Natural Resources Inventory 2012

Bath, New Hampshire

Revised in 2016

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Natural Resources Inventory Committee

A sincere "thank you" to all who volunteered over 400 hours to plan and develop this Natural Resources Inventory for the town of Bath. Your efforts will help guide the conservation of our natural resources for years to come.

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Thank you to Amanda Stone, Frank Mitchell, and Lindsay Webb from Taking Action for Wildlife (TAFW) for guiding us in this process.

Thank you to Dianne Timmins, Andy Schafermeyer, Ben Nugent, and Matt Carpenter from the New Hampshire Fish and Game Department Inland Fisheries Division for helping us learn more about our trout streams and how to protect them.

Thank you to Jordan Barnum for assistance with the design and layout of the NRI report and the Power Point presentation.

What is a Natural Resources Inventory (NRI) and why is it important?

A Natural Resources Inventory (NRI) describes the natural resources and wildlife habitats within a community, explains why they are important, and provides voluntary non-regulatory guidance for their conservation. It includes maps, data, and a report.

The NRI for Bath:

- ✓ Fulfills Natural Resources Goal #3 in the 2007 Master Plan: *to preserve the town's rural character by protecting natural resources and wildlife habitat throughout the town.*
- ✓ Updates the NRI completed in 1988 and 2012.
- ✓ Provides information to the Conservation Commission to respond to subdivision reviews for the Planning Board and to assist with Conservation Planning efforts.

What was the process?

The Taking Action for Wildlife (TAFW) program is a collaboration between the New Hampshire Fish and Game Department (NHF&G) and the University of New Hampshire Cooperative Extension (UNHCE). The program assists communities and landowners in conserving wildlife habitats, especially for species of concern. It provides training and resources, such as the statewide Wildlife Action Plan (WAP) and habitat maps.

The Conservation Commission learned about the program and scheduled an information session for interested people with UNH Cooperative Extension. The NRI committee that resulted had a broad representation of members from town boards, local river advisory committees, landowners, and college and high school interns. The committee members decided the best way to learn about and describe the natural resources of the town was to do the NRI themselves.

The committee attended workshops with UNHCE April/May 2011 to:

- Develop a work plan with a schedule
- Learn how to use the WAP maps and information

The committee met in May 2011 through May 2012 to:

- Decide what information & maps to use
- Review other NRI examples
- Collaborate on writing various sections

Outreach included:

- Presentation by UNHCE County Forester at informational meeting June 2011
- Display at Olde Home Day in August 2011
- Presentation at Church ladies group in September 2011
- Discussion at Ammonoosuc Conservation Trust annual meeting in October 2011
- Presentation at NHACC annual meeting in November 2011
- Article in local papers written by UNHCE County Forester
- Monthly fishing report for NHF&G
- Articles in local newspapers on NRI and the Eastern brook trout survey
- Bath Town Report (Conservation Commission section)
- Presentation at Bath Town Meeting in March 2012
- Reports to local advisory committees

The committee reconvened in 2016 to review and update the 2012 Bath NRI.

Use of the Wildlife Action Plan (WAP) and Habitat Maps

In 2002, the United States Congress passed a law appropriating $80 million in State Wildlife Grants to provide state wildlife agencies with the resources to address the "species in greatest need of conservation", including those species not hunted or fished. To be eligible for these funds, the New Hampshire Wildlife Action Plan was developed in 2005 and revised in 2015. Information gathered in this process included the distribution and abundance of species of wildlife and descriptions with locations of key habitats and community types essential to conservation of those species.

The Wildlife Action Plan includes several tools to assist communities with integrating wildlife habitat conservation into decisions about land use. These tools include detailed descriptions about wildlife species at risk and the habitats on which they depend and Geographic Information Systems (ArcGIS) data and maps. The **Wildlife Habitat Land Cover** and **Ranked Wildlife Habitat by Ecological Condition maps** depict the different habitats in the state, habitat quality, and conservation focus areas. These maps were revised in 2015 as part of the updating of the Wildlife Action plan (WAP).

The NRI committee decided to use this information as the basis for the NRI because:

- The information is current and readily available.
- The committee could receive free technical training through the TAFW program.
- The 2007 Bath Master Plan survey included a goal of protecting wildlife habitat.
- Healthy habitats for vulnerable species provide healthy habitats for many other species, including humans.

Wildlife Habitat Land Cover Map (Revised in 2015)

In the NH Wildlife Action Plan**,** 19 habitat land cover types are identified statewide and all lands and waters correspond to one or more of the habitats described. These habitat types are displayed for each town on a **Wildlife Habitat Land Cover map** produced by the Geographical Information System (ArcGIS) mapping process. This map can be used as an initial planning tool for habitat research, protection, or restoration, but for more definitive work, on ground verification is required.

Ranked Wildlife Habitat by Ecological Condition Map (Revised in 2015)

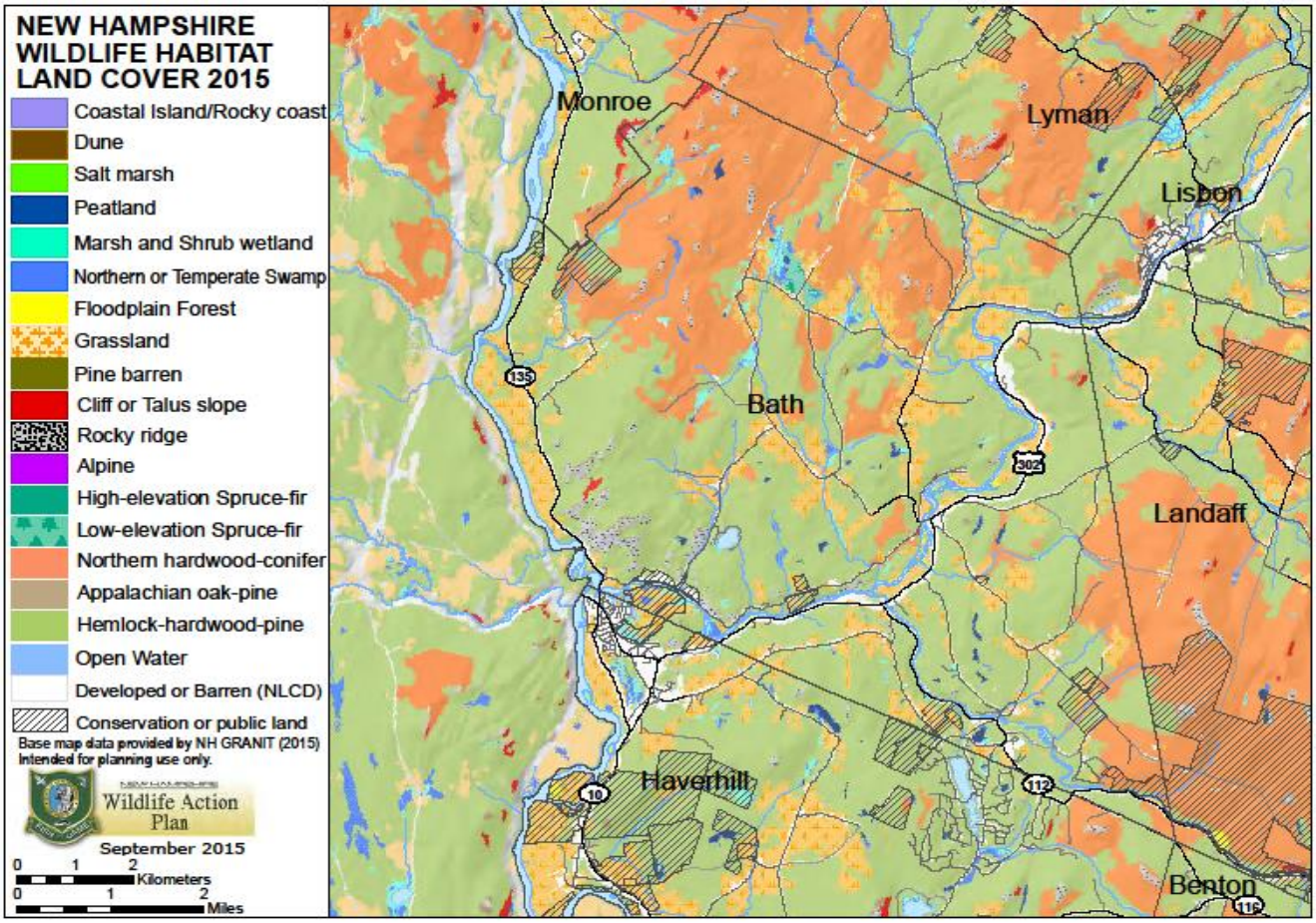
In the NH Wildlife Action Plan, the condition of wildlife habitats statewide was analyzed by ranking the biological, landscape, and human impact factors most affecting each habitat type. Biological factors include rare plant and animal species and overall biodiversity. Landscape factors include size of habitat and how close it is to other patches of that habitat. Human impact factors include density of roads around the habitat, dams, recreational use, and pollution. Different factors were chosen for each particular habitat. For example, hiking trails may reduce the habitat quality in alpine areas but are far less damaging to hemlock-hardwood-pine forests. Since the data was analyzed at a statewide scale, and incorporated many pieces of data in the condition filter, any given town may not have much high-ranking habitat. This does not mean that the town does not have important habitat!!

Copies of these maps are also available at the Bath town office or online at:
http://www.wildlife.state.nh.us/maps/wap.html

Wildlife Habitat Land Cover Types & Ecological Condition

Information for the Wildlife Habitat section was obtained from *Stewardship Series New Hampshire Wildlife Action Plan* brochures and the *New Hampshire Wildlife Action Plan.*

Wildlife Habitat Land Cover Map: Bath has 13 out of the 19 statewide habitat types.



Habitat Land Cover	Acres in Bath	% Total Bath Acres
Hemlock-hardwood-pine	**12,558.63**	**50.88**
Northern hardwood-conifer	**5,612.35**	**22.74**
Grassland	**3,419.76**	**13.85**
Developed or Barren	**1,308.57**	**5.30**
Rocky ridge	**398.31**	**1.61**
Marsh and shrub wetland	**362.28**	**1.47**
Water	**337.60**	**1.37**
Northern/temperate swamp	**317.13**	**1.28**
Floodplain forest	**124.99**	**0.51**
Peatland	**85.18**	**0.35**
Low elevation spruce-fir	**76.95**	**0.31**
Cliff and talus slope	**47.15**	**0.19**
Appalachian oak-pine	**35.36**	**0.14**

General Landowner Management Recommendations for All Habitats:

- Consult a licensed New Hampshire forester before conducting a timber harvest on the property.
- Understand and follow all laws pertaining to the harvesting of trees near wetlands and waterbodies.
- Follow established Best Management Practices (BMPs).
- Harvest timber near wetlands only when the soils are either frozen (winter) or very dry (summer).
- Consider using conservation easements to permanently protect the natural resources of the land.
- Control invasive species. The New England Wildflower Society, UNH Cooperative Extension, N.H. Department of Agriculture and other organizations offer training in invasive species identification and control.
- Report any sightings of reptiles and amphibians to the NH Fish and Game Reptile and Amphibian Reporting Program and report rare wildlife species online at http://nhwildlifesightings.unh.edu/.
- Report any rare plants to New Hampshire Natural Heritage Bureau.
- Obtain cost sharing and free technical assistance from Federal and state programs.

Conservation Strategies for Local Communities for All Habitats:

- Incorporate habitat conservation into local land use planning.
- Protect unfragmented blocks of land.
- Protect large forest blocks (500 -1,000 acres) for habitat for wide-ranging species.
- Adopt sustainable forestry.
- Educate landowners about protecting conservation areas of concern using conservation easements.
- Restore and protect wetlands.
- Control invasive species. The New England Wildflower Society, UNH Cooperative Extension and other organizations offer training in invasive species identification and control.
- Report any sightings of reptiles and amphibians to the NH Fish and Game Reptile and Amphibian Reporting Program and report rare wildlife species online at http://nhwildlifesightings.unh.edu/
- Report any rare plants to New Hampshire Natural Heritage Bureau.

Statewide Wildlife Habitat Land Cover Types Located in Bath (See map on Page 5)

Primary Critical Species are wildlife having the greatest need of conservation.
Other Associated Species are wildlife that are closely associated with that habitat type.

Hemlock-Hardwood-Pine Forest - 50.88% of total acres in Bath

Description: Hemlock-hardwood-pine forests are comprised of mostly hemlock, white pine, beech, and oak trees. Since this is a transitional forest, it can occur at different elevations and over different types of soil and topography and the composition of vegetation can be variable. This forest type is the most common in New Hampshire covering nearly 34% of the state. Many of the species that use this habitat type require large blocks of unfragmented forest. Since this forest type is so common, sometimes it is overlooked in conservation efforts.

Threats: Development and fragmentation is a huge threat.

Primary Critical Species in Bath, NH	**Other Associated Species**
American woodcock	Black bear
Bald eagle	Moose
White-tailed deer	Blue-spotted salamander
Bobcat	Wild turkey
Canada warbler	Migrating/wintering birds
Common nighthawk	
Cooper's hawk	
Eastern pipistrelle (bat)	
Eastern red bat	
Eastern small-footed bat	
Eastern towhee	
Northern goshawk	
Northern myotis (bat)	
Purple finch	
Red shouldered hawk	
Ribbon snake	
Ruffed grouse	
Silver-haired bat	
Smooth green snake	
Veery	
Whip-poor-will	
Wood thrush	
Wood turtle	

Stewardship guidelines:

- Check hemlock trees regularly for hemlock woolly adelgid.
- Conserve **large trees** (>18" diameter) which are important for roosting bats, goshawk nests, and as existing and future snags and den trees.
- Protect rocky cliffs which provide sunning areas for bobcat.
- Provide a variety of habitats including areas of young, re-growing forests with a mix of tree age classes and species and areas of mature forest.
- Provide a regenerating forest habitat in patches at least 2 acres in size.

Northern Hardwood-Conifer Forest - 22.74% of total acres in Bath

Description: This habitat type is typically found between 1,400 and 2,500 feet in elevation and is usually made up of hardwood trees such as American beech, sugar maple, yellow birch, and conifer trees such as eastern hemlock, white pine, and balsam fir. Most of northern hardwood conifer habitat occurs in central and northern New Hampshire. This transitional zone provides habitat for many wildlife species. Forest harvesting is common in this habitat and if done sustainably produces the diversity of age classes and species which is beneficial to wildlife. Forestry also has increased this type of habitat by converting spruce-fir habitats to the more economically valuable northern hardwoods.

Threats: Development pressure is heavy within some parts of this habitat type.

Primary Critical Species in Bath, NH	**Other Associated Species**
American woodcock	Bald eagle
Canada warbler	Black bear
Eastern pipistrelle (bat)	Blue-spotted salamander
Eastern red bat	Bobcat
Hoary bat	Canada lynx
Northern myotis (bat)	Cooper's hawk
Ruffed grouse	Eastern small-footed bat
Silver-haired bat	Indiana bat
Veery	Mink frog
Wood thrush	Moose
Northern goshawk	Purple finch
	Ribbon snake
	Smooth green snake
	Wild turkey
	White-tailed deer
	Wood turtle
	Migrating/wintering birds

Forester Bruce Barnum takes a core sample to age the tree and determine growth.
Picture Courtesy Samantha Clifford

Stewardship guidelines:

- Conserve **large trees** (>18" diameter) which are important for roosting bats, goshawk nests, and as existing and future snags and den trees.
- Protect rocky cliffs which provide sunning areas for bobcat.
- Provide a variety of habitats including areas of young, re-growing forests with a mix of tree age classes and species and areas of mature forest.
- Provide a regenerating forest habitat in patches at least 2 acres in size.
- Provide pockets of spruce, fir, pine or hemlock trees used as winter shelter by northern goshawk, great horned owl, red squirrel, porcupine, and white-tailed deer.
- Provide habitat for migratory forest birds such as black-throated blue warbler, eastern wood peewee, and wood thrush by softening edges between habitats and limiting management activities during breeding season (April-August).

Grassland - 13.85% of total acres in Bath

Description: Grasslands are comprised of grasses, sedges, and wildflowers with little or no shrubs and trees. The most common grassland habitats are airports, capped landfills, wet meadows, hayfields, pastures and fallow fields. Pre-colonial grasslands in New Hampshire were probably only maintained by beaver and fires started by lightning and Native Americans. The numerous agricultural lands maintained by early European settlers provided ideal habitat for some wildlife species that need grassland habitat. As these agricultural lands were abandoned, these wildlife populations began to decline.

Threats: Development and natural forest succession have reduced grassland habitat in the state. Grasslands require maintenance and must be mowed to prevent them from becoming shrublands or forests.

Primary Critical Species in Bath, NH	**Other Associated Species**
American bittern	American kestrel
Black racer	Bobolink
Eastern meadowlark	Savannah sparrow
Grasshopper sparrow	Small rodents (important as prey species)\
Horned lark	Turkey
Northern harrier	White-tailed deer
Northern leopard frog	
Smooth green snake	
Vesper sparrow	
Whip-poor-will	
Wood turtle	

Stewardship guidelines:

- Maintain fields by mowing in the fall at least once every three years to discourage trees and shrubs.
- Mow marginal fields after August 1st, the end of grassland-breeding bird season. Mowing even later (August-October) allows late-flowering wildflowers such as aster and goldenrod to provide nectar for migrating butterflies.
- Modify mowing techniques during breeding season (May through mid-July)
    - Raise mowing bar to six inches or more.
    - Avoid mowing after dark.
    - Use flushing bars on haying equipment
    - Delay mowing in wetter areas or in grasslands along rivers.
- Burn fields, particularly in areas with poor soil, to improve soil nutrients, mimic historical disturbances to grassland habitats, and spread existing native grasses
- Encourage warm-season grasses as an agricultural hay crop. Warm-season grasses are more difficult to establish, but for wildlife they offer better nesting cover (growing in bunches, with space between for movement and nests), a more dependable food source, and better winter cover. The NRCS and UNH Cooperative Extension can provide advice and possible cost-share funds to plant warm-season grasses and assist with other wildlife practices.
- Focus land conservation on large grasslands (greater than 25 acres in size).

Developed or barren – 5.30% of total acres in Bath

Developed areas were not mapped as a key wildlife habitat in NH and are generally considered a risk to wildlife. However, certain types of development can provide important habitat for some wildlife. A few examples include:

- Chimney swifts roost in large chimneys within developed areas.
- Little and big brown bats often use attics and abandoned buildings for raising pups.
- Purple martins nest in man-made nest boxes, often in close proximity to development.
- Common nighthawks use rooftops with small stones for nesting.
- Turtles often lay eggs in residential lawns and gardens.

Sand & Gravel excavation areas (barren) are not specifically listed as a key wildlife habitat in NH's Wildlife Action Plan. However, the habitat conditions present in active and abandoned excavation areas can provide unique and important wildlife habitat. When sand and gravel mines are abandoned, the exposed sandy deposits lack mineral and organic nutrients required by plants, and tend to be very dry due to rapid drainage. Vegetation tends to recover very slowly, and these sites are often maintained as shrubland or grassland habitats for a longer time. These areas are often prioritized for development. Abandoned excavation areas not immediately developed are often reclaimed, which may involve adding loam and seeding or planting, potentially reducing their value to wildlife. Some examples of wildlife that use this habitat type include:

- Common nighthawk nesting.
- Bank swallows nesting in steep sand banks.
- Blanding's, spotted, and wood turtles nesting in areas of bare soil without large trees.
- Black racers, hognose snakes, and smooth green snakes utilizing the diverse vegetative structure and laying eggs in bare sandy areas.
- Tiger beetles using exposed sandy areas provided by excavation areas.
- New England cottontail using dense regenerating shrubland habitat.
- Nesting and migration habitat for shrubland and grassland birds

NOTE: As of 2016, Bath Planning Board regulations require reclamation of commercial pits to stabilize the site to prevent runoff of soil into waterways.

Rocky ridge and talus slope– 1.61% of total acres in Bath

Description: Rocky ridges and talus slopes are two related but distinct habitats. Talus slopes, comprised of loose or stable boulders and rocks, range from open, lichen covered talus "barrens" to closed-canopy forested talus communities. Rocky ridges generally occur on outcrops and bedrock ridges and summits below the alpine zone.

Threats: Human impacts exist primarily on the rocky ridge portion of this habitat, though some trails and other impacts are found on talus.

Species: Talus slopes and rocky ridges provide crucial habitat for several rare wildlife species, including bobcat, state endangered timber rattlesnake and eastern small-footed bats, and state threatened peregrine falcon.

Stewardship guidelines: Limit trails through high risk areas and monitor indicator species for climate change.

Marsh and Shrub Wetland - 1.47% of total acres in Bath

Description: Marsh and shrub wetlands encompass a variety of wetland types, each with different vegetation, but with one thing in common: the soils in them are wet most of the year. The cycle of a beaver flowage, from ponded water (marsh) to abandoned/drained area (wet meadow), and re-growth (shrub wetland), can contain all types of wetlands over time. These wetlands fit into three groups, identified by their vegetation:

- ✓ **Wet meadows** are filled with sedges and grasses. Wet meadows may not be flooded all year, but they are wet for long periods during spring and summer.
- ✓ **Marshes** contain plants that grow out of water, but whose roots are wet, such as cattails, pickerelweed, and water lilies.
- ✓ **Shrub wetlands** are thickets of shrubs and young trees growing out of wet soils, and they often flood in the spring.

Marsh and shrub wetlands filter pollutants to prevent them from getting into local streams, hold water to reduce flooding, and provide habitat for many wildlife species.

Threats: Driveways and roads fragment wetlands or change the flow of water. The loss of an upland habitat around a wetland increases the amount of pollution and sedimentation, threatening the habitat. Another constant threat is invasive plant species that compete with native vegetation.

Primary Critical Species in Bath, NH

American black duck
American bittern
American woodcock
Eastern red bat
Great blue heron
New England cottontail
Northern harrier
Northern leopard frog
Osprey
Pied-billed grebe
Rusty blackbird
Sedge wren
Silver haired bat

Other Associated Species

Green darner dragonfly
Mink
Muskrat
Red-winged blackbird
Spring peeper
Virginia rail

Stewardship guidelines:

- Maintain beaver dams and flowages and use beaver dam water control devices to maintain a consistent water level (important for protecting property or roads). Locate new roads and development where they are unlikely to be flooded by beaver dam sites.
- Protect wetlands by conserving the surrounding uplands as well. A 300 foot wide upland buffer protects habitat for many species, consider a 1000 foot wide buffer where possible.
- Regenerate and promote growth of aspen and other hardwoods in small patches or strips along slow streams and rivers to enhance the food supply for beavers. Mallards and black ducks will benefit, as they nest on open ground around waterbodies.
- Maintain habitat structures such as dead standing trees and overhanging vegetation in the water to provide cover for wildlife; keep downed logs as basking sites for turtles.
- Leave and protect standing dead trees as habitat for heron and osprey nesting, as roosting sites for bats, and as cavity nesting sites for a variety of other birds and mammals.

- Avoid using heavy machinery within wetland soils to avoid negative impacts on animals or disruption of the wetland's flooding pattern.
- Maintain open, sunny areas with little vegetation (or sandy areas) adjacent to or near marshes for turtle nesting.
- Maintain brush and other woody debris in and around wetlands to provide cover for small mammals, amphibians, and reptiles.
- Limit recreational access as even low levels of human disturbance can disrupt marsh wildlife. Where access is allowed, avoid trampling existing aquatic vegetation. ATVs should not be allowed in or around wetlands.
- Avoid drawing down water levels in fall and winter where human-built dams are present, as this exposes dispersing and hibernating amphibians and reptiles to colder temperatures.

Northern and Temperate swamps – 1.28% of total acres in Bath

Photo by Ben Kimball (WAP 2015)

Description (Northern swamp): This habitat consists of forested wetlands that are closed or stagnant basins with limited drainage and deep organic, acidic and nutrient-poor soils. These swamps have a forest or woodland structure, but often surround open peatlands. Boreal conifers dominate, particularly black spruce (*Picea mariana*), and to a lesser extent American larch (*Larix laricina*), red spruce (*Picea rubens*), or balsam fir (*Abies balsamea*), with mountain holly (*Ilex mucronata*) being the most frequent shrub species. Due to their small size, they are not generally identified on maps but groundwater seepage can occur over extensive areas. They support a distinctive suite of plant species, and provide habitat for some amphibians.

Threats: Timber harvesting in forested wetlands changes the vegetation structure and the amount of decaying woody debris in the wetland. It can cause rutting and increase compaction of the soil, leading to increased runoff and nutrient inputs. Forested wetlands are not always properly delineated, so attempts to avoid wetlands during timber harvesting may not be successful. Decomposition of slash left near the edge of a peat swamp can alter the structure and density, and thus the water transport abilities, of the peat. Increased temperature causes changes in species composition, and the eventual conversion to a different habitat type.

Stewardship guidelines: Delineate forested swamps in northern New Hampshire and notify large landowners.

Photo by Ben Kimball (WAP 2015)

Description (Temperate swamp): Temperate peat swamps are found typically in isolated or stagnant basins with saturated, organic soils. These swamps are most frequently dominated by red maple (*Acer rubrum*), with an understory characterized by the tall shrubs highbush blueberry (*Vaccinium corymbosum*) and winterberry (*Ilex verticillata*).

Threats: Timber harvesting in forested wetlands changes the vegetation structure and the amount of decaying woody debris in the wetland. It can cause rutting and increase compaction of the soil, leading to increased runoff and nutrient inputs.

Stewardship guidelines: Work with foresters to promote use of BMPs presented in Good Forestry in the Granite State.

Floodplain Forest - 0.51% of total acres in Bath

Ice jam in the Ammonoosuc River throws chunks of ice onto the floodplain in February 2010.
Photo courtesy of Peter M.Slattery

Description: Floodplain forests (riparian forests) occur in valleys adjacent to river channels and are prone to periodic flooding. They support diverse natural communities, protect and enhance water quality by filtering and sequestering pollution, and control erosion and sedimentation. Many wildlife species use these forests at some point in their life cycle.

Threats: Floodplain forests with their rich soils have been converted to open farmland for centuries. Development has altered the natural flooding regime. Frequent disturbances from flooding and nutrient rich soils give invasive plants opportunities to establish.

Stewardship guidelines:

- Focus land conservation in areas rich in existing floodplain systems.
- Reduce recreational trails and roads within floodplain forests to decrease barriers to vernal pools and prevent an avenue for invasive plants to enter floodplain forests.
- Monitor healthy floodplain forests to prevent new infestations of invasive plants and consider controlling existing populations. Limit overstory removal of trees where invasive plant species are present to help discourage their spread by limiting the amount of light reaching the ground.
- Regenerate floodplain species such as silver maple, balsam fir, sugar or red maple.
- Avoid human development of floodplain forests. Building and construction of paved roads may separate wildlife populations, inhibit migration, create increased predation and promote collisions on roads. Paving areas of native floodplain forests lessens the water-storage capacity of the land, which can cause more frequent and catastrophic floods.

Primary Critical Species in Bath, NH	**Other Associated Species**
American black duck	Baltimore Oriole
Eastern red bat	Belted kingfisher
Northern leopard frog	Green heron
Red-shouldered hawk	Otter
Silver-haired bat	Yellow-throated vireo
Wood turtle	

Peatland - 0.35% of total acres in Bath

Photo by Ben Kimball (WAP 2015)

Description: Peatlands are wetland ecosystems that contain peat, a spongy, organic material formed by partially decayed wetland plants. The highly acidic or stagnant water is low in oxygen and lacks nutrients, creating growing conditions for a very distinct group of plants. The layers of Sphagnum moss float and expand onto the surface of the water. The peat mat provides a surface on which other vegetation can grow. Peatland types include:

- ✓ **Bogs** receive very little surface water flow and are among the most acidic peatlands. They are generally dominated by shrubs like leatherleaf and bog laurel.
- ✓ **Fens** are peatlands associated with moving water, either along a river or lake, or with a stream that flows into or out of the peatland. Fens range from very acidic (where the plants resemble those found in bogs) to mildly acidic (dominated by sedges and shrubs).

Peatlands add significantly to biodiversity. At least 550 different plants grow in peatlands in the state, many of them highly-specialized to their environment. Peatlands provide habitat for a unique collection of animals. In the north, peat bogs are a favored habitat of bog lemmings and spruce grouse. Peatlands are important for carbon sequestration because plant and animal material take a very long time to decompose. This organic material contains carbon and other nutrients, storing it away and slowly releasing it into the atmosphere. Drainage and destruction of peatlands releases this carbon into the atmosphere quicker, increasing greenhouse gases.

Threats: Threats to peatland habitats are development, altered hydrology (amount and flow of water), and unsustainable forest harvesting. If harvesting occurs when soils are not completely frozen and the ground is not snow-covered, equipment can damage or destroy fragile peat soils. Additionally, if a peat swamp undergoes a particularly intensive harvest such as a clearcut, the loss of trees can alter the hydrology of the peatland. This can result in a higher water table, preventing trees from regenerating on the wetter soils and potentially altering the vegetation structure for decades. Non-point source pollutants, such as road salt, lawn fertilizers, and pesticides, threaten this habitat by altering the acidity and nutrients.

Primary Critical Species in Bath, NH
Eastern towhee
Mink frog
Northern bog lemming
Palm warbler
Ribbon snake
Rusty blackbird
Spruce grouse

Stewardship guidelines:

- Establish buffers (300 foot) undisturbed by development to protect water and habitat.
- Prevent changes in water flow and the level of the water table:
    - Do not dam streams flowing in or out of a peatland as it will change water level patterns and can lead to damage to the peat mat and changes in vegetation.
    - Do not excavate peatland communities to create open water areas for waterfowl.
    - Do not use heavy machinery on peatland soils to avoid negative impacts to plant and animal species or disruption of the wetland's hydrology through rutting or soil compaction.
- Avoid disturbance of peatland vegetation and soils:
    - Locate ATV and other off-highway recreation vehicles (OHRVs) trails at least 100 feet from any peatland.
    - Construct raised boardwalks for walking access to the public, except near rare plants (especially orchids).
- Limit timber harvesting to selection, thinning, or some other partial harvest, and restrict to periods of frozen ground and snow cover.

Low elevation Spruce-Fir - 0.31% of total acres in Bath

Description: Lowland spruce-fir forests occur between 1,000 and 2,500 feet in elevation and are comprised of a mosaic of lowland spruce-fir forest and red spruce swamp communities. Typical vegetation includes red spruce, balsam fir, hobblebush, and bunchberry. Although lowland spruce-fir covers approximately 4% of the state, it provides habitat for over 100 vertebrate species. Lowland spruce-fir forests also contain very important deer wintering areas where the conifer trees provide food and shelter from the heavy snow.

Threats: Forest harvesting in this habitat can result in trees that are less than 2 inches in diameter or can convert the landscape to northern hardwood conifer forest.

Primary Critical Species in Bath, NH `

American marten
Bay- breasted warbler
Cooper's hawk
Hoary bat
Northern bog lemming
Northern goshawk
Purple finch
Rusty blackbird
Spruce grouse
Three-toed woodpecker

Stewardship guidelines:

- Manage for mature forest characteristics such as large trees (>18" diameter) for snags and cavity trees (American marten require den trees >20" diameter) and closed canopies for spruce grouse, bay-breasted warbler, American marten, northern goshawk.
- Retain a mature forest canopy with >50% closed tree canopy for American marten and Spruce grouse. Within the mature forest, maintain patchy openings for three-toed woodpeckers and snowshoe hare.
- Maintain and manage existing deer wintering habitat.
- Maintain late successional habitat as a conservation strategy.

Cliff – 0.19% of total acres in Bath

Description: Cliffs are steep, rocky outcrops greater than 65° in slope and 3 meters in height located low in elevation within a forest or higher in elevation and completely exposed. Cliffs have sparse vegetation that is typically restricted to cracks and crevices where soil accumulates such as sheep laurel on acidic cliffs and bulblet bladder fern on calcareous cliffs.

Threats: The popularity of cliffs and cliff tops as recreational destinations for hikers and rock climbers is rapidly increasing. Another threat to these exposed habitats is energy and communication infrastructure such as cell towers and wind turbines.

Species: Cliffs are used by several wildlife species including the state threatened peregrine falcon, state endangered timber rattlesnake, bobcat, common raven, and long-tailed shrew.

Stewardship guidelines: Educating recreational users, habitat protection, and advising wind energy developers of potentially negative impacts through regulation and policy.

Appalachian Oak-Pine Forest - 0.14% of total acres in Bath

Description: Appalachian oak-pine forests are found mostly below 900 feet in elevation in southern New Hampshire and along the Connecticut River. The nutrient-poor, dry, sandy soils and warm, dry, climate influence the typical vegetation which includes oak, hickory, mountain laurel, and sugar maple. Traditionally, Appalachian oak-pine forests are influenced by frequent fires that change the age structure of the forest which helps promote wildlife diversity.

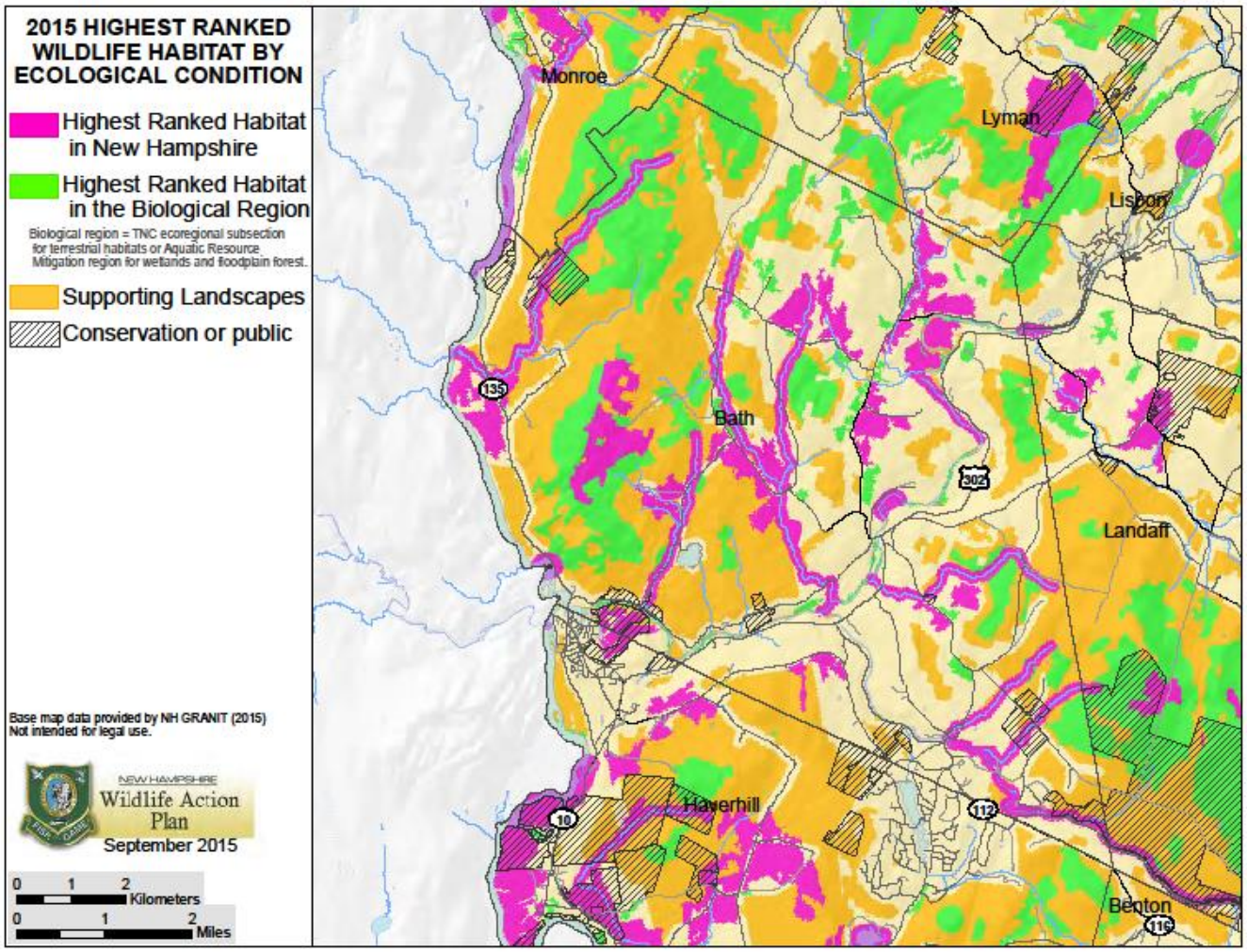
Threats: Intense development pressure has dramatically reduced naturally occurring fires and increased fragmentation of this forest type.

Primary Critical Species in Bath, NH	**Other Associated Species**
American woodcock	Black bear
Bald eagle	White-tailed deer
Blue-spotted salamander	Moose
Bobcat	Wild turkey
Canada warbler	Migrating/wintering birds
Common nighthawk	
Cooper's hawk	
Eastern pipistrelle (bat)	
Eastern red bat	
Eastern towhee	
Northern goshawk	
Northern myotis (bat)	
Ribbon snake	
Ruffed grouse	
Silver-haired bat	
Smooth green snake	
Veery	
Whip-poor-will	
Wood thrush	
Wood turtle	

Stewardship guidelines:

- Conserve large trees (>18" diameter) that produce nuts and provide snags and den trees. Maintain overstory pine or "wolf pine" for cover and perches.
- Conserve areas with particularly dry soils with an open understory and less common trees such as red pine, pitch pine, white oak.
- Conserve and regenerate a mosaic of tree age classes and a mix of tree species to create a "patchy" forest canopy.
- Provide continual patches of regenerating forest for early-successional habitat.
- Maintain fallen logs, branches, and leaves on the forest floor as cover for small mammals, amphibians, and ground-nesting birds and large downed logs for "drumming sites" used by male ruffed grouse
- Use harvest techniques to regenerate Appalachian oak-pine species, including partial "shelterwood" harvests and "group selection" harvests, combined with attention to oak-pine seed sources, seasonal timing of harvest, and planned disturbance of the forest floor to create a favorable seedbed.

Highest Ranked Wildlife Habitat by Ecological Condition map: Bath has the following ranking by acreage:



TIER/MAP COLOR	DESCRIPTION	ACRES in BATH	% OF TOTAL ACRES in BATH
#1/Purple	Highest Ranked Habitat in NH	**3873**	**15.7**
#2/Green	Highest Ranked Habitat in Biological Regions	**3574**	**14.5**
#3/Orange	Supporting Landscapes	**7563**	**30.6**

The town of Bath can use this information to begin discussions about prioritizing potential land protection efforts and providing management advice for landowners. Since wildlife species do not understand political boundaries, Bath will also look at the location of highest ranked habitats in the town and see how it relates to the surrounding towns and the larger landscape. The town may have a small area of high ranked habitat that is part of a much larger area in an adjacent town. The efforts to protect the small area may thus have a larger impact on wildlife habitat, especially if the adjacent town is also working toward the protection of those habitats.

Shrublands and vernal pools are not mapped as part of the Wildlife Action Plan and there are no acreage figures. Bath has many examples of these valuable habitat types and future inventories are recommended.

Shrublands

Description: Shrubland habitats contain thickets of shrubs and young trees mixed with scattered grasses and wildflowers. Typical plants include dogwood, alder, Viburnum, and pin cherry. Shrubland habitats are almost always temporary, existing on the land for a relatively short period of time. Old fields, shrublands, and young forests, often called **early-successional** habitats, are becoming increasingly uncommon in our state. Most large shrublands in New Hampshire are found in old fields and pastures, powerline corridors, gravel pits, and in recent clearcuts.

Impenetrable and dense, shrublands are often ignored and undervalued by people. For some species of wildlife, such as New England cottontail rabbits, American woodcock, and ruffed grouse, shrublands provide the best possible cover. The shrubs and young trees growing in these areas also provide an abundance of berries and fruit, eaten by many different birds and mammals. Shrublands exist in patches throughout the state, but most are difficult to recognize and map using traditional satellite imagery.

Threats: Land-use change, human development, fewer large beaver impoundments, and fire suppression have led to a decline in shrubland habitat. The late 1800s and early 1900s saw a widespread abandonment of farmlands. By the latter part of the 20th century, most of these abandoned fields reverted to forests, and the wildlife associated with shrublands declined. Twenty-two of our forty shrubland bird species show population declines.

Primary Critical Species in Bath, NH	**Other Associated Species**
American bittern	Black bear
American woodcock	Moose
Bobcat	White-tailed deer
Eastern towhee	
Northern harrier	
Purple finch	
Ruffed grouse	
Smooth green snake	
Whip-poor-will	
Wood turtle	

Stewardship guidelines:

- Maintain existing habitat by:
    - Allowing for the natural abandonment of beaver dams
    - Conserving larger patches (>5 acres)
    - Mowing or brush-hogging different sections every 3-5 years
    - Controlling invasive shrubs such as multiflora rose and common buckhorn
- Create new early-successional habitat near existing thickets, such as on the edges of powerline corridors or near shrub wetlands, and allow the edges of fields to become shrubby, thus "softening" the edge between field and forest. Shrub borders at least 20 feet wide will provide habitat for a variety of wildlife species.

Vernal Pools

Description: Vernal pools are wetland depressions characterized by small size, physical isolation from other wetlands, and periods of flooding in the spring and drying by summer's end. The annual drying cycle of vernal pools makes them different from other wetlands and plays a key role in determining which wildlife species uses which pools as habitat. Fish are top predators in wetlands, but they cannot survive in pools that dry out. As a result, vernal pools provide key breeding habitat for amphibians whose tadpoles and larvae are especially vulnerable to fish predation Some species such as the fairy shrimp, wood frog, spotted salamander, blue-spotted salamander, Jefferson salamander, and the state endangered marbled salamander, are vernal pool-dependent and the loss of this habitat can result in local extinction of these species

Threats: Many amphibians breed in the pools where they hatched, returning to the same pool every year. The loss of vernal pool habitat due to development is therefore a huge threat. Indirect impacts of development such as changes in water flow, changes to the water table, increased pollution, and the removal of forested canopy near pools can combine to degrade or destroy these habitats.

The surrounding habitat is also just as important as the vernal pool itself. Most of the wildlife species that use vernal pools also spend a great deal of time in the surrounding habitat, usually within 600 yards of the wetland.

Many amphibians in New Hampshire migrate to their breeding pools in the spring along discrete migration routes. Roads may cut across these routes, and vehicular traffic can kill migrating amphibians. Juvenile amphibians face similar threats during their dispersal from the pools where they hatched.

Although many vernal pools meet the state regulatory definition of a wetland, some pools either do not meet the definition (for example, no vegetation) or are overlooked during wetland mapping due to their small size and isolation.

Primary Critical Species in Bath, NH

Blue-spotted salamander
Northern leopard frog
Ribbon snake
Wood turtle

Other Associated Species

American toad
Bull frog
Damselflies & Dragonflies
Eastern garter snake
Fairy shrimp
Giant water bug
Gray tree frog
Green frog
Pickerel frog
Red-spotted newt
Snapping turtle
Spring peeper
Wood frog

Vernal Pool Stewardship guidelines: Some of the conservation strategies for vernal pools include habitat protection and supporting regulations that do not allow dredging and filling of vernal pools. Creating a model for vernal pools is very difficult because they can be found within so many other habitat types and because of the flooding and drying cycle it is not uncommon for vernal pools to be overlooked during certain seasons or during drier years. Due to this challenge they were not mapped as part of the Wildlife Action Plan.

- Work with the New Hampshire Fish and Game Department to identify and map the vernal pools on your land or in your town.
- Focus conservation efforts on areas containing a variety of wetlands such as vernal pools and others that hold water all year long. Keep in mind:
    - Isolated pools (without inlet or outlet) are less likely to have fish.
    - Small pools can have just as many (or more) breeding amphibians as larger wetlands—size is not a good measure of habitat value.
    - Most amphibians require wetlands that hold water at least four months.
    - Pools that hold water for four to 11 months (including permanent wetlands) help protect against complete reproductive failures in more seasonal pools during dry years.
    - Pools that hold water less than four months can still serve as foraging sites, as wood frog breeding sites, as habitat for insects and crustaceans, and as stepping stones for amphibians migrating to new habitats.
    - Clusters of vernal pools may be more productive for wildlife than single, isolated pools.
- Avoid creating ruts and skid roads that collect or change the flow of water. Through runoff, these disturbances can influence the timing of wet/dry periods in a vernal pool, altering the species that can breed there.
- Do not run heavy machinery through vernal pool basins (wet or dry).
- Avoid clearcuts in or around vernal pools.
- Retain ground cover (logs, surface stones, deep leaf-litter) as cover for amphibians, and maintain a moist environment on the forest floor by retaining patches of canopy shade in upland areas within 300 feet of a pool, and in corridors between vernal pools.
- Keep development, roads, and driveways at least 300 yards away from vernal pools (and other wetlands).
- Consider passing zoning ordinances that promote development to help preserve natural lands and and/or wetlands.

Wetlands

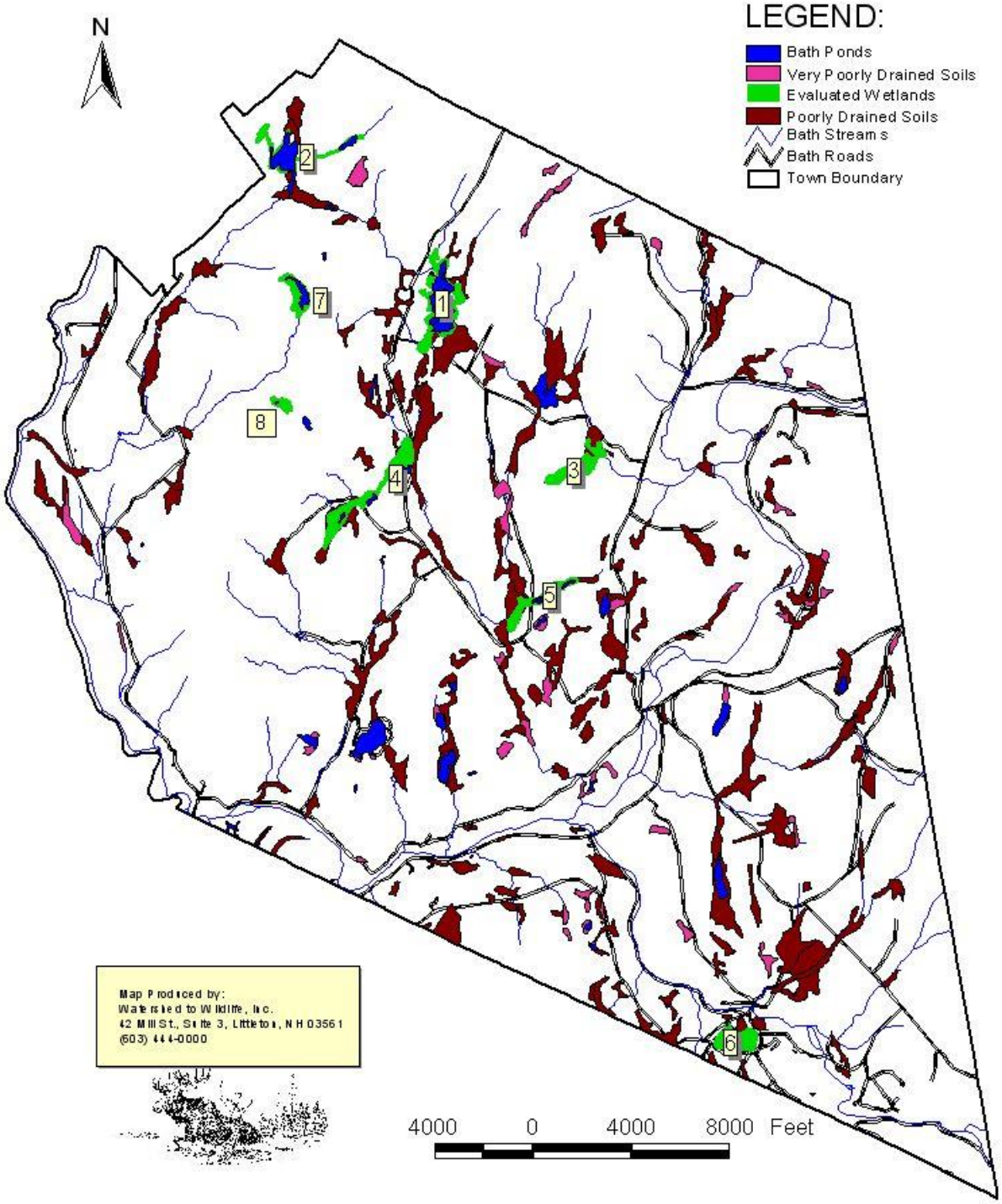
The town of Bath has a Wetlands Ordinance stating minimum setbacks for Septic Systems and a Wetland Conservation Overlay District to protect wetlands and their functionality. These documents are available for review at the Bath town office.

In February 2009, Watershed to Wildlife, Inc. prepared the "*Functional Assessment of Wetlands throughout Bath, NH"* (see the complete report in Associated Document B). The consultants used the "*Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire"*. The assessment provided Bath with the information to work towards protecting and conserving critical wetlands complexes by adopting ordinances or designating them as Prime Wetlands (Chapter Wt 700 of the NH Code of Administrative Rules). These Prime Wetlands are worthy of extra protection because of their uniqueness, fragility, and/or unspoiled character. Prime designation would add further protection to these unique and valuable wetlands before impacts and fragmentation occur. The town must vote in favor of this designation and then submit a report with appropriate maps to the State of New Hampshire, Department of Environmental Services Wetlands Bureau for their review and approval. *It should be noted however, that just because some wetlands were not part of this assessment, it does not mean they are not valuable.*

Eight wetlands were mapped, inventoried and classified by the National Wetlands Inventory criteria. In order to be considered for Prime Designation, the wetlands had to have the presence of hydric soils, hydrophytic vegetation, and wetlands hydrology. Additionally, at least 50% of the soils had to be Hydric A (very poorly drained) and the rest could be Hydric B (poorly drained). All wetlands also had to be greater than 2 acres.

For each of these wetlands, a Wetland Function – Value Evaluation form was filled out to provide a relative and objective comparison between different wetlands. Functional values that were evaluated included: groundwater recharge/discharge, flood flow alteration, fish and shellfish habitat, sediment/toxicant retention, nutrient removal, production export, sediment/shoreline stabilization, wildlife habitat, recreation, education/scientific value, uniqueness/heritage, visual quality/aesthetics, endangered species habitat, other additional noteworthy qualities.

See below for the map of evaluated wetlands from the "*Functional Assessment of Wetlands throughout Bath, NH"*.


N
LEGEND:
Bath Ponds
Very Poorly Drained Soils
Evaluated Wetlands
Poorly Drained Soils
Bath Streams
Bath Roads
Town Boundary
1
2
3
4
5
6
7
8
Map Produced by:
Watershed to Wildlife, Inc.
42 Mill St., Suite 3, Littleton, NH 03561
(603) 444-0000
4000 0 4000 8000 Feet

Summary table developed from information in the "*Functional Assessment of Wetlands throughout Bath, NH"* report developed by Watershed to Wildlife, Inc.:

Wetlands name	**NWI classification**	**Very poorly drained soil (%)**	**Poorly drained soil (%)**	**Functional value**	**# of acres**	**Wetland Value Units**	**Rank**
Jeep Trail	PUBFb	100.0	0.0	12.6	6,1	76.86	**8**
Gardner Mountain	PFO4/E1	69.3	0.0	n/a	20.5	n/a	**7**
Swiftwater-Goose Lane Rd	PFO4/SS1E PSS1E	51.2	48.8	n/a	29.1	n/a	**6**
Lang Road Dark Hollow	PUBFb PEM1Fb PEM1Eb PFO4E PSS1E	55.0	45.0	11.1	24.2	268.6	**5**
West Bath Road	PUBFb PEM1Fb PEM1Eb PFO4Eb PSS1Eb	18.7	81.3	10.9	48.1	524.3	**4**
Cross Road	PEM1E PFO4E PUBHh	61.0	39.0	n/a	25.2	n/a	**3**
Northern Mountain	PUBFb PFO5Fb PFO4Cb PEM1Eb PFO4Eb PSS1Eb	52.5	47.5	11.55	33.7	389.2	**2**
Smith Rd Childs Brook	PUBFb PFO1E	51.8	48.2	11.3	67.2	759.4	**1**

n/a = wetlands were not assessed in the field due to posted land, no access permitted

Wetland Value Units = Functional Value X number of acres

P = Palustrine, FO = Forested, SS = Scrub/shrub, EM = Emergent, UB = Unconsolidated bottom, b = beaver impacted, h = diked/impounded

Palustrine: Shallow water wetlands that have a size of less than 20 acres (8 hectares) and a depth of less than 6.6 feet (2 meters).

For a complete list of symbols and their meanings, consult the *Classification of Wetlands and Deepwater Habitats of the United States*

Rivers

As we drive around the town it may seem that there is water everywhere. This perception is colored by the fact that our roads often follow streams and rivers. In fact, there is relatively little surface water in Bath compared to the dry land available:

Land Acres	Land Sq.mi.	Water acres	Water sq.mi.	Total acres	Total sq.mi.
24,421.28	38.15	262.82	0.41	24,684.11	38.56

Source: New Hampshire GRANIT System; NH Office of State Planning & Complex Systems Research Center, UNH

In addition to being essential habitat for many wildlife species, these water areas often overlay stratified-drift aquifers and are potential discharge and/or recharge areas for the water supply.

Bath has many miles of streams and rivers, the largest of these being the Connecticut, Ammonoosuc and Wild Ammonoosuc Rivers. As described by Child in 1886, "land slopes down to form the smiling valley of the Ammonoosuc, through which that stream winds its sinuous course, cutting the town in a diagonal direction from its northeastern to its southwestern corner. Entering the town from the east the Wild Ammonoosuc River traverses its southern portion, falling into the Ammonoosuc. In the western part the streams fall into the Connecticut. These with their numerous smaller tributaries form the river system of the town..."

Each of the three rivers in Bath falls under RSA 483-B, the Shoreland Water Quality Protection Act (SWQPA). This law covers all 4th order and higher streams, providing minimal management guidelines and procedures for certain activities within specific distances of a water body.

In addition to SWQPA, the Connecticut and the Ammonoosuc Rivers are covered under RSA 483, the New Hampshire Rivers Management and Protection Act. A Designated River is managed and protected for its outstanding statewide and local natural and cultural resources. Sections of the rivers are managed in different ways depending on specific land use. Bath has segments classified as **rural**, **rural-community**, and **community**.

- **Rural** is defined as, "...those rivers or segments adjacent to lands which are partially or predominantly used for agriculture, forest management and dispersed or clustered residential development. Some instream structures may exist, including low dams, diversion works and other minor modifications."
- **Rural-Community** is defined as, "…those rivers or segments which flow through developed or populated areas of the state and which possess existing or potential community resource values such as those defined in official municipal plans or land use controls. Such rivers have mixed land uses in the corridor reflecting some combination of open space, agricultural, residential, commercial and industrial land uses."
- **Community** is defined as. "...those rivers or segments which flow through developed or populated areas of the state and which possess existing or potential community resource values, such as those identified in official municipal plans or land use controls. Such rivers are readily accessible by road or railroad, may include existing impoundments or diversions, or potential sites for new impoundments or diversions for hydropower, flood control or water supply purposes, and may include the urban centers of municipalities."

The Connecticut River was entered into the Rivers Management and Protection Program in 1991 and is the longest of New Hampshire's designated rivers (255 miles). Most of the approximately 6 miles of the river in Bath are designated Rural and the remaining 0.5 miles, around Dodge Falls Dam, are designated Community. The only free-flowing part of the Connecticut River is an approximately 3.5 mile stretch in Bath from Dodge Falls Dam to just below the mouth of the Ammonoosuc River in Woodsville.

The lower 49 miles of the Ammonoosuc, including approximately 10.5 miles in Bath, were entered into the River Management Protection Program in 2007, and the remaining 12 miles on the upper end followed in 2009. Within the borders of Bath about 8 miles of the river are designated Rural/Community, and the remaining about 2.5 miles are designated Community.

General Challenges for the Rivers

In recent years, the rivers in Bath have faced various human and natural impacts.

Natural Events: High energy storms have produced increased rainfall frequency and intensity. These storms, ice jams, and rapid snow melt can cause flooding, scouring, and course changes.

Specifically, high energy storms have caused mudslide events along Route 112 that have negatively impacted both the road and the Wild Ammonoosuc River at those locations and downstream. This mud (sediment) has found its way into the river by eradicating the riparian habitat that would normally afford the river some protection. Although the storms cannot be controlled, attention can be given to the quality, stability and maintenance of the riparian buffer.

Land use activities: Logging, construction, roadway deicing, snow-dumping, and cropland practices that **do not** follow Best Management Practices can disturb the soil and cause water quality impacts. These non-point sources of pollution are more difficult to quantify than point sources because they impact water quality through unmonitored, intermittent, or incremental contamination, and their impacts may be felt only over a long period of time.

Development Pressure: The town of Bath has seen an increase in subdivisions along the rivers, and many new residences have been constructed in the watershed. Since all three rivers fall under the jurisdiction of the New Hampshire SWQPA, the waterways are afforded some degree of protection from developmental impacts adjacent to the rivers. The rivers have additional protection because of the town's no floodplain disturbance ordinance. However, development upstream of Bath, and poorly designed development in the town on tributaries and high ground overlooking the river can have negative impacts on the water quality of not only the river but the underlying aquifers as well. Poorly maintained septic systems, pesticide and fertilizer runoff, and illegal dumping even away from the river can affect the rivers and aquifers.

Invasive species: Aquatic and wetland invasive plant species have begun to show up in ever increasing numbers and variety. In addition to being brought to the area on sport and recreational gear, aquatic invasives can come from aquariums dumped into surface waters or from flooding of landscaped “water gardens” planted with exotic plants. It is recommended that the town do invasive species inventories. For more information on invasive species, see the Invasive Species section of this NRI.

Water Quality: Water temperature is a critical parameter for aquatic life and has an impact on other parameters such as dissolved oxygen and the activity of bacteria. Temperature controls the metabolic and reproductive processes of aquatic species and can determine which fish and macroinvertebrates can survive in a river or stream. Temperature can be impacted by the quantity and maturity of riparian vegetation along the shoreline, the rate of flow, the percentage of impervious surfaces contributing storm water, thermal discharges, impoundments and the influence of groundwater. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

Rain and snow falling in New Hampshire is relatively acidic, which can affect pH levels in the rivers. After the spring melt or significant rain events, surface waters will generally have a lower pH. In general, pH measurements are more acidic in the upper portions of the watershed and more alkaline in the lower portions. The pH levels slightly below the standard are not necessarily harmful to aquatic life.

Turbidity measurements are influenced by precipitation, soil type, and the composition of the streambed. Human activities, such as removal of vegetation near surface waters and disruption of nearby soils and irresponsible recreational activity, can lead to dramatic increases in turbidity due to increased runoff.

Higher specific conductance levels can be indicative of pollution from urban and agricultural runoff, road salt, failed septic systems, or groundwater pollution. The relatively low specific conductance levels in the Ammonoosuc River watershed generally indicate low pollutant levels.

The *E. coli* bacteria are a normal component in the large intestines of humans and other warm-blooded animals and can be excreted in their fecal material. *E.coli* bacteria are a good indicator of fecal pollution and the possible presence of pathogenic organisms. Sampling *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. Several factors can contribute to elevated *E. coli* levels, including but not limited to rain storms, low river flows, the presence of wildlife, and the presence of septic systems along the river.

Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorus, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorus is increased due to human activity, algae respond with significant growth. Fertilizers used on lawns and agricultural areas can contribute significant amounts of phosphorus.

Chloride (salt) tends to remain in solution once dissolved. Chloride that enters ground water can be expected to reach surface water, and influence aquatic environments and humans. Sources of chloride include road salt, fertilizers, septic systems, and underground water softening systems.

General Recommendations: As pointed out in the Town Master Plan, rivers and streams must be protected against sedimentation and degradation. Management suggestions include requiring setbacks and vegetated riparian buffers in developments, increasing setback requirements for septic systems, and supporting efforts to strengthen the SWQPA including extending protection to third order streams. Landowners should be encouraged to follow Best Management Practices. Invasive species inventories should be completed. Ongoing water quality testing can track the parameters mentioned above to make sure they fall within acceptable levels. The water quality impacts due to recreational gold mining should continue to be monitored.

Connecticut River

General: The Connecticut River is the longest and largest river in New England. Starting from the Fourth Connecticut Lake, the river flows generally south 410 miles to Long Island Sound. By the time the river flows out of Bath, the watershed already includes 2,546 square miles. While the Connecticut is often thought of as a product of the Late Wisconsin Ice Age, the general course has been in place for more than 2 million years. This is not to deny the profound effect that the ice sheets have had on the area. Glacial Lake Hitchcock was formed by a natural dam in Connecticut and inundated the valley to about the latitude of the Comerford Dam. It is these sometimes very thick, complex sand, gravel, and varve lake deposits that have formed extensive stratified-drift aquifers and have made the area so viable for human development use.

This development of river commerce had a measurable effect on land use in the area. Though recreation is the main use for most of the river today, the Connecticut was once an avenue for travel and movement of goods. Log drives used the river during the late nineteenth and early twentieth centuries, and jam sites such as the Narrows still contain the remnants of the bases of the booms. By 1810 canals were completed that opened the river to the head of navigation at Woodsville. However, within half a century river travel was superseded by the development of rail travel within the valley, which altered the basic patterns of land use and economic activity. The coming of the railroad allowed faster, more reliable, and cheaper access to large markets for manufacturing, mining, and agricultural products. Overnight delivery of fresh milk caused a shift from the small family farm to the large industrial scale farm. Today the river corridor in Bath remains primarily agricultural. As of the late 1990s, 58% of the 530 acres of prime agricultural soils within ½ mile of the river were in active use with less than 1% having been developed.

Water Quality: There is currently no systematic water quality monitoring program on the Connecticut River in the Bath area. However, some water quality testing and analyses have been carried out in this stretch of the river. A study in 1994 noted organic enrichment, sedimentation, and fluctuating flows. The type of river bottom life found in this study indicated that organics and nutrients entering the river from these tributaries and from upstream point sources and non-point sources may be over-enriching the waters. The results of a 2000 Environmental Protection Agency (EPA) study identified 2,4'methoxychlor and thallium, and in very low concentrations phenanthrene, anthracene, fluorene, fluoranthene, pyrene, benzo (a) pyrene, benzo(a)anthracene, chrysene, indeno (1,2,3-cd) pyrene, and nickel in the Bath stretch of the Connecticut River. Also in very low concentrations, but at the highest levels found in the 200-mile study, were the pesticides 2,4'-DDD and, at the highest levels anywhere in the study, the pesticide c-Permithren. While the pesticide levels recorded were in very low concentrations that do not present much risk to aquatic life, they demonstrate that runoff of agricultural and domestic chemicals are reaching the river. In 2004 NH Department of Environmental Services (NHDES) and the Environmental Protection Agency (EPA) conducted a water quality assessment. In this region samples were taken at three sites in Monroe, and at Dodge Falls Dam, and Route 135 canoe access in Bath. Results indicated that the river's quality fully supports swimming and other forms of recreation.

Additionally, activities outside the watershed impact the water quality in the river. Mercury from Midwest coal burning power plants has accumulated in resident fish in this area to the point that the state of New Hampshire has developed a series of fish consumption warnings in our region. Acid rain also coming from the Midwest power plants is a contributor to low pH levels in area

waters. Several wastewater treatment facilities upstream from Bath on the Connecticut and Ammonoosuc Rivers have experienced problems, some of which are recurring.

In addition to water quality issues revealed through testing and analysis, fluctuating water levels due to the operation of hydroelectric dams add to bank erosion and impact habitat. In this way, dams change the character and conditions of the river for aquatic habitat and species. There are nine dams on the New Hampshire portion of the Connecticut that provide water storage for hydroelectric power. Water temperatures in impoundments rise resulting in reduced dissolved oxygen and an accumulation of nutrients and contaminants. Walleye, perch, bass, and other warm-water species inhabit the warmer water behind the dams. However, impoundment leads to a loss of habitat quality for coldwater fish including trout. The 28 foot high Dodge Falls Hydro or Ryegate dam is the only one of the Connecticut River dams in the town of Bath. Located some 270 miles from the river's mouth, this stretch of river has a four miles long 280 acre impoundment in Bath and Monroe.

The Connecticut River in the Bath area is considered Class B waters by both New Hampshire and Vermont standards. *Designated Uses for Class B waters: Acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as a drinking water supply.*

Fisheries: The Connecticut River has important spawning and feeding habitats for approximately 32 species of fish. Common fish vary from warm water perch, bass, pickerel, walleye, and pike to cold water trout. Walleye are noted as a particularly important species below Dodge Falls, and in the early spring fishermen can be seen in abundance in the Narrows. Warm water fisheries are entirely natural while populations of cold water fish are supplemented by stocking. Major dams have changed the habitat for a variety of fish, especially cold water species. Subsequently, a large salmon restoration project initiated in 1968 resulted in development of fish passage facilities at dams along river by the late 1990s, permitting passage as far as Bath. Radio tracked salmon have been recorded at the base of the village dam in Bath, their upstream progress having been halted by the dam.

Wildlife: The Connecticut River Valley continues to serve as an important corridor for migrating birds. Wetlands and agricultural lands along the river provide critical feeding and resting areas for migrating waterfowl. During spring and fall migration scaup, black duck, ring-necked duck, mallard, common golden-eye, bufflehead, mergansers, and loons use the river corridor. Some waterfowl, especially common mergansers, also winter in open water areas. Current land use patterns provide open spaces and cover for migrating songbirds that depend on native seeds, fruits, berries, and early spring insects for food and protective cover during their journeys and residence. Eagles, osprey, and kingfishers are often seen fishing the river.

Invasive Species: Invasive plant species that have been identified along or in the Connecticut River in Bath include purple loosestrife (*Lythrum salicaria, L. virgatum, L. alatum*), Yellow Iris (*Iris pseudacorus L.*), and Japanese knotweed (*Fallopia japonica*). Other potential invasives are common reed (*Phragmites australis*) and true forget-me-not (*Myosotis scorpioides L.*). Didymo (*Didymosphenia geminata*, or "rock snot") an invasive freshwater diatom (microscopic algae) with the potential to spread and destroy river bottom habitat, was documented in the Upper Connecticut in 2007. Zebra Mussel (*Dreissena polymorpha*) is an invasive animal species. The Connecticut River is considered susceptible to impact by this invasive species.

Ammonoosuc River

Covered bridge over the Ammonoosuc River in Bath Village. Picture Courtesy Samantha Clifford

General: Ammonoosuc is an Abenaki word for "fish place" or some variation. The Ammonoosuc River flows out of the Lakes of the Clouds on the western slope of Mount Washington in Sargent's Purchase. It enters the Connecticut River as a fifth order stream at the Bath-Haverhill town line. The Ammonoosuc River is about 60 miles long with a watershed of almost 400 square miles. The Bath portion of the Ammonoosuc River is about 10.5 miles long with a typical width of 150 feet and it has 12 islands. In Bath the river is spanned by four bridges and once had three dams. The single remaining dam, constructed in 1900, is located at Bath Village. It is 273 feet long and 20 feet high and has an impoundment of 24 acres. The railroad crosses the Ammonoosuc twice in Bath. Major floods have occurred in the Ammonoosuc River Valley during all seasons of the year. Damaging floods have been observed and recorded in 1828, 1869, 1927, 1936, 1938, and 1973.

Water Quality Testing: During the summer of 2005, volunteers from the Ammonoosuc River Corridor Advisory Committee began water quality monitoring on the mainstem of the Ammonoosuc River under the New Hampshire Volunteer Rivers Assessment Program (VRAP). Testing was taken over by the Ammonoosuc River Local Advisory Committee in 2008. This long-term monitoring program serves as a baseline to determine any water pollution in the river and/or watershed and allows NH Department of Environmental Services to trace potential problems to their source. Data collected is also reported to the US Environmental Protection Agency to satisfy New Hampshire's obligations under the Clean Water Act.

Volunteers sample water quality once a month at 15 locations from May through September each year. They measure water temperature, dissolved oxygen, pH, turbidity and specific conductance. Additionally, samples for *Escherichia coli* (*E. coli*), total phosphorus, and chloride are gathered for additional analysis.

The Ammonoosuc is listed as a Class B water, supporting aquatic life and recreational uses such as fishing and swimming. During the last two years of VRAP sampling of the 129 parameters tested, two samples did not meet standards for Class B waters by coming back slightly acidic.

Fluvial Erosion Hazard study: The N.H. Department of Safety's Division of Homeland Security and Emergency Management and the N.H. Geological Survey are conducting mapping that identifies bank erosion potential along rivers across the state as part of the Fluvial Erosion Hazard Program. This will provide water systems with an important opportunity to better evaluate vulnerability to damage from natural disasters. In 2009, the Connecticut River Joint Commissions sponsored a geomorphic assessment of the entire Ammonoosuc River to help identify and delineate fluvial erosion hazards.

Conducted by John Fields, the results of this work have recently been published and a series of maps generated showing the location and severity of erosion hazards, areas of channel instability, and the underlying causes for channel adjustments threatening human infrastructure and aquatic habitat. Fields provides the following geomorphic assessment of the Ammonoosuc River in Bath: "The severity of the fluvial erosion hazards varies greatly in the lower river reaches of Bath with Very High hazards mapped upstream of the dams in the villages of Woodsville and Bath where large abandoned meanders occupy wide floodplains. Downstream of the dam in Woodsville, the bedrock controlled river channel has a Very Low hazard rating. The prevalence of bedrock along the confined stream channel downstream of the Wild Ammonoosuc confluence leads to a narrow Flood Erosion Hazard zone with a Very Low hazard rating. Within the town of Bath, the river corridor downstream of Gilman Hill Road and upstream of the Upper Village poses the highest fluvial erosion hazard. This area has experienced recent and extensive bank erosion, including a channel avulsion that cut off a meander that had formed over several years. The presence of natural valley constrictions and a large sediment supply, exacerbated by past channel management practices, have created the dynamic nature of this river reach with a Very High erosion hazard rating."

The Phase 2 assessment data on erosion, bank composition, riparian corridor condition, physical habitat, channel dimensions, and other features were used to develop a River Corridor Planning Guide. The Planning Guide identifies four High priority restoration sites in Bath. For a complete copy of the study: http://www.crjc.org/ammonoosuc.htm.

Young osprey being fed on the nest on the powerlines off of Route 302 in Bath overlooking the Ammonoosuc and Wild Ammonoosuc Rivers. Picture Courtesy Samantha Clifford

Fisheries: The Ammonoosuc River is described as “an important cold water fishery” by the US Fish & Wildlife Service. The New England Rivers Center identifies the Ammonoosuc as “a most outstanding river” and rates it “high” for six of seven criteria considered: species composition, water quality, aquatic habitat, fishing quality, aesthetic experience, and current use. The aquatic habitat for cold water fish populations is highest for the lower portion of the Ammonoosuc offering good spawning substrate, a sufficient temperature regime, and some notable depths. The New Hampshire Fish & Game Department characterizes the stretch of the river below Littleton as offering the most important habitat, noting particularly the ledges in Bath which provide cool water refuge necessary for summer survival of cold water species.

Fish species identified in the Ammonoosuc River and tributaries include: Atlantic salmon, brook trout, brown trout, rainbow trout, blacknose dace, longnose dace, fallfish, common white sucker, longnose sucker, slimy sculpin, creek chub, common shiner, spottail shiner, and tessellated darter. Although trout naturally spawn in the Ammonoosuc, a stocking program is maintained as natural reproduction cannot keep up with angling pressure. Every year the NH Fish and Game Department stocks the Ammonoosuc River with rainbow, brook, and brown trout, primarily from mid-March to early July.

The Wild Ammonoosuc River

Covered bridge over the Wild Ammonoosuc River in Swiftwater. Picture Courtesy Samantha Clifford

General: The Wild Ammonoosuc River is a tributary of the Ammonoosuc River and is about 15 miles long, (8 miles of which are in Bath) with a drainage area of 60 square miles. The river flows entirely within Grafton County, arising in the White Mountains at Kinsman Notch in the town of Woodstock and flowing generally northwestwardly through the towns of Easton and Landaff into Bath, where it joins the Ammonoosuc River. In Bath it is bordered largely by forestland and the White Mountain National Forest owns approximately 4,820 feet of frontage. The New England Rivers Center identified the Wild Ammonoosuc among the rivers with the highest composite resource values. Also noteworthy is the waterfall by the Swiftwater covered bridge, a swimming hole called the Big Eddy, recognized in the book "*New England Waterfalls: A Guide to More than 400 Cascades and Waterfalls"* as a beautiful recreational site.

Water Quality: On the Wild Ammonoosuc there is no systematic water quality monitoring. About 15 miles of the Wild Ammonoosuc is considered to have impaired aquatic habitat due to low pH, including all of the river in Bath. While low pH is influenced by natural causes including geology, acid rain is also a factor.

In partnership with the Middle Upper Connecticut (MUC) water quality lab at Woodsville High School, water quality tests were performed in 1997. High school students and Bath Conservation Commission members studied the river from mid-May to mid-September. Generally, water quality measurements indicated a range in measurements of:

Dissolved oxygen:	4.3-9 mg/l
pH:	6.0 -7.5
Temperature degrees C:	12.0 -19.0

The dissolved oxygen levels decreased as the water temperature increased and the water level decreased. The water quality team concluded that any additional stress on the river would negatively impact the dissolved oxygen levels, which in turn would cause stress to the cold water fish population.

In 2005, volunteers carried out water quality monitoring under the Volunteer River Assessment Program. Of the 75 samples tested in Bath, including *E coli*, specific conductance, turbidity, dissolved oxygen, and pH, only five failed to meet standards for Class B waters as these samples came back slightly acidic. The Wild Ammonoosuc is listed as a Class B water, generally supporting aquatic life and recreational uses such as fishing and swimming.

In 2011, the New Hampshire Fish and Game Department deployed data loggers at the index sites that recorded temperature readings every hour from May 17th through November 7th. The mean water temperature in degrees C for July was 20.81 and for August, 20.08.

Fisheries: The Wild Ammonoosuc is considered habitat for cold water fish species, and is one of the most productive salmon rivers in the north country. From 1996 through 2011, as part of the federal program to restore Atlantic salmon to the Connecticut River watershed, the New Hampshire Fish and Game Department, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture Forest Service studied Atlantic salmon at two index sites. An average of 150,000 Atlantic salmon fry were stocked annually in the spring and sampled in late August/early September by electrofishing to determine growth and survival. Most years revealed a healthy cohort of fry and yearlings. Two and three year olds were present in years with high production, which also occurred during the last decade on a few occasions.

Unfortunately, Hurricane Irene (2011) wiped out the White River National Fish Hatchery and as a result the salmon fry will no longer be available. Despite the termination of this program, the Wild Ammonoosuc will still be managed as a cold water fishery with brook trout stocked annually.

Other species of fish identified during the Atlantic salmon electrofishing surveys were blacknose dace, longnose dace, brook trout, brown trout, common white sucker, longnose sucker, slimy sculpin, yellow perch, and smallmouth bass.

Recreational Dredging for Gold: Recreational gold dredging is a favorite hobby for many enthusiasts, and the number of dredgers continues to increase each year on the river. Dredging and the use of sluice boxes involves disturbing the stream sediments on a larger scale than panning. Processing stream gravels in search of placer gold releases fine sediments back into the stream. Fine sediment-laden streams can be an environmental issue. The Bath Conservation Commission, Bath police chief, and inspectors from the NH Department of Environmental Services have observed negative impacts to the aquatic habitat if too many dredgers are in the river, and/or they do not follow the rules. Citations have been given for: no permit, no landowner permission, gasoline dumped into the river, excessive turbidity, digging into the riverbank, and damming the river. Dredging and similar operations are regulated by the state under statutes RSA 482-A and RSA 485-A:17 because of the potential for environmental damage. Gold seekers who anticipate dredging for gold in New Hampshire are required to obtain a permit and to follow the regulations. Recreational panners also need to check the regulations, and everyone needs the permission of landowners to access stream locations for panning **or** dredging. Detailed information regarding permitting may be obtained by contacting the NH Department of Environmental Services Wetlands Bureau: http://des.nh.gov/organization/divisions/water/wetlands/permit-rec-mineral-dredging.htm.

Headwater Streams

Description: Headwater streams are small streams and wetlands at the highest end of a watershed, sometimes so small they do not appear on maps. Wide variations in water flow and temperature make life difficult in headwater streams. A unique group of plants, amphibians, and insects are adapted to survive in these difficult conditions. Many species take advantage of the relative safety of headwater streams for reproduction. Green frogs and spring and two-lined salamanders lay their eggs in intermittent, fishless streams. Common white suckers and rainbow smelt, two fish species, migrate every year into small streams to spawn. Headwater streams also can act as travel corridors for wildlife such as mink, otter, beaver, forest birds, and forest dwelling bats. The isolation and harsh conditions of headwater streams can also provide native fish with a refuge from introduced species. Natives such as banded sunfish, redfin pickerel, and redbelly dace can thrive in headwater streams, but are over-run by introduced fish in the more stable and often degraded habitats of larger rivers and lakes. These small streams also improve the health and integrity of rivers downstream by removing excess nutrients, such as nitrogen, from a watershed.

Headwater stream types include:

- ✓ **Mountain streams:** These streams have large rocks, steep grades, and flash floods. Stream salamanders, brook trout, and certain aquatic invertebrates are well adapted to these dynamic habitats.
- ✓ **Valley streams:** These streams flow through broad, flat valleys, tending to be slow-moving and surrounded by wetland plants and shrubs. Beaver activity creates a patchwork of wetlands around the streams. Wildlife drawn to these areas include ducks, geese, turtles, amphibians, and fish.
- ✓ **Spring-fed brooks:** These small streams flow through glacially deposited sand and gravel and originate from natural springs. Their year-round supply of cool water provides a stable environment for brook trout, particularly during hot weather.
- ✓ **Warm rocky streams** The riffles and pools of these rocky brooks are reminiscent of mountain or brook-fed streams, but are too warm to support cold-water fish. They often flow between beaver ponds in hilly terrain, serving as corridors and hunting grounds for mink, northern water snake, and other wildlife.

Threats: Despite their ecological value, headwater streams are often overlooked by conservation efforts and are not covered by New Hampshire's Shoreland Water Quality Protection Act. There is a tendency to dismiss them because they do not command the same recreational and aesthetic appeal of larger lakes and rivers, and because they are often considered too small to provide important habitat. Their small size also makes them vulnerable to human impacts. Use of groundwater by residential or commercial wells can cause streams to dry up. Roads, driveways, and poorly designed or placed culverts fragment streams, causing sedimentation, and isolate wildlife populations. Runoff from paved surfaces can introduce pollutants, increase flooding, and cause spikes in stream temperature.

Headwater Streams Stewardship guidelines:

- Conserve land from development around headwater streams.
- Incorporate headwater stream protection into town planning through conservation easements and zoning ordinances.
- Keep development, permanent roads, and driveways at least 300 feet away from streams to provide strong riparian buffers.
- Maintain pervious (permeable) surfaces on as much of the landscape as possible.
- Avoid the use of fertilizers or pesticides near any stream or wetland habitat.
- Avoid culverts, drains or ditches that discharge storm water directly into streams. Instead, apply designs that filter storm water into the ground, including porous pavement, gravel wetlands, or tree box filters. The UNH Stormwater Center is an excellent resource for the latest research in stormwater management.
- Properly size and install stream crossings as these are critical for restoring or maintaining the function of streams of all sizes. Before installing any stream crossing associated with development, consult the New Hampshire Stream Crossing Guidelines (see references for website) available from the UNH Stream & Wetland Restoration Institute and follow all NH wetland laws. For crossings associated with timber harvesting, see best management practice references below.
- Timber harvesting around headwater and small streams should maintain enough shade and large trees to maintain stream temperatures, filter run-off, and allow for woody material (dead and dying trees, leaves, branches) to naturally fall into streams. For headwater streams, buffers that maintain about 60% of the canopy in a zone as wide as the height of a mature tree (100 feet) are likely to maintain cold water temperatures and woody material in the stream. In larger streams, riparian buffers of 300 feet or more provide more effective wildlife travel corridors and habitat.

Bath, New Hampshire: *Brook Trout Report & Recommendations for Conservation* (Associated Documents A)

Summary: In July of 2011, the New Hampshire Fish and Game Department and community volunteers conducted electrofishing surveys in fourteen headwater streams in the town of Bath as part of the Eastern Brook Trout Joint Venture (EBTJV). The data yielded from the sample sites was used to identify opportunities to conserve or restore brook trout habitat in the town. In addition to collecting fish data from each survey site, observations were recorded to evaluate stream crossings, streamside buffers, and overall habitat quality. Recommendations have been developed based on observations at the selected locations. Improvements in habitat quality and stream crossings would allow for increased brook trout migration and genetic integrity as well as other aquatic organism passage into headwater streams, vital for the spawning, foraging, and the overall survival of these species. (For a complete assessment of the streams and recommendations for their management, refer to the full study under **Associated Documents A** .

From May to September, 2015, community volunteers received training from the NH Fish and Game Department in the *New Hampshire Geological Survey Stream Crossing Assessment Protocol.* They inventoried 8 stream crossings and rated their ability to pass aquatic organisms. This information will be used to solicit grant money to improve selected crossings and allow brook trout to access habitats for thermal refuges and spawning in Bath streams.

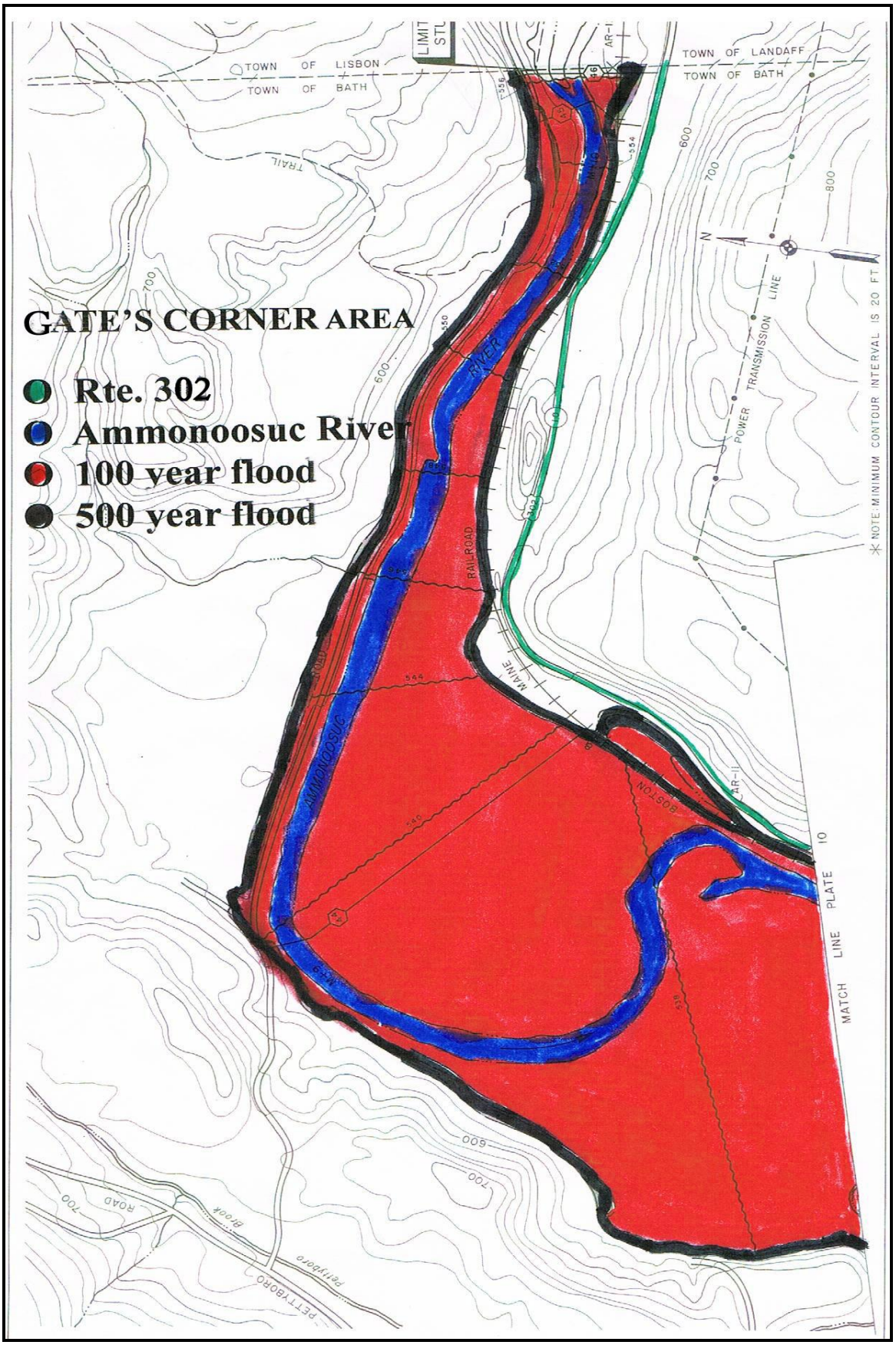
Floodplains

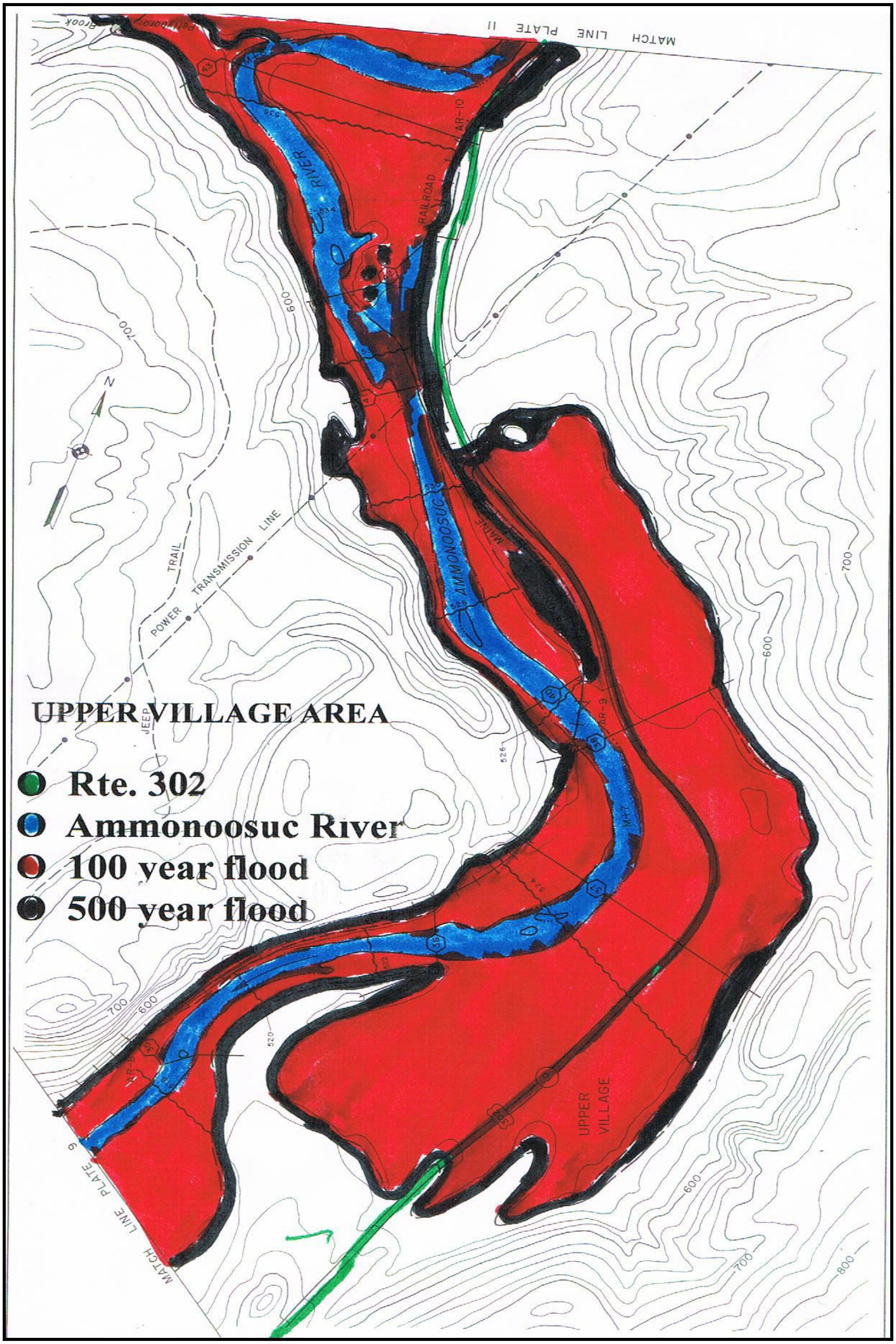
Floodplains are the area of land that becomes inundated with water when a water body overflows its banks. As a natural resource, a floodplain has multiple functions. The floodplain area can absorb some water and allow some of the flowage to spread out over the land providing an area of shallower depth that reduces the velocity of runoff. Floodplains often accumulate additional soil from the slower moving water thereby increasing productivity and/or making natural levees. They provide habitat for various birds and animals. Forested floodplains provide even more habitat as well as travel corridors for wildlife. Forested buffers combat erosion and help cool the waters for fish and other aquatic creatures.

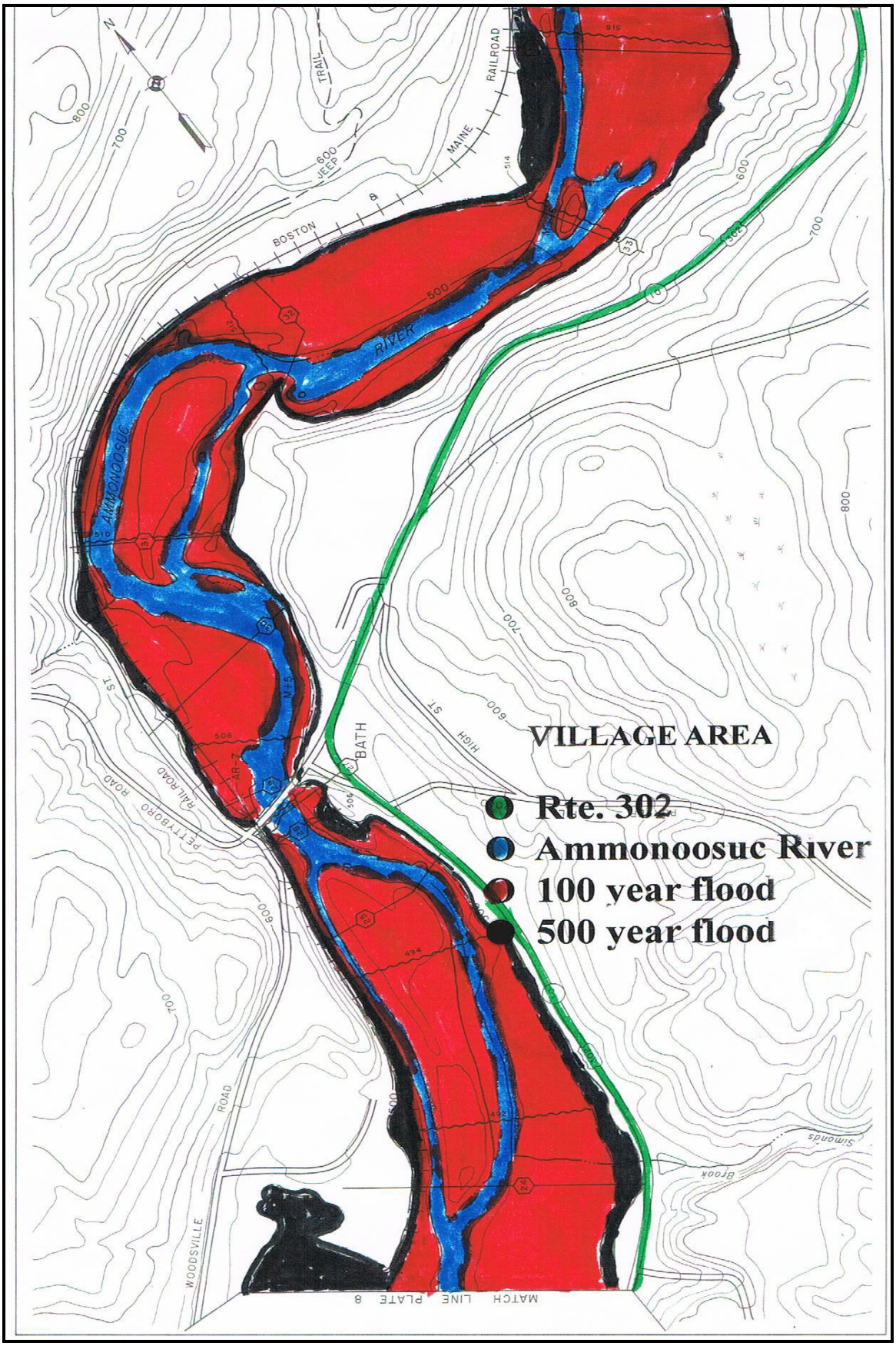
In addition to Bath's three major river systems (Connecticut, Ammonoosuc, Wild Ammonoosuc) there are numerous smaller streams and waterways. The Connecticut, forming the western boundary of the town, has little in the way of floodplain in Bath since most of its course runs through a narrow valley, the banks of which rise steeply from the river. In the absence of a floodplain in the area of the Narrows, the Route 135 road base is highly susceptible to flooding from the river. The Ammonoosuc, running from northeast to southwest has the most significant floodplain areas and uses them frequently. Flood waters are often seen at the Upper Village, above and below the dam in Bath Village including the islands and Jackman Meadow, Hancock Meadow, and Hill's Flat. The Wild Ammonoosuc in the southeastern section through Swiftwater can be very wild and has limited floodplain area to use.

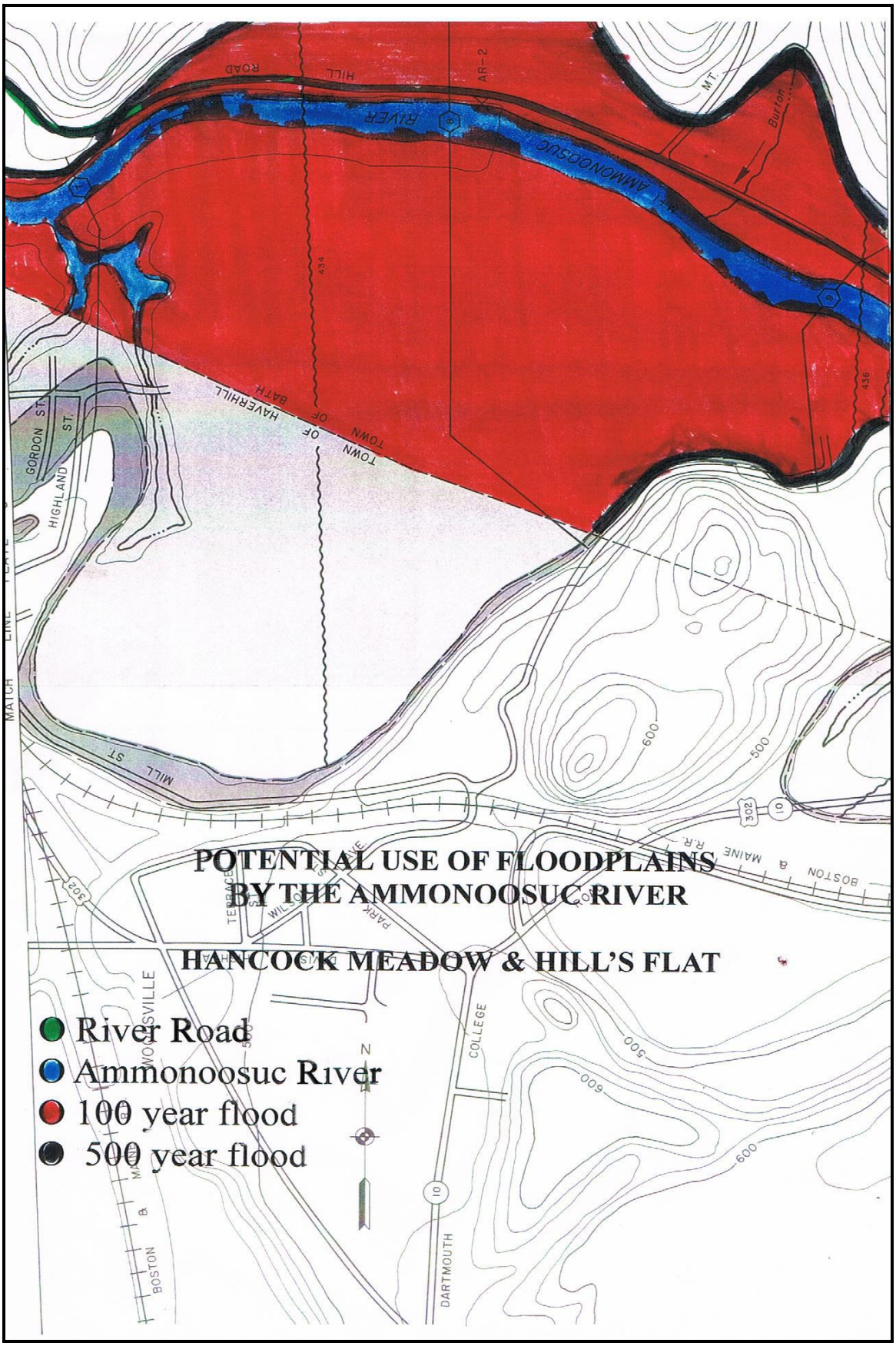
Water overflow from rivers can potentially be problematic to development. Any brook or stream can overflow its banks, cut new channels, and wash out roadways given enough rain or snow melt. A floodplain unimpeded by development, whether open land or forested, is the best protection against environmental and/or property damage. With that in mind, Bath has adopted an ordinance prohibiting building on any floodplain. New subdivisions are required to have a buffer along a waterway, and the town has also taken the necessary steps to make it possible for residents already in a potential flood area to procure flood insurance.

Below are the examples high flooding in Bath and surrounding areas. Pictures Courtesy Kathy Troy


GATE'S CORNER AREA
Rte. 302
Ammonoosuc River
100 year flood
500 year flood
TOWN OF LISBON
TOWN OF BATH
TOWN OF LANDAFF
TOWN OF BATH
LIMIT STL
AR-1
AR-II
RAILROAD
MAINE
AMMONOOSUC
RIVER
POWER TRANSMISSION LINE
BOSTON
PETTYBORO
ROAD
Brook
TRAIL
MATCH LINE PLATE 10
NOTE: MINIMUM CONTOUR INTERVAL IS 20 FT


UPPER VILLAGE AREA
Rte. 302
Ammonoosuc River
100 year flood
500 year flood
MATCH LINE PLATE II
RIVER
RAILROAD
AR-10
AMMONOOSUC
MAINE
AR-9
POWER TRANSMISSION LINE
TRAIL
JEEP
UPPER VILLAGE
MATCH LINE PLATE 6
N
700
600
800


VILLAGE AREA
Rte. 302
Ammonoosuc River
100 year flood
500 year flood
BATH
AMMONOOSUC
RIVER
BOSTON & MAINE RAILROAD
JEEP TRAIL
HIGH ST
PETTYBORO ROAD
WOODSVILLE ROAD
MATCH LINE PLATE 8


POTENTIAL USE OF FLOODPLAINS
BY THE AMMONOOSUC RIVER
HANCOCK MEADOW & HILL'S FLAT
River Road
Ammonoosuc River
100 year flood
500 year flood
N
AMMONOOSUC RIVER
MT. Burton
HAVERHILL TOWN OF BATH
MILL ST
GORDON ST
HIGHLAND ST
COLLEGE
DARTMOUTH
BOSTON & MAINE R.R.
500
600
434
436
302
10

Aquifers

An aquifer is a geologic unit or formation that contains a usable supply of water. Aquifers, often referred to as groundwater, are generally classified as fractured bedrock, till, or stratified drift. Bedrock is the solid material that underlies unconsolidated material, and groundwater can collect in cracks within bedrock. Most home wells put in since 1984 are drilled into bedrock, as bedrock aquifers generally offer sufficient yield to serve a single-family home but are usually not adequate in supporting a municipal water supply. Till, the unsorted collections of material transported and deposited by glaciers, comprises deposits covering the majority of the hill slopes and upland areas in our region. Many private water wells are dug in till, although water yield is generally relatively low. Stratified-drift deposits consist of glacial sediments transported and deposited by meltwater. The coarser stratified-drift deposits are characterized by their high hydraulic conductivity which allows effective groundwater movement and storage, while the hydraulic properties of finer stratified-drift deposits are less ideal. It is within these coarser sand and gravel stratified-drift aquifers that development of groundwater withdrawals in New Hampshire has been most successful. Stratified-drift aquifers containing significant quantities of groundwater are useful for municipal as well as single-family water supply. Stratified-drift aquifers are potentially valuable sources of groundwater depending on water quality, size, transmissivity (ability to hold and release groundwater), and connection to dependable sources of adjacent good quality surface water.

There is an ongoing exchange of water between the surface and aquifers. Streams and ponds may be fed by aquifer discharge and the aquifers may absorb water from streams, wetlands, rainfall, and snowmelt. Stratified-drift aquifers along the main sections of major rivers are generally continuous, while those situated in other locations tend to be small and discontinuous.

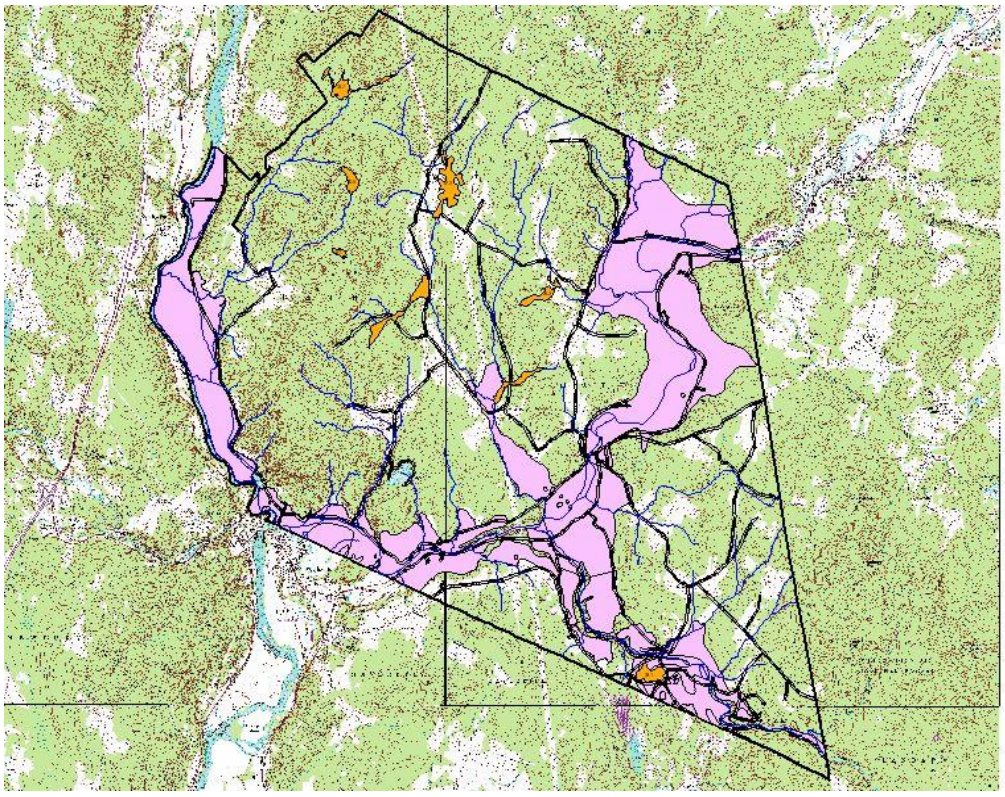
Major stratified-drift aquifers occur along the Ammonoosuc and Connecticut Rivers. In Bath all three rivers once lay under the deep water of glacial Lake Hitchcock that covered much of the Connecticut River Valley during deglaciation and probably early postglacial time. In the corridor, the lake extended up the Ammonoosuc River valley to Littleton. It is these lake deposits that form the stratified-drift aquifers. Stratified-drift-aquifers in the Middle Connecticut River watershed have saturated thicknesses ranging from 0 to more than 500 ft, with the thickest being along the Connecticut River in nearby Orford and Haverhill. In Bath, approximately 5,500 acres of the town area are underlain by stratified-drift aquifers (Sundquist 2010). About 14% of land surface in the State is underlain with stratified-drift aquifers, Bath is well above this with the ratio at almost 23%. While the USGS maps show a fairly substantial area of the Town underlain by stratified-drift aquifers, only a small fraction of that is likely to have the potential for high-yielding community wells.

Challenges: "Maintaining the high quality and availability of groundwater is important to protect public health and the environment; however, it is greatly affected by local decisions regarding land use and the management of harmful substances" (Source Water Protection Program 2011).

The threat of groundwater contamination is ever present. Recognizing this, the New Hampshire legislature passed the Groundwater Protection Act (RSA 485-C) in 1991. Best Management Practices for groundwater protection have been published by NHDES. In Bath, the most likely contaminants could result from nonpoint and point source pollution including: the misapplication of pesticides,

herbicides, and fertilizers in agricultural and domestic use, road runoff, poorly maintained septic systems, and the improper disposal of hazardous materials. Contaminated groundwater can take days or years to reach discharge points, potentially contaminating every well or spring it feeds. Cold temperatures, limited microbiological activity, lack of sunlight, and low oxygen levels slow or even stop the chemical breakdown of contaminants once they have passed through the root zone of the soil. Flushing contamination from groundwater may take many years (Gagne 2009).

The Town of Bath Master Plan addresses groundwater protection a number of times. Wetlands and other surface waters are instrumental in groundwater recharge. Aquifer, wetland, and surface water protection is included in the Town Planning Regulations and Zoning Ordinances. The town should continue to enforce existing safeguards and investigate additional means of insuring that Bath retains an adequate supply of safe groundwater. During the drought of the early 2000s, many had to drill new wells as their current ones went dry. Others have experienced inadequate production resulting from the construction of additional houses and the subsequent drilling of new wells on those lots. Because there is only a finite amount of water available at reasonable depths, respondents to the town-wide questionnaire expressed the opinion that the aquifers and other sources of water need to be protected. The plan further recommends that the town appropriate funds on an annual basis for, among other things, the preservation or enhancement of water supplies for use by the town. Additional work in mapping and studying bedrock, till, and stratified-drift aquifers should be carried out in the town to better identify areas to be protected and areas with sufficient groundwater resources to support new development.



The aquifers are shown as pink polygons and continue beyond the town line into Haverhill.

Mapped stratified-drift aquifers in the town of Bath (Watershed to Wildlife, Inc., 2009)

Lakes and Ponds

Lake Gardner, formerly known as Perch Pond until 1904, is the only lake in Bath. It is located in the western part of town on part of Mt. Gardner and all the land around the lake is privately owned. The lake consists of approximately 25 acres and is situated about 665 feet above sea level with a maximum depth of approximately 15 feet with a mean depth of approximately 8.5 feet. The lake is fed by springs and has four inlets with wetlands at one end of the lake.

According to the NH WAP Wildlife Habitat Land Cover map, the habitat type around the lake is hemlock hardwood pine mix. The Historical Notes of Bath, NH (up to 1965) report that the lake was well stocked with largemouth bass, Eastern chain pickerel, yellow perch and horned pout, all species which currently exist there today. According to the Highest Ranked Wildlife Habitat by Ecological Condition map, it is a supporting landscape for wildlife. Residents around the lake have reported muskrats as contributors to bank erosion. They have also seen many white-tailed deer, black bear, mink and turkeys, mallards, mergansers, Canada geese, great blue heron, and a passing loon.

As noted in the 2007 Town of Bath Master Plan, the lake provides flood storage capacity, wildlife habitat, and recreational opportunities**.** Residents of Lake Gardner belong to the Volunteer Lake Assessment Program (VLAP**)** and monitor several water quality parameters in the lake. This is important because acid deposition and nonpoint source pollution (e.g. septic systems) are likely to become more problematic over time. Additionally, increased amounts of blue-green algae were reported in the spring of 2011. Presently Lake Gardner is considered mesotrophic, meaning algae production is moderate, and phosphorus input and water clarity are intermediate.

Dartmouth College has included Lake Gardner in a multi-year study of glacial lakes. They placed a derrick on the frozen lake to take core samples of the mud layer. They hope to determine when the lake was formed and, as a broader endpoint, when the Connecticut River valley was formed.

Care must be taken to keep invasive species from the lake. Boats, motors, trailers, and recreational equipment (including waders and nets) should always be inspected before and after using the lake. Any plant material should be removed and disposed of away from the water. Fish, amphibians, or reptiles kept as pets should never be released into the lake.

Farmlands

With their wide variety of terrain, from swamps, ponds and brooks to open hayfields and pastures to assorted woodlands, farms are hosts to a large variety of wildlife such as moose, deer, bear, blue heron, kestrals, bats, birds, butterflies and fish. The open fields associated with farms such as hayfields, pastures and fallow fields are characterized as grasslands, the vegetation of which consists of a mixture of grass species or a combination of grasses, sedges and wildflowers. About 20% of New Hampshire's grasslands can be found in Grafton County, and within this habitat more than 70 species use the open areas and cover for breeding and its wildflowers for food, illustrating the importance of the continued presence of farms in maintaining such habitat for wildlife. In a similar fashion, croplands are also used by many wildlife species. Additionally, farms help control flooding in heavy rain or snowmelt, protect the town's visible and subsurface water resources, and are responsible for the local growth and production of nutritious food products for a variety of human tastes and consumption.

Though not necessarily still owned and operated by the original families, many of the farms left in Bath originated in the 1700's and 1800's. Today, Bath consists of dairy, beef, steer, deer, sheep, poultry, crop, blueberry, vegetable, Christmas tree, flower and other forestry farms. The farms are under current use with some under conservation easements. The farms will help to ensure the town's historical agricultural character. This includes stonewalls, historic buildings and cellar holes. Farms are of interest to hunters, photographers, tourists and others. Encouragement of sustainable agricultural and forestry practices is necessary for the maximal utilization of farms as valuable natural, agricultural, and cultural resources.

For the list of farms in Bath, consult the *Town of Bath 2007 Master Plan.*

View of Troy farm fields and Mount Moosilauke in West Bath. Picture Courtesy Samantha Clifford

Forest Resources

The events that shaped the forest reach back into the last century when much of the land was cleared for agriculture. The forest returned after abandonment from that use only to be altered again by the 1938 hurricane. Over the last 35 years most of the forested areas have once again been harvested to various levels of intensity, again shaping the forest that now exists. Forest cover types, whether hardwood, softwood, or a variation of mixed wood are a consequence of the type of soil present, aspect of slope and elevation.

According to the New Hampshire Wildlife Action Plan, Bath has 5 forested habitat types (see Habitat Land Cover table on page 5). This amounts to a total of 18,408 acres or 75% of the land acres in Bath. For more information about the wildlife value and management recommendations of these habitat types, consult the Wildlife section of this NRI.

In the 2007 Bath Master Plan, one of the town character goals is to encourage the use of forestry Best Management Practices. This goal also supports the 1987 Bath Master Plan, where the forested landscape was then and still is recognized as a valuable asset that provides:

- a renewable supply of wood products
- an effective natural method to stabilize soils
- habitat for wildlife
- outdoor recreational opportunities
- research and educational opportunities
- natural buffers for various land uses
- purification of the air
- scenic beauty

FLESA: In 1994, the town performed a Forest Land Evaluation and Site Assessment (FLESA) to identify important forestland areas to help refine the natural resource planning. The FLESA was the first pilot project in New Hampshire and was directed by a citizen committee. The process assessed the timber, wildlife habitat, recreation and development potential. Due to many changes in the town since 1994, the FLESA report needs to be updated to be useful as a planning tool today.

Town Forest: Bath has a Town Forest and Tree Farm (former Paradie Farm) located in the Carbee District off of Route 135 on a Class VI town highway. The Conservation Commission developed a forest management plan for the 164 acre parcel in 1990. The goals of the plan are to manage for timber products, wildlife habitat, good water quality and passive recreation. A timber sale was conducted in 1990 and 1991 and federal cost sharing money was used to improve access and control erosion. The forest has been used as a demonstration project to train foresters, landowners, and loggers how to install stone ford water crossing structures and water bars on access roads and skid trails. The management plan will be updated based on the NH Wildlife Action Plan Wildlife Habitat Types. (See "Forest Stewardship Management Plan for the Bath Town Forest" for complete details).

Land Protection

According to the 2007 Master Plan for the town of Bath, citizens want to:

- ✓ identify prime areas of town for protection and conservation
- ✓ encourage the purchase of land for conservation purposes
- ✓ encourage current use and conservation easements as a way to protect Bath's natural resources.

Conservation Easements: Landowners can permanently protect their land from development and keep it in conservation use by using a voluntary, legally binding agreement known as a conservation easement. Each conservation easement is designed to limit or prohibit development and other activities in order to protect the significant natural values of that particular property. Agricultural and forestry activities are usually permitted and encouraged on conservation easement lands, and structures such as culverts, bridges, barns, sheds, fences, and dams necessary for farming and forestry are allowed. Habitat management and improvement to benefit wildlife is also usually permitted. Depending on the characteristics of the property and the landowner's wishes, future residential or commercial construction may be prohibited entirely — or limited to a site where it will have the least impact on the natural values of the property. Land subject to a conservation easement remains in private ownership and can be sold, given, or inherited at any time. A conservation easement "runs with the land" so all future owners of the parcel are bound to the terms of the conservation easement. (Information obtained from the Upper Valley Land Trust website @ www.uvlt.org).

Conservation Land Protected in the Town of Bath

Property Protected	Date	Easement holder	Acreage	Land Type
Kathy & Gerry Troy Troy Farm	7/7/14	UVLT	135	Farm, Forest
Steve Lackie Lackie Farm	2/23/09	UVLT	186.4	Farm, CT River frontage
Tony Morse Goose Lane Farm	11/16/07	UVLT	48.7	Farm & Forest
Shirley Peters Foothill Farms	5/8/07	UVLT	136.2	Farm
Tom Wood Wood Farm	3/27/06	UVLT	68.4	Farm
Knoxland Farm Aldrich Farmland	9/24/04	UVLT	31.4	Farm
Knoxland Farm Hill Farmland	9/24/04	UVLT	43.52	Farm
Knoxland Farm Lackie Farmland	9/24/04	UVLT	75.0	Farm
Bath Town Forest & Tree Farm	3/13/90	Bath	164	Forest
Ray Burton	3/13/90	LCIP Bath	43.44	Farm & Forest

Properties were protected with a variety of funding sources: LCIP, LCHIP, NRCS FRPP, UVLT staff time and resources, and the town of Bath Conservation Fund. This fund was established by a vote at the 2001 Town Meeting to: *earmark 100% of the funds generated from the Land Use Change Tax for a Conservation Fund to purchase development rights and/or to qualify for conservation grants.*

FRPP = Farm and Ranchland Protection Program
LCIP = Land Conservation Investment Program
LCHIP = Land and Community Heritage Investment Program
NRCS = Natural Resources Conservation Service
UVLT = Upper Valley Land Trust

Invasive Species

Invasive Upland Plants: The incidence of non- native invasive plant species has increased rapidly as we have become more globalized. Many were brought to the United States as early as the mid 1700's as ornamental plants, others came by accident as hitchhikers by international trade and travel. They cover more than 100 million acres in the U.S. and continue to spread.

They are spread naturally by birds, wind, and water and by human activities such as gardening and transport of nursery stock used for erosion control and wildlife management and routine maintenance and construction activities along roads. These activities spread seeds and viable plant materials and can offer fertile ground for these species due to the high level of disturbance and abundant sunlight.

Invasive plant species have certain traits that give them an advantage over many native species; production of many offspring (for example purple loosestrife can produce over 2 million seeds), early and rapid development by stem and root growth, adaptability and high tolerance to many environmental conditions, and no natural controls. These species are highly competitive and in many cases suppress native species.

These aggressive invaders decrease the amount of light, water, nutrients, and space and alter hydrologic patterns, soil chemistry and moisture-holding capacity of the ground. They replace understory forest plant species and wildflowers. This has a trickle down effect of allowing them to permanently change the native environment and reduce biodiversity. There may follow a change in insect and mammal species that may impact endangered or threatened native species. This can reduce wildlife habitat, create water quality impacts, stress and reduce forest and agricultural crop production, damage personal property, and cause health problems.

Native fauna depend on native plants for food and shelter. Fruits of native plants such as blueberry, holly and viburnums are high in nutritious fats and lipids while fruits of invasive plants are often high in sugar. Giant hogweed contains photo-toxic sap that can severely burn and blister skin. Spotted knapweed may be carcinogenic in large quantities. Garlic mustard contains compounds lethal to native butterfly species. Invasive species along roadways can cause fire risk and encroachment on travel lanes. Plants push up through the pavement, damage shoulders and road edges, plug ditches and block culverts.

The costs of invasive species run into billions of dollars a year including efforts to control and eradicate them. In 1999 President Clinton signed an Executive Order establishing the National Invasive Species Council to assess the problem and provide guidance for management.

In 2000, New Hampshire passed House bill 1258-FN to create the Invasive Species Act (ISA) and the NH Invasive Species Committee. This committee is advisory and works to "prevent and control the spread of invasive species in the state". They develop outreach and educational materials, formulate management practices as guidance for control, and prepare lists of proposed prohibited and restricted invasive species (aquatic plants are not included).

RSA **430:51** "…recognizes the adverse environmental and economic effects of invasive plant, insect, and fungal species upon the state; to establish the means by which the state shall address and minimize such adverse effects; to promote research and educational activities dealing with

invasive species so as to achieve the best possible protection of agricultural, forest, wildlife, and other natural resources of the state and of human health; and to prevent and control the spread of invasive species in the state".

Chapter Agr 3800 Invasive Species states: "No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transport any living or viable portion of any listed prohibited invasive plant species, which includes all their cultivars and varieties". The New Hampshire law and rule are enforced by the NH Commissioner of Agriculture. For the *Guide to Invasive Upland Plant Species in New Hampshire*: https://t2.unh.edu/sites/t2.unh.edu/files/documents/publications/invasive.pdf

The first line of defense against invasive plant species is preventing their establishment and reducing the spread by human activity. Early detection and eradication of small populations is more successful and methodologies include pulling cutting, digging, mowing, using approved herbicides and introducing beneficial organisms for biological control. The NH Department of Transportation (DOT) has developed sixteen Best Management Practices that address soil disturbance and stabilization, movement and maintenance equipment, disposal of plant material, handling of excavated material. Their priority species include: Japanese knotweed, purple loosestrife, phragmites, oriental bittersweet, and spotted knapweed. For more information consult the NH DOT website.

Invasive Aquatic plants: The NH Department of Environmental Services prohibits the distribution, propagation, transportation, and introduction of aquatic invasive species (for the law reference and the complete list consult (Appendix 1): http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/r-wd-09-08.pdf

The first infestations were found in Lake Winnipesaukee in 1968 and now have been found in 72 water bodies in New Hampshire as of 2008. Most common invasive species include variable milfoil, Eurasian milfoil and purple loosestrife. These populations are very difficult to eradicate and prevention is the best method. The NH Lakes Host Program (Weed Watchers) uses volunteers to check boats entering and leaving the public access sites to prevent the boats carrying plant fragments from one water body to another. Aquatic invasive plants can also be found in small ponds and are introduced when people discard aquarium plants. Water garden plants such as yellow iris have escaped and formed thick growth to crowd out native species.

The algae didymo (rock snot) has been discovered in the Connecticut River valley. It originated in colder, low nutrient and high clarity streams and is now able to survive in warmer climates with more nutrients and moderate clarity and even some tannic (tea-colored) water. Didymo uses stalks to attach to rocks and plants in rivers and can form thick masses on the river bottom. The algae die off but the stalks persist for several months. It changes the appearance, structure, invertebrate diversity, and food web of a stream. Anglers and other river recreationists are encouraged to check and clean their waders, sandals and water shoes canoes and kayaks, and fishing gear to prevent the spread of didymo. There is currently no eradication method.

Species that are known to occur in Bath include: yellow iris and Japanese knotweed along the Connecticut River, purple loosestrife and Japanese knotweed along the Ammonoosuc River. Future recommendations include performing an inventory of the invasive plant populations and proper eradication of known populations.

Invasive Insects: According to the information on the New Hampshire Division of Forests and Lands website Hemlock Woolly Adelgid, *Adelges tsugae,* is a small wingless insect which has piercing mouthparts to feed in the xylem of small hemlock twigs. This insect is from Asia and was first discovered in Portsmouth in 2000. Today there are many communities with small infestations spread throughout the southeast region.

Egg masses produced by overwintering adults.

The Asian Longhorned Beetle, *Anoplophora glabripennis*, was found in Worcester, MA in August 2008 and in Boston in July 2010. This insect pest is not in New Hampshire yet but poses a serious risk to our forests. It is large, ranging from 0.75-1.25 inches long, with very long black and white antennae. The body is glossy black with irregular white spots. Beetles feed on many species of hardwood trees. Adults can be seen from late spring to fall, depending on climate.

Emerald ash borer, *Agrilus planipennis* , only attacks ash trees, and is responsible for the mortality of millions of ash trees in the mid-west. This has been found in Concord, New Hampshire as of March 2013. It has since spread to surrounding communities.

The best defense against spreading these invasive insects is to not move firewood. As of July 2011 New Hampshire banned the importation of untreated firewood without a commercial or home heating compliance agreement. If you think you have seen these species, contact your local UNH Cooperative Extension Forester.

SCENIC RESOURCES

It is frequently said that beauty is in the eye of the beholder, making it virtually impossible to quantify the scenic resources of Bath. With its many rivers and streams, open fields, forested vistas, and views of nearby mountains, it is safe to say that Bath has something to please everyone. Each resident and visitor to Bath has his own special set of views, whether visible only on private property or accessible to all travelers on the state highway and Town road systems.

The scenic value of natural landscapes and open spaces is an important factor in the character and attraction of Bath. The 2007 Bath Master Plan recognizes the importance of Bath's scenic resources and states that "The overall vision for the Town is to preserve and protect our small town rural atmosphere, historic characteristics, scenic rivers and roadways, natural resources and provide continued economic stability for all our citizens."

The 2007 Bath Master Plan identified a number of particularly scenic areas in Bath, including:

- Goose Lane: Beautiful valley views to the southwest with mountains and valleys to the northwest. A number of intact farms.
- Big Eddy: On the Wild Ammonoosuc River, the cascading waterfall and swimming hole are a popular destination of tourists and residents alike
- Lake Gardner: This 25-acre shallow lake has no public access to beaches.
- The Narrows and Saddle Rock: This natural rock formation squeezes the Connecticut River to its narrowest width as it travels from the Connecticut Lakes to the ocean.
- NH Route 135: Along the Connecticut River with views to Vermont
- NH 112: Scenic route along the Wild Ammonoosuc River from Kinsman's Notch and the White Mountain National Forest to its merger with the Ammonoosuc River

In addition, great views of Mt Moosilauke, Black Mountain, and the Gardner Range can be had from multiple locations within the Town. Note that the above list is by no means inclusive, and is included primarily to show the breadth of scenic resources within the Town.

The beautiful scenery of Bath serves to attract new residents to town and leads to increased development pressure, which in turn has the potential to degrade the integrity of scenic vistas. Wireless telecommunications towers, utility/transmission lines and commercial wind farms also have the potential to diminish scenic value, particularly on ridgelines.

APPENDIX
NH Natural Heritage Bureau Listing for Bath (July 2013)

Species or Community Name	Listed?		# reported last 20 yrs	
	Federal	State	Town	State
Natural Communities - Terrestrial				
*Hemlock-spruce-northern hardwood forest			1	17
Natural Communities - Palustrine				
Acidic riverbank outcrop			Historical	6
**High gradient rocky riverbank system			1	9
**Northern white cedar - balsam fir swamp			1	26
*Silver maple-false nettle-sensitive fern floodplain forest			1	24
Plants				
Allegheny-vine (*Adlumia fungosa*)		E	Historical	19
Alpine Milk-vetch (*Astralagus alpinus* var. *brunetianus*)			Historical	4
**balsam groundsel (*Packera paupercula*)		T	2	12
bristly rose (*Rosa acicularis* ssp. *sayi*)		E	Historical	2
*brook lobelia *(Lobelia kalmii)*		T	1	18
clustered sanicle (*Sanicula odorata*)		E	Historical	9
Great St. John's-wort (*Hypericum ascyron*)		E	Historical	7
hairy eared-rockcress (*Arabis pycnocarpa*)		E	Historical	4
Houghton's Umbrella Sedge (*Cyperus houghtonii*)		E	Historical	6
Incurved Umbrella Sedge (*Cyperus squarrosus*)		E	Historical	10
Loesel's wide-lipped orchid (*Liparis loeselii*)		T	Historical	25
Mountain Firmoss (*Huperzia appressa*)		E	Historical	14
purple virgin's-bower (*Clematis occidentalis*)		E	Historical	25
red-footed spikesedge *(Eleocharis erythropoda)*		E	1	4
small-headed rush (*Juncus brachycephalus*)		E	Historical	6
**wild chives (*Allium schoenoprasum*)		E	1	7
Vertebrates - Birds				
**Bald Eagle *(Haliaeetus leucocephalus)*		T	1	88
Northern Harrier (*Circus cyaneus*)		E	Historical	11
**Osprey (*Pandion haliaetus*)		SC	1	103
Invertebrates – Mollusks				
Dwarf Wedge Mussel (*Alasmidonta heterodon*)	E	E	1 (11/12/15)	14

Listed?
E = Endangered T = Threatened SC = Special Concern M = Monitored

Flags: Based on how rare the species or community is and how large or healthy its examples are in that town.
**** = Highest importance
*** = Extremely high importance
** = Very high importance
* = High importance

Please contact the Natural Heritage Bureau or the New Hampshire Fish and Game Department to learn more about endangered, threatened species and communities of concern.

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Brochures

"Stewardship Series New Hampshire Wildlife Action Plan":

Appalachian Oak-Pine Forests, Floodplain Forests, Grasslands, Headwater Streams Hemlock-Hardwood-Pine Forest, Lowland Spruce-Fir Forests, Marsh and Shrub Wetlands, Northern Hardwood-Conifer Forests, Peatlands, Shrublands, Vernal Pools

Tables

"Wildlife Action Plan Critical Habitats and Possible Associated Species in Bath, table provided by UNHCE, from NH WAP 2010 Appendix B and Chapter 3 (NH Wildlife Habitat Conditions).

Websites

Forested riparian buffers:

- *Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire; Chapter 4.3 Forest Management in Riparian Areas:* http://extension.unh.edu/goodforestry/assets/docs/4-3.pdf
- *Riparian Buffers for the Connecticut River Valley:* http://www.crjc.org/riparianbuffers.htm
- *Riparian Forest Buffers Function and Design for Protection and Enhancement of Water Resources:* http://www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm
- *Values of Riparian Buffers:* http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_riparianvalues.pdf

Gold dredging in rivers and streams:

- *Gold in New Hampshire* http://des.nh.gov/organization/commissioner/pip/factsheets/geo/documents/geo-1.pdf

Invasive plants:

- UNH Cooperative Extension: www.nhinvasives.org
- New Hampshire Department of Agriculture, upland invasive plant list: http://agriculture.nh.gov/divisions/plant-industry/invasive-plants.htm
- New Hampshire Department of Environmental Services, aquatic invasive plant list: http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/frightful_fourteen.pdf

Land Protection: *http://www.uvlt.org/land-conservation/*

Stream crossing for roads culvert assessment protocol:
New Hampshire Stream Crossing Guidelines May 2009
http://des.nh.gov/organization/divisions/water/wetlands/documents/culvert-assessment-protocol.pdf

Streams protected under the Shoreland Water Quality Protection Act (SWQPA):
http://des.nh.gov/organization/divisions/water/wetlands/cspa/documents/consolidated_list.pdf

Temporary stream crossings in forestry operations:
Best Management Practices for Forestry: Protecting New Hampshire's Water Quality
http://extension.unh.edu/resources/files/Resource000248_Rep267.pdf

Wildlife Action Plan (WAP):

- *NH Wildlife Action Plan* (WAP): http://www.wildlife.state.nh.us/wildlife/wap.html
- *Critical Habitats and Associated Species in NH*: http://www.wildlife.state.nh.us/habitat/critical.html
- *One Granite State, Many Habitat Types***:** http://www.wildlife.state.nh.us/habitat/types.html
- Taking Action For Wildlife (TAFW): http://takingactionforwildlife.org/.Wildlife Action Plan - Town Maps: http://www.wildlife.state.nh.us/maps/wap.html