



NASHUA RIVER
WILD & SCENIC
STUDY COMMITTEE

Nashua • Squannacook • Nissitissit Rivers

**Nashua,
Squannacook &
Nissitissit Rivers**
Wild & Scenic River Study Committee

DRAFT STEWARDSHIP PLAN

November 29, 2017



Nashua River at the Petapawag site in Groton, original oil painting by Heather Stoddart Barros, created in honor of the 85th birthday of her mother, Marlon Stoddart, a founder of the Nashua River Watershed Association.

Figure 1 Heather Stoddart Barros

Some value the river for its enriching qualities, and some for its abundant water power, and some because they can idle away their time in catching pout and pickerel. There are some also who delight in it as a “thing of beauty” and a “joy forever”. They love to wander on its banks, to plunge into its depths and float upon its surface. They return again and again to gaze on its flow when it shimmers in the sun, or is mottled by the rain-drops, or ruffled by the breeze. They are never tired of watching it from some high bank, ...or crumbling bluffs, and see it winding back and forth in the broad valley, like the convolutions of a mighty serpent, gleaming in the light with silvery scales.

History of Lancaster, Rev. Abijah Marvin, 1879

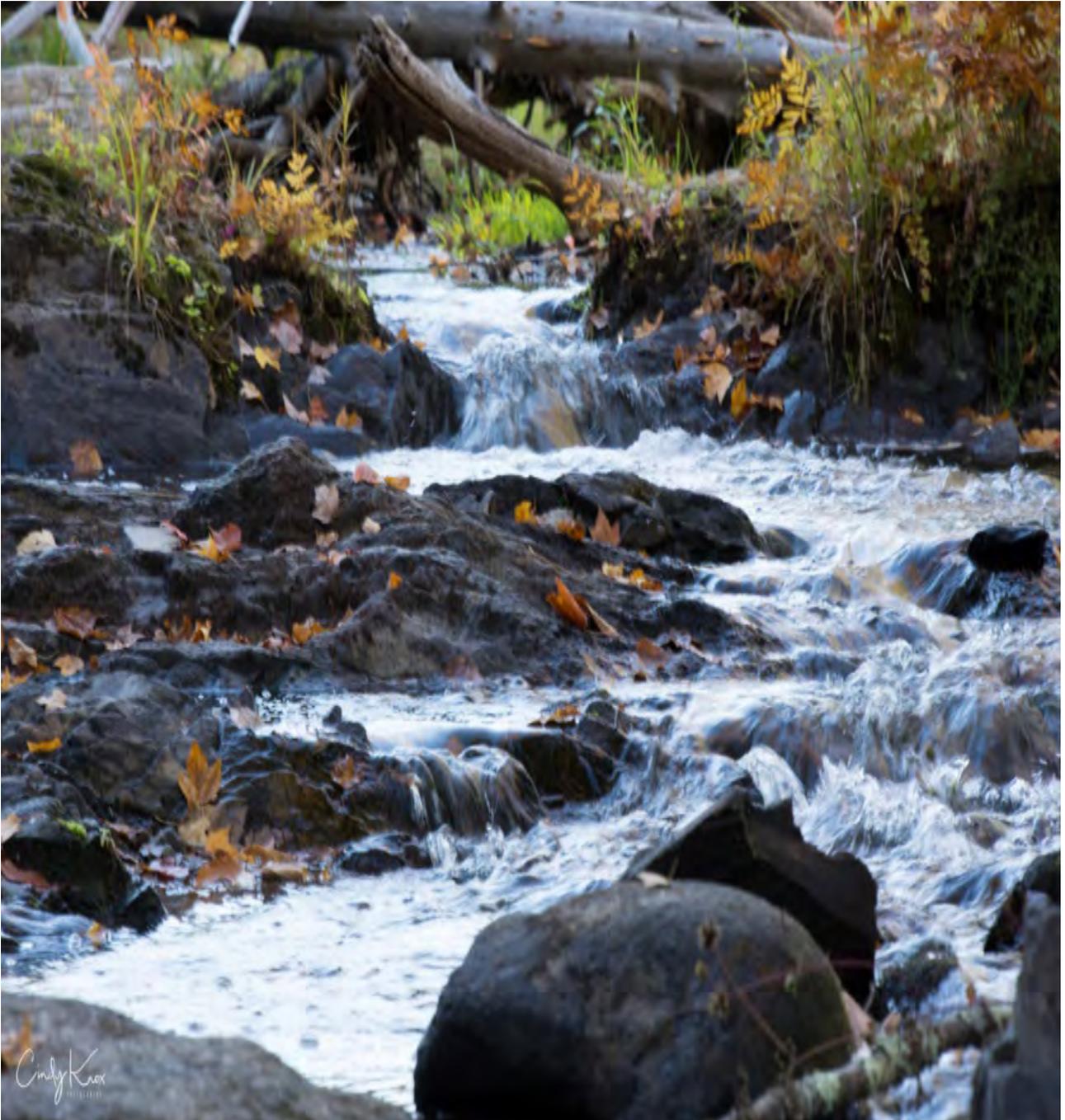


Photo: 1 Cindy Knox Photography

NASHUA RIVER WILD AND SCENIC STUDY COMMITTEE

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Town of Bolton	Rona Balco and Rebecca Longvall
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US Geological Survey	Jeff Barbaro

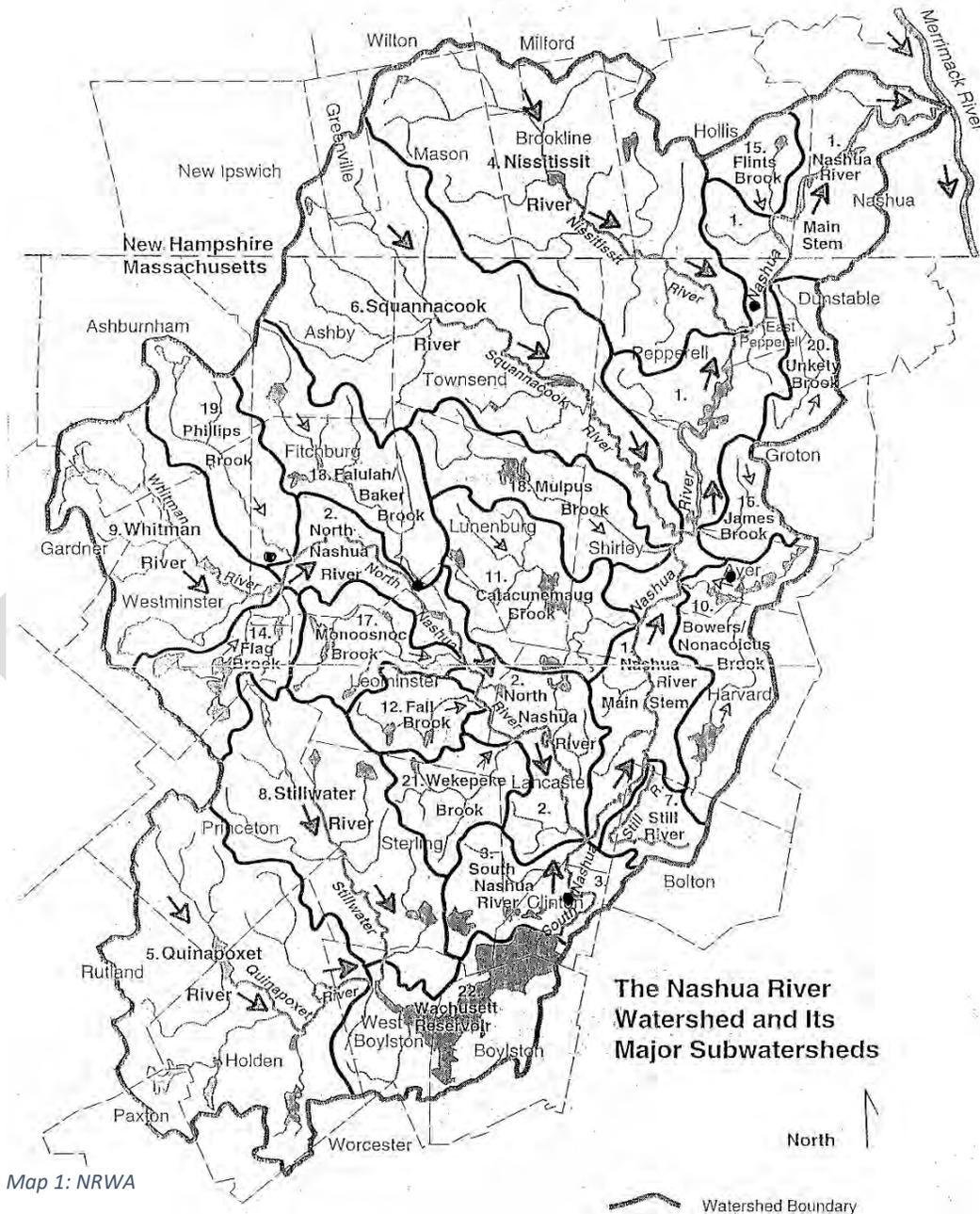
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Principal Reviewers: Martha Morgan, Neil Angus, Anne Gagnon, Paula Terrasi,...

Special thanks to those who provided assistance, ideas and input, to the study committee including, citizens who came to public meetings and agency experts who presented material to the Wild & Scenic study committee and sub-committees.

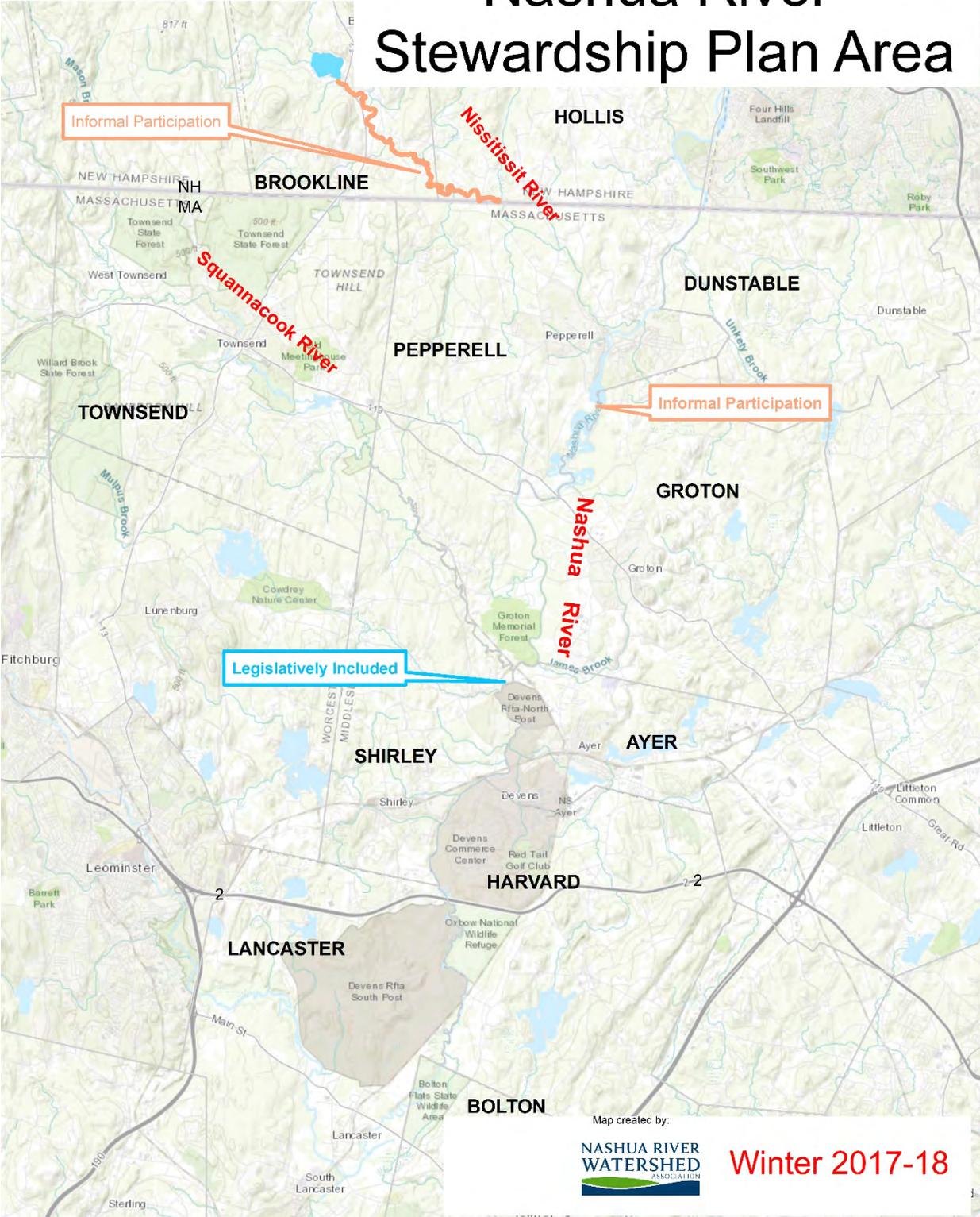
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Map 1: NRWA

Geographic Area Covered By This Plan:

Nashua River Stewardship Plan Area



Purposes:

This report has two purposes. One is to provide background information necessary to an eligibility determination by the National Park Service for Partnership Wild and Scenic Rivers system purposes. The other is to provide the Nashua W+SR Study Committee information for its river management and planning efforts. The report focuses on the Nashua, Squannacook and Nissitissit Rivers and adjacent areas within ¼ mile of each bank (the “river corridor”).

Background/Study Partners:

The river reaches in eight Massachusetts towns – Ayer, Dunstable, Groton, Harvard, Lancaster, Pepperell, Shirley and Townsend– were involved the Study since its inception in the Fall of 2015. The Study Committee was expanded in the Fall of 2017 to include representatives from Bolton Massachusetts and Brookline and Hollis New Hampshire when those communities elected to participate in the Wild and Scenic River Study. To maintain the program’s original intent of balancing various claims on the rivers, the Study Committee is designed to represent a variety of interests, including conservation, recreation, history, riparian owners, and local and state government.

Introduction:

A trip down the Nashua, Squannacook and Nissitissit Rivers -- and their tributaries - leads one through a distinctive landscape of forests, wetlands, floodplains, flatwater and moving water, farm fields, and historic districts. The importance of the Nashua goes well beyond the confines of the rivers’ corridors, and a number of resources contribute to give these river sections regional and national significance. These include:

- Public, permanently protected lands in the “greenway” corridor, including private and municipal conservation areas and forests, 4 state forests, 3 state wildlife management areas, and other “wild-like” parcels.
- The quality of the fisheries, which are the best for trout in eastern Massachusetts and are being reestablished under local restoration projects.
- Despite the proximity of these rivers to Boston MA, Worcester MA, and Nashua NH, high quality biodiversity, recreation and scenic, and historic and cultural experiences are available to visitors from these nearby urban areas.
- Varied canoeing and kayaking opportunities.

Because of these Outstandingly Remarkable Resource Values (ORRVs), three segments of the Nashua, Squannacook and Nissitissit Rivers are considered eligible and suitable for Partnership Wild and Scenic River designation.

A Stewardship Plan for the Rivers:

Because the rivers are so intensively used the residents of the Nashua, Squannacook and Nissitissit River region are concerned about maintaining and enhancing the unique ORRVs of the rivers' corridors and watershed. Some of these concerns came to light during the course of this draft Stewardship Plan (hereafter referred to as the "Plan".) According to this Plan, people are seemingly most concerned about sustaining the relatively high water quality, gains that have been decades long in the making, but that are still and increasingly threatened today; and, most people participating in this bottom-up study expressed support for a concerted effort to conserve the key resources of the rivers' corridors for future generations.

They stress that control over the future of the river should remain with local governments and private landowners. However, most people acknowledge that the conservation of the rivers and their corridors will require cooperative effort between all levels of government and private interests.

The Plan is intended to serve as a working document to assist stakeholders and guide agencies in directing staff and resources. By outlining specific strategies to mitigate priority watershed concerns it is intended to promote integrated, inter-municipal, multi-jurisdictional, watershed natural resource protection and improvement. The environmental priorities identified in this Plan may be used to focus local and regional regulatory decision-making and to target state grant programs and other resources such as educational and technical assistance programs.

The people of the Nashua, Squannacook and Nissitissit River watersheds have an opportunity to manage their rivers' resources through a regional cooperative partnership among town governments, the Nashua River Watershed (NRWA), local landowners, and the state and federal agencies which came together to create this Plan. The Committee that has formed during this study to write this Plan is capable of addressing any number of complex issues that may arise within the river's corridors.

The purpose of this Plan is to develop explicit goals, objectives and strategies for the on-going and future use and management of the land and water resources of the rivers' corridors and watersheds.

This Plan can serve as the foundation for continuing public and private efforts to protect and conserve these rivers. The goals of the Plan are to voluntarily and cooperatively work on regional issues of concern, such as water quality, to establish regional priorities for funding and implementation, and to develop standards and policies to guide decisions on matters of local concern, such as recreational use and access. This Plan includes a description of the biological diversity, recreational and scenic, and historical and cultural resources for the three rivers sections and their corridors. It also includes an evaluation of local and state laws, regulations and programs for river resource management.

Organizational considerations include a proposal to continue the work of the Study Committee, post-designation -- if designation is desired and achieved, given community support and formal decision to pursue such -- to establish a Nashua River Coordinating (or "Stewardship/Advisory") Committee comprised of participating town representatives; local residents; local, state and federal government agency staff; and private sector representatives. The to-be-formed "Coordinating Committee" will also need to consider a strategy for funding the implementation of the strategies and recommendations outlined in this Plan, which may include identifying sources of revenue and in-kind assistance notably from the local, state and federal government.

Rivers are dynamic systems. It is inevitable that in the near future, given this fact and the increasing competition for the various resources of the Nashua River corridor, that the corridor will change. Stakeholders including the residents of the region, the Nashua River Watershed Association, private landowners, local governments, state and federal agencies, and the National Park Service, have the interest and capabilities to assure that any human-induced changes enhance the resource values of the rivers and their corridor: if they follow the directives set forth in this Plan. The entities that came together to draft this Plan stand ready to offer assistance in implementing this Plan, but the town governments and private citizens must take the lead. The future of these rivers hangs in the balance.



Photo 1: Cindy Knox Photography

THE RIVERS AS CORRIDORS

The region of the Wild and Scenic Study Area has a long and remarkable history of conservationists, beginning with Native Americans, who utilized the area as prime hunting grounds because of its extraordinary wildlife habitat and density of wildlife¹. As stewards of this landscape they kept the area virtually free of all permanent settlements in order not to despoil this special and productive area.

More recently the area has spawned a long list of notable conservationists and conservation entities. Benton MacKaye (1879-1975) is one of several luminaries whose views were shaped by

¹ “Native Americans and later settlers would have been attracted to this area for not only the well-drained soils and fresh water supply, but also the wildlife that would have inhabited the many local wetlands. Wetlands in particular offered an often overlooked variety of relatively predictable, abundant, and nutritional resources for humans and their hunted prey. Wetland plants include emergent wetland species such as cattail, water plantain, and arrowhead, deep water species such as water lily, and wet meadow plants such as nutsedge. Ground nut also grew abundantly along riverbanks in the region before the introduction of domesticated pigs by Europeans.” (Groton Community-Wide Archaeological Reconnaissance Survey, Public Version, Mitchell T. Mulholland, P.I., Archaeological Services UMass Amherst, page 30 www.townofgroton.org/DesktopModules/Bring2mind/DMX/Download.aspx?PortalId=0&EntryId=14113)

our study area; he in turn “significantly influenced the evolving American conservation and environmental movements”². MacKaye is well known as the visionary inspiration behind and proponent of the Appalachian Trail and a co-founder of the Wilderness Society, his home terrain in Shirley Center provided the model and the muse for many of his ideas about forestry³, recreational trails, regional planning, conservation, transportation, wilderness preservation, and habitable and sustainable communities. MacKaye helped pioneer the idea of land preservation for recreation and conservation purposes, and was a strong advocate of balancing human needs and those of nature. Nearly one hundred years ago MacKaye urged Massachusetts’ state officials and conservationists to develop a linear park along the full length of the Squannacook River⁴ and Willard Brook, one of the Squannacook’s main tributaries. He proposed a south-north recreational greenbelt that he called a “Wachusett/Watatic Wilderness Way.” As a consultant for the 1929 Governor’s Committee on the Needs and Uses of Open Spaces he promoted a state-wide network of such wilderness ways that would serve “to control the flow of metropolitan civilization.”

“A most important element of MacKaye’s ideas and visions that are well worth heeding today, is the notion of using corridors following natural features, such as linear mountain ranges and rivers, ... for controlling and limiting growth, while providing recreational opportunities and protecting natural resources. Greenways, the conversion of abandoned railroad beds to trails, urban growth boundaries, the activities of local land trusts, and, of course, the creation of heritage areas exemplify today’s approach to ‘linking up’ separate corridor projects into larger regional networks. In combination these river corridors form not just a key habitat network but more importantly provide for landscape-level ecosystem requirements.” (Larry Anderson, Benton MacKaye and Freedom’s Way: The “New Exploration” of a Regional Environment, PowerPoint talk, March 17, 2003)

The Nashua, Squannacook and Nissitissit Rivers are ecological and biological corridors; animals use them as habitat and to pass through. The river valleys are both wildlife habitat corridors and natural south-north migration routes for terrestrial and aquatic fauna and flora set within a context of contiguous undeveloped, and, in many cases permanently protected, land. (Massachusetts Audubon Society, Focus Areas for Wildlife Habitat Protection in the Nashua River Watershed, September 2000). Our study area is one where efforts to protect major tracts of riparian land have

² Benton MacKaye, Larry Anderson, 2002, page 1)

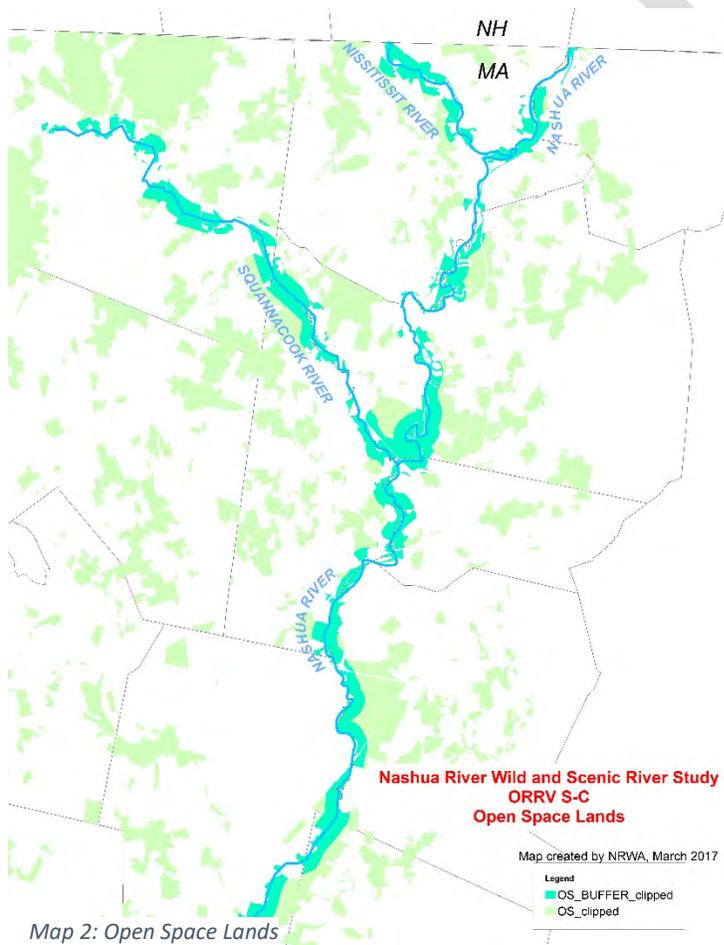
³ Benton MacKaye was also the first graduate of Harvard University’s School of Forestry in Petersham, MA.

⁴ See Appendix E - “Possible Layout for a Nashua-Squannacook Reservation”, hand-drawn map, 1945. Also, the 1952 *Conservation Land Use Plan for the Town of Groton Massachusetts* recommends “...acquiring land for a Squannacook River Park”, pages 9-10.

already met with significant success. The various conservation lands in our study area are crucial stepping stones for wildlife movement north from the anchor that is the Oxbow National Wildlife Refuge (ONWR)⁵.

“The ‘Oxbow/Intervale/Bolton Flats’ area is also cited in a report, Focus Areas for Wildlife Habitat Protection in the Nashua River Watershed, as a large wildlife habitat focus area of ~8,500 acres. These areas with large amounts of little-disturbed interior are ‘cornerstones of a habitat reserve design for the Nashua River Watershed.’ The report notes, ‘Tracks of bobcat, black bear and moose have been recorded within this focus area. Bobcats are particularly sensitive to human disturbance and their presence in an area is a very strong indicator of high quality habitat.’” (“Harvard Open Space and Recreation Plan”, page 35)

In addition to the Oxbow National Wildlife Refuge -- which itself alone protects eight miles along the Nashua River -- the Nashua, Squannacook and Nissitissit River corridors provide linear



linkages among several other sizeable public conservation lands in our study area, notably: Ayer State Game Area, Bolton Flats Wildlife Management Areas (WMA), Groton Town Forest, J. Harry Rich State Forest, Sabine Woods, Squannacook and Nissitissit River WMAs, Surrenden Farm, and Townsend State Forest.

Much of the remaining unprotected riparian land enjoys partial protection under the 1996 MA Rivers Protection Act and under local floodplain zoning

⁵ For example, the ONWR beneath the bridge carrying Route 2 over the Nashua River is one of the few locations for wildlife to cross the barrier created by that heavily trafficked highway.

bylaws⁶. These three largely protected river corridors do not abruptly end at the New Hampshire state line, rather they are continued by the holdings of the Brookline Conservation Commission, Nissitissit River Land Trust and Beaver Brook Association (~2,200 acres) in Hollis and Brookline, NH. [Note: *As far back as 1963 the New Hampshire Natural Preserves Forum wrote: “An attempt should be made to protect this [Nissitissit] River in a joint project with Massachusetts. On a small scale this would be comparable to some of the ‘Wild River’ projects of the national government.”*]

This pattern of extensive open spaces connected by riparian corridors creates a synergistically larger, unified entity from what would otherwise be fragmented areas⁷. In other words, maintaining the connectivity of ecologically and biologically diverse open spaces and habitats is important at the regional scale because connectivity lends the components of our shared landscape the resilience needed to survive challenges, such as climate change, better than isolated areas can.

In its 1992 *Survey and Evaluation of Wetlands and Wildlife Habitat, Fort Devens, MA* the US Fish & Wildlife Service stated "... the value of large, contiguous undeveloped areas for species long term protection outweighs exponentially that of an equal area of disjunct refugia spread among suburban environs" (page 71). The quantity of rare species found in our study area confirms this.

As the science of landscape ecology tells us: where lands are still interconnected, ecological processes are more likely to persist in a continuous system to provide 1) dispersal corridors -- thereby protecting local populations from chance extinction events – and, 2) opportunities for regional recolonization and genetic flow to outside populations; here, that is primarily to the north and south⁸. Our study area has high ecological integrity, and is a resource rich unit that has been state-recognized as three unique Areas of Critical Environmental Concern (ACEC): the *Central Nashua River Valley*, *Squannassit* and *Petapawag* ACECs. These three contiguous ACECs together comprise ~76,000 acres or 118 square miles.

⁶ The focus of the very first Nashua River Watershed Association “Greenway Committees” (circa 1969 on) was to get each town to have “floodplain protection” zoning bylaws.

⁷ *The Role of Riparian Corridors in Maintaining Regional Biodiversity*, Naiman, 1993

⁸ South to north corridors in New England are particularly important in a time of climate warming as species must evolve their ranges northward; see <https://climateactiontool.org>.



Map 2: MA EOEAA website

The connectivity of the three ACECs via the Nashua River provides significant linkages between important wildlife areas. Indeed, when one includes MassWildlife's Bolton Flats Wildlife Management Area the amount of open space along the Nashua River creates what could be the largest, least human-impacted habitat in the entire 530 square mile Nashua River watershed. [Note: ACECs⁹ are a formal designation made by the MA Secretary of

Environmental Affairs to protect and preserve areas of environmental significance. The designation notifies regulatory agencies and the public that most development activities under State jurisdiction within ACEC's must meet high environmental quality standards. The fundamental reason for these designations was the need to protect both open spaces and the interconnections that are essential to maintaining the biological diversity of the entire region.]

Efforts to protect our key resources go back many decades. Prepared by the Nashua River Watershed Association in 1970, the first Regional Plan for the Nashua River Greenway called for: “protecting the watershed; providing habitat for wildlife; conserving the ecology; preventing future river pollution; providing open space and outdoor recreation opportunities; maintaining high water quality; increasing property values; enhancing the general economy; and providing a population buffer zone”.

Relatedly, William P. Wharton (1880 – 1976) – of Groton MA, contemporary and friend of Benton MacKaye, incorporator of both the Nashua River Watershed Association and the New England Forestry Foundation, and President of the National Parks Association – was an advocate of numerous local as well as national conservation projects. He is also credited with introducing the idea of the Town Forest into the United States¹⁰. The area was also home to Ellen Swallow Richards of Dunstable, who is credited with establishing the field of ecology in the 1890's. The area was also the home of the Lowthorpe School, the second school of Landscape Architecture in

⁹ www.mass.gov/eea/agencies/dcr/conservation/ecology-acec/areas-of-critical-environmental-concern-acec.html

¹⁰ *Massachusetts Forest and Park (Association) News*, August 1970, page 98.

the United States, where numerous leading landscape architects studied. Noted landscape architect and Harvard Professor Charles Eliot II, was a patron of the school. In 1963, Eliot also wrote Groton's first Master Plan, which introduced advanced concepts of environmental protection and planning.

In 1923 Jeff Smith (1902 – 1987) inherited a neglected “Buttonwood” farm in Hollis, New Hampshire and devoted the next 40 years to dairy farming. After retiring he began championing limited growth and conservation, having become troubled about rapid population growth in Hollis and surrounding communities. Jeff's cousin, Hollis Nichols, joined with him in acting on their shared interest – acquiring land for conservation. Beginning with Hollis's own estate, in 1964 Jeff and Hollis organized Beaver Brook Association to protect local land from development. During the next decade and a half, with help from gifts of money, they were able to negotiate 86 different purchases totaling 1,500 acres, including Jeff's own 200 acres gifted to Beaver Brook Association. The formation of other land trusts¹¹ has also been influenced by Jeff's work.

In 1968, Jeff helped organize the Nissitissit River Land Trust dedicated to protecting all of the land along the Nissitissit River, much of which has now been protected. Jeff also inspired the formation of the Nashoba Conservation Trust in Pepperell as well as the eponymous Nichols-Smith Land Trust. The “Jeff Smith Trail” -- 8 miles over parcels of land in Hollis and Pepperell that are owned by organizations helped by Jeff -- was created to permanently honor Jeff's lifetime-long efforts. Jeff also helped establish the Hollis Conservation Commission, which in 1966 petitioned New Hampshire's Governor Peterson to stop the polluting of the Nashua River. The Commission then contacted Massachusetts conservation commissions along the Nashua River to tell them what Hollis had done and to ask them to do the same. This outreach on the part of the Hollis Conservation Commission likely played a significant role in the formation of the Nashua River Clean-Up Committee, and, as detailed elsewhere in this document, the subsequent formation of the Nashua River Watershed Association.

More recently, Marion Stoddart, also of Groton MA and one of the Nashua River Watershed Association's founders, was handed the baton to carry on the good work of both land and water

¹¹ The focus of the very first Nashua River Watershed Association “Greenway Committees” (circa 1969 on) was the formation of local land trusts throughout the watershed.

conservation, and has done so outstandingly for the past half-century. (See below “The Marion Stoddart Story” of River Restoration on page 81)

And every year Congresswoman Tsongas holds an annual “Rivers Day” in her district; in 2012 she hosted her sixth Rivers Day event on the Nashua River in Groton; in 2016 and 2017 she hosted her tenth and eleventh Rivers Day events on the Nashua River both at the newly-opened Bill Ashe Visitor Facility-Oxbow National Wildlife Refuge in Devens that featured a paddle on that river.

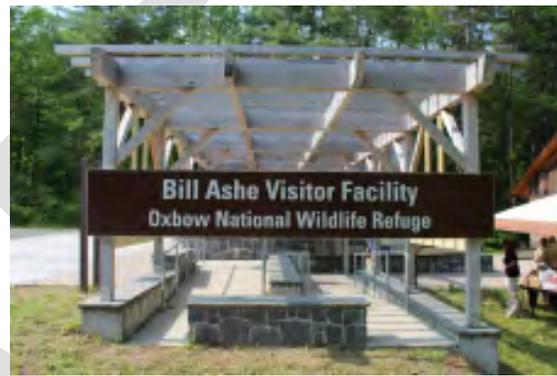


Photo 2: Both NRWA Archive

OUTSTANDINGLY REMARKABLE RESOURCE VALUES



Photo: 2 Cindy Knox Photography

To be included in the National Wild and Scenic Rivers System, a river must meet certain eligibility criteria, including possessing at least one Outstandingly Remarkable Resource Value (ORRV). An ORRV must be natural, cultural or recreational in character, river-dependent, and have unique, rare or exemplary qualities on a regional or national scale. The Nashua, Squannacook and Nissitissit Rivers possess a great many such resources that meet these criteria which are enumerated below and include aspects of: biological and ecological diversity; recreational and scenic values; and, historic and cultural resources.

Geography:

The Nashua River watershed includes parts of 31 communities in Massachusetts and New Hampshire, with a total drainage area of approximately 538 square miles. The river flows for a total of 56 miles before joining with the Merrimack River at Nashua, NH. The Nashua River and its tributaries have some highly unusual characteristics. The majority of the tributaries that feed the main stem of the Nashua River flow in a southerly direction, while the main stem flows in a northerly direction. The North Nashua River begins in the former industrial centers of Fitchburg and Leominster before flowing into Lancaster. The South Nashua River flows from the Wachusett Reservoir, which serves as part of the water supply for Boston. The two main branches of the river join in Lancaster to form the main stem which then flows to its terminus in New Hampshire.

The Shaping Forces: Geology, Aquifers and Ecoregions

Geology: The bedrock underpinning of our study area is made up of two types of rock: granite and other igneous types, and metamorphic, primarily schist and gneiss. Over ten thousand years ago, the Nashua River valley was carved by moving glacial ice that was over one mile thick. The Nashua River itself was once Glacial Lake Nashua, an enormous lake that extended from Boylston, Massachusetts north to Nashua, New Hampshire. At that time, the mainstem river flowed southward through the Worcester area.

Bedrock and a thin layer of glacial till “hardpan” dominate the higher elevations of the watershed, especially to the west and northwest, where the main tributaries to the mainstem Nashua River rise (Squannacook and Nissitissit as well the Quinapoxet, Stillwater, and North Nashua Rivers). These relatively cooler, higher-gradient rivers all flow from the northwest to the southeast and meet the Nashua River at sharp angles, turning to join the mainstem which flows in a northeasterly direction. The flow of the tributaries is additional evidence that the Nashua River used to flow south.¹² The river’s course was reversed as the edge of the last ice age glacier melted away, leaving Glacial Lake Nashua to drain to the north. There are many sand and gravel deposits dating from the glacial period in the central part of the valley. These porous deposits often have accessible groundwater used as municipal water supplies.

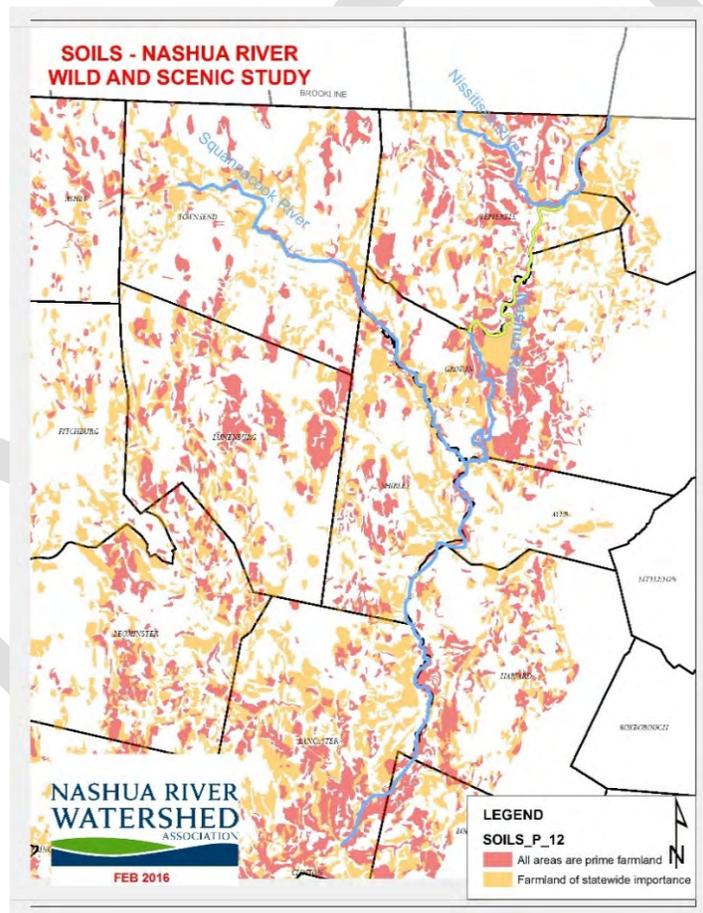
There is considerable landscape-level geomorphologic variation within our study area, which is characterized by topography dominated by glacially-shaped geological forms and river valleys underlain by aquifers. Not surprisingly it has many glacial artifacts: kettlehole ponds with fluctuating water levels, spruce bogs, kame terraces and eskers, and sandy outwash soils. Such soil acts as a recharge area in large floodplains, which support many types of rare flora. Not only is the area especially rich in diverse wetland habitats because of the meandering Nashua River, but there is also an unusual amount of field, floodplain grassland and wet meadow habitat due to the river's oxbows and wide floodplains.

¹² Reference in History of Lancaster, 1879 re: shape of Pine Hill.



This map, taken from Abijah Marvin's History of Lancaster, shows some of the early roads and bridges on the Nashua. Long ago, when the town's center was on the Old Common, to head north, travelers took a long bridge across the floodplain from Five Corners to the large curve in Neck Road. Farther north, at Lane's Crossing (where Harvard and Seven Bridge Roads cross), the traveler could take the Post Road west toward Brattleborough, Vermont, or continue north up Harvard Road. This map also shows the Neck area (across the upper part of the Y made by the river lines above). This long plateau of land sloping gently down to the river on both sides extends northward from the Meeting of the Waters to the southern base of Ponakin Hill (not shown on this map). All of Lancaster Center is on the Neck.

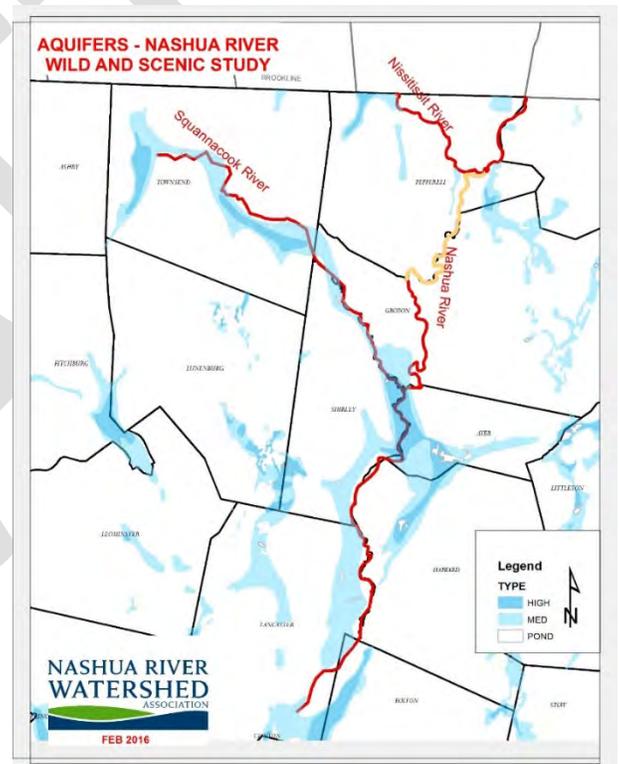
Figure 3 Images of America: Lancaster



Note: There are other considerable “ecosystem service” benefits associated with wetlands and floodplain grasslands: because of their high rates of production they are second only to rainforests in removing carbon from the atmosphere, thereby moderating global warming; (i.e.: sedges,

rushes, forbs and grasses), removing surplus nutrients from overland runoff and preventing these and other pollutants from entering our rivers.

Aquifers: High-yield, high- productivity aquifers – defined as more than 300 gallons per minute -- are found under several of our study area towns and are tapped as municipal sources of public drinking water supplies. For example, Pepperell depends on groundwater for both public and private wells, with 80% of the households' dependent on its three municipal public wells. The Devens Regional Enterprise Zone (former Fort Devens military base) has 3 gravel-packed wells that provide nearly 5 million gallons per day of potable drinking water to the more than 90 businesses and 500 residents that call Devens home. The West Groton Water Supply District operates wells on the bank of the Squannacook River. The Shirley Water District is Massachusetts' first ever Water District; it manages four gravel packed wells, supplying over 4,500 customers in Shirley and surrounding communities. In Townsend, recognition of the importance of its high-yield aquifer came with the passage of the 1986 Aquifer Protection Overlay District Bylaw which protects the aquifer from new structures pine hilland uses considered hazardous. The Wekepeke aquifer under portions of Lancaster is another high-yield aquifer which provides a municipal backup well and could be a potential public water source for the larger region. **See Table X (text box?)** for a list of the Nashua Basin water withdrawals.



As a major aquifer recharge area, the Nashua River valley stores floodwaters and precipitation in its numerous wetlands and sandy glacial soils. Maintaining flood storage capacity within the Nashua River valley is critical to preventing flooding downstream. Where the valley broadens, the river and stream beds have a flatter slope than areas upstream, and the floodplains and associated wetlands widen, the permeable sand and gravel floodplains percolate the floodwaters and act as a

giant holding tank, minimizing flood damage downstream. (*Central Nashua River Valley ACEC Nomination Report*; pages 5-6)

Ecoregions: Our study area occurs in an area of overlap of two major forest groups: the Northern (a mixed group of sugar maple, ash, beech, and birch) and Central (dominated by oaks with some hickories) Hardwoods regions. The forest vegetation of the study area is a mix of northern and central hardwoods interspersed with hemlock and white pine. These two forest types now mingle in the Nashua watershed in what is called the transition zone, giving us a wonderfully diverse array of forest types to enjoy today. Additionally, the varied topography ranges from the “Worcester Monadnock Plateau” sub ecoregion¹³ --

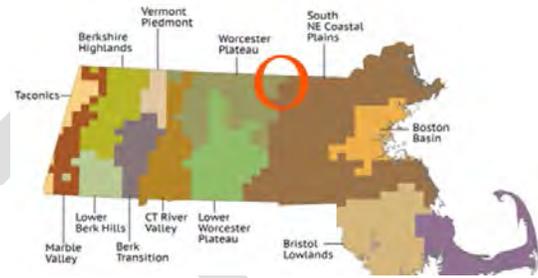


Figure 4: MA EOEEA website

areas with a distinctive ecology and physical landscape -- in the steeper headwater sections to more gently rolling terrain to generally flat lowland river valleys in the east: the large "Gulf of Maine (Southern New England) Coastal Plain Ecoregion" sub ecoregion. Because of this elevational and topographical difference, the change in habitat over a small distance can be dramatic.

Grassland habitats decreased in New England with farm abandonment in the 1800s and have become increasingly less common with suburban sprawl and the regeneration of our forests. But within portions of our study area, especially along the Nashua and Squannacook River floodplains, open fields are relatively widespread because farming is still active. Some areas are deliberately maintained as early successional habitats in order to preserve wildlife diversity; examples of this can be found in several conservation parcels in our focus area that are mowed annually to maintain an herbaceous community.

It is interesting to note that historically untilled patches of forest are more likely to have higher native biodiversity than areas that were tilled and supported row crops. Presence of dense patches of wintergreen (*Gaultheria procumbens*) have been shown¹⁴ to be more abundant in unplowed than

¹³ In southcentral New Hampshire this same eco-region is described as “Hillsboro Inland Hills and Plains” (see www.wildlife.state.nh.us/wildlife/images/wap11x17-habitat2015.jpg).

¹⁴ “Controlling site to evaluate history: vegetation patterns of a New England sand plain”, Motzkin, G., et al. *Ecological Monographs*, 66: 345-365, 1996. And, “Effects of the past and the present on species distributions: land-use history and demography of wintergreen”. Donohue, K., et al. 2000. *Journal of Ecology* 88: 303-316. Thanks to Pat Swain Rice,

plowed lands. Wintergreen patches in large areas, for example as can readily be found along the Squannacook River, suggest that these lands have been continuously forested and likely support a greater biodiversity of microflora and fauna, as well as vascular plants, than nearby areas that were tilled.

DRAFT

recently retired natural community ecologist for the MA Natural Heritage Endangered Species Program (NHESP) and author of [Classification of Natural Communities of Massachusetts](#), for bringing this to our attention.

ORRV #1 – Biological Diversity



Photo: 3 Ken Hartlage



Photo: 4 MassWildlife

Biodiversity: Another consequence of this combination of factors – the confluence of distinct ecoregions and transitions between them – is that our study area supports outstanding overall biodiversity. Biological and ecological diversity in the study corridor can be measured by the sheer number of species, and also by the number of species assemblages (natural communities of plant and animal species that share a common environment and occur together repeatedly on the landscape). Abundant wetlands, grasslands and uplands shelter many rare species, most of which need more than one habitat to survive, or depend upon increasingly rare habitats. *[Note: Another benefit of the protected areas around our study area’s several aquifers is that many MA Natural Heritage and Endangered Species Program (NHESP) Priority and Estimated Habitats are found overlying them.]*

Having a high number of state-rare species in the watershed is largely a function of the existence of intact special habitats/natural communities and the large extent of contiguous open space. The Nashua, Squannacook and Nissitissit Rivers--as well as Unkety Brook--are described by NHESP in its 2012 “BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World” Report as:

“...the watery framework for a complex landscape that supports an exceptionally high number of rare and uncommon species. Forty-one such turtles, dragonflies, freshwater mussels, salamanders, plants and other species inhabit these rivers, brooks, and vernal pools. Good populations of the globally rare Brook Floater mussel inhabit the Nissitissit River, while the equally rare Ringed Boghaunter dragonfly can be found in four boggy sites across this large Core Habitat.”

.....

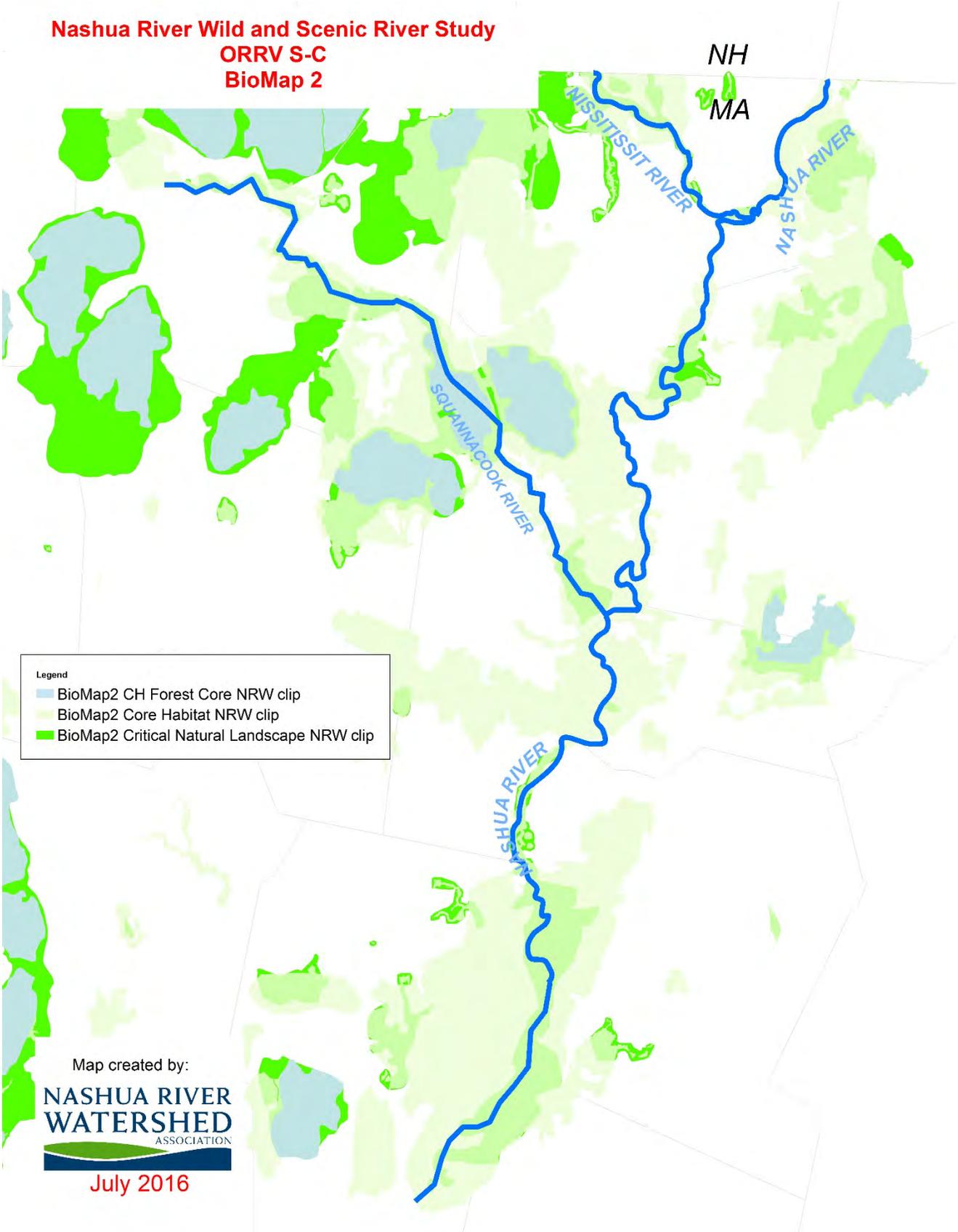
Priority Natural Communities: The Nashua River corridor consists of significant portions of terrestrial habitat designated by the BioMap2 project as “core habitat”, representing the highest priority for biodiversity conservation and protection (www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/land-protection-and-management/biomap2/).



Lovering Farm, on the Nashua River in Harvard, is pictured on May 27, 1894. The Nashua River played an important role in the history of Harvard. When the town incorporated in 1732, the Nashua defined Harvard's western boundary. Some 10,000 years ago, this area was a glacial lake bed. Clay from this glacial lake bottom was also mined to make bricks. The fertile lands along the banks of the river were some of the best agricultural lands in town. Interestingly, patterns of property ownership for these fertile bottom lands differed from the adjacent lands upslope to the east. In general, the choice agricultural bottom land lots were much smaller and changed hands more frequently. Over the years, the river meandered around this flat flood plane, creating a series of oxbows, now the Oxbow Wildlife Refuge. Over the years, the river provided a natural transportation route to Lowell and the Merrimack River to the north. In 1847, the railroad took advantage of the flat land when it built the Worcester Nashua line just to the east of the Nashua River.

Photo: 5" Images of America: Harvard "

**Nashua River Wild and Scenic River Study
ORRV S-C
BioMap 2**



Additionally, six MA NHESP exemplary or “Priority Natural Communities¹⁵” occur along the Nashua River: Kettlehole Level Bog (Groton); Pitch Pine – Scrub Oak (PP/SO) Community (Lancaster); Red Maple- Black Ash Swamp (Ayer); Alluvial Red Maple Swamp (Harvard); Small-river Floodplain Forest (Ayer); and High-terrace Floodplain Forest (Bolton and Lancaster). Since few intact floodplain forests remain in New England, these are considered by The Nature Conservancy to be “arguably the rarest forest type in the region.” Also, MassWildlife has made the Pine Hill area adjacent to the Nashua River in Lancaster a priority to preserve and to protect because it has some of Central Massachusetts last remaining Pitch Pine – Scrub Oak (PP/SO) patches. PP/SOs are a unique habitat -- threatened by forest fragmentation -- that occur on outwash sandplains, which are themselves much reduced in the study area (and state wide) because of ease of development, and for being attractive for sand and gravel mining.

ACECs: There are three Areas of Critical Environmental Concern (ACEC) in our Study area: the Central Nashua River Valley ACEC (12,900 acres, 1996), the Squannassit ACEC (37,420 acres, 2002), and Petapawag ACEC -- “swamps on a hill” -- (25,680 acres, 2002). Massachusetts’s ACEC’s “...receive special recognition because of the quality, uniqueness and significance of their natural and cultural resource.” For example, Petapawag ACEC is most important for the diversity of wildlife and rare species: the NHESP database indicates that there are sixteen state-listed rare species and one federally-listed threatened species in this one ACEC.

More specifically, within the Squannassit ACEC the Nissitissit River watershed includes sightings of American Bittern (endangered), Brook Snaketail (dragonfly, special concern), Spotted Turtle (formerly of special concern), and Wood Turtle (special concern). The Squannacook River corridor has several records of rare species including the Marble Salamander (threatened), Blanding’s Turtle (threatened in Massachusetts and petitioned for federal listing; see <https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=C05M>), Creeper (mussels, special concern), Bridle Shiner (minnow, special concern), and Wood Turtles (special concern). [Note: According to Mike Jones, State Herpetologist: “*the Nashua [River] is also the site of some of the earliest scientific observations on wood turtles, which need restoration efforts....Beginning in 1854, Sanborn Tenney*

¹⁵ www.mass.gov/eea/docs/dfg/nhosp/natural-communities-facts/priority-natural-commun.pdf and www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/natural-communities/natural-community-fact-sheets.html

and Louis Agassiz studied a population in Lancaster, described in Agassiz' *Contributions to the Natural History of the United States*¹⁶” (personal communication with Mike Jones, December 19, 2016)]. The Nashua River corridor provides breeding and migration habitat for listed bird species such as King Rail, Pied-billed Grebes, and Common Moorhens, and provides potential habitat for American and Least Bittern as well as the blue spotted salamander and the water shrew, both of which are dependent on the interspersed wetland and terrestrial habitats.

Turtles: Our study area is also the home of the largest known population of state-listed Blanding's turtle: according to herpetologist Brian Butler ours is the only core Blanding's habitat in Massachusetts. Mike Jones, State Herpetologist, writes “the Nashua River watershed supports the largest contiguous and unfragmented population of Blanding's in Massachusetts” (personal communication with Mike Jones, December 19, 2016), and NHESP calls it “...a very significant population, possibly the largest in New England”

(www.mass.gov/eea/docs/dcr/stewardship/acec/acecs/cnr-des.pdf, page 5). According to *BioMap2*, Blanding's turtles use many parts of this landscape throughout their decades-long lives, from feeding and over-wintering in deep vernal pools and buttonbush shrub swamps to nesting in open, sunny, well-drained fields and abandoned gravel pits. Because of their extensive movements over the course of the year, Blanding's turtles require larger landscapes than many other turtle species. (www.fws.gov/northeast/ecologicalservices/turtle/species/blandingsturtle.html)

Loss of only a few adults annually can cause populations to decline as they do not reproduce until late in life (14-20 years), and have low replacement rates due to low nest and juvenile survivorship. Roads are the primary cause of adult mortality. Despite concerns about the ongoing decline attributable to the lack of suitable nesting sites and continued road mortality, this local population appears to be healthy and growing -- it is a regional stronghold -- and will continue to do so as long as their travel corridors and habitats are protected. Indeed, in 2002 the region was being considered as having two of only nine “state herpetofauna reserves” due to the “presence of

¹⁶ Agassiz (1857, vol. 1, p. 294) in speaking of occurrence of wood turtles in Lancaster, Massachusetts, says it “is so common in the neighborhood. . .that I have at times collected over one hundred specimens in an afternoon....”

multiple rare herptile species, relative lack of habitat fragmentation, and diversity of wetland types.”¹⁷ www.mass.gov/eea/docs/dcr/stewardship/acec/acecs/petwag.pdf

The proposed 18,000-acre Unkety Brook Herp Reserve was to include the northern half of the proposed Petapawag ACEC, plus additional areas. This herp reserve was delineated to protect populations of Blanding’s Turtles, Spotted Turtles

(at that time on Massachusetts’s rare species list), and Blue-spotted Salamanders. Only three of the nine proposed herp reserves were known to harbor more than two of the targeted rare reptiles and amphibians; the proposed Unkety Brook Herp Reserve was one of those three. This herp reserve would have been the largest of the herp reserves delineated across the state. As the Natural Heritage report on the

Figure 7. Recommended reserve boundary for rare herpetofa conservation site, in the towns of Groton, Dunstable, a

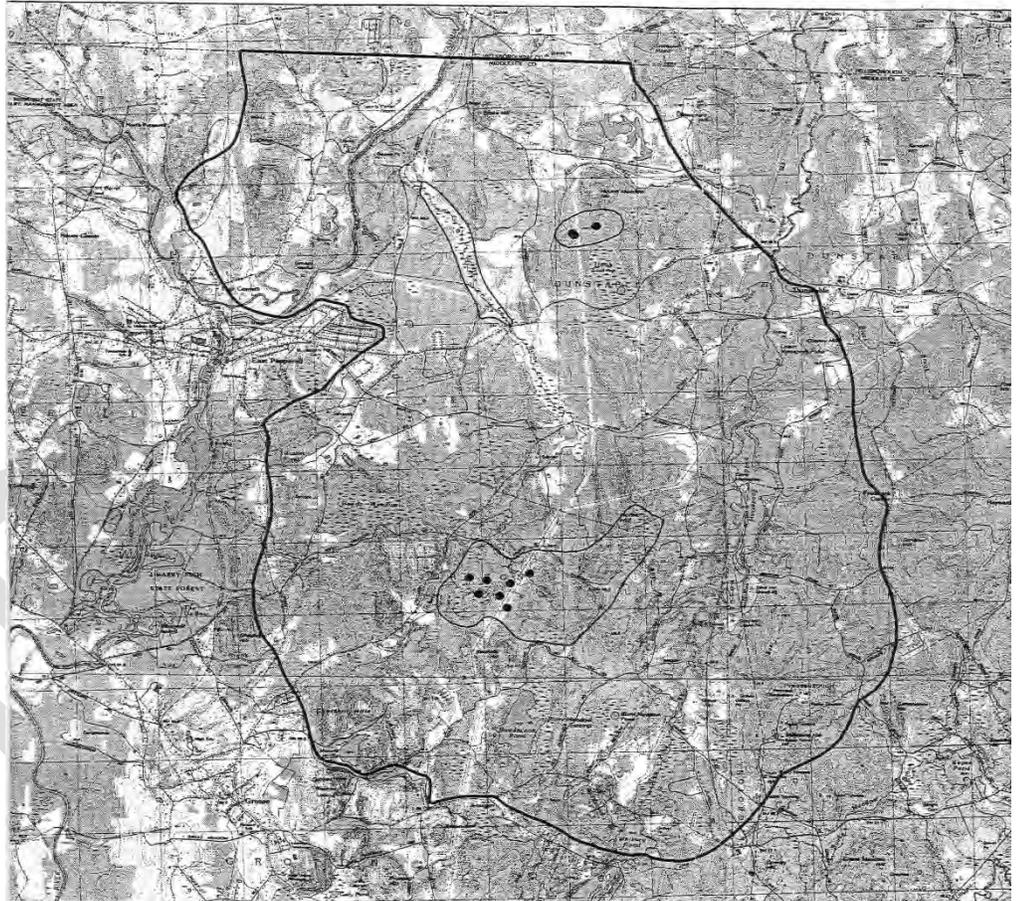


Figure 5

¹⁷ From 1998 through 2000, the MA NHESP surveyed sites across the state for state-listed rare reptiles and amphibians, eventually choosing nine areas as potential “herp reserves” because of the presence of multiple rare herptile species, relative lack of habitat fragmentation, and diversity of wetland types interspersed with undeveloped uplands. The reserve areas were delineated around known rare species sites based on dispersal distances and habitat use for each rare herptile species represented at a site, so that the population of each species could have a high likelihood of long-term persistence. The proposed 6,700-acre Squannacook Herp Reserve would have been almost completely incorporated into the eastern portion of the Squannassit ACEC, with a small part in the Petapawag ACEC. This reserve was delineated to protect populations of Blanding’s and Spotted Turtles and appears to contain the highest density of vernal pools of all nine contemplated herp reserves.

project stated, “...the Unkety site may be key to the persistence of Blanding’s turtles in Massachusetts and may be essential to maintaining connectivity with populations of target species in New Hampshire and Maine.”

Additionally, two dozen other state-listed threatened, endangered or species of special concern exist in this region. The majority of fauna on the MA List of Endangered, Threatened or Special Concern Species are so designated because of loss of habitat to development. Without places to breed, nest and find food, they have little chance of long-term survival. Part of the purpose of this study effort is to educate the public about the need to identify and protect large contiguous areas of undeveloped land as wildlife habitat.

Recommended reserve boundary for rare herpetofauna at the S
in the towns of Groton, Pepperell, Shirley, Townsend, and I

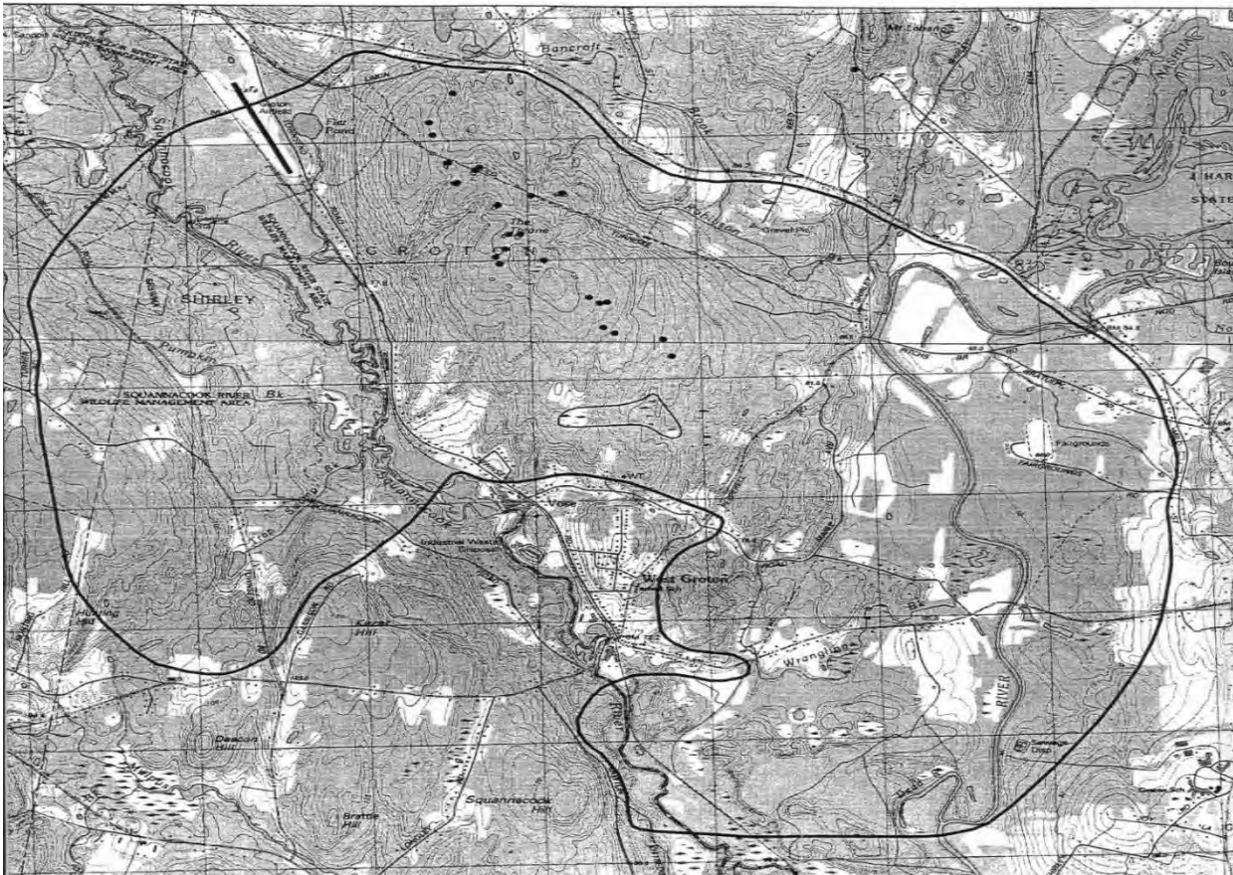


Figure 6

Fishery and Mussels: The Nissitissit River and its tributaries – Gulf, Mine and Sucker Brooks -- are coldwater fisheries resources¹⁸ (“CFR”; Mass DFG 2015) containing native Eastern Brook Trout. There are nineteen tributaries to the Nashua, Squannacook and Nissitissit Rivers that are state-defined cold-water fishery resources—as are the Squannacook and Nissitissit Rivers themselves – especially notable are: the Squannacook River¹⁹ which supports a native trout population in its upper end, and its tributaries -- Willard, Trapfalls and Locke Brooks – which support native Eastern Brook Trout. It is likely that some of these trout find their way into the mainstem Nashua River. (USFWS Oxbow National Wildlife Refuge, Final Comprehensive Conservation Plan, February 2005)

The Squannacook-Nissitissit Rivers Sanctuary Act (MGL 132A:17, 1975) was passed to protect the Outstanding Resource Waters (ORWs) of these two rivers and associated named tributaries from degradation by new discharges of pollution. Therese Beaudoin, MA Department of Environmental Protection (DEP) Watershed Coordinator, stated:

*“The Massachusetts Department of Environmental Protection has studied water quality in the Nashua Watershed since the late 1960s. The Squannacook River has provided an ideal location for establishing least impacted conditions for both water quality and flow, and has **served as a reference river for decades**. A **long term monitoring station** was established here in 1998, with sampling conducted every two months; available data show that water quality and aesthetics in the Squannacook River have been consistently among the cleanest in Central Massachusetts.”*
(emphasis added)

In 1974 a stream survey of the Nashua River system found only aquatic species most tolerant of pollution. Today, the Nashua River supports a substantial warm water game fishery (including large-mouth bass, chain pickerel, brown trout, fallfish, carp, brown bullhead, yellow perch and bluegill) which is heavily used by recreational fishermen is also “fished” by mink, otter, mergansers, bald eagles, osprey and great blue heron. Brook trout spawn in the tributaries and travel to the Nashua River for part of each year. The burgeoning fish population in the mainstem Nashua River is sustained by all the surrounding open water wetlands. American Eel exist in the

¹⁸ A Coldwater Fish Resource (CFR) is a waterbody (stream, river, or tributary thereto) where reproducing Coldwater Fish use such waters to meet one or more of their life history requirements. CFRs are particularly sensitive habitats. Changes in land and water use can reduce the ability of these waters to support trout and other kinds of coldwater fish. Identification of CFRs are based on fish samples collected annually by staff biologists and technicians. See: www.mass.gov/service-details/what-is-a-cfr

¹⁹ One may hear that the Ameri-Indian (Nipmuc) name *Squannacook* means “place for taking salmon”.

Nashua and Squannacook Rivers, and upstream eel (elvers) passage has been installed at Ice House Dam on the Nashua River, though there is no fish passage.

The Nissitissit River is home to six species of freshwater mussel -- one of the most highly endangered animal groups in North America -- which require clean water²⁰. In Massachusetts,



Photo: 6 NRWA archive

freshwater mussels are a Species of Greatest Conservation Need (SGCN) by MassWildlife and good sites need to be protected. (personal communication with Pat Swain, 2016) Two listed under the MA Endangered Species Act (MESA) are: the Creeper (Special Concern); and, the Endangered Brook Floater, notable as one of just four populations in the

Commonwealth. In fact, “the Nissitissit River was ranked as a conservation priority stream based on its relatively healthy *A. varicosa* population [Brook Floater]” [and additionally] “...named as a conservation priority because of immediate threats to *A. varicosa* populations.” (*Confirmed Occurrences and Population Assessment of the Brook Floater in Massachusetts*, Feb. 4, 2016) The recent 2015 removal of the Millie Turner Dam on the Nissitissit River in Pepperell is assumed to have a beneficial impact on the mussels in the river as it will both cool the water and reconnect populations up and downstream of the former dam.

Eastern Pearlshell in the Nissitissit River and the Creeper mussel present in the Squannacook River in Townsend are listed as species of conservation need in the MA State Wildlife Action Plan. And the Creeper mussel (Special Concern) and Triangle Floater (Species of Greatest Conservation Need) are present in the Nashua River (*Freshwater Mussel Survey in the Nashua River in the*

²⁰ “UNH [University of New Hampshire] zoologist Don Chandler and his students have found that riffle beetles, a species that lives in fresh water, are especially sensitive to water quality. When the water is clean, they thrive. In the Nissitissit River Chandler's team found 13 out of the 17 species of the insect known to exist in the state, a sign that the river is unusually clean.” <http://unhmagazine.unh.edu/f99/finickybugs.html>

Bypass Reach, Tailrace, and Impoundment of the East Pepperell Dam Pepperell, MA,
Biodiversity, May 2013, pg. 1)

As part of the Trout Unlimited's "Brook Trout Initiative", the Squan-a-Tissit chapter of Trout Unlimited has conducted an assessment of the Nissitissit River and its tributaries to identify areas where restoration or protection efforts would most help protect the native brook trout populations.

Dragonflies: The Ringed Boghaunter – MA state threatened – is found along the Nashua River in the vicinity of the Oxbow National Wildlife Refuge. Seven species of state-listed dragonfly species -- Brook Snaketail; Forcinate Emerald; Kennedy's Emerald; Spine-crowned Clubtail; and UMBER Shadowdragon -- occur in the Squannacook River corridor. Such a multiplicity of dragonflies and freshwater mussels species present in the Squannacook emphasize the high water quality of that river, and its importance in providing habitat for a variety of other species, common and rare. (Townsend Open Space and Recreation Plan, 2013, pg. 29)

"Ophiogomphus aspersus, the Brook Snaketail, is an indicator of high quality small/medium sized rivers/streams. I have collected this species in both the Nissitissit and Squannacook Rivers. This species is characteristic of clean, sandy bottomed rivers and streams that flow through forests and they thrive in medium gradient rivers/streams with abundant riffles and sandy substrate....The Bertozzi Wildlife Management Area has been well known among Odonotists in Massachusetts for its odonate diversity, there are records going back decades. It's hard to find a single location in MA where one can find as many species of odonates in one day during late spring/early summer when the adult odonates are at their peak abundance. I have personally collected 71 species of odonates either on the Squannacook River proper or in adjacent wetlands, and likewise 57 species on the Nissitissit."
(Michael Veit, personal communication Dec. 19, 2016)

Birds: During the spring and fall bird migrations, the Nashua River is the second most commonly followed flyway in Massachusetts, after Plum Island. This migratory bird mecca has over 230 bird species, half of them nesting. (Harold Herrill "Fall and Winter Birds of the Lancaster Area", Vol. 5, No. 6 The Bird Observer of Eastern Massachusetts, 1977) In particular, the open field grassland habitat -- found at Bolton Flats Wildlife Management Area, Fort Devens, Moore Airfield and Shepley Landfill -- provides nesting sites for the state endangered Upland Sandpiper and the threatened Grasshopper Sparrow. (NHESP, *An Action Plan for the Conservation of State-listed Obligate Grassland Birds in Massachusetts*, 2013) Additionally, the Pine Hill area in Lancaster mentioned above in regard to its exemplary Pitch Pine – Scrub Oak natural community has

documented Vesper and Grasshopper Sparrow territories on it according to Chris Buelow, NHESP Restoration Ecologist (June 19, 2014 email). [Note Audubon Society’s “Nashua River Watershed Important Bird Area (IBA) Site”²¹.]



Photo: 7 Both photos Ken Hartlage

Map 3 MassAudubon IBA website

This Nashua River Watershed IBA is composed of the Oxbow National Wildlife Refuge, Devens Reserve Forces Training Area (Devens RFTA), Bolton Flats Wildlife Management Area, the Nashua Greenway, Lancaster State Forest, and private lands along the Nashua River that are contiguous with the publicly owned areas. Much of this land was part of the former Fort Devens. A large portion of the former Fort Devens was transferred to the US Fish and Wildlife Service and is now the Oxbow National Wildlife Refuge. The area between the wildlife refuge, Devens RFTA, and Bolton Flats is known as the Intervale Region and is primarily privately owned, except for a small parcel of Lancaster conservation land. The public portion is composed of Lancaster conservation land called the Nashua Greenway and the Lancaster State Forest. The remaining land is privately held. The diverse habitats are reflected in a rich avifauna. The habitats include a large grassland, extensive wetlands, forested uplands, and a riverine corridor. The forest communities are Appalachian oak-pine forest, hemlock-northern hardwood forest, red maple hardwood swamps, and pitch pine-scrub oak barrens. The wetland communities present are equally diverse and include New England floodplain forest, dwarf shrub bogs, a black spruce-tamarack bog, oxbow ponds, and sandy bottom kettlehole ponds. The grassland is particularly important as the site hosting the state's third largest breeding population of Grasshopper Sparrows as well as supporting Vesper Sparrows, Upland Sandpipers, and Bobolinks.

²¹ See www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites/nashua-river-watershed This IBA includes large areas of upland and wetland habitats including grassland, wetlands, forest, and the riparian corridor. Much of the land in the IBA is owned by the federal government. It provides important habitat for upland species including declining grassland birds and a wide diversity of migratory songbirds, as well as wetland dependent species like waterfowl, rails, and bitterns. Raptors of concern known to utilize the area include the Bald Eagle, Peregrine Falcon, Northern Harrier, and Sharp-shinned Hawk. The IBA has no specific regulatory significance or authority; the program identifies areas of particularly significant bird habitat to educate people about the importance of these areas and draw attention to the need to consider the avian resources in land management plans and decisions.” (Personal communication with Heidi Ricci, Mass Audubon, Oct. 25, 2017)

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF BIODIVERSITY FEATURES

- The Oxbow National Wildlife Refuge, covers 1,667 acres and **~8 miles** of the Nashua River frontage, is the crown jewel of permanently protected land in our study area.
- The Nashua River corridor consists of significant portions of terrestrial habitat designated by the state *BioMap2* project as “core habitat”, representing the highest priority for biodiversity conservation and protection. There are six “Priority Natural Communities” along the Nashua River, according to MA Natural Heritage and Endangered Species Program (NHESP).
- Three state-designated Areas of Critical Environmental Concern (ACEC) are in our study area covering a total of ~76,000 acres: the Central Nashua River Valley, Squannassit, and Petapawag ACECs. Together these three contiguous ACEC’s comprise ~28% of total existing ACEC’s throughout the Commonwealth.
- ACECs are “areas where unique clusters of natural and human resource values exist and which are worthy of a high level of concern and protection.”
- The Squannacook-Nissitissit Rivers Sanctuary Act was passed in 1975 to protect the Outstanding Resource Waters (ORWs) of these two rivers and associated named tributaries from degradation by new discharges of pollution.
- The Squannacook River has served as a MA state reference (or “baseline”) river for decades: for least altered flow patterns and used to develop the state’s water withdrawal policy. A long term monitoring station was established there in 1998, with sampling conducted every two months; available data show that water quality and aesthetics in the Squannacook River have been consistently among the cleanest in Central Massachusetts.
- The Nissitissit River is unique in eastern Massachusetts in having both a “fly fishing only” and “catch & release” section and was improved with the recent removal of the Millie Turner dam²² in Pepperell, which is expected to

²² (Former) Turner Dam – In 1750, Turner Dam was constructed and associated with grist and saw mills. In 1838, Blake and Ballard machine shop was established on site. In 1864, Blake Brothers produced “Improved Turbine Water Wheel,” a “belt fastener” that they invented and patented; the turbine is sold nationally and internationally. In 1942, Robert and Millie Turner purchased property and razed the industrial buildings on site (ca. 1947). Dam failure occurred in 1954 caused by upstream dam breach (Potanipo Pond) and heavy ice flows. In 1956, the dam was reconstructed by Paugus Rod and Gun Club and a group of local volunteers. The property was conveyed to David Babin by Millie Turner in 2008. And in 2010, MA Department of Fish and Game purchased 17 acres from Mr. Babin for conservation purposes; the dam and underlying land (0.47 ac) was excluded. MA Division of Ecological Restoration accepted dam removal as a state Priority Project for river restoration in 2013. The dam was removed with mussel relocation, and completion of 0.47-acre property transfer to the Commonwealth in 2015.

improve flows and benefit the river's wild brook trout population. Further, due to conservation efforts, nearly 50% of the entire length of the Nissitissit River has a 300-foot vegetated buffer strip²³.

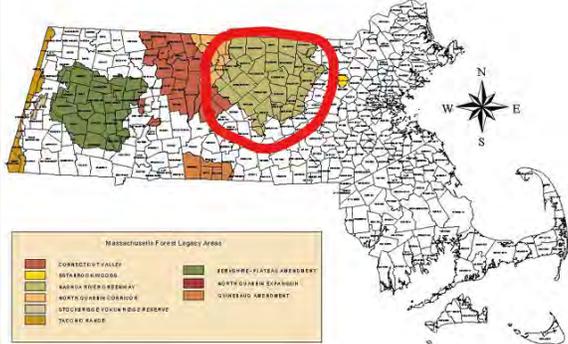
- There are nineteen tributaries to the Nashua, Squannacook & Nissitissit Rivers that are MA cold-water fishery resources (CFR), as are the Squannacook and Nissitissit Rivers.
- USFWS has stocked Alewife and American Shad in an impounded pond on the Nissitissit River in New Hampshire and is pursuing a goal to reintroduce same species to the Nashua River in the next ten years. The Nashua River is listed as part of the North American Atlantic Salmon Anadromous Fish Program.
- The Nashua River is the second most commonly followed flyway in Massachusetts, after the coast (Dunstable OSR Plan 2010-2017). Oxbow National Wildlife Refuge, is listed as a priority for protection under the North American Waterfowl Management Plan and the Emergency Wetlands Resources Act of 1986.
- As a major aquifer recharge area, the Nashua River valley stores floodwaters and precipitation in its numerous wetlands and sandy glacial soils. Another benefit of our study area's several aquifers is that many MA NHESP Priority and Estimated Habitats are found overlying them.
- Some two dozen state-listed MA NHESP threatened, endangered or species of special concern exist in this region. Five species of state-listed dragonfly species occur in the Squannacook River corridor. The Nissitissit River is home to six species of freshwater mussel -- one of the most highly endangered animal groups in North America -- which require clean water, and was ranked as a conservation priority stream because of such. The entire length of the Nissitissit in Massachusetts is identified as Natural Heritage Priority Habitat for five listed species. Such a multiplicity of dragonflies and freshwater mussels species present in the Squannacook and Nissitissit emphasize the high water quality of those rivers.
- Our study area is also the home of the largest known population of state-listed Blanding's turtle: MA NHESP calls it "...a very significant population, possibly the largest in New England."

²³ Harvard has a Nashua River Watershed Greenspace Buffer District. See the Zoning Bylaw, 125-42.B(9). This is 300 foot wide from the Nashua River in Harvard.

- Nearly the entire Nashua River watershed has been included as the “Nashua River Greenway Forest Legacy Area” under the US Forest Service administered Forestry Legacy Program in partnership with MA Department of Conservation and Recreation’s Bureau of Forestry. Two outstanding tracts protected by Forest Legacy in our

**MASSACHUSETTS
FOREST LEGACY AREAS**

study area are the Belmont Springs tract (255 acres in Pepperell) and the Pumpkin Brook Link tract (174 acres in Shirley).



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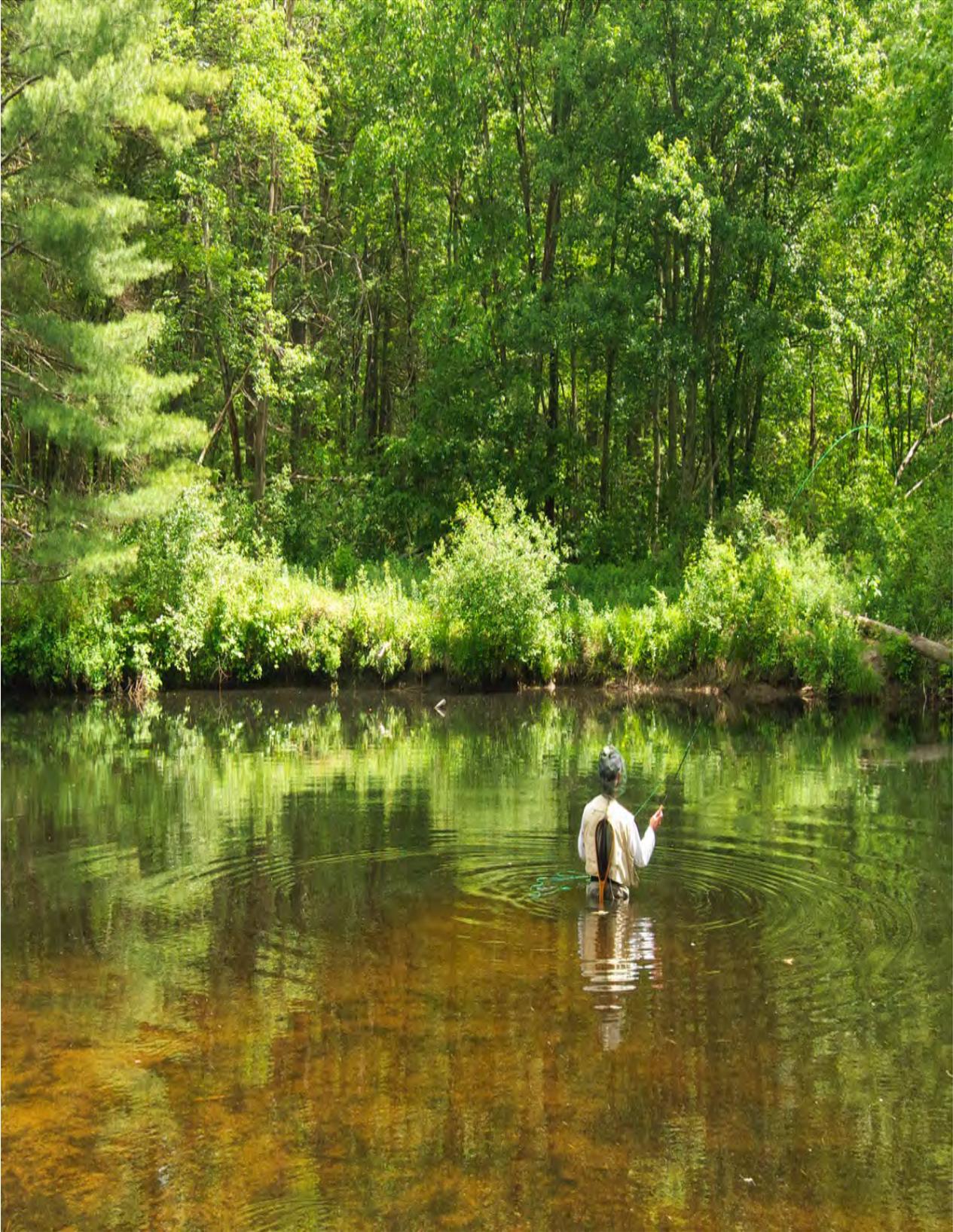


Photo 3: Nissitissit River in Pepperell, Ken Hartlage

BIOLOGICAL DIVERSITY ACTION PLAN

#1: Biological Diversity

Goal #1: Sustain and enhance existing biological diversity along and within the rivers and their tributaries.

Objective: Ensure that the outstanding existing biological richness of the rivers' aquatic and bordering terrestrial communities will be sustained and enhanced into the future; that common species will remain common; and that populations of rare and threatened species are not extirpated.

- Use a variety of media to help audiences from youth to senior citizens learn about the rich biological legacy along the region's rivers and streams; the relationships between human activities, wildlife and plant habitat needs; and conservation actions and outcomes. Provide rich field experiences and programs to help residents and visitors to the region develop and increase their connections with the natural world of the rivers and their shores.
- Work with communities and landowners to address issues of nonpoint source pollution, especially stormwater runoff and flows from disturbed areas, septic system discharges, and other sources of water quality impairment. Develop strategies to help mitigate effects of global warming.
- Work with communities and landowners to protect riparian zones from unnecessary clearing and land alteration.
- Help communities identify conservation strategies that will provide contiguous habitat, corridors, and linkages among habitat types, to address the needs of diverse plant and wildlife populations.
- Help communities identify conservation strategies that will provide contiguous habitat, corridors, and linkages among habitat types, to address the needs of diverse plant and wildlife populations.
- Work with local land trusts, local, state, and federal officials, and landowners to conserve critical habitats along the rivers and nearby uplands.

- Carry out targeted activities focused on species and communities of particular conservation interest, as detailed below.

Goal #2: Protect Priority Natural Communities & Rare Species

Habitats.

Objective: Protect habitats and corridors identified as high priority by MA NHESP and by NH Natural Heritage Bureau (NHB), and by doing so, sustain and enhance important biological communities and species.

- Provide a variety of information through many media and programs to inform residents and visitors about unique/special communities and rare species, and their needs.
- Encourage habitat management according to MassWildlife recommendations for early successional/young forest.
- Help municipalities and land trusts permanently protect all occurrences of state-recognized NHESP Priority Natural Communities along the Nashua River, according to MA Natural Heritage and Endangered Species (NHESP) Program.
- Focus on creating “south to north” land protection corridors – dispersal and migratory wildlife routes through which terrestrial and aquatic flora and fauna will be able to move and adapt-- as climate disturbance increasingly impacts biological processes and drives species north.
- Report rare species to MA NHESP and NH Natural Heritage Bureau to ensure the habitat of rare species is identified and protected.
- Develop a comprehensive approach to large woody debris (LWD) management in rivers and streams by working with stakeholders including the Squan-a-Tissit Chapter of Trout Unlimited, local

Conservation Commissions, recreational paddlers, the MA Division of Fisheries and Wildlife, and others. A comprehensive approach allows for safe paddling, but also recognizes that LWD provides important ecological benefits, and should be left in place whenever possible²⁴. The goal should be the judicious pruning of downed trees in rivers to provide for both recreational use and aquatic ecological habitat.

The “Trees, Paddlers, and Wildlife” guide²⁵ produced by the MA Division of Ecological Restoration (DER) and the companion video “Trees, Paddlers and Wildlife” produced by the Appalachian Mountain Club and MA DER should be starting references for such efforts.



Figure 7 MA EOEEA website

Goal #3. Protect state-listed Blanding’s turtles (threatened in MA and endangered in NH).

Objective: Protect existing turtle populations and help expand populations for the future. (Note: Protecting Blanding’s turtle habitat will protect a wide variety of other species in the process.)

- Reduce road mortality through public educational signage located at “turtle crossings”. Report road mortality at Linking Landscapes: www.linkinglandscapes.info/turtle-roadkill-surveys.html [Do not relocate turtles. Turtles may carry diseases, which can be transmitted to other turtles.] See www.blandingsturtle.org/uploads/3/0/4/3/30433006/nebtwg_recreation.pdf

²⁴ Large woody debris (LWD) provides habitat, improves water quality, supports invertebrate life cycles, creates physical complexity and stabilizes banks and bed so there have been concerns about clearing such from the rivers. An excellent approach to LWD management can be found in “Recreation Enhancement of the Lamprey River: Final Report to the Lamprey River Wild and Scenic 2015 Small Grants Program” www.lampreyriver.org/UploadedFiles/Files/woody_obstacles_report.pdf

²⁵ www.mass.gov/eea/docs/dfg/der/pdf/trees-paddlers-wildlife-presentation.pdf

- Create turtle nesting habitat – a limiting factor – to encourage turtles to nest in areas which will not require them to cross roads. Work with MassWildlife and MA NHESP to evaluate prime habitat. Determine road mortality ‘hot spots’.
- Defend integrity of specific vernal pools which are vital Blanding’s turtle habitat by prohibiting vernal pool modification. Encourage certification of potential vernal pools (PVPs) as appropriate. Certified Vernal Pools (CVPs) are Outstanding Resource Waters. While VPs fall under habitat for Blanding’s, most Blanding’s visit VPs in the Spring to feed on egg masses. Protecting VPs by certifying them is key but buffers around and connections between all wetlands (ponds or scrub-shrub wetlands) and upland aestivating (dormancy) and nesting areas used by Blanding’s are critical. [Submitting rare species reports to MA NHESP and NH NHB is key to protect habitat.]
- Given that maintaining forested land in forest use is vital to conserving viable populations of Blanding’s turtles, follow “Massachusetts Forestry Conservation Management Practices for Blanding’s turtles” (see www.mass.gov/eea/docs/dfg/nhosp/regulatory-review/blandings-turtle-cmp.pdf).
- Encourage continued public support and participation in the annual “Big Night” (first mass amphibian movement in early spring) activities as well as other local turtle protection happenings²⁶.
- Work with landowners, Conservation Commissions, land trusts, and others to expand protected forest land and other appropriate habitat for Blanding’s turtles adjacent to areas with existing populations, so that there will be areas for expanding populations to move into.
- Consider starting or expanding head-starting school-based or other turtle-rearing project (with proper authorization). Educating everyone about the importance of leaving wildlife wild and not taking turtles home is important. Turtles live a long time --if they don’t get run over-- and it is best for them to remain in the wild.
- Public education and awareness - signage, educational information to residents, businesses, developers, contractors. Publish newspaper articles, press releases during migration, websites,

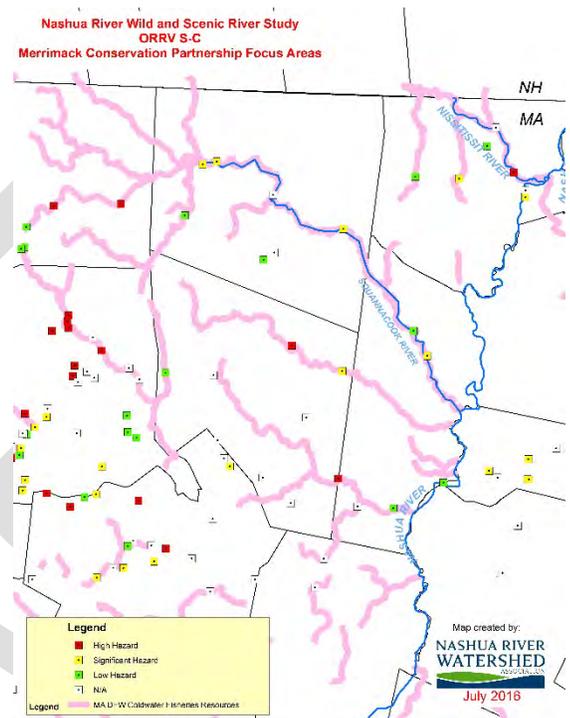
²⁶http://archive.boston.com/news/local/articles/2011/05/08/in_pepperell_volunteers_make_sure_salamanders_get_safe_passage/ Each spring in Pepperell, volunteers provide safe passage for salamanders on their nocturnal breeding migration.

mailings, local cable access. Partner with groups like Devens Eco-Efficiency Center to help raise awareness (Earth Day turtle crossing sign making project).

Goal #4: Protect and enhance coldwater fish resources (CFR).

Objective: Maintain existing populations of coldwater fish through actions that help mitigate thermal effects of a warming climate; maintain riparian forests; ensure baseflows provided by cold, clean groundwater discharges; sustain diverse aquatic invertebrate populations; and prevent nonpoint source pollution, especially sedimentation into coldwater streams.

There are nineteen tributaries in addition to the Squannacook and Nissitissit Rivers themselves that are MA state-designated CFRs as outlined in pink in this map. (Colored icons are dams and colors are explained in legend).



- In collaboration with anglers’ organizations, aquatic biologists, naturalists, local school systems, and others, increase public awareness and appreciation of how headwater streams “work,” especially in relation to base flows and storm flows, the life of coldwater streams, the recreational value of coldwater fisheries, and the ways that individuals can both enjoy and contribute to sustaining these remarkable resources. Include outreach focused on engineers who develop stormwater systems for projects, municipal members of planning and conservation boards, and others whose decisions affect stormwater management and land use change.
- Protect “small, cold, headwater brooks which are necessary for reproduction, rearing of juveniles, thermal refuge during periods of high temperatures, and as year-round habitat for some CFR species. It is imperative to maintain appropriate flow regimes and water levels (e.g., reliant on groundwater inputs during much of the year; groundwater withdrawal or limited infiltration hampers this, impervious surfaces and drainage systems create higher than normal flows during rain events), access (e.g., dams, perched culverts, etc. cut off many kilometers of important habitat), and maintain

suitable water temperatures (e.g., riparian vegetation provides shade among other important benefits to small brooks, runoff into streams from dark impervious surfaces is very warm): while accommodating demands for water supply, waste assimilation, commercial, industrial and agricultural uses. Small, coldwater brooks also buffer the temperature of the larger streams and rivers they flow into as well as some distance downstream from their confluence. The larger streams and rivers in the Nashua-Nissitissit-Squannacook complex could likely serve as overwintering habitat for trout and other coldwater species in their deeper pools.” (Adam Kautza, Coldwater Fisheries Project Leader at MassWildlife, personal communication June 1, 2017)

- Improve stream habitat by replacing/ upgrading culverts and other stream crossings. [See



Photo: 8 NRWA archive

“Restore or Maintain Watershed Connectivity to Provide Areas for Fish and Wildlife Passage and the Ability to Compensate for Increased Storm Events”, pages 5-32 in NH State Wildlife Action Plan] New or replacement bridges and culverts should ideally have openings which pass the bankfull width without constriction. Bridges and culverts should be designed to cross the river without creating

channel approaches at an angle to structures. Such sharp angles can lead to undermining of fill materials and structural components. The historic channel migration pattern of the river should be considered when installing new or replacement crossing structures, and when constructing new roads, driveways, and buildings. Planned build-out for watershed communities and resultant channel enlargement (from increased percent imperviousness) should be considered when designing new or replacement bridges and crossing structures.

- Preserve forest canopies over coldwater fish resources to insure streams remain shaded. Pay special attention to – and provide comments on --any proposed utility or natural gas pipeline construction that cross CFRs as well as adjacent solar farms with an eye toward potential negative impacts resulting therefrom.

- Maintain, protect and enhance water flow regimes that support needs of native river flora and fauna, while accommodating demands for water supply, waste assimilation, commercial, industrial and agricultural uses. Consider conducting a study to determine more conclusively the “flushing flows” needed to maintain the rivers’ ecological integrity.
- Conduct stream assessments to identify and repair man-made bank disturbance/erosion impacting natural structure and reducing riparian vegetative cover.
- Do Geographical Information Systems (GIS) analysis of area’s geology to help determine which headwaters might be prioritized for protection (given geological influences) in collaboration with state fisheries officials.

Goal #5: Protect and Enhance Anadromous Fisheries.

Objective: Ensure ongoing and sustained populations of anadromous fishes by restoring and maintaining fish passage, spawning areas, and nursery habitat throughout the river system.

- Ensure adequate fish ladders are installed at hydropower facilities, and existing ladders are maintained for both up and downstream effective and efficient passage of river herring, American shad and American eel. (Oxbow Comprehensive Conservation Plan, page 33.)
- Work with local and state highway officials to ensure that culverts and other crossings are adequate for passage of migratory fishes year-round. Evaluate road and railroad crossings and prioritize culverts for replacements using Best Management Practices for Fish Passage as summarized described in the *Massachusetts Stream Crossing Handbook* (www.mass.gov/eea/docs/dfg/der/pdf/stream-crossings-handbook.pdf).
- Encourage state and federal agencies such as US Fish & Wildlife Service to reintroduce Alewife and American Shad to the Nashua River in the next few years, similar to the program ongoing since 2014 to reintroduce Alewife in Lake Potanipo at the headwaters of the Nissitissit River in New Hampshire²⁷. (see link: www.wildlife.state.nh.us/fishing/anadromous-why-restore.html).

²⁷ “Alewife stocking has occurred for several years as part of a restoration project where the U.S. Fish & Wildlife Service and NH Fish & Game work to re-establish this native fish to our area's waters. Downstream dam removal, and

Possible Text box

“Disturbances Over the Law Relative to the Killing of Salmon and Other Fishes, 1784

In 1781 the Great and General Court passed an act prohibiting "The Killing or destroying any salmon shad or alewives in the Merrimack River or any waters falling thereinto in this state, except on Tuesdays, Wednesdays and Thursdays, under a penalty of 2 lbs [pounds]"; and further- "That no person shall erect or build annually within the months of May, June, September and October, any dams or other obstructions across said steams, nor continue said mill-dams or other obstructions under a penalty of 20 pounds."

This act, according to tradition, because of its provisions for keeping the dams open during certain months of the year, was the cause of no little commotion in Raby [Brookline], where the project of damming the Nissitissit River at or below its outlet from the pond [Lake Potanipo] was already being seriously considered. It divided the people into two factions. It was a question of "To dam or not to dam." One faction was opposed to the act, claiming that to build a dam across the river with the obligation of keeping it open during four months of the year, two of which, at least, were spring months when mill business was most active, was prohibitive to that extent that it reduced to a minimum the chances of making even a living profit in the mill business and therefore cut out all inducements for capital to invest in building mill-dams. The men who argued as above were, of course, the town's capitalists; many of them passing rich with a mortgaged farm and an income of five pounds a year. Thus it happened that they opposed the damming of the river and instead d---d the General Court for passing the law.

The other faction favored the act because, as they claimed, if the dams were not kept open during the spring months, the pond itself, as well as all the streams which flowed into it, would no longer furnish the inhabitants with their annual spring supply of brain food in the form of lamprey eels and alewives; a species of nutrition of which they openly hinted the brains of their opponents were sadly in need. This latter faction, therefore, was in favor of damming the river and obeying the law.

A few years later and while the foregoing act was still operative, a dam was built across the river at its outlet from the pond; and for many years after the seafish continued to make their annual migrations up and down the Nissitissit and its tributary streams. Indeed, that ancient "chestnut" of alewives crowding into brooks so thickly as to enable one to cross upon their backs from shore to shore, continued to be told of Douglass brook in the village well into the nineteenth century." (from History of Brookline, New Hampshire, Edward Parker, 1914, pages 100-101).

improved fishways at existing dams, will make it possible for the offspring of these stocked fish to return in future years to Lake Potanipo. These stocked adults will spawn in Lake Potanipo, and leave in a few weeks. Their young will grow in the lake all summer, and leave for the ocean during a fall high water event. It will then take 3-5 years for them to mature and return to reproduce themselves." (Michael Bailey, USFWS, 2017, personal communication)



Photo: 9 Nissitissit River headwaters at Lake Potanipo, Ken Hartlage

Goal #6: Sustain and Improve Populations of Freshwater Mussels.

Objective: Protect existing populations of freshwater mussels, and work toward restoration of extirpated populations, per MA NHESP recommendations.

- Improve habitat condition for the recovery of extirpated and declining mussel populations. Freshwater mussels in MA are of special conservation interest as one of the most highly endangered animal groups in North America and are well represented at good sites such as in Nissitissit River which need to be protected.
- Protect freshwater mussels from construction projects which have the potential for sediment release that could suffocate the mussels by insuring erosion control Best Management Practices (BMPs)²⁸ are in place for all work sites.
- Work to improve stream connectivity throughout the watershed to allow passage of host fish species on which mussel populations depend. Ensure that construction involving road and railroad crossings includes installation of adequate culverts to allow year-round fish passage. Survey small dams to ensure that they do not impair the upstream passage of a wide array of potential host fish species (not just anadromous fishes).
- As with coldwater fisheries, work with communities, landowners, Conservation Commissions, fisheries managers, and state regulators to minimize non-point source pollution, including sedimentation and temperature changes. Maintain as much forested cover as possible in riparian and upland contributing areas to minimize thermal impacts. Manage stormwater to minimize

²⁸ While not all of the BMPs will be appropriate for or accepted by every municipality, they are meant to be a guideline of some of the technologies available at the present time.

surface flows of warm water and to maintain year-round baseflows of cool groundwater and to minimize changes in forested cover.

- Monitor streams to ensure that invasive mollusks do not become established, potentially competing with native species for food and altering the benthic substrate needed by mussels. In the event of invasive mollusks being documented, establish targeted removal program promptly to attempt to prevent adverse effects on native species.

Goal #7: Minimize the Effect of Non-native Invasive Species.

Objective: Control or diminish the prevalence of aquatic and terrestrial/riparian invasive plants and animals.

- Follow the recommendations in the *Aquatic Invasive Plant Stewardship Plan for the Nashua River* written by the NRWA for the Nashua River Regional Aquatic Invasives Alliance, notably water chestnut infestation in the Groton and Pepperell sections of the Nashua River, which has the potential to spread downstream.
- Post signs warning of non-native invasive aquatics at launch sites, reminding boaters to check their boats for hitchhiking plants. Provide educational materials for lake and pond associations on invasive terrestrial and aquatic flora and fauna including the proper cleaning boats and of motors to prevent transport and spread of invasives. Present programs and prepare articles for local media to educate the broader public about aquatic invasives, how to identify them, and things individuals can do to prevent invasives' establishment and spread.
- Where feasible as time and funding permit, conduct baseline aquatic invasive weed mapping along the rivers (other than in those sections already done in the Oxbow NWR).; additionally, those areas mapped should be periodically revisited to determine if any invasive plant growth has occurred.



2017 AQUATIC INVASIVE PLANT MANAGEMENT PLAN
FOR THE NASHUA RIVER

Nashua River Regional Aquatic Invasives Alliance
 NASHUA RIVER REGIONAL AQUATIC INVASIVES ALLIANCE PARTNERS:
 Nashua River Watershed Association
 Pepperell Hydro Company, LLC
 Nashoba Paddler, LLC
 Ice House Partners, LLC
 Ducks Unlimited
 Town of Pepperell
 Town of Groton
 City of Nashua
 New Hampshire Department of Environmental Services
 Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program
 U.S. Fish & Wildlife Service, Oxbow National Wildlife Refuge

- Ensure the completion of the Invasive Species Monitoring and Control Plan by Pepperell Hydro for the Pepperell Pond Impoundment.²⁹
- Work with municipalities to incorporate invasive species control as part of the land development approval and permitting process. Invasive species identification and management during permitting, construction and operations can help reduce the spread of invasives and support greater biodiversity along the river corridors. [See an example Devens: 974 CMR 3.04(8)(n)(g)].
- Attempt to control non-native, exotic invasives -- such as purple loosestrife for example by releasing host-specific beetles: insects that feed only on this invasive plant and pose no threat to the wetland ecosystem. Evaluate results of such past efforts and if established that this is effective, expand beetle release program.³⁰
- Encourage native landscaping – at home and at businesses – for wildlife ecology, and to reduce escapes of potential new invasive species into the wild.
- Sponsor pulls of invasive species such as purple loosestrife, especially in areas where the populations of the plant are small. Annual pulling has been shown to be effective in controlling this species when started early after initial appearance of the plants.
- Control of some riparian and wetland invasives such as Japanese bamboo (aka knotweed), Purple Loosestrife, and non-native Common Phragmites by smothering with black plastic or burlap has

²⁹ Per Pepperell Hydro’s FERC license (P 12721-006), an Invasive Species Monitoring and Control Plan (ISMCP) is to be implemented by the Licensee. The objectives of the ISMCP will be: (1) to document the species composition of invasive plants from the upstream end of the Pepperell impoundment downstream to the tailrace (i.e., the project area); (2) to implement an early detection/rapid response program to identify and control new invasive species infestations within the Pepperell project area; (3) to conduct surveys and associated reporting of the project area's infestation status on a five-year cycle; and (4) to identify potential means (regional programs) to maintain or reduce the existing infestations.

³⁰ *“Invasive or Overabundant Species: Common reed has invaded a portion of wetlands of Oxbow NWR. Planning to determine its rate of spread and the most effective means of control has been initiated. Purple loosestrife is another extremely invasive plant species which threatens portions of the wetland habitats of the refuge. No formal surveys to determine the rate of spread have been conducted. The refuge has released Galerucella sp. beetles and Hylobius transversovittatus weevils as biological control agents. The Galerucella beetles are leaf-eating beetles which feed on the leaves and the new shoot growth of purple loosestrife, weakening the plant until it eventually is removed or reduced. Hylobius transversovittatus is a root-boring weevil that deposits its eggs in the lower stem of purple loosestrife plants. The hatched larvae feed on the root tissue, destroying the plant’s nutrient source for leaf development, which in turn leads to the destruction of the mature plant. Additional plant species that are considered to be invasive, and that require monitoring on the refuge include: spotted knapweed, glossy buckthorn, asian bittersweet, and autumn olive.”* From Oxbow NWR Comprehensive Conservation Plan

been found to be effective over the long term if the treatment is carried out consistently over time. Where it gets established Japanese knotweed becomes a really major problem, and floodplains are highly susceptible, thus attack it before it gets well established anywhere along the river corridors. Initiate experimental efforts to document effectiveness of this approach in the Nashua River basin and, if promising, promote such controls by watershed groups and river users.

- Support biodiversity in riparian habitat by organizing river clean-up days with local volunteers to hand-pull target common terrestrial non-native invasive species such as Japanese Knotweed, Japanese Barberry, Asian bittersweet and Glossy Buckthorn. Consider the use of herbicides, if necessary, to control the spread of terrestrial invasives. Herbicides only to be used where safe and appropriate, after obtaining the required approvals from state and local boards and committees.

#2: Water Quality and Quantity

Several key management challenges affect the ecological integrity of the river corridor. These include increasing development, invasive species, fish restoration and passage upriver, habitat fragmentation, water withdrawals, and stormwater, sediment, and nutrient runoff into the river.³¹

Goal #1: Maintain and improve our rivers' water quality so that it supports the needs of native wildlife, aquatic resources and water supplies.

Objective: Collect data, make plans and take actions that support improved water quality.

- Ensure NRWA's volunteer/citizen-based water monitoring program geographically captures representative sites. Collect streamflow and water quality data as needed to support the protection of these resources.
- Consider developing approved Watershed Based Plan for impaired sections of rivers in the designated reaches that could qualify our rivers for funding through federal Section 319 Clean Water Act grants to improve water quality.

³¹ "The CFRs in this region suffer from the effects of excessive development and its associated issues (e.g., loss of riparian forest, dams/impoundments, perched culverts and other road crossings, impervious surfaces, water withdrawal, etc.)." Adam Kautza, Coldwater Fisheries Project Leader at MassWildlife, personal communication June 26, 2016

- Conserve undeveloped and sensitive land within the subject area to limit impervious cover and mitigate the effects of urbanization. Corridor protection strategies that prevent or limit placement of infrastructure within the corridor will protect structures from future erosion and flood losses. According to Vermont Department of Environmental Conservation, “One of the primary objectives of river corridor planning is to identify the key flood and sediment attenuation areas, where human land uses may be in constant conflict with the channel evolution of particularly dynamic and sensitive stream reaches. Key attenuation reaches are prime candidates for the acquisition of river corridor conservation easements because they are critical to the capture and storage of water, sediment, nutrients, and organic material. Functioning attenuation reaches serve to reduce excess erosion, reduce the fine sediment and nutrient loading that otherwise impairs water quality, and retain the coarser sediment and organic debris important as cover habitats to aquatic organisms.”³²
- Increase street tree and urban-suburban forest canopy cover within developed areas of the watersheds to aid in stormwater quantity and quality management, while decreasing runoff temperatures. Also promote the use of other green infrastructure techniques such as vegetated roofs and walls in the built environment to better manage runoff in the watersheds.
- Protect and restore natural drainage patterns where feasible through stream daylighting and tributary restoration projects (consider appropriate sections of Varnum Brook in Pepperell); improve water quality by using low-impact development techniques to pre-treat runoff prior to discharging to any tributaries.
- Promote publicity of benefits of bioretention³³ areas and promote the use of these and other green infrastructure/low-impact development (LID) techniques for managing runoff from nearby farms and developed areas. Consider identifying a candidate site in the focus area for installing a bioretention area to demonstrate its benefits and functions.

³² http://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_RiverCorridorEasementGuide.pdf (page 3)

³³ Bioretention is the process in which contaminants and sedimentation are removed from stormwater runoff. Stormwater is collected into the treatment area which consists of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. Bioretention cells are depressed areas, generally about six inches with specific soils and plants to help naturally attenuate and filter stormwater runoff used as infiltration filter. Plants used in the cells should tolerate wet and dry conditions.

Objective: Review plans and permits for National Pollution Discharge Elimination System³⁴ (NPDES) municipal, industrial and Combined Sewer Overflows (CSO) point-source activities to ensure compliance with special designations.

a. Outstanding Resource Waters (ORWs) Status

- Review whether the 1975 Squannacook-Nissitissit Rivers Sanctuary Act intended to protect the

Chap. 130. AN ACT ESTABLISHING A SQUANNACOOK AND NISSITISSIT RIVERS SANCTUARY.

Be it enacted, etc., as follows:

Chapter 132A of the General Laws is hereby amended by adding after section 16 the following section: —

Section 17. There is hereby established in the towns of Ashby, Groton, Pepperell, Shirley, Townsend and Lunenburg a protected area to be known as the Squannacook and Nissitissit Rivers Sanctuary. Said Squannacook and Nissitissit Rivers Sanctuary shall be comprised of the waters of the Squannacook river and its tributaries, to wit: Ash swamp, Ashby reservoir, Bayberry Hill brook, Bixby brook, Flat pond, Flat Pond brook, Fitchburg reservoir, Locke brook, Mason brook, Pearl Hill brook, Pumpkin brook, Trap Fall brook, Trout brook, Walker brook, Willard brook, Witch brook with the exclusion of that section of the Squannacook river from the Hollingsworth and Vose dam at West Groton located approximately North 42° 36' 45", West 71° 38' 7", on the U.S. Geological survey map Shirley quadrangle to the confluence of the Nashua river; and the waters of the Nissitissit river and its tributaries to wit: Coon Tree pond, Gulf brook, Heald pond, Mine brook, Port Barrel pond, Park Barrel Pond brook, Stewart brook, Sucker brook, Wolf brook. After the effective date of this act, no new discharge of treated or untreated sewage or other wastewater will be permitted to be discharged to the Squannacook and Nissitissit Rivers Sanctuary. For the purpose of this section, sewage shall mean the water-carried waste products or discharges from human beings, sink wastes, wash water, laundry wastes and similar so-called domestic waters; wastewater shall mean sewage, liquid or water-carried waste products or discharges from human beings, sink wastes, wash water, laundry wastes and similar so-called domestic wastes, and also sewage, liquid or water-carried waste from industrial, commercial, municipal, private or other sources; and person shall mean any individual, association, partnership, corporation, company, business organization, trust, estate, the commonwealth or any political subdivision thereof, any administrative agency, public or quasi-public corporation or body or any other legal entity or the legal representatives, agents, or assignees thereof.

No person shall install or construct, or cause to be installed or constructed, any new outfall, drainage pipe, ditch, channel or other conveyance to carry storm water runoff, either directly or indirectly from any structure, parking lot, or storage yard, other than from a one or two-family residence and appurtenant parking and storage facilities, into the Squannacook and Nissitissit Rivers Sanctuary or any tributaries thereof until plans have been approved by the planning board and conservation commission of the affected town in which the pipe, ditch, channel or other conveyance is located. Said town may require the construction of any structure or structures or treatment works which it deems necessary to prevent the pollution of the Squannacook and Nissitissit Rivers Sanctuary by matter carried by such storm water runoff.

The attorney general shall take such action as may be necessary from time to time to enforce the provisions of this section. The superior court shall have jurisdiction in equity to enforce the provisions of this section.

Approved April 14, 1975.

state-designated MA ORWs of these two rivers (and associated named tributaries in Shirley, Pepperell, Ashby and Townsend) from degradation by new discharges of pollution is still being honored today.

b. Review NPDES Permit renewals

- Work with towns and regional stormwater collaboratives to help meet NPDES permit requirements.³⁵

³⁴ NPDES is a permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States as authorized by the federal Clean Water Act.

³⁵ The Municipal Separate Stormwater Sewer Systems (MS4) permit, which will regulate stormwater in more than 250 municipalities in Massachusetts, was scheduled to take effect on July 1, 2017, with the first action item for municipalities to comply due in September. The stay delays permit implementation until July 1, 2018, and postpones the due date for communities to file their Notice of Intent as well. Under the MS4 permit, municipalities must develop, implement and enforce a stormwater management program that controls pollutants to the maximum extent practicable, protects water quality, and satisfies appropriate requirements of the federal Clean Water Act. The MS4 permit requires implementation of six minimum control measures. Updated permit requirements include the need to address identified water quality

- Consider advocating for best management practices at wastewater treatment facilities to remove endocrine disrupting chemicals, pharmaceutical contaminants and harmful household products as yet untreated in the waste stream. The community is encouraged to properly dispose of medications at “drop boxes” available at most police stations. Prescription medications, vitamins and similar products should not be disposed of in toilets or sinks, as sewer treatment plants and septic systems are not designed to remove these products from waste streams, and can contaminate water resources.
- Keep current on the performance of existing wastewater treatment facilities to assure the continued protection of water quality. As funding becomes available or are sought, promote upgrades to the maximum extent practicable of our water pollution control facilities whose effluent makes up a majority of the river’s baseflow at certain low-flow times of the year.

c. Combined Sewer Overflows (CSO’s)

- Conduct additional Illicit Discharge Detection and Elimination (IDDE) monitoring in most impacted segments of the Nashua River basin to identify potential sources of pathogens and other contaminants. (Note: While the towns in this Wild and Scenic River study themselves do not have any CSOs, upstream communities on the North Nashua River do have such, which impact our mainstem Nashua River towns.) This is one of the MS4 elements each municipality will be responsible to comply with under the new NPDES permit.

See the [Massachusetts Clean Water Toolkit: A Guide to the Prevention and Control of Nonpoint Source Pollution in Massachusetts](#) for identifying BMPs for road maintenance, agriculture, landfills, golf courses, onsite disposal systems, and impervious surfaces at <http://prj.geosyntec.com/npsmanual/default.aspx>.

d. Reduce and prevent non-point sources

Objective: Pursue opportunities for reducing non-point source pollution impacts resulting from various land use activities using Best Management Practices (BMPs).³⁶

problems, including stormwater discharges to water bodies with approved total maximum daily loads for bacteria, phosphorus and nitrogen.

³⁶ While not all of the BMPs will be appropriate for or accepted by every municipality, they are meant to be a guideline of some of the technologies available at the present time.

- Work with municipalities to ensure erosion and sediment control plans are being prepared, implemented, monitored, enforced and removed appropriately as part of all development projects within the watersheds.
- Ensure towns have emergency plans for accidental pollutant spills (DPW, Fire Departments, or police) and have equipment for such emergencies on hand.
- Reduce pollution from landscaping chemicals and reduce water consumption. Provide advice to citizens on proper use of lawn chemicals to prevent over treatment. Encourage riparian landowners through an education campaign to reduce run-off on their property, minimize impervious surfaces and minimize pesticide and fertilizer use. Many property owners have lawns right up to the edge of the rivers or wetlands. Encouraging adequately-wide vegetated riparian buffers is key³⁷.
- Review any potentially polluting land uses within one-quarter (1/4) mile of rivers. [Agricultural uses where plowed fields with no vegetated riparian buffers are left bare throughout the winter and spring can be especially damaging.]
- Reinforce or create pet waste by-laws/ordinances -- pooper scooper laws -- and restrictions on illegal dumping and eroded areas, such as at Groton Place “dog park” along the Nashua River³⁸.
www.nashobavalleyvoice.com/groton_news/ci_18007525?source=rss
- Encourage the creation of green infrastructure networks - systems of connected natural, constructed or restored landscape features -- that help preserve ecosystem services³⁹.



Photo 4: NRWA Archive

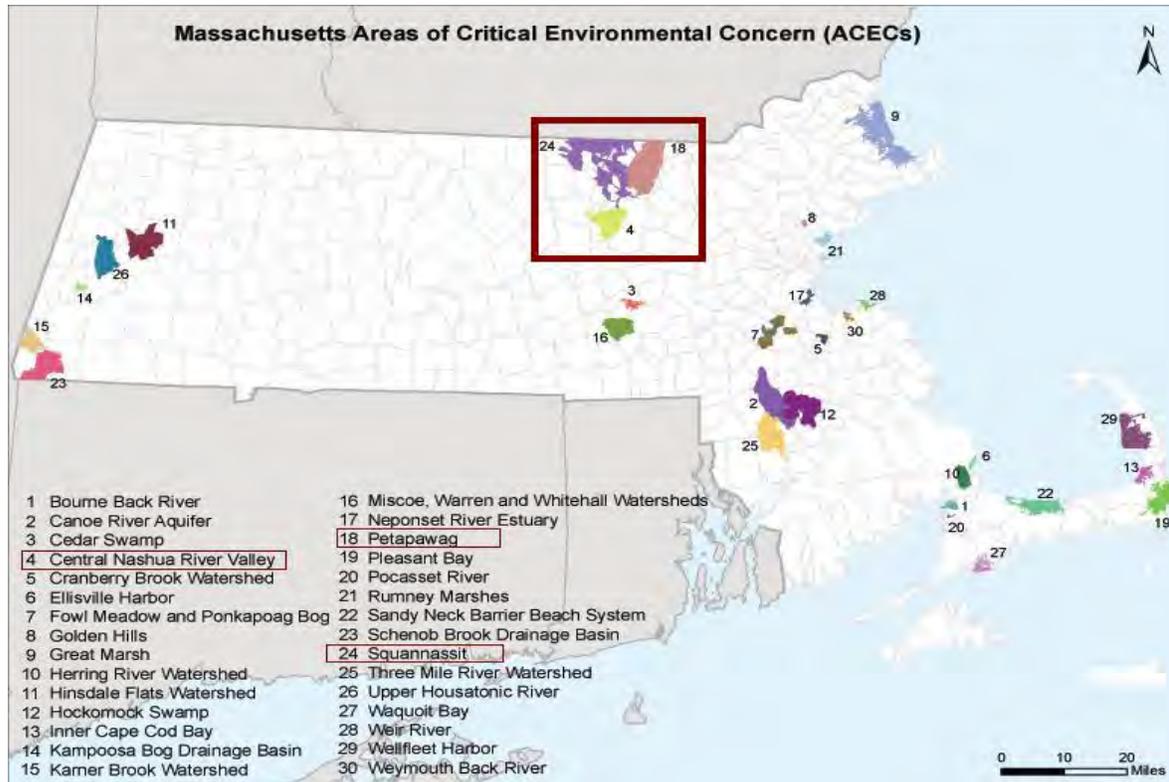
³⁷ See “Living in Harmony with Streams: A Citizen’s Handbook to How Streams Work” (Friends of the Winooski River, 2012) at <https://winooskiriver.org/images/userfiles/files/Stream%20Guide%201-25-2012%20FINAL.pdf>

³⁸ “Animal sources of pathogens are both urban and rural in nature: pet droppings on municipal streets delivered by stormwater runoff, livestock wandering into waterways, and wildlife such as beaver and moose. Some communities are installing pet waste gathering stations in public parks. While contamination by native wildlife is impossible to control, contamination by livestock is not. A single cow produces approximately 5.4 billion fecal coliforms a day, and two cows allowed unrestricted access to a stream for 24 hours can contaminate as much water as the city of Keene, N.H., uses in one day. Currently, the state of New Hampshire do not require farmers to keep livestock from entering streams, although a number of federal programs provide grants for fencing and alternative water sources.”
http://crjc.org/pdffiles/Connecticut_River_Rec_Management_Plan-Web.pdf; page 11.

³⁹ See: www.devensec.com/development/Green_Infrastructure_Guidelines_Final_8-12-14.pdf for an example education and awareness tool.

- Encourage towns to join regional stormwater collaboratives to share the resources necessary to meet stormwater management goals.
- Ensure that land use planning includes adequate water supply resources, stormwater drainage systems, and wastewater treatment systems (both onsite and centralized sewer treatment systems) as well as permanent and temporary soil stabilization techniques and groundcover for all disturbed areas.
- Partner with towns to identify the degree of threat from potential faulty/ illicitly discharging septic systems, which may result in bacterial and nutrient contamination of nearby streams and groundwater.
- Promote increased use of MA Chapter 61 Tax Incentive Program as a means of temporary land protection.⁴⁰ Encourage towns to proactively prioritize these parcels for town purchase in anticipation of their withdrawal from Chapter 61 and then land use change.
- Consider a Wild and Scenic Coordinating Group sub-committee that acts as an active, revitalized ACEC stewardship group.

⁴⁰ Towns that have established Conservation Funds are in a much better position to act upon Rights of First Refusal when a Chapter 61 property is put up for a change of use sale. The Town of Ayer established just such a fund at its recent Fall 2017 Special Town Meeting. See www.nashobavalleyvoice.com/ayer_news/ci_31423236/ayer-sets-up-conservation-fund



28% of all total ACEC acres in Massachusetts are our three contiguous ACECs

Objective: Preserve and protect important high- and medium-yield aquifers.

- Promote extended aquifer protection through land use regulations and acquisition. [[As a major aquifer recharge area, the Nashua, Squannacook and Nissitissit River valleys store floodwaters and precipitation in their numerous wetlands and sandy glacial soils.]]
- Actively promote water conservation. Encourage communities to consider mandatory conservation measures to augment volunteer efforts during droughts. Develop homeowner incentives to conserve water.
- Actively promote rainwater harvesting and reuse. Encourage communities to consider requirements for capture and storage of rainfall for non-potable water uses on development projects to help better manage stormwater runoff and reduce the use of potable water. Encourage all landowners in methods of returning water to the ground instead of running off the property, including the use of rain barrels and rain garden installation.

- Encourage towns with registered⁴¹ (not permitted) water withdrawals to also follow best management practices and conservation measures: e.g., 65 residential gallons per capita day (RGPCD), 10% unaccounted for water⁴², and Best Management Practices, such as leak detection, pricing, public education, etc.
- Ensure Massachusetts' Water Management Act regulations (310 CMR 36.00) are followed in the evaluation of new water withdrawals, and for requests for increased water withdrawals⁴³.

Nashua Basin Water Withdrawals			
Name	Registration* Volume (mgd)	Current Permit Volume (mgd)	Total Authorized Volume (mgd)
Ayer DPW Water Division	0.82	0.5	1.32
Groton Water Department	NA	0.3	0.3
MassDevelopment (Devens)	1.35	3.45	4.8
MCI Shirley	0	0.54	0.54
Pepperell Water Department	0.74	0.56	1.3
Shirley Water District	NA	0.31	0.31
Townsend Water Department	0.76	0	0.76
West Groton Water District	0.27	0	0.27
Epic Enterprises, Inc. (Ayer)	0	0.15	0.15
International, Inc. (Bolton)	0.2	0.15	0.35

- Work with Planning Boards/Town Engineers/Conservation Commissions and developers/landowners to consider maintaining or restoring predevelopment hydrology in order to protect groundwater recharge capability. Appropriate techniques include limiting impervious surfaces, rainwater harvesting, the use of swales and other LID measures, and best management practices that assist infiltration. Runoff from predevelopment cannot increase post development, which is why each town needs staff that is capable of interpreting stormwater calculations.

⁴¹ Registration Volume is the volume of water registered with the MA Department of Environmental Protection. Since 1988, persons planning to withdraw water from ground or surface sources for purposes in excess of an annual average of 100,000 gallons per day or 9 million gallons in any three-month period must apply for a Water Management Act Permit. Withdrawers with a Water Management Registration do not need a permit if they do not increase withdrawals over their registered volumes or add any new withdrawal points to their system.

⁴² Unaccounted-for water (UFW) represents the difference between "net production" (the volume of water delivered into a network) and "consumption" (the volume of water that can be accounted for by legitimate consumption, whether metered or not).

⁴³ "...[P]roduction (water supply) wells can cause streamflow depletion by intercepting groundwater that would have discharged to nearby rivers, or inducing direct infiltration of river water to the well, causing low-flow issues." Jeffrey Barbaro, USGS, personal communication, October 5, 2017.

- Maintain the ability of floodplains and wetlands to efficiently absorb water and protect the river from run-off related pollution. Assess floodplain and wetland mapping for the corridors and determine ways to improve it, coordinating with state and federal agencies. Consider conducting fluvial geomorphic assessments⁴⁴ of the three rivers beginning with where there are historical flooding and bank erosion issues. Work with town boards to inform them of the importance of floodplains⁴⁵ for floodwater storage and to encourage protection of floodplains and wetlands when considering development proposals.



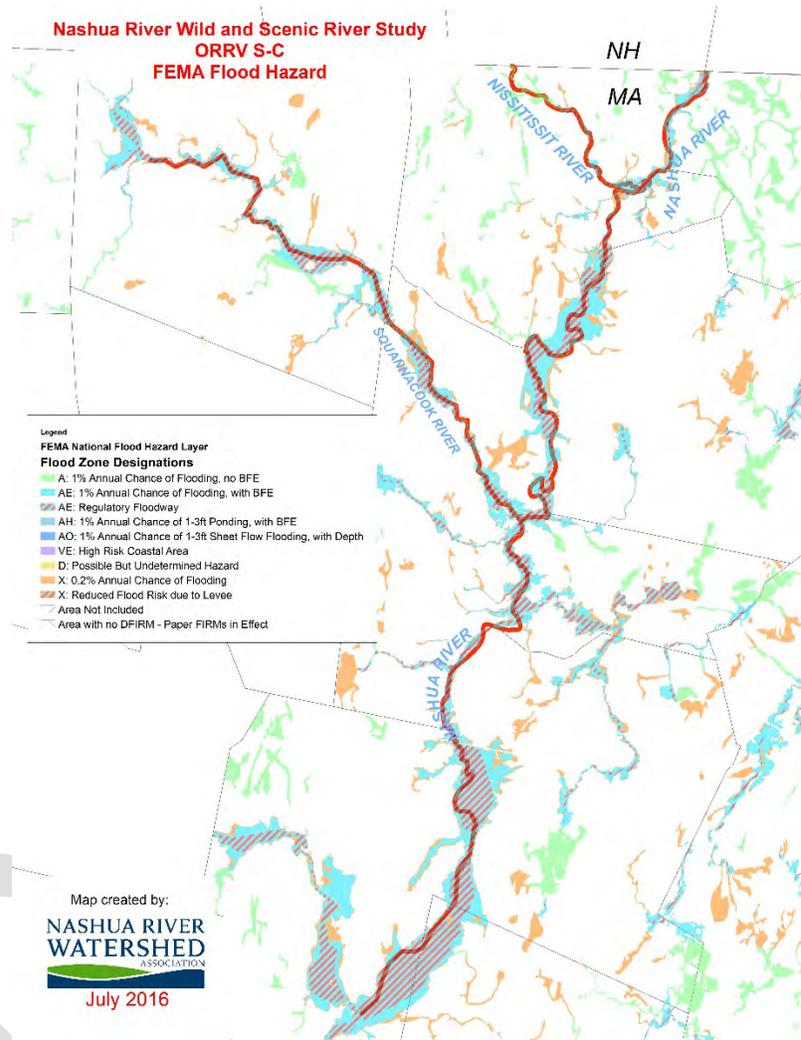
Photo: 10 NRWA

- Consider conducting watershed geomorphic assessments that would enable knowledgeable decisions to guide the management of stable river corridors. Assessments will be useful in guiding land use, development and infrastructure planning and design as well as flood hazard prevention. They can play an important role in the protection or restoration of the economic, aesthetic and ecological values of river corridors. Through understanding of the relationships between watershed

⁴⁴ Fluvial geomorphic assessments are studies of the physical condition of river systems. The assessments evaluate how, to what extent, and why river channels have become unstable. Causes ranging from major flood events to human activity are assessed. Data show that given the time and space, rivers eventually “evolve” to a channel form that is in equilibrium, or at balance, with the water and sediment inputs of their watersheds.

⁴⁵ It is important to recognize that rivers and floodplains need to operate as a connected system. Flooding is necessary to maintain the floodplain biological community and to relieve the erosive force of flood discharges by reducing the velocity of the water. Flooding and bankfull flows -- the water level stage that just begins to spill out of the channel into the floodplain -- are also essential for maintaining the instream physical structure. These events scour out pools, clean coarser substrates (gravel, cobbles, and boulders) of fine sediment, and redistribute or introduce woody debris. (NWCC Technical Note 99-1, Stream Visual Assessment Protocol, 1998 www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044776.pdf)

processes and human investments, we are able to make wise river corridor management decisions. (See http://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_rc-protectmanagefactsheet.pdf, page 5)



Objective: Educate public about the river ecology and how to keep rivers healthy.

- Post-designation, work with town DPW road crews and appropriate state Department of Transportation (DOT) agencies who should be alerted to the significance of the waterways as Wild and Scenic Rivers. This could be achieved by posting signs at bridge crossings or other appropriate locations.
- Sponsor local events to raise public understanding about native wildlife and the impacts of development patterns on habitat and ecosystem integrity, for example, provide Wild and Scenic

River outreach information at community events, fairs, festivals, canoe races, fishing events and other public gatherings.

- Work with private and public utility companies on creating and updating utility corridor management plans that recognize the importance of maintaining healthy wetlands, streams and river riparian buffers, and reducing the use of chemical pesticides in or near these sensitive areas.
- Engage with residents and others in the watershed on ecological issues, particularly with regard to recognizing that the streams, streambanks, and riparian areas including riparian buffers and corridors are sensitive places which should be conserved, restored, and protected⁴⁶.
- Pursue opportunities to educate landowners, developers, and local land use boards about the causes of non-point source pollution, its potential impacts on water quality and instream resources, and methods – such as Best Management Practices (BMPs) – for reducing or eliminating it. Pursue opportunities to demonstrate the use of BMPs in controlling non-point source pollution such as expanding riparian native vegetation buffers (to an ideal of 300 feet)⁴⁷.

#3: Habitat

GOAL #1: Maintain and enhance high-quality riparian habitat.

Objective: Protect intact and functional riparian buffers.

⁴⁶ The single most important natural system critical to maintaining the integrity of the entire Nashua River watershed is a forested riparian buffer.

⁴⁷ Buffer Width: “There is not one generic buffer size which will keep the water clean, stabilize the bank, protect fish and wildlife, and satisfy human demands on the land. The minimum acceptable width is one that provides acceptable levels of all needed benefits at an acceptable cost for a particular site. The basic bare-bones buffer is generally 50 feet from the top of the bank. filter dissolved nutrients and pesticides from runoff a width of up to 100 feet or more may be necessary on steeper slopes and less permeable soils to allow runoff to soak in sufficiently.... on cold water fisheries, the stream channel should be shaded completely. Studies show that that at least up to 100 feet, the wider the buffer, the healthier the aquatic food web. To protect against flood damage a smaller stream may require only a narrow width of trees or shrubs; a larger stream or river may require a buffer that covers a substantial portion of its flood plain. A 100 foot buffer will generally remove 60% or more of pollutants, depending on local conditions. It will also provide food, cover and breeding habitat for many kinds of wildlife but only fulfill few needs for others, such as travel cover.” (Connecticut River Joint Council Report, 1998).

Also, see “Riparian Buffer Zones: Functions and Recommended Widths”, Eightmile River Wild and Scenic Study Committee, April 2005.

- Work to maintain or expand riparian native vegetated buffers to maintain lower water temperatures [Note: Clear cold water supplied by the Squannacook and Nissitissit Rivers to the Nashua River provides a refuge for temperature sensitive fish in all three rivers.]
- Restore streambeds impacted by road sand deposition and seek solutions to reduce future road sand and other sedimentation; involve town DPWs and state DOTs in such as appropriate.
- Give high priority protection to riparian buffers. This can be reflected in each town's *Open Space and Recreation Plan* "Inventory of Lands of Conservation and Recreation Interest" as well as land use and subdivision bylaws and regulations.

Objective: Support protection of important wildlife habitat areas and migration corridors as identified and prioritized through habitat studies and assessments such as "Universal Stream Assessment"⁴⁸.

- Educate and encourage landowners to consider Conservation Easements (CEs) – aka Conservation Restrictions (CRs) in Massachusetts⁴⁹ -- and the importance of maintenance and enforcement of these restrictions. Consider providing funding to budget-strapped local land trusts whose lack of capacity makes it difficult to do required annual monitoring of all CEs.
- Encourage conservation and the preservation of existing forest, farm, and recreational land, and increase the likelihood of permanent forestland protection by increasing the number of forest landowners enrolled in current use programs (Chapter 61, 61A and 61B in MA). These programs can be used by landowners who want to keep their land in open space, but are not able or willing to execute a permanent conservation restriction/easement agreement.

⁴⁸ A Universal Stream Assessments is a survey of rivers and streams based on physical, chemical and biological data collected and analyzed using standardized field and laboratory methods. The goals are to determine the extent to which rivers and streams support a healthy biological condition and the extent of major stressors that affect them. The assessment supports a longer-term goal: to determine whether our rivers and streams are getting cleaner and how we might best invest in protecting and restoring them.

⁴⁹ www.massland.org/conserving-land-your-community

- MA Department of Fish and Game’s (DFG) Wildlife Management Areas – which are a draw for birders and other nature watchers – have a mission of prioritizing wildlife habitat⁵⁰. Encourage other state agencies⁵¹ to include hunting as a technique to reduce overpopulations of deer which can be ecologically destructive.

Note: Audubon Society’s “Nashua River Watershed Important Bird Area Site” (See Footnote #2x)
www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites/nashua-river-watershed

Objective: Protect and expand “Green Infrastructure” networks and linkages; Protect and enhance connectivity through attention to dams, culverts, streambank modifications and bottom alterations.

- Increase land protection efforts to focus on greenway connectors (i.e.: between Bolton Flats WMA and Oxbow NWR as well as Sucker Brook and Gulf Brook, and elsewhere) “to fill in the unprotected blank spots”.

⁵⁰ Additionally, DFG has a policy of minimizing trails (see www.mass.gov/eea/agencies/dfg/dfw/wildlife-habitat-conservation/wildlife-lands-trail-policy.html)

⁵¹ Nearly all DFG properties are required to allow hunting, as the vast majority of their land purchases are made possible because of funds collected for hunting and fishing licenses.

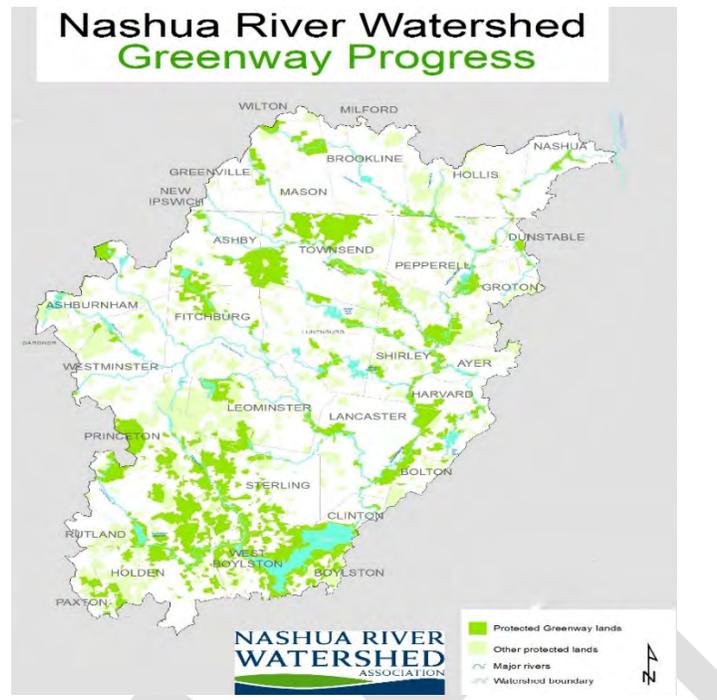


Figure 8: NRWA

- Restore, and sustain lands along all water bodies, including wetlands and their surrounding lands, as linear greenways for their natural resource values, as well as headwaters throughout the focus area, as opportunities arise.
- Continue to assist and support private landowners and local land trusts in their voluntary land conservation measures that protect important riverfront -- and watershed -- lands. Encourage all land protection agencies to pursue the purchase (in fee or conservation easements and, of course, through gifting) of important river-related lands from willing sellers if parcels come on the market and if funding is available. Give high protection priority to headwaters and tributaries of the rivers.
- Continue to look for connections to points of regional recreation and open space interest such as the Oxbow National Wildlife Refuge; the Shirley Shaker Village; Fruitlands Museum; Ayer State Game Farm; and the Squannacook State Wildlife Management Area in Shirley as well as connections to the Nashua River corridor, as stated in the *2008 Devens Open Space and Recreation Plan* in reference to its Multi-Use Trail Network Plan.

Objective: Minimize loss of valued habitat.

- Assist with protection of small, prioritized headwater streams that supply coldwater downstream.

- Assist local land trusts and conservation commissions to plan for priority land protection especially of focus rivers and tributaries.
- Minimize loss of habitat values coincident with land use practices that cause erosion.
- Work with involved parties to ensure that the Squannacook River greenway buffer – and its important turtle habitat -- is not degraded by inadvertent misuse.
- Work with and educate landowners to encourage continued and long-term management of the already protected open spaces in ways that are conducive to maintaining wildlife habitat.
- Ensure that if the South Post of Fort Devens is ever surplused that the land is permanently protected and/or becomes incorporated into the Oxbow National Wildlife Refuge. Inform all current Boards of Selectman and Conservation Commission -- in Lancaster and Harvard -- of this understanding.

11SEC. 2831. TRANSFER OF JURISDICTION AND LAND CONVEYANCE, FORT DEVENS MILITARY RESERVATION, MASSACHUSETTS.11

(a) TRANSFER OF LAND FOR WILDLIFE REFUGE.--Subject to subsection (b), the Secretary of the Army shall transfer, without reimbursement, to the administrative jurisdiction of the Secretary of the Interior that portion of Fort Devens Military Reservation in the State of Massachusetts that is situated south of Massachusetts State Route 2, for inclusion in the Oxbow National Wildlife Refuge. The transfer shall be made as soon as possible after the date on which the property is determined to be excess to the needs of the Department of Defense.

(b) LAND CONVEYANCE AUTHORIZED.--The Secretary of the Army shall convey to the Town of Lancaster, Massachusetts (in this section referred to as the "Town"), all right, title, and interest of the United States in and to a parcel of real property consisting of approximately 100 acres of the parcel available for transfer under subsection (a) and located adjacent to Massachusetts State Highway 70.

(c) LEGAL DESCRIPTION.--(1) The exact acreage and legal description of the real property to be transferred under subsection (a) shall be determined by surveys that are mutually satisfactory to the Secretary of the Army and the Secretary of the Interior. The cost of such surveys shall be borne by the Secretary of the Interior.

(2) The exact acreage and legal description of the real property to be conveyed under subsection (b) shall be determined by surveys that are mutually satisfactory to the Secretary of the Army, the Secretary of the Interior, and the Board of Selectman of the Town. The cost of such surveys shall be borne by the Town.

(d) ADDITIONAL TERMS AND CONDITIONS.--The Secretary of the Army may require such additional terms and conditions in connection with the transfer and conveyance under this section as the Secretary of the Army considers appropriate to protect the interests of the United States.

- Provide technical assistance to municipalities, landowners and private organizations seeking to protect and conserve floodplains, wetlands, forests, meadows, riparian vegetated buffers, and other fish and wildlife habitats.

- Prohibit all utility (gas and electric) in-stream crossings unless project proposal can show that there is no other feasible alternative.

- Replacement of culverts⁵² and other road-crossing structures should follow the most up-to-date



Photo: 11 NRWA archive

guidelines for stream crossing design, in order to reduce the incidence of destructive erosion, washouts, and scouring at stream crossings, and to allow for unimpeded wildlife passage under roads. (To be implemented in partnership with MA Division of Ecological Restoration.) New or replacement bridges and culverts should ideally

have openings which pass the bankfull width without constriction. Bridges and culverts should be designed to cross the river without creating channel approaches at an angle to structures. Such sharp angles can lead to undermining of fill materials and structural components. The historic channel migration pattern of the river and changing weather and precipitation patterns should be considered when installing new or replacement crossing structures, and when constructing new roads, driveways, and buildings. Planned build-out for watershed communities and resultant channel enlargement (from increased percent imperviousness) should be considered when designing new or replacement bridges and crossing structures.

- Work with and help town Department of Public Works (DPWs) properly size stream crossings at bridges and culverts, and prioritize worst ones. [These—and beaver deceivers⁵³--are often undersized for the size of the stream and result in impounding of water and sediments upstream of the crossing, and which may limit habitat connectivity and passage of fish and other aquatic fauna. (*MA 2015 State Wildlife Action Plan*, pg. 121)]

⁵² “The biggest challenge with replacing culverts with a culvert that is bottomless, is cost. It is far less expensive to use a piece of high density polyethylene pipe (HDPE), which is why most DPW’s use this material.” (Paula Terrasi, personal communication, May 30, 2017)

Information on costs associated with maintaining/replacing culverts and potential funding sources should be distributed to towns, DPWs, and select boards. Incentives should be provided for removal or modification of infrastructure identified as barriers to ecosystem services integrity. (see *NH State Wildlife Action Plan*, pages 5-32)

⁵³ Flow devices are man-made solutions to beaver-related flooding problems. Traditional solutions have involved the trapping and removal of all the beavers in an area. While this is sometimes necessary, it is typically a short-lived solution, as beaver populations have made a remarkable comeback in New England. Flow devices are relatively cost-effective, low-maintenance solutions that regulate the water level of beaver dams and keep culverts open.

- Reestablish and protect riparian zones and enhance in-stream habitat conditions, for example, locate beaver deceivers at culverts that do not have fish passage.
- Consider the effect of the two mainstem Nashua River dams – Pepperell and Ice House⁵⁴ -- on fish passage. Establish and maintain adequate upstream and downstream fish passage facilities. Upstream fish and eel passage is required under the Federal Energy Regulatory Commission (FERC) license for the Pepperell Dam⁵⁵.

⁵⁴ “No anadromous fish are currently found in the Ice House Dam project area, and upstream and downstream passage facilities are not yet in place at the next downstream dam, the Pepperell Dam in Pepperell. Ice House Partners will be responsible for constructing, operating, maintaining, and evaluating upstream and downstream anadromous fish passage facilities when requested by the Massachusetts Division of Fish and Wildlife or the US Fish & Wildlife Service.” (Federal Energy Regulatory Commission FERC Order Granting Exemption from Licensing (5 Mw or less) Ice House Partners, Inc. Project No. 12769-000, March 31, 2008.

⁵⁵ From Pepperell Hydro Settlement Agreement:

All upstream eel passage facilities shall be operational within three (3) years of license issuance.

Downstream Adult Eel Passage

To protect adult silver eels during outmigration, the Licensee shall either:

- (1) cease operating the Project from dusk to dawn from August 15 through November 30, annually. Or
- (2) operate a passage and protection system that meets the following criteria:

Downstream adult eel passage and protection measures or facilities shall be operational eight (8) years after juvenile eels are first documented using the upstream eel passage facilities. This time frame may be adjusted by the Fisheries Agencies pursuant to the results of monitoring the upstream passage of juvenile Eels.

Alternative passage and protection measures may be proposed by the Licensee, and considered by the Fisheries Agencies, if the Fisheries Agencies determine that sufficient data exist documenting their effectiveness.

Notwithstanding the foregoing, MA DFW has documented eels present in waterways upstream of the Project.

Accordingly, in order to protect such eels during their outmigration, and prior to the provision of permanent adult eel passage facilities, the Licensee shall implement interim passage measures at the dam and/or forebay. Such interim passage measures shall be designed in consultation with, and require approval by, the Fisheries Agencies and (1) shall be operational by the first passage season after license issuance, and (2) shall operate until permanent passage facilities are implemented. Approvable interim passage systems may include either use of the existing forebay drain system or the installation of a siphon system in the same general forebay location.

a. Downstream Fish Passage

The Licensee shall construct, operate, maintain and evaluate the effectiveness of downstream fish bypass passage facilities for Targeted Migrants when the upstream fish passage system begins operation. Said passage facilities shall be operational the first downstream passage season after the beginning of upstream fish passage operation.

b. Upstream Fish Passage

Within three (3) years of license issuance, the Licensee shall develop and submit for Commission approval, functional design plans for upstream fish passage facilities. The upstream fish passage must be installed at the Project after a minimum of 5,000 river herring have successfully and volitionally passed through the Mine Falls' (FERC Project No. 3442) upstream fish passage system for a minimum of two (2) consecutive years (Trigger Level). Installation of the fish passage system shall occur within three (3) years of achieving this Trigger Level, but in no event shall the fish passage system be installed before the year 2026, regardless of the number of migrants passing the downstream Mine Falls Project. Should the Trigger Level occur before the year 2026, the Licensee shall provide interim upstream fish passage through the use of a commercial aquaculture fish pump with a temporary collection chamber installed at a location to be determined in consultation with the Fisheries Agencies.

The Licensee shall seasonally operate the upstream fish passage facility in concert with upstream fish passage facilities located at the Mines Falls Project (i.e., same operational dates).

- Consider removal of Adams Dam in Townsend if determined to be appropriate.

GOAL #2: Preserve, protect and improve wildlife habitat and migration corridors.

Objective: Promote completion of a permanently protected greenway along the rivers and their tributaries as the rivers and their banks provide key dispersal and migratory routes for wildlife: both aquatic and terrestrial.

- Coordinate with towns to complete a greenway inventory of protected and unprotected lands. Evaluate if lands thought to be protected are indeed fully “Article 97” protected⁵⁶ and are deed recorded.
- Assist town boards and work with municipal officials to develop subdivision standards that require proponents to devote a significant and sizeable portion of land (not including already undevelopable wet or steep land) for open space conservation and encourage mixed-use development and cluster zoning by-right bylaws.
- Consider removal of extraneous and abandoned chain link fencing where feasible on Devens and elsewhere, which create a barrier for wildlife passage (examples of such fencing include at and around the Nashua River by West Main Street; and, at the Nonacoicus Brook wetland on the North Post south of and adjacent to the Ayer Wastewater Treatment Plant and north of the rail line.)

#4: Municipalities and Land Use Planning Strategies

Goal #1: Promote balanced growth which preserves property values and protects and enhances the riparian resources for future generations.

Objective: Engage with landowners on these issues.

- Educate and encourage landowners to plant and maintain native vegetative buffers in order to protect aquatic and riparian life by: maintaining critical water temperatures, preventing soil erosion

⁵⁶ See www.mass.gov/eea/agencies/mepa/about-mepa/eea-policies/eea-article-97-land-disposition-policy.html

and sedimentation, stabilizing stream banks, slowing down runoff, and filtering pollutants from stormwater run-off. Coordinate this effort through the local municipal Open Space and Recreational Plan committee and with Planning, Zoning, Conservation Commissions as well as Public Works, Engineering and Parks Departments.

Objective: Engage with municipalities and developers on these issues.

- Encourage communities to plan development so that natural and community resources are protected. Encourage local boards to require developers to use low impact design (LID) and other green infrastructure elements/ construction methods to minimize run-off.
- Encourage towns to focus development in environmentally compatible areas through natural resource inventory assessment and mapping overlays⁵⁷ (geology, soils, wetlands and watercourses, MA NHESP and habitat mapping, topography, micro-climate). Review and comment on proposed state and private development projects to assure water quality will not be degraded. Maintain or restore predevelopment hydrology in order to protect groundwater recharge capability.
- Encourage no net loss of wetlands and where possible, re-establish, restore, and enhance wetlands as part of new development or renovation projects. Assess where this has already been done and is effective.
- Establish a clearinghouse of information on river protection techniques that have been used successfully in other areas.

⁵⁷ See Ian McHarg's Design With Nature: https://en.wikipedia.org/wiki/Ian_McHarg

- Each town should consider integrating the recommendations of the last *NRWA Five-year Watershed Plan* and/or similar plans into its land use regulations and design standards.

In 2003, the Nashua River Watershed Association released the Nashua River Watershed Five Year Action Plan 2003-2007. The plan was developed with the former Massachusetts Watershed Initiative Nashua Team, a collaboration of watershed interests consisting of state and federal environmental agencies, municipal agencies, non-profit organizations, citizens, and other interested parties. The plan was approved by the Commonwealth of Massachusetts.

The maps, data, goals, and general information in the Plan are still of great value in learning about our watershed, its sub-basins, its resources, and its character.

The primary goals of recommended actions in the Five Year Action Plan were to:

1) Maintain the high level of water quality in the tributaries and return degraded waters to their designated uses pursuant to State Water Quality Standards.

2) Protect and manage in-stream flow and groundwater resources throughout the watershed to provide high quality drinking water supply sources and aquatic and riparian habitat.

3) Support local growth planning efforts & encourage careful land use with well-planned development in order to protect priority land areas for forest, agriculture, habitat, water resources & recreational values.

www.nashuariverwatershed.org/5yr_plan/watershed/executive.html

- Write a letter to the Planning Boards of each participating Study Committee town encouraging them to incorporate the *Nashua Wild and Scenic Rivers Stewardship Plan* into each of their Master Plans by reference or formal incorporation.
- Develop a mechanism to monitor this Stewardship Plan, implement such a mechanism, and foster watershed stewardship.

Goal #2: To restore, protect, and enhance water quality and associated aquatic resources and water supplies.

Objective: Take actions to protect and improve streambank and related conditions that negatively impact water quality.

- Prevent the accelerated enrichment of streams and contamination of waterways from runoff containing nutrients, pathogens, organics, heavy metals, and toxic substances.

- Educate and encourage landowners to maintain or restore a natural vegetative canopy along streams to ensure that mid-summer stream temperatures do not exceed tolerance limits of desirable aquatic organisms.
- Maintain the stream or waterway free of litter, trash, and other debris by supporting the organization of river clean up days sponsored by local businesses, groups and/or organizations that share an interest/stake in the river. Also support education and awareness campaigns on the impacts of trash by partnering with local schools to develop and disseminate information throughout the communities.
- Minimize the disturbance of the streambed and prevent streambank erosion and, where practical, to restore eroding streambanks to a natural or stable condition; for example, at the canoe launch parking lot at West Hollis Road/ Brookline Street crossing of Nissitissit River.
- Consider putting together Stream Teams for the subject rivers and tributaries to focus on river restoration and streambank stabilization and provide a venue for communication among stakeholders.

ORRV #2 - Recreational and Scenic Values



Photo: 12 NRWA archive

Today, river-related recreational pursuits are greatly valued in our study area due to the significant recovery of the Nashua River. In the 1960s, foul smells and excessive water pollution kept recreationalists far from the Nashua River corridor. Today, high quality water supports water-based recreation as well as the enjoyment of numerous greenway trails along and close to the banks of our surface waters.

The Nashua, Squannacook and Nissitissit Rivers and their adjacent trails offer the populace within the greater Boston, Nashua and Worcester metropolitan area a host of recreational opportunities including: hiking, biking, picnicking, horseback riding, birding, wildlife viewing and nature study, photography, fishing, hunting, leaf pepping, agri-tourism, dog walking, and boating. (Note: Most municipal and some land trust conservation lands prohibit motorized vehicle use.) There are near continuous footpaths – most likely created by anglers – on at least one riverbank along the Nissitissit and Squannacook Rivers and a majority of the length of the Nashua River shoreline in Bolton, Groton, Harvard, Lancaster, Shirley and Pepperell as well.

Hiking Adjacent Conserved Lands: Among the many major riparian conservation lands (“open spaces”) are: Oxbow National Wildlife Refuge (1,667-acres with almost eight miles of

Nashua River frontage)⁵⁸, Bolton Flats State Wildlife Management Area (~1,000 acres), Squannacook River State Wildlife Management Area (1,934 acres), Nissitissit River State Wildlife Management Area (625 acres), Townsend State Forest (3,082 acres), Nashua River Rail Trail (11 linear miles one-way), and J. Harry Rich State Forest (~500 acres), which was the first state-owned tree farm in the nation and the most intensively managed forest acreage in New England according to Hugh Putnam, former chief forester for the New England Forestry Foundation.

And significantly, there are more than one thousand additional acres of locally-owned land trust and municipal conservation properties such as Groton Town Forest (~500 acres). The Montachusett Regional Planning Commission (MRPC) has put considerable effort into creating an interactive web mapping application “MR Mapper” which has more than a dozen data layers including all existing formal trails (and trailhead parking) in six of our subject area towns. This information valuable is available on mobile devices for locational use in the field: see <https://mrmapper.mrpc.org>

A fact contributing to the success of so much protected land in the study area is the large number of varied organizations with different focuses working here to protect land. These organizations range from federal US Fish and Wildlife Service (Oxbow NWR) to state (MA Department of Fish & Game/Division of Fisheries & Wildlife –wildlife management areas), (MA Department of Conservation & Recreation – state forests & rail trails), (MA Department of Agricultural Resources – agricultural preservation restrictions) to municipal (Conservation Commissions, Town Forest Committees, Open Space Committees, etc.) and regional and local land trusts (Bolton Land Trust, Dunstable Rural Land Trust, Groton Conservation Trust, Harvard Conservation Trust, Lancaster Land Trust, Mass Audubon, Nashoba Conservation Trust, Nashua River Watershed Association: coordinating US Forest Legacy Grants and facilitating protection by others, New England Forestry Foundation, Nissitissit River Land Trust, North County Land Trust, The Trustees of Reservations, and Townsend Land Trust) as well as others such as sportsmen’s clubs, religious and educational institutions, MassDevelopment, and the Devens Enterprise Commission, etc.

⁵⁸ There are over 13 miles of trails connecting Devens trails and the Oxbow National Wildlife Refuge trails: these trails run along the Nashua River but also many tributaries.

It is worth noting that Massachusetts currently has the second most land trusts than any other state in the country after California. It is also the first state in the nation to have had a land trust (The Trustees of Reservations). The New England Forestry Foundation had its first headquarters in Groton MA: it was located there from its founding in 1944 until 2003.] And, over fifty years ago in 1967, the Hollis NH Conservation Commission was already noting “the importance of `open-space rural character versus development,’ and stressed the importance of acquiring land, `preferable along a water course.’” (2014 Annual Report Hollis NH: 50 Years of Land Conservation: 1965 – 2015, page 127)

On-Water Environmental Education: Additionally, the numerous open spaces and waterways provide educational venues such as River Classroom®, which brings approximately **3,000** students and adults every year to the Nashua and Squannacook Rivers⁵⁹. River Classroom® housed at the Nashua River Watershed Association is an environmental education program that has received the Massachusetts Executive Office of Environmental Affairs Secretary’s Award for Excellence in Environmental Education.



Photo: 13 ALL - NRWA archives

Additionally, there are four schools conveniently situated to use the Squannacook River as a nature study site: Spaulding Memorial Elementary School, Hawthorne Brook Middle School, North Middlesex Regional High School and the Tarbell Elementary School. Outdoor venues within these watersheds -- such as the Bill Ashe Visitor Facility in the Oxbow National Wildlife Refuge in

⁵⁹ The most recent school year 2016-2017 participant numbers are: 20 schools; 105 classes, 2,382 students, 1,177 chaperones (thus a total of 3,559 participants); and a total of 14,292 student hours for the school season. Since fall of 2001, a total of 382 different school have participated; 1,243 classes; 30,543 individual students; and 14,522 adult chaperones (thus a total of 45,065 participants). In terms of “student hours”, it totals 183,258 student hours.

Devens -- offer indoor and outdoor classroom facilities along the river and have direct trail and water access for on-water environmental education opportunities.

Riparian Rail Trials for Biking and Horseback Riding: Many dozens of miles of trails are located along these three rivers (see Map #x). Most prominently, the singularly popular Nashua River Rail Trail (NRRT), owned by the MA Department of Conservation and Recreation, which runs more than 11 miles from Ayer north to the state line, travels parallel to the Nashua River for a considerable distance. User counts taken in 2008 indicate that more than one thousand people take advantage of the NRRT on a typical summer weekend and a 2008 estimate by the MA Department of Conservation and Recreation indicates over 382,000 visitations to the NRRT for that year. Also, in development for more than a decade, a Squannacook River Rail Trail, is scheduled to be constructed in 2018. Phase one will travel approximately four miles in close proximity to the Squannacook River from Groton to Townsend Center MA. And, there is an abandoned rail bed turned walking trail along much of the Nissitissit River in Massachusetts in the eponymous state wildlife management area.

Boating: The Nashua River for the most part flows relatively slowly, and so is generally appropriate for boaters, including beginners. A local boat rental, Nashoba Paddler -- an economically successful, family-owned business -- on the Nashua River in West Groton rents boats to over 8,000 unique visitors each year: their customers come from near and far. Nashoba Paddler also offers tours and a summer River Camp.

It is also possible to launch one's own car-top boat at over a dozen access points; several of these sites are boat ramps suitable for trailered boats. (See listing of such in appendix below and on website). The NRWA's *Canoe and Kayak Guide* 6th Edition⁶⁰, updated and republished in 2017, is a greatly in demand, pocket-



Photo: 14 NRWA archive

⁶⁰ See <http://nashuariverwatershed.org/component/content/article/12-recreation/433-nashua-river-paddling-guide.html>

sized book that provides maps and descriptions for river outings on 72 miles of the Nashua and its main tributaries, including access points and portages.



Photo: 15 Google image

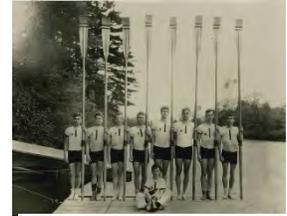


Photo: 16 Google image

Additionally, the Townsend Lions Club hold an annual canoe race – the 34th such in 2017 -- on the Squannacook River and groups often hold an annual canoe race on the Nashua River. The Groton School has always used the Nashua River for their crew team: 132 years of rowing in 2017. The Groton Greenway Committee puts on an annual spring Greenway Festival at which a featured event is a cardboard boat race. The Lancaster Friends of the Nashua River had been holding an annual festival at which Nashoba Paddler had offered free boat rentals. Finally, the Boston, Worcester and New Hampshire AMC chapters and other paddling groups (formal and informal such as meet-ups) organize numerous trips on the Nashua River and to some lesser extent Nissitissit River every year.

Fishing: Nissitissit River and two of its tributaries --Sucker and Gulf Brooks --are stocked with brown, brook and rainbow trout by MassWildlife; as is Unkety Brook – a tributary to the Nashua River-- in Dunstable. Some of these stocked trout are known to reproduce and persist in the cold-water sections of our study rivers.



The ponds, lakes, and rivers that are so abundant in Groton were not just for swimming and skating. Fishing for sport became a popular pastime in the late 19th and early 20th centuries.

Photo: 17 "Images of America: Groton"



APRIL SHOWERS. A young man pursues the timeless art of fishing along the banks of the Nashua River near the Sprague-Vose Bridge, between Lancaster Center and South Lancaster.

Photo: 18 "Images of America: Lancaster"

Over thirty different angling groups, such as Yankee Bassmasters and Freedom Bass, sponsor annual fishing tournaments in Pepperell Pond on the Nashua River. Largemouth bass is found in the Nashua River with many six pounders caught. The Nissitissit and Squannacook Rivers are widely regarded as providing some of the best fly-fishing within reach of metro-Boston anglers. [Note: The NRWA's 1984 Squannacook River Protection Plan, says: "Although readily accessible from major roads and population centers, the Squannacook River is considered by MDFW to be 'one of the three best trout fishing streams in eastern Massachusetts' and is heavily stocked" (pg. 6) – the Nissitissit being one of the other three rivers -- as it continues to be to this day.] A 1973 MA Division of Fisheries and Wildlife (DFW) Creel Census found that almost 20,000 people spent over 60,000 hours fishing on the Squannacook River. Of course, the high-water quality is in very large part attributable to high-percentage of forest in their respective watersheds.

The Squan-A-Tissit Chapter of Trout Unlimited (TU) has a strong presence in the watershed including constructing a universal access facility on the Squannacook River, and assisting MassWildlife staff when they conduct electro-shocking and fish sampling. The Squan-a-Tissit TU chapter has also adopted the Nissitissit River under the Massachusetts Adopt-A-Stream program. In the early 1990's, the Chapter was instrumental in the designation of the Henry Colombo area, a nearly two mile reach of the river that extends from the New Hampshire border to the Prescott Street Bridge in Pepperell, as a Fly-fishing only – Catch and Release area (Massachusetts' first so designated); and Chapter members have long been active in the NRWA volunteer monitoring program and the UMASS Acid Rain Monitoring Program. As part of the Trout Unlimited Brook

Trout Initiative, the Squan-a-Tissit chapter is currently conducting an assessment of the Nissitissit River and its tributaries to identify areas where restoration or protection efforts would most help protect the native brook trout populations. This assessment includes a reconnaissance survey of tributaries to identify reaches with native brook trout, a temperature survey of the Nissitissit and its tributaries, and an assessment of the connectivity of the tributaries to the mainstem.⁶¹

(<http://easternbrooktrout.org/news/newsletters/2008/ebtjv-northeast-april-2008>)

Hunting: Pepperell Pond is a much frequented waterfowl hunting location: Nashua River chapter of Ducks Unlimited chapter is a proponent for hunting on this river segment. The Townsend Rod and Gun Club (~300 acres), South Fitchburg Hunting & Fishing Club (68 acres) on tributaries to such, and the Shirley Rod and Gun Club (~200 acres) is situated on the Squannacook River⁶².

Scenic Views: The Massachusetts legislature passed the Scenic and Recreational Rivers Act in 1971. [Note: The driving motivation behind this program was to protect, preserve and acknowledge the rivers as significant recreational and scenic resources. Under this law, land development is restricted within designated river corridors, to safeguard water quality on and along the watercourses, maintain a healthy and safe environment, and enhance recreational opportunities for people.]

⁶¹ “Small, coldwater brooks also buffer the temperature of the larger streams and rivers they flow into as well as some distance downstream from their confluence. The larger streams and rivers in the Nashua-Nissitissit-Squannacook complex could likely serve as overwintering habitat for trout and other larger-bodied coldwater species in their deeper pools. To the angling community, these larger waters also provide more desirable fishing opportunities with chances to catch larger fish, both wild and stocked. It is imperative to protect the entire network of flowing waters to ensure continued integrity of coldwater fish assemblages and a robust recreational trout fishery.” (Personal communication with Adam Kautza, MassWildlife Coldwater Fisheries Project Leader, 6/1/17)

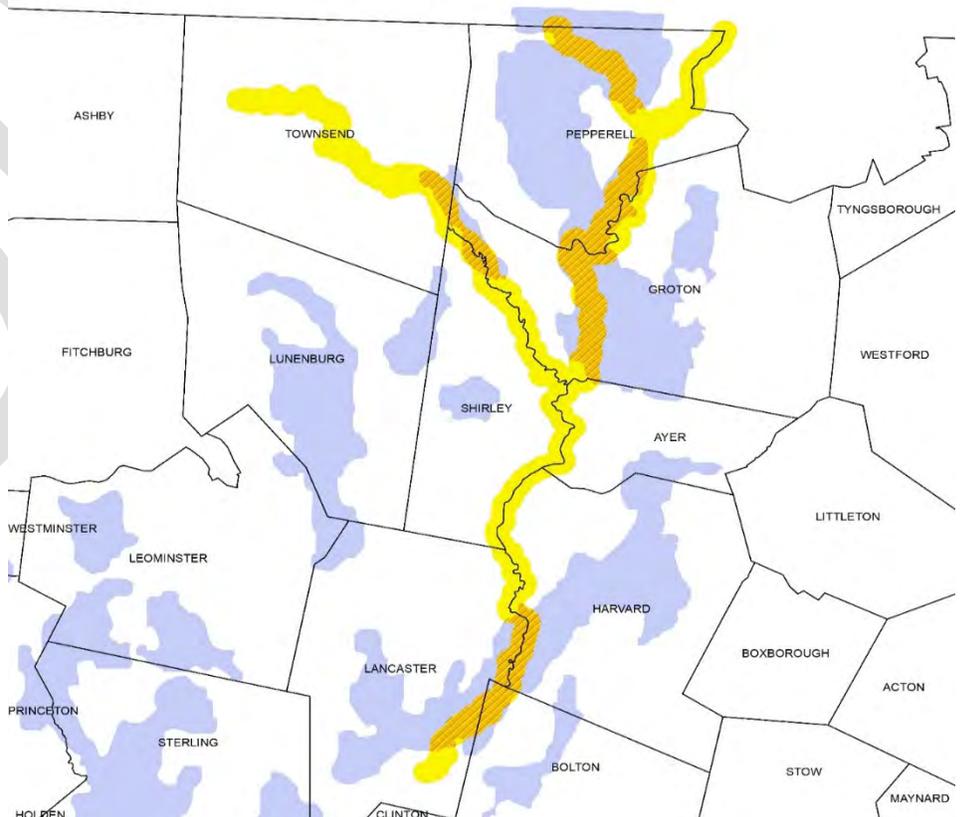
⁶² The beginning of the Squannacook River Wildlife Management Area was created when the Middlesex League of Sportsmen’s Clubs purchased and donated 259 acres along the river to the state in 1966. On the lower Squannacook, over 160 acres has been dedicated to conservation by the Shirley Rod and Gun Club.



The Wright family holds a picnic along the Nashua River c. 1900. The men and women are dressed in Victorian-style clothing, and the image provides an interesting insight into leisure-time activities at the turn of the century. William Wright, shown in the center holding a shutter line, was an amateur photographer who was active from 1880 to 1920. Many of his photographs document the local history of Harvard, Ayer, and other Massachusetts towns.

Photo: 19 "Images of America"

The MA Department of Environmental Management (now Department of Conservation and Recreation) Scenic Rivers Program prioritized the Nashua and Squannacook Rivers as needing protection. In order to attain this Scenic River status, it was necessary for the governing bodies of the riverfront communities to approve the goals of the 1984 *Nashua River Greenway Management Plan*. Local approval was gained through a series of public meetings held by the Selectmen of each river town. To this day, these rivers' shorelines are remarkably undeveloped, their scenery is exquisite.



One of the most famous views in central Massachusetts is of the Nashua River valley from Prospect Hill⁶³ at Fruitlands Museum– it looks much as it might have a century ago -- and is listed in the 1982 Massachusetts Scenic Landscape Inventory.



Photo: 20 Google image

[Note: This Inventory⁶⁴, which focused on the Commonwealth's very best landscapes, found that high scenic quality often coincides with, and depends on, the presence of a healthy natural environment, agriculture, historic features, and a lack of intensive, uncontrolled contemporary development. It advised: *“Existing or future efforts in these areas should be linked with a program for regional preservation”* (pg. 17).] Long stretches of the Squannacook and Nashua Rivers are rated as “distinctive scenic resources” in the Inventory. Just below the confluence of the Nissitissit and Nashua Rivers is a scenic, historic attraction that many tourists photograph each year: Pepperell's “Chester Waterous Covered Bridge”, which stands at the site of Blood’s Fordway, where a bridge has spanned the river since 1742. (*Pepperell Open Space and Recreation Plan*, page 42-3) It is the only covered bridge -- first erected in 1846 -- in Massachusetts east of the Connecticut River. (“Pepperell Greenway and Conservation Plan”, NRWA, 1982, pg. 38)

From https://en.wikipedia.org/wiki/Pepperell,_Massachusetts



Photo: 21 Google image

⁶³ Also, once called “Makamachekamuck Hill” prior to 1800 (see photo above).

⁶⁴ The survey was based on the subjective opinions of professionals guided by a series of objective factors. The entire Commonwealth was subject to the study, which identified the best landscapes greater than one square mile in area.

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF RECREATIONAL AND SCENIC FEATURES

- Eight thousand unique visitors use canoes & kayaks from Nashoba Paddlers LLC -- a locally owned outfitter – to explore the Nashua and Squannacook Rivers each year, in addition to the many who bring their own boats to over 20 access sites. Nashoba Paddlers additionally offers tours and a summer River Camp.
- Award-winning River Classroom®, an environmental education program housed at the NRWA, brings approximately three thousand students and adults every year to the Nashua and Squannacook Rivers.
- The Nissitissit and Squannacook Rivers are widely regarded as providing some of the best fly-fishing within reach of metro-Boston anglers.
- Several bass fishing clubs annually hold tournaments on the Nashua River.
- The Groton School has always used the Nashua River for their crew team. The Groton Greenway Committee puts on an annual spring Greenway Festival at which a featured event is a cardboard boat race. The Lions Club holds an annual canoe race on the Squannacook River.
- The eleven mile Nashua River Rail Trail (NRRT) paralleling river for several miles receives more than one thousand users on any given summer weekend day, with people enjoying walking, running, bicycling, roller-blading, and horseback riding. A 2008 estimate by the MA Department of Conservation and Recreation indicates over 382,000 visitations to the NRRT for that year.
- The ~13,900 acres of permanently conserved lands that abut the rivers provide unparalleled opportunities for hiking and wildlife viewing, and in many areas hunting. The Nashua River is a prime area of hunting waterfowl in season.
- The Massachusetts Scenic Rivers Program in the 1980's prioritized the Nashua and Squannacook Rivers as scenic rivers in need of protection. The 1982 Massachusetts Scenic Landscape Inventory included long stretches of the Squannacook and Nashua Rivers as “distinctive scenic resources” including Pepperell's much photographed “Chester Waterous Covered Bridge”. (see Pepperell 2016 Open Space and Recreation Plan, page 48).
- A central factor in designating three contiguous MA ACEC's (see above) in the watershed is for the preservation of the scenic and recreational values of the Nashua River corridor.
- The 155 miles of permanently protected greenway along the river provide recreationists on shore or water with a serene and breathtakingly beautiful “wilderness” experience within an hour's

drive of three metropolitan cities with a combined population of over 3,000,000. (“Nissitissit River NH and MA - A Preliminary Report on Proposals to Preserve”, NH DRED, 1967)

DRAFT



Photo: 22 Nissitissit River in Pepperell MA, Ken Hartlage

RECREATION and SCENIC ACTION PLAN

To protect and enhance the subject area’s recreation and scenic resources and their public enjoyment.

#1: Protected Greenway Lands

GOAL: Promote continued protection of “temporarily protected” greenway lands (Chapter 61, 61A and 61B lands in Massachusetts; “Current Use” lands in New Hampshire).

- Coordinate with towns to maintain an up-to-date greenway inventory of temporarily protected, permanently protected, and unprotected lands along the three rivers and their tributaries and headwaters. Encourage community officials to work with private, state, or federal partners and to apply for grants as appropriate to help finance selected land acquisitions as unprotected properties become available and the public supports their acquisition; similarly encourage seeking help with funding for stewardship improvements as appropriate.

- Encourage Conservation Commissions and Boards of Selectmen to prioritize parcels in Chapter 61 and Current Use properties so that the towns could be ready to act quickly when rights of first refusal (which in MA afford 120 days to act) are triggered by sale.

GOAL: Promote additional permanently protected greenway lands and continued protection and completion of the “Nashua River Greenway” – the vision of a greenway along both sides of the rivers and their tributaries.

- Ensure that if the Fort Devens South Post is ever surplus that the land is incorporated into the Oxbow National Wildlife Refuge as stipulated by 1996 Defense Authorization Act (as well as 100 acres to the Town of Lancaster). Inform all current and incoming Boards of Selectmen and Conservation Commissions -- in Lancaster and Harvard -- of this legislation.
- Continue to assist and support private landowners and local land trusts in their voluntary land conservation measures that protect important riverfront and associated watershed lands. Encourage all land buying agencies to pursue the purchase (in fee or conservation easements and, of course, gifting) of important river-related lands from willing sellers if parcels come on the market and if funding is available. The New Hampshire Legislature should provide adequate funding for Land and Community Heritage Investment Program (LCHIP) to help protect wildlife habitat and to keep land open for public recreation. Towns should take advantage of opportunities to protect land, especially on the riverfront, for public recreation and open space.
- Identify greenway gaps and pay special attention to land protection efforts that provide “connectors,” especially including between Bolton Flats Wildlife Management Area and Oxbow National Wildlife Refuge, and between Sucker Brook and Gulf Brook⁶⁵.
- Give high protection priority to headwaters and tributaries of the three rivers, especially those of primary concern (as identified in municipal Open Space and Recreation Plans).

⁶⁵ As identified in the Massachusetts Audubon Society, “Focus Areas for Wildlife Habitat Protection in the Nashua River Watershed”, September 2000.

- Maintain the greenways in a healthy state⁶⁶. Restore natural or man-made “degraded” lands⁶⁷, particularly those visible from the rivers, for example by maintaining and expanding vegetated riparian buffer to ideal 300 feet from riverbank, where possible.

#2: Fishing Use: Warm and cold water fisheries

GOAL: Ensure healthy ecosystems to support recreational fisheries.

- Keep riparian forests intact so that their shade helps keep water temperature cool, which holds more dissolved oxygen than warm water. Support and promote pavement reduction strategies within watersheds (narrower roads, porous pavements and surfaces that absorb runoff) to reduce stormwater runoff and water temperatures through education and awareness and changing of local subdivision and development codes. Reduce impervious surfaces when and wherever possible.
- Maintain, protect and enhance water flow regimes that support needs of native river fauna, while accommodating demands for water supply, waste assimilation, commercial, industrial and agricultural uses.
- Work with local, state and federal partners to keep healthy populations of native brook trout and other sport fish for recreational fishing in the Squannacook and Nissitissit Rivers. One notable example of which is the work of the Squann-A-Tissit chapter of Trout Unlimited⁶⁸ to conduct an assessment of these rivers and to identify areas where restoration or protection efforts would be most helpful. Set up a training to learn how to conduct stream crossings (or aquatic connectivity⁶⁹) surveying as needed.
- Consider the effect of the two Nashua River dams (in MA) – Pepperell and Ice House -- on fish passage. Support establishing and/or maintaining adequate upstream and downstream fish passage

⁶⁶ Greenways are considered “healthy” when they serve their function as important ecological tools for the protection and enhancement of the natural environment. They improve water quality by establishing buffers along waterways and providing habitat. These buffers serve as natural filters, trapping stormwater pollutants from urban runoff, eroding areas, lawns and agricultural lands.

⁶⁷ “Land degradation is a process in which the value of the biophysical environment is affected by a combination of human-induced processes acting upon the land. It is viewed as any change or disturbance to the land perceived to be deleterious or undesirable.” (Wikipedia)

⁶⁸ <https://squanatissit.org>

⁶⁹ https://streamcontinuity.org/aquatic_connectivity/index.htm

facilities. Comment on updated fish passage designs as they come up for review. *Note: Fish passage is a requirement of the FERC license and included in the schedule for “required” items to be completed for the Pepperell Hydro Dam⁷⁰. Fish passage will require strict review and approval by MA NHESP for the species of fish that could potentially pass through the dam area (see footnote # 32).*

- Help facilitate the continued use of the Nashua River in the “Pepperell Pond” area for bass fishing and bass fishing tournaments, notably by keeping aquatic invasives (primarily, water chestnut) to a threshold below that which may impede boating.
- Promote dialogue regarding balancing multi-uses and avoidance of over-use resulting from increased public exposure on all three rivers in order to reduce potential conflicts. [Note: The Missisquoi and Trout Rivers, Vermont’s only Wild and Scenic River, answered the FAQ “*Will designation result in increased tourism or recreational use of the rivers?*”

Not significantly. Tourism and recreational use on other rivers in the Wild and Scenic System have not seen dramatic increases in either tourism or recreational use attributed to Wild and Scenic designation. The degree to which such traffic increases largely depends on the extent to which the riverfront communities choose to promote Wild and Scenic designation.”

https://docs.wixstatic.com/ugd/7dcf17_83502e6926c84f05803f574a7ebec36b.pdf]

- Educate and encourage anglers about proper disposal of lures, weights and other fishing equipment including monofilament line.

#3: Boating Use

GOAL: Preserve and enhance opportunities for boating.

- Encourage “blue (water) trails⁷¹”. Encourage the planning of water-based recreational opportunities.
- Secure continued public use through formal agreements with private landowners at boat launches regularly used by the public.

⁷⁰ See footnote # 32 (as of Oct 5 2017 version)

⁷¹ A recently created and close-by blue trail is in Lancaster MA on the North Nashua River.

- Identify appropriate areas for car-top public access utilizing the MA Public Access Board (PAB) staff and criteria⁷² for potential car-top sites, if determined that such are needed.
- Maintain the current appropriate access sites for canoe and kayak users. Support creation of additional appropriate public access sites for canoe and kayak users, including those planned for the Pepperell Dam⁷³. Support development of appropriate handicapped accessible sites. If new river access sites are desired, first develop criteria for siting such riverside public recreation areas. Consider requiring provision for appropriate public access when bridges or culverts (especially on state roads) are upgraded.
- Improve rivers for safe boating passage given large woody debris obstructions while maintaining habitat by obtaining input and state approvals: from MA Natural Heritage & Endangered Species Program (MA NHESP) and MA Division of Fisheries and Wildlife⁷⁴.

⁷² PAB's criteria are: site must be publically owned; demonstrated recreational need for the project; safe access into and out of the water; potential for adequate parking; a responsive municipal managing authority to maintain the site; and, consistency with the mission of the MA Division of Fish and Wildlife.

⁷³ Pepperell Hydro, LLC. Recreation Plan for Pepperell Hydroelectric Project, prepared by Kleinschmidt, June 2017.

⁷⁴ Consult MassWildlife's "Trees, Paddlers and Wildlife-Safeguarding Ecological and Recreational Values on the River" and/or NH DES's Fact sheet "Managing Large Woody Material in Rivers and Streams"

<https://www.des.nh.gov/organization/commissioner/pip/factsheets/rl/documents/rl-21.pdf> . Here a key take-away is: "If the large woody material is not a threat to human health, human safety, or river integrity: Let the Sleeping Log Lie." Large woody debris provides habitat, improves water quality, supports invertebrate life cycles, creates physical complexity and stabilizes banks and bed so there have been concerns about clearing such from the rivers.



WD-R&I-21

2015

Managing Large Woody Material in Rivers and Streams

Large woody material, referred to in this document as LWM, is an essential part of life for rivers and streams. The end of life for a riverside tree is a source of nutrients for the diverse species living in the river ecosystem. River and stream habitat is preserved when the natural cycle of disturbance deposits LWM in a particular location within its corridor. Development of floodplains and property along waterways requires informed decisions and proactive stewardship with regard to preserving river health. One way we can help preserve river health is by giving streams and rivers a chance to preserve themselves when appropriate, without human interference. We can do this by not disturbing LWM in a river or stream. Removing LWM from a river or stream should only be performed if it poses an imminent threat to human health, human safety, river integrity or public infrastructure, e.g., a blocked stream crossing.

Ecological Importance of Large Woody Material

- **Provides Habitat:** LWM provides fish with shelter from high velocity flows, creating habitat for spawning, nurseries and foraging. These calmer glide and pool areas are ideal for fish to take refuge from predators and often serve as markers for migratory fish. Microbial life in the river, the crucial base of the aquatic food web, uses LWM as a colony habitat. In low flows, LWM provides twisted surfaces and hollows for these tiny organisms to proliferate, waiting to be released to the river as food for aquatic invertebrates and fish.
- **Improves Water Quality:** The presence of LWM in a river or stream provides surface area for water to flow over and around, increasing oxygenation of the water, which is vital for supporting aquatic life. LWM crevices and twisted branches serve as a bench for collecting silt, which increases the aeration in the river and assists in decreasing silt in gravel beds and river bottoms. The LWM's capacity to retain sediments and nutrients (phosphorus) reduces the potential for downstream water quality degradation from nutrient and sediment overloads.
- **Supports Invertebrate Life Cycles:** A log or limb protruding from a river or stream provides an excellent surface for many aquatic invertebrates such as mayflies and stoneflies to emerge from their river juvenile life stage to their terrestrial adult life stage. Some juvenile and adult aquatic insects rely on LWM as a source of nutrients and shelter during their life cycles. LWM is an excellent leaf and organic matter trap, which establishes ideal habitat for aquatic invertebrates.
- **Creates Physical Complexity:** When LWM is introduced into the river system, it alters the water flow, resulting in formations such as deep pools and rushing riffles. This increase in physical habitat variety increases the diversity of plants and animals that can populate the river. Biological diversity is essential in maintaining a healthy river ecosystem.

- Utilize a recreational and ecological evaluation documentation process to consider alteration of woody debris blocking boat passage under summer conditions similar to that used by the Lamprey River Watershed Association in 2015: www.lampreyriver.org/UploadedFiles/Files/woody_obstacles_report.pdf.
- Re-evaluate appropriate speed limits for Pepperell Pond. Speeding motorboats can conflict with non-motorized uses on the river and can cause bank erosion due to large wakes. Post speed limits as appropriate (see www.mass.gov/orgs/boat-and-recreation-vehicle-safety-bureau).
- Educate boaters to make sure boat hulls are clean before putting in as a way to limit the spread of aquatic invasive "hitchhikers" (see <http://stopaquaticinvasives.org/>). Keep aquatic invasives to a threshold below that which may impede boating for example at Pepperell Pond).
- Update and publicize NRWA's 2017 *Canoe & Kayak Guide*. Consider smartphone app of this guide.
- Maintain stream flow to enhance recreational and scenic qualities, while accommodating demands for water supply, waste assimilation, commercial, industrial and agricultural uses.

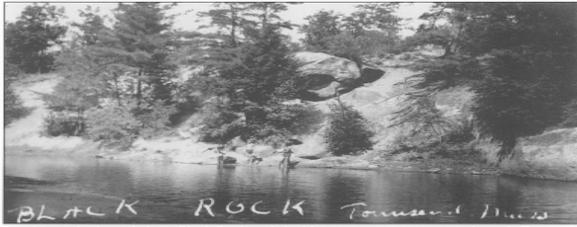
- Interface and coordinate with regional paddling groups such as the Boston, Worcester and New Hampshire Appalachian Mountain Club (AMC) chapters, which organize numerous trips on the Nashua River and occasionally the Squannacook and Nissitissit Rivers.

#4: Swimming Use

GOAL: Provide opportunities for safe swimming in our rivers.

- Increase public access to the rivers where appropriate and where sanctioned while protecting the riparian integrity and the surrounding river environment.
- Look for opportunities to reduce or eliminate sources of bacterial contamination/ pollution so that swimming is safe in the three rivers (i.e.: stormwater controls) where appropriate and where sanctioned. Determine such possible non-point pollution sources through monthly water quality sampling/monitoring. Consider designing an on-line regularly updated “flagging” system to alert swimmers of any immediate water quality threats that would make primary contact with the water unadvisable in those public areas most frequently used for swimming.
- Educate public about public health threats regarding swimming within several days after intensive rain storms that may have caused upstream combined sewer overflow⁷⁵ (CSO) releases of raw sewage, untreated polluted stormwater runoff, etc. Alert the public through social media when bacteria levels at water monitoring sites have been exceeded for safe swimming or boating (primary and secondary contact recreation, respectively).
- Monitor most heavily used swimming areas to minimize or repair erosion problems on steep sandy banks (i.e.: notably at Black Rock in Townsend and Bertozzi Conservation Area in West Groton) where appropriate and where sanctioned. Guide pedestrian access to such sites onto paths that are least destructive.

⁷⁵ CSOs are also known as combined sewer systems. They collect rainwater runoff, domestic sewage, and industrial wastewater into one pipe. Under normal conditions, it transports all of the wastewater it collects to a sewage treatment plant for treatment, then discharges to a water body. The volume of wastewater can sometimes exceed the capacity of the CSS or treatment plant (e.g., during heavy rainfall events or snowmelt). When this occurs, untreated stormwater and wastewater, discharges directly to nearby streams, rivers, and other water bodies. CSOs contain untreated or partially treated human and industrial waste, toxic materials, and debris as well as stormwater. They are a priority water pollution concern and the “twin cities” of Fitchburg and Leominster are particularly impactful. www.epa.gov/npdes/combined-sewer-overflows-csos



Local legends abound about Black Rock and the Native Americans passing through Townsend before the 18th century. According to one legend, the underside of Black Rock got its color from cooking fires built by the Native Americans. Legends aside, Black Rock has been a popular gathering place for generations of swimmers and picnickers.



Two boys, Clarence Morse (left) and Rousy Crowdry, sit at Black Rock in the early 20th century. Children of every generation have spent time there. After 1932, students at Spaulding Memorial School would walk down to the river, hang their clothes on nearby tree branches, and swim at Black Rock.



Swimming in the gristmill canal was a bright feature of life in Townsend Harbor. When the leatherboard mill closed for vacation, neighborhood volunteers would drain the water from the canal and then clean it, using rakes, shovels, and pails attached to ropes in order to clear out the debris; children could then safely play in the canal. This photograph was taken in the 1950s. (Courtesy of Carol Wright.)

- Consider restoring Harbor Pond in Townsend, which is heavily eutrophied and filling in, due to sediment transport⁷⁶, to a level that supports increased recreational use, possibly including swimming where appropriate and where sanctioned.

#5: Regional Trail System

GOAL: Maintain and enhance regional trail systems.

- Promote additional use of trail easements and linkages to further extend existing formal⁷⁷ regional trail system for passive recreational use.

⁷⁶ Sediment transport is the movement of solid particles (sediment), typically due to a combination of gravity acting on the sediment, and/or the movement of the fluid in which the sediment is entrained. (Wikipedia)

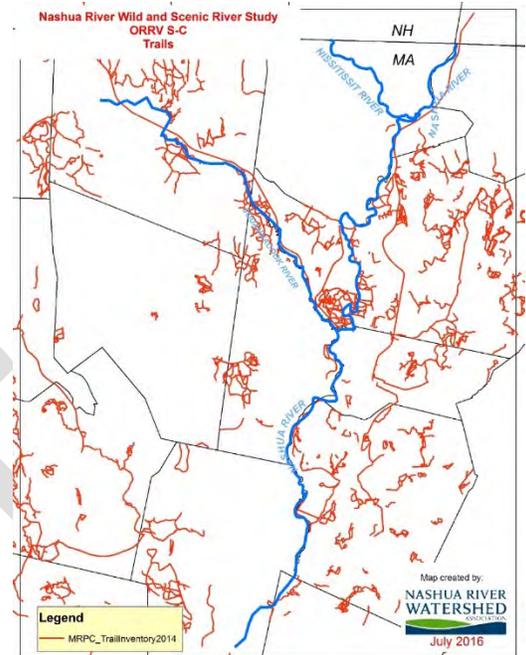
⁷⁷ Formal trails are those on existing protected lands: governmental or private (i.e.: land trust holdings or registered Conservation Easements) versus informal trails.

Many towns have the following “Trail Use Disclaimer: It is the personal responsibility of the trail user to verify that the trail is designated for the specific use of interest. Respect property owners’ rights. Conservation areas are generally open to hunting in accordance the Massachusetts law, unless POSTED otherwise. Be aware of hunting seasons and regulations. All-terrain-vehicle (ATV) use is generally not permitted in municipal conservation areas.” (www.shirley-ma.gov/Pages/ShirleyMA_ConCom/trails.pdf) Additionally, note that MA DFG has a policy of minimizing walking trails.

- Explore opportunities for extending/connecting rail trails (in all directions) for multi-uses and accessibility, while maintaining wildlife habitat.
- Increase access to existing trails and provide excellent information for trail users⁷⁸ via coordination with local trail committees, such as those in Groton and Shirley, and reliance on local volunteers and aspiring Eagle Scouts as in Pepperell.
- Encourage the work of regional trails groups such as Montachusett Regional Trails Coalition (see:



www.facebook.com/MontachusettTrails).



- Increase monitoring and maintenance of rail trails -- notably the existing Nashua River Rail Trail, the soon-to-be constructed Squannacook River Rail Trail, and the undeveloped riverside trails along the Nissitissit River in Pepperell MA (these trails are owned by DFW, which has strict regulations for trail maintenance) and in Hollis and Brookline NH – as well as other pedestrian-only river access areas in order to minimize littering, parking problems, ATV abuses, vandalism, and trespassing on adjacent private lands. Encourage “Adopt-a-Trail”-style projects. For example, the Town of Pepperell has a volunteer-based trail monitoring and maintenance program for town-owned trails available on its Conservation Commission website (see: www.town.pepperell.ma.us/172/Trail-Monitoring-and-Maintenance-Program).
- Develop riverside trails guide books or maps – both print and on-line -- for the general public to encourage trail use and assist in exploration of such trails⁷⁹.

⁷⁸ Nashoba Conservation Trust (NCT) and Town of Pepperell (TOP) together, created a trail guide with details about 16 properties including land protection history (donation, purchase, etc.), details/GPS location of the parking for the property, flora and fauna. The free guide can be downloaded from the TOP and NCT websites and is available in iBooks.

⁷⁹ For one such example see: www.americantrails.org/NRTDatabase/trailDocuments/3846_QuinebaugRiverPaddleGuide2012a.pdf

- Help users of the various trails learn how to safely navigate multiple types of concurrent use – e.g., horses, pedestrians, and cyclists simultaneously using the rail trails. Help users identify trails appropriate to their form of recreation, e.g., bicyclists on Nashua River Rail trail; fishing access trails along the rivers.
- Follow development of potential “Thoreau Trail” proposed by Freedom’s Way Heritage Association (FWHA) that would cross the Nashua River on its 50+ mile course connecting Walden Pond and Wachusett Mountain. Be mindful of the August 23, 2016 MA Division of Fisheries and Wildlife “Walking Trails Policy” which states their intention to keep MassWildlife properties in a natural state, in light of the possibility that the “Thoreau Trail” might bisect the Bolton Flats Wildlife Management Area.
- Encourage ADA (universal accessible) trails and wildlife viewing areas where feasible.
- Update municipal by-laws to include trails and greenways as part of site development process. Encourage multi- and inter-municipal planning of trails and greenways to encourage cross-regional linkages.
- Support and promote regional community trail mapping⁸⁰ such as at Montachusett Regional Planning Commission (MRPC).



#6: Other Recreational Activities

GOAL: Encourage other recreational activities as appropriate.

- Clarify appropriate recreational areas for dog owners. Reinforce or create pet waste ordinances (pooper scooper laws) and restrictions on illegal dumping, such as at Groton Place informal “dog park” along the Nashua River, or otherwise secure and maintain pet waste disposal containers.

⁸⁰ <http://www.mrpc.org/home/pages/community-trail-maps>

- Conduct browse studies to determine where deer overpopulation is occurring. Encourage deer hunting where setbacks allow to reduce overpopulations that impact wildlife habitat⁸¹ and which also lead to increased tick numbers and resulting increased cases of Lyme Disease in humans.
- Encourage continued public support and participation in: 1) the annual Groton-Oxbow National Wildlife Refuge Circle’s “Christmas Bird Count” (ongoing since 2000); 2) “Big Night”: early spring first mass amphibian movement activities; and 3) other local turtle protection happenings.
- Encourage development of “wildlife viewing and photography platforms” where appropriate. [Note: See Mass Audubon Society’s “Nashua River Watershed Important Bird Area (IBA) Site”. www.massaudubon.org/our-conservation-work/wildlife-research-conservation/statewide-bird-monitoring/massachusetts-important-bird-areas-iba/important-bird-area-sites/nashua-river-watershed]
- Provide Wild & Scenic River program information at community events, fairs, canoe races, fishing events and other public gatherings.
- Consider developing a signature event, which would continually educate the public on the value of the rivers, their outstanding resources, and the value of their designation as Wild & Scenic Rivers.
- Track new types of recreational activities and equipment that cannot be foreseen in the future – such as drone aircrafts -- to make sure they are compatible with managing and protecting our rivers’ ORRVs.
- Consider doing an economic benefits analysis of recreation in the designated area, possibly in partnership with the Freedom’s Way Heritage Association.

#7: Scenic Values

GOAL: Protect scenic views of the rivers and river valleys.

⁸¹ Consider developing town-specific Deer Management Plans.

- Encourage protection of traditional New England landscape patterns and scenic visual resources such as the viewshed across the Nashua River valley from the vicinity of Fruitlands Museum. This



may include, for example, concerns regarding steep slopes, building heights, and outdoor lighting⁸². Protect traditional New England landscape patterns and visual resources by supporting resource-based economic

activities -- “working landscapes” -- including sustainable farming, forestry, and ecotourism.

- Consider conducting a formal scenic assessment of exceptional views (such as National Park Service’s “Visual Resource Inventory⁸³”) to identify resources in need of protection that also include views from on the rivers toward undeveloped shoreline banks as the forested corridor or greenway is a much appreciated aesthetic resource.
- Pay special attention as relates aesthetics when first drafting Forest Management Plans on Massachusetts public lands along the rivers. The natural, “wild” appearance of the greenways as one recreates on the river is a key component of the special enjoyment the public derives on these rivers.
- Encourage municipalities to adopt and enforce "Scenic River Protection" type bylaws (similar to Townsend's Squannacook River Protection bylaw and, at the state level, the Squannacook & Nissitissit Rivers Sanctuary Act passed in 1975).

⁸² A reference/example of Devens Viewshed Overlay District containing regulations to limit the visual impact of new development on the Prospect Hill Overlook can be found at www.devensec.com/rules-regs/decregs304.html - see Section (8)(i) . Also, see www.nashobavalleyvoice.com/groton_news/ci_31402152/at-devens-planners-must-consider-view-business-builds .

⁸³ www.ncptt.nps.gov/blog/nps-visual-resource-protection/

ORRV #3 - Historical and Cultural Resources

The riverine environmental setting of the general area would have made it an ideal location for groups of prehistoric hunter-gatherers. This type of ecozone with its riverine fall lines, open river meadow/marsh, natural ponds, and tributary streams entering the flood plain from upland areas, is an example of a setting with high resource potential." (Appendix 2 -Fort Devens Supplemental Environmental Information for Fort Devens Realignment III-c-45).

Early Settlers: Abundant food sources and their usefulness for travel made these rivers important to Native Americans, whose occupation is documented by numerous streamside archaeological sites including: the site of a large semi-permanent Nashaway village just south of the Meeting of the Waters where the North and South Branch of the Nashua join, which is considered a major prehistoric resource; and, a native encampment along the Nashua River in Pepperell (the "Reedy Meadow Brook" site), near its confluence with the Nissitissit River.

Nipmuc groups, who called the area Petapawag or a "swampy place," occupied Groton for many thousands of years. The many wetlands of Groton have played a big part in all of the town's history, from the earliest settlers many millennia ago, to the most recent decades. Wetlands have served as transportation corridors, life sustaining sources of drinking water for people, plants, and animals, as well as sources of power, and places for recreation. The locations and types of wetlands spread across Groton have influenced how the town has developed, and continue to be important to the different themes that make up Groton. The interpretive themes presented in the following section refer back to the role of water and its influence on history within the town." (Groton Archeological Report, Page 32)

It has been suggested that the region's geography resulted in unique human settlement patterns. Former Archeological Curator of Fruitlands Museum, Michael Volmar, described the extensive, 1,000+ acre freshwater estuary at the present Oxbow National Wildlife Refuge as being communally used for hunting and gathering by Native Americans; the natural resources – including seasonal shad, salmon, and alewife fish runs -- were so abundant as to be a place where different bands could utilize such without concern for the usual territorial boundaries. Local history buffs have pondered if "the lack of settlements was because the Native Americans considered the area sacred. This was their prime hunting ground so they took special care to

protect it and keep it wild, [thus] settlements would have degraded it.” (personal communication with Robert Pine, Director of Environmental Planning and Engineering at Pine&Swallow Environmental, in Groton MA) There is a high probability of potential native American archeologic sites in the study area according to the Massachusetts Historical Commission (MHC) and local professional historian Michael Roberts of Timelines, Inc.⁸⁴ There is one confirmed Native American Graves Protection and Repatriation Act (NAGPRA) site in the Lake Potanipo Brookline NH area, which was found when the ice harvesting facility (Fresh Pond Ice Company) was being constructed in 1905. The remains went through a NAGPRA review managed by Harvard University and the remains were returned to the Abenaki native tribes in 2001.

Due to the presence of prime agricultural soils in the large floodplains along the banks of the river, there is a long-term agricultural history. Agrarian history dates back to the prehistoric Late Woodland Period. The “First Peoples” burned the land to keep it open, which made it attractive to European settlers who arrived in the 17th century.

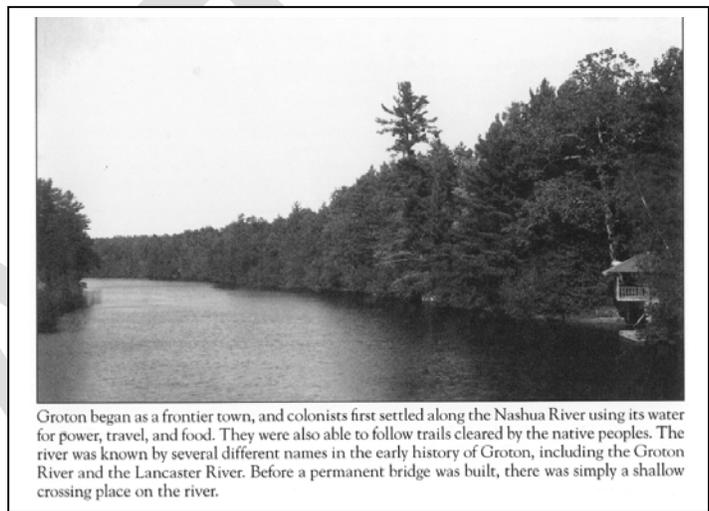
First Towns and Mills: For example, Lancaster is a long settled place, one of the first inland towns established in Colonial America, when a Native American trading post was set up near the river in 1643. Soon after European settlers followed to farm the rich soils of the Nashua Valley and in time the Squannacook Valley. However, the Natives did not relinquish this land readily and there were many struggles. The first book written by a woman in America -- The Narrative of Mrs. Rowlandson -- records her experience as an “Indian” captive taken from Lancaster MA to Canada.

In 1653, the first grant to buy land for a town (Lancaster) was along the Nashua River from the Nipmuck Tribe, known as the “fresh water people.” This tribe was associated with the Nashua, or the Nashaway, the “river with the beautiful pebbled bottom.” Originally it was “first begun for love of the Indians’ trade, but since the fertility of the soil and pleasantness of the river hath invited many more.” (MHC, Historic & Archaeological Resources of Central Massachusetts, 1985, pg. 62)

⁸⁴ It is expected that the town [Groton] includes large Native American sites that would have spanned many millennia. *Petapawag* [Ameri-Indian (Nipmuc) place-name for present-day Groton] would have been attractive to such early settlers, as it is located along one of the area’s major rivers, and it is considered likely that such sites exist in the town. One or more of these sites may contain evidence of Paleoindian occupation that has not yet been recognized, or has been lost. (Groton Community-wide Archeological Survey, pages 35-6) There is one other pre-historic site located just across the Squannacook River from Groton, the “Herfco Knoll” site, referenced on page 43 of this same Survey.

By the 1770's, Lancaster was the wealthiest agricultural town in the area, as a result of the productive lands of the "Nashua intervale": the low-lying, rich bottom lands along the river. Similarly, at some future point, Ash Swamp (headwaters of the Squannacook River in Townsend, MA), would become a "highly prized meadowland in colonial times, adjoining lowlands still in agriculture." ("Squannacook River Protection Plan", 1997, page 33)

The Nashua River served as barrier to westward settlement for 100 years after the Pilgrims arrived. A monument near the river in Pepperell marks the site of the last Indian attack in the area in 1745.



Groton began as a frontier town, and colonists first settled along the Nashua River using its water for power, travel, and food. They were also able to follow trails cleared by the native peoples. The river was known by several different names in the early history of Groton, including the Groton River and the Lancaster River. Before a permanent bridge was built, there was simply a shallow crossing place on the river.

Photo unknown, "Sample area recommended for informational signage. Scales and Son Saw and Stave Mill/Hollingsworth Paper Mill at Route 225 crossing of Nashua River. This area has the remains of the paper mill and is an excellent location for archaeological/historical signage. This area is on public land." Groton Archeological Survey, page 84) Figure 4-6.

The Petapawag Canoe Launch land in Groton protects the site of another Native American settlement. The same spot was later a trading post and witnessed an early 17th century skirmish between English settlers and First Peoples. A trading post in the vicinity dates back to 1656, where the owner John Tinker would use the river to transport goods from his home upriver in Lancaster. Groton's first European settlement was located in the nearby J. Harry Rich State Forest, and numerous cellar holes remain from that time. The old stagecoach road from Boston to Keene, NH ran through the forest to a ford in the river at the present site of the Route 119 Bridge known as the "Stoney Fordway" or "Stoney-wading-place."

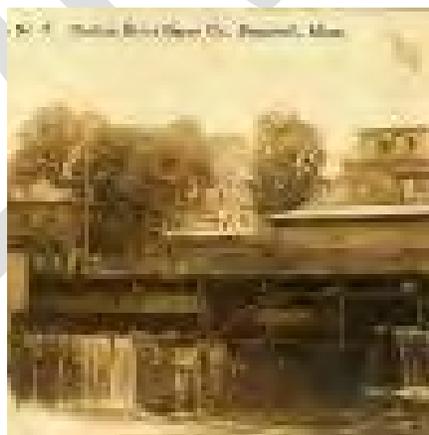
The first settlement of Groton by European Americans was heavily shaped by the water resources of Petapawag. The rivers were used for travel. The wetlands were filled with abundant flora and fauna, and the many wetlands frequently flooded nearby plains, richly fertilizing the soils. This initial European American settlement was also influenced by their predecessors, the Nashaway Nipmuc. In the same way that the primary transportation route was along the Nashua River for the Nipmuc, the first reported permanent settlement was situated on the Nashua River. This first settlement was a trading house established in 1656 to conduct business with the Nipmuc. The trading post focused on commerce in furs. Around 1655 the trading post was operated by John Tinker (Michael Roberts, 2010), and was situated at the confluence of Nod Brook and the Nashua River. Settlers and their families soon followed the first traders, drawn by the environmental diversity, with freshwater resources for fishing, and fertile soils for farming. The trading post evolved into an early seventeenth century frontier European American settlement.... [A] second main settlement cluster developed in West Groton. Situated advantageously within a "V" formed by the Nashua and the Squannacook Rivers, West Groton arose as a late industrial period New England mill village. (Groton Archeological Survey, pages 48 and 50)



The village of West Groton is situated on the Squannacook River, pictured on the left of the map. This detail of a map of West Groton shows familiar names and places. Schools, mills, and residences are listed. The depot is marked where all three roads to the village converge.

From Images of America: Groton

The Nashua River provided the original impetus for Pepperell's growth, when in 1730 a gristmill was established at Babbittasset Falls, site of the present dam. Since 1835, paper mills have been operating continuously at this site until 2002.



Similarly, in 1843, the Hollingsworth brothers of Groton were granted US patent for manufacture of paper. In 1846 the mill burned and was rebuilt. In 1881, Zachary Hollingsworth formed a partnership with Charles Vose. By 1955, the West Groton division of the international Hollingsworth & Vose Co. manufactured approximately 25 tons per day of specialized industrial paper. The mill has remained in continuous operation since 1852.



Several different mills were located on the Nashua River, where the road leading to Pepperell goes off. In the 18th century, there was a corn and sawmill at this location. During the 19th century, the mill was used first as a sawmill and gristmill before new buildings were constructed by the Hollingsworth Paper Mill. This may have been a branch of the Hollingsworth Mill in West Groton.

The first bridge in Groton to span the Nashua River in 1725 is near the current Fitch's Bridge (Groton Community-wide Archeological Survey, page 82). It carried the old county road: one of the oldest westward trails, leading to the wilderness of New York.



The area where the Ayer Ice House Dam (presently Ice House Partners /Grady Research) was purchased in 1871 by Mr. William Mitchell for the purpose of opening up a wool shoddy mill. His new company would take wool remnants and turn them in to affordable wool clothing. Unfortunately, in 1873, the very profitable facility burnt down. Even though he only had the company for two years it has always been referred to as "Mitchellville". There have been other businesses at that location that also used the water power that the Nashua River provided. In 1906, there was a power plant there that was used by the Fitchburg and Leominster Street Railway. They would provide trolley service from Ayer to as far away as Fitchburg, Leominster, and Lunenburg. After it was retired as a trolley system power station it was purchased in 1933 by Mr. Michael Horgan and he used the facilities to generate his own power to make ice.⁸⁵

⁸⁵ Personal Communication, Barry Schwarzel, Ayer Historical Commission, November 8, 2017.

National Noteworthy Social Experiments and Efforts: Fruitlands Museum, a regional resource set on 210 acres in Harvard, abuts Oxbow National Wildlife Refuge – a state and National Historic Landmark on the site of a former Transcendentalist community: the site of Bronson Alcott's short-lived utopian experiment in agriculture and intellectual living. A Shaker Village existed along Nashua River in Shirley from the late 1700s to the early 1900s. There is a Historic District along the Squannacook River in Townsend Harbor known as a “safe harbor” due to the local Abolitionists that participated within the Underground Railroad network (see Conant House reputed to be the oldest in Townsend and reputed “safe house”); another sources indicates that the name “Harbor” derives from the earliest days of the colonial settlement when four fortified garrison houses were located in the area to provide refuge during Native American attacks. Earlier, a sawmill was established at the Harbor in 1733, and a grist mill was added shortly thereafter. In Ayer, circa 1770, a grist and sawmill (Pierce’s) was built on Nonacoicus Brook. Other early mills include a 1739 clothier mill on the Squannacook River (present day “Cooperage”).



The 15.9-mile-long Squannacook River forms the western boundary of Groton and eventually flows into the Nashua River south of Groton near Ayer. As others did in surrounding areas over time, settlers found the Squannacook River an ideal location to set up mills and utilize the waterpower that was generated.

From Images of America: Groton

Historic Properties and Districts: Harvard has three properties that are listed in the National Register of Historic Places: Fruitlands Museum (which is also a National Historic Landmark), Still River Baptist Church, and the Fiske Warren House, now part of Saint Benedict’s Abbey abutting the Nashua River. There are four National Register Districts: Vicksburg Square at Fort Devens⁸⁶, Fruitlands, Harvard Center and Shaker Village. Harvard has two local historic districts, Harvard Center and Shaker Village. Another National Register District is the Shirley Shaker Village (now

⁸⁶ Devens has 89 properties listed on the National Register of Historic Places and four historic archeological sites and one prehistoric archeological site.

part of MCI-Shirley) near the banks of the Nashua River. Shirley was named “the Most Historic Small Town in the Nation.”⁸⁷

In regard to mid- 19th century cultural history there is also a former Civil War Camp called "Camp Stevens" that was built on the banks of the Nashua River on the Shirley line along the old stretch of Fitchburg Road. It is where the former David E. Ross Company once resided and where the present day KTR performance racing company is on the old camp property today. There is a memorial on the property commemorating the 950 men who served there and in the 53rd Regiment Massachusetts Volunteer Infantry. On November 2nd, 2013 a re-dedication of the memorial was held after extensive work, funded by the town of Ayer and a grant from the Massachusetts Sesquicentennial Committee, to improve the site and allow easier access to the memorial.

In regard to 20th century cultural history, parts of Ayer, Harvard, Lancaster and Shirley were chosen as US Army Post Fort “Camp” Devens during First World War, where over 100,000 soldiers were trained. It was substantially expanded during World War II to approximately 5,220 acres to become the largest military installation in New England. Notoriously, Fort Devens was the epi-center of the 1918 Influenza Pandemic. While Fort Devens was active, the US Government conducted many studies of Devens and the surrounding region: indeed, Plow Shop Pond in Ayer is considered one of the most well documented ponds in the country⁸⁸. According to MassDevelopment, the US Army has spent approximately \$160 Million to date in the environmental cleanup of Fort Devens.

Fessenden Mill, precursor site of present Sterilite Corporation, consumed 25,000 board feet of lumber daily in the making of barrels and at its heyday (~1900-1929, closed in 1960) the factory employed about 300 people. In 1875 there were eleven barrel factories in Townsend. Townsend’s present state forest once belonged to Fessenden’s; the land was sold to the state after the devastating fire of 1927 which rendered it useless as a source of material for that barrel factory.⁸⁹

⁸⁷ www.shirleyhistory.org/mosthistoric.htm

⁸⁸ *Ayer Open Space and Recreation Plan*, 2015.

⁸⁹ “Squannacook River Protection Plan”, 1997, pages 41-2.

[Note: Interestingly, in 1846 the Nashua River valley becomes a railroad corridor to New Hampshire from Ayer and Worcester. Similarly, in 1847, the Peterborough and Shirley Branch Railroad was opened through the Squannacook River corridor. Several decades later, a railroad from Massachusetts to Milford, New Hampshire was built along the Nissitissit River over which, in the days before refrigeration, two daily shipments of ice were transported from Lake Potanipo in Brookline, New Hampshire to Boston.]

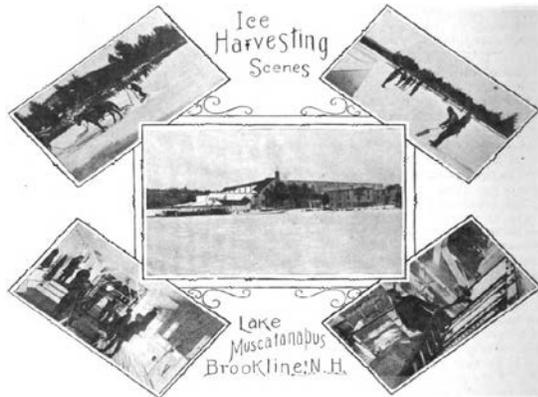


Illustration in the Cold Storage Journal, 1906



COPYRIGHT, HAZEL A. HERRICK
This Curious-Looking Boat Pushes 14-Ton Cakes of Ice to the Ice House, on a Stream near Brookline, New Hampshire. In Preventing Overnight Freeze-Ups by Running Back and Forth, It Does Work Which Formerly Required Six Men

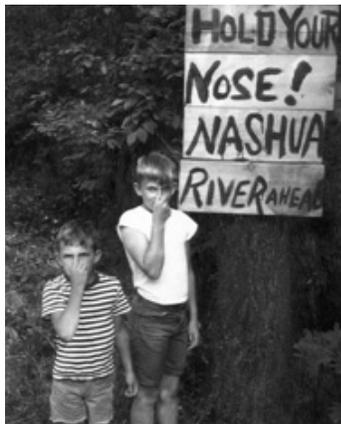
Story in 1921 issue of Popular Mechanics

“The Marion Stoddart Story” of River Restoration: Fifty years ago in the 1960’s when



there were no laws against dumping pollutants into waterways a group of concerned citizens set out to restore the Nashua River: one of the nation’s ten most polluted rivers. They dared to envision the unthinkable; “sparkling blue water with a ribbon of green along its banks”. They advocated for a revitalized river corridor safe for people and wildlife alike. Led by Marion Stoddart, they galvanized the attention of towns, government agencies, businesses, and other residents—and soon all joined in pursuing the ambitious restoration goal.⁹⁰

⁹⁰ How a Housewife Transformed an Open Sewer into a Swimmable River, Huffington Post, 7/07/2014
http://www.huffingtonpost.com/ellen-moyer-phd/nashua-river-transformed-_b_5552680.html



Although the Nashua is a native word for “river with a clear-bottom”, by the 1960’s its recovery seemed an impossible task as the river -- known locally as the "Nauseous River" because of its awful smell -- was all but biologically dead. One could smell the river from more than a mile away, riparian real estate was worthless, it notoriously ran various colors from dyes dumped into the river by the paper mills, the only wildlife were rats and sewage worms. There were sludge banks along the Nashua exceeding five-foot depth in places.

Visually, the Nashua is, in short, revolting. Sludge and scum fill the stream, and discoloration and turbidity resulting from paper mill discharges and other wastes can be found throughout most of the river’s length. Fermentation bubbles are ubiquitous and obnoxious odors constitute a widespread nuisance. (“Plan for the Nashua River Watershed”, NRWA, 1972, pg. 40)



The river was so grossly polluted in 1969 that Fort Devens



military personnel were

warned to stay away from it. It had a “U” designation signifying “unacceptable” meaning its condition did not meet any of

the existing water quality standards classifications.⁹¹

Even the 1952 *Conservation Land Use Plan for the Town of Groton MA* stated that "...the Nashua River and the lower end of the Squannacook River, are so badly polluted that they have little value to Groton for any purpose."⁹²

Marion Stoddart's activism took many forms; for example, she had children bring jars of dirty river water to the politicians and told them "we just want this river the way it was when you were kids. You could swim in it. You could fish in it." Represented by the Nashua River Watershed Association⁹³, her activism led to the passage of laws to stop the paper mills from dumping pollutants into the river including the Clean Water Act. In 1965, the federal Water Pollution Control Act passed and Massachusetts was the first state to pass similar legislation, with the Clean Water Protection Act in 1966⁹⁴. As importantly these laws provided state and federal money to build eight municipal waste water treatment facilities to improve Nashua River system water quality at a cost of more than \$250 million⁹⁵.

"Changing values and attitudes, diligent enforcement of environmental laws and regulations, educational programs by schools and NGOs, the shift from manufacturing to service industries initiated the process of ecological recovery. The rate of recovery in the well-watered temperate climate of southern New England has been nothing short of remarkable." (Paul Barten, et al, *Land Conservation, Restoration, and Stormwater Management for the Squannacook and Nissitissit*

⁹¹ "Class A waters were designated as sources of public water supply. Class B waters were designated for aquatic life, recreation (swimming and boating) and aesthetics. Class C waters were designated for indigenous aquatic life, limited recreation (boating) and aesthetics. Class D waters were designated for aesthetic enjoyment only." From below Appendix A: Warren Kimball, History of Water Quality, October 2016

⁹² It went on to say "There is not much that any town below the source of pollution can do to correct this condition beyond cooperation with the other towns affected, the industries concerned, and the State Department of public Health, which is working on the problem. We can make no recommendation other than the full cooperation of the town with the above agencies."

⁹³ In the mid-1960's, the Nashua River Clean-Up Committee was formed. The Committee was comprised of thousands of watershed citizens, businesses, industries, organizations and governmental agencies including Fort Devens. The Clean-Up Committee's mission was to restore the Nashua River for all uses. In 1969, the Nashua River Clean-Up Committee reorganized as the Nashua River Watershed Association to complete the clean-up, protect clean water, establish a continuous greenway along both sides of the Nashua River and its major tributaries.
http://nashuariverwatershed.org/5yr_plan/reading_room/perspectives.html

⁹⁴ In 1964, the Town of Hollis was the first in New Hampshire to form a municipal Conservation Commission.

⁹⁵ In 2012 the City of Fitchburg City Council voted to expend over \$70 million to separate sewers and upgrade its treatment facility.

River Watersheds, MA & NH, 2001) It took a quarter of a century to clean up a river that was "too thick to pour, too thin to plow." (*Plan for the Nashua River Watershed*, NRWA, 1972, pg. ii) Today, a sparkling blue Nashua River runs from central Massachusetts to southern New Hampshire. It hosts some of the state's best fishing tournaments. Flora and fauna thrive in it, canoeists revel in it, and swimmers splash in some sections of it. It is now a nationally recognized example of river restoration. [See below Appendix A: History of Water Quality, Warren Kimball, October 2016]

This inspiring tale has been retold in *A River Ran Wild: An Environmental History* by Lynne Cherry: a children's non-fiction book frequently used in school curriculums throughout the nation to address human effects on the environment and to show the changes of pollution throughout history, and how people in each period affected the Nashua River. In 1993 the National Geographic Magazine spotlighted the Nashua's recovery in an article "The Promise of Restoration: New Ideas, New Understanding, New Hope " in its Special Edition: *The Power, Promise, and Turmoil of North America's Fresh Water* and which provided us the dramatic before and after



images that attract the most attention at the NRWA River Resource Center. In 1987 the United Nations honored Ms. Stoddart, naming her to the "Global 500 Roll of Honor". National Geographic's 2010 *Water: Messages of Hope for Earth's Most Precious Resource* contains an essay on the Nashua River cleanup by Ms. Stoddart. Most recently, the story of Ms. Stoddart and the Nashua River was made into an independent, critically acclaimed, call

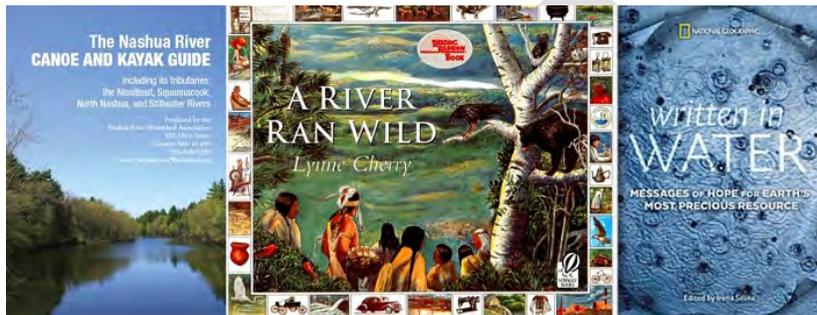
to action documentary film *The Work of 1000* (www.der.org/films/work-of-1000.html) which speaks to a model for effective leadership and advocacy, grassroots organizing and coalition building to achieve one's vision. Our locally celebrated natural resources are also a symbol of success.

Recovery has sparked recreational use of the river at places like the Oxbow National Wildlife Refuge, J. Harry Rich State Forest, Townsend State Forest, Bolton Flats State, Squannacook River and Nissitissit River Wildlife Management Areas, Groton and Shirley Town Forests, to name but some of the conserved lands abutting the rivers and protecting their shorelines.

DRAFT

SOME KEY FINDINGS ON THE EXEMPLARY STATUS OF HISTORICAL & CULTURAL FEATURES

- The story of the clean-up of the Nashua River has merited international acclaim and has served as a model for watershed groups across the nation. The Nashua River, once one of the top ten most polluted rivers in the country, was revitalized due to the efforts of internationally recognized Marion Stoddart and others.
- The polluted “before” and revitalized “after” iconic photos of the river instantly communicate this story, which has been recounted in the children’s book “A River Ran Wild Ran” by Lynne Cherry. The book has sold over 1,000,000 copies and is often used in classroom curriculums.



- The story of the clean-up was featured in National Geographic.
- Marion Stoddart was recognized by the United Nations in 1987.
- The story of the clean-up and Marion’s role was documented award-winning film “Work of 1000,” which has been shown in over two dozen film festivals across the country.
- High-yield, high- productivity aquifers are found under several of our study area towns and tapped as municipal sources of public drinking supplies.
- Parts of Ayer, Harvard, Lancaster and Shirley were chosen as US Army Post Fort “Camp” Devens during First World War and expanded during World War II to ~5,220 acres to become the largest military installation in New England.
- Fruitlands Museum is a regional resource set on 210 acres in Harvard that abuts Oxbow National Wildlife Refuge – it’s a state and National Historic Landmark on the site of a former Transcendentalist community: the site of Bronson Alcott’s short-lived utopian experiment in agriculture and intellectual living.
- The Nashua, Squannacook and Nissitissit Rivers are all included in the federally-designated Freedom’s Way National Heritage Area. A few of the many outstanding resources acknowledged by this designation:
 - The site of a major prehistoric resource - a Nashaway village – by the Meeting of the Waters where the North and South Branch of the Nashua join; and, a native encampment

near the confluence of the Nashua and Nissitissit Rivers in Pepperell. Also, the 1,000+ acre freshwater estuary at the present Oxbow National Wildlife Refuge is noteworthy as being so rich in natural resources as to be communally used for hunting and gathering by the indigenous Native Americans, irrespective of territorial boundaries.

- The first book written by a woman in America -- The Narrative of Mrs. Rowlandson -- records her experience as an “Indian” captive taken from Lancaster MA to Canada and later ransomed back home.
- The presence of prime agricultural soils in the large floodplains along the banks of the Nashua River were historically significant to the founding of the first colonial towns and are still heavily utilized to this day (see Flats Mentor Farm in Lancaster).

DRAFT

HISTORIC and CULTURAL ACTION PLAN

Today, the water within the Nashua, Squannacook and Nissitissit River watersheds is valued as an outstanding natural and ecological resource. But the watershed offers more than clean water and a thriving ecosystem to its residents. The historical significance of water in the landscape, and in the relationship of people to the landscape, make water quality management an important cultural -- as well as natural -- resource issue.

#1: Regional Conservation Ethic

GOAL #1: Celebrate the roles of influential conservationists inspired by the Nashua, Squannacook, and Nissitissit Rivers.

- Encourage further research into the lives, legacy and impact of local conservationists Benton MacKaye, William Wharton, Jeff Smith, Bill Farnsworth, Ellen Swallow Richards, Marion Stoddard and others. (For more information on these notables see pages 1X-1X above).
- Encourage displays and programs that draw the public's attention to the work of these early conservationists and their connection to our region.

LEE PIERCE "BILL" FARNSWORTH (1921–1995). Born in Lancaster, longtime resident Bill Farnsworth initiated the Nashua River Study Committee in 1962 and, in 1963, recommended a Nashua River greenway in the 1963 selectman's annual town report. Regionally, he is credited with cofounding the Nashua River Watershed Association with Marion Stoddard of Croton and several area people in 1969. In later years, he continued as a member and board director. (Farnsworth.)



IN MEMORY OF
BILL FARNSWORTH
 1921 - 1995
 FATHER OF THE
 NASHUA RIVER

FARNSWORTH MEMORIAL BRIDGE AND PLAQUE. In 1995, the bridge spanning the Nashua on Bolton Road in Lancaster was named for Bill Farnsworth, who had spent more than 25 years working to make the Nashua River healthy again and to ensure that with a "ribbon of green" along much of it, it would remain so. This plaque marks the memorial bridge. (Farnsworth.)

GOAL #2: Foster, stimulate, and support the next generation of conservationists

- Develop and support programming that introduces youth to the concept of a conservation ethic and helps deepen their own conservation ethic.

- Work with local educational institutions within the watersheds to incorporate watershed planning and management into existing school curriculums and activities.

#2: River Renewal

GOAL #1: Preserve the history of the cleanup of the Nashua River as a national model and “the Marion Stoddart Story”.

- Support the NRWA in maintaining and adding to the materials in its Conservation Clearinghouse regarding the historic clean-up of the Nashua River including Marion Stoddart’s efforts to control discharge into the river.
- Support the NRWA in maintaining and adding to the materials in its Conservation Clearinghouse that relate to the role Marion Stoddart played in the clean-up of the Nashua River.
- Encourage the continued use of “A River Ran Wild” in schools and groups for youth; recognize and celebrate the impact the book has had across the country and internationally.

GOAL #2: Use the above goal as a springboard for initiating contemporary activities.

- Develop programming and materials as appropriate to continue to tell “The Marion Stoddart Story” to a variety of audiences.
- Develop programming and materials to utilize “The Marion Stoddart Story” as inspiration for undertaking local environmental projects that can be influenced or accomplished by citizen action – champion the difference that one person can make.
- Encourage multiple partners -- including land trusts, local, state, federal and other entities – to promote successful grassroots advocacy and to be involved in the cleanup of the Nashua River as appropriate.
- Engage with businesses and municipalities whose discharges impact water quality.

GOAL #3: Continue to document the River Renewal.

- Continue the NRWA Volunteer Water Quality Monitoring program, started in 1992 & now in its 25th consecutive year; preserve previous water quality data from other sources as available.

- Ensure continued monitoring of the USGS gage on Squannacook River at Bertozzi Conservation Area which has been operating and providing water flow records since 1949.

GOAL #4: Educate and engage the public in the ongoing story of the renewal of the river and what needs to be done to keep the rivers as healthy as possible.

- Educate citizens about the boundaries and functions of the Nashua, Squannacook and Nissitissit Rivers watersheds, the specific needs for protection of and improvement to the rivers systems, the benefits of a healthy watershed to individuals and communities.
- Encourage the public to speak out on issues and to participate in the stewardship of the designated areas.
- Encourage organizations with existing education and outreach programs to continue and expand their efforts, through cooperation among those organizations. Develop methods to provide information and education about the Nashua, Squannacook, and Nissitissit River watersheds.
- Support “on water education” like NRWA’s River Classroom®.
- Promote the “Greenway Heroes: Profiles in Land Conservation®” short inspirational film on local land protection.

#3: Historical and Cultural Features

GOAL #1: Identify, protect, and enhance important historical and cultural features, sites, and pathways related to the rivers and recognize the importance of the rivers to the development of the communities.

- Encourage local historical societies and other entities as appropriate to undertake further research into the historical relationship between the adjacent communities and the rivers (i.e.: Babbitassit aka Pepperell).
- Develop materials and public programming to highlight the connection between the communities and the rivers and foster increased appreciation.
- Consider doing an “economic benefits” analysis of historic-cultural focused tourism in the subject region, possibly in cooperation with Freedoms Way Heritage Association.

GOAL #2: Recognize and protect important landscape features related to the rivers

- Continue the expansion of a protected greenway along the rivers and their tributaries.
- Protect prime agricultural soils in the large floodplains along the banks of the rivers which were historically significant to the founding of the first colonial towns and are still utilized to this day.



RIISING WATERS. The flood of 1936 causes water to rise high around a small filling station at Five Corners.

SEVEN BRIDGE ROAD. This road, which actually has seven bridges, was built sometime after 1800 as a toll road or turnpike. It was not accepted as a town road until years later. This view of what is present-day Route 117 shows some very low land on the Nashua floodplain.

From Images of America: Lancaster

- Raise awareness such that development along the river corridors is compatible with the historical and cultural character of the surroundings and fully reflect the need to protect those amenities including mill redevelopment (i.e.; RiverCourt in West Groton).
- Protect traditional New England visual resources and landscape patterns⁹⁶ -- typified by colonial mills along rivers leading to creation of a road system to connect the mills with town centers and farms, and in time by the presence of smaller villages which grew around mills-- by supporting resource-based economic activities or “working landscapes” including sustainable farming, forestry, and ecotourism, in any way possible.

⁹⁶ “Lancaster’s rivers, its riverfront land, its traditional settlement pattern, and its extensive natural resources also are at the centerpiece of its historic heritage. Early settlers built homes and hamlets at the confluence of the rivers. Access in and out of town depended upon the bridges over these rivers.” (from page 1 www.ci.lancaster.ma.us/sites/lancasterma/files/uploads/plan_historic_pres_element_vi.pdf)



The Groton Leatherboard Company established business in a mill on the Squannacook River in West Groton and was incorporated in 1899. It ran continuously until 1914 when the building was destroyed by fire. A more modern structure was built of brick, which was thought to be fire resistant, and business resumed in 1916. The company operated until 1970, when it closed permanently. The mill has been rehabbed to house an assisted-living facility.

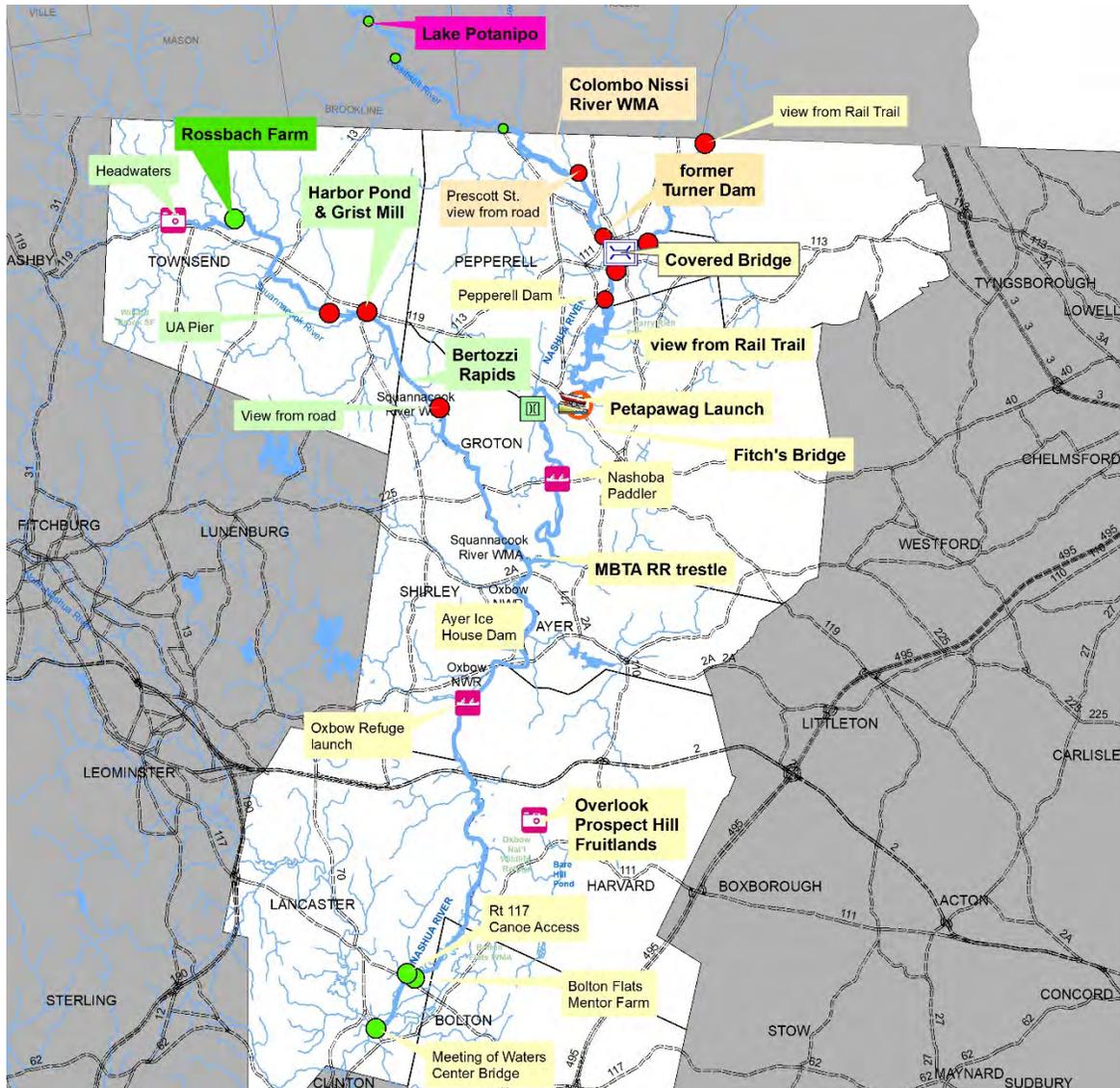


Here a group of Hollingsworth and Vose workers pose outside the mill. Mills had various jobs available and the workers here are a variety of different ages, both men and women. Most workers lived in the immediate area and were dedicated workers for many years. Oftentimes worker housing was set up in small buildings by the river.

From Images of America: Groton

- Develop documentation leading to the nomination of historic sites, an example of which is Surrenden Farm to the National Register of Historic Places as a “Rural Historic Landscape” (see page 6, Surrenden Farm Resource Management Plan DRAFT October 2016
www.townofgroton.org/DesktopModules/Bring2mind/DMX/Download.aspx?PortalId=0&EntryId=21444
- Conduct a National Park Service “Visual Resource Inventory”⁹⁷ for all three rivers.

⁹⁷ www.ncptt.nps.gov/blog/nps-visual-resource-protection/



- Investigate and protect all major prehistoric resources including but not limited to the following sites: a Nashaway village by the Meeting of the Waters where the North and South Branches of the Nashua join; and, a native encampment near the confluence of the Nashua and Nissitissit Rivers in Pepperell.
- Pursue suggestions in regards to interpretive signage of prehistoric resources as the Groton Community-wide Archeological Survey suggests:

Several locations have been established along the Nashua River where large Native American settlements might have existed. Therefore, a suitable location for a sign would be a roadside view with a vista of the Nashua River or other scenic area to provide a sense of landscape...Content should also describe the Nipmuc homeland over the 12,000 years of

occupation including that they were mobile people who moved with the seasons and made heavy use of the river for transportation, water, and food.” (page 82)

- Protect post-colonial sites such as the Shaker Village along Nashua River (described on the National Register of Historic Places as an “ethnographic Shirley landscape”), which functioned from the late 1700s to the early 1900s. Historical and archaeological information is sensitive in nature therefore specific site locations are not identified in public documents. Encourage protection of the Shirley Shaker Village and prevent further degradation of remaining buildings.
- Encourage new development along the river corridors to be compatible with existing historic development.
- Encourage further study of historical and cultural resources cited in the three Areas of Critical Environmental Concern to better understand, manage and protect them (for example post-colonial river fords like Union Turnpike in present-day Harvard MA). Document such historic sites, even if lacking structures, and landmark them with plaques (i.e.; Thompsonville in West Groton and the riverside homestead of John Tinker -- Groton’s first settler -- in J. Harry Rich State Forest).
- Consider rehabilitation of the Grist Mill (owned by the Townsend Historic Society) immediately downstream of the dam at Harbor Pond in Townsend, to allow for public demonstration of an historic mill operation.
- Pay attention to opportunities for comment and input on structural issues surrounding dams, particularly the Canal Street (aka Mason Road) Dam in Townsend. The bridge over the Squannacook is structurally interconnected with this dam. Heavy trucks and other vehicles may cause damage to the bridge and dam.
- Support development of potential “Thoreau Trail” proposed by Freedom’s Way Heritage Association (FWHA) that would cross the Nashua River on its 50+ mile course connecting Walden Pond and Wachusett Mountain⁹⁸.

⁹⁸ Be mindful of the August 23, 2016 MA Division of Fisheries and Wildlife “Walking Trails Policy” which states their intention to keep MassWildlife properties in a natural state, in light of the possibility that the “Thoreau Trail” might bisect the Bolton Flats Wildlife Management Area.

- Encourage greater participation in Freedom’s Way Heritage Association activities as a community’s sense of place depends in part upon knowledge of its history, especially when historical sites and documents can be enjoyed first-hand.



THE THOREAU TRAIL: A WALK TO WACHUSETT

- Encourage Fruitlands Museum to permanently protect undeveloped portions of its 200+ acre campus and its historic view including eventual disposition of the South Post of Fort Devens.
- Provide continued environmental educational opportunities for a broad audience. Develop methods to provide information and education about the subject rivers.
- Support grant applications and efforts by the towns to undertake archeological investigations as appropriate. For example, the Town of Groton efforts to plan and implement an Intensive Archaeological Survey on Surrenden Farm (see page 24, Surrenden Farm Resource Management Plan DRAFT October 2016) as there are known cultural resources of moderate archeological potential⁹⁹ therein consisting of historic period features including standing structures, cellar holes, stone walls, field drainage systems and other remains of the past not yet located and analyzed.

⁹⁹ “Criteria Used to Determine Archaeological Potential. Multiple environmental attributes were considered to predict which areas in Groton possess high potential to contain archaeological sites. The following is a list of the major criteria used during the community-wide reconnaissance to assess the archaeological potential of different sections of Groton:

- The presence of previously recorded pre-Contact Native American or historical sites.
- Proximity to a previously recorded National Register property or site.
- Proximity to a supply of fresh water.
- Proximity to seasonal or perennial subsistence resources, such as wild plant foods, that were used by Native Americans.
- Topographic factors such as slope, aspect, elevation, and protection from prevailing winds.
- Favorable soil characteristics (such as well-drained sandy soils that were suitable habitation or for cultivation).
- Proximity to sources of useful raw materials (e.g., lithic and clay sources, quarries, and certain plant materials).
- Proximity to topographic features that were conducive to historical industrial development, such as hydrologic locations.
- Proximity to areas that contained early historical settlement clusters, or may have witnessed early settlement.
- Proximity to established transportation routes (e.g. ancient Native American trails along rivers, early colonial thoroughfares).

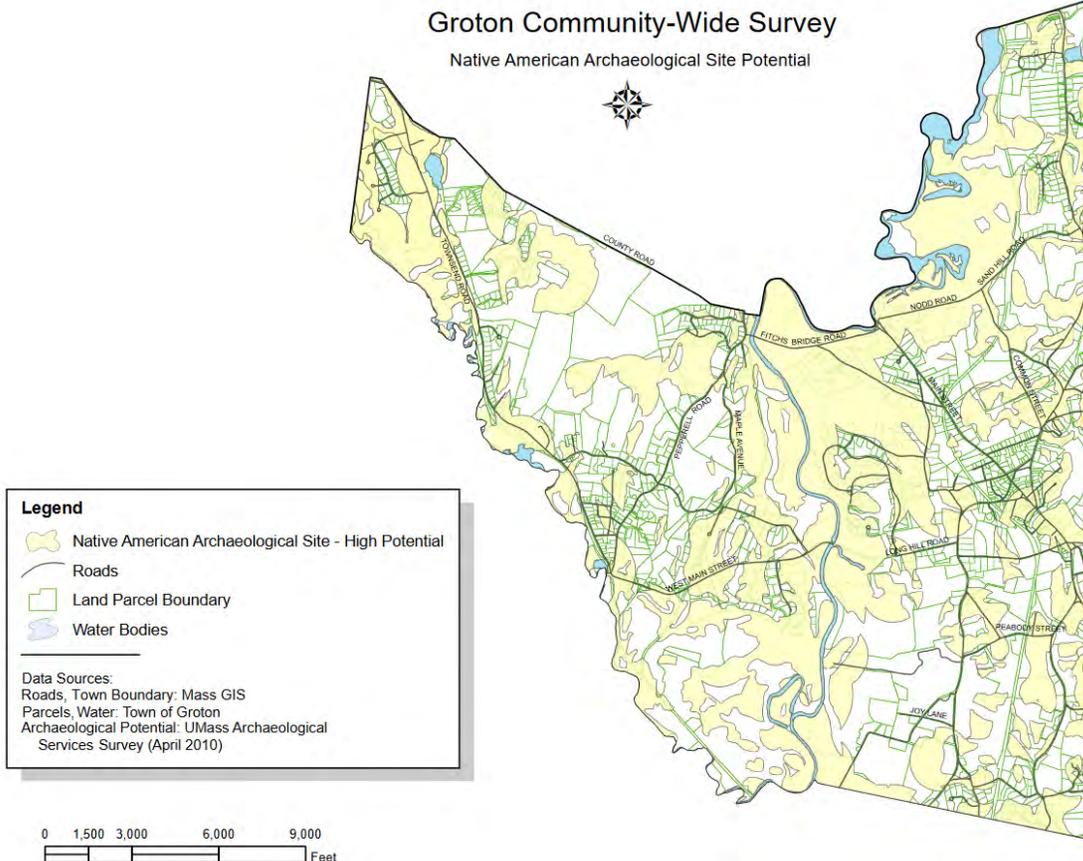


Figure 9: Groton Community-wide Archaeological Survey, page 108

- Proximity to industrial, commercial, and agricultural markets.

Assessment of Native American Archaeological Potential. Because the presence of Native American sites can only rarely be determined from historical documents, the likelihood for Native American sites to be present is usually predicted on the basis of an environmental model which uses geological, soil, and climatic data; previously recorded site locations in the southern New England region; and expected Native American site locational patterns.” (Groton Community-wide Archaeological Survey, page 100-1)

FEDERAL INVOLVEMENT

The Nashua River as a tributary of the Merrimack River is listed as part of the North American Atlantic Salmon Anadromous Fish Program. The Nashua River is also recognized as having international importance as a migratory flyway as it provides breeding and migration habitat for migratory waterfowl in the form of open palustrine and emergent wetlands. The extensive and regionally significant wetlands occurring on and adjacent to the Oxbow National Wildlife Refuge (ONWR), including its associated tributary headwaters, have been listed as a priority for protection under the Emergency Wetlands Resources Act of 1986 (P.L.) 99-645 (100 Stat. 3582). It is also named as a priority for protection due to their importance to the Atlantic Flyway for migrating birds under the North American Waterfowl Management Plan: an agreement between Canada, Mexico, and the United States. Indeed the ONWR was initially created to support the national migratory bird management program. In 2016 the “Bill Ashe Visitor Facility” at ONWR and associated boat launch on the Nashua River were built.



The Nashua River is listed in the 1987 US EPA Priority Wetlands of New England, in recognition of the value of its wetland habitats to northeast waterfowl populations (*Central Nashua River*

ACEC Nomination Report, pg. 10). As we understand it, the US Fish and Wildlife Service (USFWS) is pursuing a goal to reintroduce Alewife and American Shad to the Nashua River in the next ten years (personal communication with Michael Bailey, USFWS Assistant Project Leader, 2016) and has a river herring restoration program in place on the Nashua River: passage for river herring may be required in the future. The Nashua River is listed as part of the North American Atlantic Salmon Anadromous Fish Program. The USFWS has already stocked Alewife and American Shad in Lake Potanipo, headwaters of the Nissitissit River in New Hampshire since 2014.

*“As part of the large scale plan for fish restoration in the Merrimack River, the Nashua River Watershed is a current and future release location for river herring. Anadromous fish restoration is a cooperative effort among state agencies including the Massachusetts Division of Marine Resources, MassWildlife, and federal agencies including the Service, National Marine Fisheries Service and U.S. Forest Service. The Nashua River is considered a self-sustaining river in that it has existing fish passage facilities at dams which need to be modified or improved as part of the plan. This watershed will also be monitored and evaluated to ensure effective and efficient upstream and downstream passage of fish. Fish that would benefit from this effort include the river herring (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*) and American eel (*Anquilla rostrata*).”* USFWS Oxbow National Wildlife Refuge, Final Comprehensive Conservation Plan, Feb. 2005, pg. 33

Nearly the entire Nashua River watershed has been included as the “Nashua River Greenway Forest Legacy Area” under the US Forest Service administered Forestry Legacy Program in partnership with MA Department of Conservation and Recreation’s Bureau of Forestry (see <http://www.mass.gov/eea/docs/dcr/stewardship/forestry/other-reforest/nashua-river-greenway-expansion-2001.pdf>). [Note: This Forest Legacy Area met the eligibility criteria for a Forest Legacy Area as follows:

1. Forests are threatened by immediate and future conversions to non-forest, house lots.
2. Individual landowners have been approached about selling conservation easements and are interested in selling easements.
3. Scenic resources ... are recognized as distinctive.
4. Public has traditionally utilized the ... areas for recreation and these are opportunities to extend the existing greenway systems.
5. Numerous private wells, six public water supply wells, and designated Zone 2 drinking water protection areas lie within the sections -- protection of the water supply sources.
6. Riparian habitat for fish, waterfowl and migratory songbirds, and associated forested wetland plants and animals.
7. Contain rare and endangered flora and fauna.
8. Provide river access to all types of passive recreation including fishing.
9. Contain significant historic sites and potential sites of archeologic importance.
10. Have highly productive floodplain soils for forestry and agriculture.]

There are two Forest Legacy protected tracts in our study area: Belmont Springs tract (bisected by Gulf Brook, a tributary to Nissitissit River; 255 acres in Pepperell) and Pumpkin Brook Link tract (tributary to Squannacook River; 174 acres in Shirley).

The Nashua, Squannacook and Nissitissit Rivers are all included in the federally-designated Freedom's Way National Heritage Area (FWNHA), which extends from the site of "the shot heard round the world" in Concord to Mount Wachusett, following Henry David Thoreau's famous 1842 walk there through Bolton and Lancaster. FWNHA describes itself as:

"...intimately tied to the character of the land as well as those who shaped and were shaped by it. Here landform and climate combined to create an environment propitious to settlement, with a network of natural features, including river systems and forests, sustaining successive generations of inhabitants. Like veins on a leaf, the paths of those who settled the region are connected, providing both tangible and intangible reminders of the past. Their stories can be found on village commons, along scenic roadways lined with stone walls, in diaries and artifacts, in a cabin by a pond, along a battle road or hidden deep within a secret glen by the bank of a meandering river. (<http://freedomsway.org/redesign2/>)

In regards to previous federal grant-awarded projects in our study area, the Environmental Protection Agency (EPA) Targeted Watersheds Grants program funded the Nashua River 2004-2007 "Protecting Today's Water for Tomorrow: Combating Threats to Source Water in the Squannacook Nissitissit Sub-basin of the Nashua River Watershed" project. The NRWA and three partner organizations -- Beaver Brook Association, New England Forestry Foundation, and the Trust for Public Land -- were one of only fourteen awarded nationwide to combat threats to drinking water and protecting key water resources by conserving key land parcels. The project was highlighted in The Trust for Public Land's *Source Protection Handbook Using Land Conservation to Protect Drinking Water Supplies*, 2005. This project built upon an earlier federal EPA 2001 Source Water Stewardship Project focused on the Squannacook-Nissitissit Rivers: one of four such sites awarded nationally.

Finally, there are two US Geologic Service (USGS) river gages in our subject area: one on the Nashua River in East Pepperell

https://waterdata.usgs.gov/ma/nwis/uv/?site_no=01096500&PARAMeter_cd=00065,00060

and one on the Squannacook River in West Groton

https://waterdata.usgs.gov/nwis/uv?site_no=01096000. The former gage has been operating and providing water flow records since 1935; the latter gage has been there since 1949 and is considered by USGS to be a reference gage which is described as follows:

“long periods of unmodified streamflow, ... natural forest and wetland landcover with no water withdrawals, return flows, dams, or development. Few stations in southern New England meet these criteria, however, given population the density and history of land use in the region. GIS data for water withdrawals, water returns, dams, and land-use characteristics were evaluated to indicate difference in potential flow alteration in records for selected stations in MA.” Characteristics and classification of least altered streamflow in MA.
Armstrong, D.S., Parker, G.W. and Richards, T.A. USGS Scientific Investigations Report 2007, pg 11

SUMMARY

In sum, the diversity of distinctive glacial features, ecosystem and wildlife species, unusual plant communities, and the unfragmented open space of the study area provide outstanding recreational opportunities. The Nashua, Squannacook and Nissitissit River corridors provide multiple benefits including but not limited to: wildlife sanctuary, floodplain storage, water quality protection, and aquifer recharge. The Joint Boards of Selectmen from Ayer, Harvard, Lancaster and Shirley said it best in their 1991 mission statement:

“We recognize the unique and valuable natural resources within the region. Future open space for scenic, natural resources, or recreational purposes is an integral part of our overall objectives. Natural resources, including wetlands, rivers, aquifers, soils and wildlife, are interconnected systems knowing no town borders. Development activities in one town can have dramatic impact on a neighboring town. Therefore, effective natural resource protection within reuse planning can only be achieved through multi-town cooperation.”¹⁰⁰

In conclusion, these many outstandingly remarkable resource values -- fisheries, rare fauna and flora, recreation, and rich cultural history - make the Nashua, Squannacook and Nissitissit Rivers a strong candidate for inclusion in the Partnership Wild and Scenic Rivers System. Benton MacKaye would strongly approve.

¹⁰⁰ And see footnote #57.

REGULATORY REVIEW OF THE NASHUA RIVER WILD AND SCENIC STEWARDSHIP PLAN TOWNS

Draft of November 17, 2017

Project Overview and Methodology

Municipal Regulation and Plan Review

This review presents an inventory of the existing municipal regulations (to date), showing how each town's regulations and planning documents address the protection of the **Outstandingly Remarkable Resource Values** (ORRVs) of the towns participating in the Nashua River Wild and Scenic River Stewardship Plan ('the towns'). This review also assesses the capacity of the towns to enforce and enhance regulatory measures related to the protection of the ORRVs and river corridors proposed for inclusion in the Nashua River Wild and Scenic River Corridor (the corridor). This review inventories and analyzes the municipal land use regulations, Master Plans, Open Space and Recreation Plans and other plans and policies pertinent to protection of the ORRVs of the participating towns.

The following communities are included in this review:

The following towns in Massachusetts:

- Ayer
- Bolton
- Dunstable
- Groton
- Harvard
- Lancaster
- Pepperell
- Shirley
- Townsend

The **Devens Enterprise Zone** in Massachusetts.

The following towns in New Hampshire:

- Hollis
- Brookline

Methodology

The following major subjects and aspects of regulatory land-use controls are assessed for each participating towns:

- a. Master Planning, including both the municipal Master Plan and Open Space and Recreation Plans and other related pertinent plans
- b. Land-Use Controls, including provisions in municipal zoning bylaws (called ‘ordinances’ in New Hampshire) and regulations
- c. Water Resources Zoning and Regulations, mainly concerned with local wetland protection and stormwater management
- d. Support for land protection and natural resource protection as reflected in the above
- e. Planning Capacity in terms of whether a town has a Town Planner or other planning official, Wetland or Conservation Agent or Administrator and other staff, and whether towns have adopted programs, such as the Community Preservation Act in Massachusetts, that can provide some funding for these conservation efforts

Presentation of Findings

The results of this review are presented in two formats:

First, a summary table is provided for the towns in each State, examining planning and regulatory matters described above.

Second, there is a two-page narrative description of each town’s regulatory framework that provides some additional detail beyond that capable of being shown in tabular form. These narratives also describe areas for improvement related to each of the major topic headings.

Town Descriptions in Table and Narrative Form

The following is a more in-depth discussion of the items in each major heading described both in the Summary Tables and Town Narratives.

Master Planning: In both states, the municipal Master Plan serves as the framework supporting a town’s regulatory measures and goals and objectives relating to land-use and development. Ideally, Master Plans are updated on a regular basis, with ten years considered the desired interval for assessing whether such Plans or sections of Plans are still current or need to be revised. For purposes of this Stewardship Plan, Master Plans with a chapter devoted to the protection of water resources are considered superior to Plans in which water resources are described more generally in the chapter devoted to Natural Resource protection.

In Massachusetts, but not New Hampshire, towns are required to adopt state-approved ‘Open Space and Recreation Plans’ if they want to be eligible for certain state-funded grant programs for the acquisition and improvement of open space and the development of recreational facilities.

The **Community Preservation Act (CPA)** is a smart growth tool that helps communities preserve open space and historic sites, create affordable housing, and develop outdoor recreational facilities.

CPA allows communities to create a [local Community Preservation Fund](#) for open space protection, historic preservation, affordable housing and outdoor recreation. Community preservation monies are raised locally through the imposition of a surcharge of not more than 3% of the tax levy against real property, and municipalities must adopt CPA by ballot referendum. To date, 172 municipalities in the state have adopted CPA.

The CPA statute also creates a statewide Community Preservation Trust Fund, administered by the Department of Revenue (DOR), which provides distributions each year to communities that have adopted CPA. These annual disbursements serve as an incentive for communities to pass CPA. Each CPA community creates a local [Community Preservation Committee \(CPC\)](#) upon adoption of the Act, and this five-to-nine member board makes recommendations on CPA projects to the community’s legislative body.

This report will not describe these, but will note which towns have qualified and are participating in these programs as a wider indicator of their conservation-mindedness.

Land-Use Controls: Rather than examine the entirety of the scope of each Wild and Scenic River town’s zoning ordinance or bylaw, this Stewardship Plan focuses on those types of zoning and regulations that are most directly related to or can be used to enhance the protection of the ORRVs identified in this Stewardship Plan.

The first zoning tool that is examined is ‘**Open Space Residential Development**’ (OSRD), also known as ‘Natural Resource Protection Zoning’, and related to older, more basic approaches such as ‘cluster zoning,’ ‘conservation subdivision,’ or ‘flexible zoning’. Under this variation of subdivision development, a certain percentage of the entire parcel subject to development must be preserved as permanently protected open space, while generally permitting a similar number of housing units to be developed as in a conventional, ‘grid’ subdivision. Over the years, the practice and standards for OSRD have evolved. The amount of open space preserved in early OSRDs was

often low, in the range of 25% to 30% of the total tract area, often including large areas of wetlands and other undevelopable areas.

The most recent standards for OSRD call for the preservation of at least 50% of the total tract being developed as open space, with no more than 50% of it, sometimes less, allowed to be wetlands or other undevelopable land. The open space areas thus set aside can be linked to other protected land, allowing networks of open space across an entire town or on a regional level to be preserved. Early OSRD bylaws usually required that such developments obtain both subdivision and special permit approval, which can often be a time-consuming, expensive, and uncertain permitting process for land owners and applicants. As a result, such bylaws often are not utilized for most development. Best practice now calls for OSRDs to be allowed 'by right', meaning they are considered a preferred form of subdivision development that need only obtain subdivision approval.

Another important land use control subject to regulation is development on steep slope areas, usually defined as slopes in excess of 15% or 20%. **Development on steep slopes** often leads to erosion problems which require expensive engineering solutions to prevent or correct. Development on slopes also often requires more extensive clearing and grading than in more level areas, thereby removing more natural habitat and reducing the capacity of plants and soils to absorb precipitation. Most towns do not specify a maximum slope for development per se (though some do), but rather limit the percentage maximum slope of roads and driveways, which indirectly helps to minimize development of such steep areas.

These maximum permissible road and driveway slopes are often in the range of 10% to 15%. Some towns do a better job of addressing erosion control measures in their subdivision and site plan regulations, and in general the more specific such provisions are the greater the erosion control. Another important land use control is the maximum percent of a lot that is allowed to be rendered impervious to water. Hard surfaces such as asphalt, concrete and even hard packed gravel can prevent water from infiltrating into the soil, resulting in rainwater running off the impervious surfaces, often after being contaminated with petroleum products, road salt, pesticides, herbicides, lawn fertilizers and other pollutants, which are then released into nearby water bodies. Increased imperviousness also reduces recharge of groundwater, which is important to maintain stream flows and water supplies. **Reducing impervious surfaces** by specifying a maximum lot coverage for buildings and parking lots can help to prevent stormwater runoff, which is now the leading cause of surface water pollution in the United States.

Parking requirements that reduce the number of required parking spaces or allow for shared parking between adjacent lots can also help reduce stormwater pollution.

Many towns have adopted **aquifer protection overlay districts** to better protect their most important groundwater resource areas from pollution. These bylaws often prohibit the most risky land-uses, such as gas stations, underground storage tanks, certain industrial processes, dry cleaning, etc. from being sited over porous sand and gravel deposits (aquifers) that can supply a clean source of public drinking water. For other land uses, such overlay districts require that a greater degree of care be taken when building or undertaking certain activities.

As groundwater often supplies a large degree of ‘base flow’ to rivers and streams, especially in summer, protecting groundwater aquifers can help to safeguard water quality in cold water streams hosting many of the ORRVs identified in this Stewardship Plan.

Floodplain overlay districts are used to restrict development in low lying areas subject to flooding, or adjacent to rivers and streams in upland areas that can also be subject to flash flooding. While not often prohibiting development outright, such districts can require that any building in a floodplain be elevated above the base flood level, and require such buildings to have flood insurance. Filling is also generally prohibited in regulated floodplains, in order to prevent worsening of flooding in adjoining areas.

Changes in the hydrological cycle resulting from global warming are leading to a greater number of intense rainfall events in many regions, including New England. It is important that towns make sure they are using up-to-date floodplain maps and stormwater calculations that better reflect this new reality. Because the standardized mapping only considers historic flood data, communities should consider including additional safety factors to plan for future flood events.

Water Resource Zoning and Regulations:

In both Massachusetts and New Hampshire, towns have the ability to adopt **local Wetland Protection bylaws** that can supplement and expand upon the protection offered wetlands through the respective State Acts. As New Hampshire does not set a minimum regulatory buffer zone of 100 feet as does Massachusetts, such bylaws are perhaps of even greater value in that state. However, bylaws are also important in Massachusetts, where the buffer zone is subject to review but not actual

protection. Such bylaws can specify no build and no disturbance buffers within which new buildings or disturbances to the land are prohibited within a specific distance to the edge of wetlands. Recent science on the performance of such buffers in protecting both wetlands and surface waters from degradation supports having such buffers being as wide as possible, up to several hundred feet in some studies. The summary table and town descriptions provided in this document list the buffers, if any, of each town within the Nashua River Wild and Scenic area.

Stormwater management programs are also a vital part of water resource protection as the leading cause of water pollution today comes not from point sources such as outfall pipes of factories, but from runoff from impervious surfaces such as roads and parking lots, which carry loads of sediment and pollution into water bodies. Many of the larger towns within the Nashua River Wild and Scenic corridor are subject to the Federal NPDES Phase II program and as such need to prepare local stormwater management bylaws as well as institute programs to clean catch basins, inspect for illegal (illicit) discharges and otherwise educate municipal authorities and the public on how they can help to minimize stormwater pollution.

Low-Impact Development (LID) is an approach to development design that minimizes disruption of natural vegetation and soils and maintains water flow and infiltration patterns as much as possible. LID for stormwater management relies predominantly on vegetative approaches, such as rain gardens, as well as the use of natural features and naturalized areas like grassed swales, to both reduce the amount of and treat stormwater runoff. The table and town summaries describe the LID provisions, if any, of each of the Wild and Scenic towns.

Protection of Key Habitats and Natural Communities:

The protection of key habitats and natural communities is usually addressed at the Master Planning (including Open Space Plans) level, and is reflected in each town's efforts or lack of effort to protect the resources thus identified. Identification of such features in local plans is an important first step. Actual protection requires further actions such as acquisition for conservation purposes or imposition of regulatory protections.

As will be seen, the majority of participating towns in both Massachusetts and New Hampshire place a high priority on conservation and the protection of wildlife habitat, even if their regulatory framework currently needs to catch up to the Master Plan goals and objectives.

Planning Capacity:

This analysis examines the ability of a town, through its having the appropriate staff and by participating in programs that provide funding for planning and conservation, to implement the planning and regulatory tools that have been previously mentioned. Having either a full-time or part-time **Town Planner** greatly enhance a town's ability to implement all types of planning including programs related to water resource and wildlife habitat protection, for example. A **Conservation Agent** is someone trained in wetland science and management who assists local Conservation Commissions with their responsibilities under state and local law. Conservation Agents can also assist their Commissions with identifying high value lands for conservation and in preparing and implementing Open Space and Recreation Plans.

In Massachusetts, towns can adopt the Community Preservation Act (CPA), which allows communities to create a [local Community Preservation Fund](#) for open space protection, historic preservation, affordable housing and outdoor recreation. Community preservation monies are raised locally through the imposition of a surcharge of not more than 3% of the tax levy against real property, and municipalities must adopt CPA by ballot referendum. To date, 172 municipalities in the state have adopted CPA. The summary table indicates whether a participating town has adopted the CPA.

State-level Laws, Regulations and Policy Framework

This section will now examine in some depth the State-level laws, regulations and policies that enable and inform local planning and resource protection efforts.

Wetland Protection:

The **Commonwealth of Massachusetts**, through its Wetlands Protection Act, Massachusetts General Law Chapter 131 Section 40, regulates all activities within a 100 foot wide buffer zone to all wetlands as defined in the Act. These include “...*bank, riverfront area, fresh water wetland, coastal wetland, beach, dune, flat, marsh, meadow, or swamp bordering on the ocean or on any estuary,*

creek, river, stream, pond or lake, or any land under said waters of any land subject to tidal action, coastal storm flowage, or flooding”.

The Rivers Protection Act protects all land within 200 feet of the high water mark of rivers and perennial streams. Isolated lands subject to flooding greater than ¼ acre with a water depth of six inches are also protected. The Massachusetts Wetlands Protection Act identifies eight (8) interests, which ideally all projects proposed within wetland resource areas must meet:

1. Protection of public and private water supplies
2. Protection of groundwater
3. Flood control
4. Prevention of storm damage
5. Prevention of pollution
6. Protection of land containing shellfish
7. Protection of wildlife habitat
8. Protection of fisheries

Home Rule powers under Article 89 of the Massachusetts constitution have allowed more than half of Massachusetts’s 351 cities and towns to adopt general (non-zoning) local wetland bylaws or ordinances. These bylaws and ordinances give Conservation Commissions further power to protect wetlands through enhanced buffer zones and other means.

The **State of New Hampshire**, on the other hand, has no statewide official buffer zone, though its Department of Environmental Services has a Wetlands Bureau that regulates activities in wetlands themselves. The New Hampshire legislature, through Revised Statutes Annotated RSA 482-A, allows municipalities to adopt local wetland protection ordinances which can include provisions for buffer zones of various widths to provide additional protection above and beyond that afforded by the State. About 84 New Hampshire cities and towns have local wetland protection ordinances.

Since cities and towns in both states can adopt local wetland protection bylaws and ordinances, the question then arises as to what width a buffer zone should be. Several studies have been conducted through the years to determine just how wide a buffer zone needs to be to protect

certain values and functions of wetlands. These studies have shown that different wetland values and functions require buffer zones of varying width. For instance, in order to filter out sediments and pollutants that would reach water bodies, wetlands may require a modest buffer zone of only 50 to 100 feet.

In order to protect the widest possible diversity of wildlife species that breed and live in wetlands, including amphibians that breed in wetlands but spend part of their life cycle in adjacent uplands, a wider buffer zone up to 700 feet wide is recommended.

However, as such extremely wide buffers are often difficult to implement in many towns, the general practice is that a buffer of 100 feet provides a good deal of protection to wetlands and their associated wildlife habitat functions while being a reasonable width to regulate.

In both Massachusetts and New Hampshire it is the local Conservation Commissions that are on the front lines of wetlands protection. In New Hampshire, their function is more advisory, whereas in Massachusetts they have the ability to issue permits for activities in and adjacent to wetlands. In both states, it is the Conservation Commissions who are likely to draft local wetland protection bylaws and ordinances, although adoption requires approval of Town Meeting.

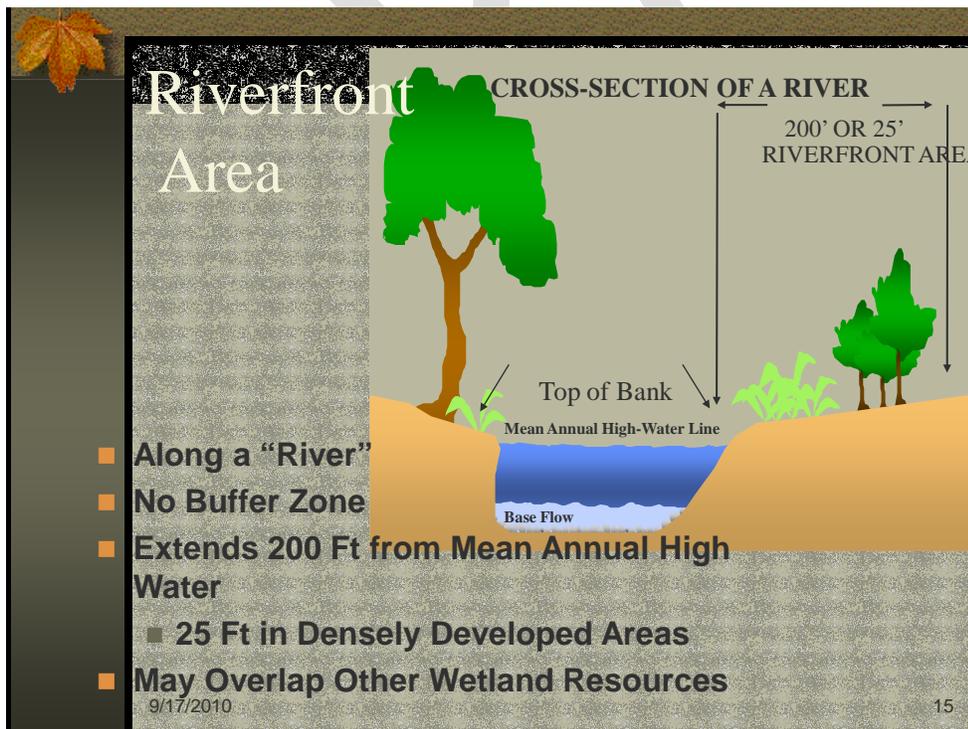
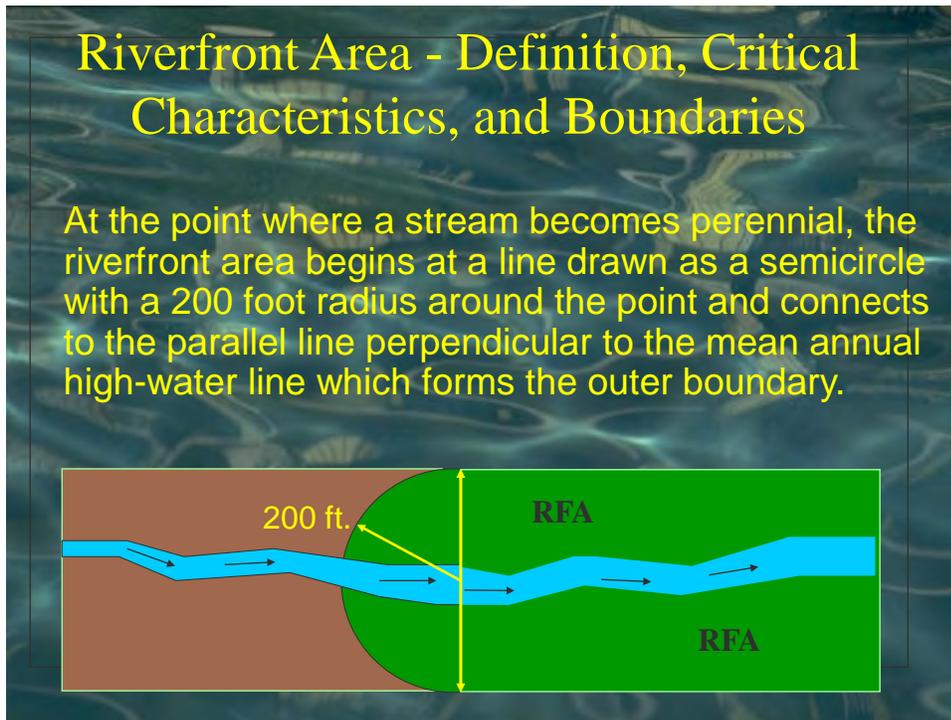
In each city or town, the Conservation Commission must weigh the environmental threats to wetlands against the political will to protect them. Some towns have public support for a fairly wide buffer zone, whereas in others that is currently politically impractical. In the latter case, the Conservation Commission can set out to educate citizens on the important functions of wetlands and how they contribute to our quality of life. Once people fully understand how valuable wetlands are, they are more likely to vote to approve a local wetlands bylaw / ordinance that provides greater protection than that provided by state law.

River and Shoreland Protection:

In the **Commonwealth of Massachusetts**, the Rivers Protection Act (RPA), Chapter 258 of the laws of 1996, is Massachusetts legislation to protect the shoreland areas along rivers and streams. The RPA creates a 200-foot wide riverfront area that extends along both banks of perennial rivers and streams. In certain urban areas where it is recognized that a natural buffer is no longer possible, a riverfront area of 25 feet has been designated.

The RPA does not set up a new permitting process or reviewing authority, but is administered by local Conservation Commissions and the Massachusetts Department of

Environmental Protection under the same procedures as the Wetlands Protection Act. Projects proposed within the riverfront area must meet the eight (8) purposes of the Massachusetts Wetlands Protection Act, which are listed in the preceding discussion of wetlands. The following figures illustrate the jurisdictional areas under the Massachusetts Rivers Protection Act.



Figures 1 & 2 Riverfront areas in the Massachusetts Rivers Protection Act

Source: Philip Nadeau, Massachusetts Dept. of Environmental Protection

In Massachusetts, the **Squannacook and Nissitissit Rivers Sanctuary Act** provides some additional protection to land adjoining those rivers in several of the participating towns in Massachusetts. The Act prohibits direct discharges of pollutants and stormwater into the waters of the two rivers. The short text of the act follows in italics:

[MA Gen L ch 132A § 17](#)

***Section 17.** There is hereby established in the towns of Ashby, Groton, Pepperell, Shirley, Townsend and Lunenburg a protected area to be known as the Squannacook and Nissitissit Rivers Sanctuary. Said Squannacook and Nissitissit Rivers Sanctuary shall be comprised of the waters of the Squannacook river and its tributaries, to wit: Ash swamp, Ashby reservoir, Bayberry Hill brook, Bixby brook, Flat pond, Flat Pond brook, Fitchburg reservoir, Locke brook, Mason brook, Pearl Hill brook, Pumpkin brook, Trap Fall brook, Trout brook, Walker brook, Willard brook, Witch brook with the exclusion of that section of the Squannacook river from the Hollingsworth and Vose dam at West Groton located approximately North 42° 36" 45", West 71° 38" 7", on the U. S. Geological survey map Shirley quadrangle to the confluence of the Nashua river; and the waters of the Nissitissit river and its tributaries to wit: Coon Tree pond, Gulf brook, Heald pond, Mine brook, Port Barrel pond, Park Barrel Pond brook, Stewart brook, Sucker brook, Wolf brook.*

After the effective date of this act, no new discharge of treated or untreated sewage or other wastewater will be permitted to be discharged to the Squannacook and Nissitissit Rivers Sanctuary. For the purpose of this section, sewage shall mean the water-carried waste products or discharges from human beings, sink wastes, wash water, laundry wastes and similar so-called domestic waters; wastewater shall mean sewage, liquid or water-carried waste products or discharges from human beings, sink wastes, wash water, laundry wastes and similar so-called domestic wastes, and also sewage, liquid or water-carried waste from industrial, commercial, municipal, private or other sources; and person shall mean any individual, association, partnership, corporation, company, business, organization, trust, estate, the commonwealth or any political subdivision thereof, any administrative agency, public or quasi-public corporation or body or any other legal entity or the legal representatives, agents, or assignees thereof.

No person shall install or construct, or cause to be installed or constructed, any new outfall, drainage pipe, ditch, channel or other conveyance to carry storm water runoff, either directly or indirectly from any structure, parking lot, or storage yard, other than from a one- or two-family residence and appurtenant parking and storage facilities, into the Squannacook and Nissitissit Rivers Sanctuary or any tributaries thereof until plans have been approved by the

planning board and conservation commission of the affected town in which the pipe, ditch, channel or other conveyance is located.

Said town may require the construction of any structure or structures or treatment works which it deems necessary to prevent the pollution of the Squannacook and Nissitissit Rivers Sanctuary by matter carried by such storm water runoff.

The attorney general shall take such action as may be necessary from time to time to enforce the provisions of this section. The superior court shall have jurisdiction in equity to enforce the provisions of this section.

In **New Hampshire**, the Comprehensive Shoreland Protection Act (CSPA), RSA 483-B, is the state's regulatory approach to shoreland protection. It applies to all fourth order and greater streams, designated rivers, tidal waters and lakes, ponds and impoundments over 10 acres. The State maintains a directory of water bodies that are subject to the CSPA.

The CSPA applies to all development and land-use activities within 250 feet of the water's edge or the high water mark, which is called the 'reference line'. This entire 250 foot wide area is termed the protected shoreland. Within this protected shoreland, there are varying levels of protection depending on the distance between the proposed impact and the reference line.

The most restrictive area is the 'waterfront buffer', which extends from the reference line 50 feet landward. Within this zone a natural buffer of native vegetation and natural ground cover is to be maintained, with only minimal disturbance allowed. The next area out is the 'natural woodland buffer', which must maintain a certain percentage of native vegetation and natural ground cover between 50 and 150 from the reference line. In order to determine the quantity of trees to remain within the waterfront buffer, the State has developed a point system that applies different scores to trees based on their diameter at breast height. A description of how this point system works can be found at the linked documents below. Between 150 and 250 feet of the reference line there are no limitations on vegetation removal.

The CSPA places restrictions on impervious surfaces, lot subdivision, excavation and filling within this area. Lots within the protected shoreland may not have greater than 30% impervious cover. Developments proposing more than 20% impervious surfaces must install a stormwater management system to the satisfaction of the State. The guidance document that the NHDES has prepared emphasizes low-impact development (LID) systems as the preferred stormwater

management methodology. The New Hampshire Department of Environmental Services recently published an environmental fact sheet detailing how vegetation must be maintained within the various areas of the protected shoreland:

<http://des.nh.gov/organization/commissioner/pip/factsheets/sp/documents/sp-5.pdf>

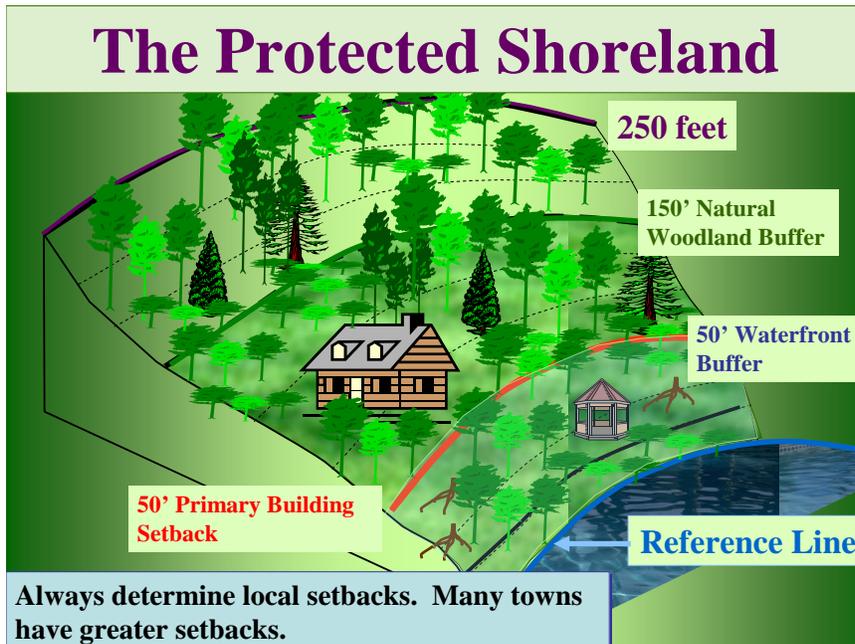


Figure 3: Jurisdictional areas in New Hampshire Comprehensive Shoreland Protection Act
Source: Jay Aube, Shoreland Protection Specialist, NHDES

In addition to the Comprehensive Shoreland Protection Act, New Hampshire also has a Rivers Management and Protection Program, which was established in 1988 with the passage of [RSA 483](#) to protect certain rivers, called [designated rivers](#), for their outstanding natural and cultural resources. The program is administered by the New Hampshire Department of Environmental Services (DES). More information on this program can be found at:

<http://des.nh.gov/organization/divisions/water/wmb/rivers/index.htm>

A similar program, called the Lakes Management and Protection Program, is applicable to the lakes of New Hampshire:

<http://des.nh.gov/organization/divisions/water/wmb/lakes/categories/overview.htm>

Stormwater Management and Low-Impact Development:

In the 1960's, the Nashua River, along with many other rivers and streams in the United States, was overwhelmed by industrial pollutants that often turned the river orange, red and other colors. Decades of such heavy pollution, often directly discharged to the rivers via pipes, left many rivers biologically dead and totally unfit for most human uses. The public outcry from this situation resulted in the eventual passage of the Clean Water Act and other federal environmental laws that prohibited direct discharges of untreated sewerage and industrial waste into rivers, streams and other waters of the United States.

Funds were made available for the construction of wastewater / sewage treatment plants and other large treatment facilities. Gradually, over the years, the rivers and streams came back to life and many formerly toxic waters are now swimmable, fishable and functioning as valuable wildlife habitat. However, it was later noticed that the rivers, streams and waterways would only clean up to a certain extent, beyond which water quality improvements were difficult to achieve.

Research indicates that precipitation running off of hard surfaces such as roads and parking lots, and from cleared lands with exposed soils, offers a pathway for pollutants such as road salt, oil, greases and lubricants, bacteria and soil particles to enter rivers, streams and waterways. This type of pollution, which cannot be traced back to a single source such as a pipe exiting a factory, came to be called non-point source pollution or stormwater runoff. It is one of the major sources of water pollution today.

Some stormwater pollution enters waterways directly by flowing over land, such as through land clearing activities that expose soils, enabling erosion to occur. Another major pathway is stormwater entering a municipal storm drainage system that is then discharged into water bodies without proper treatment. No matter how it enters waterways, untreated stormwater runoff is a major cause of water pollution.

Stormwater is worsened by hardened or impervious surfaces, which prevent runoff from soaking into the ground (infiltration) or being taken up by plants. In fact, several studies, such as that conducted by the Center for Watershed Protection, show that the health of a stream or water body is directly proportional to the amount of impervious surfaces in its contributing watershed. When the percentage of impervious cover is less than or equal to 10% of the watershed, stream quality is generally safeguarded, though in some recent studies it has been shown that negative impacts begin

occurring when a watershed reaches 5% - 7% impervious cover. When the percentage of impervious surfaces increases to 10 – 25%, the ecosystem functions of streams are increasingly impacted. Stream banks often show more erosion due to the more widely fluctuating water levels after storm events, and biological diversity begins to decrease. When the percentage of impervious surfaces increases to more than 25%, the stream is severely impacted and may become non-supportive of native plant and animal species. Such streams are often classified as urban streams, and are in essence drainage channels more than natural streams.

Figure 4 below, produced by the Center for Watershed Protection, depicts the relationship between impervious cover and stream quality in a generalized watershed.

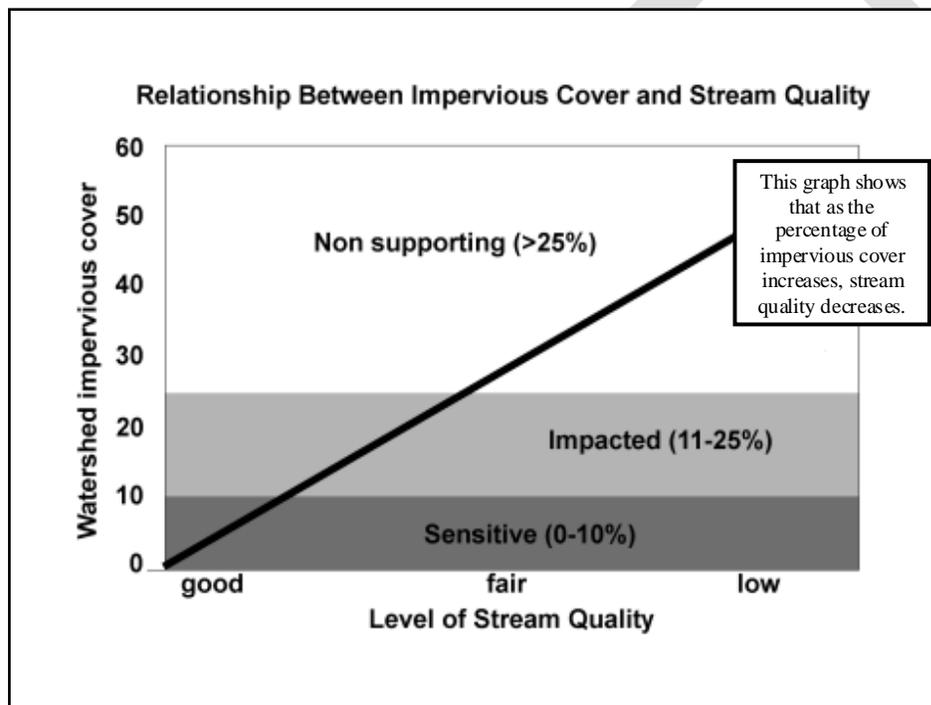


Figure 4: Relationship between impervious cover and stream quality

Source: The Center for Watershed Protection

The health of a watershed and its waterways can be safeguarded by limiting future creation of impervious surfaces and adequately treating stormwater where impervious surfaces cannot be avoided.

Figure 5 shows how the percentage of impervious surface in a Maryland watershed affects fish species and biological diversity. Though the specific features may vary, this relationship holds true

for Massachusetts and New Hampshire as well. Cold water streams are vulnerable to the effects of increasing imperviousness that comes with development.

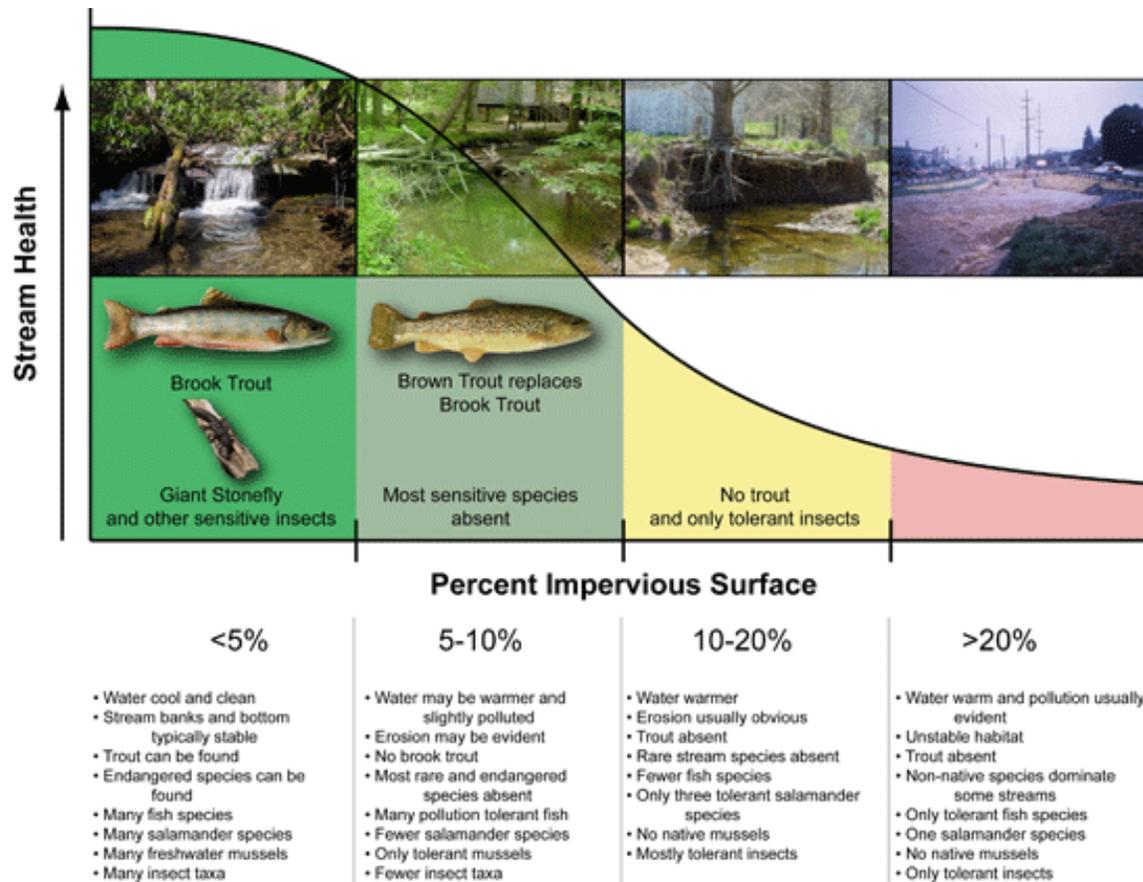


Figure 5: Aquatic organisms and impervious cover

Source: State of Maryland, Department of Natural Resources

Addressing Stormwater Pollution:

The United States Environmental Protection Agency (USEPA) developed an approach to addressing non-point source pollution called the National Pollutant Discharge Elimination System. Under Phase I of this program, which was enacted in 1990, stormwater discharges into medium to large municipal storm sewer systems were addressed. These were defined as communities serving a population of at least 100,000 people, as well as stormwater discharges from eleven categories of industrial activities. Construction activities disturbing five or more acres of land are one category of such industrial activity.

In 2003, the USEPA published the standards for Phase II of their stormwater program. This program is aimed at municipal separate storm sewer systems or ‘MS4’s’ for short. It covers all urbanized areas as identified in the 2000 US Census.

The US Census Bureau defines an urbanized area as “*a land area comprising one or more places -- central place(s) -- and the adjacent densely settled surrounding area -- urban fringe -- that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile*”. The USEPA website provides maps of all areas subject to the Phase II stormwater program at <http://cfpub.epa.gov/npdes/stormwater/urbanmaps.cfm>.

The Phase II program requires subject municipalities to address stormwater through a multi-faceted approach including public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control and pollution prevention and good housekeeping. Phase II addresses construction activities disturbing between one and five acres of land.

Even when a small town is not subject to the USEPA’s Phase II stormwater program, choosing to address stormwater in a comprehensive manner is one of the best steps a town can take to safeguard its water resources. Small towns can adopt bylaws / ordinances and accompanying regulations addressing stormwater runoff from construction sites and from illicit discharges. As previously mentioned, most new construction activities require removal of vegetation and moving dirt around a site. Doing so exposes soil that was previously held in place by vegetation to the erosive effects of rainwater and dispersal by wind. In order to minimize such effects, practices can be adopted that minimize the amount of soil exposed at any one time and that prevent soil particles and other pollutants from leaving the site in runoff. Such practices can be spelled out in bylaws, ordinances and regulations.

Typically, such regulatory provisions apply to construction activities above a certain threshold, such as a half-acre or acre of land disturbance. Some of these regulatory approaches also place limits on the amount of impervious surfaces that can be created, either as a percentage of total lot area or a maximum amount of square footage. The environmental agencies of both Massachusetts and New Hampshire have developed model stormwater bylaws, ordinances and regulations that address the impacts of construction activities.

Illicit discharges refer to unpermitted or illegal discharges of stormwater or wastes into a sewer, drainage system or water bodies such as streams, rivers, lakes and ponds. The sources of illicit discharges are many and include but are not limited to industrial discharges and untreated sewage. Illicit discharge bylaws / ordinances and regulations usually require an agent of the town to be inspecting for such discharges.

Most illicit discharge bylaws / ordinances exempt residential land-uses from regulation, including the washing of individual cars, waterline flushing, discharges from lawn irrigation and water from foundation drains and sump pumps.

Though residential uses such as those listed above are often exempt from formal regulation, homeowners and renters can still follow common sense best management practices in undertaking such activities. New construction requiring the use of LID techniques can also substantially reduce the impacts of residential construction.

Massachusetts Clean Water Toolkit

<http://prj.geosyntec.com/npsmanual/default.aspx>

or more specifically the laws and regs section:

<http://prj.geosyntec.com/npsmanual/sectionintrolawsandregulations.aspx>

Massachusetts Smart Growth Toolkit

http://www.mass.gov/envir/smart_growth_toolkit/ (in particular see modules on OSRD and LID)

New Hampshire Stormwater Manual;

<http://des.nh.gov/organization/divisions/water/stormwater/manual.htm> (available online and in hard copy)

http://des.nh.gov/organization/divisions/water/stormwater/documents/wd-08-20c_covr.pdf

Innovative Land Use Planning Techniques: A Handbook for Sustainable Development;

http://des.nh.gov/organization/divisions/water/wmb/repp/innovative_land_use.htm

Additional Recommendations for Consideration

Example Exemplary Regulatory Measures (EERMs)

This section will describe exemplary regulatory protection measures put in place either in another designated Wild and Scenic Corridor in the northeast, or in one of the participating towns for the Nashua River Wild and Scenic program. These techniques and regulatory measures could be adapted to apply to the participating towns.

A) River Protection Overlay Districts as modeled on the Farmington River Overlay Protection Districts

In Connecticut, the towns of Hartland, Colebrook, Barkhamsted, New Hartford, Granby, East Granby, Canton, Simsbury, Burlington, Avon, Farmington, Bloomfield and Windsor form the Lower Farmington River Wild and Scenic corridor. A River Protection Overlay District was prepared as model for use by the towns in enhancing the protection of their designated river corridor.

<http://farmingtonriver.org/index.php/resources/overlay-protection-districts>

The Study describes these overlay districts as follows: *“Between 1991 and 1992 the five river front towns in Connecticut (Hartland, Colebrook, Barkhamsted, New Hartford and Canton) and one town in Massachusetts (Tolland) passed zoning regulations known as the Farmington River Overlay Protection Districts. The Districts are intended to minimize the amount of activity within 100 feet of the river. Constructing new buildings, installing septic systems, and excavating sand and gravel are examples of activities prohibited in this zone. Additionally, there are limitations on vegetation removal in the zones. There are exceptions to these regulations for activities such as the enlargement of existing structures, for public access or transport, or limited timber harvest or clearing vegetation for river views. The town zoning commission through a special exception permit must approve exceptions.*

Like the town votes of support for Wild and Scenic River Designation, these measures were necessary as expressions of local commitment to the protection of the Farmington River. The Districts provide the strong local protection, the first of the three levels of river protection -- town, state and federal. The benefits of maintaining undisturbed river shorelines are well documented, and include: controlling erosion and non-point sources of pollution; providing wildlife habitat; lowering water temperatures; reducing flooding; and providing unique aesthetic components which boaters, anglers and other river users rely for an enjoyable experience.

While the Districts were developed to provide water quality and riparian habitat protection, great efforts were made in the regulation language to ensure preservation of landowner property rights. Local residents approved these Districts with the understanding that strong community-based river protection measures were necessary in the context of achieving Wild and Scenic River designation.”

Overlay Protection Districts

- [Barkhamsted's Farmington River Overlay Protection District](#)
- [Canton's Farmington River Overlay Protection District](#)
- [Hartland's Farmington River Overlay Protection District](#)
- [New Hartford's Farmington River Overlay Protection District](#)

B) Greenspace Buffer Districts

The Town of Harvard, Massachusetts has adopted a Nashua River Greenspace Overlay District as part of the Watershed Protection District provisions in the Harvard Zoning Bylaw. This district regulates proposed uses within 300 of the riverbank on the Harvard side of the river.

<https://ecode360.com/13696451>

Watershed Greenspace Buffer District. A buffer overlay district created to protect the values inherent in a watercourse, its wetlands, and its floodplains. The area within the buffer district shall be a green area (see definition).

(9) Nashua River Watershed Greenspace Buffer District. A buffer district extending along the Nashua River, from its highest point in Harvard northward to its lowest point in Harvard, shall include an area 300 feet from the center line of the Nashua River.

C) Floodplain and Floodway zoning and regulations

It is important for riverine towns to have the most up to date and comprehensive floodplain zoning and regulations as possible. (I will come back to this topic.)

D) Other Exemplary Local Models of Regulatory Measures

1. Pepperell Erosion Control provisions in section 5530 of their Zoning Bylaw

The Town of Pepperell has a very good, short section on erosion control, which not only regulates construction on or resulting in slopes of 15% or greater, but which regulates clearing of existing vegetation in steep slope areas. The most pertinent provisions are as follows:

5530. Erosion Control Site design, materials, and construction processes shall be designed to avoid erosion damage, sedimentation, or uncontrolled surface water runoff by conformance with the following:

5531. Grading or construction which will result in final slopes of 15% or greater on 50% or more of lot area, or on 20,000 square feet or more on a single lot, even if less than half the lot area, shall be allowed only under special permit from the Planning Board, which shall be granted only upon demonstration that adequate provisions have been made to protect against erosion, soil instability, uncontrolled surface water runoff, or other environmental degradation. Applications and plans for such special permits shall be referred to the Conservation Commission for its advisory review.

5532. All such slopes exceeding 15% which result from site grading or construction activities shall either, be covered with topsoil to a depth of 4 inches and planted with vegetative cover sufficient to prevent erosion or be retained by a wall constructed of masonry, reinforced concrete or treated pile or timber.

5533. No area or areas totaling 20,000 square feet or more on any parcel or contiguous parcels in the same ownership shall have existing vegetation clear-stripped or be filled 6 inches or more so as to destroy existing vegetation unless in conjunction with agricultural activity, or unless necessarily incidental to construction on the premises under a currently valid building permit, or unless within streets which are either public or designated on an approved subdivision plan, or unless a special permit is approved by the Planning Board on condition that runoff will be controlled, erosion avoided, and either a constructed surface or cover vegetation will be provided not later than the first full spring season immediately following completion of the stripping operation. No stripped area or areas which are allowed by special permit shall remain through the winter without a temporary cover of winter rye or similar plant material being provided for soil control, except in the case of agricultural activity where such temporary cover would be infeasible.

2. Hollis Rural Character Preservation Ordinance

Though mainly intended as a way to help preserve scenic vistas and rural character, the Hollis Rural Character Preservation Ordinance has applicability for erosion control and controlling disturbances of natural areas that could easily be applied to a river or stream corridor.

The Objectives of this section of the ordinance are to *“To preserve and maintain Hollis' scenic vistas and rural character, particularly as seen from Public Roads, and maintain woodlands and open spaces through the use of visually unobtrusive and environmentally sound development, while permitting the landowner to exercise his/her property rights in a manner that does not affect the density of development.”*

***Means:** This ordinance shall provide a mechanism for the Planning Board to reasonably regulate the design, placement and buffering or screening of buildings, other structures, roads and driveways in the process of subdivision and site plan application review, in such a way as to best preserve the rural and scenic qualities of Hollis' landscape, in order to:*

- 1. Eliminate the siting of new construction on or near the crest of prominent hilltops and ridges, particularly as seen from Public Roads.*
- 2. Fit development into the landscape to minimize significant landscape alterations.*
- 3. Buffer or screen development with vegetation where a natural wooded buffer or screen is sparse or non-existent.*

The Hollis Rural Character Preservation Ordinance is found in Section XV of the Hollis Zoning Ordinance: <http://hollisnh.org/regulations/HZO2017.pdf>

3. Hollis Site Plan Regulations – Section on ‘Additional Studies’

Another way that towns can address the protection of wildlife habitats and sensitive environmental areas in the face of development is to require a thorough assessment of wildlife habitat as part of the Site Plan review process. Hollis, NH has very detailed requirements for such in Section 3K of its Site Plan Regulations. Both Massachusetts and New Hampshire state law support towns hiring such consultants, at the applicant’s expense, in order to evaluate everything from traffic impacts to impacts on wildlife habitat. To enable the hiring of such “Peer Review Consultants”, a town should amend their Zoning Bylaw and Site Plan Regulations to reference the applicable enabling legislation.

Section 3 K of the Hollis’ Site Plan Regulations, http://hollisnh.org/regulations/site_plan_regulations.pdf states that:

“Wildlife Habitat Inventory and Assessment: The Wildlife Habitat Inventory and Assessment (WHIA) shall be completed on site by a wildlife biologist approved by the Hollis Conservation Commission. In order to complete a thorough inventory and assessment of the habitats and wildlife on the site, the Planning Board may require that the Wildlife Habitat Inventory and Assessment be completed over the course of all four seasons. All season assessments may be necessary to identify unique wildlife areas including, but not limited to: vernal pools, deer wintering areas, bird migration stopover habitats, mast production areas utilized by wildlife, and hibernation sites of bats and other mammals.”

4. Devens – Stormwater Management as promulgated in 974 CMR 4.00 – 4.08

Land-Use regulations in Devens, the Enterprise Zone located on land formally part of the Fort Devens, including portions of the towns of Ayer, Shirley and Harvard, Massachusetts, are prepared by the Devens Enterprise Commission, the regulatory and development agency of the Commonwealth that oversees all development and permitting at the former Army base. Its regulations and environmental standards are among the best in the region, and are often on the cutting edge of their respective areas of jurisdiction. Devens’ stormwater management performance standards and general regulations are a case in point.

These stormwater standards strongly promote and incentivize low-impact development techniques as described earlier in this Stewardship Plan. In addition, all development projects undertaken on land in Devens must adhere to the stormwater standards, whether or not they are subject to the Massachusetts Wetlands Protection Act. These standards can be found here:

<http://www.devensec.com/rules-regs/decregs408.html>

5. Framingham Land Disturbance and Stormwater Management Guidelines

The Town of Framingham, though outside of this proposed Wild and Scenic Study area, has an excellent Land Disturbance and Stormwater Management Regulation in its Zoning Bylaw. This one section of their bylaw comprehensively addresses stormwater management, including low-impact development; topographical alterations on steep slopes; tree removal and earth removal and filling. The Framingham Planning Board can issue a ‘land disturbance and stormwater management permit’ which covers any of the above development impacts. This regulation can be found in Section V. F on page 114 here: www.framinghamma.gov/DocumentCenter/Home/View/24878

Conclusions

Overall, the towns proposed for participation in the Nashua River Wild and Scenic Stewardship Plan take planning and environmental protection seriously, which is reflected in their comprehensive master planning and regulatory documents. While there is certainly room for improvement in some Master and Open Space Plans, and adopting the most current practices for such regulatory measures as the zoning bylaw / ordinance and land-use regulations, the towns of the Nashua River Wild and Scenic Corridor are well-positioned to manage the responsibilities that would come with federal designation.

It is desired that this Stewardship Plan will help to educate the participating towns on the often excellent regulatory schemes of their neighboring towns, on both sides of the State line.

DRAFT

BYLAW AND REGULATIONS REVIEW:

Ayer, Massachusetts

Plans, Policies and Local Planning Capacity

Intro Statement:

Ayer is a small town on the outskirts of the greater Boston area, about 35 miles from Boston with easy access to interstate Route 495 and Route 2. As of 2016, Ayer's population stood at approximately 8,119. Ayer is fortunate in being situated on the Boston - Fitchburg Commuter Rail Line, which not only provides a commuting alternative to local residents, but which can also serve as an incentive to economic development. The former Fort Devens Army Base abuts the Town. Devens has since been turned into an Enterprise Zone, and is a regional employment center.

Summary of Master Planning:

The Town of Ayer is in the process of revising its master planning documents, including the Master Plan itself, as well as its Open Space and Recreation Plan. Both master planning documents are anticipated to be approved in early 2018. These Plans will serve as the basis for future planning efforts for many years. Ayer is a designated 'Green Community'.

Local Planning Capacity:

The Town of Ayer has a full-time Planner as well as a full-time Conservation Administrator. The Town is part of the Montachusett Regional Planning Commission. Ayer was an early adopter of the Community Preservation Act (CPA), which the town approved in 2002. There is a Community Preservation Committee which oversees the acquisition and preservation of open space; the creation and support of affordable housing; the acquisition and preservation of historic resources; and the creation and support of outdoor recreational uses. The Ayer Community Preservation Committee has a mission to maximize the benefits of the CPA funds for the citizens of Ayer.

Zoning and Regulations

The town has an Open Space Residential Development bylaw, which allows this type of development by Special Permit from the Planning Board. It requires that 50% of the total tract area be preserved as permanently protected open space, which is in line with the most recent recommendations from the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw.

Though the town does not set a maximum slope for development per se, it does set a maximum slope of 12% for new subdivision roads, which helps to keep development out of particularly steep areas subject to erosion. Ayer has good zoning provisions for the regulation of land clearing and grading. The erosion control section of the Bylaw addresses disturbances over 10,000 sq.ft. or approximately ¼ acre. The town sets maximum building coverage as a percentage of lot area, as well as requiring a minimum percentage of open space or vegetated area on a lot, both of which help minimize impervious surfaces.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment. Ayer has both floodplain and aquifer protection overlay districts, both of which date back to 1999 and as such should be reviewed in light of the latest science and models for these districts.

The town is in the process of a comprehensive update of its Zoning Bylaw, with a Town Meeting vote anticipated in March of 2018. This new bylaw will provide the framework for greater protection of natural resources in the development review process.

Ayer's subdivision and site plan regulations are also dated. Revising those parts of these regulations that pertain to reducing impervious surfaces, limiting the cutting of vegetation and encouraging shared parking and otherwise retaining green space in the development process help to reduce stormwater runoff and its attendant impacts on water resources.

Ayer's floodplain maps date to 1982 and are out of date. The Town should contact FEMA and state agencies responsible for updating the flood insurance maps to determine when Ayer is scheduled for a map update.

The Ayer Conservation Commission attempted to pass a new local wetlands protection bylaw in 2017, but decided to withdraw it due to public opposition.

Ayer is subject to the federal NPDES Phase II stormwater permit, and has both a standard Stormwater Management Bylaw and one addressing illicit discharges. Low-Impact Development techniques are mentioned and encouraged in the bylaw, but are not required. Land disturbing greater

than 40,000 square feet (about one acre) or activities disturbing more than 1,000 sq.ft. on slopes greater than 15% require a stormwater permit to be issued by the Department of Public Works. This latter requirement is a good measure to help prevent and address erosion on steep slopes.

Opportunities for Improvement

The Ayer Conservation Commission should complete the process of revising the local Wetland Protection Bylaw and bringing it to Town Meeting for a vote in the near future. Additional public education and outreach may help to ensure a positive outcome to this effort.

The Town should check on when the 1982 FIRM (floodplain / flood insurance) maps are scheduled to be revised and then consider rewriting its existing floodplain overlay district provisions in light of the latest science and practices for floodplain protection.

Those sections of the subdivision and site plan regulations that pertain to reducing impervious surfaces, encouraging shared parking and retaining green space in the development process should be added or enhanced.

Bolton, Massachusetts –

A) Plans, Policies and Local Planning Capacity

Intro Statement:

Bolton is a small town on the outskirts of the greater Boston area, just south of the Town of Harvard and northeast of Worcester. Bolton is bisected by interstate Route 495, which benefits commuters but which also has increased development pressure in towns along its route. Between 1984 and 2004, Bolton's population increased by 80%, making it one of the fastest growing towns in Massachusetts. As of 2010, Bolton's population stood at 4,897. Most of Bolton is zoned for low-density residential use, though there is a small central business district and other non-residential zones. The western one-third of Bolton is within the Nashua River watershed, while most of central and eastern Bolton is within the Concord River watershed.

Summary of Master Planning:

The Town of Bolton Master Plan dates back to 2006, which makes it a little over 10 years old. Bolton may want to consider revising this Plan in the near future, as ideally Master Plans should be revisited every ten years or so in order to stay current and reflect the latest planning tools that are available. Bolton's most recently approved Open Space and Recreation Plan (OSRP) dates to 2005, though the Town has recently completed a new draft OSRP which has yet to be approved by the Massachusetts Division of Conservation Resources. Bolton is a designated '**Green Community**' (*more on what this entails in the preface / introduction to the Regulatory Review section.*)

Local Planning Capacity:

The Town of Bolton has a full-time Planner as well as a Conservation Agent, which positions it well in terms of addressing the resource protection and planning efforts needed to safeguard the outstanding resource and recreational values of the Nashua River. Bolton is the only town in the study corridor that is part of the Metropolitan Area Regional Planning Commission based in Boston. Bolton has not yet adopted the Community Preservation Act, which could provide needed funds to help protect open space and cultural and historic resources. The Capital Planning Committee oversees land acquisition in the town. Bolton has a Trails Committee as well as a Conservation (Land) Trust.

B) Zoning and Regulations

The town has a “Farmland and Open Space Planned Residential Development” bylaw, basically an OSRD type bylaw, which allows this type of development by Special Permit from the Planning Board. It requires that 33% of the total tract area be preserved as permanently protected open space, which is less than the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw.

Though the town does not set a maximum slope for development per se, it does set a maximum slope of 10% for minor subdivision roads and 5% for major roads, which helps to keep development out of particularly steep areas subject to erosion. Bolton’s subdivision regulations were last revised in 2015.

The Town of Bolton has a Local Wetlands Protection Bylaw which is administered by the Conservation Commission. The Bylaw features a seventy-five (75) foot upland jurisdictional area within which land disturbing activities must be approved by the Commission. The Bylaw also contains a twenty-five (25) foot no-build area from wetlands and river areas subject to the Massachusetts Wetlands Protection Act.

Bolton is not subject to the federal NPDES Phase II stormwater permit, and currently has no local Stormwater Management Bylaw or Regulations. However, the use of Low-Impact Development stormwater techniques is strongly encouraged in Section 5230.3 of the Subdivision Regulations. This section is quite comprehensive in addressing stormwater management in new subdivisions.

The Bolton Zoning Bylaw features, in Section 250.23, provisions that go into detail on environmental protection and design standards for business, commercial and industrial development. Bolton has a Floodplain overlay district, which was most recently revised in 2011. Bolton has a general town-wide performance-based bylaw for groundwater protection (Chapter 147 of the General Bylaws), which lists best management practices to safeguard the towns groundwater resources. This bylaw is administered by the Board of Health.

C) Opportunities for Improvement

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

DRAFT

Brookline, New Hampshire –

A) Plans, Policies and Local Planning Capacity

Intro Statement:

Brookline is a small town of approximately 5,260 people located to the west of Hollis, New Hampshire, and north of Townsend, Massachusetts. State Route 13 that extends south through Townsend to Fitchburg and State Route 130 that extends west from Hollis, New Hampshire are the main routes serving Brookline. The Nissitissit River flows from Lake Potanipo in central Brookline through the town to its confluence with the Nashua River in Pepperell, Massachusetts.

Summary of Master Planning:

Brookline's most recent Master Plan update dates to 2012. This Master Plan contains very detailed chapters on the protection of natural and water resources.

Unlike in Massachusetts, towns in New Hampshire are not required to have up to date Open Space and Recreation Plans in order to qualify for state conservation funds. Nonetheless, Conservation Commissions often adopt their own land acquisition and Stewardship Plans to guide them in their conservation efforts.

Brookline's Conservation Commission has been pro-active in protecting valuable riparian and wildlife habitat in the town, which for many decades was one of the fastest growing in New Hampshire. The Conservation Commission has a stated goal of conserving 25% of the land in town and has made substantial progress toward this goal over the past 20 years.

Local Planning Capacity:

Brookline has both a full-time Town Planner and Conservation staff person, which positions it well for planning and conservation efforts aimed at better protecting the outstanding resources associated with the Nissitissit River and other valuable riparian areas.

The Town updates its Zoning Ordinance, Subdivision Regulations and Site Plan Regulations on a regular basis.

The town belongs to the Nashua Regional Planning Commission, which serves the towns in south-central New Hampshire.

B) Zoning and Regulations

Brookline has an OSRD ordinance, termed “Open Space Development”. Under Open Space Development, proposed subdivisions must preserve at least 35% of their area as permanently protected open space. Unless it is not feasible due to topography and the character of the land, all subdivisions on tracts greater than 20 acres must be submitted to the Planning Board as Open Space Developments.

Brookline’s Local Wetlands Protection ordinance features a 50-foot regulatory buffer, within which there is twenty-five foot no-build zone. Unlike the Commonwealth of Massachusetts, the State of New Hampshire does not set a mandatory 100-foot wide regulatory buffer.

While wetlands themselves are protected from development, it is up to New Hampshire towns to decide whether or not to have a local wetlands protection bylaw and how strict it will be. Local Conservation Commissions can also designate ‘Prime Wetlands’ which can be afforded greater local protections. Brookline has designated eleven (11) such prime wetlands since 1992.

The Zoning Ordinance also features a very detailed Aquifer Protection section, which oversees development over the town’s widespread stratified drift aquifers. Several high risk land-uses such as new underground petroleum tanks are prohibited. Limits on impervious surfaces are found in the Aquifer Protection zone.

The Town has previously not been subject to the federal NPDES Phase II stormwater permit, though it has detailed Stormwater Management provisions in Section 6.4 of the Planning Board’s Site Plan Regulations. This section places strong emphasis on the use of ‘green’ Low-Impact Development (LID) stormwater control techniques. LID is considered the default practice unless applicants can demonstrate that it will not be effective in a particular case.

Brookline has a floodplain overlay district and the floodplain maps were updated in 2009.

Opportunities for Improvement

The first recommendation is that the Brookline consider increasing the 50-foot wetland protection regulatory buffer to 100-feet, and, if possible, increasing the no-build zone from 25 to 50 feet. Doing so will provide even greater protection to wetlands and riparian habitats associated with the Nissitissit River.

The Planning Board should also consider increasing the amount of permanently protected open space in Open Space Developments from 35% to 45% or 50% in line with best practices for this planning technique.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

DRAFT

DEVENS, MA

Devens Regional Enterprise Zone:

Established by the MA Legislature in 1993 to guide and foster the successful reuse of Fort Devens in a sustainable manner (achieving a balance of economic, social and environmental needs while maintaining and enhancing the natural resource base).

Governance:

Chapter 498 of the Acts of 1993 established a legal framework for the governance and development of a Devens Regional Enterprise Zone to promote the expeditious and orderly clean-up, conversion and redevelopment of Fort Devens for nonmilitary uses, including, but not limited to, housing, industrial, institutional, educational, governmental, recreational, conservation, commercial or manufacturing uses, in order to prevent further blight, economic dislocation and additional unemployment, and to aid in strengthening the local economy, the regional economy and the economy of the Commonwealth. Chapter 498 also established the Devens Enterprise Commission (DEC) – the regulatory and permit granting authority for the redevelopment of Devens. The DEC acts as a local planning board, conservation commission, board of health, zoning board of appeals, historic district commission and, in certain instances, as a board of selectmen. The DEC carries out these duties in the context of a unique and innovative one-stop, expedited Unified Development Permit System, which greatly streamlines the local regulatory process. Under this System, complete permit reviews for development projects are take place within 75 days.

MassDevelopment is the state economic development agency who manages real estate, assessment, taxation, utilities and public works in Devens. Together MassDevelopment and the DEC share the municipal government functions of a typical city or town.

Plans, Policies and Local Planning Capacity:

35 miles outside of Boston. Population of 1840 (US Census). Roughly 5,000 jobs (focus has been on job re-creation to make up for the over 7,000 military jobs that were lost since the closure of Fort Devens).

Master Planning:

- Devens Reuse Plan (1994): http://www.devensec.com/development/Devens_Reuse_plan.pdf - Master Plan for the orderly and sustainable redevelopment of Devens Regional Enterprise Zone (Devens).
- Devens Open Space and Recreation Plan: http://www.devensec.com/development/Devens_OSRP_1-23-08.pdf - 2008-2013. 1800 acres of the 4400 acres to be permanently protected as open space (natural resource protection, green infrastructure connections, recreation). To date, over 1400 acres have been permanently protected, including over 900 acres along the Nashua River (USFWS and MA FWS). Devens Open Space and Recreation Advisory Committee comprised of representatives from MassDevelopment, DEC, Ayer, Harvard, Shirley, USFWS, MA FWS, and EOEEA.
- Devens Water Resource Protection Report: http://www.devensec.com/development/Water_Resources_Protection_Report.pdf - focus on specific strategies for development to ensure groundwater protection due to high quality and drinking water source.

Local Planning Capacity:

Devens Enterprise Commission – regional board appointed by the governor with representatives from Ayer, Devens, Harvard, Shirley and the surrounding region. The DEC has a full-time Director of Planning and Environmental Planner.

Zoning and Regulations:

Devens Bylaws (2015): <http://www.devensec.com/bylaws/bylawstoc.html> - broad authority to help achieve reuse plan objectives. 25% affordable and special needs housing.

Devens Rules and Regulations (2013): <http://www.devensec.com/rules-regs/decregstoc.html> - detailed development regulations with innovative approaches to:

1. stormwater management (LID and green infrastructure): <http://www.devensec.com/rules-regs/decregs408.html>
2. energy efficient, smart and sustainable residential development: <http://www.devensec.com/rules-regs/decregs502.html>
3. natural resource protection (MA DEP SMS apply to all areas defined as resource areas – not just wetlands) <http://www.devensec.com/rules-regs/decregs406.html>

4. Landscape preservation, viewshed preservation and construction management:
<http://www.devensec.com/rules-regs/decregs304.html>
5. green building incentives:
6. Water resource protection districts: <http://www.devensec.com/rules-regs/decregs409.html>
7. Water use and water efficiency regulations: <http://www.devensec.com/rules-regs/decregs809.html>
8. Greenhouse Gas Mitigation regulations: <http://www.devensec.com/rules-regs/decregs411.html>
9. Renewable Energy regulations: <http://www.devensec.com/rules-regs/decregs411.html>
10. Steep slope regulations: <http://www.devensec.com/rules-regs/decregs306.html>
11. Complete Street Standards (narrow road widths, connectivity, multi-modal, universal accessibility) <http://www.devensec.com/rules-regs/decregs207.html>
12. Transportation demand management programs:
http://www.devensec.com/development/TMI_Overview.pdf
13. Parking maximums as opposed to minimums (pavement reduction):

Eco-Industrial Development:

Devens is internationally recognized as an Eco-Industrial Park. Eco-Industrial Parks are a sustainable development approach to traditional industrial parks. The “eco” of eco-industrial relates to its key concept which is to learn from and model industrial development on natural systems ecology. Natural systems use resources so efficiently that there is no waste. All by-products produced by nature are consumed or reused by other plants, animals or organisms. By applying this efficiency/no-waste model to industrial parks, EID can decrease or eliminate pollution and waste, while improving our economy and quality of life at the same time.

http://www.devensec.com/sustain/EID_As_a_Sustainable_Development_Approach.pdf

Dunstable, Massachusetts

A) Plans, Policies and Local Planning Capacity

Intro Statement:

Dunstable is a small town on the Massachusetts / New Hampshire border, located east of Groton and Pepperell, Massachusetts. As of 2017, Dunstable's population stood at 3199. Dunstable's current land use consists mainly of forest, agricultural area and low density residential use. . The zoning is primarily residential with a few very small areas devoted to commercial development.

Summary of Master Planning:

The Town of Dunstable's Planning Board is in the process of updating its 1999 Master Plan. The Town has a Master Plan Committee which is overseeing the process. Much of the new Master Plan exists in draft form and is very comprehensive. The Master Plan Committee is aiming for approval of the Master Plan at the 2018 Annual Town Meeting.

Dunstable's most recently approved Open Space and Recreation Plan (OSRP) dates to 2017, though the Town has begun the process of updating this Plan. Dunstable is not a designated 'Green Community'.

Local Planning Capacity:

Dunstable does not have any professional planning and zoning or conservation staff beyond the Administrative Assistant and therefore relies on the work of citizen volunteers in addressing local permitting and planning. The town belongs to the Northern Middlesex Council of Governments (NMCOG) which functions as a regional planning commission. The Town adopted the Community Preservation Act in 2006, which provides additional volunteer assistance and funding for land acquisition.

B) Zoning and Regulations

Dunstable has an OSRD bylaw, which allows this type of development by Special Permit from the Planning Board on tracts of at least 14 acres. It requires that 35% of the total tract area be

preserved as permanently protected open space, which is less than the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw. Dunstable has a Local Wetlands Protection Bylaw which is administered by the Conservation Commission. The Bylaw features a sixty-foot (60) wide setback from wetland resource areas for new permanent structures. This is a good measure, one which could be enhanced by an accompanying no-disturbance buffer of forty-feet (40') or more.

Though Dunstable is not currently subject to the federal NPDES Phase II stormwater permit, it will be subject to the 2016 permit for the “Urbanized Areas” in town. Dunstable is preparing the Municipal Separate Stormwater Sewer Systems (MS4) permit application. Dunstable also has a local Stormwater Management Bylaw in its general bylaws. This bylaw has two tiers of permitting; one for relatively minor projects (“Tier 1”) disturbing from 22,000 to 40,000 square feet of area, and one for major projects (“Tier 2”) disturbing more than 40,000 square feet of area. Any activity disturbing land on slopes greater than 15% which results in greater than 200 square feet of disturbance is also subject to a (major) stormwater permit.

Dunstable also has a Water Supply Protection Bylaw, administered as an overlay district with permitting through the Planning Board.

The Town has a floodplain overlay district in the Zoning Bylaws. [15.2. Floodplain District [Amended ATM May 10, 2010] 15.2.1.] The Floodplain District is herein established as an overlay district effective in all districts. The uses permitted in the underlying district are allowed provided that they meet the following additional requirements. The Floodplain District includes all special flood hazard areas designated as Zone A or Zone AE on the Town of Dunstable Floodplain District Overlay Map.

Opportunities for Improvement

Dunstable should adopt its updated Master Plan as soon as possible. Doing so will enable it to better propose and adopt innovative land-use controls that can better protect its outstanding resources.

The Planning Board may also wish to increase the amount of permanently protected open space in OSRD subdivisions from 35% to 50%, and perhaps require its use in environmentally sensitive zones that could be regulated as overlay districts (aquifer, riparian, etc.)

Dunstable's Local Wetlands Protection Bylaw has a sixty-foot (60') setback for new permanent structures, which could be enhanced by a somewhat less wide no-disturbance buffer, perhaps forty (40') feet or greater.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

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Groton, Massachusetts –

A) Plans, Policies and Local Planning Capacity

Intro Statement:

Groton is a mid-sized town near the Massachusetts / New Hampshire border, located north of Ayer and south of Pepperell, Massachusetts. As of 2012, Groton’s population stood at 10,873. Groton’s diverse mix of land-uses includes substantial active agricultural lands, forests and residential and commercial development in its downtown. Groton has a very comprehensive set of zoning bylaw and regulations, reflecting the importance the Town places on planning and conservation.

Summary of Master Planning:

The Town of Groton completed its most recent Master Plan in 2011. This Master Plan is organized around the concept of Sustainability, as reflected in the three-legged stool of a sustainable environmental, economic and societal factors. As described in the Plan’s introduction: “*Sustainability* is the overarching focus of Groton’s Master Plan and a common thread in all of the plan’s elements. To facilitate a wide-ranging discussion of sustainability, the Groton Planning Board adopted the well-known Brundtland Commission’s definition of sustainable development, originally published in *Our Common Future* (1987): “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Groton’s most recently approved Open Space and Recreation Plan (OSRP) dates to _____. The 2011 Master Plan has a chapter devoted to open space and recreation, which is very comprehensive. Groton has protected about 7,790 acres of land, representing about 30% of its land area.

Local Planning Capacity:

Groton has had a full-time Town Planner for several decades, and also has a full-time Conservation Agent / Administrator. The town belongs to the Montachusett Regional Planning Commission. The Town adopted the Community Preservation Act in 2004 and has an active Community Preservation Committee to oversee and plan projects using CPA funds. Groton has

always placed strong emphasis on municipal planning, and as such has a very strong planning capacity to address the aims of Wild and Scenic River designation.

Zoning and Regulations

Groton has an OSRD bylaw, termed “Flexible Development”, which provides for this type of development through Special Permit from the Planning Board. It requires that 35% of the total tract area be preserved as permanently protected open space, which is less than the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw.

Groton recently revised its Local Wetlands Protection Bylaw, which is administered by the Conservation Commission. The Bylaw features a fifty-foot (50’) combined no-disturbance / no-build buffer from all wetland resource areas.

The Bylaw also treats upland areas within the 100 foot regulatory buffer as resource areas, affording them and adjacent wetlands greater protection from the adverse impacts of land disturbance.

The town addresses erosion control measures in Section 352-19 of its Stormwater Regulations. More on some specific provisions...

Limits on impervious surfaces are specified in Section 218-20 of the Groton Zoning Bylaws. These limits range from a low of 25% for low density residential uses to a high of 75% for industrial uses. Section 218-23 of the Zoning Bylaws contains provisions for shared parking for non-competing abutting uses, which can also reduce the creation of new impervious surfaces. Groton also has thorough groundwater and aquifer protection measures in its zoning bylaws.

The Town is subject to the federal NPDES Phase II stormwater permit, and it does have a local Stormwater Management Bylaw, both for land disturbing activities and illicit discharges to the storm drain system and receiving waters. This bylaw has two tiers of permitting; one for relatively minor projects disturbing from 20,000 to 40,000 square feet of area, and one for major projects disturbing more than 40,000 square feet of area. Low-Impact Development (LID) techniques must be incorporated into development and redevelopment projects unless it can be demonstrated that the use of such techniques is not feasible in a given situation. LID must also be

used for stormwater management in the Town Center Overlay District centered on Station Avenue.

The Town does not have a floodplain overlay district, though the Building Inspector must check on whether construction is proposed in a floodplain and whether flood insurance is required. The floodplain provisions date to 2010 and _____.

B) Opportunities for Improvement

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

DRAFT

Harvard, Massachusetts

Plans, Policies and Local Planning Capacity

Intro Statement:

Harvard is a small town in north-central Massachusetts, with State Route 2 running through the town from east to west and Interstate Route 495 slicing its eastern border. As of 2016, Harvard's population stood at 6,526.

Harvard most recently updated and approved its Master Plan in 2016, making it one of the most recent Master Plans of the Nashua River Wild and Scenic River corridor towns. This Master Plan contains a very detailed water resources protection chapter.

Harvard has a very comprehensive set of zoning bylaw and regulations, reflecting the importance the Town places on planning and conservation.

Summary of Master Planning:

The Town of Harvard completed its most recent Master Plan in 2016. This Master Plan is very comprehensive and includes a thorough chapter on water resources and their protection.

In 2016, Harvard also adopted a new Open Space and Recreation Plan (OSRP). This Plan is very comprehensive and focuses in particular detail on protection of the Bare Hill Pond watershed.

Local Planning Capacity:

Harvard has recently established a full-time Town Planner position after many years of having a part-time Planner / Conservation Agent. The town belongs to the Montachusett Regional Planning Commission. The Town was an early adopter of the Community Preservation Act, which it adopted in 2001. The Conservation Commission functions as a land acquisition and management body, a function which it closely cooperates with the Harvard Conservation Trust.

Zoning and Regulations

Harvard has an OSRD bylaw, termed "Open Space Conservation and Planned Residential Development (OSP-PRD)", which provides for this type of development through Special Permit from the Planning Board. It requires that 50% of the total tract area be preserved as permanently protected open space, one of the highest such requirements found in the Nashua River corridor

towns. OSD-PRD can be undertaken on tracts as small as 4.5 acres, and the Planning Board does not establish a minimum building lot area per se, which is a very innovative approach.

Harvard's Local Wetlands Protection Bylaw, which is administered by the Conservation Commission, is also one of the more stringent in the Nashua River watershed. The Bylaw features a fifty-foot (50') no-disturbance zone as well as a seventy-five foot (75') no-build zone. The Bylaw also treats upland areas within the 100 foot regulatory buffer as resource areas, affording them and adjacent wetlands greater protection from the adverse impacts of land disturbance.

One of Harvard's most unique zoning provisions is the **Nashua River Watershed Greenspace Buffer District**, which is a component of Harvard's Watershed Protection and Flood Hazard overlay district. This buffer district extends along the Nashua River, from its highest point in Harvard northward to its lowest point in Harvard, and includes an area 300 feet from the center line of the Nashua River. Detailed provisions for this overlay district are found in Section 125-25 c. of the Harvard Zoning Bylaws, which states that "*No building for human occupancy and no sewage disposal system or other potential source of substantial contamination is permitted. However, if an applicant proves satisfactorily that his land is in fact not subject to inundation and not unsuitable for residential use because of drainage conditions and not an inland wetland under Chapter 131 G.L., the Planning Board may authorize by special permit (see § [125-46](#), Special permits) the use of such land as if in an AR District or, if such land does not abut an AR District but does abut a district other than a W District, as if in the other district*".

Harvard's zoning does not have any explicitly described limits on impervious surfaces per se, though it effectively limits such areas by requiring that the floor area of all new buildings not exceed 10% of the lot area (Sec.125-30a).

The Town is presently not subject to the federal NPDES Phase II stormwater permit.

The Town has a floodplain overlay district, which uses recently undated Flood Insurance Rate Maps (FIRM) dating to 2011 and 2014 for delineation of floodplain and floodway boundaries. No new permanent structures are permitted in the floodplain overlay district.

Harvard presently does not have an aquifer or groundwater protection overlay district.

Opportunities for Improvement

In general, Harvard has an excellent set of bylaws, regulations and an up-to-date Master Plan. Its wetlands protection bylaw features the most protective no-disturbance and no-build buffers in the Nashua River watershed region.

Though the town is not subject to the federal NPDES Phase II stormwater general permit, adopting a stormwater control bylaw and regulations would offer even greater protection for Harvard's surface water resources.

The town should consider adopting an aquifer and/or groundwater protection overlay districts.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

DRAFT

Hollis, New Hampshire

Plans, Policies and Local Planning Capacity

Intro Statement:

Hollis is a small town of 7,817 people located west of Nashua, New Hampshire and to the east of Brookline, New Hampshire. Pepperell, Massachusetts borders Hollis on the south. The Nissitissit River flows through southwestern Hollis after entering the town from Brookline before flowing into the Nashua River in Pepperell. Southern and central Hollis contains extensive agricultural land encouraged by the presence of extensive prime and statewide importance agricultural soils, while northern Hollis is forested.

Summary of Master Planning:

Hollis's most recent Master Plan update dates to 1998. Though dated, this Master Plan contains very detailed chapters on the protection of natural and water resources. Unlike in Massachusetts, towns in New Hampshire are not required to have up to date Open Space and Recreation Plans in order to qualify for state conservation funds. Nonetheless, Conservation Commissions often adopt their own land acquisition and management plans to guide them in their conservation efforts. Hollis' Conservation Commission and Land Protection Study Committee have been pro-active in protecting valuable riparian and wildlife habitat in the town. Approximately **one-third** (*confirm*) of Hollis' land area is protected open space, much of it held by the non-profit Beaver Brook Association.

Local Planning Capacity:

Hollis has a part-time Town Planner as well as a Conservation Commission staff person, which enables the Town to better implement its plans and enforce the provisions of the zoning ordinance and related regulations.

The Town updates its Zoning Ordinance, Subdivision Regulations and Site Plan Regulations on a regular basis.

The town belongs to the Nashua Regional Planning Commission, which serves the towns in south-central New Hampshire.

Zoning and Regulations

Hollis has an OSRD ordinance, termed “Hollis Open Space Planned Development” (HOSPD). Under HOSPD, all proposed major subdivisions must preserve from 40 - 50% of their area as permanently protected open space, depending on the density of units proposed on the tract. Major subdivisions are those creating five or more new building lots.

Hollis’s Local Wetlands Protection ordinance features a 100-foot regulatory buffer zone. While wetlands themselves are protected from development, it is up to New Hampshire towns to decide whether or not to have a local wetlands protection bylaw and how strict it will be.

The wetlands ordinance prohibits new primary structures that are not ‘grandfathered’ by virtue of being proposed on lots predating the wetland ordinance.

Local Conservation Commissions can also designate ‘Prime Wetlands’ through a state-approved process which affords these wetlands additional scrutiny in the permitting process. Though Hollis has not designated Prime Wetlands meeting the State definition, it has designated certain wetlands as sensitive environmental areas that should be given special consideration and protection during the permit application process. (Note: see description below which I’ll carry over into State level overview)

The Zoning Ordinance also features a very detailed Aquifer Protection section, which oversees development over the town’s widespread stratified drift aquifers. Several high risk land-uses such as new underground petroleum tanks are prohibited. Limits on impervious surfaces are found in the Aquifer Protection zone.

The Town has previously not been subject to the federal NPDES Phase II stormwater permit, though it has had a Stormwater Management Committee, which has not met since 2012. Hollis has a floodplain overlay district and the floodplain maps were updated in 2009.

Opportunities for Improvement

The first recommendation is that Hollis reconvene its Stormwater Management Committee in anticipation of having to meet the requirements of the revised NPDES Phase II Stormwater Permit. Even if Hollis continues to be exempt from this federal permit, it would be beneficial for the Committee to work with the Planning Board, Conservation Commission and Highway Department to better address the control of stormwater when land is proposed for development, as well as to address illicit discharges to Hollis’ storm drain system and surface waters.

Additional recommendations include... *(Will work on something...)*

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

From Hollis, NH wetland ordinance definitions:

PRIME WETLAND: Under the New Hampshire statute (RSA 482-A) for protecting wetlands from “despoliation and unregulated alteration”, municipalities are able to designate some of their high value wetlands as "Prime Wetlands" (RSA 482-A:15). These designated wetlands are given special consideration by the Wetlands Board in permit application reviews.

Lancaster, Massachusetts

Plans, Policies and Local Planning Capacity

Introduction Statement

Lancaster is a mid-size town in North Central Massachusetts that is close to Routes 2, I-190 and I-495, and has been growing steadily for the last 10-15 years. It is Lancaster's aim to shape and guide its growth so that the Town retains its character and identity while fostering the expansion of the tax base and services to its citizens. As of 2016, Lancaster's population stood at 8,186.

Summary of Master Planning

Lancaster completed its most recent Master Plan in 2007, the first new Master Plan in 40 years. This plan, though 10 years old, is extremely comprehensive and still suitable as the basis for current and future planning, zoning and regulatory efforts. The Master Plan does not have a dedicated Water Resources chapter, as these are discussed in the more comprehensive Open Space and Natural Resources chapter. The Town will begin the process of updating the Plan in 2018 in order to better reflect new planning practices and trends.

Lancaster's most recently approved Open Space and Recreation Plan (OSRP) dates to 2010. This Plan includes detailed chapters on water resource and wildlife habitat protection. The Commonwealth of Massachusetts recommends that OSRPs be revised every seven (7) years in order to serve as the basis for state-funded grant applications. Lancaster's Open Space and Recreation Committee have been working on an update since January 2017 and expect to have a copy ready for re-certification by the end of 2017.

In 2014, the Lancaster Green Belt Vision Plan was created to form a continuous, contiguous greenway of parcels that run from the south of Lancaster, along the Nashua River, and through to the north of Lancaster. The Green Belt will provide town-wide recreational trails, as well as a corridor for migratory wildlife.

Local Planning Capacity

Lancaster has a full-time Town Planner as well as a Conservation Agent. The Town land use boards and commissions (Planning Board, Conservation Commission, and the Zoning Board of

Appeals) regularly update their respective bylaws and regulations. Lancaster is also a member of the Montachusett Regional Planning Commission (MRPC) who is chartered to carry out comprehensive regional planning. MRPC offers technical and professional services to its members, including planning in the areas of community development, economic development, transportation, housing, environment, and geographic information systems.

Zoning and Regulations

Flexible Development Bylaw

Lancaster's open space residential development bylaw provides for this type of development through a Special Permit from the Planning Board. This bylaw is called *Flexible Development* and requires that 40% of the total tract area be preserved as permanently protected open space, in exchange for smaller lot sizes in a clustered arrangement.

Wetlands Protection Bylaw

Lancaster's Local Wetlands Protection Bylaw was last revised in 2007. The Bylaw features a twenty-five foot (25') no-disturbance buffer from all wetland resource areas. Though this is certainly better than not having a no-disturbance buffer, the latest science on wetland buffer zones supports a wider no-disturbance buffer to adequately protect water quality and habitat values of wetlands adjacent to development.

Stormwater Management Bylaw

The Town is subject to the federal NPDES Phase II stormwater permit. As such, the Town adopted a Stormwater Management Bylaw in 2007, an Illicit Discharge Bylaw in 2007, and a Water Withdrawal Bylaw in 2010. All of the bylaws serve the Town well in the protection of our rivers and water bodies as they are heavily enforced.

Overlay Districts

Lancaster has a Water Resource Protection Overlay District in the Zoning Bylaw. This bylaw primarily addresses the protection of groundwater, most specifically the stratified drift aquifers in

town. Any use that would render any lot in the overlay district with 15% or greater impervious surfaces requires a special permit from the Planning Board.

The Town also has a Floodplain Overlay District and Bylaw which was recently revised in 2011, coincident with the Town's floodplain (FIRM) map revisions by FEMA.

Other Initiatives

Green Community

In 2010, Lancaster was designated as a Green Community by the MA Department of Energy Resources. Lancaster was one of the first municipalities in the State to receive this designation. This designation mandates that the Town's municipal facilities and vehicles must reduce energy consumption by 20%.

The Town has undertaken several actions to try and meet this goal, such as new heating systems, upgraded lighting, insulation and weatherization measures, LED street lighting and electric vehicles with a docking station.

Complete Streets

In 2017, Lancaster was designated as a Complete Streets community by the MA Department of Transportation. The Complete Streets program provides funding to municipalities for construction of pedestrian- and bicycle-friendly roads, sidewalks and connections to places of public interest. A prioritization plan has been adopted, and in its first year the Town will start reconstruction of sidewalks on Main Street, along with curb ramps and cross walks. Bicycle racks will also be installed at the Library, Community Center and elementary and middle schools.

Land and Water Conservation Fund (LWCF) Grant

In 2016, the LWCF grant was received from the National Park Service, and administered by the MA Department of Conservation Services, for the construction of a multi-purpose, multi-generational park space called the Nathaniel Thayer Memorial Park. Phase 1 of the park project, which is a playground with a splash pad and a bathroom facility, will be constructed in 2018. Other pieces of the park will include athletic fields, passive recreation fields, a basketball court, tennis courts, dog park, walking paths and an amphitheater.

Bartlett Pond Dam Removal

In 2014, the dam at the Bartlett Pond Recreation Area was removed. The dam removal has improved the water quality of the Wekepeke Brook, which was classified as a distressed water basin. The removal of the dam and concrete impoundment has allowed for the replacement of warm still water with free flowing, oxygenated, cooler, deeper water which has had a large-scale benefit for the local habitat.

Designated Blue Trail

In 2016, the Lancaster Friends of the Nashua River officially designated the Town's first blue trail, or water trail, over the North Nashua River. The blue trail runs from a launch point in the bordering City of Leominster, and runs to a take-out point at the Pellechia Recreation Area that is south of the Cook Conservation Area along the North Nashua River. Signs have been placed along the roadside to direct the public to these locations.

Opportunities for Improvement

The first recommendation is that Lancaster should consider updating its 2007 Master Plan. Though the existing Master Plan reflects the first major revision in decades, there are likely several sections that would benefit from updating.

The Town should continue its efforts to update the 2010 Open Space and Recreation Plan, which is due to be completed by the end of 2017.

The Town should also continue its efforts to plan for the Green Belt as outlined in the 2014 Green Belt Vision Plan.

The Conservation Commission may also want to consider increasing the no-disturbance buffer in its local Wetlands Protection Bylaw to greater than 25 feet. The science supports having much more extensive no-disturbance buffers, especially for the protection of riparian habitats and their associated assemblage of species.

Finally, directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

Pepperell, Massachusetts

Plans, Policies and Local Planning Capacity

Intro Statement:

Pepperell is a mid-sized town on the Massachusetts / New Hampshire border, located north of Groton and south of Brookline and Hollis, New Hampshire. As of 2016, Pepperell's population stood at 12,152. Like other older mill towns once dependent on water power for industry, Pepperell has several villages within its borders, including East Pepperell near the Pepperell dam on the Nashua River, Pepperell Center and Pepperell's Historic District to the west of the center. Over the years, the Pepperell Conservation Commission has protected several thousand acres of land, much of it centered on Gulf Brook, a pristine trout stream that flows into the Nissitissit River. This conservation land forms a linear network of protected land which can serve as a good model for effective protection of wildlife habitat.

Summary of Master Planning:

Pepperell completed its most recent Master Plan in 2007. This plan, though now 10 years old, is very comprehensive and is still suitable as the basis for future planning and zoning and regulatory efforts. This Master Plan does not have a Water Resources chapter per se, though water resources are described in the Natural Resources chapter. The Northern Middlesex Council of Governments (NMCOG) has been contracted to update Pepperell's Master Plan. A Master Plan Committee is currently being organized as of 2017 and a new Master Plan should be ready for adoption by Town Meeting in the near future.

Pepperell's recently updated its Open Space and Recreation Plan (OSRP) in 2016. The plan has been approved by the State. OSRPs are considered current for 7-years. This Plan includes detailed chapters on water resource and wildlife habitat protection. Pepperell was designated a 'Green Community' in 2015.

Local Planning Capacity:

Pepperell has a full-time Town Planner as well as a part-time Conservation Administrator. The Town Land-Use Boards (Planning, Conservation Commission and Zoning Board) regularly update their respective bylaws and regulations. Unlike most of the other towns in the Nashua River Wild and Scenic Corridor, which belong to the Montachusett Regional Planning Commission (MRPC), Pepperell, along with Dunstable are members of the Northern Middlesex Council of Governments (NMCOG), a regional planning agency which is based out of Lowell, Massachusetts.

Zoning and Regulations

Pepperell's OSRD bylaw provides for this type of development through Special Permit from the Planning Board. It requires that 40% of the total tract area be preserved as permanently protected open space, which is slightly less than the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw.

Pepperell's Local Wetlands Protection Bylaw was last revised in 2002. The Bylaw features a combined fifty-foot (50') no-disturbance / no-build buffer from all wetland resource areas. This is one of the wider such no-disturbance buffers within the Nashua River watershed region.

Pepperell also has a thorough groundwater and aquifer protection bylaw termed the Water Resource Protection Overlay District (WRPOD) which covers much of the western part of the town. The WRPOD covers much of the western part of the town but also an area around the Jersey Street wells and the Nashua Road well, which is on the Hollis, NH state line.

There is a good section on erosion control in section 5530 of Pepperell's Zoning Bylaw.

The Town is subject to the revised federal NPDES Phase II stormwater permit, which it will need to address in 2018 if the current federal schedule holds. The Town was able to obtain an exemption from the previous version of the permit issued in 2004. Pepperell will need to adopt a local Stormwater Management bylaw and undertake the other 'minimum controls' specified in the stormwater permit. Pepperell will need to comply with the new stormwater permit, which is currently under appeal by the City of Lowell and the Town of Franklin. Pepperell has contracted with a consulting firm to assist it in preparing its Notice of Intent (NOI).

The town is a member of the Northern Middlesex Stormwater Collaborative and participate in meetings and training sessions related to stormwater regularly. Pepperell is planning to adopt a Stormwater Bylaw and is also addressing how to fund efforts (perhaps a stormwater utility) to comply with the permit. All zoning regulations will be reviewed to determine which regulations will require updating, changes, etc. for compliance with the Permit or to address minimizing impervious surface impacts.

The Town floodplain overlay district, included in the Code of the Town of Pepperell, was adopted on June 7, 1993 and amended on May 3, 2010. This floodplain bylaw only addressed construction in the floodway, however, not within the wider 100 and 500 year floodplain zones.

Opportunities for Improvement

The first recommendation is that Pepperell update its Open Space and Recreation Plan, which dates to 2008 and is therefore out of date. The Open Space and Recreation Plan was updated in 2016 and received conditional approval from the state.

Pepperell should also consider revising its floodplain protection bylaw and/or regulations to address all impacts within the 100 and 500 year floodplains, not just within the floodway itself.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment. This will be addressed as part of the review process under stormwater.

Shirley, Massachusetts –

Plans, Policies and Local Planning Capacity

Intro Statement:

Shirley is a mid-sized town of approximately 5,700 people located to the west of Ayer and Harvard and adjacent to Devens in north-central Massachusetts.

Summary of Master Planning:

Shirley is in the process of updating its Master Plan, with the most recent draft dating to April, 2017. The Planning Board is aiming to adopt this revised Master Plan in the fall of 2017.

The town's Open Space and Recreation Plan (OSRP) is also being revised, with the most recent draft dating to 2014, with adoption planned for later in 2017 or 2018. This Plan includes detailed chapters on water resource and wildlife habitat protection.

Shirley is a designated 'Green Community'.

Local Planning Capacity:

Shirley currently lacks a Town Planner, though in the past it has had this position as part of its town government. A part-time or full-time Planner would be very useful in ensuring the successful implementation of recommendations made in the revised Master Plan. The town belongs to the Montachusett Regional Planning Commission. Shirley has not adopted the Community Preservation Act.

Zoning and Regulations

Shirley has an OSRD bylaw, termed "Low-Impact Development", not to be confused with stormwater-related low impact development. It requires that 35% of the total tract area be preserved as permanently protected open space, which is less than the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw. LID is allowed through Special Permit from the Planning Board.

Shirley's Local Wetlands Protection Bylaw was originally adopted in 2005, and has not been revised since then. The Bylaw features a twenty-five-foot (25') no-disturbance and a forty-foot (40') no-build buffer from all wetland resource areas.

Shirley has a Water Supply and Wellhead Protection Overlay District for the protection of its groundwater resources.

The Town is subject to the federal NPDES Phase II stormwater permit, and it does have a local Stormwater Management Bylaw, both for land disturbing activities and illicit discharges to the storm drain system and receiving waters. Activities disturbing one or more acres of land are required to obtain a stormwater management permit.

Shirley has a floodplain overlay district and the floodplain maps were updated in 2010.

Opportunities for Improvement

The first recommendation is that Shirley adopt the draft Master Plan and Open Space and Recreation Plan, which can then serve as the basis for zoning that greater protects natural resources. Second, the town should consider revising its 'Low Impact Development' (OSRD) bylaw to protect more open space and perhaps rename it so as to alleviate confusion with the stormwater management use of the term.

Third, a somewhat wider (than 25') no disturbance zone in the Local Wetlands Protection Bylaw would provide better protection to Shirley's wetlands and surface waters.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

Townsend, Massachusetts –

Plans, Policies and Local Planning Capacity

Intro Statement:

Townsend is a mid-sized town on the Massachusetts / New Hampshire border, located north of Lunenburg and south of Brookline and Mason, New Hampshire. As of 2010, Townsend’s population stood at [REDACTED]. Townsend features several villages within its borders, such as the Harbor Pond area on an impoundment of the Squannacook River, West Townsend near the Ashby border and Townsend Center with its classic town common at the intersection of Routes 13 and 119. Much of Townsend’s land area is protected land within the Townsend and Willard Brook State Forests, which are administered by the Massachusetts Department of Conservation and Recreation.

Summary of Master Planning:

Townsend completed its most recent Master Plan in 2001. An attempt to update the Master Plan in 2008 was not brought to completion. The 2001 Master Plan should be revised as soon as practicable.

Townsend’s most recently approved Open Space and Recreation Plan (OSRP) dates to 2013. This Plan includes detailed chapters on water resource and wildlife habitat protection.

Townsend is a designated ‘Green Community’.

Local Planning Capacity:

Townsend has a full-time Planning Administrator as well as a Conservation Agent. Much of the Planning Administrator’s function is related to plan review and the clerical functions of the Planning Board rather than Master Planning and other long-range projects. The town belongs to the Montachusett Regional Planning Commission. The Town attempted to but failed to adopt the Community Preservation Act in the mid-2000s.

Zoning and Regulations

Townsend has an OSRD bylaw, termed “Open Space Preservation Development”, which provides for this type of development through Special Permit from the Planning Board. It requires that 30% of the total tract area be preserved as permanently protected open space, which is less than

the 50% recommended by the Massachusetts Executive Office of Energy and Environmental Affairs for this type of bylaw. The bylaw also requires applicants to demonstrate that an OSPD is at least as good as or superior to a conventional development, which is a burden of proof that could discourage this type of development. The bylaw dates to 1986, with some revisions since then, and should be revisited in light of current recommended planning practices.

Townsend's Local Wetlands Protection Bylaw was originally adopted in 1983, and has been revised periodically since then. The Bylaw features a thirty-five-foot (35') no-disturbance buffer from all wetland resource areas. This no-disturbance buffer is a good provision, though the latest wetland science supports a wider buffer to better protect water quality and riparian wildlife habitat.

Townsend has thorough groundwater and aquifer protection measures in its zoning bylaws. The Town is subject to the federal NPDES Phase II stormwater permit, and it does have a local Stormwater Management Bylaw, both for land disturbing activities and illicit discharges to the storm drain system and receiving waters. Activities disturbing 40,000 sq.ft. or more of land, or 1,000 sq.ft. or more on slopes greater than 15% require a stormwater management permit. Low-Impact Development (LID) techniques are recommended but not absolutely required in the Stormwater Management Bylaw.

The Town does have a floodplain overlay district, though the Building Inspector must check on whether construction is proposed in a floodplain and whether flood insurance is required. Townsend does have a floodplain overlay district and the floodplain maps were updated in 2010.

Opportunities for Improvement

The first recommendation is that Townsend update its Master Plan, which dates to 2001 and is perhaps no longer an effective basis for zoning and other regulatory amendments that could help to safeguard the outstanding resource values identified in this report.

Secondly, the town's Open Space Planned Development bylaw should be revised to reflect the latest planning practices such as protecting a greater amount of open space and providing for more flexible dimensional requirements.

Directly defining and limiting impervious surfaces in all zoning districts may be even more effective in safeguarding water quality impacts resulting from development and redevelopment.

REGULATORY REVIEW TABLES:
(DRAFT) ZONING AND REGULATORY REVIEW: NASHUA WILD & SCENIC RIVERS STUDY
– Version for NH Towns

Category	Brookline	Hollis
Regulatory Measure	Valerie Rearick, Town Planner 1-603-673-8855 x 215	Wendy Trimble, PB Secretary; 603-465-2209 x 108
Master Planning		
Current Master Plan?	YES – 2011 / 2012	NO – dates to 1998
Water Resources Protection Chapter?	YES	YES
Current Open Space Plan?		
Has the Zoning Bylaw been revised in the last five years?	YES	YES
Land-Use Controls		
Does the town have OSRD zoning?	YES	YES
If so, what is protected open space requirement?	35%	40% - 50% depending on overall density of housing.
Is OSRD allowed by right or Special Permit?	Appears to be by right – follow subdivision Process	Special Exception (SP)
Does the town have a maximum slope for development?	Not per se – limits on new road and driveway slopes	Not per se – limits on new road and driveway slopes
Does the town have Erosion Control measures for construction on steep slopes?	It has a Stormwater Management section 6.4 in Site Plan Regs. LID is default method. Very good.	Good standards for construction on steep slopes and hillsides in “Rural Character Preservation Ord.” (OTHER – check)
Does the zoning limit the % or area of impervious surfaces?	There are impervious limits found in the Aquifer Protection Dist.	Max. Building coverage in Comm. Zone / More?

Do parking requirements for commercial devt. provide for shared or alternative parking?	YES – good provisions for such in Site Plan Regs sec. 4.6.01	YES – shared parking is encouraged when possible.
Any resource protection overlay zones (besides wetlands)?	Yes, Aquifer Protection and Floodplain	
Water Resource Zoning and Regulations		
Does the town have a local Wetlands Protection Bylaw?	YES	YES
If so, are there no-disturbance or no-build setbacks?	There is a 50 foot no-build area within the 100 foot buffer zone	Not per se – but the bylaw is otherwise comprehensive.
If yes to a WPB, are upland areas adjacent to wetlands considered resource areas?	NO – may not be applicable in NH law?	NO - may not be applicable in NH law?
Does the town have an Aquifer or general groundwater protection bylaw?	YES	YES
Does the town have wellhead protection as part of this?	YES	YES
Does the town have a Stormwater Control Bylaw with LID provisions?	YES – Section 6.4 of Site Plan Regulations. Pretty good example.	There was a stormwater committee that has since disbanded. Follow-up.
What area of land disturbance triggers Stormwater Review?	I believe one-acre but I need to confirm.	Same as for Brookline.
Is minimizing impervious surfaces a goal of the stormwater bylaw or regs?	YES – right up front	
Is the use of LID required in certain circumstances?		

	YES – it is the default method	
Protection of key wildlife habitat and natural communities?		
Is protection of wildlife habitat and natural communities specified in OSRD or other zoning?	YES	YES
Is such addressed in Open Space or Master Plans?	YES	YES
If so, what areas are called out in such plans?	See Natural Resource Chapter	Good provision for “Wildlife Habitat Inventory and Assessment” in Site Plan Regs (page 4)
Planning Capacity		
NH programs?		
Does the Town have a full or part-time Town Planner or Planning Administrator ?	YES	YES - Full-time Planning Secretary and part-time Planner
Does the Town have a full or part-time Conservation Administrator ?	YES – Kristin Austin 603-673-8855 x 216	YES - Connie Cain 603-465-2209 x 105
Does the Town have a land acquisition Committee and/or fund for open space ?	YES to both: 100% of Land-Use change tax goes to fund	YES to both: 50% of Land-Use change tax goes to fund
Which RPC does the Town belong to?	NRPC	NRPC
Something about success of Planning and Conservation warrant articles or bylaws at Town Meeting etc.?		
OTHER		Hollis has a “ Rural Character Preservation Ordinance ” that is quite innovative.

(DRAFT) ZONING AND REGULATORY REVIEW: NASHUA WILD & SCENIC RIVERS STUDY – Version 7

Category	Ayer	Bolton	Devens	Dunstable	Groton
Regulatory Measure	Heather Hampson is Planning Admin. @ 978-772-8218 Mark Archambault, Town Planner: 978-772-8218	Erica Uriarte, Town Planner @ 978-779-3308	Peter Lowitt, Director Neil Angus, Planner Devens Enterprise Commission	Cheryl Mann, Secretary 978-649-4514 x 230	Takashi Tada, Town Planner: 978-448-1105
Master Planning					
Current Master Plan?	YES – it is in the process of being updated as of 2017. Set for adoption in 2018.	YES – revised in 2006.		YES- in the process of being updated. Expected to be approved a fall STM 2017. The previous Master Plan dates to 1999.	YES – revised in 2011.
Water Resources Protection Chapter?	YES	NO – though water resource protection is mentioned.	YES – in OSRP. Also earlier VHB report from 1994.	NO – but water resources covered in Natural Resources.	YES
Current Open Space and Recreation Plan	NO – though it is slated for adoption in 2018.	YES	YES – covers the period 2008 – 2013, though data is still current (confirm with AI)	YES – covers the period 2010 – 2017. Will be updated this year.	YES – revised in 2012.
Designated “Green Community”?	YES	YES	N/A	NO	NO
Has the Zoning Bylaw been revised recently?	YES – it is in the process of being comprehensively updated as of 2017 and is scheduled for a Town Meeting vote in 2018.	YES	YES	YES – as recently as 2016.	YES

Do parking requirements for commercial devt. provide for shared or alternative parking?	YES, by Special Permit. See Sec. 9.1.5 (D) in zoning bylaw.	NO	YES – parking regulations emphasize shared parking as well as alternative pavement	No commercial development in town	YES – good guidelines for shared parking in Section 218-23.
Any resource protection overlay zones (besides wetlands)?	Floodplain and Aquifer Protection Overlay Districts	Floodplain and Mixed-Use Village Overlay Districts	Floodplain and Water Resources Protection.	Section 15.2.1 of Zoning bylaw-Floodplain District Overlay	Floodplain and Water Resources Protection.
DATE of FIRM maps flood zoning is based on	1982	2011	2011	2010	2010
Water Resource Zoning and Regulations					
Does the town have a local Wetlands Protection Bylaw to supplement the WPA?	NO	YES	YES	YES – the wetland protection bylaw was revised in 2013.	YES
If so, are there no-disturbance or no-build setbacks?	The Bylaw proposes a 100 foot <i>regulatory</i> buffer.	100 foot regulatory buffer with a 25 foot wide no disturbance zone from the edge of WPA juris. wetlands.	100 foot regulatory buffer with a 50 foot no-build zone and a 25 foot no-disturbance zone.	100 feet <i>regulatory</i> buffer zone. 60' No new permanent structure setback.	YES, there is a 50 foot combined no-disturbance / no-build zone.
If yes to a WPB, are upland areas adjacent to wetlands considered resource areas?	YES – within the 100 foot buffer zone.	YES – land within 75 feet of a wetland is considered a resource areas subject to review and permitting.	NO	NO	YES
Does the town have an Aquifer or general groundwater protection bylaw?	YES – Section 8.1	YES – there is a general town-wide bylaw for groundwater protection. General good practices listed.	YES	YES - Water Supply Protection Bylaw. Aquifer protected under this.	YES

Does the town have wellhead protection as part of this?	YES	YES	YES	YES - Zone 1 and 2 wellhead delineation protection	YES
Does the town have a Stormwater Control Bylaw with LID provisions?	SORT OF – has stormwater control bylaw, but LID not emphasized.	NO – though Sec. 5230.3 of the Subdiv. Regs. Has good provisions for such.	YES – 2012 – excellent Stormwater Management Section in 974 CMR 4.00, sec. 4.08	Has Stormwater and Erosion control bylaw but does not include LID.	YES
What area of land disturbance triggers Stormwater Review?	Typically 40,000 sq.ft. except for slopes > 15% then 1,000 sq.ft.	N/A	All development is subject to stormwater review	>20, 000 s.f. requires Land disturbance permit from PB	> 20,000 s.f. requires minor permit / > 40,000 s.f. major permit
Is minimizing impervious surfaces a goal of the stormwater bylaw or regulations?	NO	N/A	YES	In Water Supply Protection Bylaw 15% or 2500 s.f. (whichever greater) imperv. requires authorization if the water supply area.	YES
Is the use of LID required in certain circumstances?	NO	LID is required in the Commercial Zone and is strongly encouraged in Section 5230.3 of the Subdiv. Regs.	YES – emphasis on bioretention and biofiltration. LID is considered the default stormwater management technique in Sec. 4.08 2 ix.	NO	YES - Low-impact development (LID)/green infrastructure techniques must be incorporated into development and redevelopment projects in the Town unless it can be shown per § 352-9A(1) that the use of LID techniques is not feasible

	AYER	BOLTON	DEVENS	DUNSTABLE	GROTON
Protection of key wildlife habitat and natural communities?					
Is protection of wildlife habitat and natural communities specified in OSRD or other zoning?	YES – in the Erosion Control section	NO	YES, in Site Plan design standards there are requirements to preserve trees and reduce edge habitat on new development sites.	Yes, purpose in OSRD to preserve natural features and conditions. Not specific for wildlife habitat though.	YES
Is such addressed in Open Space or Master Plans?	YES	YES – Open Space and Recreation Plan is currently being revised. Town has excellent planning process.	YES – esp. the Open Space and Recreation Plan	Preserving open space, protecting natural communities and resource conservation are primary objectives in both Open Space and Master plans.	
If so, does it describe areas recommended for further protection in detail?	YES	The OSRP goes into great detail on recommended land for protection.	See Devens Open Space and Recreation Plan	YES - endangered wildlife habitat, groundwater and aquifers, fields and forests, river greenways, shorelines, Scenic roads and views, etc.	

	AYER	BOLTON	DEVENS	DUNSTABLE	GROTON
Planning Capacity					
Has the Town adopted the Community Preservation Act (CPA)?	YES – adopted in 2002.	NO	N/A	YES	YES – adopted in 2004.
Does the Town have a full or part-time Town Planner or Planning Administrator?	YES	YES	YES	NO	YES
Does the Town have a full or part-time Conservation Agent?	YES	YES – Rebecca Longvall 978-779-3304	YES	NO	YES
Does the Town have a land acquisition committee and/or fund for open space?	There's a Community Protection Advisory Committee (CPAC)	Capital Planning Committee oversees land acquisition			
Which Regional Planning Commission is the town part of? Does it actively engage with the RPC?	Montachusett Regional Planning Commission (MRPC)	Metropolitan Area Regional Planning Commission (MAPC)	Not Applicable to Devens	Northern Middlesex Council of Govts.	MRPC

(DRAFT) ZONING AND REGULATORY REVIEW: NASHUA WILD & SCENIC RIVERS STUDY – Version 7					
Category	Harvard	Lancaster	Pepperell	Shirley	Townsend
Regulatory Measure	Bill Scanlan, Town Planner: 978-456-4100 x 329	Noreen Piazza, Planner: 978-365-3326 x 1311	Steve Parker, Planner: 978-433-0336	PB Clerk (no name): 978-425-2600 x 240	Michele Decoteau, Clerk 978-597-1700 x 1722 Karen Chapman, Planner 978-597-1700 x 1723
Master Planning					
Current Master Plan?	YES – revised in 2016.	YES – revised in 2007.	NO – however the 2007 Master Plan is very comprehensive.	Presently being revised. Draft as of May, 2016. Need to confirm status.	NO – adopted in 2001. The update of 2008 was never adopted. The PB may try again.
Water Resources Protection Chapter?	YES – revised in 2016.	YES.	Not per se. Water resources mentioned but not explicitly addressed.	YES. In the Open Space and Recreation Plan.	YES.
Current Open Space and Recreation Plan	YES - In process of being reviewed by Div. Con. Services	YES – 2005.	YES – completed in 2008.	YES. Draft as of 2014.	YES. Adopted in 2013.
Designated “Green Community”?	YES	YES	YES	YES	YES
Has the Zoning Bylaw been revised recently?	YES	YES	YES – most recently in 2016.	YES – as recently as 2016.	YES
Land-Use Controls					
Does the town have OSRD zoning?	YES. OSC-PRD section 125-35) In the process of being revised.	YES. It’s called ‘Flexible Development’, Sec. 220-15.	YES.	YES – though they call it ‘Low Impact Devt.’ Section 4.2A, page 40.	YES, though it dates to 1986. See Zoning Bylaw Sec. 145-39.

Water Resource Zoning and Regulations												
Does the town have a local Wetlands Protection Bylaw to supplement the WPA?	YES		YES. 2007	YES, adopted in 2002.	Shirley Cons Agent, Mike Fleming: 978-425-2600 x245	YES, originally adopted in 1983, revised since then.						
If so, are there no-disturbance or no-build setbacks?	YES, there is a 50 foot no-disturbance zone as well as a 75 foot no-build zone.	YES, there is a 25 foot no-disturbance zone.	YES, there is a 25 foot no-disturbance zone and a 40 foot no-build zone.	YES, there is a 50 foot combined no-disturbance / no-build zone.	YES, there is a 25 foot no-disturbance zone and a 40 foot no-build zone.	YES, there is a 35 foot non-disturbance zone.						
If yes to a WPB, are upland areas adjacent to wetlands considered resource areas?	(See Riparian project table)	Sort of. See section 215-4 of Wetland Bylaw. Talk to Conservation Agent.	YES, if within the above 50 feet.	NO	NO							
Does the town have an Aquifer or general groundwater protection bylaw?	NO	YES, Water Resource Protection District, sec. 220-39.	YES, the WRPOD overlay district.	YES, Water Supply and WHPOD, section 4.13	YES, Section 145-40. Aquifer Protection Overlay District.							
Does the town have wellhead protection as part of this?	NO	YES	YES, wellhead protection for Zone IIs, 3 of which are specified.	YES, a good one.	YES, Section 145-54 Groundwater Protection District.							
Does the town have a Stormwater Control Bylaw with LID provisions?	NO – not subject to Phase II.	YES	NO – though subject to new permit	Not sure – contact Conservation Agent.	YES, for Phase II stormwater control.							
What area of land disturbance triggers Stormwater Review?	One acre under State permit only.	One acre or 43,560 sq.ft.	Not applicable yet	Contact Conservation Agent.	40,000 square feet.							
Is minimizing impervious surfaces a goal of the stormwater bylaw or regulations?	N/A	YES.	Not applicable yet	Contact Conservation Agent.	Not explicitly.							

Is the use of LID required in certain circumstances?	N/A – NO	Not that I see. Ask Noreen or David Koonce.	Not applicable yet	Contact Conservation Agent.	
Protection of key wildlife habitat and natural communities?	HARVARD	LANCASTER	PEPPERELL	SHIRLEY	LEFT OFF HERE
Is protection of wildlife habitat and natural communities specified in OSRD or other zoning?	YES	YES	YES		YES – See Zoning Bylaw Section 145-41 the Squannacook ACEC.
Is such addressed in Open Space or Master Plans?	YES – in the Master Plan.	YES	YES		
If so, does it describe areas recommended for further protection in detail?			Gulf Brook, Sucker Brook, Nashua River, Nissittissit River watersheds and Bio-map core areas.		
Planning Capacity	HARVARD	LANCASTER	PEPPERELL	SHIRLEY	
Has the Town adopted the Community Preservation Act (CPA)?	YES – adopted in 2001.	NO	NO	NO	NO

Does the Town have a full or part-time Town Planner or Planning Administrator?	YES	YES	YES	Need to check status	YES
Does the Town have a full or part-time Conservation Agent?	YES	YES	YES	YES	
Does the Town have a land acquisition committee and/or fund for open space?	Conservation Commission	Find out who is responsible			
Which Regional Planning Commission is the town part of? Does it actively engage with the RPC?	MRPC	MRPC	Northern Middlesex Council of Govts.	MRPC	

Possible text box

CLIMATE DISTURBANCE

Changes in climate and local weather patterns will likely affect aquatic systems by exacerbating or accelerating habitat degradation due to other identified threats. Increased periodicity and intensity of drought may cause loss of aquatic habitat through short-term drying, but may also concentrate effects of pollutants. Additionally, increases in severe rain and snowfall events will increase runoff of pollutants from agricultural and urban areas into waterbodies.

Increases in rain will also increase atmospheric deposition of pollutants, including nitrogen deposition. In addition to increased nutrient pollution from runoff and atmospheric deposition, increased surface water temperatures will allow longer growing seasons for nuisance aquatic plants and harmful algal blooms.

Severe storms, such as Superstorm Sandy, can cause scouring and/or sedimentation of river banks, impacting SWAP plants on shorelines and sandbars. There is a potential for species located in backwaters to be impacted by high flows and washed from their habitat. (MA 2015 State Wildlife Action Plan, pg.x)

APPENDIX A: History of Water Quality

by Warren Kimball

Water Quality Standards

Water Quality Standards were first established for the Commonwealth of Massachusetts by the Division of Water Pollution Control (DWPC) in 1967. They created four inland water classifications as water quality goals. Class A waters were designated as sources of public water supply. Class B waters were designated for aquatic life, recreation (swimming and boating) and aesthetics. Class C waters were designated for indigenous aquatic life, limited recreation (boating) and aesthetics. Class D waters were designated for aesthetic enjoyment only. Table_ shows the original Classifications assigned to certain segments of the Nashua River Watershed in 1967. It also shows the current condition of these waters in the early 1970's as listed in the first DWPC Nashua River Basin Management Plan (1975). A "U" designation signified "unacceptable" meaning the current condition did not meet any of the existing Classifications. Waters in the Nashua River Watershed not listed here were Classified either A or B and were generally thought to meet those Classifications.

It can be seen that the current condition of the main body of the Nashua River was grossly polluted. Furthermore, the expectation for the river's future was below Class B. Class B coincided with the national "fishable/swimmable" goal established in the Federal Clean Water Act of 1972.

During the public hearing process for the 1967 Water Quality Standards, Mrs. Marion Stoddard testified on behalf of the Nashua River Clean-Up Committee. She presented a comprehensive package prepared by the Committee that showed overwhelming evidence for support of a B classification for the river. She also called for the elimination of Class D from the Standards. When the Water Quality Standards were revised in 1974 Class D was eliminated. Also, Class C segments on the main stem of the Nashua River, the South Branch and the lower Squannacook River were reclassified to a new Class B1 designation. Class B1 had all the same criteria as Class B except for dissolved oxygen, which was held at a Class C level. The North Branch of the River remained at

Class C. The Standards were revised again in 1978 and in this revision all Class C and B1 segments of the river were upgraded to Class B. This was to reflect the desire to attain the national “fishable/swimmable” goal and did not indicate the current condition of the river.

The Squannacook and Nissitissit Rivers are both designated Class B, cold water fisheries. This affords these rivers more stringent dissolved oxygen and temperature criteria within the B Classification. Other waters in this discussion are designated warm water fisheries and have less stringent criteria than cold water fisheries. Class C waters are not assigned a “fisheries” designation and have less stringent dissolved oxygen and temperature criteria than and warm water fisheries.

Water Quality Report Cards

In order to show the history of water quality of the Nashua River Watershed water quality report cards were created to graphically display the water quality of the river at a point in time. Four report cards were created in order to show the existing water quality during each decade from the early 1970’s to the early 2000’s. They display the results of water quality surveys conducted primarily by the DWPC (and its successor agencies) during this time. The information presented here singles out the historically polluted portions of the river including the South Branch, North Branch, and main stem of the Nashua River as well as two relatively clean tributaries; the Squannacook and Nissitissit Rivers. These rivers were divided into nine segments for the sake of discussion. Information on fish tissue was available only in the more recent assessments, and was spotty. Therefore, for the sake of trend analysis it is shown as “not assessed” on all the report cards in order to make the assessment more comparable.

For each of the nine segments, eight categories of pollutants are assessed for the aquatic life use and three categories of pollutants for the recreational uses. The level of pollution is color coded to verbal categories of “good”, “fair”, “poor” and “very poor”. “Good” means meeting Class B criteria and the other categories roughly coincide with Class C, Class D and U respectively. In order to provide a uniform basis of comparison, all water quality was assessed using criteria for a modern Class B water - meaning the criteria that would be used today.

Severity points were also assigned to these categories (1, 2 and 3 respectively) indicating the level of impacts depending on the degree to which Class B criteria are violated. Severity points in a segment can be totaled to compare with other segments or to the same segment over time. Total severity points can be further weighted by multiplying by the segment's length. In this manner the number of parameters violated, the severity of the violation and the river miles affected can be tallied to glean additional useful information.

Caution should be used in viewing the report cards so that they are not afforded a degree of precision that is unwarranted. Water quality is highly variable and the data sets used to fill out the report card were seldom uniformly comparable. In a few instances the information was contradictory. Additionally, the criteria used to assess the segments has changed over time as well as the Classifications of the waters. Considerable judgement was used in formulating the report cards. The use of broad verbal categories such as "good", "fair" and "poor" water quality and "slight", "moderate" and "severe" impacts is intentional and meant to envelop all the above considerations and sources for error. These same terms were often used in the source material to describe the river and the levels of pollution and therefore adds credibility to the judgements used in the report cards.

The report cards are aimed at showing the relative change in water quality over time, and for this purpose they are quite demonstrative.

Early Water Quality History

The Nashua River watershed was once settled by the Nashaway Indians members of the Algonquin Tribe. One commonly accepted translation for their name for the river is "the river with the beautiful pebbled bottom". They harvested plentiful salmon and alewives from the river. The area was subsequently settled and cleared by Massachusetts Bay colonists for farming and raising livestock.

During the 19th century the watershed experienced extensive industrial development including grist mills, textile mills and paper manufacturing mills. It seems water quality at this time met the

fishable/swimmable goal according to a nineteenth century account from the history of the Town of Lancaster: “Some value the river for its enriching qualities, and some for its abundant water power, and some because they can idle away their time catching pout and pickerel. There are some also who delight in it as “a thing of beauty” and a “joy forever”. They love to wander on its banks, to plunge into its depths and float upon its surface. They return again and again to gaze on its flow when its shimmers in the sun, or is mottled by the raindrops, or ruffled by the breeze”.

Unfortunately, the increased industrial development profoundly impacted the river. Paper manufacturing became the leading industry in the basin and numerous dams were built along the river and its tributaries to create storage impoundments for industrial process and cooling water and hydroelectric power. The paper mills discharged untreated process wastes to the river that coated the bottom with paper sludge. The use of dyes in the Fitchburg Mills made the river notorious for changing color downstream in accord with the color of paper being manufactured that day.

The City of Fitchburg installed one of the first wastewater treatment plants in the United States (1915). The plant provided secondary treatment- a degree of treatment rare at that time. In 1932 the City of Leominster installed an activated sludge treatment plant for its municipal wastes. But the industries did little or nothing to treat their discharges, largely negating the attempts by Fitchburg and Leominster to improve water quality. These two towns have combined sewer systems, a type that is purposely designed to overflow to the river during heavy rainfall, further exacerbating pollution problems. The severity of this pollution gave the river the dubious distinction of being the most polluted stream in Massachusetts.

By the 1970's The Division of Water Pollution Control listed 40 municipal and industrial discharges to the river and its tributaries. There were also numerous potential nonpoint sources of pollution such as urban storm water from Fitchburg, Leominster, Clinton and Ayer, agricultural runoff (apple orchards), malfunctioning on-site disposal systems as well as landfills and open dumps near the river banks. However nonpoint source pollution was largely masked by the much more prominent point sources of pollution.

The following is a ranking of the most significant pollutant loads to the river in the early 1970's:

Rank	Waste Load	Receiving Water
1	Fitchburg Paper Mills	North Branch
2	Fitchburg Wastewater Treatment Plant	North Branch
3.	Leominster Wastewater Treatment Plant	North Branch
4.	Clinton Wastewater Treatment Plant	South Branch
5.	Ayer Wastewater Treatment Plant	Main Stem
6.	Fitchburg Combined Sewers	North Branch
7.	Pepperell Paper Mills	Main Stem
8.	Leominster Combined Sewers	North Branch

As can be seen, by the 1970's municipal treatment plants contributed high levels of pollution to the river. These treatment plants were antiquated and overloaded and provided inadequate treatment of municipal wastewater.

The North Branch of the Nashua is punctuated by eleven dams. Dams can increase water temperature, increase sedimentation of sludge, decrease oxygen levels and, in some cases, stimulate eutrophication. The South Branch has two dams. The Wachusett Reservoir Dam is the largest in the watershed and has been implicated in contributing to water quality problems due to the meager minimum release of water. The main Stem has two dams; the Ayer Ice Company Dam and the Pepperell Pond Dam. The Pepperell Pond impoundment is long (over 4 river miles) and shallow. River velocities slow in this segment and pollutants settle to the bottom and time is afforded for biochemical reactions.

Water Quality in the Early 1970's

Figure _ shows the Report Card for water quality in the Nashua River in the early 1970's. The information for this report card comes primarily from a water quality survey conducted by Massachusetts Division of Water Pollution Control 1973 and its Management Plan from 1975. It also draws from a 1975 Management Plan by Camp, Dresser and McKee Inc., prepared for New England Interstate Water Pollution Control Commission.

The water quality in the early 1970's serves as a picture before major cleanup efforts were initiated by state and federal programs. Municipal treatment plants in Fitchburg, Leominster, Clinton and Ayer were present, but they were antiquated and ineffective. Industrial pollution was largely unabated.

The report card shows that the Nashua River in the early 1970's was biologically dead. Fish could not live in the river. Dissolved oxygen, necessary for the survival of aquatic life, was depleted by oxygen demanding paper waste and sewage. Aquatic habitat was destroyed by the coating of the river bottom with paper sludge and in the water column with turbidity. Even if fish could survive in the water column they would not be able to lay eggs and propagate in this degraded habitat. Domestic wastewater added levels of ammonia to the water column that were toxic to fish.

The most severe pollution was to the North Nashua Branch from the paper mills, municipal systems, and combined sewer overflows. The South Branch also had similar, but not quite as severe, water quality problems. Industrial cooling water discharges on the North and South Branches contributed to high instream water temperature; unsuitable for fish survival. Together the North and South Branches combined to pollute the Main Stem. The Main Stem shows signs of recovery along its length as the river's natural processes attempted to clean the river, only to be insulted again below Pepperell Pond by more paper mill wastewater.

Recreational uses on the river fared no better than the aquatic life. Bacteria from urban runoff and combined sewer over overflows on the North Branch combined with dyes, turbidity, odors and paper sludge repelled people from the river. The South Branch contributed to bacterial problems because the Clinton Treatment Plant did not practice chlorination at the time. Together, the North and South Branches, again, combined to pollute the Main Stem with effects lingering through Pepperell Pond. Below Pepperell Pond more discharges of paper mill wastewater and malfunctioning onsite private septic systems contributed to more degraded conditions.

Compared with the Nashua River, the Squannacook and Nissitissit Rivers were relatively pristine. There were slight excursions from the stringent dissolved oxygen and temperature criteria for cold water fisheries and occasional elevated bacteria levels from faulty onsite septic systems. A paper

company downstream on the Squannacook River provided generally good treatment for its wastewater but occasionally contributed to some slight turbidity. These rivers were considered fishable and swimmable in stark contrast to the rest of the assessed waters.

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Nashua River Watershed Water Quality- Early 1970's									
Segment	South Nashua		North Nashua		Main Stem			Squannacook	Nissitissit
	Above Clinton WWTF	Below Clinton WWTF	Above Leominster WWTF	Below Leominster WWTF	Above Peppereil Pond	Peppereil Pond	Below Peppereil Pond		
AQUATIC LIFE									
Biology									
Dissolved Oxygen									
Temperature									
pH									
Nutrients									
Toxics									
Habitat									
Hydrology									
RECREATION									
Bacteria									
Aesthetics									
Fish Tissue									
Total Points	11	17	22	22	20	15	20	3	3
Segment Miles	3.0	1.6	9.6	9.9	13.5	8.8	3.7	14.3	4.5
Weighted Score	33	27.2	211.2	217.8	270	132	74	42.9	13.5
	Key		Water Quality		Severity Points		Total		1027.9
		Good		0- no impacts					
		Fair		1- slight impacts					
		Poor		2- moderate impacts					
		Very poor		3- severe impacts					
		Not Assessed		data not available					

Water Quality in the Early 1980's

In 1975 the City of Fitchburg completed construction of two new wastewater treatment plants. The Westerly Plant was designed primarily to process paper manufacturing waste. The Easterly Plant was designed to treat domestic wastewater at an advanced level that included both phosphorus removal and nitrification (ammonia removal). Leominster was rebuilding its treatment facility at the turn of the decade to increase its capacity and add phosphorus removal. Pepperell was also constructing a modern facility. Clinton and Ayer were planning upgrades to their facilities.

The upgrades of the Fitchburg treatment facilities made a huge difference in pollution loads to the North River. DWPC estimated that total suspended solids were decreased by 90% and oxygen demanding wastes were decreased by 50%. Bottom deposits of sludge were replaced by slime and pollution tolerant insects. The river's habitat was recovering but still not up to water quality goals. The dissolved oxygen levels began to recover in the lower portion of the North Branch but were again depressed when it joined the South Branch. They then recovered in Pepperell Pond and remained good in the lower portion of the river. Temperature problems in the river were largely eliminated.

Recreational uses of the river remained impaired. Urban runoff and combined sewer overflows kept bacterial levels high on the North Branch. In the South Branch bacterial levels remained high until the Clinton Treatment Plant added chlorination to its treatment process. Start-up problems with this upgrade, however, contributed to toxicity problems in the river. The removal of sludge in the North Branch reduced aesthetic nuisance conditions considerably. The North Branch recovered considerably in its lower segment and even the turbidity from South Branch did not quell the recovery. Aesthetic problems are less severe in the Main Stem. However, as Pepperell Pond recovers from one type of pollution it becomes susceptible to another. The abundance of nutrients compiled in the sediments contributed to severe eutrophication of the pond. Nuisance vegetation, such as duckweed, covered the surface of the impoundment, impairing recreational uses.

In the Squannacook River, nutrients in the lower part of the river created some slight aesthetic issues. Faulty septic systems continue to be an issue. The Nissitissit River is referred to by DWPC in 1977 as one of the cleanest rivers in the state. Minor temperature and bacteria excursions from criteria are noted in the survey data.

In the Nashua River Watershed, the recovery from the 1970's is evident. Two segments, the South Branch above Clinton and the Main Stem below Pepperell Pond, are largely fishable and approaching swimmable. The rest of the river is still not fishable/swimmable but improvements are evident. The total weighted severity points for the system dropped from 1027.9 to 808.4; an over 20% improvement. The appearance of more green areas on the report card shows that most of these improvements were to the aquatic life use.

Nashua River Watershed Water Quality Early 1980's

Segment	South Nashua		North Nashua		Main Stem			Squannacook	Nissitissit
	Above Clinton WWTF	Below Clinton WWTF	Above Leominster WWTF	Below Leominster WWTF	Above Pepperell Pond	Pepperell Pond	Below Pepperell Pond		
AQUATIC LIFE									
Biology									
Dissolved Oxygen									
Temperature									
pH									
Nutrients									
Toxics									
Habitat									
Hydrology									
RECREATION									
Bacteria									
Aesthetics									
Fish Tissue									
Total Points	7	19	22	15	14	16	9	7	2
Segment Miles	3.0	1.6	9.6	9.9	13.5	8.8	3.7	14.3 (3.6)	4.5
Weighted Score	21	30.4	211.2	148.5	189	140.8	33.3	25.2	9
	Key		Water Quality		Severity Points		Total		808.4
		Good	0- no impacts						
		Fair	1- slight impacts						
		Poor	2- moderate impacts						
		Very poor	3- severe impacts						
		Not Assessed	data not available						

Water Quality in the Mid 1990's

The information for this report card comes from a comprehensive survey conducted in 1978 by the Massachusetts Division of Watershed Management, the Massachusetts Water Resources Authority, the Nashua River Watershed Association and the U.S Environmental Protection Agency.

In the South Branch, urban runoff causes slight problems above the Clinton treatment plant but problems below the plant persist because of lack of instream dilution and high nutrient loadings from the facility. Recreational uses continue to be impaired by urban runoff. Remarkably the North Branch, once the most polluted system in the Nashua Watershed, now has recovered to pollution levels equal to or below other portions of the river. This can be seen by examining the total severity points in the various segments. Above Leominster the Two Fitchburg Facilities have drastically reduced pollution in the river but the combined sewer overflow problems have not been addressed. The aquatic life is impacted by apparent instream toxicity; perhaps from a legacy of pollutants trapped in the sediments. Recreational uses are impaired by the bacteria, turbidity and odors from the combined sewer overflows. Below Leominster, nutrients from the treatment facility and continued impacts by combined sewers impair uses.

In the main stem of the river carry over pollution from the North and South Branches and high nutrient levels from the Ayer treatment facility contribute to water quality problems above Pepperell Pond. Within the pond recycling of nutrients creates a highly eutrophic condition with the water becoming choked with nuisance vegetation. This, in turn, lowered benthic dissolved oxygen and adversely affected aquatic life. Very poor aesthetic conditions adversely affected recreation. In terms of total severity points Pepperell Pond now becomes the most polluted segment of the river. Below Pepperell Pond carryover pollution from the pond and rapid flow fluctuations from the hydropower operation are sources of problems but these are characterized as slight.

Both the Nissitissit and the Squannacook Rivers have slight temperature and pH perturbations causing slight impacts to aquatic life. The water quality problems of the Nashua River are shifting from the impacts from paper companies and municipal wastewater on the North Branch to the

impacts of CSO's on the North Branch. CSO's were once ranked sixth most important source of pollution. These impacts carry over to the main stem of the river. Nutrients remain high through most of the watershed due to inadequate removal at municipal facilities and from the CSO's. The focus of abatement actions in the watershed is shifting from the North Branch to the Clinton facility and to Pepperell Pond. The weighted severity points for the watershed show an approximate 50 % reduction in pollution from the early 1970's; a remarkable achievement.

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Nashua River Watershed Water Quality Mid 1990's									
Segment	South Nashua		North Nashua		Main Stem			Squamcook	Nissittisit
	Above Clinton WWTF	Below Clinton WWTF	Above Leominster WWTF	Below Leominster WWTF	Above Pepperell Pond	Pepperell Pond	Below Pepperell Pond		
AQUATIC LIFE									
Biology									
Dissolved Oxygen									
Temperature									
pH									
Nutrients									
Toxics									
Habitat									
Hydrology									
RECREATION									
Bacteria									
Aesthetics									
Fish Tissue									
Total Points	5	10	10	7	10	12	6	3	3
Segment Miles	3.0	1.6	9.6	9.9	13.5	8.8	3.7	14.3	4.5
Weighted Score	15	16	96	69.3	135	105.6	22.2	42.9	13.5
	Key		Water Quality		Severity Points		Total		515.5
		Good	0- no impacts						
		Fair	1- slight impacts						
		Poor	2- moderate impacts						
		Very poor	3- severe impacts						
		Not Assessed	data not available						

Water Quality in the Early 2000's

The information for this report card comes primarily from the Massachusetts Department of Environmental Protection's 2003 Assessment Report or the Nashua River Watershed.

The South Branch above the Clinton wastewater facility was assessed as fishable/swimmable although there are some lingering concerns about flow releases from Wachusett Reservoir. Below the facility phosphorus concentrations are still high due to the discharge and there are slight impacts to recreational uses from urban runoff.

In the North Branch evidence of instream toxicity persists in the segment above Leominster, impairing aquatic life. Recreational uses suffer from the continued discharge of combined sewer overflows. Below Leominster nutrients levels are high due to municipal wastewater discharges and aesthetic concerns are derived from odors from CSO's. The severity points show that the pollution level on the North Branch is about a third of the level of the early 1970's.

In the Main Stem of the river nutrient levels remain high due to carry over from upstream sources and recycling from the sediments in Pepperell Pond. The adverse effect of these nutrients are largely shown in Pepperell Pond in the form of massive blooms of nuisance and nonnative vegetation. This condition impairs both the aquatic life and recreational uses of the waterbody. Pepperell Pond continues to be the focus of pollution issues in the river with other sections of the Main Stem generally reaching fishable/swimmable status.

The most recent fish sampling both the Squannacook and Nissitissit Rivers displayed a lack of cold water species. This is disturbing for these rivers are thought to be relatively pristine. Water quality monitoring revealed higher than desired temperatures for cold water populations. The source of this impairment is unknown and suspected sources include, dams, beaver activity or climate change.

The South Branch, North Branch and Main Stem of the Nashua River have undergone an approximate 70% reduction in pollution levels during the period of the early 1970's to the early

2000's - as demonstrated by the weighted score on the report cards. This dramatic reduction was largely brought about by the treatment of industrial and municipal wastewater mandated by the NPDES permit program. The problems that persist are largely due to high phosphorus levels and untreated CSO's. The phosphorus levels are from several municipal wastewater sources but adverse effects are largely exerted in Pepperell Pond. The CSO's are on the North Branch but effects carry over to the Main Stem.

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Nashua River Watershed
Water Quality Early 2000's

Segment	South Nashua		North Nashua		Main Stem			Squannacook	Missitissit
	Above Clinton WWTF	Below Clinton WWTF	Above Leominster WWTF	Below Leominster WWTF	Above Peppereil Pond	Peppereil Pond	Below Peppereil Pond		
AQUATIC LIFE									
Biology									
Dissolved Oxygen									
Temperature									
pH									
Nutrients									
Toxics									
Habitat									
Hydrology									
RECREATION									
Bacteria									
Aesthetics									
Fish Tissue									
Total Points	1	5	7	6	5	8	3	6	5
Segment Miles	3.0	1.6	9.6	9.9	13.5	8.8	3.7	14.3	4.5
Weighted Score	3	8	67.2	59.4	67.5	70.4	11.1	85.8	22.5
	Key		Water Quality		Severity Points		Total		394.9
					Good				
					Fair				
					Poor				
					Very poor				
					Not Assessed				
					0- no impacts				
					1- slight impacts				
					2- moderate impacts				
					3- severe impacts				
					data not available				

APPENDIX B: Special Designations in the Nashua River Watershed

by Warren Kimball

Outstanding Resource Waters (ORW's)

Outstanding Resource Waters are designated in the Massachusetts Surface Water Quality Standards [314 CMR 4.04(3)]. These waters are determined by the Massachusetts Department of Environmental Protection based on their outstanding socio-economic, recreational, ecological and/or aesthetic values. These are waters whose high quality will be protected and maintained. With minor exceptions new or increased discharges of pollutants are prohibited to these waters assuring that existing high water quality is preserved. In the Nashua River Watershed all public surface water supplies and their tributaries are designated as ORW's. In addition waters designated in the Squannacook and Nissitissit Rivers Sanctuary are designated as ORW's.

Coldwater Fisheries Resources (CFR's)

A Coldwater Fisheries Resource is a body of water that is used by coldwater fish species to fulfill one or more of their life history requirements. These species include trout and slimy sculpin, among others. These fish require cold, well oxygenated water and suitable habitat for spawning, feeding and refuges. These requirements make these habitats particularly sensitive to alterations or pollution. Changes in land and water use can reduce the ability of these waters to support coldwater fish. The Massachusetts Division of Fisheries and Wildlife identifies CFR's and maintains a list that is updated annually. Coldwater Fisheries are also designated in the Massachusetts Surface Water Quality Standards and are given more stringent Temperature and Dissolved Oxygen criteria than other inland waters. However, these regulations are updated less frequently and do not reflect the most recent information available from Fish and Wildlife. There are 90 CFR's in the Nashua River watershed but many are unnamed streams. It is a reasonable assumption that when a named waterbody is identified as a CFR, that its unnamed tributaries are also CFR's.

Areas of Critical Environmental Concern (ACEC's)

Areas of Critical Environmental Concern are designated by the Massachusetts Executive Office of Environmental Affairs pursuant to 301 CMR 12.00. ACEC's are those areas within the Commonwealth where unique clusters of natural and human resource values exist and which are worthy of a high level of concern and protection. The aim is to preserve and restore these areas and all EOEA agencies are directed to take actions with this in mind. Three ACEC's exist in the Nashua River Watershed. The Squannassit ACEC includes over 37 thousand acres on the west side of the Nashua River in Ashby, Ayer, Groton, Harvard, Lancaster, Lunenburg, Pepperell, Shirley and Townsend. The Petapawag ACEC includes over 25 thousand acres in Ayer, Dunstable, Groton, Pepperell and Tyngsborough on the east side of the Nashua River. The Central Nashua River valley ACEC contains nearly 13 thousand acres in Bolton, Harvard, Lancaster and Leominster. Although designated separately it is important state that the Nashua River corridor is a central feature of all three ACEC's.

The Squannacook and Nissitissit Rivers Sanctuary

The Massachusetts General Laws Chapter 132A, Section 17 establishes the Squannacook and Nissitissit Rivers Sanctuary (SNRS). The sanctuary comprises the surface waters of both rivers and their tributaries. A small section of the Squannacook River is excluded: from the Hollingsworth and Vose Dam to the confluence with the Nashua River. In these waters no new discharge of treated or untreated sewage or other wastewater is permitted. Storm water discharges and conveyances must be approved by the planning board and conservation commissions of the affected towns. The Attorney General has the authority to enforce these rules. This sanctuary was subsequently designated as an ORW in the Surface Water Quality Standards underscoring the desire to preserve these waters.

APPENDIX C: Special Designations of MA Rivers and Tributaries

MA State recognition of Rivers entirely or partially within the proposed Wild & Scenic Designation						
Stream Name	Miles	ORW	CFR	ACEC	Sanctuary	Other
Nashua River	30.5			X		
Unkety Brook	6.5		X	X		
Reedy Meadow Brook	2.2		X	X		
Nissitissit River	4.2	X	X	X	X	
Mine Brook	0.5	X	X	X	X	
Sucker Brook	3.7	X	X	X	X	
Beaver Brook	0.1	X		X	X	
Gulf Brook	2.5	X	X	X	X	
Stewart Brook	2.1	X		X	X	
Varnum Brook	0.9			X		
Greens Brook	1.3			X		
Robinson Brook	1.7			X		
Bancroft Brook	2.2			X		
Wrangling brook	2.3			X		
Dead River	0.8			X		
James Brook	4.3			X		
Squannacook River	14.1	X	X	X	X	
Trap Swamp Brook	0.6	X		X	X	
Pumpkin Brook	2.0	X		X	X	
Witch Brook	2.8	X		X	X	

Stream Name	Miles	ORW	CFR	ACEC	Sanctuary	Other
Trout Brook	1.6	X		X	X	
Bixby Brook	2.3	X		X	X	
Bayberry Hill Brook	1.9	X	X	X	X	
Mason Brook	1.5	X	X	X	X	
Walker brook	2.5	X		X	X	
Willard Brook	5.6	X		X	X	
Pearl Hill Brook	6.3	X	X	X	X	
Locke Brook	4.3	X	X	X	X	
Trapfall Brook	5.0	X	X	X	X	
Mulpus Brook	9.5		X	X		
Nonacoitcus Brook	1.4			X		
Willow Branch Brook	1.4			X		
Cold Spring Brook	1.2			X		
Bowers Brook	6.3					
Walker Brook	1.9		X			
Morse Brook	1.4		X			
Trout Brook	1.3					
Catacoonamug Brook	5.4		X			
Still River	3.3		X	X		

APPENDIX D: List of Canoe Launches by Town

Directions and descriptions of these launch sites can be found in the NRWA Canoe and Kayak Guide. View launch locations and directions on Google map. [hyperlink to google map]

Massachusetts

Devens

On the Nashua River

Hospital Road/Oxbow National Wildlife Refuge Launch

Groton

On the Nashua River

Nashoba Paddler Private Launch

Petapawag Boat Launch

On the Squannacook River

West Groton Water Dept. Launch

Harvard

On the Nashua River

Still River Depot Road/ Oxbow National Wildlife Refuge Launch

Lancaster

On the Nashua River

Rt. 117/Seven Bridge Road Launch

On the North Nashua River

North Main Street Launch

Pellechia Canoe Launch

Main Street Bridge/Rt. 70 Launch

Pepperell

On the Nashua River

Rt. 119 Car-top Only Launch

Kemp Conservation Area Launch (future status unclear as of 2016)

Canal Street Launch

Downstream of Pepperell Dam Launch

On the Nissitissit River

Prescott Street Bridge Launch

Shirley

On the Nashua River

Walker Road Upstream of Ayer Ice House Dam Launch

Walker Road Downstream of Ayer Ice House Dam Launch

Sterling

On the Stillwater River
Moore's Corner Launch

Townsend

On the Squannacook River
Stone Bridge/Canal Street Launch
Off Elm Street Launch
Harbor Pond Church (above Harbor Pond Dam) Launch
Rt. 119/Main Street (below Harbor Pond Dam) Launch

New Hampshire

Brookline

On the Nissitissit River
Bond Street Launch
Rt. 13/Fire Road Launch
South Main Street Bridge Launch

Hollis

On the Nashua River
Rt. 111/Depot Road at Runnells Bridge

On the Nissitissit River
West Hollis Road Launch

APPENDIX E: Archaeological Sites in the Former Fort Devens Area

As of 2013 there were 20 recorded pre-contact Native American archaeological sites within the former Fort Devens section of the Nashua River drainage. All of these sites were identified as a result of local collector activities going back to the early 1940s and CRM investigations conducted within the former Fort Devens lands in the past two decades. These sites include five areas along the Catacoonamaug Brook near its confluence with the Nashua River, which represent probable short-term, task-specific occupations, and two sites along Nonacoicus Brook near its confluence with the Nashua River, which may be larger year-round base camps. Based on the data collected through avocational activities, academic archaeological studies, and cultural resource management (CRM) surveys, generalizations about site types and distribution within the Nashua River drainage can be made. Archaeological and documentary evidence of pre-contact settlement patterns and land use in the Nashua River valley spans the earliest human occupations during the PaleoIndian Period (ca. 10,000 years before present [B.P.]) through the Late Woodland (ca. 1000 B.P.) and contact (ca. 400 B.P.) periods. Native American populations appear to have exploited the diverse natural resources of the Nashua River valley. Settlement/land use patterns associated with temporal periods or specific cultural groups consisted of sites of varying internal complexity and size. These include large base camps, as well as less complex sites of various sizes used temporarily during hunting or other foraging and resource collection activities and lithic manufacture.

Also as of 2013 there were 89 recorded post-contact Euro-American archaeological sites within the former Fort Devens section of the Nashua River in the towns of Ayer, Harvard, Shirley, and Lancaster. Most of these sites appear on eighteenth and nineteenth century town maps and consist of residential home-farmsteads related to former villages and neighborhoods. For example, the lands on the east side of the Nashua River on the former Fort Devens Main Post were formed from lands situated in the northwestern portion of the town of Harvard, historically known as the Shabikin District. This historic neighborhood was on the periphery of the principal civic-institutional and manufacturing village centers in the town and attempted to succeed to the town of Shirley in the mid-1700s. It contained scattered home-farmsteads during the eighteenth and nineteenth-centuries, most of which were still standing at the time of military acquisition for the formation of Camp Devens in 1917. In addition to recorded residential and small-scale industrial (mill) sites, expected types of undocumented early Euro-American sites in this same general area could include scattered farmsteads, garrison houses, fur trading posts (locally known as truck houses), and saw/gristmill features. The archaeological remains of such sites would typically consist of cellar holes and dry-laid fieldstone foundations related to wood-frame structures, privies, wells, animal pens, dams, wheel pits, tail and head races, and associated artifact assemblages (domestic, architectural, and/or trade-good items).

Suzanne G. Cherau, MA, RPA
Senior Archaeologist/Principal Investigator

APPENDIX F: EXPERTS CONSULTED

Anne Gagnon - Dept. of Fish & Game Northeast District Land Agent MA Division of Fisheries & Wildlife

Lynn Harper Habitat Protection Specialist Natural Heritage & Endangered Species Program MA Division of Fisheries & Wildlife

Adam Kautza, PhD Coldwater Fisheries Project Leader MA Division of Fisheries & Wildlife

Todd Richards Assistant Director of Fisheries MA Division of Fisheries & Wildlife

Warren Kimball – former MA DEP

Michael Fleming – former MA DCR

Betsy Colburn, Ph.D. - Aquatic Ecologist at Harvard Forest

Libby Herland – former Project Leader at U.S. Fish and Wildlife Service, Eastern Massachusetts NWR Complex including Oxbow National Wildlife Refuge

Michael Jones - MA state herpetologist

Larry Anderson – Author of Benton MacKaye: Conservationist, Planner and Creator of the Appalachian Trail

Jeffrey Barbaro - Chief Groundwater Hydrology Studies, USGS New England Water Science Center

Michael Roberts – Timelines, Inc.

Bobbie Spiegelman – Groton Historical Society

Martha Remington – Bolton Historical Society

Tim Red Loon Kelly - Lead Singer, Big Hill Singers, Nipmuk Tribe

Suzanne Cherau, MA, RPA - Senior Archaeologist/Principal Investigator The Public Archaeology Laboratory, Inc. Cultural Resource Management

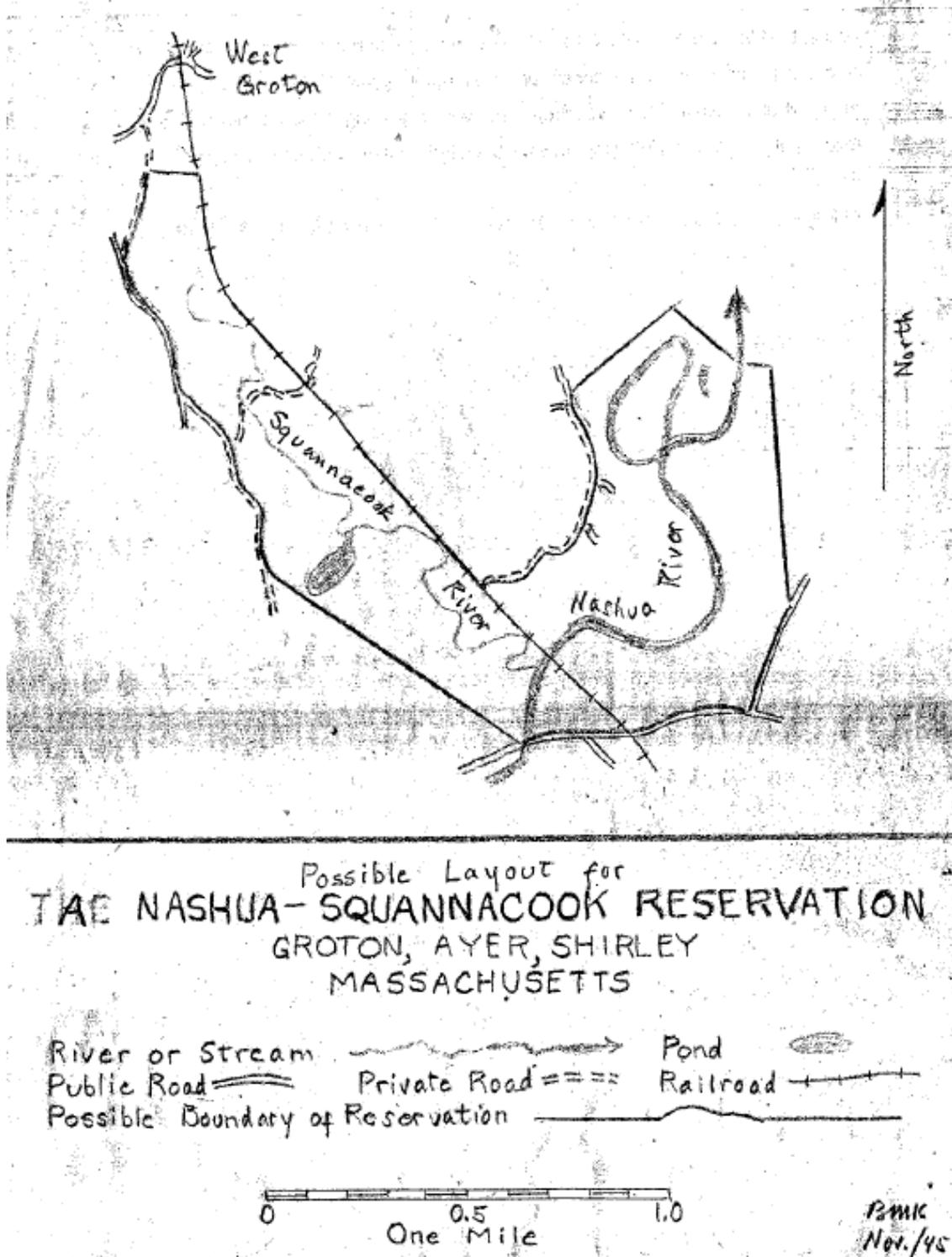
Robert Pine – Pine& Swallow, Principal

APPENDIX G: Existing Protected Conservation Areas

River Segment	Protected Area	Acreage	Features
Nashua Mainstem	Bolton Flats WMA	~1,335	“...extends along the Nashua River in Harvard, Lancaster, and Bolton. The river here is slow and meandering, with adjacent High-Terrace Floodplain Forest and Low-Energy Riverbank. The combination of a slow river, floodplain forest, and dry sand makes for excellent turtle habitat. In fact, 3 state-listed rare turtle species Blanding's Turtles, Wood Turtles, and Spotted Turtles have all been documented from this stretch of river.” Also see www.mass.gov/eea/agencies/dfg/dfw/wildlife-habitat-conservation/habitat-restoration-key-sites.html#bolton
	Oxbow National Wildlife Refuge	~1,667	“...particular value in carrying out the national migratory bird management program....” along nearly 8 miles of the Nashua River, the Refuge's interspersed wetland, forested upland and old field habitats is ideally suited for this purpose. There are a number of non-contiguous sections in Shirley, Ayer, Harvard & Lancaster on both sides of the river, some of which was acquired as part of the decommissioning of portions of Fort Devens. Rare species. Hunting & the fact that the Refuge has different rules (no dogs, etc...)
	Portion of Mulpus Brook WMA	124-acres portion of 517-acre total	Mulpus Brook is an important cold-water tributary to the Nashua. However, note that the majority of Mulpus Brook WMA is outside the ¼ mile corridor of the Nashua River.
	J. Harry Rich State Forest	~679	“...along the Nashua River is a wooded with broad level trails for easy walking. It offers excellent views of the river and surrounding area as it winds along the banks” through a portion of which linear Nashua River Rail Trail passes. One of the few state-owned tree farms in the nation and one of the first such in MA....and described as “...the most intensively managed forest acreage in New England”. www.nashuariverwatershed.org/recreation/hiking-walking.html
	Groton Town Forest	~513	“...provides protection for the watershed, educational activities, recreation, and wildlife habitat...created by vote of the Town Meeting in 1922, was among the first dozen such town forests in the Commonwealth”. As part of the Surrenden Farm protection effort, the town of Groton granted the MA Dept of Fish & Game a Conservation Restriction on the Groton Town Forest, thereby opening it up to hunting and permanently protecting it as open space.
	Sabine Woods and Groton Place (abutting properties)	~146 and ~54, respectively	“...owned and managed by the New England Forestry Foundation (NEFF), is a former estate featuring open fields and river vistas, broad trail.... with ~1,800 feet of frontage on the east side of the Nashua River...proclaimed "Wild Life Sanctuary for The Benefit and Pleasure of the People of Groton”.
	Ayer Game Farm & MDF&W NE Headquarters	~116 91 + 15.7	Previously used to raise pheasants for stocking, this property is now used as offices for the DFW Office of Fishing & Boating Access. This property directly abuts the Groton Town Forest and Surrenden Farm. Another section abuts the DFW Northeast District Headquarters.

	Surrenden Farm/General Field	~325	Sitting prominently in a 1,500-acre block of contiguous protected open space, 360-acre Surrenden Farm was Groton's highest conservation priority until it was purchased by the town and several conservation organizations in 2006. With 3/4 mile of Nashua River frontage, forest and scenic rolling hayfields, Surrenden Farm had been one of the largest remaining unprotected landscapes in town. The General Field is 143 acres of agricultural land that has survived since early colonial times. DFW has a CR on 10 acres of Groton Water Dept. land and a Conservation Restriction on 159 acres on Surrenden Farm West.
	Unkety Brook WMA	Portion = 185 acres of a total of 527 acres	In Dunstable and Pepperell a 185-acre portion of the Unkety Brook WMA is located along the eastern bank Nashua River. These parcels lie between the river and DCR's rail trail, providing important wildlife habitat south of the confluence of Unkety Brook with the Nashua.
Nissitissit	Nissitissit River WMA	~447 acres 22 parcels acquired from 1974 to 2017	Very popular for catch and release, hunting, bird watching, and hiking on abandoned rail bed which runs along the river. The section of the river from the NH border to the Prescott bridge in Pepperell is one of only 9 designated catch & release areas in the state. In addition, in this section anglers must use a conventional fly rod and fly line. The former Turner dam was removed in 2015, benefitting fish passage and restoring coldwater habitat.
Squannacook	Squannacook River WMA, WCR and WCE	~1,934 comprised of 1,641 in fee, 49 parcels from 1965 to 2017	This non-contiguous WMA extends from Shirley through Groton & Townsend to Ashby, consisting of almost 50 different fee-owned parcels. The Squannacook WCR is a 68-acre donated restriction on development of the South Fitchburg Hunting & Fishing Club that does not allow public access. The Squannacook WCE consists of 4 Conservation-Restricted parcels totaling 299 acres which are open to the public, 2 in Shirley at the confluence with the Nashua and 2 in Townsend, 1 of which is located in the headwaters. (2,008 total)
	Townsend State Forest	~3,082	Non-contiguous parcels owned by the MA Dept. of Conservation & Recreation. Portions are located across the river from & adjacent to portions of the Squannacook River WMA, while other large blocks extend away from the river to the NH border & include many small tributaries to the river & hiking trails.
	Willard Brook State Forest	~2,930	
	Bertozzi Conservation Area	~56 (42 acres in Groton and 14 acres are across the river in Shirley)	Municipal land adjacent to state Squannacook River WMA; popular swimming hole.

APPENDIX H: "Possible Layout for a Nashua-Squannacook Reservation"



APPENDIX I: SUMMARY OF PUBLIC OUTREACH EVENTS & FORUMS

Paddle on the Nashua River



Photo: Cindy Knox

Join Nashua River Wild and Scenic Study Committee members on a free paddle. Pre-registration required.

Monday October 16 — 4:00 to 5:30 PM
(Raindate in case of inclement weather Wednesday October 18)

Nashua River launching from Nashoba Paddler, LLC
398 West Main Street, Groton, MA 01450

The one-mile stretch of the river we will paddle passes by Groton Place/ Sabine Woods, Groton Town Forest, Groton School boat house, Surrenden Farm, Dead River and more. Join other local officials in learning about the "Outstandingly Remarkable Resource Values" (ORRV's) on the Nashua to see first-hand and up-close the many that make our rivers eligible for National Park Service Wild & Scenic status. There is perhaps no better way to appreciate these ORRV's than from a boat on the river itself. This is a unique opportunity to get acquainted with our rivers' natural, cultural, historic, recreational and scenic characteristics in the company of one's municipal colleagues and counterparts. This is a great time of year to paddle on an exceptionally undeveloped stretch of river to explore. Beginner paddlers & those who have never paddled here before are welcome.

The paddle will begin promptly at 4:00 P.M. and last about 90 minutes (please arrive early to sign liability forms & hear boat safety/paddle instructions). The paddle is free, but registration is required and spaces are limited to two per town first come first served. To register: contact your Town Administrator. Please direct questions to Al Futterman at alf@NashuaRiverWatershed.org or (978) 448-0299



Nashua, Squannacook & Nissitissit Rivers Should Receive 'Wild & Scenic' Protection

by Mary J. Minger
Members of the eight-town study committee are hoping through their task of documenting for the US Congress why portions of the Nashua River and its tributaries, the Squannacook and Nissitissit, should be designated Wild and Scenic Rivers. They shared an update of their findings and provided a "tasting" experience with the general public April 27 at the Nashua River Watershed Association's "River Experience" at the Groton School.

The Nashua River and Scenic Rivers Act originally protected rivers just as listed lands in the West," said Jamie Fothergill, from the National Park Service who has been "Swain Leader" for the Wild and Scenic Rivers Program in the East for the past 25 years.

"That began as an experiment of using local personnel to study and manage for the rivers in the East has become a proven process that works. This very flexible system allows local communities to plan and manage their own rivers' river resources."

After the Boards of Selectmen of Andover, Chatham, Groton, Harvard, Lancaster, Shelton, Townsend and Townsend voted to endorse the study, Congress authorized it in December 2004. Congressman Niki Tsongas publicly announced the study in January 2015. Each Board of Selectmen has a representative on the study. Other working members come from the Groton Park Service and Nashua River Watershed Association. "The committee has been meeting monthly, interviewing regional resource experts to find the Outstandingly Remarkable Resource Values (ORRV's) of the river system. There are extremely wide-ranging values. Over 300,000 people use the Nashua River and find every year. The Squannacook and Nissitissit rivers provide valuable recreational opportunities. The area has some of the best trout water and warm water fishing. It provides opportunities for boating and fishing and the enjoyment of the river's banks. The Watershed Association is the lead organization. The study also provides educational opportunities.

The study committee will work to come up with a Management Plan to protect these river resources. Each town will need to approve their plan before they can be submitted to Congress. If Congress approves the Wild and Scenic designation, a local Advisory Committee would be established to oversee any development, which traditionally have occurred in several phases.

These have a very flexible and flexible. They can be used for land acquisition, education, recreation, or whatever the priorities of the local management committee and the community.

A Wild and Scenic River designation does not affect local laws and regulations. It does permit any building of new hydroelectric dams on the river. And it allows the local committee to have input on any federal projects that might damage or affect the river. It can provide access to other grant monies and support regional

Do you enjoy recreating on or near our local rivers?
Come share your thoughts...we'd like your input to our "Wild & Scenic River" Study for the Nashua, Squannacook & Nissitissit Rivers

Tuesday October 24, 2017 from 7:00 to 8:30PM
Nashua River Watershed Association, 592 Main Street in Groton MA

The Nashua River Wild & Scenic Study Committee invites you to a public input meeting oriented to river sports enthusiasts & recreational users including anglers, canoeists, hikers, hunters, kayakers, etc....you know who you are!

One of the several "Outstandingly Remarkable Resource Values" that make our three rivers eligible for National Park Service Wild & Scenic status is our recreational opportunities: no one knows these values better than you do. If you share your knowledge & insights with us at this meeting our draft Management Plan will be enhanced: come tell us what you know that is unique & special, & what can be improved.

If you cannot attend please contact us at any time to offer your comments.
For more information see: www.WildandScenicNashuaRivers.org
Refreshments will be served.

Pre-registration requested, but not required.
To register, email alf@NashuaRiverWatershed.org or call (978) 448-0299.

Let's Protect The Nashua, Squannacook & Nissitissit Rivers

- The National Park Service Partnership Wild and Scenic Rivers Program is dedicated to protecting nationally significant river resources through locally based partnerships.
- Legislation sponsored by U.S. Congresswoman Niki Tsongas was signed into law on December 19, 2014 which authorized the study.
- The Nashua, Nissitissit, and Squannacook Rivers are an essential part of our region's culture, character, and history. They are also an essential part of our future.
- Currently, eight Massachusetts communities along the Nashua, Nissitissit, and Squannacook Rivers are working together on a planning process with local groups and state & federal agencies. Our mission is to craft a vision for the future of these rivers, to consider their eligibility and suitability, to be part of the National Wild & Scenic River System, and to determine how these rivers should best be managed in order to protect water quality and outstanding values such as biological diversity, recreation, and cultural & historical resources.
- Upon completion of the three-year planning process, if participating communities vote affirmatively, the US Congress will be asked to designate the rivers as Partnership Wild and Scenic Rivers.
- This process will result in the formation of strong local partnerships and will build public awareness, appreciation of these rivers, and support for the voluntary, locally based management plans to be developed as part of the study. The goal is to protect our shared outstandingly remarkable resources for the future as well as attract public and private funding to enhance public enjoyment of these rivers.

River featured by the Nashua River Wild & Scenic River Study Committee 8.5.16
For more information about the Study Committee and its planning work contact:
Al Futterman alf@NashuaRiverWatershed.org
Nashua River Wild and Scenic Association 592 Main Street Groton, MA 01450
(978) 448-0299 www.NashuaRiverWatershed.org
For more information about NPS Wild & Scenic Rivers see: www.nps.gov/pwr/

Squannacook

The Squannacook River is a 16.4-mile-long river in northern Massachusetts. It is a tributary of the Nashua River. Its subbasin covers 73 square miles. Currently, 16.4 miles of the Squannacook are included in the Study Area.

Nashua

The Nashua River is a 37.5-mile-long river in Massachusetts and New Hampshire and is a tributary of the Merrimack River. Its watershed covers 66 square miles. Currently, ~23 miles of the Nashua are included in the Study Area.



"WILD AND SCENIC" NASHUA RIVERS STUDY COMMITTEE PUBLIC UPDATE AND INPUT SESSION

When: Thursday, April 27, 2017 from 7:00 to 9:00 p.m.

Where: NRWA's River Resource Center, 592 Main Street (Rt. 119) in Groton, MA

What: Do you think that the history of the Nashua River's restoration, from one of the ten most polluted rivers in the 1960s to the sparkling river today, is remarkable? Do you like to fly fish and you find the cold water fisheries of the Squannacook and Nissitissit Rivers outstanding? Are you amazed at the diversity of turtles, birds, plants, and unique habitats that are found in and around our rivers? When you paddle on the Nashua, Squannacook, or Nissitissit River, do you feel revitalized?

The Nashua River "Wild and Scenic" River Study Committee invites you to join a public conversation on April 27th to discuss our rivers' cultural history, outstanding biological and ecological resources, and extensive recreational opportunities.

The locally-appointed Study Committee was formed after the U.S. Congress passed legislation authorizing the National Park Service to commence a study of sections of the Nashua, Squannacook, and Nissitissit Rivers to determine if they are eligible and suitable for designation as part of the Federal Partnership Wild and Scenic River Program. Appointees to the Study Committee come from eight riverfront towns: Ayer, Dunstable, Groton, Harvard, Lancaster, Pepperell, Shirley, and Townsend. The Nashua River Watershed Association is playing a lead role along with the National Park Service. The Committee also includes representatives from the US Fish & Wildlife Service, the MA Department of Fish & Game, the MA Division of Ecological Restoration, USGS, and volunteers.

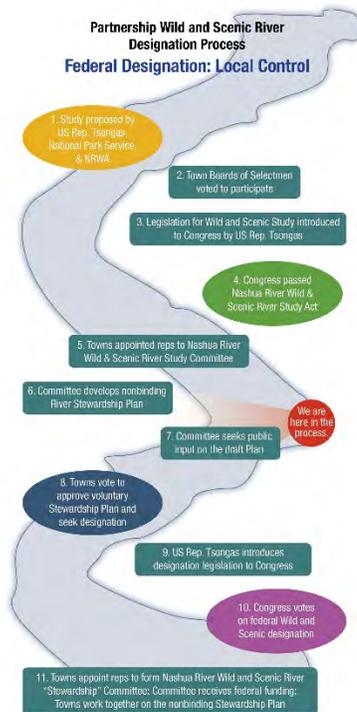
Committee members are combing through any and all pertinent local, regional, state, and federal records, reports, historical documents, and related data to clarify which resources are considered "outstanding and remarkable"— all to help make the case for the federal designation of "Wild and Scenic."

Those attending the April 27th event will hear about the Committee's findings to date and also have the opportunity to share thoughts on the findings and suggest additional resources that may have been overlooked so far. The Study and designation process will be explained and next steps outlined.

RSVP: RSVP requested for planning, though walk-ins are welcome. RSVP to Al Futterman, NRWA Land Programs and Outreach Director, at 978-448-0299 or email al@NashuaRiverWatershed.org.

Learn more: www.WildandScenicNashuaRivers.org

Photos left to right: Nashua River, Squannacook River, and Neesabot River, by Cindy Kilar Photography.



**The Groton Line
Nashua Study Takes the River A Step Closer to Wild & Scenic**

By Art Campbell
Jan132015



Carolyn Perkins
Congresswoman Niki Tsongas, NRWA founder Marion Stoddart and Executive Director Elizabeth Ainsley Campbell

The Nashua River took another step toward becoming a national "Wild and Scenic River" Monday, when Congresswoman Niki Tsongas and representatives of local conservation organizations announced the passage and signing of the Nashua River Wild and Scenic River Study Act.

Tsongas backed a reconnaissance survey by the National Park Service that gave the Nashua a thumbs up, qualifying it for this study. According to a June, 2014 letter to Congresswoman Tsongas from the Department of the Interior: "the elements for a

Do you know and care about the biological, historical and cultural resources on or near our local rivers?
Come share your thoughts...we'd like your input to our "Wild & Scenic River" Study for the Nashua, Squannacook & Nissitissit Rivers



Tuesday November 28, 2017 from 7:00 to 9:00 PM
(focused on **Biological Diversity** resources)

AND
Wednesday November 29, 2017 from 7:00 to 9:00 PM
(focused on **Historical and Cultural** resources)

EACH HELD AT
Nashua River Watershed Association, 592 Main Street in Groton MA

The Nashua River Wild & Scenic River Study Committee invites you to a public input meeting for those who wish to comment on our draft Management Plan. Specifically, two of the "Outstandingly Remarkable Resource Values" that make our rivers eligible for National Park Service Wild & Scenic status are the "biodiversity," and "historic and cultural" resources. Attend the evening that has the focus you are interested in or both. If you share your knowledge & insights with us at these meetings our Plan will be enhanced: come tell us what you know that is unique & special, and what can be improved.

If you cannot attend please contact us at any time to offer your comments.



Pre-registration requested, but not required.
To register, email Al Futterman at al@NashuaRiverWatershed.org

Refreshments will be served. See our website: www.WildandScenicNashuaRivers.org

Table 1
Nashua River Watershed
Water Use Classifications

Segment Number	Description	River Miles	Classification			Early 1970's Condition
			1967	1974	1978	
1	South Branch Outlet Lancaster Mill Pond, Clinton, to Clinton WWTF, Clinton	3.0	B B	B		U
2	Clinton WWTF to confluence with North Nashua River, Lancaster	1.6	C B	B1		U
3	North Branch Fitchburg Paper Co. Dam #1, Fitchburg to Leominster WWTF, Leominster	8.4	C B	C		U
4	Leominster WWTF to confluence with the Main Stem Nashua River, Lancaster	9.9	C B	C		U
5	Main Stem Nashua River Confluence of North and South Branches, Lancaster to Confluence with Squannacook River, Shirley/Groton	13.5	C B	B1		U
6	Confluence with Squannacook River to Pepperell Pond Dam, Pepperell	8.8	C B	B1		U
7	Pepperell Pond Dam to New Hampshire State Line	3.7	C B	B1		U
8	Squannacook River Entire length	14.3	B/C B	B/B1		B/C
9	Nissitissit River Massachusetts portion	4.5	B B	B		B

Table 2
Nashua River Report Card
Severity Point Criteria

Indicator	1 slightly impacted	2 impacted	3 severely impacted
I. Aquatic Life			
A. Biology Invertebrates	Diversity-medium Density- low/medium 54-79% reference	Diversity-low Density- medium/high 21-50% reference	Diversity- low/absent Density-high/absent 17% reference
B. Chemistry Baseline Dissolved Oxygen minimum daily average Temperature maximum weekly average pH standard units	< 5.0 mg/l < 75% saturation > 80.6°F >75 °F 6.0-6.5 or 8.0-8.5	< 3.0 mg/l < 5.0 mg/l >83°F >77°F 5.5-6.0 or 8.5-9.0	< 2.0 mg/l > 90 °F < 5.5 > 9.0
Nutrients Total Phosphate-P	> 0.05 mg/l	> 0.10 mg/l	> 0.20 mg/l
Toxics Ammonia-N	> 0.5 mg/l	> 1.0 mg/l	> 2.0 mg/l
Sediments	> threshold effects	> probable effects	> 2 x probable effects
C. Hydrology	Criteria not available-BPJ		
D. Habitat Suspended Solids Sludge Deposits	> 10 mg/l rare	> 25 mg/l occasional	> 80 mg/l common
II. Recreation			
A. Bacteria (Geometric mean) Total Coliform Fecal Coliform E. coli	> 1000/100 ml > 200/100 ml > 126/100 ml	> 5,000/100 ml > 1000/100 ml > 630/100 ml	> 10,000/100ml > 2,000/100ml > 1260/100 ml
B. Aesthetics Color/odor/turbidity Nuisance conditions	rare	occasional	common
C. Fish Flesh	Limited Advisory	Full Advisory	Best Professional Judgment (BPJ)

Table 3 – Historic Flood Crests

**Nashua River Historic Crests
(flood stage = 8)**

- (1) 19.10 ft on 03/20/1936
- (2) 16.19 ft on 04/07/1987
- (3) 15.75 ft on 03/17/2010
- (4) 14.08 ft on 09/23/1938
- (5) 13.78 ft on 04/01/2010
- (6) 13.10 ft on 04/18/2007
- (7) 11.86 ft on 06/26/1944
- (8) 11.77 ft on 03/20/1968
- (9) 11.73 ft on 06/02/1984
- (10) 11.40 ft on 06/08/1982
- (11) 11.02 ft on 10/17/1956
- (12) 10.81 ft on 04/03/2004
- (13) 10.75 ft on 04/06/1960
- (14) 10.56 ft on 03/08/1979
- (15) 10.38 ft on 02/28/2010
- (16) 10.26 ft on 04/18/1996
- (17) 10.16 ft on 10/22/1996
- (18) 10.10 ft on 04/01/1993
- (19) 9.95 ft on 04/03/1962
- (20) 9.88 ft on 03/21/1983
- (21) 9.85 ft on 09/13/1954
- (22) 9.76 ft on 03/12/1998
- (23) 9.64 ft on 03/09/2011
- (24) 9.51 ft on 03/24/2001
- (25) 9.38 ft on 05/16/2006
- (26) 9.21 ft on 04/02/2014
- (27) 9.06 ft on 04/05/2005
- (28) 9.00 ft on 10/17/2005
- (29) 8.95 ft on 04/24/2000
- (30) 8.90 ft on 03/17/1953
- (31) 8.79 ft on 03/10/1942
- (32) 8.63 ft on 04/04/1959
- (33) 8.52 ft on 03/31/2005
- (34) 8.43 ft on 03/10/2008
- (35) 8.23 ft on 06/16/1998
- (36) 8.23 ft on 04/04/1970
- (37) 8.20 ft on 12/14/2008
- (38) 8.18 ft on 03/25/2010
- (39) 8.17 ft on 03/17/1986
- (40) 8.15 ft on 03/23/1948

**Squannacook River Historic Crests
(flood stage = 7)**

- (1) 8.50 ft on 04/17/2007
- (2) 8.16 ft on 04/06/1987
- (3) 8.07 ft on 04/02/2004
- (4) 8.04 ft on 10/16/1955
- (5) 8.03 ft on 03/15/2010
- (6) 7.62 ft on 10/21/1996
- (7) 7.56 ft on 03/31/2010
- (8) 7.46 ft on 04/17/1996
- (9) 7.41 ft on 03/20/1983
- (10) 7.32 ft on 01/10/1956
- (11) 7.31 ft on 02/26/2010
- (12) 7.30 ft on 04/01/1987
- (13) 7.22 ft on 03/14/1977
- (14) 7.21 ft on 04/06/1984
- (15) 7.21 ft on 03/08/2011
- (16) 7.07 ft on 05/15/2006
- (17) 7.00 ft on 09/12/1954

List of Maps:

Within the text:

Figure #:

Figure #:

Fold out maps at the end of this Plan:

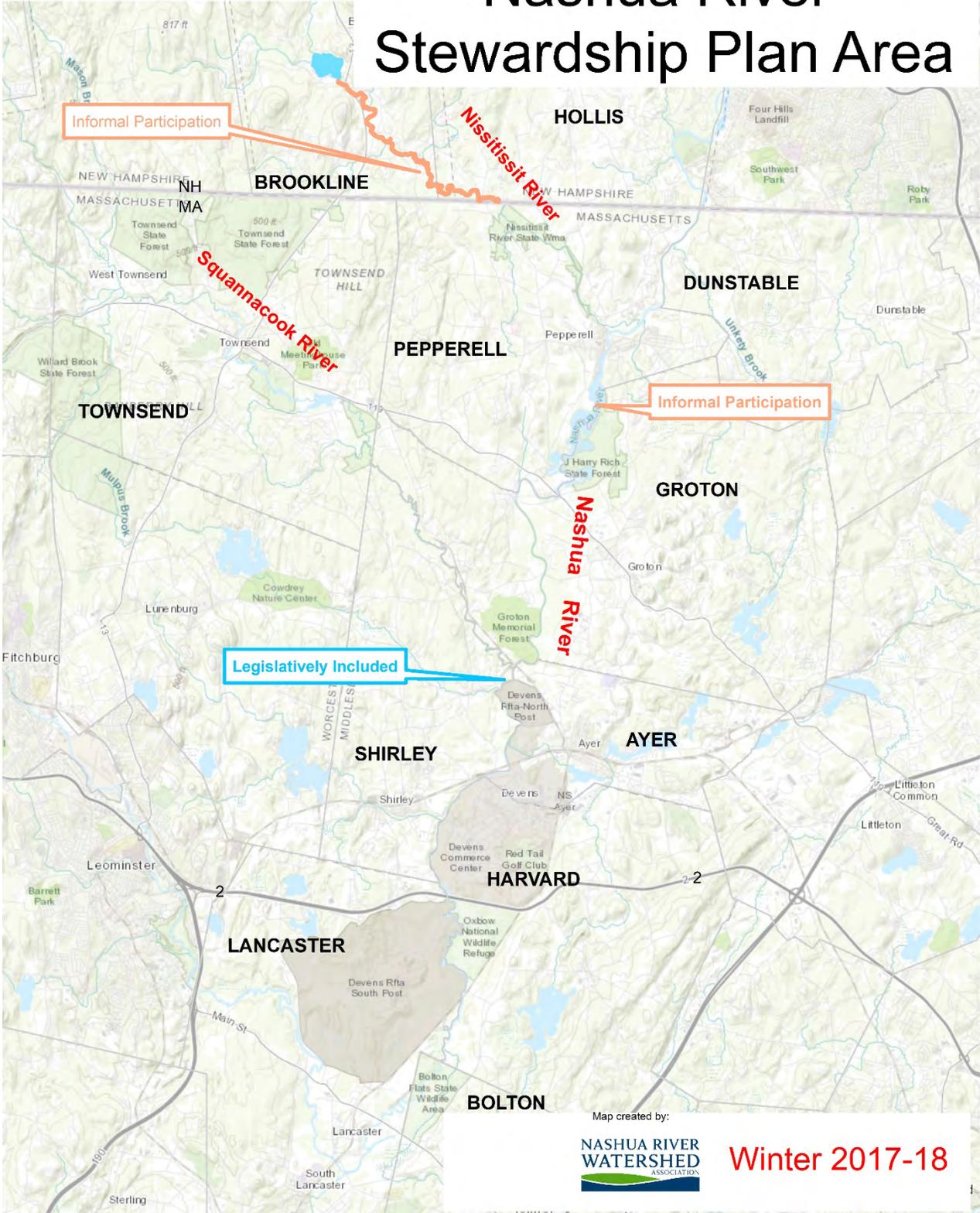
Study Area Map

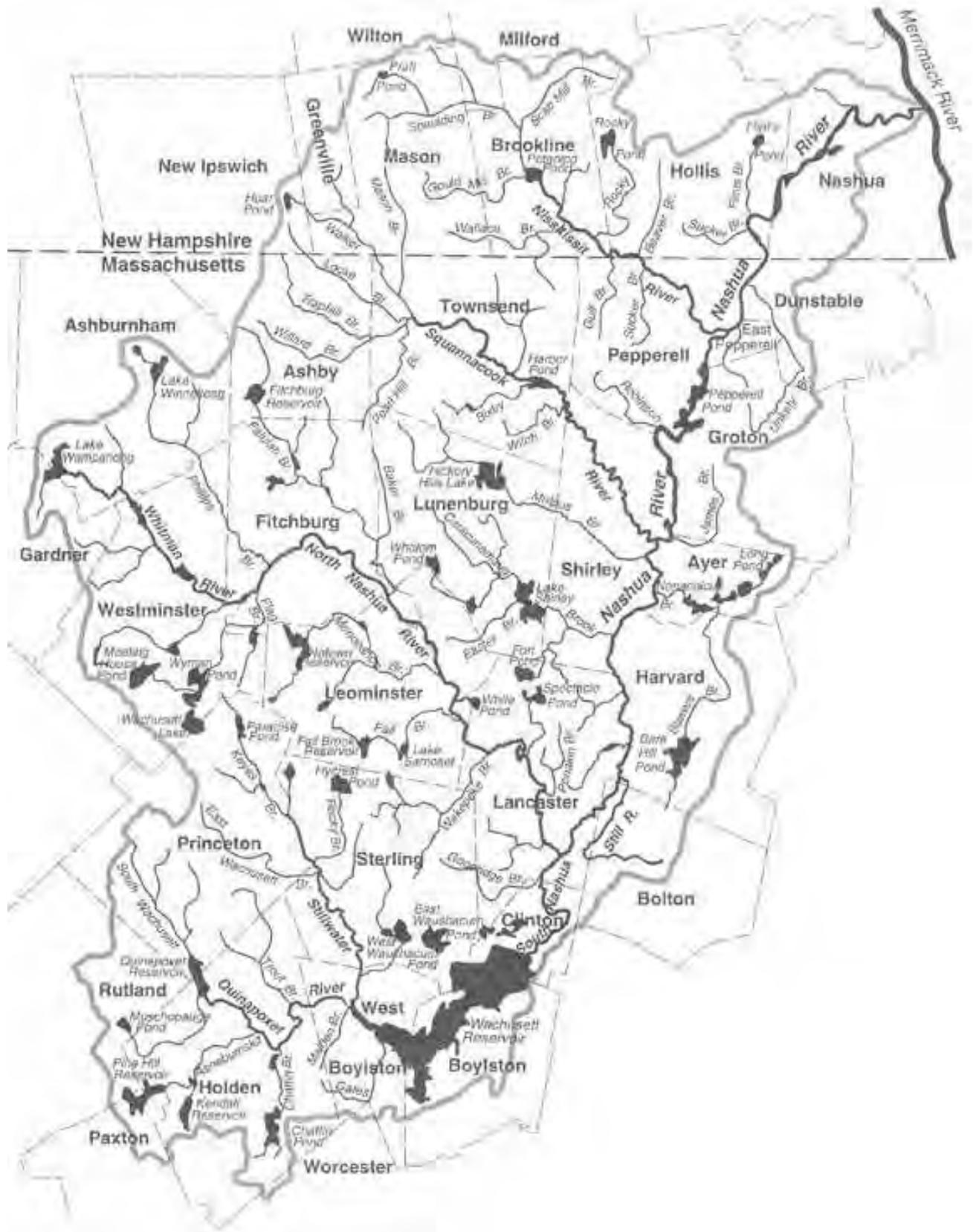
ORRV #1 Map

ORRV #2 Map

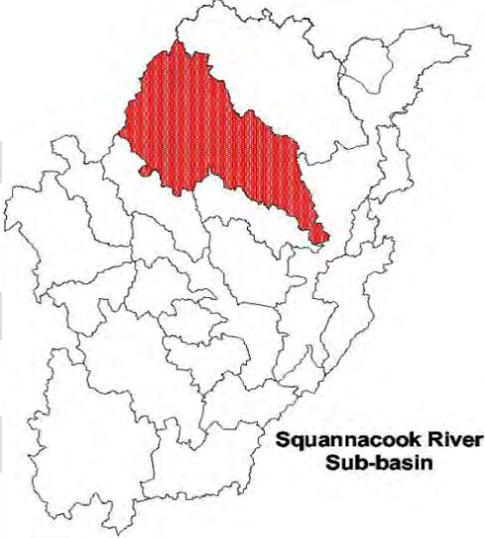
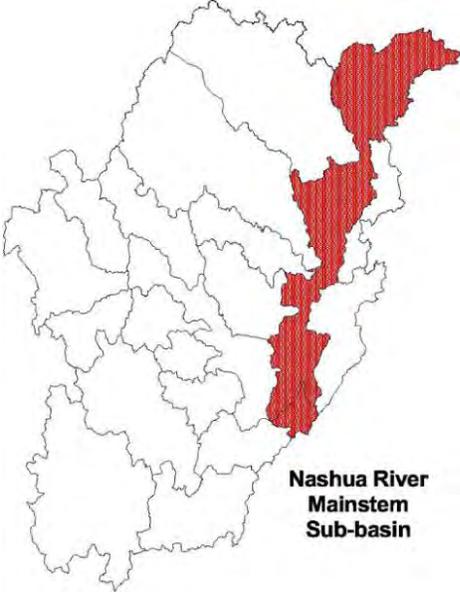
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Nashua River Stewardship Plan Area





SUB-WATERSHEDS:





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