

# **CITY OF BERLIN, NEW HAMPSHIRE**

## **NATURAL RESOURCES INVENTORY** October 2005



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## INTRODUCTION AND OBJECTIVES

The City of Berlin, New Hampshire is the northern most city in the state and contains approximately 61.5 square miles (39,360 acres) of land and 0.7 square miles (448 acres) of inland waters. There were 73 residents in Berlin when the first census was taken in 1830. The population had grown to 16,615 residents according to the 1950 census but dropped to 10,331 by 2000, mostly due to the temporary closing of the paper mill, the city's largest employer. Berlin had a population of 10,122 according to the 2003 census and is slowly rebounding today through alternative economic ventures including increased tourism. Berlin also remains a strong industrial region, with the paper mill still the largest employer, though much reduced from its former status.

The Androscoggin River runs north to south through the eastern side of the City and is historic and scenic with numerous bunks and stone piers constructed for log and later pulp drives, storage and diversion into the paper mill. At one point in time, the Androscoggin was heavily polluted with industrial waste and human sewage, but water quality currently continues to improve, and the river is now used for numerous recreational purposes.

Berlin contains a wide range of ecological habitats including some exemplary communities such as terrestrial red oak – pine rocky ridge, palustrine herbaceous riverbank/floodplain, kettle hole bog system, and Northern white cedar seepage forest. Berlin is comprised of unusually large areas of exposed and shallow ledge. Co-occurring in the City are the Upper Ammonoosuc River headwaters, Israel River Headwaters, and the Middle Androscoggin River, numerous industrial and commercial businesses, the Berlin Industrial Park, and some rare or endangered animal and plant species. Berlin also contains the villages or place names of Cascade and Berlin Mills. Berlin contains several open water bodies, perennial streams, large wetland complexes, and uplands with numerous rock outcrop peaks offering spectacular views. Some of the hills in Berlin include Cates Hill, Mount Forest Hill and Overlook, Mount Jasper, and Jericho Mountain. Many scenic vistas and roads exist throughout the City. Approximately 41% of Berlin is White Mountain National Forest land. The WMNF land is contiguous throughout the eastern end of Berlin providing protection from development for over one third of the City.

The City of Berlin is a unique New Hampshire community that has progressed through the agricultural, industrial, and current eras. Presently, forestry and forestry industry is the main economy (with a long historical record), followed by retail, and tourism. Except for hobby farms, farming today is all but non-existent.



A rich producing hayfield along the Androscoggin River in Berlin

As is true of many communities of its size, Berlin has a municipal Drinking Water System and Sewerage Disposal System for the downtown area which meets Environmental Protection Agency regulations within the Clean Water Act. With its stratified drift aquifers found mainly along the Androscoggin, Upper Ammonoosuc, and Upper Connecticut Rivers the City recognizes a need to become more proactive in wanting to sustain natural resources, especially water quality. As with many communities, development and transportation corridors tend to follow along the rivers and valleys with flatter topography.

This project provides a base Natural Resource Inventory with digital data that can be integrated with other available and future data. For example, data from this project is compatible with existing GIS data from other projects such as the Berlin GIS and parcel data.

One of the goals of this project is to provide inventory, management, and planning tools for the City by incorporation into the Master Plan. Another goal of the project is to integrate all existing data for Berlin, with data created and field verified from this project. This produces a seamless comprehensive town-wide composite, and provides an educational and planning tool, as well as promotes conservation of riparian habitat, wetlands, and unique co-existing natural resource features throughout the City.

Measurable objectives of this project include the following:

1. Provide the City of Berlin with the ability to integrate existing GIS coverages with those currently under development, and future GIS data, in a compatible format stored and retrievable in one comprehensive database
2. Incorporate natural resources, scenic vistas, riparian buffers and other related elements into the Master Plan for comprehensive planning
3. Increase awareness of the values of the City including scenic view areas, recreation areas, riparian buffer habitat, and wetlands with associated wildlife habitat through a public presentation and discussion



## Natural Resource Inventory for Berlin, NH

4. Ability for the City to provide hardcopy printouts of spatial data as requested or needed
5. Ability of the City to continually build upon and update the digital database

### METHODOLOGY

Berlin's City Planner, Pamela LaFlamme, assisted Watershed to Wildlife, Inc. (WTW) by providing general information, existing data and maps, and additional sites for field verification and documentation within the City. James Steele of North Country Council performed GIS analysis of existing data and data layers created by WTW. North Country Council, regional planning commission, partnered with WTW in a contractual arrangement for technical assistance, and to integrate the data to create a Natural Resource Inventory for the City. Throughout the project WTW communicated with North Country Council periodically to give updates of the work as it progressed.

#### ***Field Work***

Fieldwork was conducted to get an overall view of Berlin with a focus on previously identified target areas. This work included inventories and assessments on several wetland complexes, beaver ponds, and floodplain habitat throughout the City, as well as higher elevation uplands. In some cases Class VI roads and established trails were followed, while in other cases compass based orienteering and topographic maps were used. GPS data were collected at points of interest including monuments, brook crossings, vernal pool locations, dense softwood stands, and perennial stream confluences with rivers. In addition, photographs were taken with a digital camera along points of interest throughout the City. During fieldwork sessions, any unique habitat co-occurrences were noted and located on a map. Observed invasive plant species were also documented. All data belongs to the City and was delivered on CD-ROM(s) and hardcopy format where appropriate.

#### ***Gather Existing Digital Data***

Existing maps and data for the City of Berlin were collected. The following table shows which maps were obtained, their scale, and the national mapping standard accuracy measure. Since many decisions are based on parcels as they relate to rivers, roads, trails, ponds, wetlands and other features, it is important to point out the working accuracies of these data sources. Combining these sources in various overlays provides an excellent overview and planning tool but does not replace the need to perform site-specific investigations for many developmental requests. Please refer to the table below to better understand some of these accuracy issues.

#### **Accuracies of Existing Maps**

<b>Data</b>	<b>Source</b>	<b>Ratio</b>	<b>Scale</b>	<b>National Mapping Standard Accuracy</b>
1992, 1998, and 2003 DOQ	GRANIT -.sid version	1:5,000	1" = 416.7'	Acceptable accuracy within 12.48 feet
Topographic	GRANIT	1:24,000	1" = 2,000'	Acceptable accuracy

## Natural Resource Inventory for Berlin, NH

<b>Data</b>	<b>Source</b>	<b>Ratio</b>	<b>Scale</b>	<b>National Mapping Standard Accuracy</b>
Maps (DRGs)				within 60 feet
Roads and Trails, Power Lines, Railroads, Hydrology, Conservation lands, and NHB Data	GRANIT	1:24,000	1" = 2,000'	Acceptable accuracy within 60 feet
Soils	NRCS	1:20,000	1" = 1,667'	Acceptable accuracy within 50 feet
Geology & Aquifers	USGS & NH-DES	1:24,000	1" = 1,667'	Acceptable accuracy within 60 feet
National Wetland Inventory	U.S. Fish and Wildlife Service	1:24,000	1" = 2,000'	Acceptable accuracy within 60 feet
Forested Lands	Landsat Thematic Mapper	1:100,000	1" = 8,333'	Acceptable accuracy within 240'
GPS Points	Garmin III plus	N/A	N/A	Generally within 30' but dependent upon satellite availability, PDOP, refraction, and topology.

### ***Compile Existing Data into Arcview and ArcGIS***

GIS analyses were conducted by North Country Council with assistance from WTW. Digital data was gathered from GRANIT, Natural Resource Conservation Service (NRCS), NH-DES, the US Fish and Wildlife Service, Berlin GIS and Parcel data. GRANIT data includes the following:

1. DOQs – Aerial photography
2. Topographic maps
3. Digital Elevation Information
4. Hydrology (rivers, streams, lakes and ponds)
5. Roads and trails
6. Power lines and rail roads
7. Conservation lands
8. National Wetlands Inventory
9. Soil Information
10. Aquifers, and Subwatersheds
11. Geology

Existing available maps were then integrated using Arcview and ArcGIS software. Using the 1998 and 1992 Digital Orthographic Quadrants (DOQ), USDA 2003 aerial photography, topographic maps, and soils maps, features were digitized and overlaid onto a base map. These include: permanent openings, and dense softwood stands. Potentially significant wildlife habitat areas were noted.

Wetlands were reviewed and analyzed using the DOQ, National Wetland Inventory (NWI) and NRCS soils maps (displaying hydric soil map units). New Hampshire requires that three parameters be met for classification as a jurisdictional wetland: the presence of hydric soil; sufficient hydrology; and hydrophytic vegetation. When soils maps alone are used, they could potentially over-estimate the number of wetlands throughout the City. This is particularly true given that up to 35% of a soil classification can be inclusions (for example, upland areas within NRCS hydric soil units or wetland areas within NRCS upland units). On the other hand, examining the DOQs alone would under-represent the number of wetlands, because only open water, emergent, and scrub-shrub wetlands are easily identified. Forested wetlands are often missed using aerial photography alone. Some types of wetland delineations require extensive fieldwork beyond the scope of this project. Despite differences and potential errors, data provided from these sources are important tools, and can be built-upon in future studies.

Prime farmland, farmland of statewide importance, and farmland of local importance throughout Berlin were determined using the NRCS soils map data. Data was displayed in Arc View and queried so only those soils classified as important farmland was displayed in the Town. Much of the prime farmland, additional farmland of statewide importance and some of the additional farmland of local importance are now used for crops (including hayland). Land used for pasture, woodland, recreation, or land uses other than urban, built-up or disturbed areas will still qualify as prime farmland, additional farmland of statewide importance, or additional farmland of local importance. The rationale for this approach is that land not already committed to irreversible (urban) uses is still available for cropping. Three categories of important farmlands have been described by the NRCS and they are:

1. Prime Farmland as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It maybe cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained yield of crops in an economic manner. These soils are generally flat and free of stones.
2. Farmland soils of statewide importance are lands, in addition to prime farmland, that are of statewide importance for the production of food, fiber, forage and oilseed crops. Criteria used to define this agricultural land were determined by State and local agencies in New Hampshire. The soils on the list are important to agriculture in New Hampshire, yet they exhibit some properties that exclude them from prime farmland. These soils can be farmed satisfactorily by greater inputs of fertilizer, soils amendments and erosion control practices than those necessary for prime agricultural farmland. They produce fair to good crop yields when managed properly.
3. Farmland of local importance is land, in addition to prime and statewide farmland, that is of local importance for the production of food, fiber, forage and oilseed crops. The criteria used to define this farmland were determined by local agencies in Coos County. Relative values from 100 to 0 were assigned to each of the county's soils based on each soil's potential to grow corn silage or grass-legume hay. The local agencies then determined that soils with relative value of 54 or greater would qualify as farmland of local importance.

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Permanent openings (areas dominated by grasses, forbs, brambles, or shrubs) were digitized from the DOQs after field verification. The regions digitized include only those openings managed as permanent opening habitat. They do not include clear-cuts where the intent is for timber harvesting and regeneration for future logging. Dense softwood (or conifer) cover areas were also digitized from the DOQs. These areas have been recognized as significant wildlife habitat and could be deer and moose wintering areas. Steep slopes were determined using the NRCS soils maps. Data was displayed in Arc View and queried so only those soils map units with 15% slope and greater were displayed in Arc View.

North Country Council will create maps at the end of this project with the features described above. All information gathered, compiled, and mapped for this report was delivered to the City of Berlin in digital format.

### ***Public Information Workshop***

At the completion of the fieldwork, and GIS analyses for the natural resources, a public information meeting will be held to explain results from the work. The goal of this meeting is to increase public awareness of the importance of the natural resource inventory including; scenic/recreation areas, riparian habitat, wetlands, and associated wildlife habitat. In addition, work done from this project was displayed for public viewing at the meeting.



## RESULTS

### ***Rivers and Large Waterbodies***

The Androscoggin River flows for approximately 32,215 feet or 6.1 miles through the eastern side of the City along Route 16. Along this stretch there are numerous log and pulp bunks that were constructed of stone and logs (some with large metal pins and chains that still remain today), used historically when the river was used for log and pulpwood drives. The present paper mill in downtown Berlin abuts the Androscoggin River for approximately one mile. There are 5 dams across the Androscoggin River as it flows through Berlin, with numerous dams to the north and south of Berlin that greatly impact the river and its former natural flow.



A section of the Androscoggin River with good vegetative buffers.  
(Note the log/pulpwood bunker constructed in the middle of the river.)

The Dead River flows for approximately 17,300 feet or 3.3 miles through Berlin in more of a diagonal north to south direction along Route 110. Though a much smaller flowage in volume, steepness and energy than the Androscoggin River, the Dead River has a wide floodplain which provides much riparian habitat and adjacent large wetland complexes. The Dead River confluent with the Androscoggin River just south of the Routes 110 and 16 intersection which also serves as Berlin's Main Street.



An example of the Dead River's wide floodplain and modest slope in Berlin

The Upper Ammonoosuc River is also located in Berlin and flows for approximately 32,852 feet or 6.2 miles in a west to east direction and then swings northerly into the abutting Town of Milan. Most of the Upper Ammonoosuc River flows through the WMNF and has relatively steep slopes.

A segment of the North Branch of the Upper Ammonoosuc River is also located in Berlin, flowing for approximately 7,541 feet or 1.4 miles, in a west to east direction that swings to a northerly direction out of Head Pond and into Milan. Protecting the biological diversity and scenic values along these rivers is a priority for the City of Berlin. An excellent example of the attraction and value of such rivers to a community is the Northern Heritage Park developed along the Androscoggin River in the northern section of the City's Main Street area. Bateaux, kayaks, and canoes are often used as recreational devices for the Public to enjoy the river. The abundance of wildlife sign observed during this study along these rivers and adjacent buffers indicates the importance of maintaining the quality of these areas.

With the exception of the area where the paper mill abuts the Androscoggin River, there are mostly vegetative buffers, though narrow, along Route 16 in places that help control erosion and road runoff to varying degrees. There are a few other areas of concern where little to no buffers exist and in some cases, impervious surfaces are located along the riverbank. As future development occurs along the floodplain, careful planning, maintenance of riparian buffers, and stormwater runoff control will be essential.

There are numerous small streams and brooks throughout the City of Berlin, such as Cold Brook, Stony Brook, Spruce Brook, Refuge Brook, Brandy Brook, Spring Brook, Number 9 Brook, West Brook, One Mile Brook, Bend Brook, Jericho Brook, Cascade Alpine Brook, Bean Brook, and Horne Brook to name some, with several unnamed drainages. The flow for most of these streams and brooks is generally in a west to east direction towards the Dead and Androscoggin rivers, but there are exceptions to this.

Jericho Lake, Head Pond, York Pond, and Godfrey Dam, and numerous smaller unnamed ponds are found in Berlin. All ponds have associated wetland complexes, some of



them covering very large areas. These extensive networks of wetlands contain excellent wildlife habitat. Head Pond, Jericho Lake, and the Godfrey Dam have some degree of protection from future development as they are over 10 acres in size and classified as Public Waters subject to the Comprehensive Shoreland Protection Program. Jericho Lake is also under conservation easement through the State of NH. York Pond is in the WMNF and is therefore protected from development.

All water bodies offer recreational and wildlife value for Berlin, its immediate abutters, and the entire region. Swimming, kayaking, canoeing, bird-watching, hiking, fishing and hunting are all common occurrences in Berlin. Tourism accounts for a large portion of income for northern New Hampshire and these waterbodies are significant components.



Head Pond

### ***Riparian Habitat***

The rivers and streams in Berlin contain many acres of riparian habitat rich in plant and wildlife species. Within these periodically flooded areas are upland and wetland soil habitats with a multitude of ‘edges’ creating unique opportunities for plant and animal species to thrive. The diverse riparian habitat in Berlin includes scrub-shrub, grassland, meadow, and forest. These areas support numerous songbirds, including ground nesters, raptors, ducks, herons, bank swallows, and many other avian species too numerous to list.

The riparian buffers are adequate for the majority of the floodplain areas, but could use improvements in some areas. Along the Androscoggin River buffers are not adequate generally in areas close to roads, parking lots, and industry with impervious surfaces. Overall,

however, the majority of the riverbanks are well buffered and do not experience erosion problems.

Riparian buffers provide travel corridors containing shelter, food, and birthing places for numerous terrestrial mammals such as beaver, muskrat, river otter, white-tailed deer, moose, black bear, raccoons, skunks, red and gray fox, coyote, weasel, mink and smaller mammals.

Floodplain forests are unique natural communities that occur within floodplain land along river corridors. Their uniqueness and location adjacent to riparian habitat and rivers provide valuable wildlife habitat for breeding birds, spring migratory birds, insect populations, and amphibians. Generally, larger patches of forested floodplains exhibit greater species richness and support greater diversity of wildlife. Migratory and breeding bird populations associated with floodplain forests include downy and hairy woodpeckers, American robins, gray catbirds, warbling vireos, and song sparrows. Hemlock, White Pine, Box Elder, White Cedar, Spruce and Balsam Fir are abundant along the Berlin reaches of four rivers, and are dominant tree species in much of the floodplain. The interwoven root system of these species is important in controlling bank erosion.

Throughout Berlin and New Hampshire red maple swamps are also common examples of forested flood plains. In New Hampshire, red maple swamps are home to such rare species as the marbled salamander. They are the principal forest type used by breeding wood ducks in the northeast. Songbirds (e.g., Canada warbler, veery) and birds of prey (e.g., red-shouldered hawk, barred owl) also have an affinity for red maple swamps. Nearly 50 species of mammals utilize red maple swamps, including black bears, white-tailed deer, moose, and bats.



Good riparian habitat along the Dead River



The City of Berlin has plentiful wildlife, in part due to its riparian habitat areas. The importance of maintaining, and in many cases, increasing these areas cannot be overstated. As development pressures and natural resource management increase, the effect on these areas needs to be carefully weighed a balance found to prevent loss of the functionality of this habitat. It is intended that digital tools such as those produced from this project will assist Berlin in assessing proposed future impacts before they occur. Retaining existing buffers, and promoting the growth of additional riparian buffers are critical to maintain water quality, prevent erosion, improve fisheries habitat and wildlife travel corridors, and minimize flooding.

### **Wetlands**

Wetlands are the core of life for the majority of plant and animal species and contain diverse habitats with numerous edge habitat needed by many species. It is estimated that riparian areas and wetlands are utilized by over 90% of the region's wildlife species and provide the preferred habitat for over 40% of local species. Future trails and observation points overlooking these wetlands provide excellent opportunity for wildlife viewing.

Based on National Wetland Inventory (NWI) data there are approximately 1,983 acres of wetlands in Berlin, (5% of the land mass). Based on NRCS data, which excludes the WMNF land, there are approximately 2,972 acres of hydric soils in Berlin, (12.7% of the land mass). New Hampshire requires three parameters in defining wetlands; hydrophytic vegetation, hydric soils, and hydrology. Although excellent tools, generally NWI data under represents the size and number of wetlands, and NRCS hydric soil data alone over represents the size and number. Field determinations will be necessary to accurately delineate all wetlands in the town. These can be incorporated over time with additional field verification.



Large persistent emergent wetland, bordering a scrub-shrub wetland complex, and then a forested upland located just south of the Berlin/Milan town line. There was sign of several species of wildlife, including beaver at this site (a beaver lodge is hidden among grasses and cattails in this photo).

## Natural Resource Inventory for Berlin, NH

Wetland areas are dynamic and constantly changing. The general trend without severe weather is for wetlands to slowly fill-in over time. The process begins with open water. As time passes, submerged plants appear. Floating-leafed plants, such as water lilies, follow these. Then further emergent plants such as reeds, sedges, and wetland grasses follow. Shrubs such as high bush cranberry (*Viburnum trilobum*), sweet gale (*Myrica gale*), and bog rosemary (*Andromeda glaucophylla*) begin to appear. Heaths such as leatherleaf (*Chamaedaphne calyculata*) and labrador tea (*Ledum groenlandicum*) appear among the shrubs. Trees such as black spruce (*Picea mariana*) and tamarack (*Larix laricina*) then emerge. Balsam fir (*Abies balsamea*), red maple (*Acer rubrum*) and gray birch (*Betula populifolia*) swamps follow the spruce and tamarack. This natural successional process is often referred to as eutrophication.

On the other hand, there are several environmental and human-induced reasons for wetlands to actually increase in size. Some examples of these follow:

- Human development including damming or excavation including the mining of gravel and sand could increase wetland sizes and often create new wetlands.
- Severe weather changes – an increase in rain will increase the wetland area, whereas a drought may diminish the area
- The cyclic movements of beaver as hardwood saplings regenerate in early succession. In Berlin there is abundant sign of beaver activities in most of the wetland complexes, large waterbodies, and streams
- Human activities such as logging and landscape alteration can dredge out wetland areas or increase the amount of runoff into wetlands



This lush wetland contains bog cotton, swamp aster, pitcher plants, and a host of wetland species at Head Pond.



Vernal pools are unique and often isolated wetlands. A vernal pool is a temporary body of water which provides essential breeding habitat for certain reptiles, amphibians, and crustaceans – such as wood turtles, wood frogs, spotted salamanders, and fairy shrimp. They fill annually from precipitation, runoff, and rising groundwater. Vernal pools are usually dry by the middle of summer, making them uninhabitable for fish, and therefore a safer environment for amphibians. Vernal pools vary in size, shape, and location. Vernal pools are common in New Hampshire, and the State recognizes their value as important habitat. Several vernal pools were documented during field work for this NRI, and future studies could easily document additional ones throughout the City.



Vernal pools located near a logging road were inadvertently constructed while ditching for road drainage. Bordering these vernal pools is a large acreage of forest. No obligate species were documented at this time of year (late September), but this site should be revisited next spring.

### ***Permanent Openings***

As is the situation in most all of New Hampshire, the City of Berlin has experienced a loss of working farms. As the percentage of non-developed, permanent openings in New Hampshire has decreased significantly over the past 50 years, the state is encouraging landowners to create or maintain permanent openings as important wildlife habitat. These permanent openings, dominated by grasses, forbs, brambles, or fruiting shrubs, provide necessary habitat for about 22% of New England's wildlife species, and seasonally important

habitat to nearly 70% of species. The eastern bluebird and northern harrier are two examples of species of concern in New Hampshire, which rely on permanent openings.

Permanent openings in general also have the advantage of creating edge habitat. Wherever an open area meets the forest the area of transition will attract the largest diversity of species, both plant and animal. Generally, there will be species adapted to permanent openings, those adapted to forested habitat, and those who specialize in the transition zone area who will frequent these edge habitats.

Approximately 721 acres of land is managed for permanent openings, including agriculture, in Berlin. This is approximately 1.8% of the total town's land area, and is well below the average of 10% openings throughout the State of NH. Most of the larger permanent openings are found along Cates Hill and the Androscoggin River. Often overlooked areas of permanent opening are below the miles of electricity transmission lines that run through most municipalities. Berlin has nearly 7.5 miles of transmission lines traveling mostly in a north-south direction through the eastern end of the City. These areas used to be sprayed with herbicides to kill vegetation. They are now mostly mechanically mulched with excavators known as Brontosaurus: a much better technique for wildlife. Retaining permanent openings will be beneficial to the diversity of wildlife and vegetation throughout the town.

## **Forested Lands**

As with surrounding New Hampshire towns, the City of Berlin contains large acreages of forest. Much of Berlin's land mass has been devoted to forestry, and harvesting has occurred as growth cycles have warranted. Berlin is an exemplary example for the State of NH in its long historical dependence and utilization of forestland which continues to this day. Typical tree species that grow in this location are white pine (*Pinus strobus*), white birch (*Betula papyrifera*), yellow birch (*Betula lutea*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), poplar (*Populus* spp.), white ash (*Fraxinus americana*), eastern hemlock (*Tsuga Canadensis*), red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and tamarack (*Larix laricina*). Northern white cedar (*Thuja occidentalis*) is also prevalent, in some sections of Berlin, especially in some of the Boreal Forest wetlands. Northern white cedar provides particularly dense cover for wildlife, including winter deer yards.

Over 84% of Berlin contains forested habitat. Forested areas include hardwood stands, mixed hardwood and softwood stands, and softwood stands. Most of these forested habitats are mixed hardwood stands of varying age classes. Over, 3,441 acres or 8.65% of Berlin's land area is dense softwood cover. Some of these stands are important deer wintering areas, which cover only about 3% of land base in New Hampshire. For the area to be considered a deer yard two basic elements must be met: (1) Core area identified by concentrations of dense softwoods, and; (2) Mixed hardwood and softwoods adjacent to, or within the core area will provide accessible forage.

Many of the dense softwood stands scattered throughout Berlin are relatively small (10 to 20 acres), however there are a few larger ones ranging from 50 to 200 acres. Many are lowland softwood stands, associated with watercourses and riparian habitat. Most of the larger softwood stands are found in the northern portion of Berlin. A common sight in Berlin's thick softwood stands is moose trails and mineral licks, often found near roadways.





This young moose was observed in a mineral lick (moose wallow) near the Nansen Ski Area.

Even though deer or moose may not use the smaller softwood stands in the winter, many other smaller mammals and birds rely on them. They provide shelter from harsh winter weather by reducing snow accumulation and wind speeds, access to food supplies, and escape from predators.

## **Soils**

The nature of soil has a profound effect on plant growth. Whether it is rich with organic material, very poorly drained, or sandy, will affect the type of vegetation adapted to grow in those conditions. Scientists can learn much about the soil type by examining the vegetation. At the same time, examining the soil will predict the type of vegetation that can grow in the area.

Soil information is critical in making sound land use decisions. By examining soil types and morphology, many predictions are made regarding forest management, erosion potential, and development possibilities. For example, residential development should be located away from areas with unstable soil conditions, high water tables, and slow percolation rates due to constraints for building foundations and septic system placement.

Soil information is also an excellent indicator of critical resource areas such as wetlands, agricultural lands, forestlands, and wildlife habitat. In descriptions of soil types, the NRCS evaluates soil types according to their capacity for agriculture, woodland, community development, recreation, and wildlife habitat.





Berlin contains a variety of soils and parent bedrock materials. Though much of Head Pond contains organic soils, this photo illustrates gravelly, cobbly, sandy soils. Note the horizontal striations on the larger stones in the center of the photograph.

Several factors exert a major influence on soil development. These include climate, time, topography, parent material, biota, and human activities. Studying soil can also lead to an understanding of how that soil was formed. For example, the southern end of Head Pond contains Peacham and Bucksport mucky soils. These soils have been formed by sediment being deposited from past floodwaters, and accreting acidic bog-like conditions. These types of soil are classified as Alluvium (deposited by running water) and Histosols (containing over 50% organics in the upper 32 inches). As another example, soils with a deep, rich top layer (or A horizon), such as the hayfields along the Androscoggin River, indicate that the area has been used for agriculture for many years. Throughout the forested areas of Berlin, spodosol soils continue to develop under the acidic organic litter. These soils take many years to develop identifiable horizons and typically have an albic or “E” horizon just under the organic or “O” horizon. The “E” horizon is generally 1 to 3 inches thick and is described as looking similar to wood ash. The phenomenon is caused by the actions of water and acidic decomposition or fallen needles and leaves stripping off the normal coatings of clay and or iron oxides. The spodosols are relatively young soils.

A parameter sometimes overlooked in soils is that of pH. New Hampshire soils are commonly slightly acidic due to the influence of granite, referencing the term ‘The Granite State’. There are a few areas in Berlin where there are calcareous soils with ‘sweeter’ higher pH due to small pockets of calcium within the granite bedrock. In Berlin they tend to be near

wet areas, often seeps. Such areas often offer opportunities for unique habitat and rare (at least to northern NH) plant life. An abundance of white cedar in an area sometimes suggests higher pH soils.

Arc View compatible shape files of the NRCS soils map and the USGS geologic bedrock of the City of Berlin have been included with the digital data. It is important to recognize that these delineations are limited in detail as they are Category II and III Levels derived from large grid fieldwork done in 1983 and USGS Quadrant maps at 1:24,000 scale. These soil delineations are also limited for site-specific use in that minimum area polygons are three acres in size and can contain up to 35% inclusions of various soils and slopes.

### ***Prime, State and Local Farmland***

As stated in the methodology section, prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It can be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well-managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment. Another factor that influences farmland along the Androscoggin River is the presence of an abundant volume of moving water. The fact that water reacts much more slowly than air to temperature changes provides a mini-climate within the floodplain area, offering cooler temperatures in the extreme heat of summer and warmer temperatures (including the formation of fog) in the cooler fall temperatures extending the growing season.

Throughout the City of Berlin there are only 572 acres (0.9 mi<sup>2</sup>) of land classified as USDA prime and/or statewide importance farmland. This represents less than 2.5% of land base in Berlin. Most of these soil types lie in a band along the Androscoggin River flood plains. Additionally, Berlin has 5,135 acres of farmland classified as local importance. These last soils are mostly located in the Cates Hill area.

Decision makers must be aware of the long term implications of various land use options for the production of food, fiber, forage and oilseed crop, and the trade-offs involved. Actions that put high quality farmland in irreversible uses should be initiated only if those actions are clearly in the public interest.

### ***Stratified-Drift Aquifers***

There are three types of groundwater aquifers: Stratified-drift; till; and bedrock. The basic difference is that stratified drift and till aquifers are composed of unconsolidated glacial deposits (loose earth materials), while bedrock aquifers are solid rock. In stratified drift aquifers, the materials are sorted sand and gravel. In till aquifers, the material is a gravel, sand, silt and clay mixture. In bedrock aquifers, the rock is fractured.

Stratified-drift aquifers are an important source of ground water for commercial, industrial, domestic, and public-water supplies in the State of New Hampshire. Approximately 14% of land surface in the State is underlain with Stratified-drift aquifers. In and around Berlin they consist of stratified, sorted, principally coarse-grained sediments (sands and gravels) deposited by glacial melt-water during the time of deglaciation.

Approximately 3.4 mi<sup>2</sup> (2,147 acres) or about 5.4% of the area of Berlin is underlain

with Stratified-drift Aquifers. These are located primarily along the Androscoggin River and Dead River floodplains, but also found in other areas of the Town such as the Godfrey Dam area in the Upper Ammonoosuc River watershed. Berlin is fortunate to have two developed sources of Drinking Water; the Brown Farm gravel packed well which supplied the City for many years within the Androscoggin River watershed (an is still used for emergency situations as a back up), and the Godfrey Dam impoundment in the Upper Ammonoosuc watershed which currently serves as the primary source for the City.

Wells used by communities and private landowners draw groundwater from aquifers. The stratified-drift aquifers represent further potential groundwater sources for the City of Berlin. These aquifers should be protected to insure their future quality and availability.

## ***Slope***

Slope is the amount of rise or fall in feet for a given horizontal distance. It is expressed in percent. A 15% slope means that for a 100-foot horizontal distance, the rise or fall in height is 15 feet. Slope is one significant aspect of landform, which presents limitations for development. As slopes become steeper, the expense of building increases. Furthermore, increased slope means there is a greater chance of erosion, structural problems, and water pollution problems. In general, slopes greater than 25% are considered too steep to provide adequate sites for structures such as roads, homes, and septic systems. On steep slopes, soils are usually shallower, the volume and velocity of surface water runoff is higher, and the erosion potential is greater than on flatter areas. The consequences of erosion are loss of soil resulting in sedimentation of surface waters and loss of the productive capacity of the land. The NRCS soils maps were used to determine areas with slopes equal to and greater than 15%: areas where development would be restrictive. Approximately 9,518 acres or 40.6% of land throughout Berlin (excluding the White Mountain National Forest) contains slopes that are over 15%. Of that, approximately 2,825 acres or 12.1% contain slopes over 25%. The flat land throughout Berlin is located mostly along and around the Androscoggin River and Dead River floodplains. These flatlands, though, are often associated with flood hazard areas, especially if the water table is high.

A positive aspect of Berlin's steep slopes is the opportunity for panoramic views in numerous locations throughout the Town. Identification and proper planning are important to Berlin to maintain these viewsheds. (Please refer to the section on 'Scenic Resources' in this report).

## ***Rare Species and Exemplary Natural Communities***

The City of Berlin has potential for numerous occurrences of these species and communities due the unique diverse habitats throughout. Based on the NH bedrock geology data, some of these occurrences are due to calcareous soils which are rare, as aforementioned in the 'soils' section of this report. Berlin also has a large amount of exposed rock outcrop which is critical habitat to some plant and animal species. There are some documented plant and bird species occurrences in this area with ongoing studies.

New Hampshire Natural Heritage Bureau documented Natural Communities occurring in Berlin are; Terrestrial Red Oak – piny rocky ridge, Palustrine northern white cedar seepage forest, Palustrine herbaceous riverbank/floodplain, Palustrine kettle hole bog system, and Palustrine medium level fen system.



## Natural Resource Inventory for Berlin, NH

The bald eagle (*Haliaeetus leucocephalus*) is making a comeback in NH and has been documented in Berlin. With abundant lakes and pond over 10 acres in size, the common loon (*Gavia immer*) is also found and documented in Berlin. Other rare bird species documented in Berlin are the common nighthawk (*Chordeiles minor*) and rusty blackbird (*Euphagus carolinus*).



Though not listed as rare, pitcher plants require special conditions to grow and thrive, as this plant is along the south shore of Head Pond. Many more rare species could likely be found with a detailed plant inventories.-

The abundance of steep slopes, forestland, and wetland complexes in Berlin suggest that other plant and animal species exist, but need further investigation and documentation.

Below is a list of rare, threatened, or endangered species documented throughout the City of Berlin. Many of these species have historical occurrences, which mean that they have not been seen for over 20 years. Data was extracted from the New Hampshire Natural Heritage Inventory Bureau.

### New Hampshire Natural Heritage Inventory Rare Species and Exemplary Natural Communities throughout Berlin<sup>1</sup>

Species Name	Listed?		# Locations reported in last 20 years	
	Federal	State	Town	State
<b>NATURAL COMMUNITIES - Terrestrial</b>				
Red oak – pine rocky ridge	-	-	Historical	12
<b>NATURAL COMMUNITIES - Palustrine</b>				
**Herbaceous riverbank/floodplain	-	-	1	3

<sup>1</sup>

# Natural Resource Inventory for Berlin, NH

	Listed?		# Locations reported in last 20 years	
Species Name	Federal	State	Town	State
**Kettle hole bog system	-	-	1	20
***Medium level fen system	-	-	1	61
**Northern white cedar seepage forest	-	-	1	8
<b>PLANTS</b>				
Bilberry ( <i>Vaccinium uliginosum</i> var. <i>alpinum</i> )	-	T	Historical	
Fragrant Fern ( <i>Dryopteris fragrans</i> )	-	T	Historical	13
Leafy-bracted Aster ( <i>Symphyotrichum novi-belgii</i> var. <i>crenifolium</i> )	-	-	Historical	3
Mountain Sweet-cicely ( <i>Osmorhiza chilensis</i> )	-	E	Historical	15
**Neglected Reed Bent-grass ( <i>Calamagrostis stricta</i> var. <i>inexpansa</i> )	-	E	1	7
Smooth Woodsia ( <i>Woodsia glabella</i> )	-	E	Historical	4
<b>VERTEBRATES - Birds</b>				
** Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	T	E	1	16
** Rusty Blackbird ( <i>Euphagus carolinus</i> )	-	W	1	8
**Common Loon ( <i>Gavia immer</i> )	-	T	1	199
**Common Nighthawk ( <i>Chordeiles minor</i> )	-	T	1	10

**Listed?** E = Endangered T = Threatened  
**Flags** \*\*\*\* = Highest importance  
 \*\*\* = Extremely high importance  
 \*\* = Very high importance  
 \* = High importance

These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact Natural Heritage Inventory at (603) 271-3623 to learn more about this or other ways of setting priorities.

New Hampshire is home to more than 500 species of vertebrate animals. Many of these animals live in Berlin and the surrounding towns. The number would be considerably larger if a complete list of invertebrates (insects, crustaceans, clams and snails) were included. About 75 percent are nongame wildlife species - not hunted, fished or trapped. Twenty-one species are endangered and thirteen are threatened in the state. The New Hampshire Fish and Game Department maintains a list of Endangered or Threatened animal species in New Hampshire, which is shown below. Little information is available relative to their occurrence in Berlin, but their habitats, when identified should be protected.



## Natural Resource Inventory for Berlin, NH



Rock outcrop with striped maple, mountain ash, and red oak among other species as part of a 'red oak – pine rocky ridge' found on Forest Hill in Berlin. The adjacent region was recently clear-cut.

### Endangered and Threatened Wildlife in New Hampshire - Effective 04-06-03

#### ENDANGERED

Common Name	Scientific Name
<b>MAMMALS</b>	
Canada lynx	<i>Lynx canadensis</i>
Small-footed bat	<i>Myotis leibii</i>
<b>BIRDS</b>	
Pied-billed grebe	<i>Podilymbus podiceps</i>
Bald eagle*	<i>Haliaeetus leucocephalus</i>
Northern harrier	<i>Circus cyaneus</i>
Golden eagle	<i>Aquila chrysaetos</i>
Peregrin falcon	<i>Falco peregrinus</i>
Piping plover*	<i>Charadrius melodus</i>
Upland sandpiper	<i>Bartramia longicauda</i>
Roseate tern*	<i>Sterna dougallii</i>
Common tern	<i>Sterna hirundo</i>
least tern	<i>Sterna antillarum</i>

## Natural Resource Inventory for Berlin, NH

Common Name	Scientific Name
purple martin	<i>Progne subis</i>
sedge wren	<i>Cistothorus platensis</i>
<b>FISH</b>	
Sunapee trout	<i>Salvelinus alpinus</i>
Shortnose sturgeon*	<i>Acipenser brevirostrum</i>
<b>REPTILES</b>	
Timber rattlesnake	<i>Crotalus horridus</i>
<b>AMPHIBIANS</b>	
Marbled salamander	<i>Ambystoma opacum</i>
<b>INVERTEBRATES</b>	
Dwarf wedge mussel	<i>Alasmidonta heterodon</i>
Brook floater	<i>Alasmidonta varicose</i>
Frosted elfin butterfly	<i>Incisalia irus</i>
Karner blue butterfly*	<i>Lycaeides Melissa samuelis</i>
Persius dusky wing skipper	<i>Erynnis persius persius</i>
Ringed bog hafter dragonfly	<i>Williamsonia lintneri</i>

### THREATENED

Common Name	Scientific Name
<b>MAMMALS</b>	
Pine marten	<i>Martes Americana</i>
<b>BIRDS</b>	
Common loon	<i>Gavia immer</i>
Osprey	<i>Pandion haliaetus</i>
Cooper's hawk	<i>Accipiter cooperii</i>
Arctic tern	<i>Sterna paradisaea</i>
Common nighthawk	<i>Chordeiles minor</i>
Three-toed woodpecker	<i>Picoides tridactylus</i>
Grasshopper sparrow	<i>Ammodramus savannarum</i>
<b>REPTILES</b>	
Eastern hognose snake	<i>Heterodon platyhinus</i>
<b>INVERTEBRATES</b>	
Pine pinion moth	<i>Lithophane lepida lepida</i>
Pine barrens Zanclognatha moth	<i>Zanclognatha Martha</i>
Cobblestone tiger beetle	<i>Cicindela marginipennis</i>

To learn more about threatened or endangered species or unique communities, contact the New Hampshire Natural Heritage Bureau office of NH Division of Forest and Lands for plant species (271-3623), or the Nongame and Endangered Species Program of the NH Fish and Game Department (271-2461).





With the abundance of mature forest and wetlands and rocky outcrops, future studies for rare, endangered, or threatened species seem warranted in Berlin.

## ***Scenic Resources***

The combination of four rivers flowing through Berlin, along with the abundance of rocky outcrops and ledges, provides residents and tourists with many scenic resources. In recent years, development and population growth throughout the state and region have caused people to appreciate the natural scenery northern New Hampshire has to offer. Traveling along the roads and trails throughout Berlin, visitors and residents have panoramic views of mountains, rolling hills, and overlooks of the City's main street. From many vantage points the views include landscape scenery dominated by wetlands or waterbodies surrounded by forest.

Another means to obtain a view of the landscape is from the air. The Berlin Airport is located in Milan. This offers a unique opportunity for Berlin residents and visitors to fly over their city for a birds-eye-view. This is a particularly popular view during the fall foliage season.

The following are some of Berlin's many scenic vista points.

- Cates Hill
- Nansen Riverfront Park
- Head Pond

## Natural Resource Inventory for Berlin, NH

- Jericho Lake State Park
- Northern Heritage Park riverfront
- Several locations on Route 16
- Several locations on Route 110
- Forest Mountain overlook
- Numerous peaks throughout the WMNF

The City of Berlin has designated Cates Hill Road as a Scenic Road.



Panoramic views of Berlin taken from Forest Hill overlook.

### **Conservation Land**

At the time of this study, there are approximately 16,982 acres of conserved or protected land in Berlin. This is 43% of the City's land area. There may be other areas more recently placed into conservation easements, but their exact size and location have not been entered into the GRANIT database at this time. Most of this conserved land is part of the WMNF, which contains nearly 16,367 acres of land (41% of Berlin's land area).

A conservation easement on private land is a property right that can be bought or sold. It allows property owners to put limitations on their property when an easement is sold, or for another person to set limitation upon the property owner when an easement is purchased. There are efforts by landowners in the town to conserve and connect smaller parcels into one larger, contiguous area of land for conservation.



Conservation lands other than the WMNF, listed registered with the State of NH include: the Twitchell Environmental Study area (308.56 acres), Berlin Water Works (22.53 acres), Jericho Lake recreation area (285.09 acres), and the Icegulch Town Forest (< 1 acre).

### ***Invasive Plant Species***

There is an increase in public awareness and concerns about the rapid growth of invasive species in NH and throughout New England, particularly around water bodies and wetlands. Without counting plantings on people's lawns and gardens, only one species was observed and documented during fieldwork for this project; Japanese Knotweed (*Polygonum cuspidatum*). There is an abundance of this species in many areas of Berlin. Though often found along riparian areas, there was no Purple loosestrife (*Lythrum salicaria*) observed during this study, though it should be noted that this was not an exhaustive search for invasive species.



Japanese knotweed was observed in a number of locations, particularly along Routes 16 & 110.

The City of Berlin may want to consider seeking assistance from the Conservation Commission, Androscoggin Watershed Association, IPANE, NEWFS, and other organizations that have begun programs to control or eradicate invasive species.

### ***Habitat Area Summary Table***

The table displayed below is a summary of different habitat areas in acres and square miles.

<b>Habitat Type</b>	<b>Number of Acres</b>	<b>Number of Square Miles</b>	<b>Percentage of Town Land Mass</b>
Berlin Town Boundary	39,805	62.2	100%
WMNF	16,366	25.6	41.1%
Dense Softwood Cover	3,441	5.4	8.6%
Wetland Complexes (from NWI data)	1,983	3.1	5.0%
*Hydric Soils (WMNF excluded)	2,972	4.6	12.7%



## Natural Resource Inventory for Berlin, NH

Stratified Drift Aquifers	2,147	3.4	5.4%
Permanent Opening	721	1.1	1.8%
Prime Farmland	336	0.5	1.4%
Farmland of Statewide Importance	236	0.4	1.1%
Farmland of Local Importance	5,135	8.0	21.9%
*Steep slopes – 15% and greater (WMNF excluded)	9,518	14.9	40.1%
*Steep slopes – 25% and greater (WMNF excluded)	2,824.5	4.4	12.1%
Conservation Lands	16,982	26.5	42.7%

### DISCUSSION – FUTURE APPLICATIONS AND BENEFITS

This project has compiled natural resource data into a digital database in GIS format and produced a written report for use in the City's Master Plan update. It contains a database with a comprehensive, updateable, digital inventory of the entire City. It is also anticipated that efforts from this project will aid in future work and inventories, as well as provide data to guide future development throughout Berlin.

It is anticipated that results from this study will help the City of Berlin in many ways. City-wide zones based on habitat and vegetation can be identified and classified. Data gathered from this work will also assist the Planning and Select Boards and the Conservation Commission in determining possible conflicts for future development. Perhaps the most powerful advantage of this project is that future studies and events can be integrated to build upon this database and the City's existing GIS indefinitely.

Based on results from this study Watershed to Wildlife, Inc. and North Country Council have identified areas for additional work. They include the following:

1. There are numerous wetland complexes adjacent to the four main rivers and their tributaries, including several large ponds and lakes. The importance of wetlands in floodplains cannot be over emphasized. It is hoped that the City will pursue ways to study the functionality and vulnerability of these wetlands, with a long-term goal of prime wetland designations.
2. Based on results from this project, there are numerous softwood stands in Berlin. This suggests that maintaining the existing stands for the benefit of the deer, moose and other wildlife populations is very important.
3. By identifying existing riparian buffers, the City can examine areas where new buffers should be established or where existing ones should be extended and protected. Riparian landowners should be encouraged to retain, enhance, or improve buffers along the riverfronts. Depending on the goals of the landowners, they should be encouraged to grow shrub and tree buffers as wide as possible.

## Natural Resource Inventory for Berlin, NH

4. The potential for a population increase throughout the City makes it wise for landowners to sustainably conserve their land, particularly along the rivers. By taking a proactive approach to deal with future development pressures, the scenic vistas and beauty will remain as impressive (or even better) tomorrow as they are today. Scenic easements are types of conservation easements that make protection of scenic resources possible.
5. It is hoped that Berlin will continue to work with other organizations and agencies throughout the region to share future data as it becomes available. This will avoid an all-to-common problem of separate entities replicating work.

Long-term usages of this project could include, but are not limited to: assisting the City and others in determining “least-impact” sites for telecommunication towers or wind farms; guiding refinement of the Master Plan based on impacts of river corridors; and empowering the City to digitally produce “what-if” scenarios with visual plots for proposed development in the City of Berlin. Furthermore, the City is in a position to request that all future development plans be delivered in digital format, which would build upon the initial database as well as update the tax maps for assessment at little cost to the City.

## **MAPS**