

1 INTRODUCTION

The Town of Grantham, NH is 17,778 acres. Grantham is located in northern Sullivan County, ten miles east of the Connecticut River and five miles south of Mascoma River. An east-west ridgeline connects the second highest peak in Sullivan County, Grantham Mountain, to Sargent Hill offering scenic views throughout much of the town. Ten ponds ranging in size from five to over three-hundred acres, fifteen named streams, countless unnamed tributaries and drainages, and wetlands mapped and unmapped, are representative of New Hampshire's abundant water supplies. Also representative of New Hampshire is Grantham's primarily forested landscape. All of these natural resources and more contribute to Grantham's small town atmosphere and rural character.

The Town of Grantham, New Hampshire (Figure 1-1, Appendix A) contains several major land use elements, some unique among NH communities.

- **I-89 and NH 10**—Interstate 89 and NH Route 10 run parallel to one another, south to north, splitting the town into an east and a west side. Interstate 89 especially fragments the landscape and creates a serious barrier to wildlife movement due to its width and traffic volume. Most of the commercial land use in Grantham occurs at Exit 13 off I-89 where it intersects with NH 10. This area, because of the highway access, is zoned commercial and is likely to be a target of future development.
- **Eastman Community**—The Eastman Community, incorporated in 1971, is a planned, private, four-season, recreational community located east of I-89. It is comprised of 3,600 acres, approximately 2,624 of them in Grantham. Eastman Pond, the largest water body in Grantham, is at the center of the residential development. A golf course, recreational trails and other amenities complete the community. Three-hundred and thirty-six condominiums and over 1,000 lots exist for private homes (some private lots remain undeveloped).
- **Grantham Village**—With the disappearance of active agriculture in the late 1800's, development in Grantham was focused in the village area where available waterpower serviced the lumber industry. Located south of the commercially zoned area at I-89 Exit 13, Grantham Village is mainly accessed by NH 10. The village currently has the highest density of residential development in Grantham other than Eastman.
- **Blue Mountain Game Preserve**—Absorbing the southwestern corner of Grantham, the Blue Mountain Game Preserve (locally known as Corbin Park) is an approximately 24,000 acre fenced preserve stocked with native and non-native game animals. Over 2,500 acres lie within the Grantham town boundary and the rest within the Towns of Croydon, Cornish, and Plainfield. Privately owned, Corbin Park is unlikely to be developed but remains without a permanent easement. Additionally, large tracts of privately owned, undeveloped lands border the park and also remain unprotected. The town is actively communicating with landowners regarding stewardship of these bordering properties.

- **Grantham Town Forest, Sherwood Forest, and Reney Memorial Forest**
These three lots comprise nearly 10% of the Town of Grantham, or 1,717 acres. These parcels are important for wildlife habitat, connectivity, recreational opportunities, and contributing to the rural character of the town.
- **Enfield Wildlife Management Area**—Enfield Wildlife Management Area (WMA), primarily in the Town of Enfield to the north but extending over the northern border of Grantham, is mostly forested with northern hardwoods and scattered stands of spruce and fir. The WMA has marshland, beaver ponds and numerous water bodies, including the forty-acre Butternut Pond which lies within the borders of Grantham.

This report to the Grantham Conservation Commission (GCC) and the Town of Grantham provides a thorough inventory of natural resources in Grantham, identifies priority conservation areas, potential threats to resources, and suggests technical resources to aid the town in future conservation and land use planning efforts.

1.1 BACKGROUND

Grantham, like many small towns in New Hampshire, is facing the pressure of development. A small community sandwiched between the economic hub of the Upper Valley and the recreational hub of the Lake Sunapee Region, Grantham had the third highest growth rate in the state between 1990 and 2000. It continues to grow at a pace faster than the overall growth rate of the State of New Hampshire (Carey, et. al., 2005). In 2005, the results of a community survey conducted for the town's Master Plan highlighted residents' desire to maintain a rural community. Grantham is characterized by the woods, wildlife, undeveloped spaces, and low traffic volumes that distinguish a small, quiet community in an uncrowded and unpolluted environment. Conserving natural resources to maintain this rural character is strongly supported by the community. The Master Plan recommends the town be more proactive in providing stewardship for its remaining open spaces by actively seeking out lands to conserve, protecting water resources, and providing local decision makers with the power to control development that could adversely affect significant natural resources.

In 2006, the town took its first step toward a greater effort to protect its open space by voting at town meeting to increase the amount of Current Use Change penalty tax allocated to the Conservation Fund from 50% to 100%. In response, the Grantham Conservation Commission determined the need for a Critical Conservation Lands Index (CCLI) to identify its natural resources and greatest conservation needs. With maps and a thorough written report, the CCLI would be the base from which a future conservation plan could be established and a valuable resource when updating or implementing local ordinances.

Moose Plate Grant funding from the New Hampshire State Conservation Committee gave the Town of Grantham and the GCC the leverage to appropriate matching conservation funds toward their goal of completing a CCLI. A partnership with Plymouth State

University's Center for the Environment provided technical assistance through a graduate student and additional match for the local funds. The partnership was critical to allow a project of this scale to move forward.

1.2 PURPOSE AND NEED

The purpose of this project is to:

1. Bring the Town of Grantham into compliance with the provisions of RSA 36-A:2 by meeting the requirements of indexing all open space or natural areas and all wetland areas. RSA 36-A:2 permits a city or town to establish a conservation commission and provides direction into the responsibilities of such a commission.
2. Identify important wildlife habitat, conservation priorities, and landscape connectivity needs within, and associated with, the Town of Grantham, New Hampshire. Through maps and a written report the town will be provided with tools to educate and guide the Grantham Select Board, Planning Board, Zoning Board of Adjustment, and citizens on protection of open space and conservation needs.
3. Provide comprehensive recommendations and guidance to the town to assist in future land use planning and conservation efforts.

A Critical Conservation Lands Index is a first step in a municipality's effort to identify those natural areas considered irreplaceable and worthy of protection from development. Typical CCLI's lack two components essential to making comprehensive land-use decisions; first, habitat does not end at the imaginary town boundary as most maps depict; and second, recommendations are usually broad and lack direction, making them difficult to implement for Conservation Commissions and Planning Boards who oftentimes lack scientific and land use planning training and expertise. The New Hampshire Wildlife Action Plan (NHWAP), released in 2006, recognizes the need to base local land use planning and conservation activities on sound scientific data and landscape connectivity needs. This project proposes to support the NHWAP by providing a strong scientific basis and technical guidance. This report further directs where town planners and decision makers can find the information they need to develop and apply innovative land use policies and regulations.

State law (RSA 674:21) authorizes towns to employ innovative land use controls, apply smart growth techniques, and protect open space. The NHWAP encourages innovative land use techniques to protect wildlife habitat. Recommendations found within the CCLI should provide the town with measurable goals and direction on how to achieve them. The New Hampshire Department of Environmental Services has released *Land Use Planning Techniques: A Handbook for Sustainable Development* (http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm) for municipalities. The handbook details techniques and provides model language that towns can adapt locally. The Grantham CCLI will refer to this guide frequently and to other resources for technical assistance where applicable within the recommendations. Not all

chapters of the handbook are referenced in the CCLI; the town should review the remaining chapters as well for additional guidance on preserving rural character.

In the fall of 2005, NHFGD submitted the preliminary NHWAP to the United States Fish and Wildlife Service. Approved in the spring of 2006, this federally mandated and funded plan addresses the species and habitats “in greatest need of conservation” and focuses heavily on habitat needs and connectivity. Among the conservation strategies proposed in the NHWAP, is Strategy 1300: Local Regulation and Policy. Recognizing the lack of scientific knowledge among municipalities and those who would govern land use, Strategy 1300 states:

Communities should have a sound, scientific basis for developing and implementing innovative land use incentives, legislation, and other measures that conserve habitat and landscape connections, maintain ecological function and protect water quality and quantity.

Strategy 1300 objectives focus on educating and assisting municipalities in their conservation and land use planning and policies. To support the objectives of the NHWAP, the Grantham CCLI will include sections on the economic benefits of protecting natural areas and the threats to habitats and species in addition to the usual resource identification sections. These additions will enhance the town’s education, expanding the town’s knowledge from basic identification of the resources to why the resources are important and what issues need to be addressed to protect them.

The Grantham CCLI intends to provide the town with the science on which to base conservation strategies within the town’s borders and in cooperation with neighboring towns to preserve the integrity of habitats and work toward regional goals.

1.3 METHODOLOGY

This project was originally proposed as a two phase undertaking. The first phase, the “Conservation Index” was to be the completion of a set of maps, including a co-occurrence map depicting conservation focus areas. Maps are based on best available GIS data. The second phase was to be the Critical Conservation Lands Index written report providing descriptions of the town’s natural resources. With the agreement of the GCC, both phases were merged into one process. By identifying the resources for both the maps and the text at the same time, no detail was overlooked in either section.

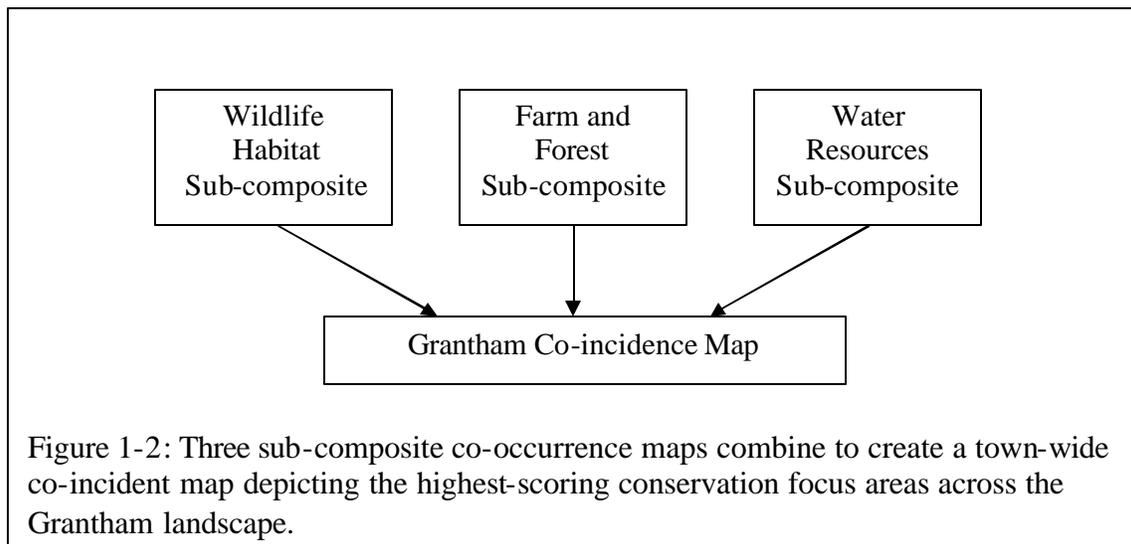
Information was gathered for the Critical Conservation Lands Index report through a number of sources including information and records provided by the GCC, interviews with people knowledgeable about the natural resources in Grantham, best available GIS data, and other documentation (see Sources Cited for complete list of resources).

To address the issue of “imaginary borders” (i.e. cutting off habitat either at the town boundary or at a randomly selected buffer around the boundary), the focus was intended

to be on landscape connectivity. Landscape connectivity typically refers to the corridors that wide-ranging mammals use to travel from one habitat to the next. Several concurrent efforts to map connectivity by the New Hampshire Fish and Game Department (NHFGD), the New Hampshire Audubon Society, and the Society for the Protection of New Hampshire Forests are ongoing. Hence, choosing a study area based on connectivity across the landscape was not feasible for this study. Instead, the digital maps provided to the Town of Grantham as a part of the CCLI include the towns surrounding Grantham as a reference for landscape scale conservation issues. Hard copies of the multi-town maps were not printed for the simple reason of readability on a small scale. Access to the ArcView 9.x software program is required to view the multi-town version of the maps. The town may also choose to purchase hard copies at a later date by providing the digital data to another vendor.

The original contract called for a single co-occurrence map—an analysis of all the natural resources in town—with the objective of identifying key areas on which the town could focus conservation efforts. Through the guidance of Dan Sundquist of The Society for the Protection of New Hampshire Forests (SPNHF), it was suggested that the single co-occurrence map be broken down into a series of sub-composite maps. Each sub-composite map would be a co-occurrence analysis focusing on a select group of natural resources: wildlife habitat, farm and forest, and water resources. By analyzing each group separately, the resources could be compared only against like resources thereby providing more rational analyses.

The priority conservation areas for the three sub-composites would then be overlapped in a final co-incidence model where each identified area would be of equal value. Where they overlapped would indicate the highest priority location (Figure 1-2) in town.



1.3.1 CO-OCCURRENCE MAPPING

In order to identify priority conservation areas, or Conservation Focus Areas (CFA), in Grantham, a weighted co-occurrence model that attributes relative importance values to individual natural resources was applied. Values for each resource were determined using the “shared vision” approach of the Delphi process. The objective of the Delphi approach is for anonymous voting to eliminate the typical group dynamic where the most skilled or assertive debater usually wins the debate. Discussion to clarify what resources would be included in the vote is allowed but discussion regarding resource value is not. Thus, voting members of the GCC could make decisions in an anxiety-free manner and vote according to their own sense of the importance of each resource to conservation planning. Direction for this process was also provided by Dan Sundquist, SPNHF.

A list of thirty-four natural resource data layers (Table 1-1) were presented to the GCC and discussed to ensure that all essential layers were included and any questions about the information were addressed. Again, the importance of each individual resource was not debated. The data layers were presented in the three sub-composites groups: field and forest resources, water resources, and wildlife habitat resources. GCC members then participated in anonymous voting to distribute one-hundred points across the data layers for *each* sub-composite. The individual votes were pooled and summarized by a neutral third party (Plymouth State University student, Denyce Gagne) and the mean value calculated for each data layer. The mean values were input into each GIS data layer that represented the natural resources voted on and analyzed to produce a series of co-occurrence maps.

Using the ArcView Spatial Analyst extension, each data layer was converted from a polygon or line feature to a grid (Figure 1-3) with a cell resolution of fifty meters. In the GIS process, each grid is spatially coordinated with the others, so that all cells align. Each cell is assigned the mean value previously input for that resource layer.

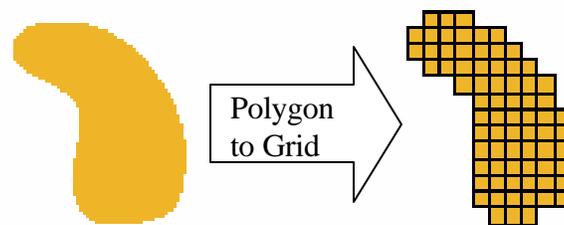


Figure 1-3: A polygon feature is converted to a grid where each individual square shares the same attribute data as the original polygon.

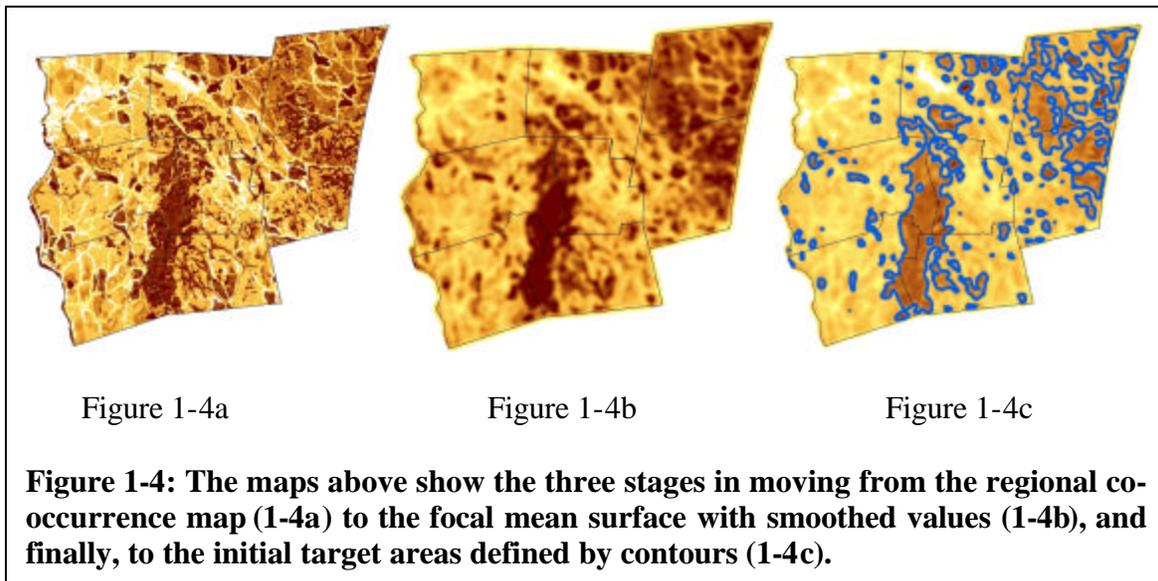
Table 1-1: Natural Resource Data Layers Included in Co-occurrence Analysis

Wildlife Habitat Sub-composite	Unfragmented Lands <100 acres
	Unfragmented Lands 100 - 500 acres
	Unfragmented Lands 500 - 2,500 acres
	Unfragmented Lands 2,500 - 10,000 acres
	Unfragmented Lands >10,000 acres
	High Elevation Spruce/Fir Forest
	Lowland Spruce/Fir Forest
	Northern Hardwood/Conifer Forest
	Floodplain Complexes >500 acres
	Marsh Complexes >250 acres
	Peatland Complexes >250 acres
	Grasslands & Meadows
	Rocky Ridge/Talus Slope
	Highest Ranked Habitat in NH
	Highest Ranked Habitat in Biological Region
	Other NWI Wetlands & Hydric Soils
	Riparian & Shoreland Buffer Zones (300')
	Steep Slopes >25%
Southfacing Slopes	
Existing Deer Wintering Areas	
Potential Deer Wintering Areas	
Field and Forest Resources Sub-composite	Prime Agricultural Soils
	Farmland of Statewide Importance
	Farmland of Local Importance
	Productive Forest Soil Class IA
	Productive Forest Soil Class IB
Water Resources Sub-composite	Lakes/Ponds
	Streams \geq 4th order
	Streams \leq 3rd order
	NWI Wetlands & Hydric Soils
	Riparian & Shoreland Buffer Zones (300')
	Floodplains
	High Yield Aquifers
	Low Yield Aquifers or Yield Unknown

In Spatial Analyst, all grids in a sub-composite were added together. The sum of the mean value of all cells co-incident in each grid was calculated. The result is displayed from lowest to highest value as a color gradient from light to dark, as shown in Figure 1-4a.

A focal mean analysis was run on the co-occurrence results to average scores within a moving analytical window. This has the effect of smoothing the complex spatial mosaic

of score variances in the original co-occurrence map by creating a continuous surface of relative values (Figure 1-4b). It is important to keep in mind that these are statistical values, not conservation values. Contours of the surface were generated and cell counts analyzed in a histogram to find a logical threshold or break point from which to begin delineating CFAs (Figure 1-4c). (See appendix C for histogram results for each sub-composite.) The logical threshold for each co-occurrence sub-composite was approximately 25% of the land area (see Appendix C). The results portray CFA locations within the Town of Grantham. These areas provide the GCC with general locations to focus their conservation efforts.



The focal analysis for the study area was clipped to the borders of the Town of Grantham and contours generated for the clipped area to investigate whether a significant difference existed between the CFAs for the larger study area and the CFAs just for Grantham Town. A significant difference did not exist. In fact, the CFAs for the Town of Grantham were identical to the CFAs for the entire study area.

The maps were presented to the GCC for review of the results. If any voting member was initially confused about the Delphi process or the initial results did not accurately represent the collective vision of the group, members were offered the chance to go through the process a second time. Therefore, the next step was not to debate the results, but instead offer the Commission members a chance to anonymously change their votes. With the Delphi process, consensus is usually reached in two rounds of voting (Sundquist, 2009); in Grantham, the original results were determined representative of the GCC's vision after the first round.

See Section 5.4.3 for the results and interpretive discussion of the co-occurrence mapping.