Chapter Seven: Natural Resources

I. OVERVIEW

The Northeast Kingdom is recognized for its diverse wildlife, large undeveloped areas, and vast woodlands. The region's natural resources (depicted in Figure 7.1 on the following page) provide residents and others a variety of benefits. The largest source of revenue in the region is from outdoor recreation, and much of the tourism industry relies on the healthy and scenic environment to remain viable.

Therefore, the natural resources in the Northeast Kingdom have intrinsic scenic and economic values that require careful consideration when making planning decisions. The overarching goal for the region is to balance local economic needs with the protection of the resources that so many of region's residents enjoy and depend upon.

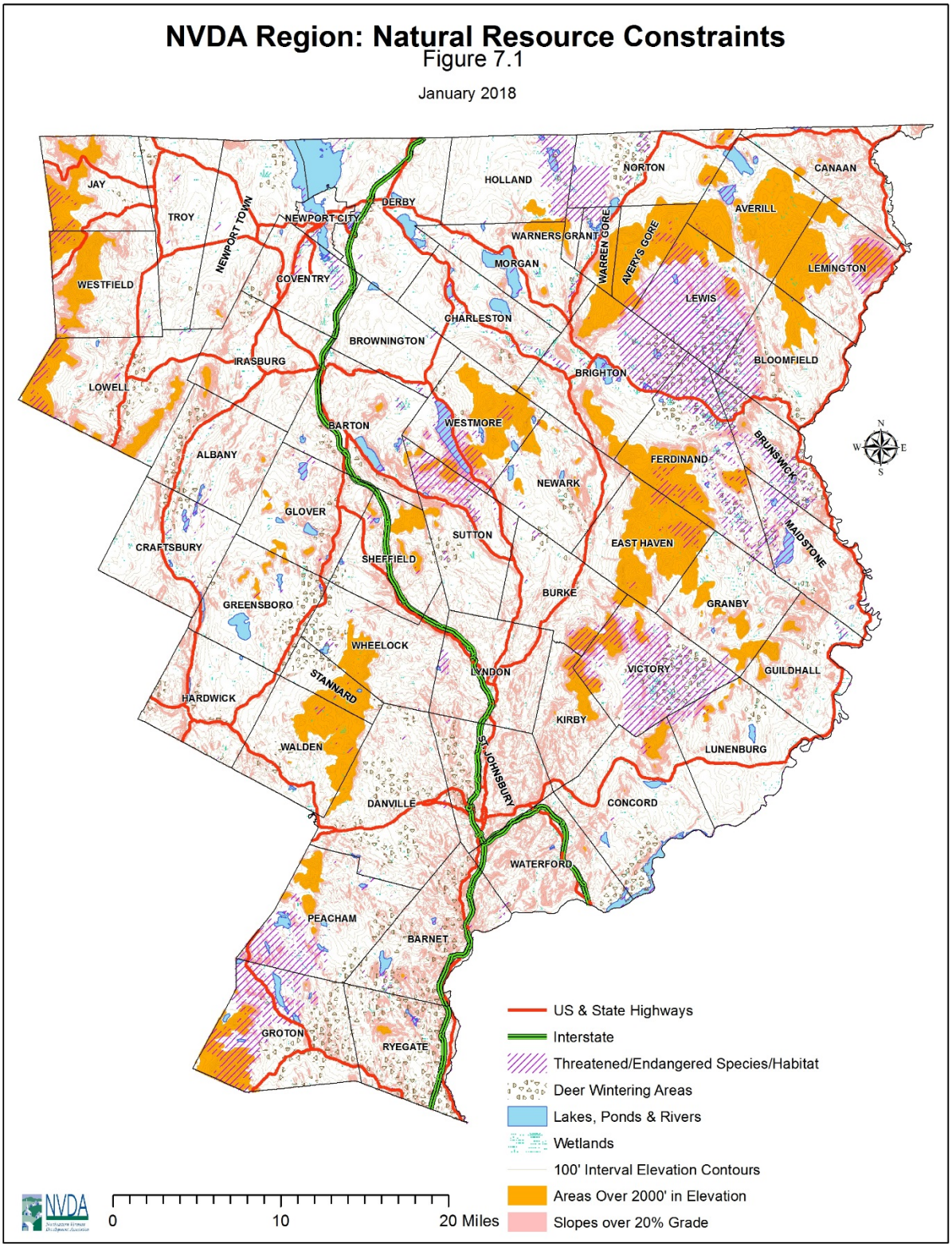
The Northeast Kingdom lies mostly within three physiographic regions:

- *The Northeast Highlands*, an extension of New Hampshire's White Mountains, make up most of Essex County and northern Caledonia County. On average, this area is cooler than the rest of the state. The growing season here averages less than 90 days and snowfall accumulation frequently exceeds 36 inches.
- In much of Orleans County and parts of Caledonian County the topography is primarily *rolling hills* interspersed with occasional plains of fertile agricultural soils. Both of these physiographic regions have extensive glacial deposits.
- The third region is the *Connecticut River Valley*, which extends the length of the region along its eastern border. Level topography and rich alluvial soils well suited for agriculture characterize this physiographic region.

The forests are mainly northern hardwoods with large stands of red spruce and balsam fir. Black spruce and succession species such as white pine and aspen fill recent clearings. The region contains some of the State's largest bog and wetlands complexes, with fabulous stands of red pine, black spruce, hemlock, northern white cedar and hardwoods dispersed throughout. Essex County has more wetlands than any other county in Vermont.

The majority of the region's water drains either north to Quebec as part of the St. Francois River watershed or east and south as part of the Connecticut River watershed. Much of the region's western edge drains north and west as part of the vast Lake Champlain basin. The region's lakes, ponds, streams and rivers are famous for the excellent and diverse fishing opportunities they offer. The more than 130 lakes and ponds found concentrated in the region represent a disproportionately high share of the State's total. This region is home to most of
Vermont's larger, deeper lakes and the legendary 20-30 pound lake trout that have inhabited them since the last ice age.

This combination of forest and water resources creates prime habitat for many wildlife species, and draws many tourist and visitors to the Northeast Kingdom to enjoy them.


NVDA Region: Natural Resource Constraints
Figure 7.1
January 2018
JAY
TROY
NEWPORT TOWN
NEWPORT CITY
DERBY
HOLLAND
NORTON
CANAAN
AVERILL
WARNERS GRANT
WARREN GORE
AVERY'S GORE
LEMINGTON
MORGAN
WESTFIELD
COVENTRY
LEWIS
CHARLESTON
BROWNINGTON
IRASBURG
BRIGHTON
BLOOMFIELD
LOWELL
BARTON
WESTMORE
ALBANY
FERDINAND
BRUNSWICK
NEWARK
GLOVER
SUTTON
EAST HAVEN
MAIDSTONE
CRAFTSBURY
SHEFFIELD
BURKE
GRANBY
GREENSBORO
WHEELOCK
LYNDON
VICTORY
GUILDHALL
STANNARD
HARDWICK
KIRBY
WALDEN
LUNENBURG
ST. JOHNSBURY
DANVILLE
CONCORD
WATERFORD
PEACHAM
BARNET
GROTON
RYEGATE
N
W
E
S
US & State Highways
Interstate
Threatened/Endangered Species/Habitat
Deer Wintering Areas
Lakes, Ponds & Rivers
Wetlands
100' Interval Elevation Contours
Areas Over 2000' in Elevation
Slopes over 20% Grade
NVDA
0
10
20 Miles

I. WATER RESOURCES

Water Quality

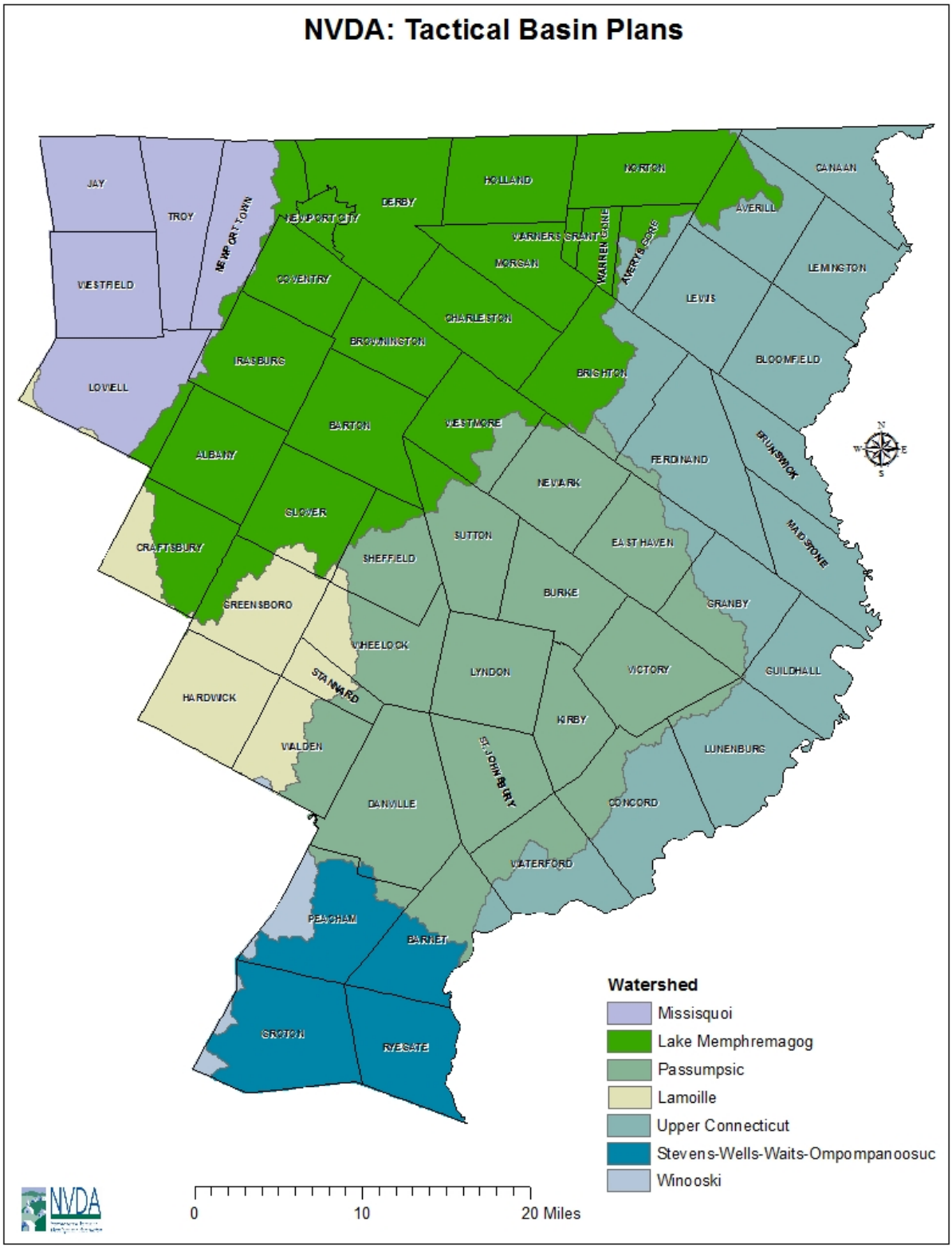
The Vermont Clean Water Act enacted in 2015 the purpose is to manage and regulate the waters of the State so that water quality is improved and not degraded. To authorize and prioritize proactive measures designed to implement the Total Maximum Daily Load or TMDL of phosphorous concentrations in Lake Champlain and Lake Memphremagog and improve water quality across the state. One key step in Vermont's clean water efforts has been bolstering the cooperation and coordination between the Municipalities, Regional Planning Commissions and the Department of Environmental Conservation watershed management division through the Tactical Basin Plans.

A drainage basin is any area of land where precipitation collects and drains off into a common outlet, such as into a river, bay, or other body of water. The drainage basin includes all the surface water from rain runoff, snowmelt, and nearby streams that run downslope towards the shared outlet, as well as the groundwater underneath the earth's surface A watershed is simply the area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or groundwater. There are 17 basins in the State 7 of which are within our region. Basin 6 Missiqoui Bay, Basin 7 Lamiolle River, and Basin 8 Winooski River all drain into Lake Champlain and are subject to the Lake Champlain TMDL. Basin 17 Lake Mempremagog is subject to the Lake Mempremagog TMDL approved by the EPA in 2017. Basin 16 Upper Connecticut River is expected to need a TMDL to regulate Nitrogen concentrations in the future. Basin 15 Passumpsic River is the most central and encompassing basin. Basin 14 Wells-Waits-Ompompanoosic is the southernmost basin. The Vermont Legislature has directed the Vermont DEC to prioritize funds to project with the greatest reduction in phosphorous. In collaboration with Regional Planning Commissions and their member municipalizes DEC is analyzing and recommending projects for funding to reduce phosphorus in the waters of the State.

Joint working groups were formed to address agricultural issues and lake/river water quality monitoring and objectives. The Lake Memphremagog Quebec/Vermont Working Group, established by the governments of Quebec and Vermont in 1989, completed their *Final Report on Managing Lake Memphremagog and its Environment* in 1993. Recommendations were made to reduce point and non-point sources of pollution, and a Vermont Memphremagog Steering Committee was formed in the spring of 1995 to work with its Quebec counterpart to implement priority recommendations.

The Connecticut River Joint Commissions were established by the legislatures of New Hampshire and Vermont and directed to serve in an advisory capacity, promoting public involvement in decisions affecting the Connecticut River and its watershed. Five local river subcommittees operate along the river in Vermont and New Hampshire. The two subcommittees in our region are the Headwaters and the Riverbend. The Connecticut River Conservancy is another citizen-based advocate for the environmental well-being of the Connecticut River. This organization founded in 1952, includes representatives from the four states where the river flows: Vermont, New Hampshire, Massachusetts and Connecticut. This organization conducts research, produces publications, awards small project grants, and initiates programs to generate local activism in the River watershed.

There are also several local Lake Associations involved in watershed activities throughout our region. In the Lake Memphremagog watershed a Stormwater Collaborative has been formed bringing together multiple agencies and municipalities to address water quality degradation in the watershed. Another example is the Lake Parker Association in West Glover, which has done work with watershed assessment, road erosion control, shoreland vegetation enhancement, lay monitoring and invasive aquatic species prevention. These lake associations have created a network for local citizens to help restore the health of their water systems.


NVDA: Tactical Basin Plans
JAY
TROY
NEWPORT TOWN
NEWPORT CITY
DERBY
HOLLAND
NORTON
CANAAN
AVERILL
WARNERS GRANT
WARREN GORE
AVERYS GORE
LEMINGTON
VIESTFIELD
MORGAN
COVENTRY
LEVIS
CHARLESTON
BROWNINGTON
BLOOMFIELD
IRASBURG
BRIGHTON
LOVELL
BARTON
VIESTMORE
FERDINAND
BRUNSWICK
ALBANY
NEWARK
GLOVER
SUTTON
EAST HAVEN
MAIDSTONE
CRAFTSBURY
SHEFFIELD
BURKE
GRANBY
GREENSBORO
WHEELOCK
LYNDON
VICTORY
GUILDHALL
HARDWICK
STANNARD
KIRBY
VALDEN
LUNENBURG
ST JOHNSBURY
DANVILLE
CONCORD
WATERFORD
PEACHAM
BARNET
GROTON
RYEGATE
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W
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S
Watershed
Missisquoi
Lake Memphremagog
Passumpsic
Lamoille
Upper Connecticut
Stevens-Wells-Waits-Ompompanoosuc
Winooski
NVDA
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20 Miles

No comprehensive studies have been completed on the quality of Vermont's groundwater, yet based on the small number of public water supplies throughout the state that have detected any contamination, the Water Quality Department describes Vermont's groundwater as "excellent."

Vermont's classification system for surface water establishes management goals and practical uses. The Water Resources Board classifies all surface waters in Vermont as either Class A or Class B. The October 30, 2014 Water Quality Standards recognize two categories of Class A waters. Class A(1) waters are ecological waters, which are managed to maintain waters in a natural condition. All of the waters above 2,500 feet in elevation are classified A(1). Class A(2) waters are managed as public water supplies and therefore allow moderate water level fluctuation. Class B waters are designated as being either Water Management Type 1, 2, or 3 depending upon their protection and management. An overlay of both Class A and Class B waters is an Outstanding Resource Water (ORW). These waters are designated by the Water Resources Board as having exceptional natural, recreational, cultural, or scenic value. Most waters in the Northeast Kingdom, like in the rest of Vermont, are Class B, which is consistent with State policy to achieve and maintain Class B waters with suitability for swimming, boating, and drinking with treatment as well as for irrigation and livestock watering.

The Water Quality Division maintains a river and lake assessment database listing impaired surface waters. This database is updated every two years with the most recent information and data from a variety of sources. Table 7.1 displays the impaired lakes and rivers within the Northeast Kingdom from this database. Threats listed are addressed at the local, regional, state or federal levels. For instance, agricultural runoff is a local and regional issue, whereas sewage overflows and mercury issues should be addressed across the entire range of management levels.

Table 7.1: State Targeted-Impaired Surface Waters

Water Body	Threat or Impairment
Burgess Brook	Sediment: Asbestos mine tailings erosion/ asbestos fibers
Coburn Brook -- Newport	Agricultural activity and runoff
Mud Creek, from Vt./Que border	Agricultural runoff/nutrients enrichment
Passumpsic River Tremont St. Downstream – 5 miles through St. Johnsbury	E Coli: St. Johnsbury WWTF passes combined sewer overflows
Lower Sleepers River – St. Johnsbury	E Coli: St. Johnsbury WWTF passes combined sewer overflows
Lake Memphremagog – Newport	Phosphorous: Excessive algae growth; nutrient enrichment
Stearns Brook & Tributary – Holland	Nutrients: Agricultural runoff

Source: State of Vermont 303(d) List of Impaired Waters, September 2014

Table 7.2: Local Lake Associations	
Local Associations involved in Watershed Activities:	Programs Conducted by Local Lake Associations:
Lake Memphremagog Watershed	
Averill Lakes Assoc. (Great and Little Averill, Forest Lake) Crystal Lake Reservation Assoc. Daniel's Pond Assoc. Echo Lake Assoc. Elligo Lake Assoc. Friends of Little Hosmer Island Pond Assoc. Lake Parker Assoc. Memphremagog Watershed Assoc. Salem Lake Assoc. Seymour Lake Assoc. Shadow Lake Assoc. Westmore Assoc. (Lake Willoughby, Long Pond, Bald Hill Pond)	Bacteria Monitoring Exotic Species Spread Prevention Lake Assessment Lake Protection Through Town Zoning Land Conservation Landowner Education Lay Monitoring Program Local Advocacy Road Erosion Control Runoff Diversion Shoreland Vegetation Enhancement Testing of Shoreline Septic Systems Watershed Assessment
Lamoille River Watershed	Watershed Management Committee
Greensboro Assoc. (Caspian Lake)	
Passumpsic River Watershed	
Cole's Pond Assoc. Joe's Pond Assoc. Lyford Pond Assoc. South End Newark Pond Assoc.	Basin 14: SEWER Save Everyone's Wells River Passumpsic River Network Passumpsic Valley Land Trust
Stevens River Watershed	CT River Watershed Advisory Commission
Harvey's Lake Assoc.	Barton River CPP Program
Upper Connecticut River Watershed	Lamoille River Anglers Association
Maidstone Lake Assoc. Miles Pond Assoc. Neal Pond Assoc.	Missisquoi River Basin Association
Source: VT Agency of Natural Resources, Water Quality Division, Pamphlet: "Watershed and Lake Associations of Vermont", October 2003	

Surface Waters

The Northeast Kingdom has the largest amount of surface water of any region in Vermont, excluding Lake Champlain. The region is famous for its pristine trout and salmon lakes, and the general diversity of fishery resources. Lakes such Willoughby, Seymour, and Caspian offer high quality trout fishing, while Lake Memphremagog and the Moore Reservoir are known for small-mouth bass. The Clyde, Black, Barton and Willoughby Rivers, primary tributaries to Lake Memphremagog, draw anglers from all over the Northeast for the large leaping rainbow trout, brown trout, and landlocked Atlantic salmon that migrate upstream from the big lake. The region's lakes and rivers serve as significant sources of recreation for residents and visitors, as well as being the source of drinking water for some communities.

Ground Water

Ground water is a critical resource for the rural areas of Vermont. Approximately 60 percent of Vermont's citizens depend upon ground water for drinking and general uses. According to the state Water Quality Division, in many rural communities nearly 100 percent of the public and private drinking water sources are from ground water. Ground water occurs in two general hydrogeologic settings, bedrock and unconsolidated aquifers. Igneous and metamorphic crystalline bedrock along with carbonate bedrock form the bedrock aquifers within the state. Unconsolidated deposits are comprised of glacial till, which is basically sand and gravel.

As ground water moves through these materials, the organic and mineral substances that are dissolved or picked up dictate the quality of water. These water sources often tend to be better quality than surface water because of the leaching process. However, toxic substances can stay with ground water for very long distances. Although groundwater quality is generally good, the resource is nonetheless fragile. Contaminated wells destroy property value. The cost of developing and installing new groundwater sources for public water supply is estimated between $500,000 and $1,000,000 (Water Quality Division, 2000). This cost is prohibitive for many towns in the Northeast Kingdom, making prevention and education critical management tools.
One way to avoid costly groundwater contamination cleanup is to begin a Well Head Protection Program (WHPP). This is addressed in the Water Supply section of the Utilities and Facilities chapter of this document.

Wetlands

Vermont's wetlands are defined as those areas of the state that are inundated by surface or ground water with a frequency sufficient to support plants and animals that depend on saturated or seasonally saturated soil conditions for growth and reproduction. These areas are commonly known as ponds, bogs, fens, marshes, wet meadows, shrub swamps, and wooded swamps. Wetlands often occur in association with lakes, ponds, rivers, and streams, creating transitional areas between dry land and open water. However, wetlands can also be isolated from any obvious connection to surface water. In order to be classified as a wetland under Vermont law, an area must have wetland soils and wetland plants, in addition to at least seasonal water.
Wetland soils are often anaerobic and the plants have adapted to growing in such waterlogged conditions.

Every town in the region contains wetlands that have been designated by the state as significant The Vermont Wetland Rules classify all wetlands into one of three classes. Classes One and Two are considered " significant" and protected under the Vermont Wetland Rules. All three wetland types are protected by Vermont's Act 250. The online Vermont Natural Resources Atlas contains an atlas layer that depicts the three classes of wetlands designated by the State. The information is found on the Watershed Protection layer of the Atlas, under the sublayer "Outstanding Water Resources" and "Wetlands." The Vermont Natural Resources Atlas can be viewed here: http://anrmaps.vermont.gov/websites/anra/

Wetlands provide important ecological functions, including flood and erosion control, and providing habitat for fish and wildlife. They aid in the maintenance of water supplies by trapping nutrients and sediments and recharging groundwater, and they provide recreational and educational opportunities.

Wetlands were once considered wastelands and were thought to be "improved" by draining and filling. As a result, nearly half of Vermont's original wetland resources have been lost, and hundreds of acres are lost annually. Human activities and development continue to encroach upon this finite resource. Agriculture and forestry activities as well as residential, commercial and industrial development all result in wetland alteration. Replacing new wetlands is costly and often impractical, so wetlands preservation is important.

Floodplains

Floodplain maps identify flood hazard areas, defined as those areas that are inundated by the waters of the 100-year flood. Limiting extensive development in flood-prone areas is the best way to prevent flood damage while allowing the floodplain to function as it should. Overdevelopment in flood hazard areas increases risks to human life, property damage, and leads to habitat loss for wildlife species. Preventative measures, such as flood hazard regulations, can reduce these risks. Flood hazard regulations enable property owners to obtain both flood insurance and mortgage loans for property in flood hazard areas. Overdevelopment in floodplains can lead to an increase in intensity and frequency of flooding. This is especially true in areas that are losing wetlands due to development. Wetlands act like sponges-soaking up excess water-and when these are filled in or altered, there is an increased potential for flooding along other parts of the stream banks. Prevention is the best strategy for reducing environmental and human impacts from flooding. Preventative strategies include various planning and zoning tools, open space preservation, and watershed management.

Pollution

The Connecticut River Joint Commissions' *The Watershed Guide* indicates that most aquifer contamination comes from "non-point" sources. This means that contaminants can come from drainage areas some distance away from the point of contamination. Contamination sources include "point" sources such as leaking gasoline storage tanks, failing septic systems, salt storage piles, landfills, storage tanks, or "non-point" sources such as urban and agricultural runoff, and mining operations. Cleanup of bedrock aquifers is costly and often ineffective.

Many farmers use Best Management Practices (BMPs) to reduce the amount of pollution entering waterways. Millions of dollars in state funds have been committed to help farms implement Best Management Practices. These practices are also useful for landowners and towns to avoid polluting waterways. There are BMPs for timber harvesting, construction and development, septic system care, road construction, road salting and dumping, golf courses, site excavation, sand and gravel operations, urban runoff, chemical and petroleum products, land application of bio-solids, and docks, moorings, and marinas. Education and voluntary compliance are essential to mitigating the production of non-point source pollution.

Erosion and Sedimentation

Erosion and discharge of sediment into rivers, lakes, and streams can cause significant damage to aquatic communities. Sediments suspended in the water or deposited on bottoms can adversely affect the growth, feeding, and reproduction of many organisms. Other impacts include loss of topsoil, contamination of water by heavy metals, increased flooding potentials and high municipal costs for ditch, culvert, and drain cleanup. The rate of erosion is influenced by the type of soil, vegetative cover, topography, and climate.

Vermont's extensive network of dirt roads are a cause of erosion and sedimentation which can transport phosphorus, nitrogen, and/or pollutants into waterbodies. Part of the implementation of the VCWA and efforts to meet EPA standards for phosphorus concentrations in Lake Champlain and Lake Memphremagog has been to regulate Vermont's road network as stormwater infrastructure. Beginning in 2018 the Municipal Roads General Permit will regulate all municipal roads in order to reduce phosphorus run off from the municipal road network. The central means of accomplishing this goal is to install best management practices that reduce or eliminate erosion and sedimentation in the road network.

Failing Septic Systems

Failing septic systems can be a major source of pollution. Septic systems fail due to inadequate soils, poor design or construction, inadequate maintenance, or increased use from seasonal to year-round use. Failing septic systems can result in either effluent surfacing on the ground or contamination of ground water. Both situations contaminate water supplies and are hazardous to human health.

II. MINERAL RESOURCES

Soils

In general, soils can be classified as clay, silt or sand. Combinations of one or more of these can create many variations of soil. Soil is influenced by the organic matter that is deposited on the surface and by the organisms that exists within it, in combination with parent materials. Within soils, organisms and fungi provide food for animals and create organic matter for more efficient vegetative production. This vegetative layer, in turn, helps to purify surface water.

The availability of soils suitable for cultivation plays a crucial role in agricultural productivity. Out of the 257,000 acres of potentially primary agricultural soils in the Northeast Kingdom, 133,565 acres were in production in 1992 as compared to 142,832 acres in 1987. It should be noted that less than 8% of these acres are found in Essex County, where most of the terrain and soil composition is better suited for the forestry industry. Despite this fact, there are still important agricultural soils in Essex County along the Connecticut River.

Sand and Gravel

The primary sources of sand and gravel follow streams and waterways or are adjacent to water bodies. During the ice age streams tunneled through ice sheets. These streams allowed deposits of sand and gravel and other debris to build up, creating deposits called eskers. Water flow is easier through these deposits, forming rivers and streams. The Passumpsic River corridor in Caledonia County is one of the largest, continuous eskers in the region, approximately 24 miles in length. Clear, clay-free materials of eskers are excellent for concrete and asphalt aggregates, roadbeds and other construction uses.

Sand and gravel deposition also happened when large glacial ice remnants melted. Much of the remaining sand and gravel was deposited in the valleys along waterways. One of the largest areas of sand and gravel deposits in the region extends from west of Island Pond to the eastern border of the Nulhegan Basin.

Sand and gravel deposits often serve as important areas for groundwater aquifer recharge and filtration. Disturbance of these areas can result in a reduction of their natural ability to retain and filter groundwater. As minerals are extracted, deposits become shallower and less able to filter contaminants from the water. Because of these infiltration concerns, the distances from gravel pits to surface and ground water supplies should be examined.

The prospects for sand and gravel extraction are difficult to measure. While the 1990 Census identified only three sources of sand and gravel extraction activity, the District 7 Act 250 Office has issued over 50 permits in the Northeast Kingdom counties for extraction of sand and gravel. In addition to these, there are small pits like many town sources for local road maintenance not subject to Act 250 standards. The contribution of mineral extraction to the local economy is difficult to ascertain because most extraction is done as part of some other business or is additional income for entrepreneurs. There are active granite quarries in Ryegate and South Ryegate.

Earth resources such as sand and gravel are commonly utilized by local and state road departments, railroads, and commercial paving operations. Other mineral resources like granite, talc, and soapstone have been important for communities in the past, and along with other mineral resources may become useful again.
From a regional perspective, it is good to have mineral resources available locally as transportation costs are reduced and the extraction process may create local employment. For local planning efforts, NVDA encourages towns to identify important mineral resource deposits and develop policies that would minimize potential conflicts between land uses should the extraction of sand, gravel, or other

mineral resources become feasible. A site reclamation or rehabilitation plan shall be developed for any earth extraction activity that requires an Act 250 permit or meets the definition of "substantial regional impact" as defined in this plan.

As mineral resource extractions and their transport have the potential to be damaging to the environment and public infrastructure if carried out improperly, NVDA recommends that mitigation policies consider negative impacts such as:

1. Excessive dust and noise which may result in unreasonable nuisance to neighboring properties and create air quality issues,
2. Improper site management which may lead to excessive soil erosion, soil compaction, water quality impacts, or inadequate site restoration,
3. Site degradation which may result in aesthetically unpleasing conditions in the immediate vicinity of the project and/or the community, and
4. Deterioration of town and state highways or other public infrastructure due to frequent truck traffic.

Many local zoning bylaws contain special provisions designed to minimize the environmental impacts of earth resources extraction, and to assure reclamation or restoration of the site once work is completed. This is desirable. However, there are large sand and gravel pits and former mined sites that pre-date local and state regulations that require rehabilitation. Towns should consider connecting the owners of these pits and the Natural Resource Conservation Service (or other state agencies or organizations) to develop reclamation or rehabilitation plans that will stabilize the sites and minimize impacts. Towns should also identify and consider possible new uses for these old sites in their local plans. Solar facilities and outdoor recreational uses have taken advantage of former pit sites in some communities.

Soil Compaction

Compacted soil, which occurs naturally, as well as through land development and industrial processes, makes it more difficult for water to be absorbed. This creates two changes to the soil formation process. First, water cannot flow through the soils in order to leach contaminated particles. Second, it creates erosion and carries away soil. As discussed under water resources, erosion contributes to flooding, removal of productive topsoil, distribution of chemicals on the soil, and sedimentation of surface water.

III. AIR QUALITY

The air we breathe is less tangible than other resources, but equally important. Air quality is adversely affected by industrial, residential, and transportation emissions. The cyclical patterns of air are intricately connected with all other biological systems where change in one affects the others. Although the Northeast Kingdom is the antithesis of cityscapes where industrial pollution may be visible on a daily basis, there are still sources of air pollution that persist.

Industrial Emissions

Toxins such as sulfur dioxide and nitrogen oxide, emitted into the atmosphere when fossil fuels are burned, contribute to the acidification of our surface waters. The sulfates and nitrates remain in the atmosphere until rain transports them to the earth's surface where they increase the acidity of the soil and water. A study conducted for the Vermont Department of Environmental Conservation's Air Pollution Control Division concluded that 99.9 percent of the pollutants responsible for wet sulfate deposition in Vermont originate from out-of-state industrial sources.

Residential Emissions

The number one generator of air pollution in Vermont is the automobile, and its use continues to grow.

Issues related to automobiles are addressed in the Transportation section of this regional plan. Household emissions include heating systems using wood and fossil fuel, and trash burning. Although municipalities no longer burn trash, there are many households that continue to burn residential wastes. The dioxins, hydrochlorides, carbon monoxide and various carcinogens released into the atmosphere pose risks to our health, the health of the surrounding ecosystems and create obnoxious odors for numerous neighbors.

Light Pollution

As development increases, outdoor lighting may become an issue for some residents. Neighbors of new developments with significant outdoor lighting can be particularly sensitive this. Directing outdoor lighting in new developments to reduce excessive light reduces complaints and allows people to enjoy the night sky.

IV. WILDLIFE HABITATS

All wildlife species have three basic needs for survival: food, water and cover. The spatial relationship of these factors and their availability comprise the habitat of a given species. To promote a diversity of wildlife species, it is important to conserve various habitat types as well as critical areas that support basic needs for some species. For example, white-tailed deer live in a variety of forested and non-forested areas, but specific softwood wintering areas are critical for their survival. The deer have adapted to this habitat for their survival and without it they would not survive the harsh winters in Vermont.

Almost every kind of human development results in the loss of some wildlife habitat. Single developments, even at a large-scale, do not usually destroy a wildlife population. It is the cumulative impact of developments that gradually diminish wildlife habitats. It is difficult to plan for the protection of wildlife habitat because their ranges tend to cross human defined political boundaries. This may require municipalities to work together on habitat protection issues.

The region's large tracts of undeveloped land provide excellent habitat for a variety of species. Both residents and visitors enjoy the variety of wildlife present. A 1996 survey by the Vermont Department of Fish and Wildlife revealed that 242,000 Vermont residents 16 years and older engaged in fishing, hunting, or wildlife- watching activities. In the same year, both resident and nonresidents spent $341 million on wildlife-associated recreation in Vermont. This is a significant portion of our economic base and warrants attention.

Habitat Connectors

Habitat connectors refers to land or water that links larger patches of habitat within a landscape to allow for the movement, migration, and dispersal of animals and plants. They can be a forest block, riparian area, or a specific road crossing that wildlife repeatedly use. Examples include small habitat blocks that serve as stepping stones between core forest, riparian habitat along streams and rivers, strips of forest cover between developed areas, hedgerows, or fencerows. Sizes can range from a fraction of an acre to one or two hundred acres.

Movement of animals from one habitat patch to another is the most common function attributed to habitat connectors. This is true for both wide and small ranged animals. Bobcats and black bears might use connections quite frequently, whereas spotted salamanders might use them only a few nights each spring to move from hibernation sites to breeding pools.

Habitat connectors should be considered at two scales: landscape and local. Landscape scale connectivity is important for connecting populations of wildlife over large areas or within a region. This allows for genetic variability and ensures migration. Examples of a large forest pattern that includes forest blocks and habitat connectors are the connections between the Green Mountains of Vermont and the White Mountains of New Hampshire. The habitat connectors between both mountain ranges allow for diverse and abundant wildlife populations that are able to withstand the effects of disease or other significant impacts. At this large

scale, there is some overlap between forest blocks and habitat connectors. Very small forest blocks of minimal habitat or forestry value can function as connecting habitat. These smaller blocks serve an important connectivity role at a large landscape scale.
Habitat connectivity at the local scale occurs where roads overlap with the network of connected habitat. In some cases, fish and wildlife movement associated with specific road crossing areas is seasonal, as evidenced by salamander spawning migrations in early spring. In other cases, movement could be simple happenstance of an animal curious for new food sources on the other side of the road. Many species of wildlife are selective to specific habitat conditions along roads and are faithful to crossing them in the same place as long as those habitat conditions persist.

Deer Wintering Areas

One of the most prized game species; the white-tailed deer is very adaptable and thrives in this area due to the diversity of landscapes. The home range of white-tailed deer includes many habitats such as edges between fields and forests, wetlands, and broadleaf and coniferous forests. During the winter, it is critical for deer to stay in forested areas sheltered by needle-leaf softwoods such as balsam fir, cedar, spruce, hemlock, and white pine. These evergreens intercept the snow and create a refuge for the deer. Such a canopy offers thermal protection and greater mobility on the ground in deep winter. Although these "wintering areas" may only be a fraction (10%) of their yearly range, they are the single most important factor in determining the carrying capacity of the land. Without such habitat, the deer population would virtually die off in this region.

Black Bear Habitat

Unlike deer wintering habitat, the Department of Fish and Wildlife has not completely mapped the critical black bear habitat in Vermont. Bear require large uninterrupted tracts of forestland that often contain American beech stands, wetlands and high elevations. In other areas, black bear populations have dwindled due to habitat loss resulting from highway and urban development. Unlike the wild turkey, black bear in Vermont were able to escape to high elevations during the 1800s when forested land was scarce. Habitat changes returned the black bear population, some say, to where it was before European settlers arrived. The black bear population in Vermont is now estimated at 3000. Public support, increased awareness of construction impacts on habitat, and private responsibility are necessary to protect the remote and extensive forestland necessary for the bear's survival.

River and Riparian Habitat

Vermont's river corridors provide critical habitat for many species of plants and animals, including some that are classified as endangered or threatened. Along the rivers of the state, there are 27 species included on the Federal Endangered Species List. River and riparian habitats serve important functions for many plants and animals.

A riparian buffer is a unique ecosystem. It provides food and shelter for everything from caddis flies to brook trout to food for mammals and birds such as the river otter and kingfisher. The mink, bald eagle, Louisiana water thrush, dusky salamander, black bear and wood turtle all require streamside woods. These areas provide vital food supplies and safe corridors for game species as well. Natural riparian forest along rivers in Vermont is greatly reduced, removed for farming, development, highway and rail corridors, and landowner access to the river.

Maintaining and repairing riparian buffers is inexpensive and can provide many economic benefits. A municipality will spend more money on bank stabilization, stormwater control and water quality improvements than it would by leaving or replanting riparian vegetation. Riparian buffers, which can eliminate the need for costly riprap, are an effective tool to avoid the costs of bridge collapse, and washed out roads. Farmers sometimes lose land when they clear riparian vegetation to grow crops because

unstable banks can create a situation during floods when the rivers jump their channels and cut a new ones into cropland.

Threatened and Endangered Species

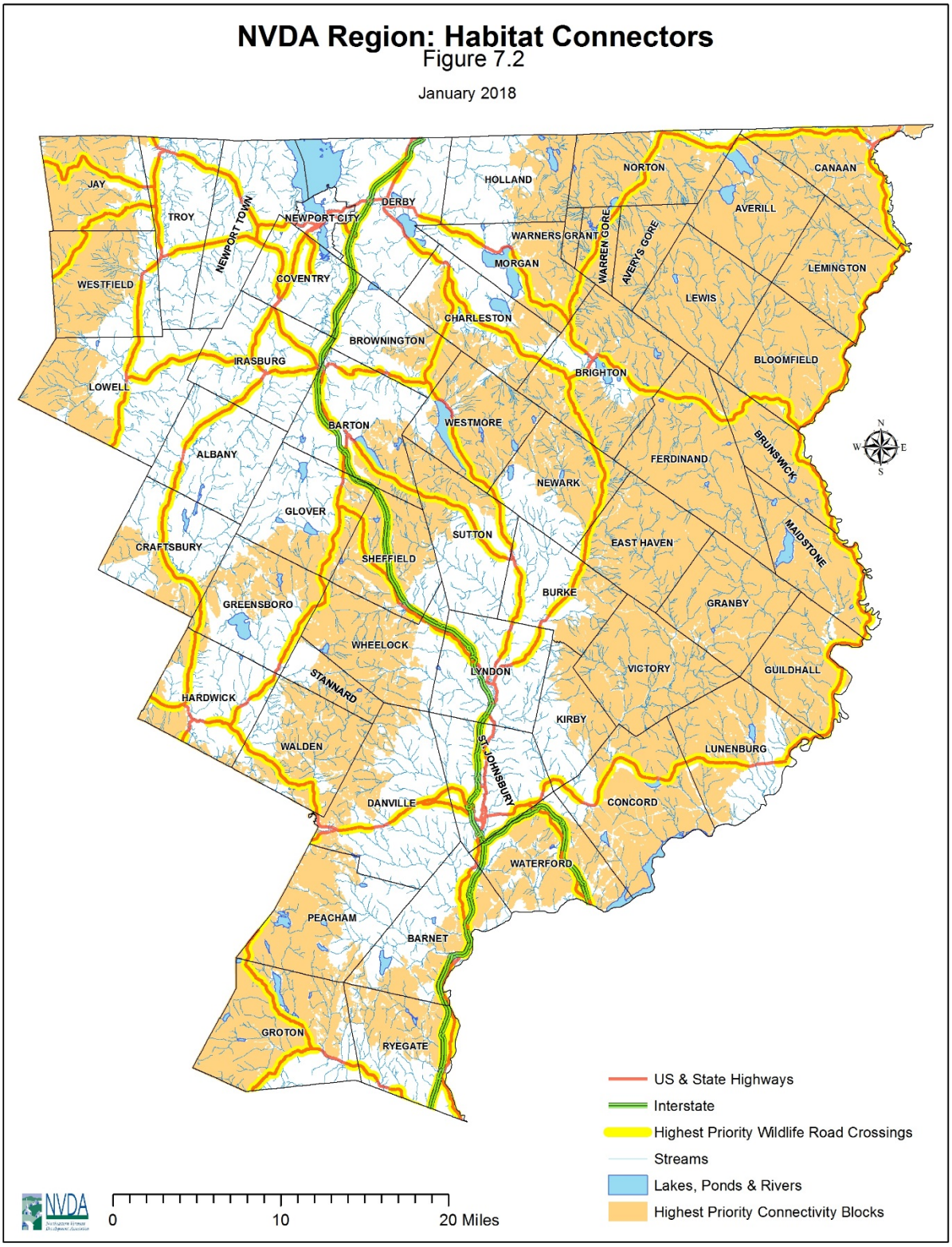
The Endangered Species Listing by the U.S. Fish and Wildlife Service shows that there are six animal species and two plant species in our region whose survival is in question. Threatened species include the Bald Eagle, Canada Lynx, and Puritan Tiger Beetle. Endangered species include the Indiana Bat, Eastern Puma, Dwarf Wedge Mussel, Jesup's Milk-Vetch and the Northeastern Bulrush.

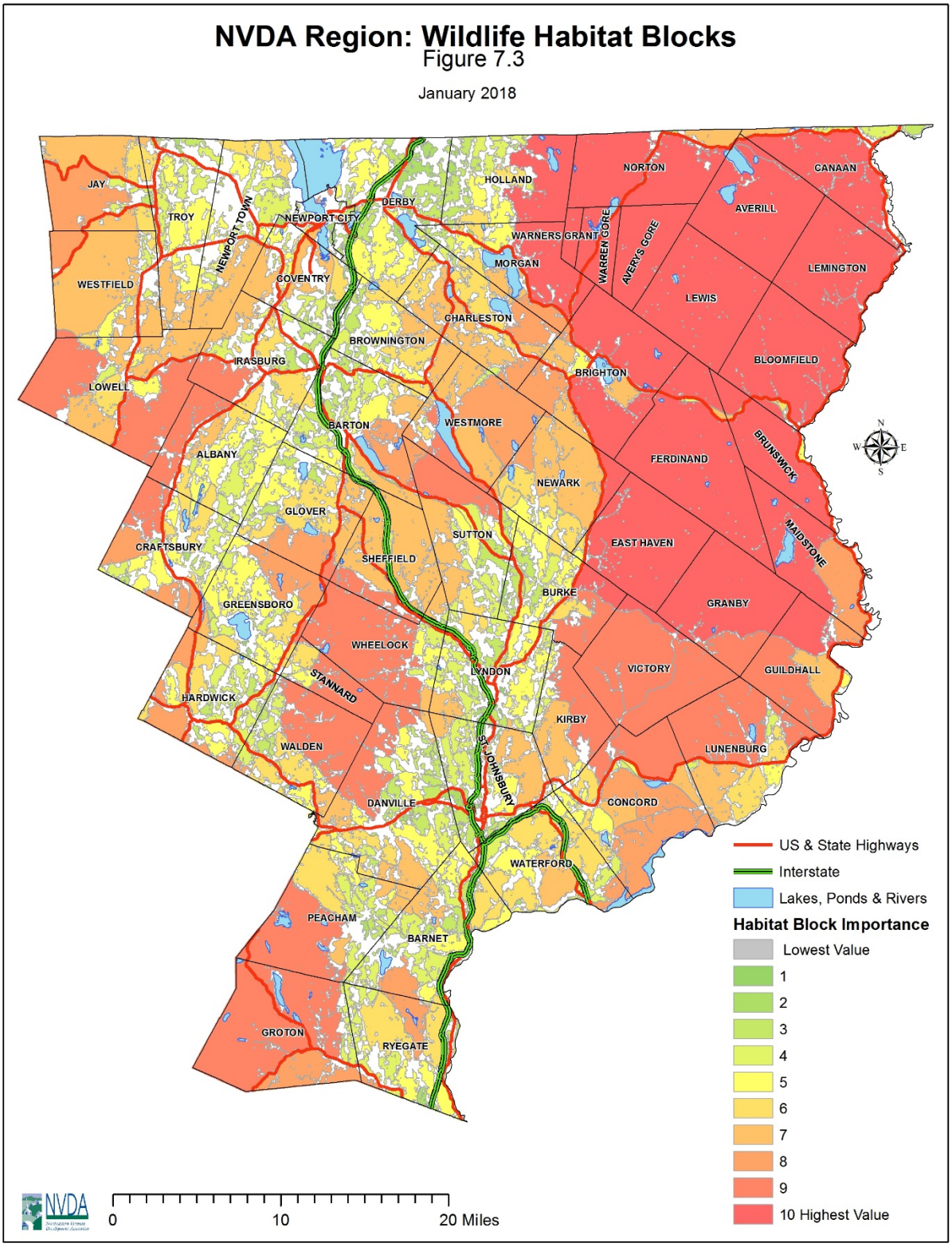
Often the preservation of these threatened and endangered species has more to do with habitat protection than any other factor. A species is considered endangered if it normally occurs in the state, and its continued existence appears to be in jeopardy. A species is threatened if its numbers are significantly declining due to loss of habitat or human disturbance. Habitat loss and degradation is the principle cause of the decline in biological diversity and is the number one factor relating to species endangerment. Human development is the primary cause of habitat loss and degradation.

Non-native Invasive Species

Many non-native species introduced to this region intentionally or otherwise are creating significant problems in both terrestrial and aquatic ecosystems. Because they have been imported here from outside the region, there are no natural predators to control the spread of these non-native species. They often take over an area by out-competing the existing flora or fauna, choking out native species.

Purple Loosestrife and Eurasian Water milfoil are two invasive aquatic plants that currently infest a number o f lakes, ponds, and wetlands in our region. Purple Loosestrife is a wetland perennial that has infested thousands of acres in Vermont and can be found in almost every town in our region. It chokes out the native vegetation and can decrease the food and shelter for native wildlife species. Eurasian Water milfoil has also taken hold in several lakes of our region, including Brownington and Clyde Ponds and Lakes Elligo, Salem, Crystal, Willoughby, and Memphremagog. This freshwater seaweed creates a dense, impenetrable canopy of stems and leaves that consumes large quantities of oxygen, suffocating fish and other creatures. Preventing its expansion to other water bodies through education and controlling it within each lake's boundaries is currently the most effective way to manage it.


NVDA Region: Habitat Connectors
Figure 7.2
January 2018
JAY
TROY
NEWPORT TOWN
NEWPORT CITY
DERBY
HOLLAND
NORTON
CANAAN
AVERILL
WARNERS GRANT
WARREN GORE
AVERY'S GORE
MORGAN
LEMINGTON
WESTFIELD
COVENTRY
LEWIS
CHARLESTON
BROWNINGTON
IRASBURG
BRIGHTON
BLOOMFIELD
LOWELL
BARTON
WESTMORE
ALBANY
FERDINAND
BRUNSWICK
NEWARK
GLOVER
SUTTON
EAST HAVEN
MAIDSTONE
CRAFTSBURY
SHEFFIELD
BURKE
GRANBY
GREENSBORO
WHEELOCK
LYNDON
VICTORY
GUILDHALL
STANNARD
HARDWICK
KIRBY
WALDEN
LUNENBURG
ST. JOHNSBURY
DANVILLE
CONCORD
WATERFORD
PEACHAM
BARNET
GROTON
RYEGATE
N
W
E
S
US & State Highways
Interstate
Highest Priority Wildlife Road Crossings
Streams
Lakes, Ponds & Rivers
Highest Priority Connectivity Blocks
NVDA
0
10
20 Miles


NVDA Region: Wildlife Habitat Blocks
Figure 7.3
January 2018
JAY
TROY
NEWPORT TOWN
NEWPORT CITY
DERBY
HOLLAND
NORTON
CANAAN
AVERILL
WARNERS GRANT
WARREN GORE
AVERY'S GORE
LEMINGTON
MORGAN
WESTFIELD
COVENTRY
LEWIS
CHARLESTON
BROWNINGTON
IRASBURG
BLOOMFIELD
BRIGHTON
LOWELL
BARTON
WESTMORE
ALBANY
FERDINAND
BRUNSWICK
NEWARK
GLOVER
SUTTON
MAIDSTONE
EAST HAVEN
CRAFTSBURY
SHEFFIELD
BURKE
GRANBY
GREENSBORO
WHEELOCK
VICTORY
GUILDHALL
LYNDON
STANNARD
HARDWICK
KIRBY
WALDEN
LUNENBURG
ST. JOHNSBURY
DANVILLE
CONCORD
WATERFORD
PEACHAM
BARNET
GROTON
RYEGATE
N
W
E
S
US & State Highways
Interstate
Lakes, Ponds & Rivers
Habitat Block Importance
Lowest Value
1
2
3
4
5
6
7
8
9
10 Highest Value
NVDA
0
10
20 Miles

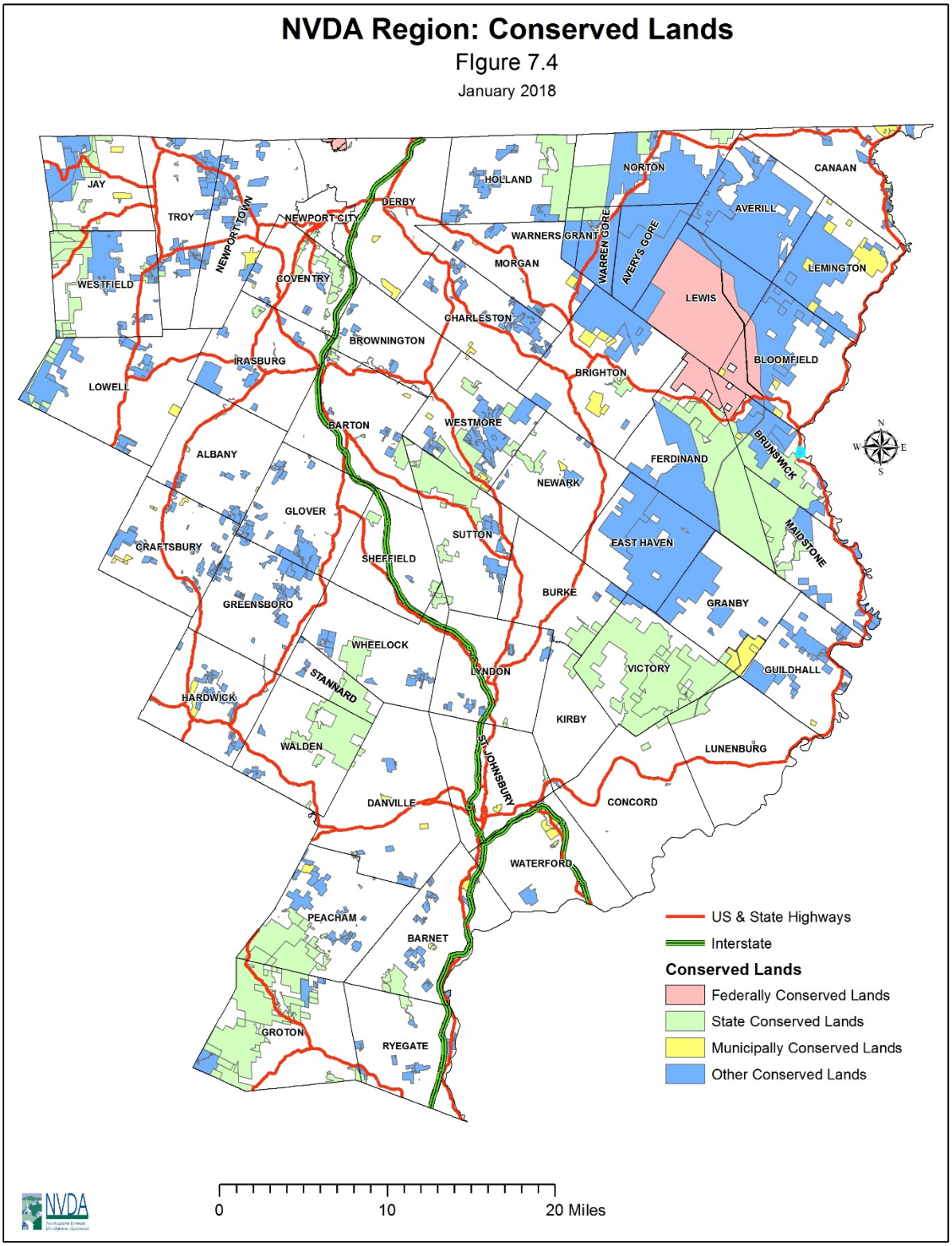
Public Lands

The region contains many conserved public lands. Recently, more than 132,000 acres of remote forestland, primarily in Essex County, was conserved by Vermont's largest land conservation project. Of this, 84,000 acres was resold to Essex Timber Co. LLC, with easements to ensure that these lands are conserved as a working forest for the sustainable production of wood products as well as to maintain public access. In the same transaction, U.S. Fish and Wildlife Service formed the Silvio O. Conte National Wildlife Refuge in the towns of Lewis, Ferdinand, Bloomfield and Brunswick totaling nearly 28,000 acres. The 23,000 acre West Mountain Wildlife Management Area was created in this land transfer, as well. The goals of this purchase were to protect public access to the land; conserve and protect biological diversity, wildlife habitat and natural communities; and conduct sustainable management and utilization of forest products.

Table 7.3: Public Lands in the NEK

Town	Parcel Name	Acres
Averill	Averill Mountain WMA	510
Newark	Bald Hill Wildlife Management Area	932
Troy	Big Falls SP	16
Holland	Bill Sladyk WMA	9,496
Norton	Black Turn Brook SF	593
Brighton	Brighton SP	152
Sutton	Calendar Brook WMA	340
Barton	Crystal Lake SP	16
Burke	Darling State Park	1,997
Newport City	Eagle Point WMA	420
Groton, Peacham	Groton SF	23,706
Burke	Hazens Notch SP	307
Sheffield	Holbrook SP	202
Jay	Jay SF	3,877
Peacham	Levi Pond WMA	260
Jay	Long Trail SF	2,774
Lyndon	Lyndon State Forest	72
Maidstone	Maidstone SF	475
Wheelock, Sheffield	Mathewson SF	795
Groton	Pine Mtn WMA	2,194
Ryegate, Barnet	Roy Mountain WMA	1,590
Westmore	Sentinel Rock SP	330
Coventry, Newport City	South Bay WMA	1,813
Walden, Stannard, Wheelock	Steam Mill Brook	10,421
Victory	Victory Basin WMA	4,970
Victory, Lunenburg	Victory SF	15,997
Barton	Wenlock WMA	1,994
Brunswick, Ferdinand, Maidstone	West Mountain WMA	22,738
Barton	Willoughby Falls WMA	130
Westmore, Sutton	Willoughby SF	7,300

Source: NVDA, 2002


NVDA Region: Conserved Lands
FIgure 7.4
January 2018
JAY
TROY
NEWPORT TOWN
NEWPORT CITY
DERBY
HOLLAND
NORTON
CANAAN
AVERILL
WARNERS GRANT
WARREN GORE
AVERYS GORE
LEMINGTON
MORGAN
WESTFIELD
COVENTRY
LEWIS
CHARLESTON
BROWNINGTON
IRASBURG
BRIGHTON
BLOOMFIELD
LOWELL
BARTON
WESTMORE
ALBANY
FERDINAND
BRUNSWICK
NEWARK
GLOVER
SUTTON
EAST HAVEN
MAIDSTONE
CRAFTSBURY
SHEFFIELD
BURKE
GRANBY
GREENSBORO
WHEELOCK
VICTORY
GUILDHALL
LYNDON
STANNARD
HARDWICK
KIRBY
WALDEN
LUNENBURG
ST. JOHNSBURY
DANVILLE
CONCORD
WATERFORD
PEACHAM
BARNET
GROTON
RYEGATE
US & State Highways
Interstate
Conserved Lands
Federally Conserved Lands
State Conserved Lands
Municipally Conserved Lands
Other Conserved Lands
NVDA
0
10
20 Miles

Open Space

The Northeast Kingdom is composed of rolling hills, farmlands, lakes and rivers, forests, country roads, and compact village centers. These areas combined create an open, picturesque landscape unlike any other. Open space provides not only scenic beauty and wildlife habitat, but is necessary for the numerous outdoor activities enjoyed by the region's residents and visitors, and is key to the agricultural and forestry traditions of the region. The region contains more than 1,300,000 acres of land. Almost 200,000 acres are either publicly owned or have public recreation/access easements. Many recreational activities rely on private landowners allowing access to their properties, so it is the responsibility of users to respect the landowner and their land. Vermont landowner liability law (12 V.S.A. 5793) maintains "an owner shall not be liable for property damage or personal injury sustained by a person who, without consideration, enters or goes upon the owner's land for a recreational use unless the damage or injury is the result of the willful or wanton misconduct of the owner." Still, according to the Vermont Department of Forests, Parks & Recreation, posting of private land in the state doubled in the last decade from approximately 100,000 acres in 1988 to approximately 250,000 acres in1997.

V. Goals and Strategies

NATURAL RESOURCE GOALS

- The overarching goal for the region is to balance local economic needs with the protection of the natural resource that so many of the region's residents enjoy and depend upon.
- The quality and quantity of the region's surface waters should be protected, maintained, and restored.
- The quality and quantity of existing and potential groundwater resources should be protected and improved.
- Significant wetlands within the region should be protected. The region's mineral and soil resources should be used in a manner that will support the sustainable growth and development of the region.
- A consistently high level of air quality should be maintained for the health, safety, and enjoyment of the region's residents and visitors.
- Adequate resource information for the region should be maintained to improve the region's ability to plan for protection of wildlife resources in the area.
- Critical wildlife habitat should be protected.
- The native biodiversity of the region should be maintained, and restored when appropriate.
- Private, public and community interests should be considered in matters affecting local recreation and open space.

NATURAL RESOURCE STRATEGIES

- Provide public education on state and local water quality issues as they relate to local planning and development.
- Discourage inappropriate development in flood hazard areas and floodplains. Support compatible land uses in flood areas, such as agriculture and passive recreation.
- Support the efforts of watershed organizations working in the region.
- Coordinate the region's basin planning efforts with local plans and related activities.
- Encourage and assist communities to identify and protect community water supplies. Education on water conservation and resource protection should accompany these efforts.
- Prevent the degradation of significant wetlands through public education.
- Minimize the negative impacts of mineral and earth resource extraction and processing facilities.
- Support development of new markets and uses for local mineral resources. Encourage the use of locally obtained minerals for building construction and highway construction and maintenance.
- Support efforts to reduce air pollutants generated in the region from the residential, commercial, industrial, and transportation sectors.
- Support broader state and regional efforts to minimize pollutants entering the region from out of state.
- Support local and state efforts that inventory, delineate and map important habitats and wetlands.
- Support local efforts to protect critical wildlife habitat and maintain habitat connectivity.
- Assist interested towns with planning and mapping for the protection of habitats and natural resources.
- Support state and local efforts to mitigate the impacts of the non-native species through ecologically sound methods (e.g. insect control, etc.).
- Support the protection of endangered and threatened native species.
- Maintain and improve the resource stewardship in the area by supporting and advocating for recreation and environmental education opportunities.
- Provide technical support for dark skies initiatives to prevent or minimize light pollution.