CHAPTER 4: NATURAL RESOURCES

1. INTRODUCTION

Located in the upper portion of the Connecticut River Valley, Hanover is situated just north of the confluence of the Mascoma, White and Connecticut Rivers. Its boundaries demark land that rises from river bottom through a markedly varied terrain, a mix of lowlands, upland terraces, and steep slopes to the summits of Moose Mountain. The Town is divided longitudinally into four general regions: relatively flat terrace by the river, hilly uplands, the Moose Mountain Ridge and poorly drained lowlands to the east of Moose Mountain.

Basic to the formulation of a plan to guide Hanover's future growth and development is an understanding of the Town's natural resources: underlying geologic formations, soils, surface and groundwater, forests and plant life, wildlife, clean air and night sky. These resources present both opportunities for and constraints to development and must be conserved or used with care so as not to preclude their continued use and existence. If Hanover is to protect its natural resources and provide a high quality of life for its citizens, the capability of Hanover's natural resources to accommodate development must be respected. The recommendations in this plan are based on the premise that Hanover's natural heritage should be preserved and future development of the Town be guided by the ability of the land to support that development.

This chapter establishes the importance of accepting natural resources as the essential infrastructure underlying Hanover's quality of life. Text and maps identify and describe Hanover's natural resources and indicate ways to maintain the natural infrastructure in a healthy condition. Areas with high resource value that have been protected by the Town or other landowners, through acquisition and conservation easements, are discussed in the Open Space Lands Chapter.

2. COMMUNITY VALUES AND GOALS

Hanover residents have expressed solid and increasing support for the protection of the Town's natural resources for many years.

- In 1974 and 1981, a large majority of master plan survey respondents favored controlling developments in such areas as hilltops, scenic views, streams, marshes, and steep slope areas. (see Figure 4-1)

- The 1998 Scenic Locales Committee report, *Something for Everyone,* underscores the public's mandate for scenic protection and provides guidance for a multi-faceted action program for ensuring that the scenic quality of Hanover's landscape will be sustained in the future and not randomly chipped away.

- The 1999 *Guiding Growth in Rural Hanover* project included a survey of 804 property owners in the rural area of town who expressed the continuing importance of the Town's rural character. Asked for the most important elements of rural character, respondents cited dark night sky, woods, wildlife, and fields.

- The *Open Space Priorities Plan*, endorsed by the Planning Board and Board of Selectmen, and adopted by the Conservation Commission in 2000, describes eleven conservation and recreation areas in Town where conservation efforts should be focused to protect and soundly manage the Town's natural resource base.

3. EXISTING RESOURCES

Water Resources

Water resources are essential elements of the environment in Hanover. They are important to conserve since they:

- supply water for domestic and business uses,
- provide wildlife habitat,
- contribute to Hanover's scenic beauty,
- offer recreation opportunities.

Rivers, Brooks and Ponds Hanover's surface water resources, both naturally occurring and man-made, include the Connecticut River, Goose Pond, Occom Pond, Storrs Pond, the Hanover Reservoirs, Slade Brook, Girl Brook, Camp Brook, Mink Brook and numerous smaller brooks. Although Hanover is located entirely within the Connecticut River watershed, only some of the Town's surface waters, such as Mink Brook and Slade Brook, drain directly into the Connecticut. The brooks in the southeast corner of town drain to the Mascoma River or Mascoma Lake, while those to the northeast around Goose Pond drain through Goose Pond on their way to the Mascoma.

Of Hanover's 31,232 acres, water bodies cover 2.4 percent, or 746 acres. Except for the Hanover Reservoirs, where human activity is very restricted to protect the quality of the drinking water supply, water bodies are available for recreational use. The entire watersheds of the first two reservoirs, Fletcher and Parker, are owned by the Hanover Water Company. The third reservoir is not as well protected. Surface waters provide many benefits in addition to recreation, such as flood storage capacity, wildlife habitat, scenic value, and water supply. Surface water pollution can result from a variety of human activities within the watershed. In general, the closer the activity is to the brook or pond, the greater its impact is on the surface water quality; many activities close to water bodies and wetlands are subject to State and Town regulations.

The New Hampshire Shoreline Protection Act (RSA 483-B) applies to the Connecticut River, Goose Pond, Fletcher and Parker Reservoirs, and Storrs Pond, as well as Mink Brook from just below Ruddsboro Road to the Connecticut River. The Shoreline Act provides for a 50 foot building setback and a 75- to 125- foot septic system setback, depending on soil types. The Act also regulates the siting of solid waste facilities, the fertilizing of lawns, and shoreline frontage, and requires that any existing natural woodland buffer within 150 feet of the shore be maintained.

The more stringent Hanover Zoning Ordinance requires a 75 foot building setback and 125-foot septic system setback for all soil types. The Town's setbacks apply to all year-round ponds and streams, as well as to ponds over 10 acres, and fourth order streams covered by the state law. Additional protection has been provided for the Reservoirs, Storrs Pond, Occom Pond,

Goose Pond, and the mouth of Mink Brook through inclusion in the Town's conservation-oriented Natural Preserve and Forestry zoning districts, as well as by public and private acquisition.

Water quality is an issue at Goose Pond, which is located both in Hanover and in Canaan. Old septic systems, never designed to handle year-round loading, pose a threat to the pond's water quality as well as to wells on the small shorefront lots. The Hanover Zoning Ordinance limits the remote Goose Pond area to seasonal use only. No new year-round residential uses may be established. The Town has a record of legal action when seasonal homes have been converted to year-round use. Canaan, where most of the Pond's surface and shoreline are located, has not adopted a zoning ordinance. Although the state's septic system regulations apply to conversions, regulating conversions and preventing year-round use is a source of continual enforcement difficulty. In recent years, a homeowners association was formed to manage and protect the pond.

Water quality may also be a concern along Hanover's brook corridors: Mink, Camp, Girl, Lovejoy, Pingree, Pressey, Marshall, Monahan, Straw, Slade, Coleman, Hewes, Tunis, Committee Meadow, and Pete's. Inadequate treatment of sewage by septic systems, fertilizers, pesticides and herbicides used on lawns and in gardens, and storm water runoff carrying silt, salt, and other debris are causes of concern, which merit further study. Long-term water quality and quantity monitoring programs should be undertaken in these brooks.

Surface water quality can be improved by control of erosion and sedimentation. Development on steep slopes is a significant source of sedimentation of surface waters; soils tend to be shallower, the volume and velocity of surface water runoff is higher, and the erosion potential is greater. The resulting sedimentation causes increased siltation and turbidity, and increased nutrient and chemical loading. Areas of steep slopes occur throughout the Town, much of it associated with Moose Mountain Ridge and the larger hills.

Vegetated buffers along shorelines, even along small brooks, can prevent erosion and sedimentation, while at the same time help maintain natural water temperatures and preserve fish and wildlife habitat. Although the vegetated buffer provisions of the Shoreline Protection Act are applicable to the Town's great ponds, part of Mink Brook and the Connecticut River, Town regulations do not require the maintenance of a natural vegetated buffer along other brooks within the required shoreline setback.

Wetlands Wetlands are defined in the Hanover Zoning Ordinance as those areas of hydric soil that are inundated or saturated at a frequency and duration sufficient to support wetland vegetation; this is the definition used by the Army Corps of Engineers. Described as poorly drained and very poorly drained soils by the USDA Natural Resources Conservation Service (NCRS), wetlands include high water table soils, swamps, marshes, bogs and wet meadows. Long thought to be useless, wetlands are now valued for storage of floodwaters, storage and adsorption of soluble nutrients that otherwise would contaminate downstream water bodies, discharge of water to water bodies during periods of low flow, groundwater recharge, filtration, habitat for many species that depend on wetlands for part or all of their life cycle, and recreational opportunities. Even temporary wetlands appearing seasonally as vernal pools serve important wildlife breeding functions and provide important habitats.

According to the Upper Valley Lake Sunapee Regional Planning Commission's measurement of the NCRS-identified soils in Hanover, over 2,600 acres (approximately 8%) of the land area of the Town can be considered wetland based. The Conservation Commission's 1988 Hanover Wetlands Inventory covers only a portion of the total wetland acreage, but includes some of the most accessible wetlands, and thus those most apt to be impacted by development proposals. Using aerial photographs and fieldwork, 86 wetlands, forming a total of 620 acres, have been identified and mapped (Map 4-2 Hydrology). This Inventory categorizes wetlands by size, hydrology, soils, and vegetation, and identifies the location and tax map-and lot number for each.

Hanover's wetlands are primarily associated with brooks, such as those along Pressey Brook, Scales Brook, Straw Brook, Slade Brook, Monahan Brook, Girl Brook and Mink Brook. Hanover also has one true bog, the Bottomless Pit, located off Great Hollow Road near the Lebanon line.

The wetlands recommended for protection by the Wetlands Inventory should be considered priorities for the Town's conservation efforts. Filling a wetland changes the natural drainage patterns, inhibiting groundwater recharge, floodwater retention and other important natural functions. Development should not occur in wet areas.

Sufficient distance should be maintained between wetlands and septic systems to protect the water quality. Septic systems do not function properly in areas of high seasonal groundwater, and septic system effluent will contaminate the water. Hanover regulates building within 75 feet of a wetland and requires leaching fields to be set back 125 feet.

For a discussion of Hanover's surface water supply, see Chapter 11 Municipal Facilities and Services.

Groundwater Hanover's glacial past endowed the Town with significant sand and gravel deposits. The coarse texture of these deposits retains and transmits a large quantity of water. While each of these deposits allow for generous water supply in their immediate area, they also allow for rapid and untreated percolation of effluents that may be pollutants. Septic tank effluent, leaking fuel storage tanks, landfill leachate, road salts, and improperly stored hazardous materials are potential sources of aquifer pollution. Excavation of sand and gravel from such deposits increases the risk of contamination.

All Hanover residents outside the urban area rely on groundwater for drinking, mainly from individual private wells, yet very little is known about the aquifers in the Town. The aquifer map developed for the United States Geological Survey (USGS) by John Cotton in 1976 shows areas with medium or high potential to yield groundwater for public supply wells along Pressey Brook in the northeast corner of town, along a section of Hewes Brook, in Etna around the intersection of Hanover Center Road and Ruddsboro Road, along Mink Brook and south along Great Hollow Road, and along the Connecticut River from Storrs Pond south to the town line (Map 4-2 Hydrology).

Hanover's major aquifer along the Connecticut River until recently supplied a deep well located behind the Rivercrest development; use of this well has been discontinued for a number

of reasons. While the exact location and extent of the aquifer is not known, it is generally thought to parallel the Connecticut River. The identification of aquifer recharge areas and important aquifer areas is an ongoing process. New, more detailed, aquifer maps are being developed for the Middle Connecticut River Basin through a cooperative effort involving NH Department of Environmental Services and the USGS. Because information about the surficial geology is the first step toward understanding the sustainability of our groundwater supply, the Town has recently partnered with the State Geological Survey to have surficial geology mapped in the area of town not served by the Hanover Water Works.

Land uses associated with materials that pose a high risk to the aquifer should be regulated in aquifer and aquifer recharge areas. These include any principal use involving the production, sale, storage, or transportation of oil, gas, or toxic or hazardous substances; uses that concentrate contaminants, such as septage lagoons or solid waste facilities; snow dumps and road salt storage facilities. Other uses involving chemicals, such as cleaning services and laboratories, can be safely located in aquifer areas only if carefully planned and monitored.

Efforts to identify and acquire a well field site in case of future need should continue. Hanover's Director of Public Works has stated that the Connecticut River itself may be the most likely source of additional future supply.

Septic systems pose one of the most common risks to groundwater quality. Improper siting, design, and maintenance can lead to groundwater contamination. Although increased depth to seasonal groundwater would further reduce pollution, the state's septic system regulations have significantly decreased historical problems associated with improper siting and design. However, septic system owners do not always follow through with proper maintenance. Several good publications are available for public education, but distribution has been limited.

Since excavations pose a significant threat to groundwater quality when not planned and managed properly, excavation regulations should be developed to offer important additional protection for the Town's groundwater resource. In addition to ensuring that the operation of the excavation does not jeopardize water quality, the regulations should ensure that pits are finished safely and re-vegetated.

Underground storage tanks are now recognized as serious threats to groundwater quality. Research has shown that it is not uncommon for underground tanks to develop leaks. Given New Hampshire's acidic soils and rain, most tanks over 15 years old are expected to have leaks. Unfortunately, toxic substances such as gasoline and fuel oil are commonly stored in underground tanks. The state regulates underground storage tanks with volumes larger than 1,100 gallons when in commercial use or abandoned. New tanks have to meet strict design standards and all tanks are subject to regular testing. Regulation of commercial use of tanks with volumes less than 1,100 gallons, and of all residential use underground tanks regardless of size, has been left to localities. Since this includes virtually all residential underground storage tanks, Hanover should take the initiative to protect its groundwater from this source of contamination lest such pollution contaminate underground water supplies and require many years of restoration.

Floodplains Floodplains are periodically inundated flatlands adjacent to rivers and streams,

serving as:

- storage areas for water during times of flooding, and
- providing habitat and travel corridors for wildlife.

Hanover's floodplains are located along many of the Town's brooks as well as the Connecticut River and are shown on the Flood Insurance Rate Maps available at the Town Office. Development in floodplains presents some special problems, including a high probability of property damage during flooding, the restriction of water storage capacity resulting in potentially greater flooding, and the increased likelihood of erosion and sedimentation, causing in turn increased turbidity of water in rivers and streams and damage to downstream property owners.

Since floodplains are relatively level they also serve as attractive and inexpensive land to develop. Paving, mineral extraction, and urban development seriously reduce the floodplain's absorption capability, and may intensify downstream flooding. Structures can be torn from foundations by floodwaters, thereby creating dangerous impoundments at river bottlenecks, such as bridges. Although past residential development occurred on floodplains on Route 10, areas along River Road and as scattered homes in the Mink Brook watershed, Hanover regulations now restrict development within the 100-year floodplain, defined as that area which has a likelihood of being flooded once in a 100- year period. (Map 4-2 Hydrology)

Soils

Soils are the product of a parent material (rock), topography, climate, biotic forces and time. Soils are an important natural resource, since it is soil properties such as depth, permeability, wetness, slope and susceptibility to erosion that define the land's capability to support development, agriculture, and forestation.

The history of Hanover's soil began 500 million years ago when New England lay under the Atlantic Ocean. Marine sediments, mud, sand and gravel, were deposited on the floor of the ancient ocean. Over time, the pressure from the upper layers heated the lower, and the sediments were converted into sedimentary rocks, shale, sandstone and conglomerate. Volcanic lava eruptions deposited igneous rocks. Crustal uplift and metamorphic activity were followed by erosion and another period of submersion. It was during this period of sedimentation of deep quartz deposits that the quartzite backbone of Moose Mountain was formed. Quartz deposits were then overlaid with limestone and slate.

Around 350 million years ago, heat and pressure created during a long period of mountain-building metamorphosed both older and newer sedimentary and volcanic rocks. Magma intrusions cooled within these old rocks. The Lebanon and Mascoma granites were formed in this way. Lebanon granite underlies the Balch Hill/Velvet Rocks area. A second crustal uplifting again elevated New England above sea level. Mountains lined the edges of the European and North American continents following the collision of the two land masses. The White and Green Mountains and Connecticut and Hudson River Valleys follow the north/south orientation of the North American shoreline that crumpled at that time.

Approximately 20,000 years ago, Hanover was covered by a continental glacier which

left a legacy of glacial till, clays, and boulders. As the glacier receded, melt water retained by till dams created Lake Hitchcock, stretching from Connecticut to the Upper Valley. The width of the lake varied from nearly 10 miles at its toe to the south to about a mile in the Upper Valley. Varved clays and silt were deposited on the lake bottom and now underlie the Hanover Plain. Streams running under and from the glacier left gravel ridges and sand deposits, such as the eskers that form Occom and River Ridges. These geologic events, plus the effects of climate and biotic activity, have contributed to soil-building and erosion over time, leaving the soils present in Hanover today.

Agricultural Soils Soils particularly suited to agricultural use are an important natural resource, both highly productive and limited in quantity. On the basis of soil quality, moisture supply, availability, and slope, the Natural Resource Conservation Service (NRCS) has defined important farmland in three categories: nationally- significant prime soils, agricultural soils of statewide importance, and agricultural soils of local (Grafton County) importance. Soil types associated with each of these three categories as they are found in Hanover are listed in Figure 4-2 and are shown on Map 4-3. Roughly 5,900 acres of Hanover's soils are classified by the NRCS as being one of those three types of soil important for agriculture. This represents about 19% of the Town's land area. Many of these soils occur in parts of Town that already support some form of development, as prime agricultural soils are well drained, level, and easily developed. Hanover's few remaining areas of prime agricultural soils are an important and irreplaceable resource. Once developed, agricultural soils cannot, in a practical sense, be considered available for viable future agricultural use.

As discussed above, it takes thousands of years to establish soil structure. Once developed, the soil structure is changed and loses its productivity. Hanover’s agricultural soils have special properties that may be more important to the community than they are today.

Fortunately, most of Hanover’s undeveloped prime agricultural soils are currently protected by their location (i.e. the area surrounding the reservoir closest to town) and by their ownership, the Hanover Waterworks. Should this land no longer be essential for protecting the surface water quality, it should remain undeveloped because of its importance as agricultural soil as well as for other open space benefits such as agricultural use, recreation, wildlife habitat, and its contribution to the forested backdrop to the town.

The protection of prime agricultural lands relies on voluntary landowner cooperation and land use planning and zoning that encourages development to be located other than on important soils. The Upper Valley Land Trust assists landowners in evaluating protection options. The Conservation Commission and the Conservation Council offer education on the location and importance of this resource.

Agricultural land use is the most logical technique for the preservation of open space. Working farmland provides many of the features that we value as rural character:

- Fields create openings to allow distant vistas.
- Farmers add diversity to the social and economic fabric of the community.
- Fresh food, locally produced, helps to reduce our reliance on agribusiness and to avoid the huge transportation and subsidized water costs, and gives us some measure of food security.

Protecting agricultural soils, protects community options. Agriculture is a suitable use of agricultural soils; buildings are not.

Erodible Soils on Steep Slopes Steep slopes can be defined simply by a grade or by a combination of the grade and soil type. For example, in Hanover, a combination of grade and soil type has been selected to guide future development of the Town. The combination of even a moderate (8-15%) slope and a highly erodible soil, such as a Hitchcock soil, is seen as a moderate to severe erosion hazard by the Natural Resources Conservation Service(NRCS) for certain land uses including agriculture, forestry, construction or development requiring cut and fill, and recreation. The Grafton County Soil Survey should be used as a guide for establishing development limitations based on grade and soil type.(see Map 4-1 Topography)

Forest cover is the optimal vegetation for controlling erosion and slowing runoff. The tree canopy helps to dissipate the energy forces of a strong rainfall; the leaves and forest litter help to prevent compaction (so common with lawns), keep the ground moist and retard runoff. On steep slopes (however defined) choice of vegetation is critical for retarding runoff, preventing erosion and recharging groundwater.

The top edge of a steep slope is vulnerable to erosion. Mowing to the crest of a steep slope (whether a stream bank or not) may lead to erosion. As with the slopes themselves, there should be a vegetative buffer of deep-rooted trees and shrubs to help hold the soils at the crest of the slopes. For land considered steep, then, forest vegetation should be retained and kept undisturbed. Lawns and even meadows may be inappropriate on steep slopes depending on the soils. Landowners wishing to obtain a view in a forest may limb the trees, selectively cut so that roots still hold soils and soils do not dry out with too much sunlight, and introduce shrubs.

Forest Resources

Forest resources are plentiful in Hanover. In the mid-1980's, forest covered approximately 26,276 acres, or 83 percent, of the total land area. While some additional area has since been cleared for development, some old field area has also reverted to forest.

The predominant forest type is a mixed hardwood/softwood. The largest tract of unbroken forest runs in a north/south direction on both sides of Moose Mountain. Much of this forest is protected by virtue of its ownership by the National Park Service and the Town. This represents a continuing reforestation trend begun around the turn of the century, the beginning of a period during which many farms in the region were abandoned. In 1926, when land use was first mapped in Hanover, forest covered only 17,241 acres.

About three-fourths of the approximately 20,000 acres of Hanover in the Current Use Program are in the Forest Land category. Under the Current Use taxation provisions, land in the program is assessed at its value as forest land, rather than its value as potentially developable land. If the land is later developed, owners must pay 10% of the now higher value of the land to the Town.

Most logging activity currently underway in Hanover is on a relatively small scale. Many

forested acres, including the Water Company land, some owned by the Town, such as the Town Forest, the Gile Tract, and land on Pressey Brook, are professionally managed. Hanover's forests today are used primarily to complement home sites, or as open space for recreation and wildlife habitat. Landowner education and promotion of best management practices could result in increased value and productivity from these privately owned woodlands.

Flora

Hanover's land is geologically atypical for New Hampshire, having deep alluvial soils left where Lake Hitchcock lay during glacial times, and bands of nutrient-rich volcanic bedrock. As a result, the Town has areas of unusually rich, sweet soil (high pH) supporting a wide diversity of botanical species, many of which are rare elsewhere in the state. With elevations ranging from river floodplain at about 400 feet above sea level to the peaks of Moose Mountain at 2300 feet, and topography ranging from flat meadows to steep slopes, the range of habitats is broad.

Hanover harbors a wealth of botanical treasures. (See Appendix 4-1, from *Botanical Survey Field Work,* by Alice Schori, 2001) Positive or probable identifications to the species level have been made for 525 vascular plant species. Another 14 were identified to the genus level. Of these 539 different plants, only 18% were found to be "alien" species, not native to this area. Most of those have been introduced intentionally or accidentally from Europe, Asia, or to other parts of the United States. More than a quarter of the alien species, or 5% of all species identified, fall in the category of "invasive" or "potentially invasive." Five percent of species are rare, threatened, or endangered, and another 4% are uncommon.

The New Hampshire Natural Heritage Inventory records 39 threatened or endangered species that have been reported in Hanover. Thirty-six occurrences of six species that are candidates for listing on a proposed "State Watch List" were found. Fifty-eight occurrences of 21 uncommon species were observed as well.

Land use and drainage changes, habitat fragmentation and incompatible uses such as mechanized uses of the trail system are causes of concern to the health of the flora in Town.

Invasive plants have caused significant environmental and economic damage in New England, and many of those plants have been identified in Hanover. Twenty-four invasive species, virtually all alien, and five potentially invasive species were identified during the course of the botanical inventory conducted in 1999-2000. One hundred seventy-two occurrences were observed.

Invasive species were most commonly noted near residential areas, roads, and areas that disturbed by farming or (sometimes) logging. Careless development practices can encourage their spread. Building sites and other disturbed areas are particularly susceptible to invasive plants, whose enormous reproductive capacity can overwhelm the ability of other species to reestablish themselves. Seeds of invasive species can arrive on the wheels of excavation machinery, on imported materials such as hay bales, or with the root balls of nursery stock.

Invasive plants are best eradicated before they multiply. They should not be planted knowingly. Precautions should be taken to prevent inadvertent import, and they should be removed when they appear in disturbed areas. In particular, areas in which rare plants have been

identified should be regulated in order to conserve such plants and protect habitat. The dumping of yard wastes in natural areas or in the woods should be strongly discouraged.

Wildlife

Hanover riverbanks, streams, ponds, marshes, fields, forests and hilltops are home to a variety of species, representing a sound and healthy biodiversity. Figure 4-3 lists the State-listed endangered and threatened species that have been recorded in Hanover. Map 4-3 shows the locations of some of Hanover's deer wintering areas.

Protection and support of our flora and fauna will be accomplished only by maintaining adequate areas of natural habitat with a sufficient number of connecting travel corridors. Every development in Town results in the loss of some wildlife habitat. No single development will destroy Hanover's wildlife; however, the cumulative effect of many "small" decisions over time might. This is another area that would benefit from increased landowner awareness and also where the proper siting and design of developments can help minimize the impact on habitat and corridors.

Scenic Resources

Hanover's varied terrain and traditional settlement pattern are appealing and visually attractive, an important asset that contributes significantly to quality of life for its residents. In response to a subdivision that negatively threatened some of the most outstanding views in town, the Scenic Locales Committee was created in 1997 to identify, prioritize, and suggest protection methods for important locales in the local landscape. The Committee's survey of 1200 households yielded a list of the most scenic locales in Hanover: Moose Mountain, Goose Pond, Mink Brook Corridor, King Road/Robert Frost Lane, Etna Farm at Ruddsboro Road, Etna Village and Hanover Center, Hanover Country Club Golf Course, Hanover Water Company land and the view of Mt. Ascutney at Trescott Road. Dozens of other locations both in-town and out-of-town were also cited by smaller but significant numbers of people. (See Map 4-4 Scenic Resources)

Landscape quality, especially its natural beauty, is an elusive but important consideration in land use decision-making. As shown on Figure 4-1, 75% of the master plan survey respondents favored protecting scenic views. Both residents and visitors appreciate a high quality Town landscape, one that encourages community identity and pride.

Hanover's regulations enable consideration of scenic resources to be incorporated in the development review process in a number of ways. The Zoning Ordinance should further protection of the Town's scenic resources by minimizing the density of development in the rural areas of Town and by enabling the Planning Board to provide incentives for clustering. Hanover's Subdivision Regulations provide incentives for clustering, a technique which can result in the preservation of scenic features or in improving the visual quality of the development itself. Hanover's Site Plan Review Regulations include several means for providing for aesthetically pleasing development as authorized under RSA 674:44. These include requiring development to conform to the natural topography of the site, minimizing site clearing, regulating exterior lighting and signs, and requiring proper landscaping and screening.

In addition to these land use regulations, the Town has designated several roads as scenic roads as further means to protect the scenic character of the community: Rope Ferry Road,

Hilton Field Lane, Occom Ridge Road, Clement Road, Pleasant Street, Reservoir Road, Pinneo Hill Road, River Road, Goodfellow Road, King Road, Three Mile Road, Ruddsboro Road, Goss Road, Goose Pond Road, Moose Mountain Road, and Ferson Road. The New Hampshire Scenic Road law (RSA 231:157), supported by the Town's Scenic Road Policy, enables Planning Board review and public input prior to work on scenic roads that would involve removing trees or altering stone walls.

As stated in the report of the Scenic Locales Committee, the natural skyline of the hillsides in Hanover is an important visual environmental asset. Hilltop development can both destroy these scenic vistas and upset fragile summit ecosystems. Hilltops are areas of thin soils; once the vegetative cover is disturbed, erosion can be difficult to control. Erosion and resulting sedimentation can cause damage and accelerate the filling in of lakes, wetlands and streams. Landowners should be encouraged to preserve hilltops and steep slopes on their properties as open space lands by means of easements, conservation restrictions, or other instruments. Among the hilltops and steep slopes that should be protected are those associated with Oak, Balch, Lord's, Huntington, Pinneo, and Hayes Hills; Moose Mountain; Mount Tug; Twin Peaks at the Gile Tract, Rix Ledges; and Velvet Rocks. The Town's development review powers should also be used to the fullest extent possible to encourage the proper siting of new development to minimize negative visual impacts. In assessing visual resources, the Planning Board should consider distant views and large scale panoramas; details of short and medium distance, such as waterfalls, wetlands, rock formations, rivers and streams; and characteristic scenes as in the mixture of pasture, crop, woods, villages, mountains and valleys.

5. POLICIES AND RECOMMENDATIONS

- Protect and preserve our natural resources including both urban and rural open space, wildlife habitat, water and wetlands, agricultural and forestry lands and associated recreational resources.
- Conserve Hanover's natural and scenic resources for the use and enjoyment of current and future generations.
- Preserve Hanover's biodiversity by protecting an ecosystem that will support the diverse mix of plants and animals necessary for that system to be sustainable.
- Protect fragile environmental areas, such as wetlands, aquifers, areas subject to flooding, steep slopes, and important wildlife habitats, from inappropriate types of land uses.

General

- Exclude development from environmentally sensitive lands of high resource value: floodplains, wetlands (including hydric soils), headwaters of major streams, perennial stream courses and adjacent natural buffer, and steep slopes. These lands may be excluded in whole or in part from the calculation of development density. This exclusion may be applied differently between areas served by the existing water and sewer infrastructure from those that are not.
- Subject to stringent review that includes impact identification, avoidance, and mitigation, permit development on lands of moderate resource value: lands with important agricultural soils and moderate slopes, aquifers, hilltops and ridgelines, significant identified wildlife habitats and corridors, and areas of identified biodiversity.

- Only after stringent review and mitigation, permit development on certain other lands especially those significant to open space protection.
- In evaluating environmental impact, assess cumulative impact, not simply incremental impact.
- Consider an environmentally sensitive (ES) overlay district into the Zoning Ordinance to provide additional protection for steep slopes, hilltops and ridges, water bodies and wetlands, scenic and/or recreational features, important cultural features and agricultural soils, exceptional natural features and open space, community gateways and/or landscape transitions, and any other areas deemed appropriate.
- Amend the Town's land use controls to allow flexibility in site development, so that impacts on natural features can be minimized.
- Develop regulations with consideration of aesthetic impacts, and environmentally friendly roads construction and maintenance standards with special attention to how runoff is handled.
- Increase funding to enable the Conservation Commission to conserve land in response to the community's goals for protection of natural resources as stated in the Open Space Priorities Plan
- Maintain an up-to-date system for mapping natural resources as a basis for decision making.

Water Resources

- Monitor and enforce best management practices rigorously on land subject to municipal oversight such as conservation easements, subdivisions and town-owned lands, in order to prevent erosion and contamination of ground and surface waters.
- Amend the Zoning Ordinance to regulate development on grade/soil combinations that present erosion hazard to protect hillsides from development that will result in slope instability and to minimize erosion and sedimentation that is likely to occur on slopes.
- Study water quality, and promote natural riparian environments on land adjacent to Hanover's brooks, streams and wetlands by regulating building, development and livestock.
- Protect water quality with setbacks between septic systems, stream banks, and wetlands and septic systems.
- Require landowners to maintain natural vegetation along shorelines to stabilize the bank and filter runoff before it reaches the wetland or water body.
- Study potential adoption of a special overlay protection district to implement elements of the Connecticut River Management Plan.
- Work with organizations such as the Upper Valley Local River Subcommittee of the Connecticut River Joint Commissions and the Goose Pond Protective Association to protect the water quality and conserve the shorelines of the Connecticut River and Goose Pond.
- Continue Conservation Commission review of all dredge and fill applications to ensure that impacts on the water body are minimized and thorough erosion controls are being planned.
- Protect aquifer areas from activities which pose a high risk to water quality, such as underground fuel storage tanks.

- Regulate development that presents risks to water quality in sand and gravel and aquifer recharge areas and that involves significant impervious cover or inhibits aquifer recharge in recharge areas.
- To protect water quality, consider earth materials excavation regulations as authorized by RSA 155-E to ensure that Hanover's excavations are operated and finished safely and re-vegetated appropriately.
- Land use regulations should take into consideration the amount of impervious cover created by any development especially within aquifer recharge areas, and headwaters.
- Identify and map aquifers and recharge areas; incorporate the protection of aquifers and recharge areas into Hanover's conservation and recreation network and the Final Strategic Concept.
- Identify and secure future water sources for public water supply.
- Promote public education about proper septic system maintenance as one means for protecting groundwater quality.
- Inventory existing underground fuel storage tanks, then consider implementing a local regulatory program.
- Consider local underground storage tank regulations with design and installation standards for all tanks not regulated by the State.
- Explore a proactive approach to underground fuel storage tank pollution by creating an education program and an assistance fund for tank replacement.
- Establish leak containment and clean-up procedures in anticipation of leak detection
- Restrict development within flood hazard areas by maintaining and enforcing the floodplain regulations currently contained in the Zoning Ordinance.
- To address the challenge of groundwater recharge, review and adopt measures to minimize runoff from all sources (roads, parking, buildings, and home sites) into storm sewers and streams.
- Restrict impermeable surfaces in rural areas and in stream headwaters.
- Retain forest cover in stream headwater areas in order to promote groundwater recharge.
- Update the water resources map as new data are available so that setback requirements, dredge and fill permits and other regulations applicable to water bodies, floodplains, wetlands and streams are applied appropriately.
- Promote water conservation by residential and nonresidential users as one means for protecting the Town's water resources.

Agricultural Soils

- Protect the Town’s large undeveloped parcel of Natural Resource and Conservation Service-designated, nationally important agricultural soil around the Reservoirs, and other areas of important agricultural soils, from development that would destroy their usefulness in growing crops in the future through the proper design and siting of development.
- Consider incentives so that development proposed for land with agricultural soils can be re-designed to locate site improvements on non-agricultural soils.
- Build incentives to promote sustainable agricultural use of land through creative lot layout.

Steep Slopes

- Define steep slopes based on grade/soil characteristics explained in the Grafton County Soils Survey.
- Permit uses only of the sort recommended for these slopes and soils as outlined in the Grafton County Soils Survey.
- Prohibit development or disturbance of steep slopes where soils will not support such development.
- Establish planting standards for steep slopes requiring re-vegetation when grass is not sufficient to hold steep banks; shrubs and trees should be planted for long-term stability.
- Require retention of existing forest cover for steep slopes.
- Discourage lawns and encourage meadows and woody vegetation on sloping lands to help recharge groundwater on moderate slopes.
- Educate Hanover citizens about value of forest cover and meadows, and their value in groundwater recharge and watershed protection.
- Protect the tops of steep slope banks with a vegetative buffer.
- Require that any forest disturbance for development in rural areas to be kept to a minimum; aim for a goal of 65% forest cover in these areas.

Flora

- Promote public education relative to rare species found in Hanover to make landowners aware of the potential for disrupting important habitats and for implementing the recommendations in the biodiversity studies relative to land management for conservation of rare flora and their habitats. (see Appendix 4-1)
- Forestall the proliferation of undesirable invasives from construction and other activities, and encourage the removal of existing invasives from development and other sites by providing information to property owners, developers and landscapers.
- In order to set a positive example for other landowners, on public lands, be proactive in controlling invasives.

Forest Resources

- Continue the use of a professional forester to manage the Town forests for multiple use, including wildlife habitat.
- Promote the use of Best Management Practices on private forest land.

Wildlife

- Initiate formal studies of Hanover's wildlife to establish a baseline and to track animal populations over time through programs such as Keeping Track.
- Promote public education relative to rare species found in Hanover to make landowners aware of the need for important habitats.
- Maintain habitat suitable to sustain life and to allow for genetic diversity.
- Encourage landowners to protect deer wintering areas through the proper design and siting of development.
- Cooperate with neighboring towns to achieve regional-scale reserves providing habitat for large mammals and promoting biodiversity by preventing fragmentation of large lots on Moose Mountain and the lands to the east of the mountain, and by accommodating

intermunicipal wildlife corridors such as those along Rix Ledges and Mt. Support.
- Consider impacts on wildlife and disruption of habitat in making land use decisions.

Scenic Resources

- Support and implement the recommendations of *The Scenic Locales Report*. (See appendix to Chapter 3 Land Use)
- Preserve important scenic vistas, steep slopes and hilltops by conservation easements, land acquisition, or appropriate regulation relating to the use of topography to minimize negative impacts.
- Continue minipark development, floral plantings and planting of wayside trees by supporting the cooperative relationship between the Town's Department of Public Works and the Hanover Improvement Society and Garden Club.
- Preserve trees and other scenic features where possible when reviewing proposals for widening of existing Town roads or construction of new roads.
- Encourage clustering and other siting approaches to preserving attractive public vistas.
- To minimize negative visual impacts, where possible incorporate into site plan review standards design strategies such as landscaping and use of topography to benefit aesthetics of the project.
- Implement site plan review regulations to continue to address conformation of the development to the natural topography of the site, minimizing site clearing, regulation of exterior lighting and signs, and landscaping and screening requirements.
- Strengthen and extend implementation of the State's scenic road law.
- Consider additional roads for scenic designation.
- Periodically review and update the inventory of Hanover's visual resources in the report of the Scenic Locales Committee.

Figure 4.-1: 1994 Master Plan Survey - Resource Protection Responses

Do you favor controlling development in such areas as:	Favor	Oppose	No Opinion	No Answer
Hilltops & ridge lines	74	11	10	5
Scenic views	75	11	10	4
Steep slope areas	69	11	14	6
Wetlands	77	12	7	4
River banks	74	11	10	5
Floodplains	75	10	10	5
Wildlife habitat	75	12	8	5

Figure 4-2 Agricultural Soils in Hanover, New Hampshire

NRCS Code	Soil Name	NRCS Code	Soil Name
	Prime Soils		**Soils of Local Significance**
1	Occum fine sandy loam, freq. flooded	2	
4	Pootatuck very fsl	5	Suncook loamy fine sand
8	Hadley silt loam, ff	22C	Rippowam fsl
9	Winooski silt loam	26A,B,C	Colton loamy sand
24A,B	Agawam fsl	36C	Adams loamy sand
27A,B	Groveton fsl	62D	Charlton fsl
28A,B	Madawaska fsl	72D	Berkshire loam
56B	Becket fsl	76D	Marlow fsl
62B	Charlton fsl	90B,C,D	Tunbridge-Lyman complex
76B	Marlow fsl	109	Limerick silt loam
78B	Peru fsl	114	Walpole-Binghamville.complex
101	Ondawa fsl,occasionally flooded	130C	Hitchcock silt loa.
104	Podunk fsl	310A,B,C	Quonset loamy sand
108	Hadley silt loam,occasionally flooded	313	Deerfield loamy fine sand
130A	Hitchcock silt loam	330D	Bernardston silt loam
132A	Dartmouth silt loam	360B,C,D	Cardigan-Kearsarge complex
201	Ondawa fsl, occasionally flooded	614	Kinsman sand
330B	Bernardston silt loam.		**Soils of Statewide Significance**
334B	Pittstown loam	62C	Charlton fsl
558B	Skerry fsl	72C	Berkshire loam
401	Occum fsl, occasionally flooded	76C	Marlow fsl
632A	Nicholville very fsl	78C	Peru fsl
		130B	Hitchcock silt loam
		132B	Dartmouth silt loam
		330C	Bernardston silt loam
		334C	Pittstown loam
		632B	Nicholville very fsl

fsl=fine sandy loam; ff=frequently flooded

Source: Soil Survey of Grafton County Area, New Hampshire, Natural Resources Conservation Service, 1988.

Figure 4-3: State Listed Endangered and Threatened Species, 1995

ENDANGERED SPECIES

Common Name	Scientific Name
Fauna	
Bald Eagle	Haliaeetus leucocephalus
Dwarf Wedge Mussell	Alasmidonta heterodon
Brook Floater	Alasmidonta varicosa
Flora	
Arethusa	Arethusa bulbosa
Fairy Slipper	Calypso bulbosa
Bur Sedge	Carex sparganioides
Ram's-Head Lady's-Slipper	Cypripedium arietinum
Showy Lady's-Slipper	Cypripedium reginae
Narrow-Leaved Spleenwort	Diplazium pycnocarpon
White Adder's-Mouth	Malaxis monophyllos var brachypoda
Leafy Pondweed	Potamogeton nodosus
Pink Wintergreen	Pyrola asarifolia
Canadian Germander	Teucrium canadense var virginicum
Large-Flowered Bellwort	Uvularia grandiflora

THREATENED SPECIES

Common Name	Scientific Name
Golden-Fruited Sedge	Carex aurea
Large Yellow Lady's-Slipper	Cypripedium pubescens
Squirrel-Corn	Dicentra canadensis
Goldie's Fern	Dryopteris goldiana
Meadow Horsetail	Equisetum pratense
Showy Orchis	Galearis spectabilis
Fringed Gentian	Gentiana crinita
Woodland Hound's-Tongue	Hackelia virginiana
Northern Waterleaf	Hydrophyllum virginianum
River Bank Quillwort	Iosetes riparia
Green Adder's-Mouth	Malaxis unifolia
Thin-Leaved Alpine Pondweed	Potamogeton alpinus
Gregarious Black Snakeroot	Sanicula gregaria
Three-Leaved Black Snakeroot	Sanicula trifoliata
Dwarf Ragwort	Senecio pauperculus
Barren Strawberry	Waldsteinia fragarioides
Blunt-Lobe Woodsia	Woodsia obtusa

Source: New Hampshire Department of Resources and Economic Development's Natural Heritage Inventory - April 28, 1995

APPENDIX 4-1: BOTANICAL BIODIVERSITY

Hanover harbors a wealth of botanical treasures. The area is geologically somewhat atypical for New Hampshire, including deep alluvial soils left where Lake Hitchcock existed during glacial times and bands of nutrient-rich volcanic bedrock. As a result, the Town has many areas of unusually rich, sweet soil supporting a wide diversity of plant species many of which are rare elsewhere in the state. With elevations ranging from river floodplain at about 400 feet above sea level to the peaks of Moose Mountain at 2300 feet, and topography ranging from flat meadows to steep slopes, the range of habitats is very broad.

Alice Schori, one of the botanists who worked on the town's Botanical Survey Field Work conducted during 2000 and 2001 said, "The charge to identify as many vascular plant species as possible in the Town is an invitation to a lifetime of exploration." Over 500 species have been identified, but many others are doubtless waiting to be identified. Grasses, mosses, lichens, and liverworts in particular, are underrepresented in the lists because their identification tends to be very time-consuming. Because of time constraints and the extensive territory to be covered, some plants have been identified only to genus or tentatively to species. Another reason for some uncertain identifications was immaturity of plants at the time they were seen.

General Findings

Positive or probable identifications to the species level were made for 525 vascular plant species. Another 14 were identified to the genus level. Of these 539 different plants, only 18% were found to be "alien" species, not native to this area. Most of those have been introduced intentionally or accidentally from Europe or Asia. A few species, such as black-eyed susan and giant reed, are native to other parts of the United States, but not to this region. The relatively low proportion of alien species is probably related to the selection of observation points, most of which are in the less thickly settled parts of town. Areas like the Mink Brook Nature Preserve and Mink Brook West trails, which are near downtown Hanover and are surrounded by residential areas, have relatively more alien species and greater populations of the invasive ones.

More than a quarter of the alien species, or 5% of all species identified, fall in the category of "invasive" or "potentially invasive." These problem species are discussed below. Five percent of species are rare, threatened, or endangered, and another 4% are uncommon.

Rare Species

The New Hampshire Natural Heritage Inventory (NHNHI) has records of 39 threatened or endangered species that have been reported in Hanover. Most of the records of historic finds are too imprecise to be of much use in finding current populations, if they still exist. Many are based on herbarium samples collected in the late 1800's or early 1900's, often giving only "Hanover" as the location, and many of the species have not been reported again since their initial collection. Nevertheless, 14 of the rare species known to have occurred in Hanover historically were found during this study. All of the rare species that had been reported within the last 20 years were found, as well as 10 others. Some were found at more than one site, for a total of 33 occurrences. It is likely that eight of these occurrences are previously known populations, although some of the records are too vague to be sure.

In addition to the rare species known to have occurred in Hanover sometime in the past, 11 "new" rare species were found during the 1999-2000 field season. Photos or specimens were obtained for all but two of the "new" rare species, and rare plant reports will be filed with the

Natural Heritage office.

Seven of the new finds are State-listed threatened species, although wild millet (Milium effusum) and variegated scouring rush (Equisetum variegatum) may be down-listed to "State Watch" when the State Tracking List is revised. Three others are State-listed endangered species: LeConte's violet (Viola affinis), lesser panicled sedge (Carex diandra), and granular sedge (Carex granularis).

The remaining "new" find is quite exciting. Giant pinedrops (Pterospora andromedea) was listed as "State extirpated" because it had not been reported in New Hampshire for close to one hundred years. The Hanover population of pinedrops, although perhaps consisting of only about 15 plants, is definitely the largest known population of pinedrops in New England. (The exact number of plants is difficult to determine because an individual may bloom sporadically, taking a year or more off before sending up another flowering stem.)

Thirty-six occurrences of six species that are candidates for listing on a proposed "State Watch List" were found. In fact, one of them, wild ginger (Asarum canadensis), was found at so many sites (20) as to call into question the necessity of putting it on the watch list. Another Watch List species, mayapple (Podophyllum peltatum), which occurs in two patches at the Tanzi Tract, could be a garden escape if it occurs in someone's backyard at the top of the slope, but it appears to be growing in the exact sort of conditions and with the same associated species as it does in New York State. It would be useful and instructive to approach the landowners at the top of the slope to try to determine whether the population is natural or introduced.

Fifty-eight occurrences of 21 uncommon species were observed as well. Some of these species may be rare enough to deserve to be on the tracking list, but more information about them is needed before such a decision can be made.