%)
within 250 feet of road	140 acres (14%
within 500 feet of road	325 acres (33%)
within 1000 feet of road	630 acres (63%)
greater than 1000 feet from road	375 acres (37%)
within 100 feet of a building	11 acres (1%)
within 500 feet of a building	300 acres (30%)

SWAMPY FORESTS/FORESTED WETLANDS

Many beautiful forested wetlands are found in Lyndeborough, ranging from small, isolated basins within forests, to extensive seasonally flooded streamside forests, to slightly raised forested inclusions within shrub and marsh wetland complexes. Red maple is the dominant tree in these ecosystems. Often, this tree can temporarily withstand complete saturation of the root zone, and it has the ability to persist in permanently flooded areas by keeping its roots near the soil surface, just above the water table. In slightly less saturated conditions hemlock and red spruce add a coniferous element to forested wetlands. Other trees like red oak, white pine, white ash, and yellow birch often grow in scattered raised positions where their roots can attain just enough oxygen to persist.

Some of the most ecologically important forested wetlands in Lyndeborough are black gum swamps, which are found in distinct concentrations at a few locations. Interestingly, most of these occur over Spaulding Tonalite bedrock, which may be a mere coincidence, but the association is strong enough to suggest that this bedrock, along with analysis of topography and hydric soils could be used to determine areas where more of these swamps may occur. One patch of four mature tamarack trees was found along Curtis Brook just downstream of Badger Pond. A closer examination of this shrub-forest wetland complex may expand the known plant occurrences significantly as there is probably more peat-bog associated plant species occurring along with the larch in this area.



THE LONE PATCH OF TAMARACK (OR EASTERN LARCH) IN LYNDEBOROUGH, ALONG CURTIS BROOK BELOW BADGER POND

National Wetland Inventory wetland types with a 'PFO' prefix are considered palustrine forested wetlands, and include areas seasonally, semi-permanently, and permanently flooded by dikes & dames, beaver, or other features like natural topographic constrictions. They are classified according to this modifier, as well as the dominant tree type (hardwoods vs. softwoods vs. mixed vs. dead). The NWI maps 360 acres of forested wetlands; 233 acres of broad-leaved deciduous (mostly red maple swamps); 53 acres of needle-leaved evergreen (mostly hemlock swamps); and 75 acres of dead forest (mostly beaver killed areas). The largest block of forested wetland occurs in the eastern portion of the Putnam Pond Conservation Area.

SHRUB SWAMPS/SCRUB WETLANDS

Approximately 162 acres of NWI palustrine shrub swamps (PSS prefixes) occur in Lyndeborough. The highest diversity of shrub species in Lyndeborough occurs in these wetlands which are situated in beaver and dike/dam flooded basins, forest enclaves, and pond and stream margins. Nineteen of 51 shrubs (37%) documented during this NRI occur mostly in these ecosystems. Certainly more occur that were not documented. These areas are extremely important habitat for birds, reptiles, and mammals, and they provide important flood protection services to downstream areas as the dense thickets slow water, absorb and slow the speed and power of floods, and retain ice and snow. Often shrub swamps and shrub dominated communities & ecosystems occur as inclusions within wetland complexes and are not mapped by the NWI. Additionally, many are small, isolated patches within forest canopies and are smaller than the minimum mapping units. Landscape, biological, and habitat diversity is greatly increased by these scattered pockets of high-value berry and nut producing species.

EMERGENT MARSHES/WET MEADOWS

Approximately 160 acres of palustrine emergent marshes (PEM prefixes) appear in the NWI data. Pond margins, old, filled-in beaver ponds, and hydric field soils support homogenous to highly diverse ecosystems dominated by grasses, sedges, rushes, and cat-tails. Scattered shrubs and trees like red maple are common. Often, these systems may be completely flooded and pond-like in spring, and as water levels drop through summer rich, dense meadows green up, last a month, and then begin to brown. These areas are important habitat for birds, muskrat, mink, reptiles, and amphibians.

WETLAND NATURAL COMMUNITY DESCRIPTIONS

Major and common wetland natural communities are described here, but this list is not comprehensive. A detailed prime wetlands analysis or other wetlands inventory is required to identify a more complete list of wetland communities. Furthermore, NWI classifications appear to be relatively out-of date; such a project would benefit the town by re-classifying major wetland areas to accurately reflect current ecological, vegetative, and disturbance attributes.

FORESTED WETLANDS

Red maple –sensitive fern swamp (S3S4)

A common southern and central New Hampshire forested wetland, often positioned in shallow drainages at the headwaters of stream systems. Diverse assemblages of herbaceous and shrub species include spicebush, winterberry holly, jack-in-the-pulpit, Virginia bugle, poison ivy, marsh fern and royal fern. The presence of sensitive fern indicates slightly minerotrophic conditions, meaning that water sources are predominantly from springs or streams, and the water has picked up nutrients & minerals and lost some acidity as it coursed through and over bedrock.

Red maple-*Sphagnum* basin swamp (S4)

Another very common and similar red maple swamp, often situated in shallow depressions within upland forests. Widespread throughout central and southern New Hampshire. High cover of *Sphagnum* mosses, cinnamon fern, and marsh fern and the absence of sensitive fern distinguish this type from the red maple-sensitive fern swamp.

Seasonally flooded red maple swamp (S4S5)

Another very common red maple swamp, most often associated with low gradient sections of small streams. Soils are typically sandy alluvial deposits or muck and peat over alluvium. These are not technically considered floodplain forests because they flood seasonally and not necessarily in conjunction with temporary flooding situations. This results in more development of organic soil horizons, whereas in floodplains most organic material is flushed away. Commonly these are associated with upstream portions of historically beaver-dammed wetland complexes and may be successional stages in forest development following beaver pond abandonment. The finest example of these communities in Lyndeborough occurs along Cold Brook in the vicinity of Whittemore meadow, supporting this pattern of successional development. Indian poke (seen above) is at times the dominant early spring herb. Shrubs like highbush blueberry and maleberry may be present in abundance. Cinnamon, royal, and sensitive fern, tussock sedge, and blue-joint reed grass are abundant in this example.

Hemlock-cinnamon fern forest (S4)

Another fairly common type in Lyndeborough, typically along upland-wetland ecotones. Similar to red maple-sensitive fern and red maple-*Sphagnum basin* swamps except featuring more hemlock and less red maple.

Black gum-red maple basin swamp (S1S2)

Black gum ranges from Maine to Florida, and is widespread and abundant in southern bottomland forests. In New Hampshire, black gum basin swamps are restricted to the southern region, and are some of the rarest natural communities in the state. As of 1999, NH Natural Heritage Bureau had documented only 112 sites in the state where these swamps occur. Lyndeborough appears to be a hot spot for this tree and its associated natural community variants. All four variants on the black gum-red maple basin swamp occur in Lyndeborough. The black gum is the longest living broadleaf deciduous tree in North America, and the oldest recorded black gum age in New Hampshire is ~690 years old. There is a very strong correlation between diameter and age, which is actually not typical for many northeastern trees. Natural Heritage found that the "vast majority" trees of over 15 inches diameter at breast height (DBH) were more than 200 years old; all trees over 20 inches DBH were greater than 225 years old; and only ~10% of sampled trees over 25 inches DBH were under 300 years old. The largest diameter tree recorded during the Heritage studies was ~30 inches DBH, and was aged ~380 years. The oldest tree was aged 679 years, and was ~27 inches DBH. The largest black gum I measured in Lyndeborough were 27, 28, and 29 inches DBH. These trees, if they were intact enough to extract an accurate core sample, could be the oldest broadleaf deciduous trees in North America; however, their trunks are rotten and their age will forever remain a mystery. For more details on these communities refer to Sperduto *et al.* (2000). Starting on the next page I list the four variants, in order from most common to least common, and provide brief vegetation descriptions. Location descriptions are limited to preserve the security of these sites.

Aerial photo of a boggy woodland/tall shrub thicket black gum red-maple basin swamp in eastern Lyndeborough. The largest black gum recorded in Lyndeborough is at left center of the swamp. This tree is 29" DBH and 60' tall. Notice the approximately 25 dead snags in the swamp; these are all equally large black gum that I believe were killed when beaver raised the water level about 20-30 years ago. Based on their size it is possible that these could have been the some of the oldest broadleaved deciduous trees in North America.

Hemlock forest/woodland variant of Red Maple-Black Gum Basin Swamp

Several sites resemble fairly typical red maple-hemlock swamps, but have an abundance of black gum in the overstory. Yellow birch and hemlock are understory and midstory components. Generally, minimal herb layers feature *Sphagnum* mosses, hay-scented fern, marsh fern, and *Carex* species. Some clones of 6-10 black gums in clumps were observed. Many trees over 15 inches were observed. The tree in the center of this image measured 18" diameter and I aged it at between 330-365 years old based on a core sample. A very interesting pattern of hydrologic connectivity appears to unite these fragmented swamps along faint bedrock-controlled drainage systems. These may serve as important vernal pools, and future inventories should be directed at spring amphibian surveys.

Mountain laurel variant of Red Maple-Black Gum Basin Swamp

A few sites featured abundant mountain laurel in the shrub layer, cinnamon fern and *Carex* species in the herb layer, and more hemlock overstory dominance. Raised hummocks were 40-60cm above shallow pools of very stagnant, tannin rich water. Often, these sites were providing amphibian breeding habitat. Sperduto *et al.* (2000) suggest that these variants may be higher in nutrients than boggy black gum swamps. These swamps appear to be connected to the above variants by subsurface drainage systems. The distribution of these swamps in such high density on Piscataquog Mountain suggests possible geologic affinity.

Boggy forest/woodland variant of Red Maple-Black Gum Basin Swamp

One example of this variant was found in the vicinity of Badger Pond. A well developed shrub layer features highbush blueberry, maleberry, winterberry holly, and meadowsweet. Abundant ferns include cinnamon, marsh, royal, and sensitive ferns. Herbs include mad dog skullcap, jewel weed, jack-in-the-pulpit, and goldthread. The species here suggest a slightly more mineral rich chemistry than a typical example of this variant.

Boggy woodland/tall shrub thicket variant of Red Maple-Black Gum Basin Swamp

The most interesting example of a black gum swamp is the 2 acre shrub swamp in east Lyndeborough. Highbush blueberry, winterberry holly, buttonbush, mountain laurel, silky dogwood, and maleberry formed a dense shrub thicket heavily used by moose. Royal fern, *Sphagnum* mosses, dewberry, Indian hemp and *Carex* species formed a rich understory layer on low hummocks between shallow channels. Two dozen large black gum snags suggest a mass mortality event a couple decades ago brought on by temporary beaver flooding. This particular swamp should be considered an exemplary example of this variant. Fortunately it is protected by a Conservation Easement and, although it is in close proximity to non-protected land, should not be affected by human-caused alterations in hydrology. Beaver resurgence, however, could threaten the few remaining giant black gum around the perimeter. There appears to be few or no regenerating black gum in the shrub layer, although a detailed inventory is needed to confirm this.

Subacid forest seep (S3S4): foamflower-graminoid variant

An example of this seep was encountered in the vicinity of Whittemore Meadow along Cold Brook. Foamflower, sedges, asters, jewel weed, and numerous ferns were present along this very small seep that fed a seasonally flooded red maple swamp below. Slightly less than acidic conditions reflect enriched bedrock minerals. This slightly enriched condition supports the foamflower and also spicebush. The forest above the seep reflected this in its abundance of sugar maple and ash.

Vernal woodland pool (S3)

Numerous potential vernal pools were recorded throughout the field season for this NRI. They occur as isolated, shallow depressions in forested settings, not connected to any other wetland or stream systems. Positive identification as vernal pools will require annual monitoring to document indicator species. Vegetation is variable, and typically reflects the surrounding environment and forest setting. Pools ranged from completely devoid of vegetation, to luxurious marsh-like pools of royal fern, cinnamon fern, and sedges, to black gum swamps. Some shrubs recorded in these variable pools include mountain holly, winterberry holly, highbush blueberry, mountain laurel, and maleberry. *Sphagnum* mosses are occasionally dominant on hummocks within some pools. Indicator species observed in some pools include wood frogs (eggs & frogs), spotted salamanders (egg masses), and fairy shrimp. Further monitoring and documentation is strongly encouraged.

SCRUB-SHRUB WETLANDS

The following communities occur fairly consistently in Lyndeborough as the margins along some larger ponds (Putnam & Badger), in seasonally flooded flats (as in east side of cemetery Road opposite of Putnam Pond boat ramp), and as flood-prone edges of sluggish streams. They vary from each other in minor ways, depending on mineral status of the water, amount of peat development, and flood regime. Often, they may occur in complex mosaics in close proximity.

Highbush blueberry-winterberry shrub thicket (S4)

Winterberry-cinnamon fern wooded fen (S4)

Highbush blueberry-sweet gale-meadowsweet shrub thicket (S4)

Common traits of these widespread and typical shrub wetlands are dominance by highbush blueberry, secondary dominance by winterberry, and repeated occurrence of meadowsweet, sweet gale, cinnamon fern, *Sphagnum* mosses, maleberry, speckled alder, and occasional willows. Gaps between shrubs are often occupied by tussock sedge, swamp candles, woolgrass, blue flag iris, and occasional hemlock saplings. Typically, soils are permanently saturated because of their proximity to ponds and streams, and spring flooding is dependable. Red maple has a near constant presence, but seldom achieves tree-size stature. Often, these communities are flooded for periods by beaver expansion, which prevents succession from transitioning them towards red maple dominance. These habitats are used by numerous birds, white-tailed deer, moose, and reptiles.

Tall graminoid emergent marsh (S4)

A fairly common wet meadow marsh dominated by blue-joint grass, *Leersia virginiana*, tussock sedge, and occasional ferns and herbs such as sensitive fern, blue flag iris, and Joe-pye weeds. These are often inundated during spring flooding and then dry out through the summer. Often found along the margins of ponds, such as around the northern and eastern edge of Badger Pond. Often forming mosaics with the Mixed tall graminoid-scrub-shrub marsh (S4S5) community (below), where higher density of shrubs such as meadowsweet, sweet gale, highbush blueberry, maleberry, winterberry holly, and *Viburnums.* Good examples of both types occur along Curtis Brook, at Whittemore Meadow (picture below), and the upper reaches of Furnace Brook.

Medium depth emergent marsh (S4) & Cattail marsh (S4)

Slow water areas, pond margins, small beaver ponds, and medium depth (2-3 feet) areas of marshes are dominated by tussock sedge, pickerel weed, cattails, woolgrass, bulrush, common arrowhead, swamp candles, yellow loosestrife, mild water pepper, sensitive fern, and other aquatic species. Scattered shrubs and dwarf red maple commonly occur on raised hummocks. Closer examination of these communities will certainly document additional species, specifically submerged aquatics. The picture above, Badger Pond from New Road, shows a mosaic of these types with alder, meadowsweet, red maple, and other shrubs throughout. The highly invasive exotic weed purple loosestrife poses a significant threat to these communities, and was observed in nearly all of them encountered. These communities are critical habitat for numerous declining bird species including pied-billed grebe, marsh wren, American bittern, and black duck.

Deep emergent marsh-aquatic bed (S4S5) & Aquatic beds (S5)

Areas mapped as NWI codes PUB (unconsolidated bottoms) include these areas of shallow ponds, the margins of deeper ponds, and slow moving eddies and edges of streams that support communities dominated by pickerel weed, white water lily, yellow pond lily, and common arrowhead. Slightly more shallow areas support emergent herbs like mild water pepper, swamp loosestrife, water hemlock, bulb-bearing water hemlock, narrow leaved gentian, tearthumb, branching bur-reed, nodding smartweed, and inflated bladderwort. Deep muck underlies these areas, including much of Badger, Putnam, and Burton Ponds, a small pond upstream of Stonebridge Road on Furnace Brook, a few small beaver ponds along low gradient sections of Cold, Stony, and Curtis Brooks, and other areas mapped as Unconsolidated Bottoms. Warm water fish, otter, beaver, muskrat, and many snakes and turtles require these habitats. The finest example of these types occurs at Putnam Pond (above) where a flood control dam built in 1977 backed up existing marshes and swamps, previously called Lucas Flats, into a 48 acre shallow pond. The 24 foot tall earthen dam consists of 43,867 cubic yards of fill and can store up to 988 acre-feet of water (an acre-foot is the volume equivalent of 1 acre of surface water that is one foot deep). Public boat access via Cemetery Road provides a wonderful opportunity to explore a rich mosaic of wetland types. The Pond is protected by the State of New Hampshire Water Resources Board and leased to the Town of Lyndeborough as the Putnam Pond Conservation Area.

SIGNIFICANT WETLAND COMPLEXES

The total wetland area in Lyndeborough is probably around 2,000 acres, or ~10% of Lyndeborough. This figure includes all NWI mapped wetlands, all ponds, an assumption that most hydric soils are wetlands, an estimate of the ummapped areas including vernal pools and black gum swamps, and an estimate of around 75 acres of streams[2].

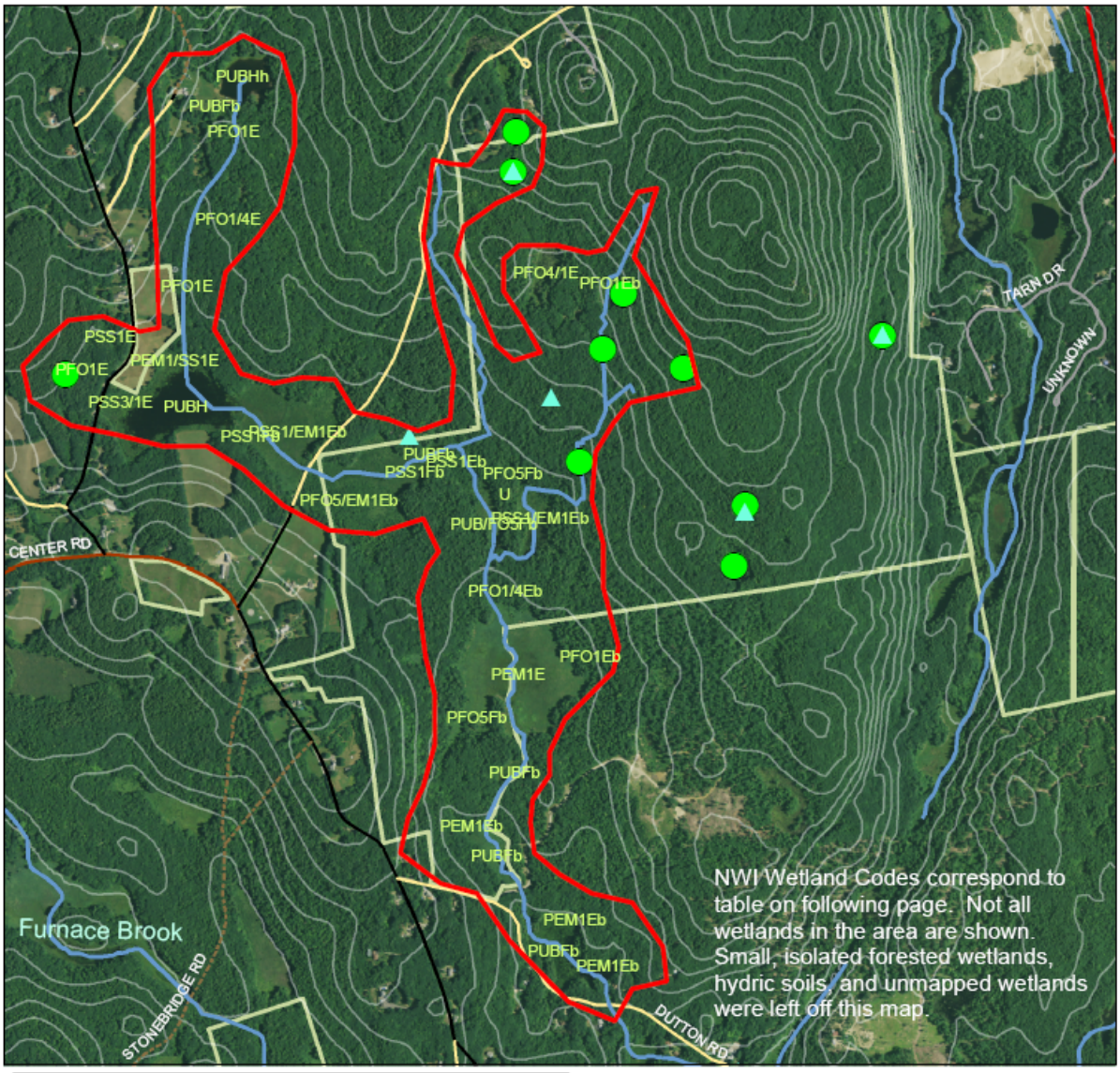
Not all wetlands are equally important in meeting the natural resource values stated at the beginning of this chapter. Two wetland complexes are particularly significant in their size, diversity of wetland types, wildlife habitat, connectivity to conservation lands and/or unfragmented forest blocks, and position to slow and control floods. They are both in the geographic center of Lyndeborough, one along Curtis Brook and the other along Furnace Brook. They are mapped and described in detail in the next several pages.

[2] estimate based on this equation: 41 miles of stream x average width of 15 feet (includes wetland edge features)

BADGER POND/CURTIS BROOK HEADWATERS WETLAND COMPLEX

Around 120 acres of contiguous wetlands are found just northeast of the center of Lyndeborough at the headwaters of Curtis Brook, an important tributary to Purgatory Brook, and ultimately the Souhegan River. This is the second most extensive, complex, and diverse wetlands mosaic in Lyndeborough. Twenty NWI wetland types occur in under 3/4 square mile of area, many of which are different from those at the Central Lyndeborough/Furnace Brook/Putnam Pond Complex. Additionally, much of this complex is within the 1,700 acre Piscataquog Mountain Unfragmented Forest Block.

A significant portion of this wetland system is protected by a Conservation Easement on Piscataquog Mountain and by public ownership of Badger Pond. Included in the protected lands are numerous Black Gum Swamps, vernal pools, a perrenial spring, and part of the largest wet meadow (PEM1E) in Lyndeborough. Agricultural runoff, several roads, and fairly high-density housing threaten the quality of the water in this system. Furthermore, critical habitats occuring in this complex are not currently protected from development impacts. Similarly to other wetland complexes in Lyndeborough, high ecological, cultural, and watershed values make this an important priority for conservation and good management.



BADGER POND/CURTIS BROOK HEADWATERS WETLAND COMPLEX

WETLAND TYPES AND STATISTICS

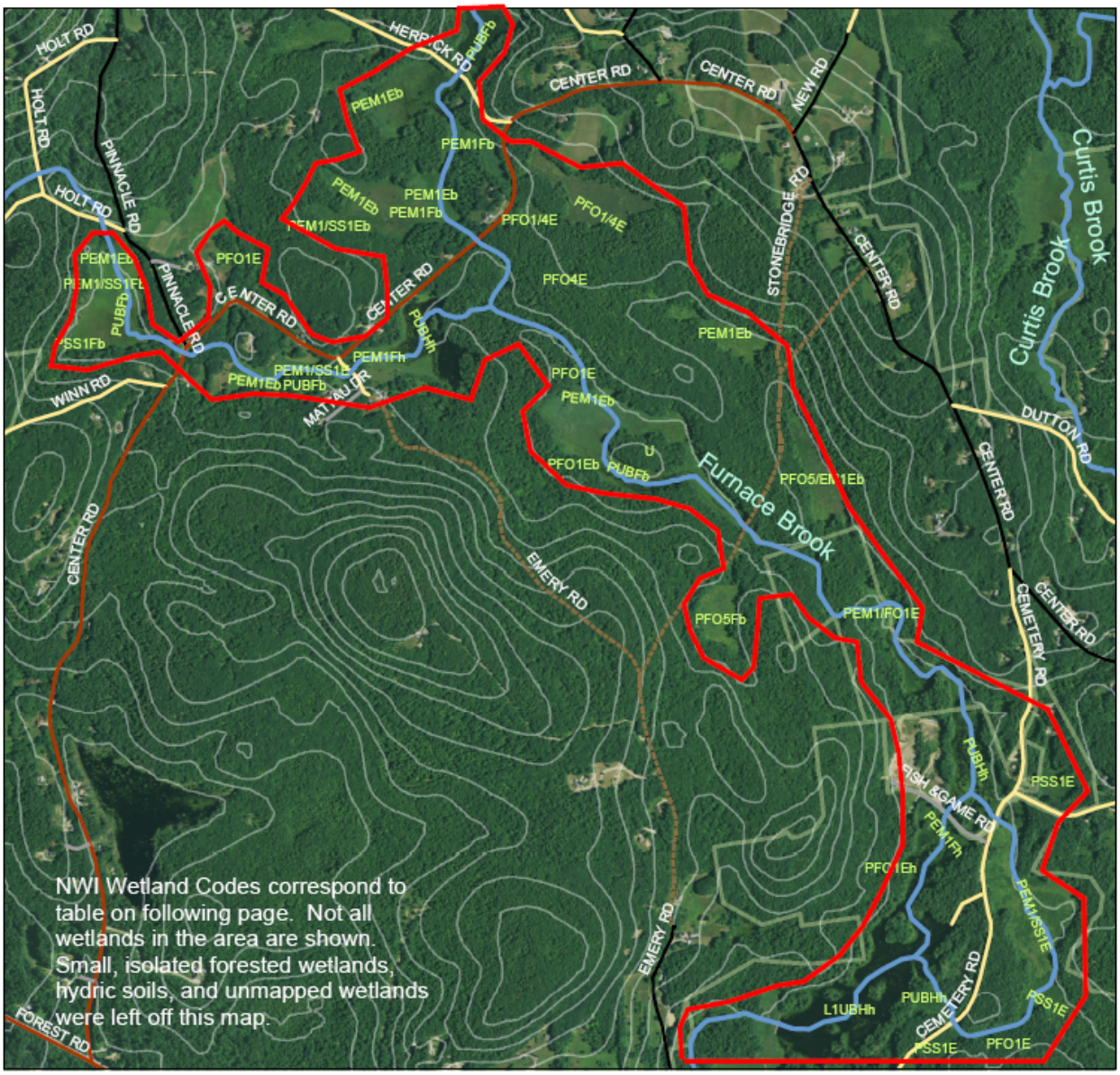
NWI Code	Description (*per* Tiner, 1999)	Count	Average Area	Total Area
PSS1E	seasonally flooded deciduous shrub swamp	1	0.92	0.92
PFO1Eb	seasonally beaver-flooded deciduous forested wetland	1	0.62	0.62
PEM1Eb	persistent seasonally beaver-flooded emergent marsh	3	0.52	1.55
PEM1/SS1E	persistent emergent marsh/seasonally flooded shrub swamp	1	1.69	1.69
PFO4/1E	seasonally flooded mixed forested wetland	1	1.97	1.97
PFO1/4E	seasonally flooded mixed forested wetland	1	2.32	2.32
PUB/FO5Fb	aquatic beds/semi-permanently beaver-flooded forested wetlands	1	2.75	2.75
PFO1/4Eb	seasonally beaver-flooded mixed forested wetland	1	2.97	2.97
PFO5Fb	semi-permanently beaver-flooded dead forest	2	1.68	3.36
PUBHh	permanently impounded aquatic beds	1	3.53	3.53
PSS3/1E	seasonally flooded mixed shrub swamp	1	3.58	3.58
PFO1E	seasonally flooded deciduous forested wetland	3	1.34	4.01
PSS1Eb	seasonally beaver-flooded deciduous shrub swamp	1	4.19	4.19
PSS1Fb	semi-permanently beaver-flooded deciduous shrub swamp	2	2.4	4.81
U	unclassified	1	5.08	5.08
PUBH	permanently flooded aquatic beds	1	10.22	10.22
PUBFb	semi-permanently beaver-flooded aquatic beds	5	2.19	10.97
PSS1/EM1Eb	persistent seasonally beaver-flooded deciduous shrub swamp/emergent meadow	2	7.45	14.9
PFO5/EM1Eb	persistent seasonally beaver-flooded dead forest/emergent marsh	1	16.12	16.12
PEM1E	persistent seasonally flooded emergent marsh	1	23.05	23.05

Total NWI Wetland Area = 119.2 acres in 20 different NWI wetland types

CENTRAL LYNDEBOROUGH/FURNACE BROOK/PUTNAM POND WETLAND COMPLEX

Nearly 200 acres of semi-contiguous wetlands are found in the center of Lyndeborough, adjacent to and near Furnace Brook, and its tributary Herrick Brook from the north. This is perhaps the most extensive, complex, and diverse wetlands mosaic in Lyndeborough. Twenty NWI wetland types occur in under 1 square mile of area. Additionally, much of this complex is within the 1,000 acre Stimson Hill-Putnam Pond Unfragmented Forest Block. In the 20+ years since the NWI many wetland types may have changed, and some may have expanded. However, it is unlikely that any areas have reverted to upland; this really does not occur in temperate ecosystems in the absence of geologic uplift.

A portion of this wetland system is protected by the Putnam Pond Conservation Area, but many critical habitats upstream are not currently protected from development or exploitation. The extent of this complex, the diversity of wetland types within, its location in an unfragmented forest block, the recreational assets of two Class VI roads, and the importance in flood control and water quality makes this complex one of the most important ecological landscapes in Lyndeborough.



CENTRAL LYNDEBOROUGH/FURNACE BROOK HEADWATERS WETLAND COMPLEX

WETLAND TYPES AND STATISTICS

NWI Code	Description (*per* Tiner, 1999)	Count	Average Area	Total Area
PFO4E	seasonally flooded coniferous forested wetland	1	0.36	0.36
PFO1Eh	seasonally flooded, impounded deciduous forested wetland	1	0.62	0.62
PFO1Eb	seasonally beaver-flooded deciduous forested wetland	1	0.94	0.94
PEM1/SS1Fb	persistent emergent marsh/ semi-permanently beaver-flooded deciduous shrub swamp	1	1.35	1.35
PEM1/SS1Eb	persistent emergent marsh/ seasonally beaver-flooded deciduous shrub swamp	1	1.6	1.6
PSS1Fb	semi-permanently beaver-flooded deciduous shrub swamp	1	1.83	1.83
PEM1/FO1E	persistent emergent marsh/seasonally flooded deciduous forested wetland	1	2.44	2.44
PFO5Fb	semi-permanently beaver-flooded dead forest	1	4.01	4.01
PEM1Fh	persistent semi-permanently impounded emergent marsh	2	2.19	2.19
U	unclassified	1	4.6	4.6
PFO1E	seasonally flooded deciduous forested wetland	4	1.17	4.68
PFO5/EM1Eb	dead flooded forest/seasonally beaver-flooded emergent marsh	1	5.57	5.57
PEM1Fb	persistent semi-permanently beaver-flooded emergent marsh	2	3.36	6.72
PSS1E	seasonally flooded deciduous shrub swamp	3	2.49	7.48
PFO1/4E	seasonally flooded mixed forested wetland	2	5.08	10.17
PEM1/SS1E	persistent emergent marsh/seasonally flooded shrub swamp	2	6.97	13.95
PUBHh	permanently impounded aquatic beds	4	5.92	23.69
PUBFb	semi-permanently beaver-flooded aquatic beds	4	6.47	25.87
L1UBHh	gravelly bottom impounded pond	1	26.11	26.11
PEM1Eb	persistent seasonally beaver-flooded emergent marsh	7	5.71	39.95

Total NWI Wetland Area = 186.3 acres in 20 different NWI wetland types

Chapter 6
Wildlife & Habitats

Topics addressed in this chapter:

- Lyndeborough's known & potential mammals, reptiles, amphibians, fish & birds
- Defining important habitats
- Co-occurrence analysis of important habitat areas

Lyndeborough's wildlife is as varied as its habitats. The rich mosaic of wetlands, forests, shrublands, and agricultural areas that have been reviewed provide adequate environments for many species. This NRI positively documented 154 animals, or approximately 70% of the species that have a high probability of occurring in Lyndeborough; this includes 25 mammals, 7 reptiles, 10 amphibians, 3 fish, and 109 birds. Expanded survey efforts would probably yield town totals of ~47 mammals, ~16 reptiles, ~13 amphibians, ~12 fish, and ~150 birds.

Wild animals are important elements of the biological and cultural landscape. Some habitats are maintained by wildlife, such as beaver flooding streamside forests, moose browsing on forest shrubs, muskrat 'mowing' marshes, and porcupine stunting the growth of hemlock groves. Wildlife are loved by the people of Lyndeborough and were regarded as a strength of the town in the 2001 *Community Profile.* The occasional stumbling bear in early spring, the opportunity to hunt many species in deep forests, the fishing and trapping, and the bird watching are all activities enjoyed for generations in Lyndeborough. Of particular intrigue are the many tales told of the fleeting glimpse of a cougar as it bounds across a field or into the dark forest.

Many species were decimated during the 19th century and in the past few decades have made strong recoveries. Moose, bear, and bobcat, despite habitat loss in southern New Hampshire, have returned to the region after not being seen for maybe one hundred years. Beaver were once trapped to the point of local extirpation, but their mark is indelible across Lyndeborough in the mosaic of wetlands they have affected. Many species expanded with the

spread of agriculture in the past, and now these are declining as forests fill in many of the remaining pockets of grassland, shrub thickets, and farm fields. To protect the full range of species for future generations will require not only conserving land to prevent sprawl from consuming available habitat, but will require cooperative efforts across property lines and through generations to maintain critical habitats such as dry montane shrublands, early successional forests, open, expansive pastures, and old growth forest reserves. The threats to wildlife – climate change, habitat loss, foreign diseases, invasive species, suburban sprawl, poor land management, unsustainable forestry practices, and ignorance – have not been this widespread, pervasive, and destructive since the obliteration of the primeval forests in the 18th and 19th centuries. To meet those challenges the conservation community has developed innovative tools – Natural Resources Inventories, Conservation Easements, Best Management Practices, and Citizen Science – to steer society in the direction of protecting the fabric of the ecology that not only allows wildlife to flourish, but that hands society the privileges of clean air and water, beautiful scenery, and the passing chance of seeing what you swear was a cougar fade into the blended colors of the forest.

SIGNS OF THE TIMES – A PAIR OF ADULT FISHER TRACKS CROSS THE PATH OF AN ATV IN DEEP SAND NEAR PISCATAQUOG MOUNTAIN. COYOTE SCAT REMAINS FROM HIS PASSING A COUPLE WEEKS EARLIER.

MAMMALS

New Hampshire hosts 63 species of mammals (See Appendices for a complete list of all NH species). The Piscataquog Watershed hosts 47 native species (PWA, 2005b) most of which probably occur in Lyndeborough. Mammal detection efforts for this NRI included observing track, scat, sign, and sightings while conducting bird surveys and vegetation inventories. Approximately ½ of the potential native mammals were identified. Specific inventories or studies to document mammals were not conducted but would prove useful. "Keeping Track" transects should be reinstated.

The following mammals were catalogued during the 2004 spring and summer inventory of the Cold, Brennan, and Rand Brook Watersheds (PWA, 2005a):

Beaver
Black Bear
Bobcat
Deer mouse
Eastern chipmunk
Eastern coyote
Fisher
Gray fox
Gray Squirrel
Long-tailed weasel
Meadow vole
Mink
Moose
Muskrat
Northern flying squirrel
Porcupine
Raccoon
Red squirrel
River otter
Short-tailed weasel
Snowshoe hare
Striped skunk
White-footed mouse
White-tailed deer
Woodland jumping mouse

The 2002 Master Plan lists species commonly occurring around homes and development:

Raccoon
Opossum
Skunk
Muskrat
Beaver
Porcupine
Woodchuck
White-tailed deer
Squirrels
Mice
Bats
Foxes
Rabbits
Coyote
Otter
Black bear
Fisher
Moose

Hague (2005) lists these species from her NRI of the Rose Mountain Area:

Black bear
Beaver
Bobcat
Coyote
White-tailed deer
Fisher
Snowshoe hare
Mink
Muskrat
Moose
Porcupine
Raccoon
Otter

A LARGE MALE BLACK BEAR, MARKING HIS TERRITORY, LEFT DEEP GOUGES IN THIS 18" RED PINE ON PISCATAQUOG MOUNTAIN

The following species were documented during this NRI in either field work or conversation with others. Significant additions to the list could be made by employing inventory methods targeted at small mammals, such as moles, voles, and mice. The majority of large species have been recorded. Focal wildlife species for the Piscataquog River Watershed (2005b) are marked with a #.

Animal	Observed/reported sign
Black bear[#]	Tracks, scat, scratched red pines
Coyote	Tracks, scat, vocalizations, sightings
Cougar	Tracks (1990), accounts in SE Lyndeborough and Mont Vernon
Bobcat[#]	Tracks, first person accounts from several residents
Red fox	Tracks, sightings, accounts
Ermine	Accounts
Fisher[#]	Tracks, accounts
Raccoon	Sighting, tracks, accounts
White-tailed deer	Tracks, scat, sightings, scrapes, rubs, feeding sites, accounts
Moose[#]	Tracks, scat, scrapes, rubs, sighting, accounts
Porcupine	Tracks, scat, dens, sightings
Chipmunk	Tracks, sightings, vocalizations, feeding debris
Gray squirrel	Tracks, sightings, vocalizations, feeding debris
Red squirrel	Tracks, sightings, vocalizations, feeding debris
Woodchuck	Sighting
Mink[#]	Accounts
Beaver[#]	Sighting, feeding sign, tracks, habitat signs
Otter[#]	Sighting, scat, feeding debris, tracks, slide
Muskrat	Sighting, debris mounds
Deer mouse	Sighting
Northern flying squirrel	Sighting, denning
Snowshoe hare	Tracks, scat
Eastern cottontail	Sighting
New England cottontail[#]	Unsubstantiated account
Unknown bat	Sightings
Unknown woodland vole	Sighting

REPTILES & AMPHIBIANS

Information available at: http://www.wildlife.state.nh.us/Wildlife/Nongame/reptiles_amphibians.htm

Eighteen species of reptiles occur in New Hampshire; eleven snakes and seven turtles. Twenty-two amphibians occur in New Hampshire; two toads, eight frogs, and twelve salamanders. Because many of these species occur explicitly in either northern sub-boreal forests or in the lowland coastal plain, Lyndeborough can not be expected to provide habitat for all of these. A reasonable expectation for species richness is what PWA (2005b) reports for the Piscataquog Watershed: 16 species of native amphibians (8 salamanders, 8 frogs), all six native turtles, and 9 species of snake.

Turtles

Two turtles were positively identified for Lyndeborough during the NRI. Two species were identified for the Cold, Brennan, and Rand Brook Watershed area (PWA, 2005a; marked with an *). Focal wildlife species for the Piscataquog River Watershed (2005b) are marked with a #.

- Snapping turtle *(Chelydra serpentina)* is widespread and secure in New Hampshire
- Eastern painted turtle* *(Sternotherus odoratus)* is widespread and secure in New Hampshire.

Species that probably occur in Lyndeborough based on reports for neighboring towns include:

- Blanding's turtle[#] *(Emydoidea blandingii)* is a species of concern in New Hampshire & a Wildlife Action Plan species of greatest conservation need. It has been reported for New Boston, Mont Vernon, Amherst, Milford, and Peterborough. A Lyndeborough resident reportedly observed one in the vicinity of Crooked S Road.
- Common musk turtle *(Sternotherus odoratus)* is widespread and secure in New Hampshire. It has been reported for New Boston, Mont Vernon, and Amherst. Requires soft, muddy bottoms such as at Putnam and Badger Ponds.
- Wood turtle*[#] *(Glyptemys insculpta)* is a species of concern in New Hampshire and a Wildlife Action Plan species of greatest conservation need. It has been reported for Francestown, New Boston, Amherst, Milford, Wilton, Temple, and Peterborough.
- Spotted turtle[#] *(Clemmys guttata)* is a Threatened species in New Hampshire & a Wildlife Action Plan species of greatest conservation need. A specimen was observed in person in captivity for research purposes in Francestown along Rand Brook. It is reported for New Boston, Mont Vernon, Amherst, and Milford.

Frogs

Six species of frogs were positively identified for Lyndeborough during this NRI. The same species minus spring peeper were reported for the Cold, Brennan, and Rand Brook Watershed area (PWA, 2005a). Species reported for Lyndeborough by the NH Fish & Game Reptile and Amphibian Reporting Program (RAARP) are marked by an [@]. Focal wildlife species for the Piscataquog River Watershed (2005b) are marked with a [#].

- Green frog[@] *(Rana clamitans melanota)* is widespread and secure in New Hampshire.
- Bull frog *(Rana catesbeiana)* is widespread and secure in New Hampshire.
- Gray tree frog *(Hyla versicolor)* is widespread and secure in southern/central New Hampshire.
- Pickerel frog[@] *(Rana palustris)* is widespread and secure in New Hampshire.
- Wood frog[#] *(Rana sylvatica)* is widespread and secure in New Hampshire.
- Spring peeper[@] *(Pseudacris c. crucifer)* is widespread and secure in New Hampshire.

Toads

One toad species was documented in Lyndeborough for this NRI. It was also reported for the Cold, Brennan, and Rand Brook Watershed area (PWA, 2005a):

- American toad[@] *(Bufo a. americanus)* is widespread and secure in New Hampshire.

Salamanders

Three species of salamander were documented in Lyndeborough for this NRI:

- Red spotted newt[*@] *(Notophthalmus viridescens)* is widespread and secure in New Hampshire.
- Northern redback salamander[*@] *(Plethodon cinereus)* is widespread and secure in New Hampshire.
- Spotted salamander[@] *(Ambystoma maculatum)* is widespread and secure in New Hampshire.

Species that probably occur in Lyndeborough based on reports for neighboring towns include:

- Northern dusky salamander*[#] *(Desmognathus fuscus)* is widespread and secure in New Hampshire and has also been reported for Amherst, Wilton, Temple, and Peterborough.
- Northern two-lined salamander*[#] *(Eurycea bislineata)* is widespread and secure in New Hampshire and has been reported for Amherst, Temple, and Peterborough.
- Four-toed salamander[#] *(Hemidactylium scutatum)* is vulnerable in New Hampshire and has been reported for Wilton, Temple and the Piscataquog Watershed.

Snakes

Five snakes have been positively documented in Lyndeborough. Four species were identified for the Cold, Brennan, and Rand Brook Watershed area (PWA, 2005a; marked with an asterisk). Focal wildlife species for the Piscataquog River Watershed (2005b) are marked with a #.

These two snakes have been reported for Lyndeborough by the NH Fish & Game Reptile and Amphibian Reporting Program (RAARP):

- Eastern milk snake* *(Lampropeltis triangulum triangulum)*
- Ribbon snake*# *(Thamnophis sauritus);* vulnerable because of wetland loss and fragmentation.

These three snakes were documented during this NRI:

- Northern water snake*# *(Nerodia sipedon sipedon)* at Putnam Pond
- Garter snake* *(Thamnophis sirtalis)* at several sites
- Smooth green snake *(Opheodrys vernalis)* at Putnam Pond; vulnerable, Species of Special Concern; NH Wildlife Action Plan Species in Greatest Need of Conservation. Utilizes fields, woodland openings, and blueberry barrens.

Species that probably occur in Lyndeborough based on reports for neighboring towns include:

- Northern brown snake *(Storeria dekayi dekayi)* is widespread and secure in southern New Hampshire, and has been reported for Wilton.
- Northern red-bellied snake *(Storeria occipitomaculata occipitomaculata)* is widespread and secure in New Hampshire and is reported for New Boston.
- Black racer *(Coluber constrictor)* is a species of concern in New Hampshire and a Wildlife Action Plan species of greatest conservation need. It is reported for Peterborough and Amherst. It requires large patches of dry, brushy, rocky, and ledgy habitat such as the dry montane shrublands of Lyndeborough Mountain.
- Eastern hognose snake# *(Heterodon platirhinos)* is a Threatened species in New Hampshire and a Wildlife Action Plan species of greatest conservation need. It is reported for Amherst, Mont Vernon, and New Boston. It could occur in the lowest areas of Lyndeborough in riparian areas and marshes with adjacent pine forests.
- Northern ringneck snake *(Diadophis punctatus edwardsii)* is widespread and secure in southern New Hampshire. It is reported for Wilton and New Boston and probably occurs in mixed shady woods and rocky areas.
- Timber rattlesnake *(Crotalus horridus)*, a state Endangered species, occurs at one undisclosed site in New Hampshire. Abundant potential habitat exists in Lyndeborough on talus slopes and rocky ridges.

FISH

Thirty-five native and fourteen introduced freshwater fish occur in New Hampshire. An additional eight species are anadromous to lower reaches of major rivers. Fish were not intensively sampled for this NRI. In the Souhegan Watershed, chain pickerel was caught by net during field work in Stony Brook, and brown bullhead (locally known as hornpout) was caught by hook at Putnam Pond. Native brook trout were caught by hook in Rand Brook. The following fish are reported for the Souhegan River (NRPC, 2006) and the Piscataquog River headwaters in the Cold, Brennan, and Rand Brook Watersheds (PWA, 2005a). These species may or may not all utilize their headwater tributaries in Lyndeborough. Some 16-20 fish occur in the Piscataquog River Watershed (PWA, 2005b) but not all were documented in these headwater studies. Focal wildlife species for the Piscataquog River Watershed (PWA, 2005b) are marked with a #.

Souhegan River		**Piscataquog Headwaters**
Native Fish	*Introduced Fish*	*All Native Fish*
banded sunfish#	brown trout	blacknose dace
American eel	rainbow trout	bluegill
Atlantic salmon	smallmouth bass	brook trout#
blacknose dace	largemouth bass	brown bullhead
brook trout#		chain pickerel
brown bullhead		common shiner
chain pickerel		creek chubsucker
common shiner		fallfish
common white sucker		longnose dace
creek chubsucker		pumpkinseed
fallfish		redbreast sunfish
golden shiner		slimy sculpin#
longnose dace		white sucker
longnose sucker		yellow perch
margined madtom		
pumpkinseed		
redbreast sunfish		
spottail shiner		
yellow bullhead		
yellow perch		

BIRDS

Approximately 222 species of birds breed, winter, or are year-round residents of New England (Degraaf & Yamasaki, 2001), many of which are found predominantly at or near the seacoast. Around 205 species have been recorded breeding in Southern New England (Dettmers & Rosenberg, 2000), and around 179 in Northern New England (Hodgman & Rosenberg, 2000). Lyndeborough is situated at the boundary between the physiographic zones referenced in the above two studies, and offers a broad range of habitats from both regions. It does, however clearly lack in extensive Boreal forests, alpine and sub-alpine systems, coastal dunes and estuaries, and pure pitch-pine barrens. The Piscataquog Watershed Association (2005) estimated that approximately 125 species are likely to breed in the watershed, with additional species occurring during migrations. Given Lyndeborough's position geographically (in relation to physiographic regions at the largest scale, and the Piscataquog watershed at the finest scale), as well as the range of habitats available, it is likely that around 150 species might be expected to occur during breeding and migrations, but certainly not consistently in space or time. Excluding bird species that are specific to the aforementioned habitats, it is likely that most others native to central New England would occur.

Observing and recording the suite of birds that might utilize, or at least pass through, Lyndeborough's varied terrain would be a lifetime's task. Walter & Karen Holland have recorded the birds seen at their Stonefield Farm, since October of 1982. In that time they have recorded 91 species. Research at the 2,826 acre New Boston Air Force Station (NBAFS) several miles east of Lyndeborough has documented 148 species of birds (Department of Defense Partners in Flight, no date), which is probably a realistic estimate of the species that might be seen in Lyndeborough. Inventories through the spring and summer of 2004 by the Piscataquog River Headwaters Project-1 (HW-1) documented 72 birds (Russell & Brooks, 2005) in the Cold Brook watershed in Lyndeborough and the Brennan and Rand Brook watersheds just to the north. Fifty-one species of birds have been recorded within the 1,625 acre Wapack National Wildlife Refuge in neighboring Greenfield, and another 30 are expected there (US Fish & Wildlife Service, 2008). Breeding Bird Surveys done for NH Audubon by Francie Von Mertens of Peterborough for more than ten years have recorded many species at 17 stops along Lyndeborough roads between Greenfield and Mont Vernon. Inventory work for the 2008 NRI yielded 65 species, and conversations with residents and landowners revealed another four

species that had been seen in the past. Cumulatively then, 109 species have been positively recorded in Lyndeborough, and about another 40-50 have been recorded nearby. Assuming that my estimates, which are based on several other studies, are correct, then around 2/3 of the full suite of bird species have been documented in Lyndeborough. The tables on the following pages provide details on each bird seen or expected in Lyndeborough based on the above sources (excluding NBAFS), as well as its conservation status and critical habitat, if applicable.

Four key habitats support the broadest range of birds. Dry shrublands, old fields, hayfields, and early successional forests (collectively *early-successional habitat*) are critical habitat for the rufous-sided towhee, bobolink, chestnut-sided warbler, woodcock and cedar waxwing, among many others. *Wet shrublands*, like the shrub-scrub swamps of Badger Pond, are important for the red-winged blackbird, alder flycatcher, gray catbird, northern harrier, and many more species that need cover, perching sites, and rely on aquatic insects for food. *Mature unfragmented forests* are essential habitat for the scarlet tanager, winter wren, the thrushes & veery, ovenbirds, and vireos. *Marshes, wet meadows, and pond margins* consisting of emergent vegetation are important for ducks, geese, kingbird, American bittern, tree swallow, great blue heron, killdeer, and many other wetland-dependant birds.

These four priority habitats (early succesional, shrub swamps, marshes, and mature forest) represent a modest fraction of Lyndeborough, but that is not to say the mixed matrix connecting them is of little value. The nearly contiguous cover of forest that binds these isolated habitats together provides food, cover, and territory for dozens of species. The ever-changing nature of these ecosystems as they respond to beaver disturbance, timber harvesting, ice-storms, blow downs, forest fires, and wetland succession allow critical habitats to rotate through the landscape through time, creating what ecologists term *spatial and temporal heterogeneity*. Tracts of land between and around critical habitats provide necessary buffers from pollution and human activity, plus allow room for populations to disperse, demographics to shift, species to interact with distant populations and share genes, and adapt to sudden changes in home habitat. As a chain is only as strong as its weakest link, so to are habitats only as functional as the supporting landscape that surrounds them. The birds of Lyndeborough are listed on the following two pages. Conservation information and references are provided following the tables.

Common Name	NRI[a]	HW-1[b]	NWR[c]	Other[d]	PIF Priorities[e]	BCR 14 Priorities[f]	WAP[g]	PIF Habitat[h]
alder flycatcher				9				
American bittern		X		6		Moderate	RC	FW
American black duck		X		10	III - IIC	Highest	C	FW
American crow	X	X	X	1,8				
American goldfinch	X	X	X	1				
American kestrel		X		1				
American redstart			X					
American robin	X	X	X	1				
American woodcock	X	X	E	1,3	IA	Highest	C	ESF/ESS
bald eagle				1		Moderate	C	FW
bank swallow		X				Moderate		
barn swallow	X	X		1		Moderate		
barred owl	X	X		1				MF
bay-breasted warbler			X		IB	High	C	
belted kingfisher		X		1				
black and white warbler		X	X	1	IIA			MF
black-capped chickadee	X	X	X	1,8				
black-throated blue warbler		X	X		IA - IB	High		MF/NH
blackburnian warbler			X		IA	Moderate		
black-throated green warbler	X		X			Moderate		
blackpoll warbler			X			Moderate		
blue-headed vireo			X					
blue Jay	X	X		1,8				
blue winged warbler				1	III - IA	High		ESF/ESS
bobolink		X		9	IIC - III	High		GA
broad-winged Hawk	X	X		1				
brown creeper		X	X	1		Moderate		
brown-headed cowbird		X		1				
Canada goose	X	X		1,8				
Canada warbler			X		IA	High	RC	
cedar waxwing	X	X	X	1				
chestnut-sided warbler	X	X	E		IA	High		ESF
chimney swift	X	X	E	1	IIC - IIA	High		US/NH
chipping sparrow	X		X	1				
common grackle	X	X		1				
common merganser	X	X		10				
common nighthawk			E	1		High	T	ESF/US
common redpoll		X		1				
common yellowthroat	X	X		1				
Coopers hawk		X	E	1			T	MF/NH
dark-eyed junco	X	X	X	1				
downy woodpecker	X	X	X	1				
Eastern kingbird	X	X		1				
Eastern bluebird		X		1,2				
Eastern phoebe	X	X	X	1				
Eastern meadowlark				1			C	
Eastern wood pewee		X	E	1	IIA	High		MF/NH
European starling		X		1				
evening grosbeak	X		X	1				
fox sparrow				1				
golden crowned kinglet	X		X	5				
golden eagle				3			E, RC	
gray catbird	X	X	E	1	IIA			ESF
great blue heron	X	X		1			C	FW
great crested flycatcher		X						
great horned owl	X			1,2				
hairy woodpecker	X	X	X	1,8	IIA			MF
hermit thrush	X	X	X	1,8				
hooded merganser	X	X						
horned lark				1		Moderate	C	GA
house finch				9				
house sparrow	X			1				
house wren				1				
indigo bunting				1				

Common Name	NRI[a]	HW-1[b]	NWR[c]	Other[d]	PIF Priorities[e]	BCR 14 Priorities[f]	WAP[g]	PIF Habitat[h]
killdeer	X	X		1		Moderate		
least flycatcher		X						
little green heron				6				
Louisiana waterthrush		X			IA			MF
magnolia warbler			X	1				
mallard duck	X	X						
merlin				1				
mockingbird				1				
mourning dove	X	X	X	1				
mourning warbler				1				ESF
Nashville warbler			X	1				
Northern cardinal	X	X		1				
Northern flicker	X	X	E	1		Moderate		
Northern goshawk		X	E	1,2,7		Moderate	C	MF/NH
Northern harrier	X		E			Moderate	E, RC	GA/FW
Northern oriole		X		1	IA			MF
Northern waterthrush				9				
ovenbird	X	X	X	1	IIB	Moderate		NH
osprey	X			1			T	FW
Philidelphia vireo			X					
pileated woodpecker	X	X	X	1,8				
palm warbler	X					Moderate		
pied-billed grebe				10				FW
pine grosbeak			X			Moderate		
pine siskin				1				
purple finch			X	1	IIA	High	C	MF/NH
raven	X	X	X	1,8				
red-bellied woodpecker				1				
red-breasted nuthatch	X	X	X	1				
red-eyed vireo	X	X	X	1				
red-shouldered hawk	X	X	E	1			SC	MF
red-tailed hawk	X		X	1,8				
red-winged blackbird	X	X		1				
ring-necked pheasant				1				
rock dove				1				
rose-breasted grosbeak	X		X	1	IIA	Moderate		MF/NH
ruby-throated hummingbird		X		1				
ruffed grouse	X	X	X	1		Moderate	C	
rufous-sided towhee	X	X	E	1,8	IIA		C	ESS
scarlet tanager	X	X	X	1	IIA - IA			MF/NH
screech owl			E	1				
sharp-shinned hawk		X	X	1				MF/NH/MCF
snowy owl				4, 10				
song sparrow	X			1				
spotted sandpiper		X						
swamp sparrow				9				
tree sparrow				1				
tree swallow	X	X		1				
tufted titmouse	X	X	X	1				
turkey vulture	X	X		1				
veery	X	X	X	1	IIB	High	C	NH
warbling vireo				9				
white-breasted nuthatch	X	X	X	1,8				
white-throated sparrow	X		X	1				
whip-poor-will			E	5	IIC	Moderate	RC, SC	ESF/ESS
wild turkey	X	X		1,8				
winter wren	X		X					
wood duck	X	X		1, 10		Moderate		
wood thrush	X		E	1	IA	Highest	C	MF/NH
yellow-bellied sapsucker	X		X			High		
yellow warbler	X	X		1				
yellow-billed cuckoo		X						
yellow-rumped warbler	X	X	X	1				

a: An “X” here indicates this is a species identified by the author during NRI field work in 2008.

b: An “X” here indicates this is a species identified by the Piscataquog River Headwaters Project-1 field work in 2004.

c: An “X” here indicates this is a species recorded at the Wapack National Wildlife Refuge.
An “E” here indicates this species is expected to occur at the Wapck NWR.

d: A number here indicates the source for a bird record:
- 1= Walter & Karen Holland: Stonefield Farm Life List
- 2= Mike Decubelis: sightings in North Lyndeborough
- 3= Leo Trudeau: sightings in North Lyndeborough
- 4= Amy Trudeau: sightings in North Lyndeborough
- 5= Francie Von Mertens: sightings in vicinity of Gulf Road & Frye Brook
- 6= Jessie Salisbury: sightings in vicinity of Cram Hill
- 7= Julie Zebhur: sighting on Piscataquog Mountain
- 8= Emily Hague: Rose Mountain Natural Resources Inventory (Hague, 2005)
- 9= Francie Von Mertens: NH Audubon Breeding Bird Surveys
- 10= Pete Gallagher: hunting observations

e: “Partners in Flight Landbird Conservation Plan” species conservation priority rankings (Dettmers & Rosenberg, 2000; Hodgman & Rosenberg, 2000). (If two ranks, then the first represents northern New England and the second southern New England):
- IA= high continental priority – high regional responsibility
- IB= high continental priority – low regional responsibility
- IIA= high regional concern
- IIB= high regional responsibility
- IIC= high regional threats
- III= U.S. National Watch List

f: Atlantic Coast Joint Venture “Blueprint for the Design and Delivery of Bird Conservation in the Atlantic Northern Forest” species conservation priority levels (Dettmers, 2002):
- Highest= highest priority for conservation
- High= high priority for conservation
- Moderate= moderate priority for conservation

g: NH Fish & Game Department Wildlife Action Plan wildlife risk ranks:
- C= species of concern
- SC= species of special concern in NH
- RC= species of regional concern
- T= threatened in NH
- E= endangered in NH

h: Partners in Flight priority habitats (Dettmers & Rosenberg, 2000; Hodgman & Rosenberg, 2000):
- US= urban & suburban environments
- FW= freshwater wetlands
- GA= grasslands & other agricultural lands
- ESS= early successional shrub habitats
- ESF= early successional forests
- MF= mature mixed forests
- NH= northern hardwood forests
- MCF= mature conifer (spruce-fir) forest

DEFINING SIGNIFICANT, IMPORTANT & CRITICAL HABITATS OF LYNDEBOROUGH

Any piece of land can provide habitat for some animal, whether it's a mole living in your lawn, the chickadees and juncos at your bird feeder, or isolated sandy shores along Putnam Pond where snapping turtles lay their eggs. Defining the most important habitats is a process based on understanding the needs of all wildlife species, recognizing the most imperiled species in the region, and identifying the habitats they require to meet their dietary, breeding, and shelter requirements. The following habitats are of highest importance to the suite of species found in Lyndeborough, based on field inventory results, the Piscataquog Watershed Conservation Plan (PWA, 2005b) and published standards by Kanter *et al.* (2001), NH Ecological Reserve Advisory Group (1998), and the NH Wildlife Action Plan (NH Fish & Game, 2006).

Existing & potential habitats of rare species: Plants like fern-leaved false foxglove, Blackgum Swamps, and flowering dogwood; birds like the rufous-sided towhee, great blue heron, bobolink, and palm warbler; and other species like Blanding's turtle, hognose snake, and wood turtles require specific habitats to survive. Where they already occur obviously meets their needs, thus highlighting the importance of these areas.

Unfragmented Forest Blocks: These large, deep-woods areas, ranging from ~750 to ~3,500 acres in Lyndeborough, provide secluded breeding, feeding, and denning areas for black bear, bobcat, fisher, numerous forest birds like thrushes and large woodpeckers, and possibly mountain lion. Large blocks provide security to all aspects of ecological systems as they allow populations, individuals, and processes to shift in response to human & natural disturbances.

Large Wetland Complexes: Mosaics of marshes, meadows, shrub swamps, forested wetlands, open water ponds, forested streams and ecotonal riparian areas support great diversity as many species require specific wetland habitat elements. Mink require grassy wet meadows and marshes, otter and fish require deeper open water to hunt prey, beaver require damable streams, moose require areas of emergent and submerged vegetation to wallow, white tailed deer require shrubs for cover and feeding, Blanding's and spotted turtles require shrubby hummocks, and numerous birds and reptiles have still more specific habitat needs. The greater the range of these habitats in close proximity the higher the value of the entire complex.

Agricultural & Open Lands: Extensive grasslands which are declining at alarming rates provide critical nesting and foraging habitat for more than 150 species in New England, including eastern meadowlark, bobolink, horned lark, purple martin, vesper sparrow, upland sandpiper, smooth green snake, and northern harrier. Also, they are important white-tailed deer nocturnal feeding sites. Dry shrublands, old fields, and young forests support woodcock, New England cottontail, black racer (snake), rufous-sided towhee, chestnut-sided warbler, cedar waxwing, and many more birds; these habitats are described in more detail in a few pages.

Unique & Uncommon Lands: Scarce features and environments tend to support isolated populations of uncommon birds, plants, fungi, and forest types. Types occurring in Lyndeborough include talus slopes, exposed ledges, slabs, & cliffs, black gum swamps, vernal pools, dry shrublands, spruce stands, mast areas, wild apple trees, seeps & springs, 'old-growth' forest patches, blow-down areas, fire-influenced forests, bogs, and rich-mesic forests.

UNFRAGMENTED FOREST BLOCKS OF LYNDEBOROUGH & SURROUNDING AREA

Seven blocks of unfragmented forest were identified during NRI mapping. A base data layer available form NH GRANIT was used to initially provide polygon features. This data was developed for the whole state of New Hampshire by buffering roads by 300 feet. While this is appropriate for state-wide or regional planning, it was not 100% representative of Lyndeborough's forest blocks. Recently released color aerial imagery from the summer of 2008 was used to adjust the layer to exclude homes, maintained roads, and agricultural areas that are frequently disturbed by human activity. Furthermore, buildings data from the tax map GIS project was used to identify primary homes and farmsteads. The blocks, as I identified them, do not share a common distance from roads, homes, or farms, but rather are adjusted to represent the relative level of impact I estimate those places as having on a forest ecosystem, based on my experience and understanding of Lyndeborough. For example, some blocks start at maintained roads in places where traffic is minimal, there are few residences, and ecosystem processes are ultimately minimally affected by human infrastructure. Conversely, some blocks were adjusted to exclude by several hundred feet mowed farm fields, high-density residential development, and high-traffic roads. Some homes situated deep in forest blocks have relatively minor affects on ecosystem processes so a smaller exclusion area around the home and driveway was used. This analysis results in the following unfragmented forest blocks which total 10,710 acres, or 55% of Lyndeborough:

Northern Wapack Range Block 1224 acres in Lyndeborough: 0 acres protected
7190 acres total in Lyndeborough, Greenfield, Peterborough, and Temple

Lyndeborough Mountain Block 3580 acres in Lyndeborough: ~650 acres protected (~18%)
4529 acres total in Lyndeborough, Francestown, and Greenfield

Purgatory Falls Block 939 acres: <15 acres protected (<1.5%)
923 acres in total Lyndeborough and Mont Vernon

Piscataquog Mountain Block 1732 acres: ~800 acres protected (~47%)
1895 acres in Lyndeborough, Mont Verrnon, and New Boston

Cold Brook Block 1421 acres: ~500 acres protected (~34%)

Burton Pond Block 750 acres: 0 acres protected
1348 acres total in Lyndeborough and Wilton

Stimson Hill-Putnam Pond Block 1064 acres: ~150 acres protected (~14%)

CRITICAL HABITAT TYPES: PRIME LYNDEBOROUGH EXAMPLES

Seven unique areas in Lyndeborough are outlined in turquoise on the IMPORTANT ECOLOGICAL FEATURES map. These are not necessarily the most important actual places in Lyndeborough for meeting wildlife and human needs, but each is a good example of some of the rare, declining, or essential habitat types that maintain the immeasurable beauty of Lyndeboroughs natural environment. Despite their uniqueness unto themselves, they all share a common trait of being within large blocks of undeveloped forestland. Only half of these critical habitats are currently protected from exploitation and habitat loss. Future conservation projects should focus on these communities and habitats to ensure the long-term viability of Lyndeboroughs incredible natural assets.

1- **Early successional forest & grassland complex**: Abandoned pastures and farm-fields provide habitat essential to the survival of numerous birds, such as woodcock, bobolink, and whip-poor-will, as well as the New England cottontail and other mammal and reptile species.

2- **Mature beech - red oak forest** that is beginning to attain old-growth characteristics links existing conservation lands, produces tremendous hard mast (tree nuts and seeds), and protects watershed values for Cold Brook.

3- Decades or even centuries of frequent burning to promote blueberry production stripped soil from the mountaintops and created very rare **dry montane shrublands** and spruce ridgeline communities that allow birds like the rufous-sided towhee and predators like bobcat to persist.

4- Broad elevational and moisture gradients rise from rich expanses of marsh and shrub wetlands, through unique dry **Appalachian oak-pine** forests and very old **hemlock-white pine** forests broken occasionally by rare **black gum swamps**, perennial **springs**, and **beaver flowages**. The diversity of wet and dry communities in such close proximity promotes high bio-diversity.

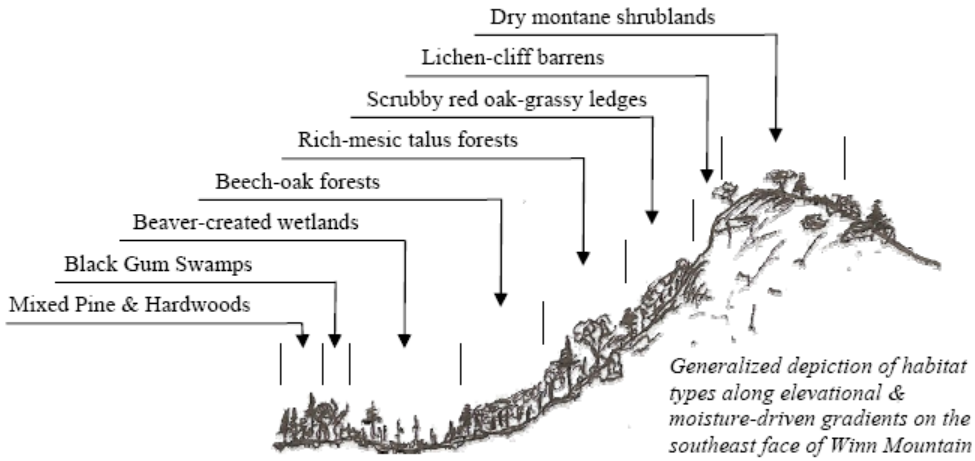
5- Heavily fractured and jointed bedrock rich in minerals was torn and shattered by the glaciers of the last ice age. This 'plucking' from a smooth mountaintop created steep and rough **rich talus woods** that support high plant species richness, uncommon communities, and provides deep woods habitat-elements for many animals. Above the steep slopes are more early successional alder, aspen, oak, pine and birch-dominated **dry montane shrublands**.

6- **Extensive marsh, shrub, and forested wetlands** broken by brief reaches of tumbling stream expand nearly two miles up Furnace Brook from the Putnam Pond flood control dam. Mink, otter, beaver, as well as dozens of birds, amphibians, reptiles and large mammals rely on extensive blocks of **undeveloped wetlands complexes** for their survival.

7- Very uncommon **mature beech – white oak forest** that produces vast amounts of hard mast is dotted with numerous vernal pools, where common and rare amphibians and reptiles breed. A wide-ranging ecological gradient from the **emergent aquatic beds** of Putnam Pond to the craggy bedrock exposures on the dry hillside provides diverse habitats for numerous plants and animals.

WINN MOUNTAIN: HIGH DIVERSITY ALONG ELEVATIONAL AND MOISTURE GRADIENTS

At 1,676 feet above sea level, Winn Mountain is the third highest summit in Lyndeborough, although its dramatic southeast face earns it the distinction of being the most striking of Lyndeboroughs hills. Throughout this report, mention is made of diversity along elevational and moisture gradients, which means a wide range of environments for different plant communities, ecological processes, and habitats to occur; from the low and wet places to the high and dry. A relatively short walk from base to summit will pass rare black gum swamps, dry Appalachian oak-pine-mountain laurel forests, hemlock-dominated wetlands, beaver ponds, rocky ridges, cliffs, and slabs, rich talus slopes and dry montane shrublands. This variety of environments, within a permanently protected conservation easement, provides the necessary habitat for many of the species documented in this research. Similarly diverse gradients occur on other hillsides in Lyndeborough, though each is comprised of different arrangements of communities.

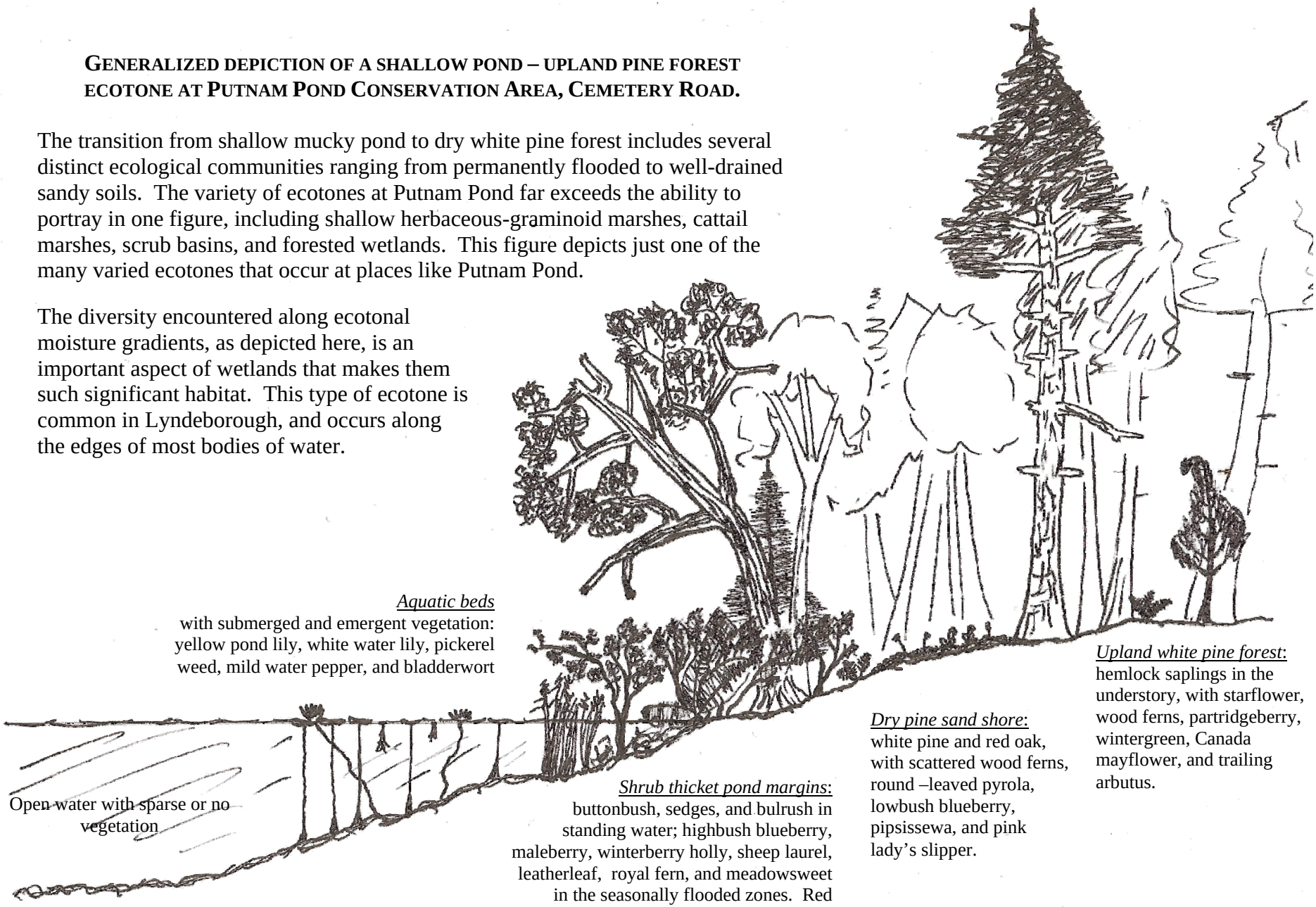


Generalized depiction of habitat types along elevational & moisture-driven gradients on the southeast face of Winn Mountain

GENERALIZED DEPICTION OF A SHALLOW POND – UPLAND PINE FOREST ECOTONE AT PUTNAM POND CONSERVATION AREA, CEMETERY ROAD.

The transition from shallow mucky pond to dry white pine forest includes several distinct ecological communities ranging from permanently flooded to well-drained sandy soils. The variety of ecotones at Putnam Pond far exceeds the ability to portray in one figure, including shallow herbaceous-graminoid marshes, cattail marshes, scrub basins, and forested wetlands. This figure depicts just one of the many varied ecotones that occur at places like Putnam Pond.

The diversity encountered along ecotonal moisture gradients, as depicted here, is an important aspect of wetlands that makes them such significant habitat. This type of ecotone is common in Lyndeborough, and occurs along the edges of most bodies of water.



DRY MONTANE SHRUBLANDS: THE ECOLOGICAL CONTEXT

Perhaps unknown to many wildlife enthusiasts, Lyndeborough has historically been a hot spot for rare dry, low-elevation montane shrub habitats. The extensive shrublands of Rose, Pinnacle, and Winn Mountains, and potentially on Piscataquog Mountain too, were maintained by periodic burning to promote blueberry production during a fascinating chapter in the history of agriculture in southern New Hampshire. Until the 1970's the mountain-tops were set ablaze as often as once per year to regenerate the thick carpet of low-bush blueberry. Burning would usually occur in the spring, when snows still sat in the woods below, to prevent the fires from creping down-slope beyond the orchards. Every summer for years, children, teens, families, and elders would gather to rake up the berries, clean the bounty in long-since rotted shacks high on the mountains, and pack them for shipment to market. This form of wild-harvesting agriculture was at times possibly widespread in southwestern New Hampshire, as 'blueberry balds' can be found in Troy (Gap Mountain), Fitzwilliam (Little Monadnock Mountain), the southern Wapack Range, and elsewhere. Furthermore, it is highly possible, though I have found no concrete evidence, that Native Americans had also maintained these areas as open berry producing shrublands as they did elsewhere in northern forests (Kautz, 1983). Sadly, because a burn has not occurred since the 1970's, they are rapidly disappearing as forests overtake the shrubs; a natural step in forest succession.

Typically, shrub communities are not known for their rare plant species due to their ephemeral nature; they do not persist long enough to allow slowly propagating rare plants to persist (Latham, 2003). These particular sites, however, may be exceptions in that they are in close proximity to known populations of the state-threatened fern-leaved false foxglove (*Aureolaria pedicularia* var. *intercedens*; see appendices for species information from NH Natural Heritage Bureau). Ecologist Rick Van de Poll has documented this plant on the rugged west ridge of Winn Mountain (personal communication, July 2008), and surveys for this NRI added 6 new populations to the list. This plant is fire adapted, thus it requires burned or otherwise severely disturbed early-successional habitats to persist (NH Natural Heritage Inventory, 1998). These habitats are important for numerous other rare plants in New Hampshire, though no other species have been described yet for Lyndeborough.

Just how uncommon are these areas? In the recently published book "Managing Grasslands, Shrublands, and Young Forest Habitats for Wildlife: A Guide for the Northeast" biologist Brian C. Tefft writes:

> "Shrublands and old fields are critical wildlife habitats that are essential for the survival of many wildlife species. The loss of these habitats through conversion to other land uses, residential development or through succession, is resulting in the decline and disappearance of some wildlife dependent on early-successional habitats. In eastern North America over the last 60 years, open habitats (grasslands, savannah, barrens, and shrublands) have declined by 98%, with shrubland communities comprising 24% of this decline. These habitat changes provide significant challenges for wildlife biologists who strive to maintain a biologically diverse mix of species and habitats on the landscape. If we are to address these declines, management practices must be employed to create and maintain sufficient early-successional habitats that provide the proper structure and size to meet the needs of associated species." (Tefft, 2006: p.28)
>
> "Of 40 bird species associated with shrubland habitats, 22 are undergoing significant population declines in eastern North America. Additionally, 139 species of reptiles, amphibians, birds, and mammals either prefer (17 species) or utilize (122 species) shrub and old-field habitats. Shrubland habitats in the Northeast also contain higher proportions of state-listed butterflies and moths than other natural community types. Of 3,500 species of butterflies and moths in the Northeast, 58 are dependent upon shrublands, which provide sunny open areas in combination with desired host plants such as scrub oak and blueberry. Fifty-six of these are considered rare." (Tefft, 2006: p.29)

Dry montane shrubland community showing black chokeberry, mountain ash, scrubby red oak, white pine, white & gray birches, smooth sumac, and other shrubs

Dry shrublands are considered critical habitat to restore and conserve by the New Hampshire Ecological Reserve System (NH Ecological Reserve Advisory Group, 1998), and NH Fish & Game Department considers any uncommon habitats, such as dry shrublands/early successional communities significant and important to conserve or restore (Kanter et al., 2001).

The conservation of these areas is extremely important in the protection of declining bird and insect populations. Furthermore, proper management to maintain the successional state of these lands, including renewing the tradition of prescribed fire, is a vital component of wildlife conservation in the northeast. The chart below, originally appearing in DeGraaf & Yamasaki (2001) lists the species that rely on these habitats for their survival.

Common Name	Habitat Preference[a]	Seasonal Use[b]	Population Trend[c]
Spotted turtle	Preferred	B/NB	Locally common
Black rat snake	Preferred	B/NB	Locally common
Northern harrier	Utilized	W	Decreasing
American kestrel	Utilized	W	Decreasing
Ring-necked pheasant	Preferred	B/W	----------
Northern bobwhite	Utilized	B/W	Decreasing
American woodcock	Utilized	B	Decreasing
Mourning dove	Utilized	B/W	Decreasing
Black-billed cuckoo	Utilized	B	Decreasing
Yellow-billed cuckoo	Utilized	B	Decreasing
Common nighthawk	Utilized	B	Decreasing
Whip-poor-will	Utilized	B	Decreasing
Willow flycatcher	Preferred	B	Trend uncertain
Eastern kingbird	Utilized	B	Decreasing
Loggerhead shrike	Utilized	B	Decreasing
Northern mockingbird	Preferred	B/W	----------
Blue-winged warbler	Preferred	B	Stable
Golden-winged warbler	Preferred	B	Decreasing
Chestnut-sided warbler	Utilized	B	Decreasing
Prairie warbler	Preferred	B	Decreasing
Mourning warbler	Utilized	B	Decreasing
Common yellowthroat	Utilized	B	Decreasing
Yellow-breasted chat	Utilized	B	Decreasing
American tree sparrow	Utilized	W	Decreasing
Field sparrow	Utilized	B/W	Decreasing
Vesper sparrow	Utilized	B	Decreasing
Fox sparrow	Preferred	W	Stable
Song sparrow	Preferred	B/W	--------
White-throated sparrow	Preferred	B/W	Decreasing
American goldfinch	Utilized	B/W	Decreasing
Eastern cottontail	Preferred	B/W	Common
New England cottontail	Preferred	B/W	Rare
Snowshoe hare	Preferred	B/W	Common
White-footed mouse	Preferred	B/W	Common
Ermine	Preferred	B/W	Common

[a] Habitat preference as described by DeGraaf and Yamasaki (2001).

[b] Seasonal use of habitats: B = Breeding, NB = Non-breeding W = Wintering, as described by DeGraaf and Yamasaki (2001)

[c] Continental population trend taken from Breeding Bird Survey data for avian species (Hunter et al. 2001); New England status after DeGraaf and Yamasaki (2001) all others.

IDENTIFYING LYNDEBOROUGH'S CRITICAL HABITATS WITH CO-OCCURRENCE ANALYSIS

In this chapter I have reviewed the available data, documented the species that occur in Lyndeborough, and determined the habitats that these species require to maintain stable populations. To review, the most important habitats in Lyndeborough are:

- Existing & Potential Habitats of Rare Species
- Unfragmented Forest Blocks >750 acres
- Mast Producing Hardwood Forests
- Large Wetland Complexes
- Riparian Zones & Wetland Ecotones
- Vernal Pools
- Agricultural & Open Lands
- Dry Montane Shrublands
- Early Successional Ecosystems
- High Elevation Ecosystems

These qualities were given values based on my best professional judgment in order to rank Lyndeboroughs area by habitat quality. There is no currently accepted protocol for applying values to natural resource assets or qualities, so the values I have applied are based on my understanding and observation of these ecosystems and species, filtered through published literature that suggests and identifies habitats of significance. The findings of this analysis are shown on the HIGHEST QUALITY HABITAT CO-OCCURRENCE map.

Chapter 7
Conservation & Public Lands

Topics Addressed in this Chapter

- Entities involved in land conservation
- Area of land conserved
- Natural Resources protected in conservation lands

Approximately 3,100 acres of land in Lyndeborough (~16% of total surface area) consisting of 51 parcels are permanently protected from development by Conservation Easements, Fee Ownership by a conservation organization, agency, or town, deed restrictions, or Flowage Easements as part of flood control projects. Within the 1 mile buffer of Lyndeborough, an additional 4,015 acres are protected by the same array of mechanisms. In total, 18% of the 39,500 acre project area is protected lands (112 parcels totaling 7,115 acres). Just over 22% of New Hampshire is protected and more than half of municipalities have less than 10% protected (Forest Society, 2001) so Lyndeborough has slightly more conservation land than the average southern New Hampshire town.

Land conservation is a critical component of sustaining human occupation of this planet. In the absence of protecting open spaces from development society would ultimately eliminate the numerous features of this planet that we require to persist, including clean air and water, habitat for crop pollinators, wetlands to absorb and mitigate floods, natural spaces for recreation and spiritual rejuvenation, forests for producing wood and fuels, farms for producing food, and other values that are beyond measure. The Society for the Protection of NH Forests has set a goal of conserving 25% of each town in order to safeguard these resources that society relies on every day.

PATTERNS IN LAND CONSERVATION:
ORGANIZATIONAL, AGENCY & MUNICIPAL RESPONSIBILITY

Numerous entities share responsibility for the conservation and public lands in Lyndeborough and vicinity. At least five non-profit conservation organizations own land and/or hold Conservation Easements on land in the area. Four state agencies and one federal agency own land and/or Conservation Easements on land in the area. Each town either owns land and/or holds Conservation Easements on land in the area. Additionally, some lands are owned or held in easement by school districts and unknown entities. These entities are summarized below and on the Conservation & Public Lands Ownership Patterns map on page 158.

FO=*Fee Ownerships* CE=*Conservation Easements* FE=*Flowage Easements*

State Agencies 938.3 acres in total area 596.7 acres in Lyndeborough

NH Fish & Game Department……...299.6 acres in Lyndeborough & Milford
11 Hazen Drive Concord, NH 03301
603-271-3361
http://www.wildlife.state.nh.us

In Lyndeborough	*Within 1 mile buffer*
1 FO (50.2 acres)	1 FO in Milford (168.6 acres)
1 CE (80.8 acres)	

NH Department of Environmental Service.....……556.9 acres in Lyndeborough & Wilton
29 Hazen Drive, PO Box 95 Concord, NH 03302-0095
603-271-3503
http://des.nh.gov/

In Lyndeborough	*Within 1 mile buffer*
3 FO (416.1 acres)	2 FO in Wilton (36.8 acres)
3 FE (35.4 acres)	2 FE in Wilton (68.4 acres)

NH Department of Resources & Economic Development……..14.2 acres in Lyndeborough
172 Pembroke Road P.O. Box 1856 Concord, NH 03302-1856
603-271-2411
http://www.dred.state.nh.us

In Lyndeborough	*Within 1 mile buffer*
1 FO (14.2 acres)	none

New Hampshire Department of Agriculture……..….67.6 acres in Milford
PO Box 2042 Concord, NH 03302-2042
(603) 271-3551
http://agriculture.nh.gov

In Lyndeborough	*Within 1 mile buffer*
not active in Lyndeborough	1 CE in Milford (67.6 acres)

Private, non-profit organizations 4,018.5 acres in total area 2,454.7 acres in Lyndeborough

Francestown Land Trust ……..471.7 acres in Lyndeborough & Francestown

PO Box 132 Francestown, NH 03043
http://francestownlandtrust.org

In Lyndeborough	*Within 1 mile buffer*
1 FO (34.9 acres)	6 FO in Francestown (424.3 acres) 2 CE in Francestown (12.5 acres)

Monadnock Conservancy……..…157.2 acres in Greenfield

P.O. Box 337 Keene, NH 03431-0337
(603) 357-0600
www.monadnockconservancy.org

In Lyndeborough	*Within 1 mile buffer*
not active in Lyndeborough	4 CE in Greenfield (157.2 acres)

Piscataquog Land Conservancy……...……584.9 acres in Lyndeborough, Francestown, Greenfield, & New Boston

5A Mill St. New Boston, NH 03070
(603) 487-3331
www.pwa-nh.org

In Lyndeborough	*Within 1 mile buffer*
6 CE (370.8 acres) 2 FO (52.4 acres)	1 FO in Francestown (86.5 acres) 1 FO in Greenfield (4.5 acres) 2 FO in New Boston (6.3 acres) 4 CE in Francestown & New Boston (64.4 acres)

Forest Society…….1,641.6 acres in Lyndeborough

Society for the Protection of NH Forests
54 Portsmouth Street Concord, NH 03301
603-924-9945
www.spnhf.org

In Lyndeborough	*Within 1 mile buffer*
6 FO (378.5 acres) 2 CE (1,263.1 acres)	none

New England Forestry Foundation……1,163.1 acres in Lyndeborough, Francestown & New Boston

PO Box 1346 Littleton, MA 01460
(978) 952-6856
www.neforestry.org

In Lyndeborough	*Within 1 mile buffer*
1 FO (182.9 acres) a portion is in Francestown 5 CE (172.1 acres)	5 FO in New Boston (766.9 acres) 2 CE in New Boston (41.1 acres)

Federal Agencies 1,139.7 acres in total area 0 acres in Lyndeborough

US Fish & Wildlife Service……..……1,139.7 acres in Greenfield

Wapack National Wildlife Refuge
Northeast Regional Office 300 Westgate Center Drive Hadley, MA 01035
(413) 253-8562
northeastplanning@fws.gov

In Lyndeborough	*Within 1 mile buffer*
not active in Lyndeborough	1 FO in Greenfield (1,139.7 acres)

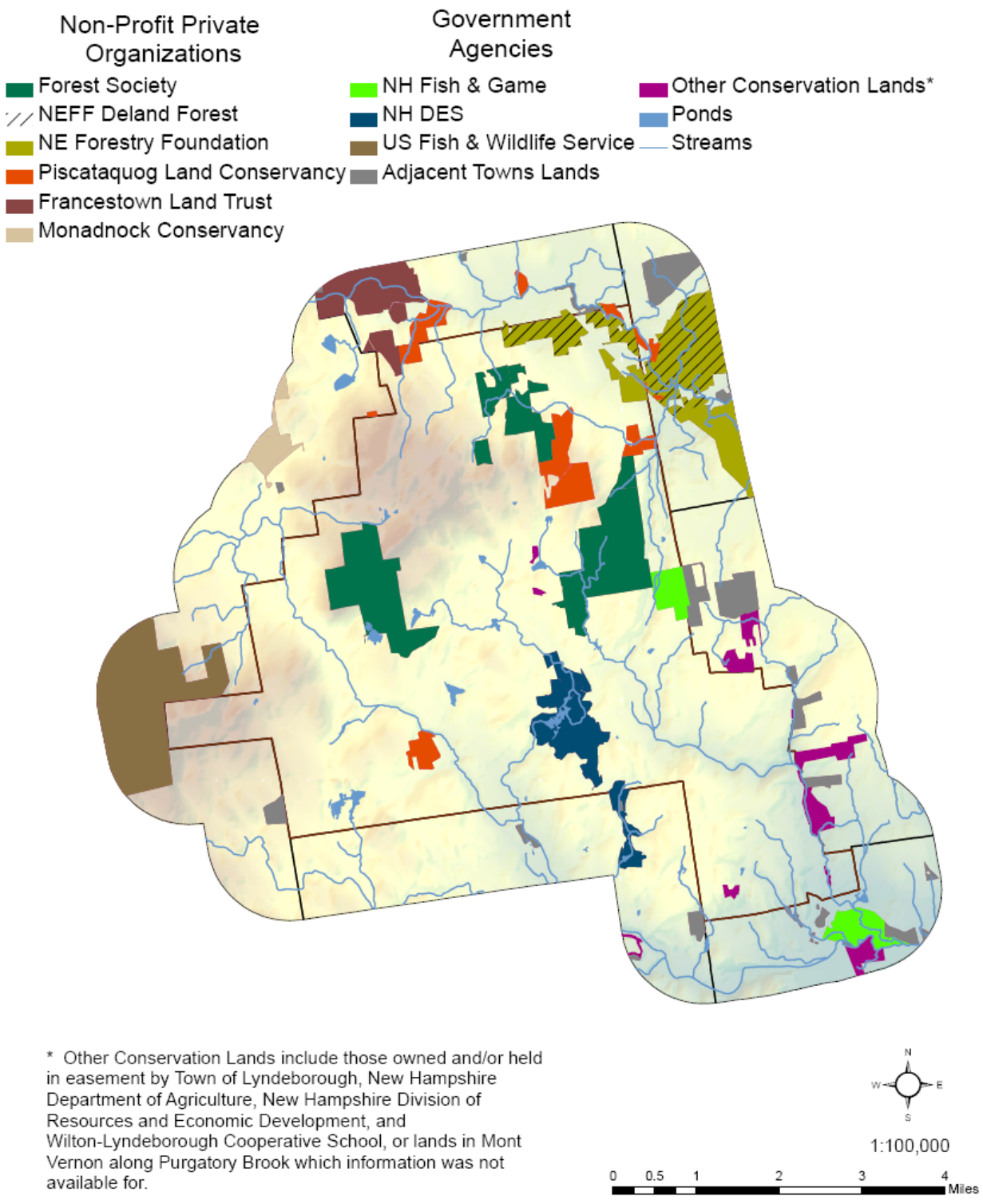
Municipalities 1005.9 acres in total area 30.6 acres in Lyndeborough
(see the table accompanying the CONSERVATION & PUBLIC LANDS map for details)

Lyndeborough

2 FO: Upper & Lower Purgatory Falls (7.2 acres)
1 CE: Bullard Road (9.4 acres)
2 DR (deed restricted): Schmekel & Douglas Fields (14 acres)

Within the 1 mile buffer, adjacent towns protect 975.3 acres on 18 Conservation Easements, 17 Fee Ownership Town Properties, and 4 properties of unknown status in Mont Vernon. Of greatest significance are the three Conservation Easements and six Town Forests in Mont Vernon that protect 317 acres along the Lyndeborough town line, as well as the properties of unknown status that protect an additional 253 acres along Purgatory Brook and its tributaries.

Conservation & Public Lands Ownership Patterns



* Other Conservation Lands include those owned and/or held in easement by Town of Lyndeborough, New Hampshire Department of Agriculture, New Hampshire Division of Resources and Economic Development, and Wilton-Lyndeborough Cooperative School, or lands in Mont Vernon along Purgatory Brook which information was not available for.

KEY TO LABELS SHOWN ON CONSERVATION & PUBLIC LANDS MAP

FO=*Fee Ownership* CE=*Conservation Easement* DR=*Deed Restricted* FE=*Flowage Easements* UU=*Unknown*

ID	Name	Acres	Type	Parent Agency
0	New Boston Town Forest	170.1	FO	New Boston
1	Hardwick	202	FO	Francestown Land Trust
2	Driscoll Hill Town Forest	2.8	FO	Francestown
3	Swensen	19.6	CE	Piscataquog Land Conservancy
4	Dunscombe	7.1	CE	Francestown
5	Ellen Reilly	10.1	CE	N.E. Forestry Foundation
6	Deland	105.4	FO	N.E. Forestry Foundation
7	Dunscombe	16.2	CE	Francestown
8	Deland	2.2	CE	N.E. Forestry Foundation
9	Daggy	17.1	CE	Piscataquog Land Conservancy
10	Deland	382.9	FO	N.E. Forestry Foundation
11	Deland	182.9	FO	N.E. Forestry Foundation
12	Deland	35.3	CE	N.E. Forestry Foundation
13	Deland	42.9	CE	N.E. Forestry Foundation
14	Mulligan	11	CE	Piscataquog Land Conservancy
15	Mulligan	16.7	CE	Piscataquog Land Conservancy
16	Rand Brook 1	20.8	CE	Monadnock Conservancy
17	Deland	39.8	FO	N.E. Forestry Foundation
18	Deland #1	25	CE	N.E. Forestry Foundation
19	Deland #1	17.1	CE	N.E. Forestry Foundation
20	Roger D. Whittemore Reservation	98.1	FO	Forest Society
21	Woodland Hill Farm	18.4	CE	Monadnock Conservancy
22	Deland #1	51.8	CE	N.E. Forestry Foundation
23	Frances Hildreth Townes Forest	208.7	FO	N.E. Forestry Foundation
24	Kingsbury Timber - Deaf Dog & Needham	163.3	FO	Forest Society
25	PWA Land	2.1	FO	Piscataquog Land Conservancy
26	Townes, C. & F.	14.5	FO	New Boston
27	Wright	4.2	FO	Piscataquog Land Conservancy
28	Deland	30.1	FO	N.E. Forestry Foundation
29	SPNHF (King)	34.8	CE	Mont Vernon
30	West Hill	0.8	CE	Milford
31	West Hill	0.5	CE	Milford
32	Joslin Land	2.1	FO	Milford
33	Wilton Town Forest	4.3	FO	Wilton
34	Townes #2	28.8	CE	N.E. Forestry Foundation
35	Blanchard Hill Farm 2	98.5	CE	Monadnock Conservancy
36	King-Hibbard Forest	34.3	FO	Forest Society
37	Kingsbury Timber - Fuller Lot	47.8	FO	Forest Society
38	Olsen / Poirier + Zebuhr	660.8	CE	Forest Society
39	Swartz Easement	602.3	CE	Forest Society
40	Piscataquog WMA	80.8	CE	N.H. Fish & Game
41	Piscataquog WMA	50.2	FO	N.H. Fish & Game
42	Hebert Lot	143.6	FO	Mont Vernon
43	Town of Mont Vernon Land	47.9	FO	Mont Vernon
44	Wapack National Wildlife Refuge	1139.7	FO	U.S. Fish & Wildlife
45	Souhegan River Watershed Site #8	40.8	FO	N.H. Dept. Environmental Services

ID	Name	Acres	Type	Parent Agency
46	Town of Mont Vernon Land	14.3	FO	Mont Vernon
47	Souhegan River Watershed Site #8	11.1	FE	N.H. Dept. Environmental Services
48	Souhegan River Watershed Site #8	23.5	FE	N.H. Dept. Environmental Services
49	Souhegan River Watershed Site #8	373.9	FO	N.H. Dept. Environmental Services
50	Souhegan River Watershed Site #8	1.4	FO	N.H. Dept. Environmental Services
51	Purgatory Falls	30.6	FO	Mont Vernon
52	Purgatory Falls	1.8	FO	Lyndeborough
53	Purgatory Falls	12.3	FO	Mont Vernon
54	Souhegan River Watershed Site #8	0.8	FE	N.H. Dept. Environmental Services
55	Town of Mont Vernon Land	33.1	FO	Mont Vernon
56	Souhegan River Watershed Site #33	36.3	FE	N.H. Dept. Environmental Services
57	Temple Town Forest	43.5	FO	Temple
58	Souhegan Site	3.9	FO	Wilton
59	Souhegan River Watershed Site #33	35.3	FO	N.H. Dept. Environmental Services
60	Goss Park	18.7	FO	Wilton
61	Souhegan River Watershed Site #33	32.1	FE	N.H. Dept. Environmental Services
62	Souhegan River Watershed Site #33	1.5	FO	N.H. Dept. Environmental Services
63	Ulricson Easement	8.5	CE	Milford
64	Curtiss Dogwood Natural Area	14.2	FO	N.H. Dept. of Resources & Economic Dev.
65	West Hill	1	CE	Milford
66	West Hill	0.1	CE	Milford
67	West Hill	2.2	CE	Milford
68	West Hill	7	FO	Milford
69	Carnival Hill	35.4	FO	Wilton
70	West Hill	11.4	FO	Milford
71	Milford Fish Hatchery	168.6	FO	N.H. Fish & Game
72	West Hill	2.1	CE	Milford
73	West Hill	0.5	CE	Milford
74	Ferguson Easement	36.3	CE	Milford
75	Outdoor Education Area	12.6	FO	Wilton-Lyndeborough Coop. School
76	Holcombe Easement	5.2	CE	Milford
77	West Hill	0.9	CE	Milford
78	Savage - Agric. Pres. Rest.	67.6	AR	N.H. Dept. of Agriculture
79	Normandin	6.3	FO	Francestown Land Trust
80	Normandin	34.9	FO	Francestown Land Trust
81	Bicknell - Francestown	86.5	FO	Piscataquog Land Conservancy
82	Bicknell - Greenfield	4.5	FO	Piscataquog Land Conservancy
83	Normandin	37.1	FO	Francestown Land Trust
84	Murray	4.8	CE	Francestown
85	Seamans	90.4	FO	Francestown Land Trust
86	Turner	61.8	FO	Francestown Land Trust
87	Turner	26.7	FO	Francestown Land Trust
88	Wicklow	2.3	CE	Francestown Land Trust
89	Wicklow	10.2	CE	Francestown Land Trust
90	Grossman Conservation Easement	20.2	CE	Piscataquog Land Conservancy
91	Grossman Conservation Easement	130.2	CE	Piscataquog Land Conservancy
92	Grossman Conservation Easement	56.1	CE	Piscataquog Land Conservancy
93	Grossman Conservation Easement	46.2	CE	Piscataquog Land Conservancy
94	Rice Natural Area	16.6	FO	Piscataquog Land Conservancy

ID	Name	Acres	Type	Parent Agency
95	Rogers Conservation Easement	39.4	CE	Piscataquog Land Conservancy
96	Blanchard Hill Farm III	19.5	CE	Monadnock Conservancy
97	Greenfield02-00042	5.8	CE	Greenfield
98	Mount Vernon02-109	0	CE	Mont Vernon
99	Mount Vernon02-109	0	CE	Mont Vernon
100	Bicknell - Lyndeborough	35.8	FO	Piscataquog Land Conservancy
101	Brooks	78.7	CE	Piscataquog Land Conservancy
102	Roger D. Whittemore Reservation	16	FO	Forest Society
103	Roger D. Whittemere Reservation	19.2	FO	Forest Society
104	Schmekel Fields	8.1	DR	Lyndeborough
105	Douglas Hill Field	5.9	DR	Lyndeborough
106	Purgatory Lower Falls	5.4	FO	Lyndeborough
107	Bullard Road	9.4	CE	Lyndeborough
108		44.6	UU	Unknown
109		50	UU	Unknown
110		87.4	UU	Unknown
111		71.2	UU	Unknown

NATURAL RESOURCES PROTECTED CURRENTLY BY CONSERVATION LANDS

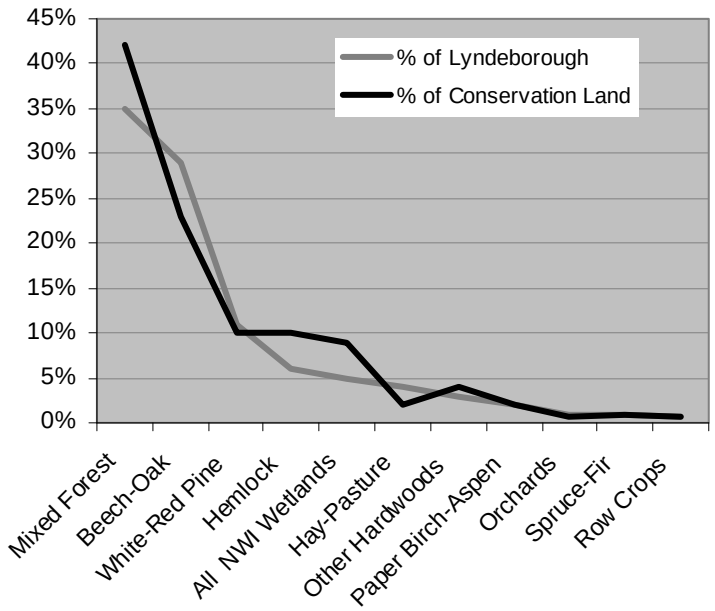
Total Area Conserved in Lyndeborough: 3,101.5 acres
Percent of Lyndeborough Conserved: 15.8%

Conservation Status of Land Cover Types (2001 Landcover Assessment & National Wetlands Inventory data)

Land Cover Type	Percent of Lyndeborough in this Cover Type*	Total Acres of this Cover Types	Acres of this Cover Type Conserved	Percent of this Cover Type Conserved	Percent of all Conservation Land in this Cover Type*
Row Crops	<1%	5	0.8	16%	<1%
Hay-Pasture	4%	905	64.62	7%	2%
Orchards	1%	270	8.83	3%	<1%
Beech-Oak	29%	5625	709.66	13%	23%
Paper Birch-Aspen	2%	390	57.2	15%	2%
Other Hardwoods	3%	570	112.19	20%	4%
White-Red Pine	11%	2135	305.86	14%	10%
Spruce-Fir	1%	187	31.31	17%	1%
Hemlock	6%	1250	309.27	25%	10%
Mixed Forest	35%	6905	1303.71	19%	42%
All NWI Wetlands	5%	1003	271	27%	9%
Streams	7.9 miles of stream are within or bordered by conservation lands				19%

* because the 2001 Landcover Assessment classified ~615 acres of NWI Wetlands as other cover types the figures above may add up to more than 100%

Percentage of Lyndeborough & Percentage of Conservation Lands by Land Cover Type



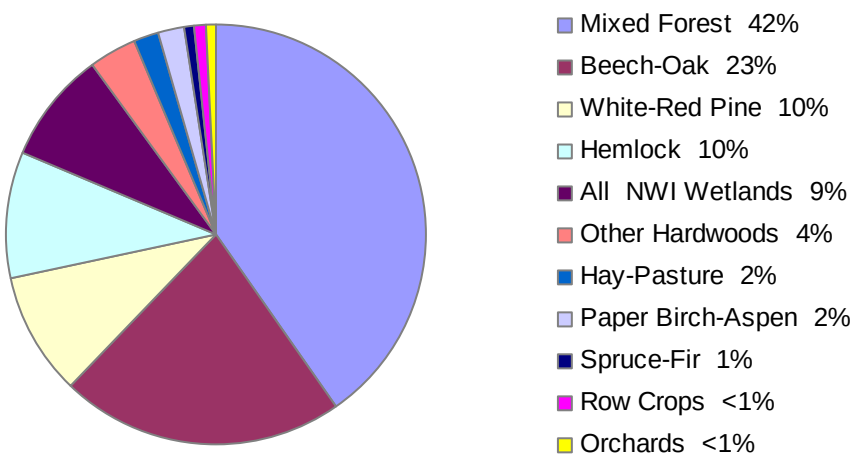
•Conservation lands generally protect a proportionally fair share of each land cover type.

•Mixed Forests cover a major share of conservation lands.

•Cover types that are slightly more adequately conserved include wetlands and hemlock forests.

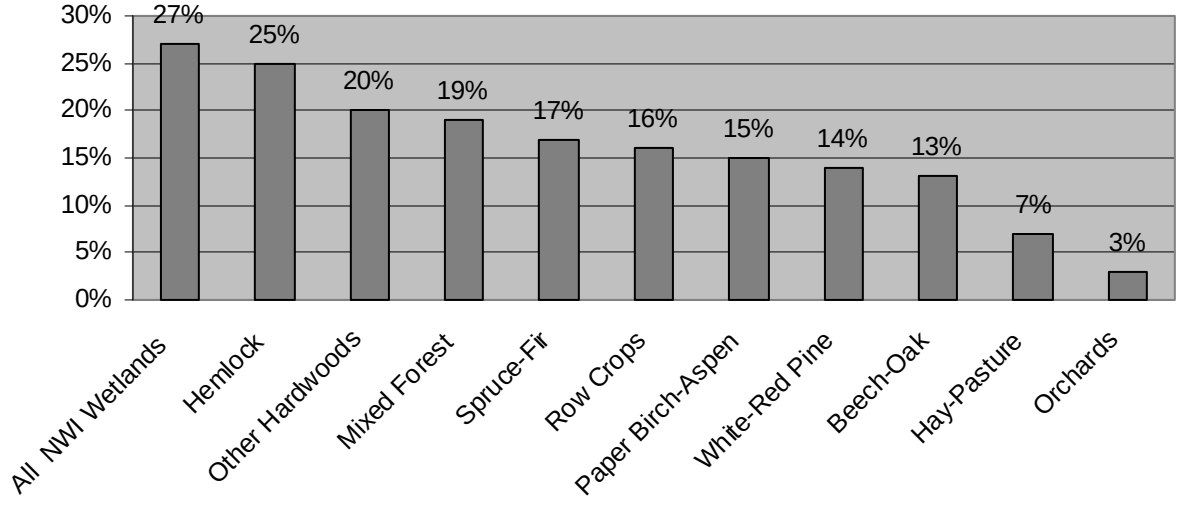
•Cover types that are slightly less adequately conserved include pine forests, beech-oak forests, and pastures.

Proportion of Land Cover Types on Conservation Lands



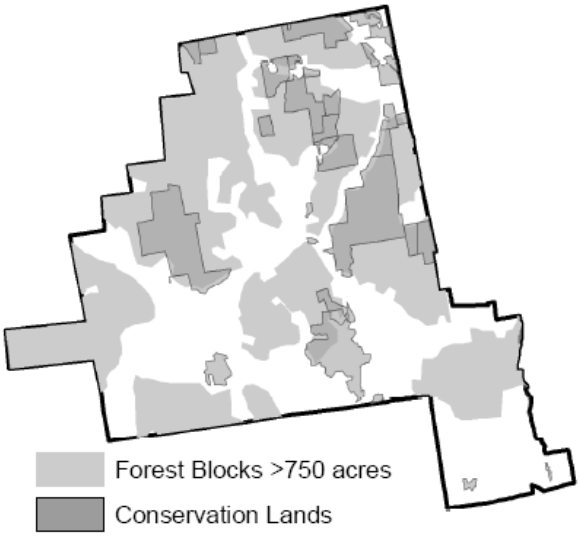
This chart provides an alternative view of conserved land cover types. Most conservation land consists of mixed forests and beech-oak forests, but remember that most of Lyndeborough is of these types. For their total area, wetlands cover a substantial portion of conservation lands.

Percent of Each Land Cover Type Conserved



Wetlands are disproportionately protected in Lyndeborough compared to upland cover types. This is mostly because of the large wetland-dominated Putnam Pond Conservation Area. Hemlock and other hardwoods are more protected than the average (mean=15.8%), but remember that these types are relatively limited across the landscape compared to mixed, pine, and beech-oak forests. Of concern is the relative paucity of orchards and pastures that are under conservation agreements or ownership.

Conservation of Unfragmented Forest Blocks >750 acres



Lyndeborough's 7 forest blocks total 10,705 acres, or 55% of the towns' area

These blocks contain:

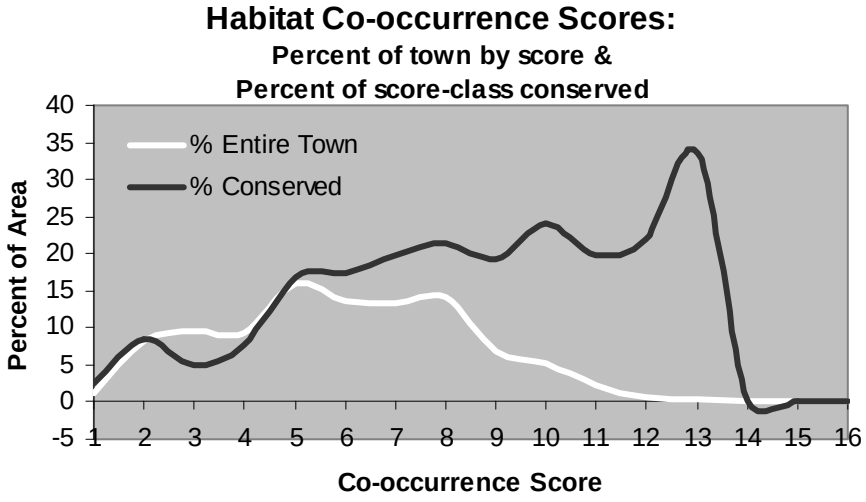
- 540 acres, or 54%, of all NWI Wetlands
- 21 miles, or 51%, of all mapped streams

2,280 acres, or 21%, of forest blocks >750 acres are conserved

Conservation of Highest Quality Habitats

This table based on the HIGHEST QUALITY HABITAT CO-OCCURRENCE MAP

Co-occurrence Score	Acres in Lyndeborough	% of Lyndeborough	Acres of score class conserved	% of score class conserved
0	243	1.2	6	2.5
1	1627	8.1	139	8.5
2	1906	9.5	97	5.1
3	1833	9.2	140	7.6
4	3189	15.9	532	16.7
5	2712	13.6	472	17.4
6	2682	13.4	530	19.7
7	2813	14.1	601	21.4
8	1373	6.9	264	19.2
9	1048	5.2	253	24.1
10	480	2.4	95	19.7
11	133	0.7	29	21.9
12	51	0.3	17	33.5
13	6	<1	0	0
14	4	<1	0	0
15	<1	<1	0	0



- 28% of area scored in lowest 25% (scores of 0-3); 24% is conserved (382 acres)
- 57% of area ranked in second quartile (scores 4-7); 19% is conserved (2,135 acres)
- 15% of area ranked in third quartile (scores 8-11); 11% is conserved (641 acres)
- <1% of area ranked in the upper quartile (scores 12-15); 28% is conserved (17 acres)

Summary: Most Conservation Land in Lyndeborough protects habitats in the low to moderate quality range. Some of the most important habitats in Lyndeborough are protected, but none of the three highest score classes are.

Summary of Features Protected by Conservation Lands in Lyndeborough

- 3,105 acres
- 15.8% of total surface area
- 21% of Forest Blocks >750 acres
- 2,850 acres of forest
- 19% of stream frontage
- 271 acres, or 27%, of NWI Wetlands
- 20% of agricultural lands
- 15% of lowest half of habitats (scores 0-7)
- 21% of upper half of habitats (scores 8-15)
- 27% of upper quartile of habitats (scores 12-15)
- at least 10 black gum swamps
- at least 12 vernal pools
- at least 4 miles of recreational trails
- the 3rd highest summit in Lyndeborough (Winn Mtn, 1,676')
- 3 scenic waterfalls (Senters, Upper Purgatory, Lower Purgatory)
- thousands of acres of working forest
- hundreds of acres of active agricultural land
- rare natural community at Curtis Dogwood State Preserve
- substantial portions of the two largest wetland complexes
- examples of 5 of the 7 critical habitat types described in chapter 6

Chapter 8
Co-occurrence Mapping of Conservation Priorities

Thus far, numerous elements of Lyndeborough's Natural Resources have been identified and addressed. Geology, soils, agricultural lands, vegetation, land cover, wetland plants, natural communities, ecosystems, wildlife species, habitats, water resources, and conservation lands have been analyzed. In this section I provide a cumulative analysis of natural resource features through Co-occurrence Mapping with the intent of identifying the most important lands in Lyndeborough for enhanced land conservation activities. Permanent conservation & protection, better management, and wise use of the areas identified here will provide reasonably good assurance that natural resources, such as clean air & water, a healthy environment, abundant wildlife, open space to recreate, and high quality of life will be protected for current and future generations of Lyndeborough residents and neighbors.

Co-occurrence mapping is the process by which selected features are given values based on their importance in the analysis. The analysis presented here identified lands that meet the concerns expressed by residents in the *Community Profile* (2001), the Lyndeborough Master Plan (2002), as well as fitting into the larger framework of the New Hampshire Everlasting Initiative promoted by the Society for the Protection of NH Forests (Forest Society, 2001):

> *"The Society for the Protection of New Hampshire Forests envisions a living landscape where managed woodlands, farms, and wildlands are woven into the fabric of community life. We envision people caring for lands that sustain dynamic communities with clean water and air, employment, forest and agricultural products, habitat for native plants and animals, scenic beauty, and recreational opportunities"*

To meet this vision, the Forest Society suggests that each town needs to protect 25% of its area in a mosaic of working forests, old-growth reserves, active farms, wetlands, recreational

areas, water supply lands, and other open spaces. While many towns in the southern New Hampshire can no longer meet this vision, it can still be achieved in Lyndeborough because of its extensive tracts of undeveloped, high quality habitat and agricultural lands. The goals of the Forest Society's New Hampshire Everlasting Conservation Initiative are:

Conserve Lands That Support a Healthy Quality-Of-Life

•Trails, Community Agriculture, Community Parks, Drinking Water, Towns Forests and Conservation Areas, Scenic Beauty and Community Character

Conserve Our Share of the World's Managed Forests

• "Productive forest soils and historically well-managed forests should receive high priority for conservation"

Conserve Habitat for Native Species

Conserve Lands that Keep our Water Clean

• conserving remaining undeveloped source lands for existing public drinking water systems and new lands necessary to supply the anticipated population many generations from now
• buffering water courses and wetlands from development with natural vegetation
• preventing development of more than ten to twenty percent of each watershed with pavement and buildings

Conserve Productive Agricultural Land and the Farm Economy

•Permanently conserve the remaining "prime" and "statewide importance" farm soils and enough other agricultural lands so that:

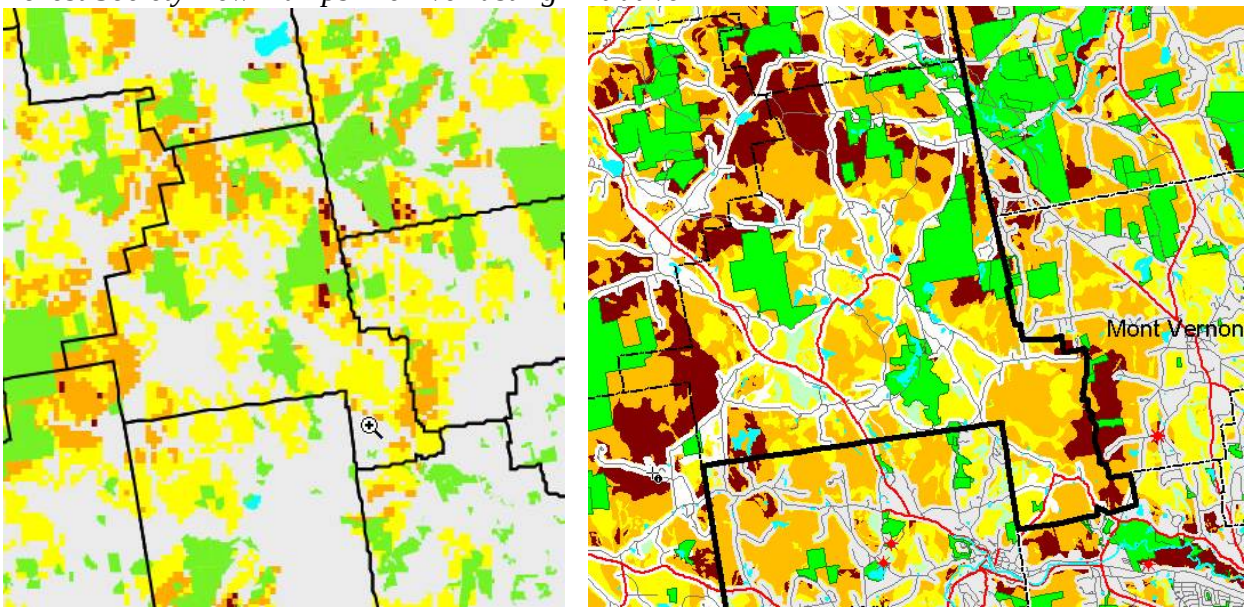
→ the agricultural infrastructure can be sustained or strengthened
→ every community has land for growing healthy food, whether it be victory gardens, flowers and landscape plants, market gardens, or dairy farms
→ New Hampshire can sustain its current level of per capita food production using environmentally sound methods

These goals can be met in Lyndeborough; the land is there, the natural resources exist in good condition, the people have expressed their concern for maintaining these aspects of a high quality of life, and this NRI provides the science-based assessment of these assets. The Co-occurrence Maps presented here, CONSERVATION PRIORITIES CO-OCCURRENCE and IMPORTANT AGRICULTURAL LANDS CO-OCCURRENCE, identify the areas that are critical to protect in order to meet these multiple demands.

CONSERVATION PRIORITIES ANALYSIS

The areas identified on the CONSERVATION PRIORITIES CO-OCCURRENCE Map are those with the most co-occurring values that are of significance to natural resources conservation. The data do not include cultural, sentimental, and unquantifiable values that certainly exist among residents and neighbors of Lyndeborough. These should be considered when applying these results to conservation efforts. Several areas emerged from these results as Focus Areas for enhanced land conservation. These Focus Areas are high in biological, agricultural, and cultural importance, at local and regional scales. Furthermore, they have ranked high in the wildlife habitat quality analysis discussed in Chapter 6 and feature significant wetland complexes discussed in Chapter 5. Below, I discuss other co-occurrence analyses and their correlation with this NRI's results.

Forest Society New Hampshire Everlasting Initiative

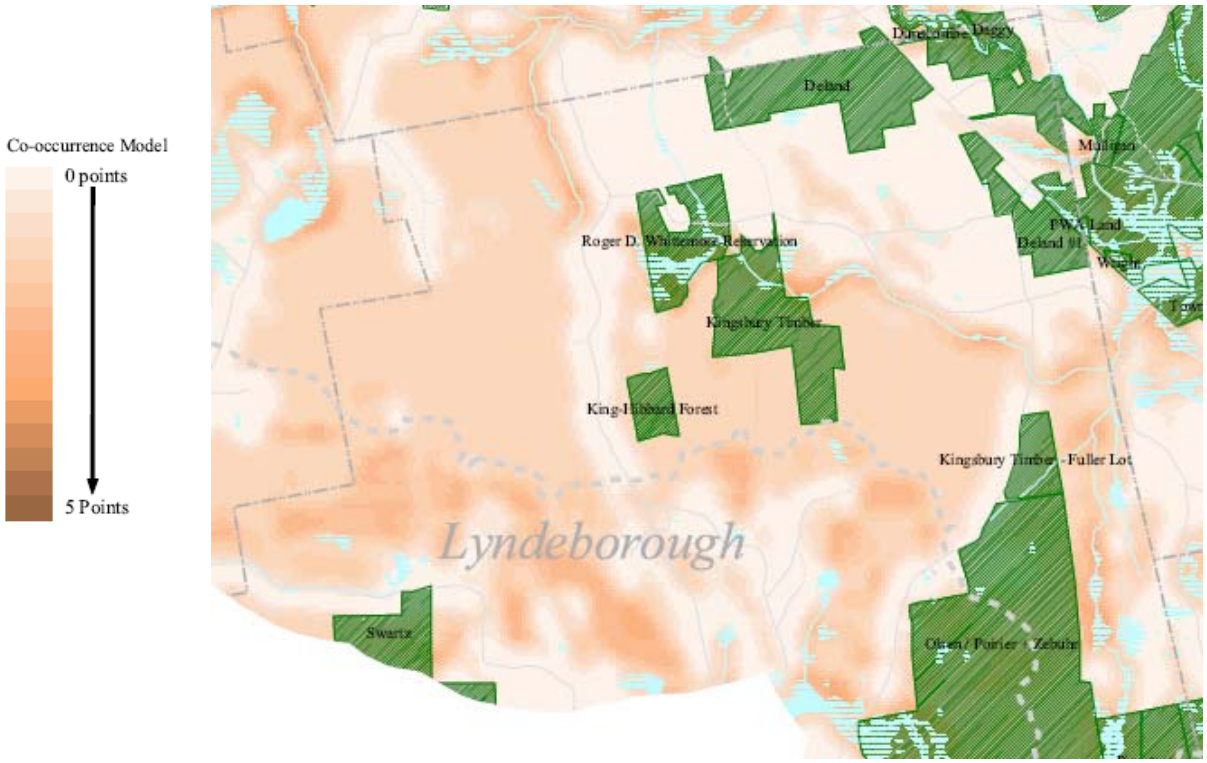


The Forest Society completed a co-occurrence analysis of New Hampshire at two scales that developed statewide and regional outputs, shown above (Forest Society 2001; 2007).

Yellow = 1 NH Everlasting Goal Present
Orange = 2 NH Everlasting Goals Present
Red = 3 NH Everlasting Goals Present

Similar results were generated, including ranking higher elevation areas, unfragmented forests, wetland complexes, and stream corridors highly.

Piscataquog River Watershed Conservation Plan

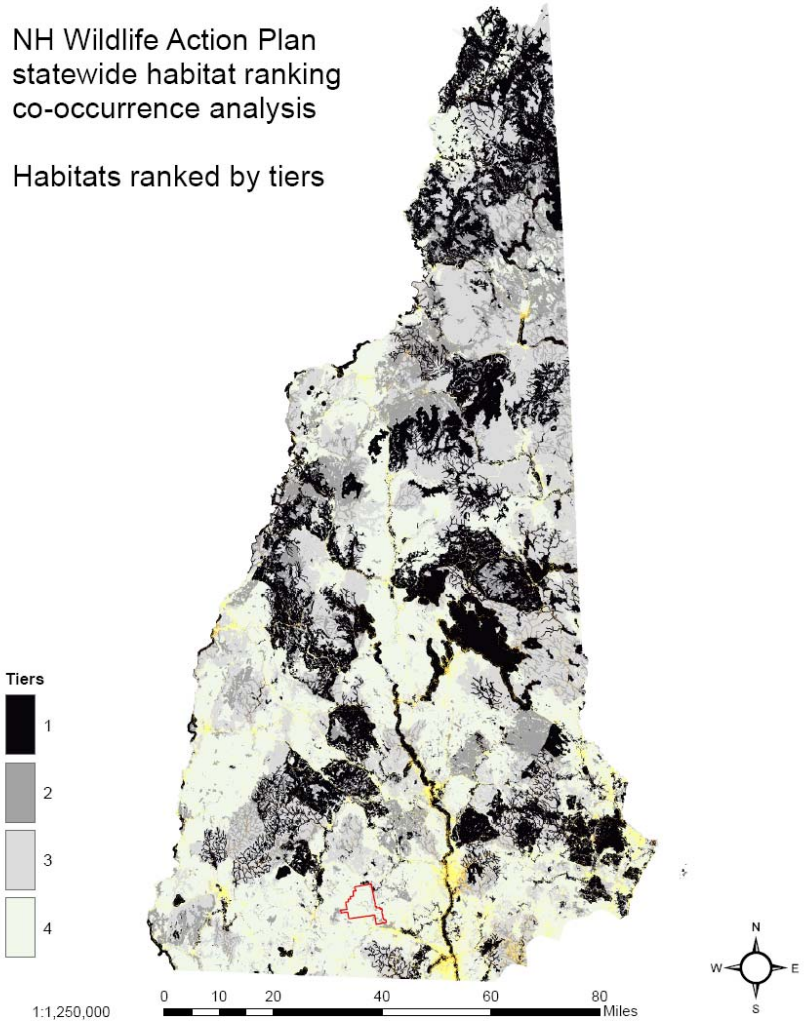


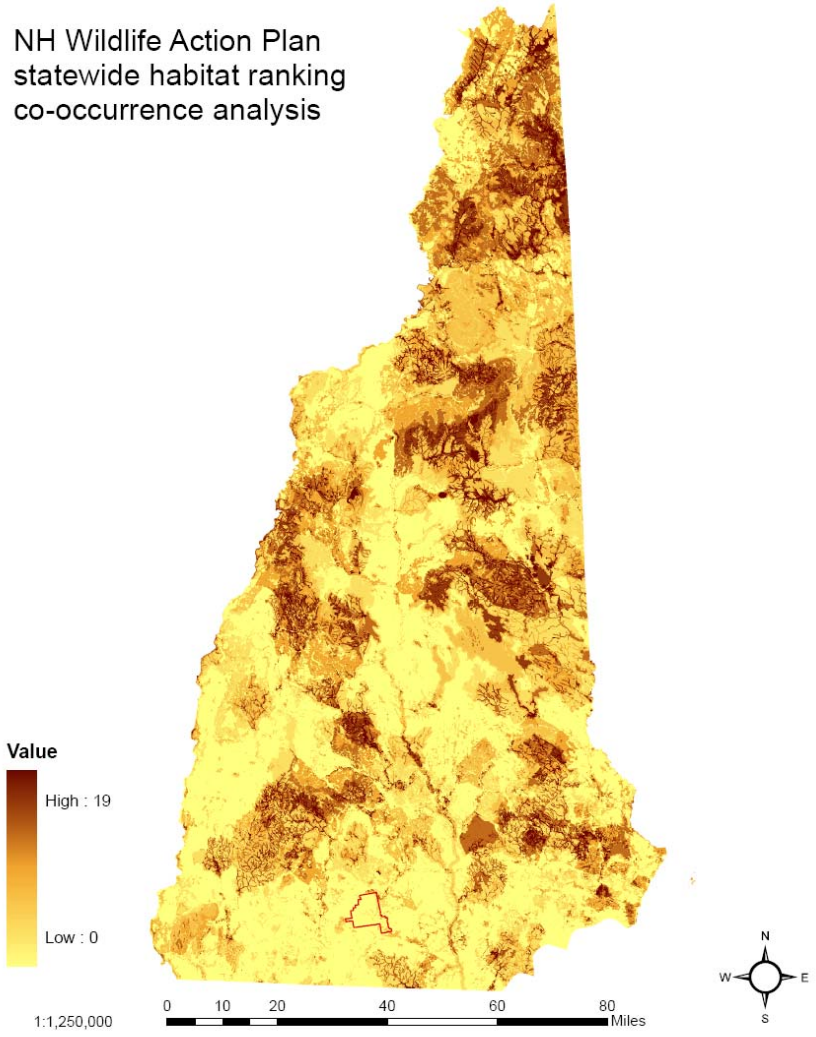
The map above is a portion of the Piscataquog River Watershed Co-Occurrence Model developed by the Society for the Protection of New Hampshire Forests for the Piscataquog Watershed Association in 2004.

Their analysis of the entire 220 square mile Piscataquog River Watershed utilized 8 values for co-occurrence analysis:

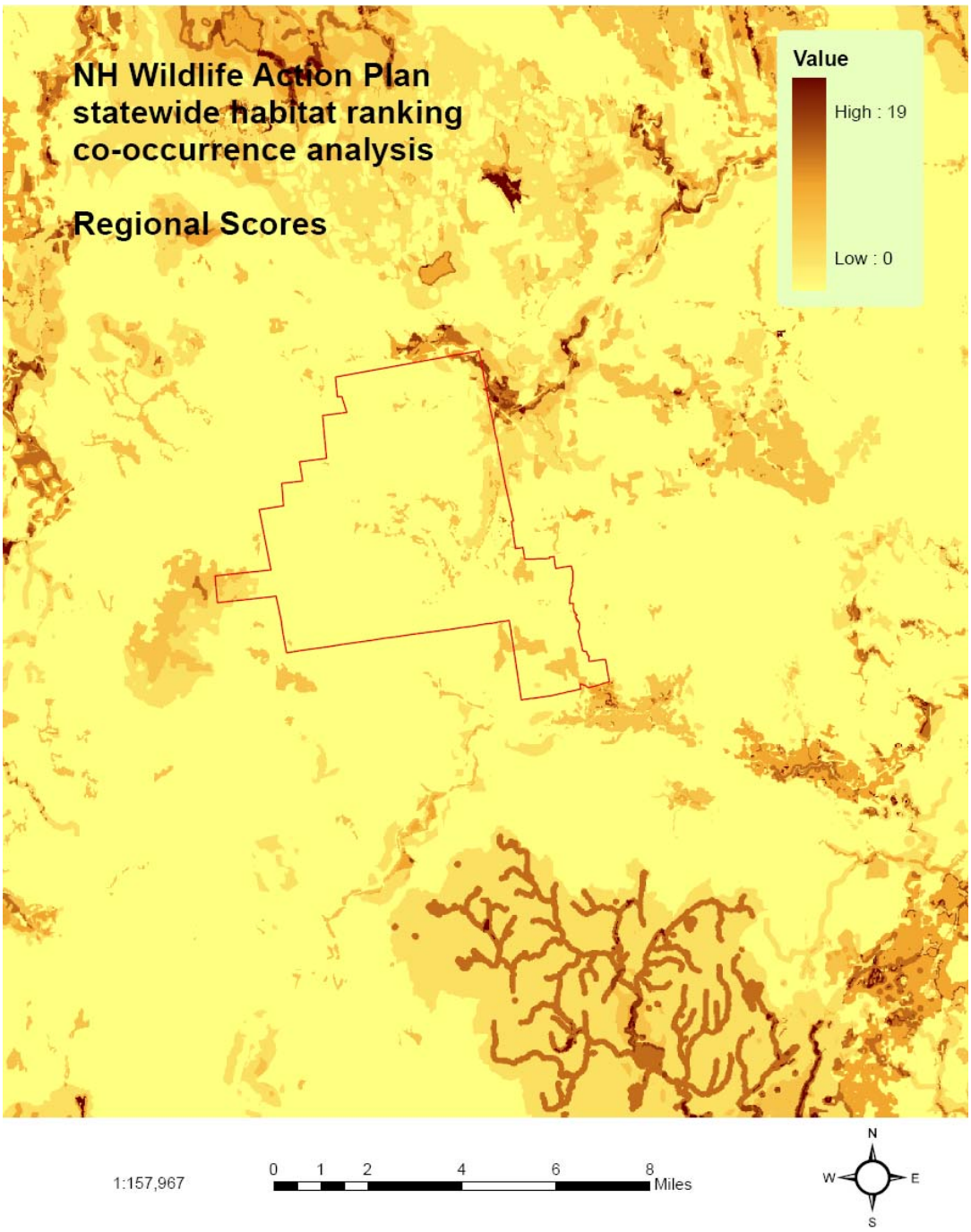
- Unfragmented Forest Blocks >500 acres
- Agricultural Lands >40 acres
- 300 foot Riparian & Shoreline Buffers
- Composite Wetlands >20 acres
- Emergent Wetlands
- Alluvial Soils
- Slopes >35%
- South Facing Slopes >10%

Higher scoring areas for the Piscataquog Watershed and vicinity include the southern aspects of Rose Mountain and The Pinnacle, the Cold & Schoolhouse Brook corridors, and upper reaches of the Badger Pond – Curtis Brook Wetland Complex.





From the statewide perspective presented in the Wildlife Action Plan, Lyndeborough ranks very low in habitat quality, abundance, extent, and priority for conservation. A weakness in this data is a relative dearth of data for much of southwestern New Hampshire, including Lyndeborough. Had the WAP included the rare plant, community, and wildlife documentation that this NRI has procured, then the results would almost certainly have ranked Lyndeborough higher. Areas that have been extensively surveyed for such features, such as the White Mountain National Forest, industrial timberlands of the north, and seacoast areas under intense development pressure, have scored higher simply because more rare occurrences have been documented. However, this is not to play down the incredible habitat values of the immense forest blocks and sub-boreal forests of the North Country. (Also see map on next page for a regional scale perspective of these data).



Most of Lyndeborough is ranked very poorly by the Wildlife Action Plan. Important features that ranked higher in the analysis were marsh wetlands, peatlands, spruce-fir forests, agricultural lands, floodplain forests (mainly in New Boston & Francestown), and areas in proximity to known rare element occurrences.

Despite the apparent lack of guidance provided by this information, it can be used to supplement the NRI by suggesting that enhanced conservation of these agricultural lands, high-elevation forests, and wetlands can have a positive impact on conserving bio-diversity at the state level.

CONSERVATION FOCUS AREAS

(Refer to Co-occurrence maps)

Based on this NRI's co-occurrence mapping, and supported by field inventory, the 2001 Community Profile, the 2002 Master Plan, New Hampshire Everlasting mapping, Wildlife Action Plan mapping, Piscataquog Watershed mapping, and other publications, the following areas are determined to be the most important priorities for land conservation in Lyndeborough, listed in order of their importance.

#1 *Lyndeborough Mountain Uplands & Headwaters*

The western portion of Lyndeborough Mountain, including the summits and ridgelines of Rose Mountain and The Pinnacle, and the valley between them and Winn Mountain, features extensive forest blocks, wild high-quality wetlands, important headwaters reaches of streams important to the Souhegan *and* Piscataquog River systems, popular recreational trails, and critical habitat areas. These areas are of immense cultural significance to the people of Lyndeborough and feature some of the highest quality habitats in Lyndeborough.

Additionally, Co-occurrence Mapping of the 220 square mile Piscataquog River Watershed (PWA, 2005b) ranked portions of this area as highly valuable to that watershed. The northern slopes of Lyndeborough Mountain ranked highest at the regional-scale and second highest at the state-scale for the New Hampshire Everlasting analyses. Hague (2005) similarly suggested Rose Mountain as a conservation priority with significance to conservation efforts in the Piscataquog River Watershed. Related to this focus area is the ridge of North Pack Monadnock that descends western Lyndeborough and is managed by the High Ridge Tree Farm. This ridge is ranked high in both the Wildlife Action Plan and New Hampshire Everlasting state perspective, and moderately high at the town-scale.

#2 *Cold Brook Corridor*

Much of Cold Brook is already protected by Conservation Easements and Forest Reservations. High ranked wetland and riparian habitats in large forest blocks, recreational opportunities, very low surrounding population density, large undeveloped lots, and proximity to existing conservation lands make this Focus Area an important aspect of a comprehensive natural resource protection strategy.

Cold Brook has been identified as an *Aquatic Focus Area* and a *Terrestrial Focus Area* by the Piscataquog Land Conservancy (PWA, 2005b). This corridor has high statewide and regional significance according to New Hampshire Everlasting analyses, and wetlands of moderate statewide significance according to the Wildlife Action Plan. Additional conservation activity here on a few key undeveloped parcels could connect existing conservation areas into a block of 1,700 contiguous acres.

#3 *Central Lyndeborough-Furnace Brook-Putnam Pond Wetland Complex*

Extensive, diverse, contiguous, and relatively unfragmented wetlands and associated uplands upstream of the large block of conserved land at Putnam Pond provide critical habitat, recreation on Class VI roads, water quality protection, and flood mitigation properties. This complex is discussed at length in Chapter 5.

These wetlands have moderate statewide significance according to both the Wildlife Action Plan and New Hampshire Everlasting analyses. Additional conservation activity here on a few key undeveloped parcels could potentially expand the 450 acre Putnam Pond Conservation Area into a contiguous block of 1,000 acres.

#4 *Purgatory Brook Corridor*

Recent conservation in Mont Vernon has substantially expanded the protected lands network in their Purgatory Brook Focus Area. A wild, relatively unspoiled stretch of stream in a deep gorge with unique geological features, three scenic waterfalls, popular recreational trails, and high quality habitat occur in this corridor. The corridor provides habitat connectivity between the Souhegan and Piscataquog River systems through Mont Vernon and New Boston.

The Purgatory Watershed Conservancy, a partnership between residents of Lyndeborough and Mont Vernon and the New England Forestry Foundation has set a goal of conserving 1000 acres in the Purgatory Watershed (see http://www.purgatorywatershed.org/). The Souhegan Valley Land Trust has been involved in projects here and makes another strong partner in this Focus Area (www.svlt.org). This corridor scored moderately high at state and very high at regional scale in the New Hampshire Everlasting analyses. Conservation efforts here would provide an opportunity to collaborate with neighboring towns and land trusts to expand on the protection of this remarkably beautiful stream.

#5 *Agricultural Lands*

All agricultural lands have high value to society, wildlife, the economy, and quality of life so these were analyzed separately to provide a more appropriate analysis of these lands without the influence of wildlands-related factors. The results are provided on the IMPORTANT AGRICULTURAL LANDS CO-OCCURRENCE Map. High-scoring lands are those that feature NRCS agricultural soils, flat or low slopes, southern or flat aspects, and are currently used for farming. Focus Areas (areas with concentrations of high-scoring land) include the areas below, listed in relative order of their significance:

- much of Center Road east of Lyndeborough Center
- fields in the vicinity of Purgatory and Salisbury Roads
- cluster of farms, fields, and orchards between Center and Mountain Roads and Lyndeborough Mountain.
- fields and forests on the drumlins of North Lyndeborough

Some of these lands scored moderately high in the Wildlife Action Plan and New Hampshire Everlasting analyses.

Chapter 9
Conclusions & Recommendations

"Lyndeborough's high elevations (above 1000 ft.) are a unique local and regional resource and contain large wilderness and undeveloped areas. The wonderful views and vistas offered from these sites merit their conservation. It is recommended that the Town make an active effort to retain areas above 1,500 feet elevation as open space to provide access for the community to these areas and to establish sound forest management to maximize their open space/recreational value. In addition, development above 1,000 feet elevation should continue to be limited. The higher elevations in Lyndeborough may not be considered of statewide importance but they have regional and local significance. For this reason, assistance and funds should be actively sought to protect and preserve these important resource areas."

-Lyndeborough Master Plan, 2002 p.IV-3

Co-occurrence analysis of significant wildlife habitat, conservation priorities, and important agricultural lands has provided a concrete basis for making informed decisions in town planning, conservation activities, and land management that will protect and enhance natural resources for the residents, neighbors, and wildlife of Lyndeborough. The results of these analyses are built upon a foundation of field verification of natural resource qualities and attributes, the highest detail mapping yet completed for the project area, and substantiated by published criteria for defining critical habitats, conservation priorities and farmlands. These results are presented along with their correlation to local and regional plans such as the Piscataquog River Management Plan (PWA, 2005b), the NH Wildlife Action Plan (NH Fish & Game, 2006), the New Hampshire Everlasting Conservation Initiative (Forest Society, 2001), the Souhegan River Watershed Management Plan (NRPC, 2006), the Lyndeborough Master Plan (2002), and the Lyndeborough Community Profile (2001). Utilizing the information presented here will help accomplish the goals and objectives of these other plans while safeguarding natural resources and quality of life for generations to come.

RECOMMENDATIONS FOR PROTECTING LYNDEBOROUGH'S IMPORTANT NATURAL RESOURCES

The richness of Lyndeborough's environment is now catalogued for the first time since 1906, when the town history provided lists of plants, descriptions of the streams, ponds, and geology, and accounts of the landscape at that time. Here, I have reviewed the current status of the ecology and environment of Lyndeborough in as exhaustive of a manner as time would allow, but still this effort is incomplete. The following steps should be considered to ensure that the most complete information is available, that these data are utilized appropriately, and that natural resources receive the protection required to sustain human and natural demands:

•Monitor potential vernal pools to determine their status and identify indicator species.

•Continue documentation of plants as only ~50-60% of species were encountered.

•Complete a wetland-specific inventory that reclassifies wetlands according to current status.

•Coordinate expanded bird watching efforts to document the additional ~30-40 species that probably occur. Also, re-instate Keeping Track transects and direct them at highest ranked habitats.

•Significant rare species information was collected during this NRI. Locations of black gum swamps, fern-leaved false foxglove populations, and exemplary natural communities were documented but not reported to NH Natural Heritage Bureau. Landowners were contacted to ask for their permission to report these occurrences, and most were agreeable. The Conservation Commission should formally seek these permissions and then complete documentation for these rare plants and communities to ensure the best available science is used in other conservation planning efforts in the future. A copy of the reporting form is included in the appendices. Also, report amphibian and reptile documentation to NH Fish & Game Department to update their RAARP database.

•Develop a Conservation Plan to protect the resources identified in this NRI. Included in the appendices is a simple yet informative document written by UNH Cooperative Extension describing the steps in preparing a conservation plan.

•Identify parcels within high-scoring areas and engage landowners in discussions regarding protection of the resources therein, whether through wise use and stewardship or through Conservation Easements or Purchase. The protection of these lands is critical to the long-term well-being of Lyndeborough.

•Understand and learn how to describe Conservation Easements and other methods of land protection so fair and accurate descriptions can be made to landowners. Included in the appendices is a simple yet informative document written by UNH Cooperative Extension describing Conservation Easements.

•Understand how natural resources can be protected through better land management and other non-regulatory techniques. A third document by UNH Cooperative Extension is provided in the

appendices titled “Non-regulatory techniques for protecting important natural resources.” Lyndeborough has already completed some of these steps, including completing an NRI. Follow through with the remainder and build on the consensus embraced at the 2001 *Community Profile.*

•Share this NRI with town boards and make sure the information is utilized to the best extent possible. Also, share this NRI with residents and use it as a tool to build excitement and energy around natural resource conservation.

•Continue to use the existing zoning guidelines regarding development on severe soils, steep slopes, and at high elevations.

•Consider active management and ecological restoration of town forests to meet the requirements of native wildlife and mitigate for the probable effects of climate change. Acknowledging that many of Lyndeborough’s natural communities evolved under the influence of fire and many species utilize the early succesional habitats it induces, consider the experimentation and controlled use of it on town property, or offer support to landowners who wish to use fire.

•Reach out to and collaborate with neighboring towns and land conservation organizations. Engage in cross-boundary projects that meet the needs of multiple communities.

•Consider adopting mud-season use limitations of Class VI roads as they have eroded and deteriorated severely in the past decade. Work with private landowners to reduce the damage to critical habitats caused by off-road vehicle use on Rose Mountain. Also, work with the Forest Society and private landowners to address the same issue on Winn Mountain. Repair damage to Pinnacle Road where Duncklee Brook crosses to eliminate further degradation of the stream ecosystem. Support the efforts of the newly formed Lyndeborough Trail Association in identifying, marking and maintaining a town-wide trail network.

•Consider requiring landowners to utilize Best Management Practices for forestry activities. Hire a town forester to inspect timber harvests to ensure wise stewardship.

•Support and have a presence at activities and initiatives that support local agriculture, such as a farmers market, fairs, festivals, and other events.

•Identify the areas in Lyndeborough that are the most suitable for future development based on their not being high quality habitat, conservation priorities, or important agricultural land. Attempt to focus future development on these areas, utilizing high-density clusters that maintain substantial wildland and wetland buffers.

•Minimize or end the use of salt on dirt roads and paved roads near wetlands. Salt induced de-stabilization of frozen dirt roads can lead to severe washouts and major damage to life or property. Included in the appendices is an article by Julie Zebuhr from Lyndeborough Views regarding this problem.

•Consider convening an invasive species task force to develop a plan for reducing the effect of these plants on native ecosystems.

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