Vermont Agency of Natural Resources

Watershed Management Division

PASSUMPSIC AND UPPER CONNECTICUT RIVER TACTICAL BASIN PLAN

June 2014

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

VERMONT
AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation

This Passumpsic and upper Connecticut River Tactical Basin Plan was prepared in accordance with 10 VSA § 1253(d), the Vermont Water Quality Standards[1], the Federal Clean Water Act and 40 CFR 130.6, and the Vermont Surface Water Management Strategy.

Approved[1]:

David Mears, Commissioner — Date 6/20/14

Department of Environmental Conservation

Deb Markowitz, Secretary — Date 6-20-14

Agency of Natural Resources

1) Pursuant to Section 1-02 D (5) of the VWQS, Basin Plans shall propose the appropriate Water Management Type of Types for Class B waters based on the exiting water quality and reasonably attainable and desired water quality management goals. VANR has not included proposed Water Management Types in this Basin Plan. VANR is in the process of developing an anti-degradation rule in accordance with 10 VSA 1251a (c) and is re-evaluating whether Water Management Typing is the most effective and efficient method of ensuring that quality of Vermont's waters are maintained and enhanced as required by the VWQS, including the anti-degradation policy. Accordingly, this Basin Plan is being issued by VANR with the acknowledgement that it does not meet the requirements of Section 1-02 D (5) of the VWQS.

Cover Photo: Moose River in Victory

Table of Contents

List of Figures

List of Tables

Executive Summary

The Passumpsic and upper Connecticut River Tactical Basin Plan provides an overview of the health of the basin and objectives and actions to protect high quality waters and address high-priority stressors that are described on a statewide basis in the Surface Water Management Strategy. The Passumpsic and upper Connecticut River basin has some of the least developed watersheds and best water quality in the state along with some of the state's largest potential floodplain restoration opportunities. However, there are waters with elevated levels of pathogens, flood and erosion hazard risks, high sediment and nutrient levels and the basin is a source of nitrogen pollution to the Long Island Sound among other issues. The heart of this plan is the implementation table in chapter 4, which includes objectives and actions to protect or restore surface waters in the basin. Below are the top ten actions in the plan from this table:

- VANR recommends that the Nulhegan River, Washburn Brook, Calendar Brook Trib 22, and Nation Brook Trib 3 be considered as candidates for reclassification to Class A(1) waters.
- Petition for the reclassification of Victory Basin and Mud and Dennis Pond wetlands as Class 1 Wetlands.
- Improve river corridor and floodplain protections for the Passumpsic, Millers Run, East and West Branch Passumpsic River in town zoning bylaws to allow these streams to develop new floodplains and reduce flood damage.
- Implement an intensive water quality monitoring program to evaluate phosphorus, nitrogen, sediment and E. coli sources in the Basin. Use sampling results to identify pollution sources in the basin and work with basin partners to address these.
- Complete stormwater separation project for the St. Johnsbury wastewater treatment facility to end combined sewer overflows.
- Evaluate potential for Green Stormwater Infrastructure (GSI) to reduce combined sewer overflow frequency in the Tremont Street neighborhood or similar target watershed.
- Contact landowners in priority areas with important floodplain protection or restoration opportunities to encourage participation in conservation and restoration programs.
- Complete outreach to farmers to improve nitrogen management on farms through the use of Adapt N software, pre-side dress nitrate testing and demonstrating the use of shorter duration corn with legume cover crops.
- Complete a stormwater master plan in the Dish Mill Brook Watershed working with key partners to identify stormwater and sediment source areas, treatment options, and required maintenance schedule for proposed as well as existing infrastructure.
- Work with the communities of Burke, Newark, Danville, Walden, St Johnsbury and Concord to complete capital improvement inventories and develop a local template that can be applied to other towns in the basin and that includes use of bridge and culvert assessment data.

The Vermont Agency of Natural Resources has prepared an online mapping tool that allows the reader to identify the locations of many Passumpsic and upper Connecticut River Basin features, and actions identified in the Implementation Table. This resource is online via this link.

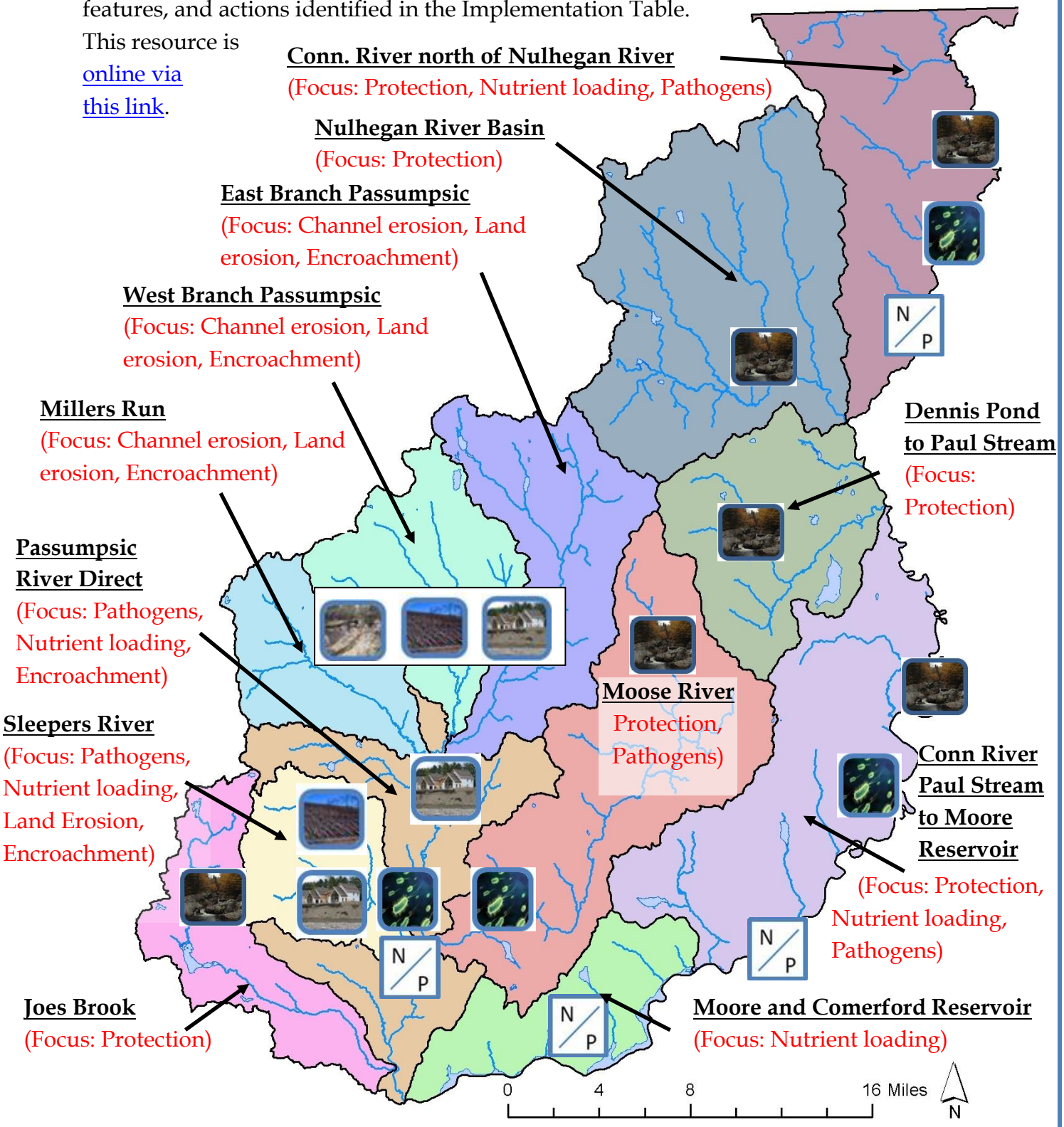

Figure 1. Passumpsic River and upper Connecticut River basin map with major sub-basins stressors identified in this plan for action and focus for protection efforts.

Chapter 1 - Introduction

A. Basin Description

This Basin includes the Passumpsic River watershed and the drainage to the Connecticut River in Vermont north of the Passumpsic River confluence. The total area of the basin is 989 square miles with the Passumpsic River covering 507 square miles and drainages directly to the Connecticut River covering 482 square miles. Major tributaries to the Passumpsic River include Joes Brook, the Sleepers River, Millers Run, the East and West Branches of the Passumpsic River and the Moose River while the larger tributaries to the upper Connecticut River basin include Miles Stream, Halls Stream, Paul Stream and the Nulhegan River. The watershed and its sub-watersheds are described in detail in Chapter 2.

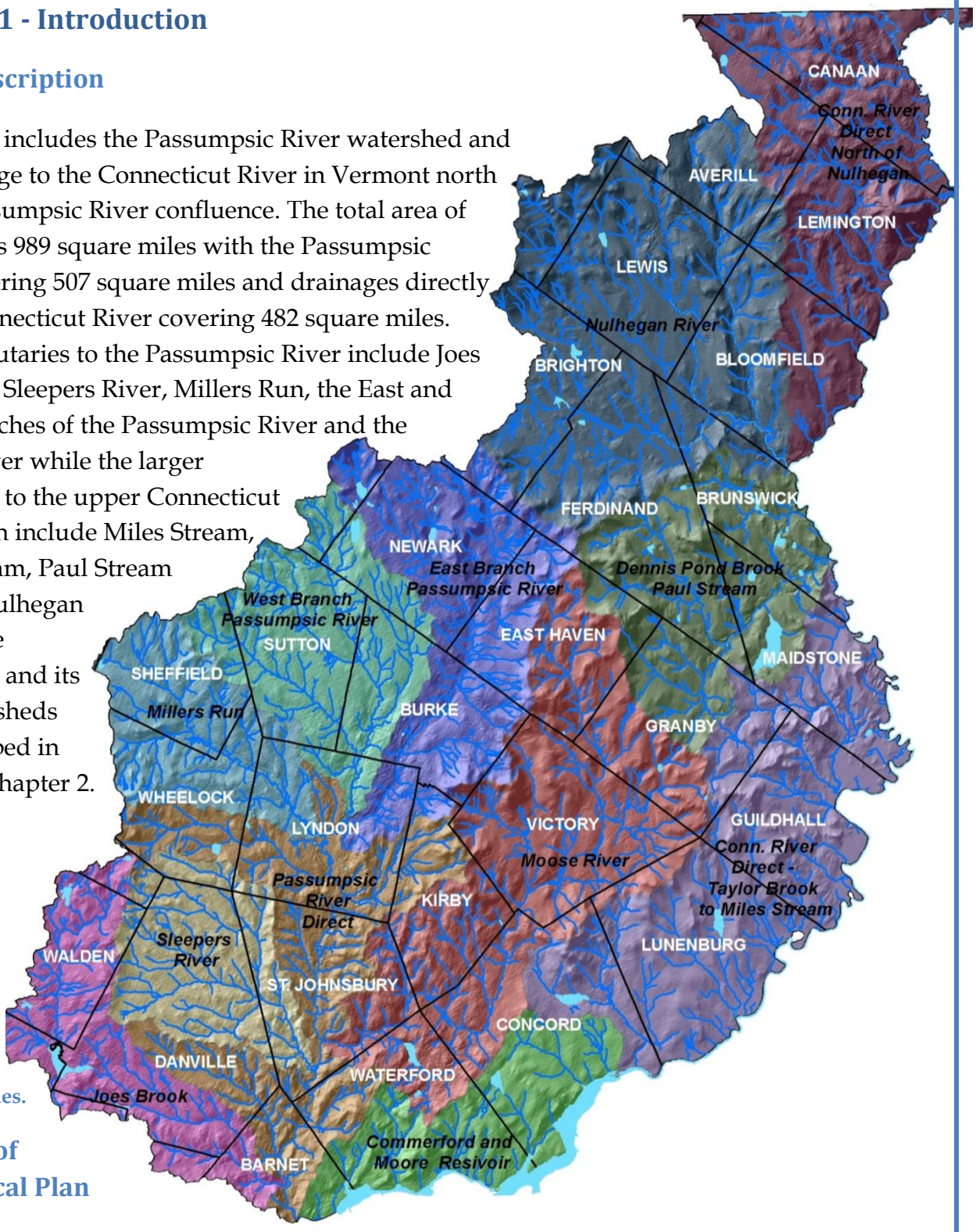

Figure 2. Passumpsic River and Upper Connecticut River basin map with major sub-basins and municipalities.

B. Purpose of the Tactical Plan

Tactical basin plans are developed according to the goals and objectives of the Vermont Surface Water Management Strategy, to protect, maintain, enhance, and restore the biological, chemical, and physical integrity, and public use and enjoyment of Vermont's water resources, and to protect public health and safety. This tactical plan is a guide for the Agency of Natural Resources (VANR) as well as state, federal, and local watershed

partners and members of the general public that need to work together collaboratively to achieve these goals at the basin scale. The Tactical Planning Process is outlined in Chapter 4 of the Surface Water Management Strategy.

VANR completed a Passumpsic River watershed comprehensive river plan in 1992. That plan contained 28 actions to protect and restore water quality and aquatic habitat in the basin but did not include areas of the upper Connecticut River watershed that are included in this plan. Many of the recommendations in the 1992 plan focused on objectives that related to management of hydroelectric facilities and, through efforts of VANR and its watershed partners, many of these have been implemented or are in progress. This tactical plan builds upon those original plan recommendations by promoting specific, geographically explicit actions in areas of the basin identified for intervention, using on-the-ground monitoring and assessment data.

C. Planning process

The planning process for the Passumpsic and upper Connecticut River Basin plan included meeting with Agency of Natural Resource Staff, other state agencies and federal partners to identify a draft list water quality issues in the basin and actions to address these. Further meetings took place with key players in the basin including the Passumpsic Valley Land Trust, Connecticut River Joint Commissions subcommittees, Connecticut River Watershed Council, Natural Resources Conservation Districts, Agency of Agriculture, Northeast Vermont Development Association, Q Burke resort, and the Town of St Johnsbury to discuss specific actions related to these organizations and businesses. A more complete list and description of organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the Passumpsic and upper Connecticut River Basin is included as Appendix D.

The draft list of objectives and actions was modified based on input from these meetings and the draft plan was written and presented at two public meetings held in Brunswick on April 17th 2014 and in St Johnsbury on April 22nd 2014. Public comments from these meetings and provided directly to VANR were then considered and changes made to the draft plan if deemed necessary as well as addressed in the responsiveness summary included as Appendix G.

D. Implementation Process

This Tactical Plan spells out clear, attainable objectives and targeted actions to achieve those objectives. The plan contains an Implementation Table (Chapter 4) by which progress can be tracked with regard to measurable indicators of each major objective.

Actions defined in the Implementation Table will be addressed over the life of the Passumpsic and upper Connecticut River Tactical Plan, envisioned as five years. Successes and challenges in implementing actions will be reviewed in biannual meetings with watershed partners. The Tactical Plan will not be a static document. Tropical Storm Irene has taught us that VDEC and its partners must develop adaptive management techniques as new natural and anthropogenic events present themselves. The implementation of actions and the implementation table itself may be modified during this plan's cycle to best address any unanticipated events.

Chapter 2- Water Quality in the Basin

A. Watershed Description

The Passumpsic and upper Connecticut River basin is made up of two major watersheds, the Passumpsic watershed and the Connecticut River watershed north of the Passumpsic River. The Passumpsic River watershed is located in northeastern Vermont and drains 507 square miles, a major portion of Caledonia County and minor portions of Essex, Orleans and Washington counties. The Passumpsic River mainstem forms where the East Branch and West Branch join just northeast of Lyndonville and flows about 23 miles to the south until it reaches the Connecticut River in East Barnet passing over a series of seven hydroelectric dams along the way. The East Branch originates in the town of Brighton and flows south-southwesterly for about 19 ½ miles draining a 65-square-mile watershed before meeting the West Branch. The West Branch originates from several tributaries in the town of Westmore and flows south-southeasterly for about 14 miles before joining the East Branch. The West Branch drains a 68-square-mile watershed. A more extensive basin description is available in *The Passumpsic River Watershed - Water Quality and Aquatic Habitat Assessment Report* (VDEC 2009).

The upper Connecticut River basin includes all the drainages north of the Passumpsic River watershed. The largest watershed in this basin is the Nulhegan at 151 square miles followed by Leach Stream with a watershed of 59 square miles (mostly in Quebec), and Paul Stream with a watershed of 44 square miles. While the Connecticut River is a New Hampshire water with the exception of areas flooded by dams after the boundary agreement of 1934, the river is considered in this plan because it is the receiving water for the watershed. A more extensive basin description is available in *Northern Connecticut River and Direct Tributaries ~Basin 16~Water Resources, Water Quality, and Aquatic Habitat Assessment Report* (VDEC 2011).

For this Tactical Plan the basin is broken down into the following subwatersheds, shown in Figure 2:

- Joes Brook Watershed

- Sleepers River Watershed
- Millers Run Watershed
- West Branch Passumpsic Watershed
- East Branch Passumpsic Watershed
- Moose River Watershed
- Passumpsic River Direct Watershed
- Canaan, Lemington, Bloomfield streams flowing to the Connecticut River plus the Connecticut mainstem itself;
- Nulhegan River watershed, which is the Nulhegan River and its many branches;
- Paul Stream, Wheeler Pond, Dennis Pond Watersheds and the Connecticut River mainstem to which these watersheds drain;
- Maidstone, Guildhall, Lunenburg streams draining to the Connecticut River plus the Connecticut mainstem to which they flow;
- Concord, Waterford and Barnet streams to the Connecticut River plus the two reservoirs in this segment and Connecticut River north of the Passumpsic River.

B. Assessments undertaken in the Passumpsic and Upper Connecticut River basin

Several types of assessments are conducted and integrated into the tactical basin planning process to improve water quality. In the Passumpsic and upper Connecticut River basin this includes stream geomorphic assessments, water quality monitoring,

Table 1. Status of assessments for the Passumpsic and upper Connecticut River basin

Sub-Basin	Stream Geomorphic Assessment	Water Quality Monitoring	AEM	Road Erosion Inventory	Culvert Inventory	Stormwater Mapping	Illicit Discharge Detection	Stormwater Master Planning
Joes Brook	U		PC	X	C	C	U	
Sleepers	U		PC	X	C	C	U	
Millers Run	C	X	PC	X	C	C	X	X
East Branch	C	X		X	C	C	X	X
West Branch	C			X	C	C	X	X
Moose	C	X	PC	X	C	C	U	X
Passumpsic Direct		X		X	C	C	U	X
North of Nulhegan	PC	X	PC	X	X	C	X	
Nulhegan	PC					NA	NA	
Paul Stream – Dennis Pond					PC	NA	NA	
Maidstone - Lunenburg	PC	X				C	U	
Concord-Barnet	PC		PC	X	X	C	U	

X= proposed in plan C= Completed PC= Partial Completed U=Underway NA=Not Applicable

Agricultural Environmental Management Assessment (AEM), road erosion inventories, bridge and culvert inventories, stormwater infrastructure mapping, illicit discharge detection and elimination, and stormwater master planning.

Stream Geomorphic Assessments

Stream geomorphic assessments (SGA) provide the basis for stream alteration regulatory decisions, technical assistance for fluvial conflict resolution, stream corridor protection and restoration, flood hazard mitigation and water quality protection. The assessment data are critical to prioritization of riparian and fluvial process-related water quality restoration and protection projects and so a summary of stream geomorphic assessments and related projects is included in Appendix E.

Fisheries Assessment

The Passumpsic and upper Connecticut River basins are home to a diversity of fish species, many of which support popular recreational fisheries (VFWD 2013). The majority of the small streams within this watershed provide suitable habitat to support naturally reproducing trout populations, and most of the larger, warmer rivers are stocked with trout to provide fishing opportunities for anglers. Wild populations of native brook trout flourish in the colder, higher elevation streams. Some of the smaller tributaries of the Connecticut River also support naturalized populations of wild rainbow and brown trout. Both species were introduced to Vermont in the late 1800s, rainbow trout from the west coast and brown trout from Europe. These small tributaries are serving as spawning and juvenile rearing habitat for brook, brown, and rainbow trout living in the Connecticut River.

Trout and other species also move upstream and downstream to meet their habitat needs. These movements may be localized or may involve a number of miles of travel. For example, during warm periods in the summer, trout often migrate to coldwater refuges such as the mouths of tributary streams or to areas of groundwater inflow. Likewise, trout may migrate in the fall to areas providing overwintering habitat.

In addition to stream fisheries, there is a wide diversity of lake and pond angling opportunities in these basins. It is important to note that ponds with wild populations of brook trout that are abundant enough to provide angling opportunities are exceedingly rare in Vermont. While the majority of small, coldwater ponds in Vermont were probably once home to brook trout, the widespread introduction of warmwater fish species have eliminated brook trout from nearly all of these waters. Of the five ponds in the state that are managed exclusively as wild brook trout fisheries (no stocking), three of them (Cow Mountain Pond, Unknown Pond in Avery's Gore, and West Mountain Pond) occur in the Passumpsic and upper Connecticut River drainages.

The maintenance of quality fisheries requires the continued protection and enhancement of aquatic habitat including:

- *Forested riparian areas* - undisturbed, forested buffers along streams, rivers, lakes and ponds are extremely important in maintaining cool water temperatures and stable streambanks and shorelines, filtering pollutants and providing food and shelter for fish and other aquatic organisms.
- *Habitat connectivity* – dams and poorly designed culverts can limit the movement of fish and other aquatic populations to critical spawning, feeding and refuge habitats.
- *Natural hydrologic regimes* – regulated stream flows from hydroelectric facilities and water withdrawals can reduce habitat availability and quality in downstream reaches. Lake level fluctuations often impact littoral zone habitats and can negatively affect fish and other aquatic organisms.
- *Preventing the introduction of exotic species and pathogens* – A variety of non-native invasive aquatic species and harmful pathogens are present in Vermont or surrounding states. Limiting the spread of these detrimental species will help maintain healthy fisheries.

C. Surface waters exhibiting very high quality biological integrity or fisheries.

Biological Integrity

There are several sub-watersheds in the Passumpsic and upper Connecticut River watershed that support very high water quality conditions and ecological integrity (Figures 3 and B.1, Table B.1). VDEC assesses ecological integrity using biological assessments of macroinvertebrate and fish communities, which are assessed on a gradient from "poor", at the most impacted, to "excellent" at the most natural. Based on VDEC's long-term sampling of stream locations in the Passumpsic and upper Connecticut River watershed, several sampling sites reliably exhibit very good or even excellent ecological integrity which are highlighted in Appendix B. These waters should be protected through the antidegradation policy. Some of these waters regularly exhibit excellent ecological integrity and are recommended for consideration to be reclassified as Class A(1) waters while others are identified for additional assessment to confirm A(1) conditions for potential future consideration for A(1) reclassification as shown in Figure 3 and described in Chapter 3. In addition to this, the entirety of the Nulhegan river watershed has been identified by the Agency as a potential Outstanding Resource Water based on widespread natural and recreational values that the basin exhibits which is discussed in detail in Chapter 3.

Very High Quality Lakes Best Lakes – Passumpsic and Upper Connecticut River basin

The Lakes and Ponds Management and Protection Section of VDEC recently completed a process to identify high quality lakes in the state to prioritize conservation and

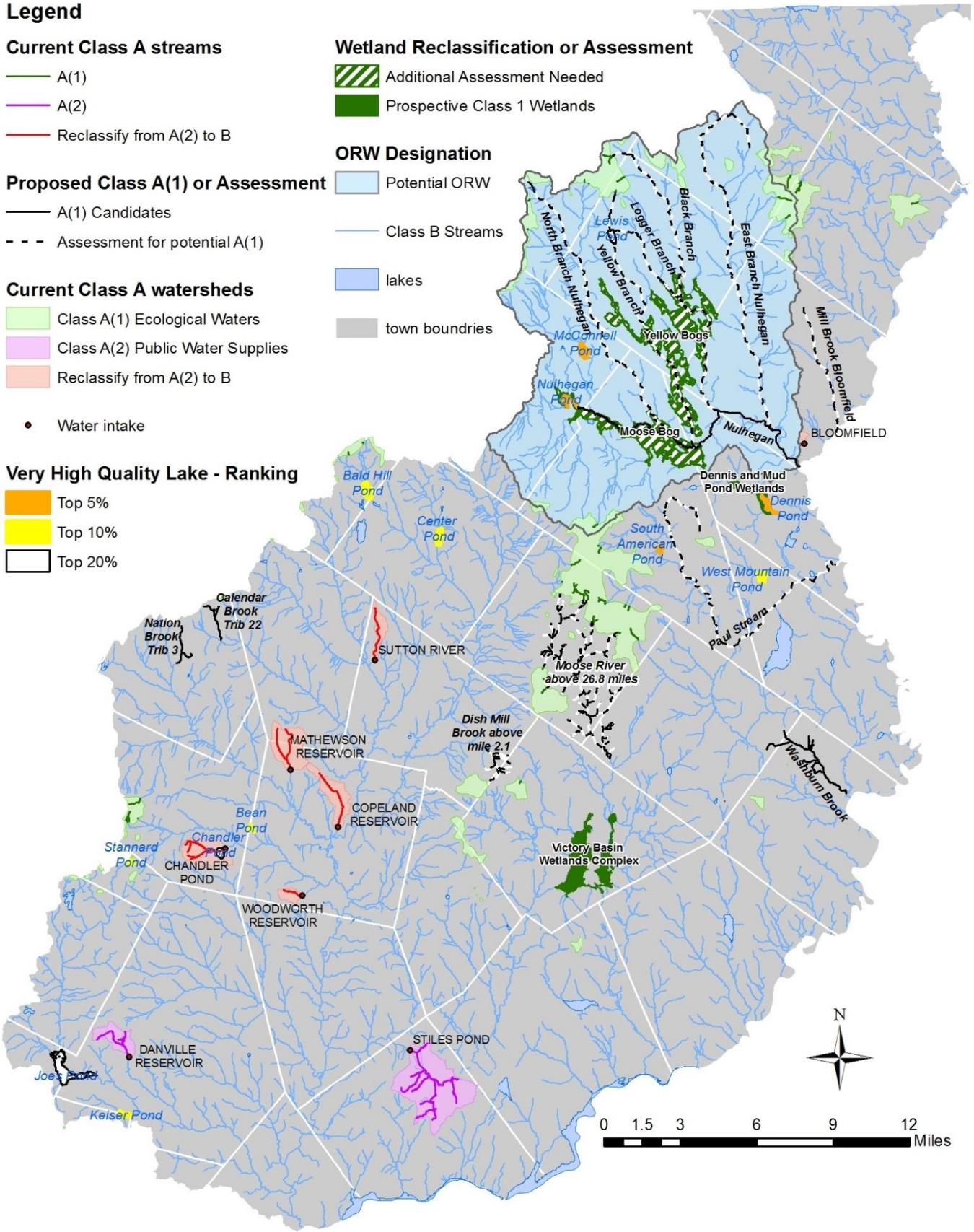

Figure 3. Map of Class A waters, potential streams and wetlands for reclassification or assessment, very high quality lakes and potential Outstanding Resource Waters in the Passumpsic and upper Connecticut River Basin.

protection efforts. Lakes were independently ranked in three separate categories using long-term datasets for water quality, biological diversity and unusual or scenic natural features. Scores from the separate categories were combined to identify lakes with exemplary qualities in all three.

Four lakes in the Passumpsic and upper Connecticut River Basin (South America, Dennis, Nulhegan, and McConnell ponds,) were ranked in the top 5% of lakes in Vermont. All four of these ponds were ranked highly for both biological diversity and unusual scenic or natural features. Bald Hill, Bean, Center, Stannard, West Mountain, and Keiser ponds were all ranked in the top 10% of lakes and with the exception of Bald Hill Pond this was due to high levels of biological diversity. In the cases of Bean, Center and Keiser ponds this high rating was because of good water quality and for Stannard Pond for unusual scenic or natural features. Chandler, Joes, and Lewis ponds were ranked in the top 20% of lakes based on biological diversity and good water quality in Chandler and Lewis ponds, and unusual scenic or natural features on Joes Pond. These lakes are presented in Table 2 and Figure 3.

Table 2. Lakes and ponds in the Basin that exhibit very high quality on VDEC's Best Lakes analysis based on Water Quality, Biological Diversity, Unusual or Scenic Natural Features. Maximum score for each category is Five for a total maximum score of 15.

Lake or pond	Water Quality	Biological Diversity	Unusual Scenic/ Natural Features	total	rank
SOUTH AMERICA	3	5	5	13	Top 5%
DENNIS	2	5	5	12	Top 5%
NULHEGAN	3	5	4	12	Top 5%
MCCONNELL	1	5	5	11	Top 5%
BALD HILL	5	2	3	10	Top 10%
BEAN (LYNDON)	5	5		10	Top 10%
CENTER	5	5		10	Top 10%
STANNARD	2	4	4	10	Top 10%
WEST MOUNTAIN	3	5	2	10	Top 10%
KEISER	4	5		9	Top 10%
CHANDLER	3	5		8	Top 20%
JOES (DANVILLE)		4	4	8	Top 20%
LEWIS	3	5		8	Top 20%

Unique Basin Characteristics

The Connecticut River and its surrounding floodplains and wetlands host a number of important natural communities as well as threatened and endangered species and is an important recreational resource. This was acknowledged when the Connecticut River and its watershed received the first and now apparently only national 'Blueway' designation by the US Department of Interior (the program has since been ended). This

designation was in recognition of the river's ecological values and its recreational use by the 1.4 million people who use the river annually. As stated in the press release, this designation will "provide a new national emphasis on the unique value and significance of a 'headwaters to mouth' approach to river management." The Connecticut River Paddlers trail that is managed by partner organizations supports a series of primitive campsites and access points from the rivers headwaters south to Long Island Sound. A map of campsites and access points in Vermont and New Hampshire has recently been published including segments adjacent to this basin.

The Connecticut and its adjacent floodplain and wetland communities are important for a number of social and ecological reasons including:

- Providing important habitat for migrating waterfowl.
- Reducing phosphorus, nitrogen, and sediment loading to the Connecticut River and eventually Long Island Sound.
- Storing floodwaters and reducing the magnitude of downstream flooding.
- Providing locations for the natural migration of the Connecticut River to support a return towards the equilibrium condition unconstrained by existing infrastructure. The Connecticut River has been straightened in many locations in the upper watershed (Fields 2006) and in many places is working to reestablish its natural sinuosity.
- The potential for the restoration of significant areas floodplain forest habitat, which has largely been lost through the conversion of this natural community to agricultural lands. These habitats support many plant and animal species, some of which are rare or uncommon in Vermont.
- Benefits to the aquatic community adjacent to and downstream from floodplain forests from increased shading and improved aquatic habitat.
- As a migration pathway facilitating for the movement of wildlife between larger habitat blocks.

While there are small patches of existing floodplain forests and wetlands along the Connecticut River, there are much larger areas where these communities can be restored. Three important studies have identified priorities for floodplain and wetland restoration in the Connecticut River watershed:

- TNC study of ecologically important floodplain forests in the Connecticut River watershed. (Marcs et. al 2011)
- Ammonoosuc Conservation Trust Farmland & Floodplain Conservation Initiative
- Upper Connecticut River Mitigation and Enhancement fund (MEF) priorities areas report

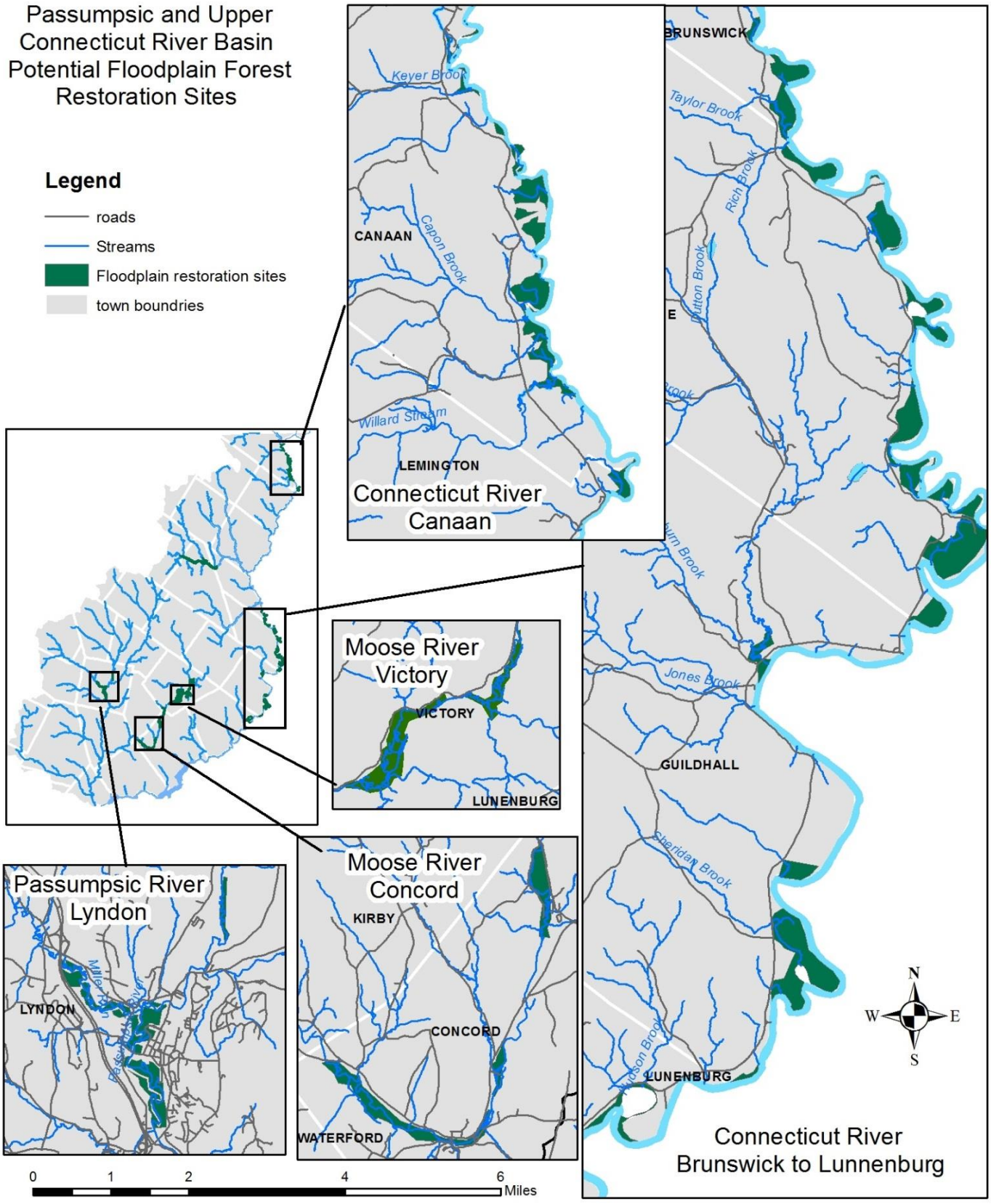

Figure 4. General areas of potential floodplain restoration in the Passumpsic and upper Connecticut River basin based on a TNC study *Ecologically Important Floodplain Forests in the Connecticut River Watershed* by Christian Marks et al 2011. The full TNC report is available on the Web here.

These reports have identified and prioritized specific areas of the Connecticut River floodplain for protection and restoration potential. These include floodplain areas (shown in Figure 4) in Canaan and further downstream from Brunswick to Lancaster which are mapped in the TNC study of ecologically important floodplain forests (Marks et al 2011). These same areas are also identified in the MEF priority areas report. The TNC report also identified floodplain forest in the town of Lyndon on the Passumpsic River, Millers Run, West Branch Passumpsic River and along the Moose River. This tactical plan integrates the recommendations of these three studies into a unified suite of recommendations for floodplain restoration along the Connecticut River mainstem and in the Passumpsic River watershed.

There are also a number of significant aquatic and riparian natural communities in the basin including Black Spruce swamps, Black Spruce and Tamarack Swamps, Lowland Bogs, Lakeside Bogs, Poor Fens, Cedar Swamps, and floodplain forests which were identified in the nongame and natural heritage program reports entitled: *Exceptional natural habitat and rare plant and animal species of Essex County Vermont (1990)*; *Floodplain Forests of Vermont: Some Sites of Ecological Significance (Sorenson 1998a)*; and *Northern White Cedar Swamps and Red Maple Northern White Cedar Swamps of Vermont: Some Sites of Ecological Significance (Sorenson 1998b).*

The Dwarf Wedgemussel is a federally endangered species that is found in the Connecticut River from Maidstone to Concord Vermont. This species was listed as federally endangered on March 14th 1990 due to significant reductions in its density across its historical range and its extirpation from Canada (NH Wildlife Action Plan).

The Dwarf Wedgemussel population along this basin is the most robust of the three major populations identified in the Connecticut River watershed. Threats to the species generally result from altered hydrology along with pollution, such as chlorine, ammonia, heavy metals, sediment and nutrient runoff, and associated low dissolved oxygen levels. Further, competition from introduced species such as Zebra Mussels are a major potential threat to the survival of Dwarf Wedgemussel. Sediment and nutrient reductions as well as riparian restoration a the primary focus of this plan and together these actions support the survival of this endangered species along with the many other associated water quality and habitat benefits that these actions provide.

D. Stressors, and Causes and Sources of Impairment

The Vermont Surface Water Management Strategy (VDEC 2012) lays out the goals and objectives of the Watershed Management Division to address pollutants and stressors that affect the designated uses of Vermont surface waters. The strategy discusses the 10 major stressors that are managed to protect and improve surface waters. A stressor is defined as a phenomenon with quantifiable damaging effects on surface waters resulting from the delivery of pollutants to a waterbody, or an increased threat to public health and safety. Stressors result from certain activities on the landscape, although occasionally natural factors result in stressors being present. Managing stressors requires the management of associated activities. When landscape activities are appropriately managed, stressors are reduced or eliminated, resulting in the objectives of the Strategy being achieved, and the goals met. The pictures at the right link to the stressor chapters of the Surface Water Management Strategy that describe in detail the stressor, its causes and sources, and the Division's approach to addressing the stressor through monitoring, technical assistance, regulations and funding.

Read more...Click to choose stressor


Acidity


Channel Erosion


Flow Alteration


Encroachment


Invasive Species


Land Erosion

Nutrient Loading


Pathogens


Toxics


Thermal Stress

In the Passumpsic and upper Connecticut River basin, the primary causes of stressed and impaired streams are pathogens, followed by elevated mercury levels in fish, which stress all streams (and lakes) in the basin (VDEC 2012a and 2012b). Land and channel erosion, non-erosion nutrient loading, encroachment, toxics, and to a small degree acidification are other causes of stressed streams in the basin. Landscape activities resulting in these include: combined sewer overflow from St Johnsbury, developed land runoff, agricultural runoff, channelization, dredging, logging and hazardous waste sites. Table 3 lists the known stressed, impaired or altered streams in the Passumpsic and upper Connecticut River based on the basin assessment, 303(d) and other lists and assessment database updated with recent information and information from New Hampshire for the Connecticut River.

Table 3. Causes and sources resulting in Impaired (I), Altered (A), or Stressed (S) stream conditions in the Passumpsic River and upper Connecticut watersheds along with assessment priority and needs(VDEC 2012a, VDEC 2012b, and FB Environmental Associates 2010).

Stream segment(s)	Stressor	Source(s)	Mileage (condition)	**Assessment Priority** / Assessment need
Passumpsic River – Tremont Street - 5 miles downstream.		Combined Sewer Overflow	5 (I)	No assessment needed
Lower Sleepers River		Combined Sewer Overflow	1.5 (I)	No assessment needed
Chesterfield valley and Moose River		Agriculture	5.7(S)	**Moderate** / E. coli sampling
Connecticut River - Canaan	 Pathogens	Unknown	2.9*(I – NHDES)	**Moderate** / E. coli sampling targeted at swimming holes
Connecticut River Canaan to Guildhall		Unknown	5.3* (I – NHDES)	**High** / E. coli sampling targeted at swimming holes - Lyman Falls
Connecticut River Guildhall to Lunenburg		Unknown	40* (I – NHDES)	**Moderate**/ E. coli sampling targeted at swimming holes
Halls Stream		Unknown	.6*(I – NHDES)	**High** / E. coli sampling targeted at swimming hole
Leach Creek up to Wallace Pond	 Channel erosion	Morphological instability	1 (S)	**Moderate** / Phase 1 SGA completed Phase 2 needed with watershed assessment
Willard Brook		Morphological instability	.3 (S)	**Low** – few conflicts / Phase 1 SGA completed
Millers Run	  Channel and Land Erosion	Channel instability, Agriculture	9.5(S)	Phase 2 SGA Completed
Dish Mill Brook	 Land erosion	Developed land runoff	1.3(S)	**Moderate** / SGA completed WQ sampling to identify source
Dish Mill Brook tributary		Developed land runoff (bridge)	.1(S)	**Moderate** / SGA completed Biological. WQ sampling and assessment upstream.
Joes Brook		Penstock Break	1(S)	**Moderate**/ Biological
Scales Brook		Development -	.1 (S)	**Moderate**/Biological and

Stream segment(s)	Stressor	Source(s)	Mileage (condition)	**Assessment Priority** / Assessment need
		Agriculture		watershed assessment
Murphy Brook		Logging	4 (S)	**Low**/Biological assessment completed in 2012.
Passumpsic River – Tremont Street - 5 miles downstream.	 Non-Erosion Nutrients	Combined Sewer Overflow/ stormwater runoff	5 (I)	**Moderate**/ Biological
Entire watershed (as part of Long Island Sound watershed)		Urban and agricultural lands, atmospheric deposition	Long island sound Dissolved Oxygen impairment (not in watershed)	**High /** subwatersheds with high percentages of developed and agricultural land use including: Connecticut River direct above and below the Nulhegan, Millers Run, Passumpsic East, West Branches and Direct and the Sleepers River.
Sleepers River	 Encrochment	Channelization	2.7 (A)	No assessment needed
Sleepers River		Oil, sediment contamination due to hazardous waste	1.3(S)	**Low** / Biological Assessment OK along with chemical monitoring.
Lily Pond Outlet stream		Priority org, and metals due to hazardous waste	1(S)	**Moderate** / Biological Assessment
Halls Stream	 Toxic contaminants	Iron due to hazardous waste or stormwater	.6 (S)	**Moderate** / Biological or metals sampling
All basin waters		Atmospheric deposition of mercury	All waters (S)	**Low**
Moore Reservoir		Atmospheric deposition of mercury	1235 acres (I)	**Low**
Comerford Reservoir		Atmospheric deposition of mercury	777 acres (I)	**Low**
Joes Pond	Water Level Fluctuation	Joes Pond dam	396 acres (A)	**Low**
Unknown Pond	Acidification	Atmospheric deposition	19 acres (I)	**Moderate/**Ongoing assessment of improvements due to pollution abatement efforts

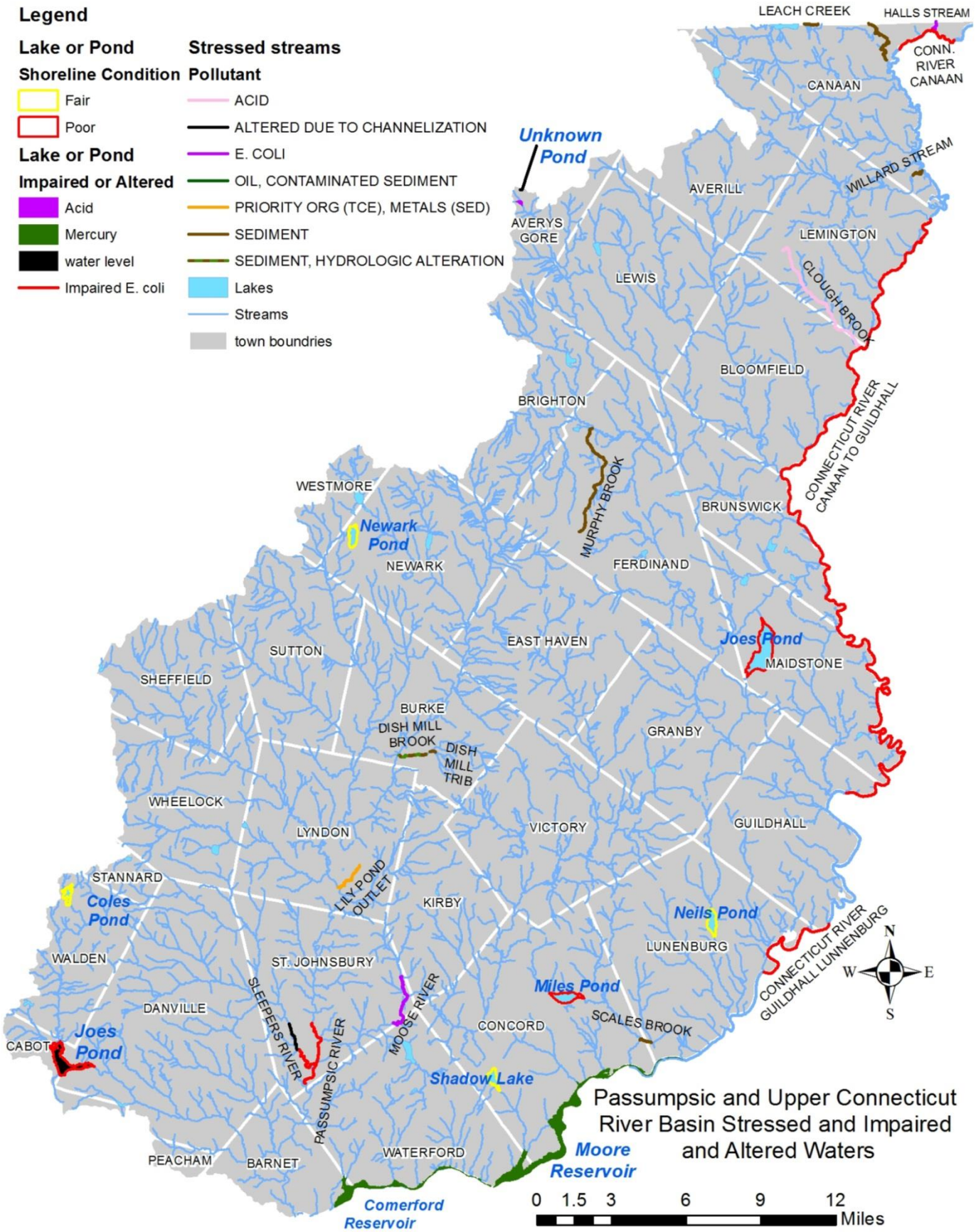

Figure 5. Impaired, Altered and Stressed waters in the Passumpsic and upper Connecticut River Basin along with lakes show to have reduced or poor shoreline condition.

Concerning lakes, the primary causes of impaired or stressed lake or pond acres are elevated levels of mercury in fish causing impairment of all lake acres of Moore and Comerford reservoirs and stressing all other lakes and ponds in the basin. In addition 19 acres of Unknown Pond are impaired due to acidification with another 1184 acres stressed due to acidification, approximately 1390 acres are stressed due to low DO (mostly Moore Reservoir which NH DES considers impaired) with another 802 acres stressed due to nutrient enrichment with three lakes showing increasing nutrient trends. A number of lakes including Coles, Sawdust, Beck, Newark, Joes, West Mountain, Wallace, Mile and Miles ponds are stressed due to sedimentation with a total of 441 acres listed as stressed, although many of these listings are based on historical assessments which need to be updated. 396 acres of Joes Pond are listed as altered due to water level fluctuations.

The Vermont Lake Score Card shows that three lakes in the basin (Bald Hill Pond, Maidstone Lake, and Miles Pond) have increasing nutrient trends based on spring phosphorous sampling or the Lay Monitoring Program data. In addition to this, Joes Pond, Miles Pond and Maidstone Lake are rated as having poor shoreline conditions while Neils Pond, Newark Pond, Shadow Lake and Coles Pond are rated as having reduced shoreline conditions as shown in Figure 5.

Unknown Pond is impaired for acidity and is included in a TMDL for 30 acid impaired lakes that lays out actions to address acid impairment. This TMDL is focused on reducing atmospheric deposition of acid-causing compounds on a regional scale including from midwestern power plants and regional motor vehicle and industrial sources (VDEC 2003), so there are no specific basin actions to address this impairment. The full TMDL is available on line through this link: ***TMDL for 30 Acid Impaired Lakes***.

Similarly, the mercury stress of all waters in the basin and the impairment of Moore Reservoir are addressed through the Northeast Regional Mercury Total Maximum Daily Load (New England Interstate Water Pollution Commission, 2007). Similar to acidification, the source of most of the mercury to the basin is from regional and midwestern sources and so beyond the scope of this plan. However, Vermont has supported the Vermont Mercury Education and Reduction Campaign to increase awareness about the issue of mercury and to address mercury sources on a statewide basis.

There are a number of issues not captured in tables three and four but that are still relevant to the tactical planning process for the basin. No waters are listed as stressed or altered due to invasive species in the basin, however, with populations of Eurasian watermilfoil nearby in the Memphremagog and Wells River watersheds, and many other aquatic invasive species in other waters in the state or in nearby states, lakes in

this basin are at risk for this and many other non-native invasive species. Didymo, an invasive alaga, is also present in both the upper Connecticut and Passumpsic rivers and while this infestation has not risen to the level to consider these waters as altered, we are still monitoring the impact of this species on aquatic communities and fisheries and working to prevent its further spread. In addition to these aquatic species, there are riparian invasive species such as Japanese Knotweed that reduce the quality of riparian habitat that are present in some sections of the basin but not as common in the upper portions of the upper Connecticut River watershed. See Appendix C for more information on spread prevention for invasive species. Thermal stress has not been identified as causing stress to waters in the basin, however with predictions of regional warming due to climate change and increased land development, this may become a greater issue in the near future with particular risk to brook trout populations that thrive in cooler waters.

Nitrogen in Long Island Sound

Low levels of dissolved oxygen in the Long Island Sound are caused by elevated nitrogen loading and resulting algae growth and decomposition in the sound. One source of this nitrogen is the Connecticut River watershed, including the Passumpsic and upper Connecticut River basin. A USGS report found loading of nitrogen of 1610, 1890, and 1690 pounds per square mile per year from the Moose River at Victory, Passumpsic River at Passumpsic, and for the upper Connecticut River above Wells River Vermont.

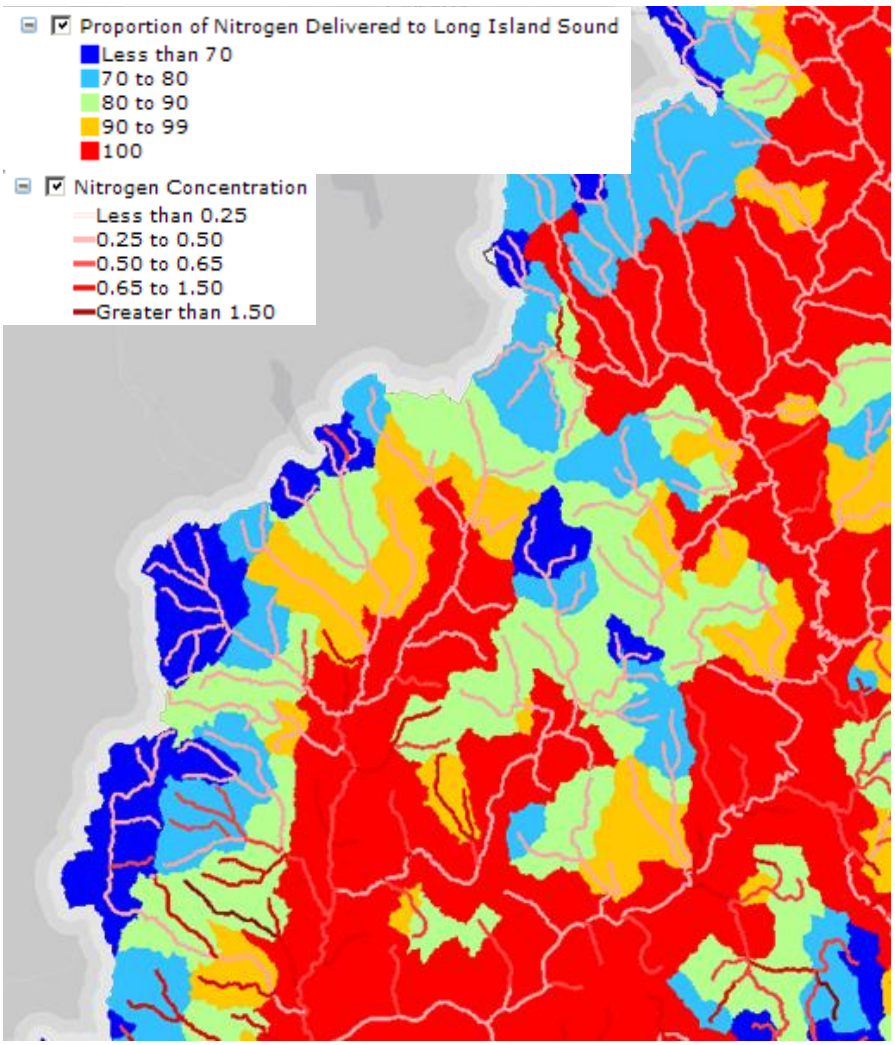

Figure 6. Sparrow output (from Connecticut River atlas) showing estimated proportion of instream nitrogen delivered to Long island sound along with estimated nitrogen concentration.

These rates of loading are lower than the estimated loading from the Connecticut River watershed above Thompsonville Connecticut, at 2230 pounds per square mile per year, but higher than other subwatersheds, suggesting that levels of nitrogen loading are intermediate even though much of the basin is forested (Deacon, 2006.)

Loading of nitrogen in the Connecticut River watershed has also been modeled through the Spatially Referenced Regressions on Watershed Attributes (SPARROW) model by the New England Interstate Water Pollution Control Commission and USGS presented in a publication by Richard Moore published in 2004. This modeling included estimated loading from municipal discharges, agricultural, developed lands along with atmospheric deposition with additional calculations for watershed and in stream nitrogen loss. The model estimated that nitrogen contributions from the Vermont portion of the Connecticut River watershed come largely from atmospheric deposition (65%) followed by agricultural land (21%), developed land (4%) and municipal wastewater (9%). The modeling though this program shows little instream loss of nitrogen in all but the smallest streams – suggesting sources far up in the watershed

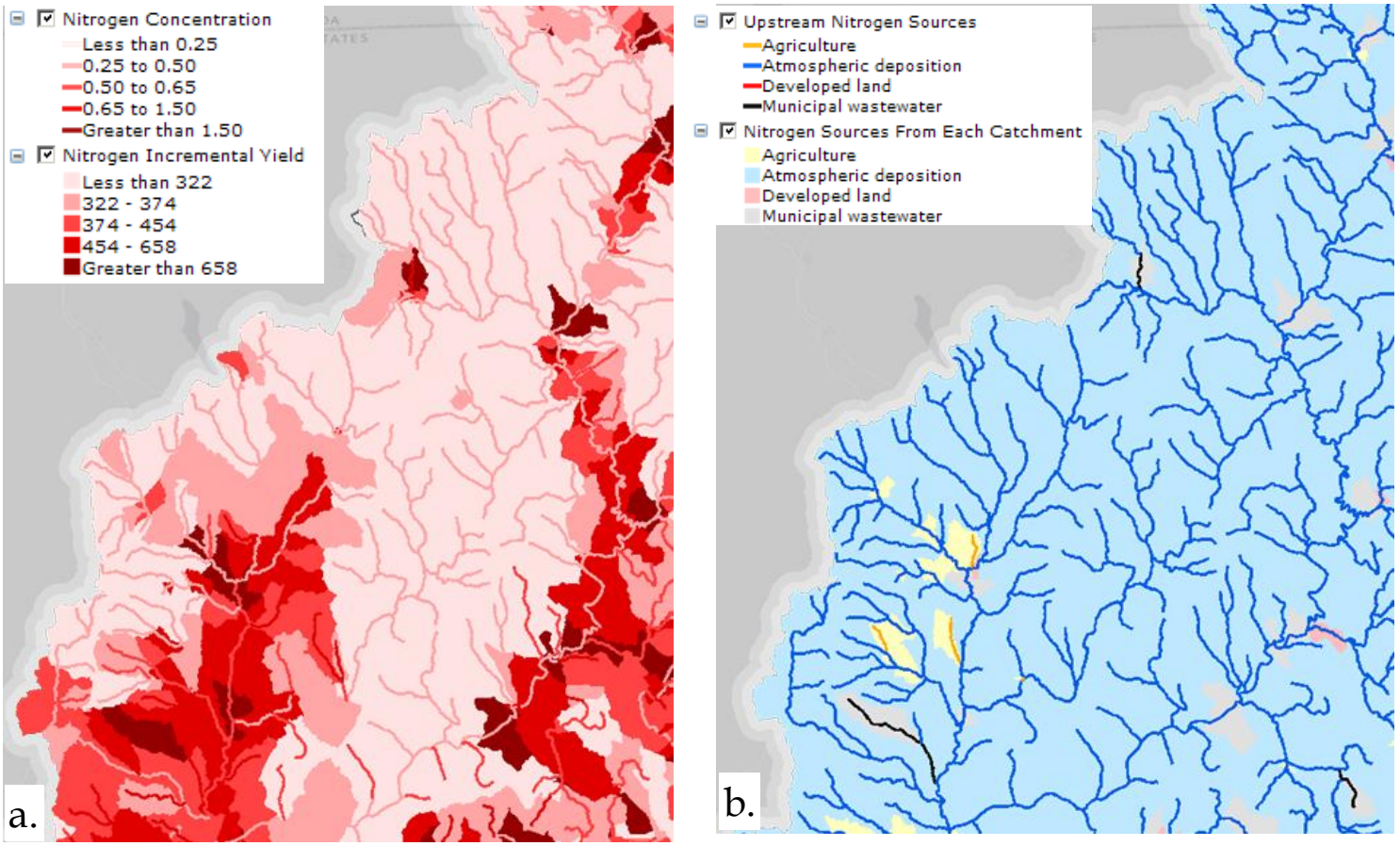

Figure 7. a. Subwatershed nitrogen yield for the upper Connecticut River subwatersheds b. Primary nitrogen sources for subwatersheds along with upstream nitrogen sources showing dominance of atmospheric deposition as a nitrogen source in the upper Connecticut River watershed (graphics taken from Connecticut River Atlas).

may still contribute to nitrogen loading of Long Island Sound.

A TMDL for Long Island sound was produced in 2000 by the states of New York and Connecticut but this did not address target nitrogen reduction efforts as far north in the Long Island Sound basin as Vermont. There is a current effort to revise this TMDL and, because efforts to reduce nitrogen loading in New York, Connecticut, and Massachusetts have not been sufficient to restore the sound, the revised TMDL may require nitrogen loading reductions in Vermont. This Tactical Basin Plan therefore presents actions to address nitrogen.

Flood Resiliency

The importance of flood resiliency was highlighted in the aftermath of tropical storm Irene and other recent flooding events across Vermont. Act 16, which takes effect in July 2014, requires municipal and regional plans to incorporate a "flood resilience" component or element. Working towards resiliency means both proactively reducing vulnerabilities to flooding and flood damage, and improving response and recovery efforts when flood events do occur, so that communities bounce back quickly from natural resource, social and economic impacts.

In the Passumpsic and upper Connecticut River basin, the town of Lyndonville has the third highest level of repeated flood damage of any community in Vermont and therefore flood resiliency is a priority issue in this basin plan. In addition to the inundation that occurs regularly in Lyndonville, there are a number of rivers in the basin including the East Branch of the Passumpsic and Millers Run, Sheldon Brook, and the Sleepers River, which exhibit increased fluvial erosion hazard risks, as noted in Appendix E.

Improving flood resilience requires mapping local flood hazard areas, identifying flood attenuation zones (including floodplains, river corridors, forests and wetlands) and implementing specific actions and town policies that will help protect these areas and reduce the risks facing future and existing development. In addition to this, activities that increase floodwater generation such as increased impervious surfaces, directly connected stormwater systems or activities that concentrate dispersed flow should be minimized or mitigated to reduce the risks associated with excessive amounts of stormwater runoff. In the months following release of this plan, VANR will be publishing statewide maps of river corridors, and will be using this and more local information to make flood resiliency an integral part of town planning. Numerous tactical plan actions will assist communities in becoming more flood resilient including: Actions 11-18, 26-29, and 35-51.

Assessment needs and priorities

Due to the large size of this basin, low population density and limited resources for water sampling, it is important to prioritize future assessment work where it is most needed. Tables 1 and 3 show a number of assessment priorities across the basin but below are some additional considerations for each type of assessment.

Sources of E. *coli* bacteria are a priority for additional assessment along the Connecticut River and on Halls Creek where swimming holes are present, and to a lesser extent on the Moose River and Chesterfield Valley Brook. Pathogen sampling for remote locations of the basin is logistically challenging. Collaboration with NH DES is important for efficient sampling along the Connecticut River since the river is a New Hampshire water and sampling should be done in a way that it can be used in NH DES evaluation of stream condition.

Nitrogen sampling is important to understanding sources of nitrogen in the Connecticut River watershed, which will be important for any evaluation of success in reducing nitrogen loading as part of a revised TMDL. Sampling should be targeted towards watersheds with larger agricultural and developed land uses such as the Millers Run, Sleepers River, Passumpsic River mainstem and Connecticut River.

E. Direct discharges to surface waters in the Passumpsic and Upper Connecticut River Basin

In the Passumpsic and adjacent upper Connecticut River drainages are six municipal wastewater treatment facilities, one electrical paper manufacturing facility, and one wood-fired electrical generating facility providing water pollution control infrastructure for the basin. All of these are subject to NPDES discharge permit requirements issued by the State of Vermont (Table 4).

An overarching consideration for the issuance of permits for municipal facilities in the Passumpsic and adjacent upper Connecticut River drainages is the Long Island Sound TMDL for nitrogen. This multi-state TMDL has been promulgated with interim wasteload and nonpoint source nitrogen load allocations. As of the issuance of this tactical plan, all facilities are operating under administrative continuance of existing permits while the wasteload allocations are being refined. Specifically, the WSMD is implementing a wasteload allocation plan and permitting strategy in all Connecticut River direct discharges to account for the new nitrogen limitations, to meet an interim total Vermont wasteload of 1,727 lbs N/day. Under that strategy, permit reauthorizations are planned for these facilities in 2015.

As part of a necessary refinement of the facility-specific nitrogen wasteload allocations, the WSMD, with assistance from certain municipalities, is conducting an extensive sampling effort to document the current loading conditions for nitrogen.

Table 4. Passumpsic and upper Connecticut River Basin wastewater treatment facilities and other facilities subject to NPDES direct discharge permits.

Facility (permit #)	Permit expiration date	Planned Permit Re-Issuance Date	Design Flow MGD	IWC[1] 7Q10 / LMM	Treatment type	Receiving Water
Danville (3-1235)	12/31/2011	2015	0.06	0.15 /0.08	Aerated lagoons and ultraviolet light disinfection.	Water Andric
Lyndon (3-1111)	6/30/2012	2015	0.75	0.03/0.01	Complete mix activated sludge, with anoxic selectors, centrifuge, sludge digestion, and chlorination/de-chlorination.	Passumpsic River
St Johnsbury (3-1290)	10/20/2006	2015	1.6	0.03/0.01	Rotating biological contact chamber, anaerobic digestion, chlorination/de-chlorination.	Passumpsic River
Weidmann Electrical Technology (3-1184)	3/31/2017	2017	0.35	0.01/0.004	Storage equalization lagoons, air floatation save-all unit, rotary screen, and belt filter press.	Passumpsic River
Canaan (3-0330)	3/31/2014	2014	0.185	0.005/0.001	Aerated lagoons, chlorination.	Connecticut River
Lunenburg FD2 (3-1140)	12/31/2013	2014	0.076	<0.001 /<0.001	Aerated lagoons, chlorination.	Connecticut River

1) *Instream Waste Concentration – or the proportion of river flow at lowest base (7Q10) and low median monthly (LMM) flow attributable to discharge, for the facility design flow. Note that the IWC is specific to the flow of receiving water.*

Facility-specific information

Canaan

The Canaan facility is presently undergoing construction of a significant upgrade which will introduce publicly available septage receiving, add a new headworks building with fine screen and aerated grit chamber, retrofit the existing lagoons to provide new aeration and solar mixers, and construction of a new control building with new lab and

office space, new blowers, and associated work. The reconstruction is scheduled for fall of 2014.

Danville

The Danville WWTF is a small facility discharging to a receiving stream of limited assimilative capacity. A waste management zone extends from the outfall one-mile downstream. Owing to the small size of the receiving water, this facility is required to monitor receiving water flow during summer months, and release effluent only in such quantities as can be assimilated, based on measured effluent concentrations for key pollutants.

Lyndon

The Lyndon WWTF was upgraded in 2012 from extended aeration to complete mix activated sludge with anoxic selectors. The upgrade included new mechanical fine-screens, grit removal, and centrifugation to de-water sludges, to improve operational and cost efficiency. The facility is participating in the Long Island Sound TMDL nitrogen treatment optimization study.

St. Johnsbury

The St. Johnsbury facility is actively pursuing remediation of CSO outfall points as required by Order of the Department, under authority of 10 V.S.A.§1272. Several outfall points are identified by this Order, which are being remediated in sequence by the City as follows. During 2013, the project addressing the Westside North area is being completed. A Preliminary Engineering Report prepared by the Dufresne Group, dated January 30, 2013, calls for the replacement of the existing combined sewer with a new separated sanitary sewer and storm sewer system along Eastern Avenue, Western Avenue and Main Street. This project will reduce the volume of combined sewer discharges to four CSOs. In addition, the St. Johnsbury wastewater treatment facility is presently in the planning stage to undergo a minor refurbishment project to the headworks and the digester. The headworks building will replace primary pumps, add coarse and fine screening to replace the existing comminutor, and improve flow monitoring of received septage. This project is detailed in a Preliminary Engineering Report prepared in 2013. The facility is participating in the Long Island Sound TMDL nitrogen treatment optimization study.

F. Targeted Priorities for this Tactical Basin Plan.

Based on the above stressors, causes and sources of impairment, and our understanding of the Long Island Sound and flood resiliency issue described above, eleven geographically explicit objectives are identified as the focus of this basin plan. Projects

to address other stressors or water quality concerns will still be considered, as consistent with the Surface Water Management Strategy and as priorities change over the years. Future iterations of this basin plan may well include new objectives which raise to the top priority through the iterative planning process.

Objective 1: Protect and restore high quality waters in the basin through reclassification to A(1) waters or Class 1 wetlands, Outstanding Resource Water (ORW) designation, or restoration through strategic woody debris placement.

Objective 2: Reduce prevalence of and damage caused by flooding in Lyndonville and erosion hazards throughout watershed.

Objective 3: Create a better understanding of water quality conditions in the Passumpsic and upper Connecticut River watershed addressing waters with elevated E. *coli* levels, swimming holes with not previously sampled, potential nitrogen, sediment and phosphorus source areas.

Objective 4: Resolve Passumpsic and Sleepers River E. *coli* impairments and complete assessments in areas of potential E. *coli* contamination.

Objective 5: Protect and restore important floodplain and wetland habitat in the Basin.

Objective 6: Reduce nitrogen loading to the Connecticut River and Long Island Sound.

Objective 7: Improve the biological condition of Dish Mill Brook which is stressed by increased scour from stormwater flows and sedimentation.

Objective 8: Reduce phosphorus and sediment loading to stressed lakes, ponds and streams in the Basin.

Objective 9: Restore littoral habitat on impacted lakes and ponds in the Basin.

Objective 10: Monitor and minimize spread of Didymo – and prevent spread of other invasive species not currently present in the basin including Eurasian water milfoil.

Objective 11: Reduce levels of oil and contaminants reaching the Sleepers River.

Chapter 3- Management Goals for Waters in the Passumpsic and upper Connecticut River Basin

The protection or improvement of water quality and water-related uses can be promoted by establishing specific management goals for particular bodies or stretches of water. The management goals describe the values and uses of the surface water that are to be protected or achieved through appropriate management. In Chapter 2 of this plan, a number of waters were identified as being of notable high quality, and these, as well as other unique areas, may be candidates for establishing alternate management goals or augmented protections through one of the processes that are further described below.

- Opportunities for reclassification of waters.
- Identification of existing uses.
- Opportunities for designation of Outstanding Resource Waters.
- Classification of wetlands.
- Designation of waters as warm and cold water fisheries.

The Agency of Natural Resources is responsible for determining the presence of existing uses on a case by case basis or through basin planning, and is also responsible for classification or other designations. Once the Agency establishes a management goal, the Agency manages state lands and issues permits to achieve all management goals established for the associated surface water. Before the Agency recommends management goals through a classification or designation action, input from the public on any proposal is required and considered. The public may present a proposal for establishing management goals for Agency consideration at any time. When the public develops proposals regarding management goals, the increased community awareness can lead to protection of uses and values by the community and individuals.

Public involvement is an essential component to restoring and protecting river and lake ecology. The Vermont Water Quality Standards state "Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest." Emphasis on the identification of values and expectations for future water quality conditions can only be achieved through public contributions to the planning process.

Many of the Passumpsic and upper Connecticut River Basin's rivers and streams, lakes and ponds, and wetlands currently achieve a very high quality of water and aquatic habitat and are exceptional places to swim, fish, boat, and otherwise enjoy. Some of these are identified in Chapter 2. In addition to protecting and improving water

resources by managing stressors, there is the opportunity to protect surface waters by identifying and documenting the excellent quality and preserving those excellent conditions or features through various classifications or designations. Several statewide references and reports available with descriptions of the exceptional ecological quality or recreational uses of Vermont surface waters. A major new resource, the Agency's BioFinder, provides a statewide application identifying surface water and riparian areas with a high contribution to biodiversity.

A. Classification

Class B to Class A(1).

Since the 1960s, Vermont has had a classification system for waters that establishes management goals. Setting water quality management goals was the responsibility of the Vermont Water Resources Panel until these responsibilities were transferred to the Agency of Natural Resources in 2013 through Act 138. These goals describe the values and uses of surface waters that are to be protected or restored through appropriate management practices. The current classification system includes three classes: A(1), A(2), and B.

Presently in all basins across Vermont, waters above 2,500 feet in elevation are classified A(1) by Vermont statute. In the Passumpsic and upper Connecticut Basin, the only A(1) waters include those above 2,500 feet in elevation. The management objective for A(1) waters is to maintain their natural condition. Through biological monitoring VDEC has documented that the following streams have the water quality sufficient to be proposed for designation as Class A(1) waters:

- Nulhegan River
- Washburn Brook
- Calendar Brook Trib 22
- Nation Brook Trib 3

In addition to this, the following waters have water quality data that suggests that they may have water quality to be designated as Class A(1) waters but additional water quality sampling is needed to confirm water quality conditions. These waters include:

- Paul Stream
- Mill Brook (Bloomfield)
- Steam Mill Brook above mile 5.6
- Dish Mill Brook Above Mile 2.1
- Moose River above Mile 26.8
- East, North, Black, Yellow, and Logger Branches of the Nulhegan River

Reclassification of abandoned Class A(2) – Public Water Supply

Waters used as public water supplies are classified A(2). The only class A(2) waters in the Passumpsic and upper Connecticut River basin that are currently used are Stiles Pond in Waterford (St. Johnsbury water supply), and the Danville Reservoir on a tributary to Brown Brook (emergency water supply for Danville). There are seven additional A(2) waters that are listed in the Water Quality Standards (VWRB 2011) but are no longer used as surface water drinking supplies or emergency drinking water supplies. Four of these were historically used by the town of Lyndonville including:

- Unnamed tributary to Millers Run including Mathewson Reservoir
- Unnamed tributary to Millers Run including Copeland Reservoir
- Chandler Pond and its watershed
- Woodworth Reservoir and its watershed
- Unnamed tributary to the Connecticut River in Bloomfield
- Two unnamed tributaries to the Sutton River near West Burke above the Murry Water System intake

VDEC recommends that all seven of the aforementioned surface water supplies that are no longer used or intended for use as an emergency supply be reclassified from A(2) to B in recognition of the greater level of protection conferred by this classification for aquatic biota and habitat, due to the preclusion of artificial controls that may be used to manage Class A(2) waters.

B. Existing Uses

All surface waters in Vermont are managed to support designated uses valued by the public including swimming, boating, and fishing. The degree of protection afforded to these uses is based on the water's class as described above. The existence of uses is protected absolutely if the Agency of Natural Resources identifies them as existing uses under the anti-degradation policy of the Vermont Water Quality Standards. Specifically, this means that an existing use may not be eliminated by the issuance of a permit or other action where compliance with the Water Quality Standards is assessed (VDEC, 2012). The Agency identifies existing uses of particular waters either during the basin planning process or on a case-by-case basis during application reviews for state or federal permits. During the Passumpsic and upper Connecticut River planning effort, VDEC has identified:

- The existing use of the waters for swimming;
- The existing use of waters for boating;
- The existing use of the water for water supply, and

- The existing use of water for recreational fishing.

It is VDEC's long-standing stipulation that all lakes and ponds in the basin have existing uses of swimming, boating and fishing. During the planning process, VDEC has collected sufficient information to identify the existing uses listed in Appendix A for rivers and streams. The list is not meant to be exhaustive. The public is encouraged to nominate other existing uses, which may be included in the basin plan or catalogued for a more thorough investigation when an application is submitted for an activity that might adversely affect the use.

C. Outstanding Resource Waters

In 1987, the Vermont Legislature passed Act 67, "An Act Relating to Establishing a Comprehensive State Rivers Policy." A part of Act 67 provides protection to rivers and streams that have "exceptional natural, cultural, recreational or scenic values" through the designation of Outstanding Resource Waters (ORW). Depending on the values for which designation is sought, ORW designation may protect exceptional waters through permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities. At the present time there are no ORW designations in the Passumpsic and upper Connecticut River basin.

The Nulhegan River watershed has been identified by the Agency as a potential ORW for the natural, scenic, and recreational values it includes. The Nulhegan River basin is defined by a plutonic depression ringed by more resistant metamorphic rock that has resulted in the creation of widespread wetlands throughout the watershed which support a remarkable aquatic assemblage diversity, incidence of aquatic or riparian rare, threatened or endangered species, and significant natural communities. Biological assessment of the Nulhegan River shows excellent conditions on this river and many of its tributaries (see Appendix B). In regards to recreational values, the Nulhegan River is accessible to the public through state and federal lands including lands with public access easements. The Nulhegan River is part of the Northern Forest Canoe Trail and is also an important fishery which is the focus of restoration efforts by the Vermont Department of Fish and Wildlife and Trout Unlimited to address long term impacts of historical logging. The Nulhegan Basin has been identified by the Audubon Society as an Important Bird Area. VDEC would support efforts that would pursue the designation of the Nulhegan River basin as an Outstanding Resource Water.

D. Other High Quality Waters

The current Water Quality Standards require that all basin plans place Class B waters into one of the three water management types. As consistent with prior Plans issued by VANR, this Plan does not make specific recommendations for water management

types. However, the surface waters identified in Appendix B are listed in recognition of their high quality. It is the intent of the Agency to provide protections to the very high quality condition of these surface waters coincident with application of the Agency's Anti-degradation Procedure. Further, the list of waters in Appendix B is intended to be used by municipalities to impart additional municipal protections as determined to be appropriate. The Agency will provide technical assistance to municipalities who are interested in promoting further surface water protections.

E. Class 1 Wetland Designation

It is policy of the State of Vermont to identify and protect significant wetlands and the values and functions they serve in such a manner that the goal of no net loss of such wetlands and their functions is achieved. Based on an evaluation of the extent to which a wetland provides functions and values it is classified at one of three levels:

Class I: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and, therefore, merits the highest level of protection

Class II: Merits protection, either taken alone or in conjunction with other wetlands

Class III: Neither a Class I or Class II wetland

There are currently no Class I wetlands in the Passumpsic and upper Connecticut River basin. However, as part of the development of this tactical basin plan, several surface waters have been identified as prospective candidates for Class I, which are presented below. These wetlands have passed a cursory review by the Vermont Wetlands Program Ecologists. In addition, there are two wetlands that warrant study for Class I potential. These wetlands are also listed below. As part of the implementation of this tactical basin plan, the Department will develop and implement procedures and documents to enable submission, evaluation, and implementation of petitions to classify wetlands as Class I. Those wetlands that satisfy criteria for designation may be proposed for such designation through Departmental rulemaking authority consistent with the Vermont Wetland Rules.

Prospective candidates in the Passumpsic and upper Connecticut River basin for reclassification to Class I status include the Dennis and Mud Pond wetlands in Brunswick and Victory Basin wetlands complex in Victory.

Wetlands in the Passumpsic and upper Connecticut River basin that warrant further study for Class I potential include Moose Bog in Ferdinand and Yellow Bogs in Essex County.

F. Warm and cold Water Fish Habitat Designations

All wetlands are designated as warm water fish habitat for purposes of the Vermont Water Quality Standards along with the following ponds: Bruce Pond in Sheffield, Chandler Pond in Wheelock, Keiser Pond in Peacham/Danville, Dennis Pond in Brunswick, Stevens Pond in Maidstone. For warm water fish habitat, the WQS specifies a lower minimum dissolved oxygen concentration than waters in the remainder of the basin which are cold water habitat. No changes to warm water fish or cold water habitat designations are proposed by this plan.

Chapter 4- Watershed Improvement Actions and Implementation Table

The tactical plan implementation table (Table 5) identifies targeted objectives for the Passumpsic and upper Connecticut River Basin, and specific actions to achieve the stated objectives. Action items include both necessary data collection and assessment efforts and specific implementation activities. It is envisioned that the action items will be accomplished within the next five years. Action items reflect many of the primary goals and objectives identified in the Statewide Surface Water Management Strategy. This implementation table serves to identify high priority implementation actions and tasks that provide opportunities for all stakeholders in surface water management across each major river basin to pursue and secure technical and financial support for implementation. Specific locations for target actions are mapped online at this link. This tactical plan implementation table is intended to be a working document and will be updated with input from watershed partners every two years.

A. Watershed projects completed by VANR and/or its partners during the planning process

VDEC recognizes that good ideas that emerge from planning efforts often proceed prior to the final issuance of the plan being developed. Several important projects were completed during the planning process by VDEC's watershed partners, either independently or with VDEC support. The projects include:

- Better Backroads project on Mooney Road in St. Johnsbury, Vermont.
- Stormwater mapping for all communities in the watershed.
- Stormwater and sediment mitigation project scoping in Dish Mill Brook Watershed.
- Illicit Discharge Detection and Elimination (IDDE) project for St Johnsbury.
- Trees for streams buffer planting projects along the Connecticut River, Passumpsic River, East Branch Passumpsic River.
- Johnson Farm WMA conservation and floodplain restoration project.
- Many floodplain protection and restoration projects along the Connecticut River focused in the towns of Cannan and Maindstone.
- Passumpsic River bridge and culvert assessment.
- Vermont Fish and Wildlife/Trout Unlimited habitat restoration project along the East Branch Nulhegan River.

Project Highlight- Johnson Farm conservation project

A number of partners in the basin were involved in the conservation of 266 acres as part of a wildlife management area along the Connecticut River in Canaan and the

conservation of a working farm by the Vemront Land Trust. The project protected over six miles of river frontage which now has a floating buffer (that moves with the river as it moves) which will be restored to a floodplain forest. Funding for the project came from the Upper Connecticut River Mitigation and Enhancement Fund, significant investments from the Vermont Housing and Conservation Board and funding from the USDA Natural Resource Conservation Service, Pew Charitable Trusts, and the Department of Environmental Conservation through an Ecosystem Restoration Program grant. A floodplain restoration plan for the parcel and buffer planting was completed in 2014 and restoration efforts are expected to occur over the next few years.

Stormwater and sediment mitigation in Dish Mill Brook Watershed

Figure 8. Sediment runoff in the Dish Mill Brook watershed.

The Vermont Department of Environmental Conservation completed a stormwater map for the Dish Mill Brook watershed in 2014 that includes areas of ski area development and adjacent town roads and private developments. In addition to this, the Caledonia County Natural Resources Conservation District has completed Stream Geomorphic Assessments of Dish Mill Brook and key tributaries. Biological monitoring has shown degradation of the water quality of Dish Mill Brook over time and so VDEC and the Caledonia County NRCD have met with Q Burke and the Town of Burke and hopes to involve other partners in the watershed to discuss ways to reduce sedimentation and stormwater runoff from roads and developed areas of the watershed. With assistance from CCNRCD the town or Burke applied for a Better backroads grant to assess roads in the town and watershed. CCNRCD also applied for an ERP grant to support the consolidation of existing studies into stormwater master plan for the Dish Mill Brook watershed and some initial design work for projects in this basin including an evaluation of private roads for erosion control and sediment reduction projects. Also planned are discussions with the Burke Planning Commission on possible zoning regulations to minimize sediment and stormwater runoff and possibilities for rain gardens, infiltration trenches or other GSI techniques.

St. Johnsbury Better Backroads Project

Mooney Road has required continual maintenance from the Town of St. Johnsbury and resulted in a massive amount of sediment entering a wetland that drains to the Passumpsic River. In 2013 the Town of St. Johnsbury worked with the VDEC Watershed Coordinator to develop a Better Backroads proposal for the road which involved hiring a hoe ram to remove ledge so two 500 foot rock lined ditches could be installed. The project has greatly reduced sedimentation to the wetland and the town is interested in pursuing a road inventory grant to identify other town road erosion issues and applying for additional Better Backroad grants to address these.

Figure 9. Pictures of erosion from ditch on Mooney Road prior to Better Backroads project (left) and installation of rock lined ditch during construction (right).

Upper Connecticut River Cooperative Invasive Species Management Area (UCCISMA)

The UCCISMA is currently wrapping up a Federal "Pulling Together Grant" where the collective group accomplished many tasks including:

- 12 miles surveyed for invasive species in Nulhegan River and Indian Stream drainages.
- Developing a "Clean, Dry, Drain" program for watercraft with signage developed and installed at 16 locations within CISMA; video available on the internet.
- Two interns identified 1,172 invasive species locations involving 34 species with locations uploaded to iMap.

- Identified 12 priority Japanese knotweed sites - along 25 miles of the Connecticut River between Colkebrook and Maidstone.

Using funding provided by Plum Creek, the Northwoods Stewardship Center has agreed to act as the 2014 coordinator and using the UCCISMA strategic plan as a guide they hope to source future funding to continue Invasive species control and spread prevention efforts.

B. The Tactical Plan Implementation Table

Table 5 below is organized in four columns, the first of which describes the action, the second lists the lead and key players that will be implementing the actions, the third includes the potential funding sources, and the fourth column includes the priority and status of the action to be completed. All the actions are listed under objectives that are tied to stressors in the surface water management strategy and targeted towards priority areas in the basin. Every effort will be made to implement these actions within five years following the approval of this plan. That said, unforeseen events such as landowner unwillingness to move forward, lack of funding, or changes on the ground may prohibit the implementation of certain actions. Other actions will likely develop after the initial distribution of the plan and may be addressed within the same time period or in future updates to this plan.

Table 5. Implementation Table - Restoration, Protection, Assessment and Monitoring Actions – All actions are scheduled to be implemented from 2014-2019

Objective 1: Protect and restore high quality waters in the basin through reclassification to A(1) waters or Class 1 wetlands, Outstanding Resource Water (ORW) designation, or restoration through strategic woody debris placement. --*Related potential stressors Encroachment and Land Erosion* Priority areas - see Figure 3			
Action	**Lead/**Key Players	Funding	**Priority**/Status
1. VANR recommends that the Nulhegan River, Washburn Brook, Calendar Brook Trib 22, and Nation Brook Trib 3 be considered as candidates for reclassification to Class A(1) waters.	**VANR/**Conte refuge, Friends of the Nulhegan		Top 10
2. Petition for the reclassification of Victory Basin and Mud and Dennis Pond wetlands as Class 1 Wetlands.	**VDEC/** VFWD, TNC, Consultants		Top 10
3. Collect additional information on Moose and Yellow Bog to determine if reclassification is appropriate.	**VDEC**/Conte Refuge, Friends of the Nulhegan, Consultants		High
4. Collect information necessary to	**VANR/** Conte		High

support a petition for waters in the Nulhegan river basin as an ORW.	refuge, Friends of the Nulhegan, Consultants		
5. Complete biological assessments and other assessments to evaluate reclassification of Mill Brook (Bloomfield), Paul Stream, Steam Mill Brook above mile 5.6, Dish Mill Brook above Mile 2.1, East, Black, Yellow, Logger, and North Branches of the Nulhegan River as Class A(1) waters.	**VANR/** Conte Refuge, Friends of the Nulhegan, Consultants		High
6. Reclassify seven historical water supplies from Class A(2) waters to Class B waters.	**VDEC**/ Burke, Lyndon, Bloomfield		High
7. Identify high priority lakes for protection or reclassification.	**VDEC**		High
8. Improve lakeshore buffer protections in town zoning bylaws for lakes and ponds in the basin.	**Towns/**NVDA, VDEC, NRCD, Lake Associations.	604(b)	High
9. Support easements or conservation of undeveloped lakeshore habitat on priority lakes and ponds.	**VANR/** Lake Assn., Land trusts, landowners	VHCB, UCRM&E	Medium
10. Restore instream woody habitat in the East Branch Nulhegan watershed through strategic wood placement to increase brook trout populations. Based on study results extend these efforts to other watersheds where this practice is shown to be effective.	**Trout Unlimited/** VFW, Conte Refuge, Landowners	UCRM&E	Medium
Objective 2: Reduce prevalence of and damage caused by flooding in Lyndonville and erosion hazards throughout watershed. ***Related stressors: Channel erosion and Encroachment*** Priority areas: Lyndonville and upstream watershed for flooding and Millers Run, East and West Branches, South Wheelock Branch and Sleepers River for Erosion Hazards (see Figure E2)			
Action	**Lead/**Key Players	Funding	**Priority**/Status
11. Improve river corridor and floodplain protections for the Passumpsic, Millers Run, East and West Branch Passumpsic River in town zoning bylaws to allow these streams to develop new floodplains and reduce flood damage.	**Towns/**NVDA, CCNRCD, VDEC	ERP, UCRM&E, Municipal planning grants	Top 10
12. Complete Phase 1 and targeted Phase 2 assessments on unassessed tributaries in the lower watershed.	**CCNRCD /** Towns, NVDA, VDEC	ERP	High/ Phase 2 completed 2014 except for Joes

			brook
13. Meet with towns to discuss updating zoning bylaws to address erosion hazards after completion of Phase 2 assessments in the lower Passumpsic River watershed.	**Towns/**NVDA, CCNRCD, VDEC	PDM, 604(b)	High/ planned for 2014
14. Complete priority river corridor protection projects recommended in Phase 2 SGA reports (Figure E2).	**Towns/** NVDA, CCNRCD, VDEC	ERP, UCRM&E	High
15. Finalize and get FEMA approval for all hazard mitigation plans for Lyndon and upstream towns as well as towns interested in receiving increased state match under the Emergency Relief and Assistance Fund.	**Lyndon/** NVDA, CCNRCD, VDEC, FEMA	PDM	Medium
16. Support implementation of mitigation measures listed in all hazard mitigation plans including the removal of repeat flooding structures and evaluation of other mitigation measures to reduce future flood losses.	**Lyndonville/** NVDA, CCNRCD, VDEC, FEMA	PDM	Medium
17. Complete priority buffer planting projects recommended in Phase 2 SGA reports through Trees for Streams program or CREP program (Figure E3)	**Towns/** NVDA, CCNRCD, VDEC	ERP, Watershed grants	Medium
18. Support Low Impact Development (LID) standards and the use of Green Stormwater Infrastructure (GSI) in the watershed and protections of wetlands and floodplains that store floodwaters upstream.	**Towns/** NVDA, CCNRCD, VDEC	ERP, VANR, 604(b)	Medium
Objective 3: Create a better understanding of water quality conditions in the Passumpsic and upper Connecticut River watershed addressing waters with elevated E. *coli* levels, swimming holes not previously sampled, potential nitrogen, sediment and phosphorus source areas. ***Related stressors: Pathogens, Nutrients non erosion, Channel Erosion, Land Erosion.*** Priority Areas: Moose River and Gauge Brook, Connecticut River at swimming holes and Halls Stream, swimming holes, agricultural and developed land areas – areas with high densities of back roads and logging operations (see Tables 1 and 3.)			
Action	**Lead/**Key Players	Funding	**Priority**/Status
19. Implement an intensive water quality monitoring program to	**ECNRCD/** CCNRCD, CRJC, Coos County	ERP, Watershed grants, LaRosa	Top 10/

evaluate phosphorus, nitrogen, sediment and E. coli sources in the Basin. Use sampling results to identify pollution sources in the basin and work with basin partners to address these.	NRCD, CRWC, VDEC, Consultants, Burke Conservation Commission	partnership, private funding sources	
20. Establish a long term bi-state volunteer monitoring program covering the Connecticut River main stem and if possible major tributaries that is integrated with NH DES Volunteer River Assessment Program.	**Volunteers/** VDEC, CRJC, NHDES, CRWC, Burke Conservation Commission	LaRosa Partnership,	High/ monitoring program with NH DES and CRWC for 2014.
Objective 4: Resolve Passumpsic and Sleepers River E. *coli* impairments and complete assessments in areas of potential E. *coli* contamination. -- *Related stressor: Pathogens* Priority Areas: St Johnsbury CSO locations and assessment needed for Moose River and Gauge Brook, Connecticut River in select locations and Joes Pond (see Figure 5.)			
Action	**Lead /** Key Players	Funding	**Priority**/ Status
21. Complete stormwater separation project for the St. Johnsbury WWTP to end Combined Sewer Overflows.	**St. Johnsbury/** VDEC	Clean Water State Revolving Fund, Town	Top 10 / ongoing separation projects
22. Evaluate potential for GSI to reduce CSO frequency in the Tremont Street neighborhood or similar target watershed.	**St. Johnsbury/** VDEC, CCNRCD, NVDA	ERP, Clean water state revolving fund	Top 10/
23. Identify opportunities for increased treatment of separated stormwater before it is discharged to surface waters through the use of GSI.	**St. Johnsbury/** VDEC, CCNRCD	ERP, Town	High/CCNRCD ERP grant to develop design for treatment.
24. Where elevated levels of E. *coli* are confirmed in agricultural areas based on water sampling, target BMP projects on farms to reduce manure runoff in these areas.	**ARS/** VAAFM, NRCS, NRCD, VDEC	UCM&E, ERP, Watershed Grant	High -if identified/
25. Continue one additional season of E. *coli* sampling at Joes Pond to determine if elevated E. *coli* levels from 2012 recur and if elevated levels recur, work to identify and address E. *coli* sources.	**Danville/** Joes Pond Ass., VDEC	VDEC staff, Town, Watershed grant, LaRosa	High/ 2013 sampling meet water quality standards.
Objective 5: Protect and restore important floodplain and wetland habitat in the Basin. ***Related stressors: Encroachment, Channel Erosion, Nutrient loading*** Priority Areas: Lunenburg through Brunswick and in the town of Canaan and other existing and			

potential floodplain and wetland restoration sites in the upper Connecticut Passumpsic River watershed (see Figure 4.)			
Action	**Lead /** Key Players	Funding	**Priority**/Status
26. Contact landowners in priority areas with important floodplain protection or restoration opportunities to encourage participation in conservation and restoration programs.	**ECNRCD/** CCNRCD, VDEC, PVLT, TNC, VLT, VRC, CRJC, Consultants	UCRM&E, ERP, Watershed grant	Top 10
27. Complete floodplain protection projects and where applicable restoration projects.	**TNC /** VLT**,** VRC**,** NRCS, VFWD, VRC, ECNRCD, CRWC	UCRM&E, CREP, ERP, PF&W, watershed grant	High
28. Complete wetland restoration projects on marginal agricultural lands which have been historically drained.	**VDEC/** NRCS, ENRCD, TNC, VLT, VFWD, Consultants	UCRM&E, CRP, CREP, ERP, PF&W	High
29. Work with towns on the Connecticut River from Lunenburg to Canaan to strengthen NFIP bylaws and shoreland protections along the Connecticut River.	**Towns/** VDEC, NVDA, NRCD	Municipal planning grants	High
Objective 6: Reduce nitrogen loading to the Connecticut River and Long Island Sound. ***Related stressors: Nutrient loading (non-erosion)*** Priority Areas: Basin wide with focus on sources areas shown in Figure 7.			
Action	**Lead/**Key Players	Funding	**Priority**/Status
30. Complete outreach to farmers to improve nitrogen management on farms through the use of Adapt N software, pre side dress nitrate testing and demonstrating the use of shorter duration corn with legume cover crops.	**UVM Ext/** NRCD, AAFM, NRCS	Long Island Sound Futures fund, 319	Top 10
31. Reduce nitrogen loading from wastewater treatment plants as identified in WSMD wasteload allocation plan.	**VDEC/** Towns	Clean water state resolving fund, Local funding	High
32. Identify potential nitrogen sources and highest priority BMP's for reducing nitrogen runoff from agricultural and developed lands in the Basin.	**ARS/** NRCS, VDEC, NRCD, AAFM	ERP, UCM&E	High
33. Complete IDDE in Danville, Lyndonville, Moose- Concord,	**VDEC/** CCNRCD, Towns	ERP	Medium

Canaan-Beecher Falls, Lunenburg-Gilman subwatersheds.			
34. Complete BMP's to address nitrogen runoff as suggested by studies above or low cost strategies such as buffer plantings in locations targeted to filter runoff or with other local water quality benefits targeting areas identified in Figure 7.	**VDEC/** Lake Associations, VDEC, NRCD's	EQIP, ERP, UCM&E, AG BMP, CREP, CRP	Medium
Objective 7: Improve the biological condition of Dish Mill Brook which is stressed by increased scour from stormwater flows and sedimentation. ***-- Related stressors: Channel Erosion, Land Erosion.*** Priority Areas: Dish Mill Brook tributary and adjacent drainage to Dish Mill Brook(see Figure 5)			
Action	**Lead /** Key Players	Funding	**Priority**/Status
35. Complete a stormwater master plan in the Dish Mill Brook Watershed working with key partners to identify stormwater and sediment source areas, treatment options, and required maintenance schedule for proposed as well as existing infrastructure.	**CCNRCD/** VDEC, Q Burke, Town of Burke, Kingdom Trails, VDFPR, Homeowner Associations, NVDA	ERP, Municipal planning grants, 604(b), Private or local funding	Top 10/ Meeting with Burke Mountain and town of Burke to identify list of potential projects.
36. Complete Better Backroads assessment and projects for High Meadow Road, the Mountain Road as well as other town and private roads in the Dish Mill Brook Watershed.	**CCNRCD**/ Q Burke, VDEC, Homeowner Associations, Town of Burke	Better Backroads Grants, Private or local funding, ERP	High/ Potential for CCNRCD to apply for grant in 2014.
37. Work with towns to develop zoning bylaws to protect pre-development hydrology and minimize increases in sediment and stormwater in this watershed. Bylaws should also protect natural features such as wetlands, streams, floodplains, and riparian buffers.	**Town of Burke /** VDEC, NVDA	Municipal planning grants, 604(b)	High
38. Implement high priority sediment reduction and stormwater treatment projects identified through stormwater master planning including low impact development retrofits and roadway erosion control projects if identified as a priority.	**Q Burke/** VDEC, CCNRCD, VDFPR	Private or local funding, ERP, Dry hydrant funding, Better Backroads Grants	Medium
39. Work with homeowners associations, QBurke, other partners	**CCNRCD/** VDEC, Q Burke, Town of	ERP, Private funding,	Medium

in the Dish Mill Brook watershed to put in rain gardens to reduce stormwater runoff.	Burke, homeowner associations, NVDA	Watershed grant	
40. Work with developers in the Dish Mill Brook watershed to use innovative green stormwater infrastructure techniques in future development proposals.	**Q Burke/** VDEC, CCNRCD, NVDA, Developers, VDFPR	Private funding, ERP	Medium
41. Support regulatory review of ski area long term development plans for additional stormwater treatment to handle existing discharges in areas proposed for future development. Evaluate trails network(s) for soil erosion potential. As necessary update Water Quality Remediation Plan.	**QBurke**, VANR, NRB	QBurke	Medium
Objective 8: Reduce phosphorus and sediment loading to stressed lakes, ponds and streams in the Basin. ***Related stressors: Channel Erosion, Encroachment, Land Erosion, Nutrient Loading (non-erosion)*** Priority Areas: Maidstone Lake, and Wallace, Stevens, Miles, Mile, West Mountain Ponds- Leach Stream, First and Murphy Brooks (See Figure 5) along with Connecticut River above Moore Reservoir and the Passumpsic River watershed.			
Action	**Lead/**Key Players	Funding	**Priority**/Status
42. Work with the communities of Burke, Newark, Danville, Walden, St. Johnsbury and Concord to complete capital improvement inventories and develop a local template that can be applied to other towns in the basin and that includes use of bridge and culvert assessment data.	**NRCD**/ NVDA, VAOT, VDEC, Town Road Foreman and Select Boards	Better Backroads grant, Watershed Grant, UCM&E, ERP	Top 10/ Plans for Burke, Concord, and St Johnsbury assessments in 2014.
43. Complete VANR Bridge and Culvert surveys in the upper Connecticut River watershed with priorities on the Leach Stream watershed and the towns of Canaan and Concord.	**ECNRCD/** Towns, NVDA, VDEC	ERP, Better backroads grant, Watershed grant, UCM&E	High
44. Complete a dirt road erosion inventory (including class IV roads) in the upper Passumpsic River watershed (towns of Wheelock, Sutton, Newark, Burke) to identify priority erosion projects for Better Backroads project grants. Continue	**NVDA**/ NRCD, VAOT, VDEC, Town Road foreman and select boards	ERP, Better Backroads grant, Watershed grant	High

work in Kirby, Lyndon, St Johnsbury, Danville, Walden, Concord, Lunenburg.			
45. Complete projects to address major identified sediment sources (or AOP barriers) while working to minimize concentration of runoff into ditches.	**Towns/**VDEC, NRCD, VAOT , NVDA,	Better backroads, ERP	Medium
46. Purchase a hydroseeder through a cooperative agreement to share with multiple towns.	**NVDA**/ NRCD, VAOT, VDEC, Town Road Foreman and Select Boards	UCM&E, ERP grant	Medium
47. Complete lake assessments on lakes listed as stressed for sedimentation and nutrient enrichment to determine current status and where high levels of nutrient and sediment stress are confirmed complete watershed assessments.	**VDEC/** Lake associations	VDEC staff	Medium
48. Identify logging sites in these watersheds that are sources of sediment and determine cause of sedimentation, how to prevent this in future logging jobs and any potential restoration opportunities such as restoring hydrology where past logging roads have captured runoff.	**VDEC/**VDFPR, Lake Associations, NRCD's	NSRC	Medium
49. Set up a series of workshops and trainings with towns to discuss key barriers preventing towns from addressing priority water quality issues associated with transportation infrastructure building on the well attended road resiliency workshop held in 2012.	**NRCD**/NVDA, VAOT, VDEC, Town Road Foreman	ERP grant, Watershed grant	Medium/ CCNRCD received watershed grant to hold workshop in 2014
Objective 9: Restore littoral habitat on impacted lakes and ponds in the Basin. ***Related stressors: Encroachment, Land Erosion, Nutrient Loading (non-erosion)*** Priority Areas: Shadow, Neils, Coles, and Newark Ponds with reduced habitat from development and Miles, Maidstone, and Joes Ponds with poor shoreline habitat from development (see Figure 5.)			
Action	**Lead/**Key Players	Funding	**Priority**/Status
50. Identify lake associations or blocks of interested landowners for targeted outreach for the LakeWise certification program.	**VDEC/** Lake associations, NRCD	Watershed grant	High

51. Fund buffer restoration to allow landowners to meet LakeWise standards targeted to contiguous blocks of landowners.	**VDEC/** Lake associations, NRCD	ERP	Medium
Objective 10: Monitor and minimize spread of Didymo – and prevent spread of other invasive species not in the basin including Eurasian water milfoil. -- ***Related Stressor: Aquatic Invasive Species*** Priority Areas: Basin wide			
Action	**Lead/**Key Players	Funding	**Priority**/Status
52. Support Upper Connecticut Cooperative Invasive Species Management Area (UCCISMA) as an organization that can coordinate early detection and rapid response for invasive species in this basin.	**ECNRCD**/ NRCS, VDFPR, VDEC, Conte, NorthWoods	UCM&E	Medium
53. Support lake associations in starting up and continuing VIP programs on lakes in the basin.	**Lake associations**/ VDEC	ANS	Medium
Objective 11: Reduce levels of oil and contaminants reaching the Sleepers River. ***Related Stressor: Toxic Substances*** Priority Areas: Fairbanks Morse and St Johnsbury landfill site (see Figure 5.)			
Action	**Lead/**Key Players	Funding	**Priority**/Status
54. Continue recovery efforts for oil on the Fairbanks Morse site until threat to surface waters has been sufficiently addressed.	**Landowners**/ Consultants, VDEC		Medium
55. Complete a Phase 2 brownfield assessment to identify any additional contamination at the Fairbanks Morse site and address any that may be impacting surface waters.	**St Johnsbury, NVDA/** VDEC	Brownfields grant	Medium
56. Consider streambank and floodplain restoration opportunities that might be possible with any redevelopment of the Fairbanks Morse site.	**St Johnsbury, Landowners/** NVDA, VDEC, CCNRCD	ERP, UCM&E	Medium

List of Acronyms

319 -Federal Clean Water Act, Section 319
604(b) -Federal Clean Water Act, Section 604b
AAP -Accepted Agricultural Practice
AEM -Agricultural Environmental Management
Agency -Vermont Agency of Natural Resources
AMP -Acceptable Management Practice
ANS -Aquatic Nuisance Species
AOP -Aquatic Organism Passage
ARS -Agricultural Resource Specialist
BBR -Better Backroads grant
BMP -Best Management Practice
CCNRCD- Caledonia County Natural Resource Conservation District
CREP -Conservation Reserve Enhancement Program
CRJC- Connecticut River Joint Commissions
CRP- Conservation Reserve Program
CRWC -Connecticut River Watershed Council
ECNRCD- Essex County Natural Resource Conservation District
ERP – Ecosystem Restoration Program grant
EQIP -Environmental Quality Incentive Program
FEH -Fluvial Erosion Hazard
FERC -Federal Energy Regulatory Commission
GSI- Green Stormwater Infrastructure
IDDE – Illicit Discharge Detection and Elimination
LID -Low Impact Development
MAPP -Monitoring, Assessment and Planning Program
NHDES- New Hampshire Department of Environmental Services
NOFA -Northeast Organic Farming Association of Vermont
NPDES -National Pollution Discharge Elimination System
NPS -Non-point source pollution
NRCD -Natural Resource Conservation District
NRCS -Natural Resources Conservation Service
NVDA- Northeast Vermont Development Association
ORW -Outstanding Resource Water
PDM -Pre-Disaster Mitigation
PFW -Partners for Fish and Wildlife
R T&E -Rare, Threatened and Endangered Species
RCP -River Corridor Plan
RMP -River Management Program
RPC -Regional Planning Commission
SGA -Stream Geomorphic Assessment
TFS -Trees For Streams
TMDL -Total Maximum Daily Load
TNC -The Nature Conservancy
TU -Trout Unlimited
UCM&E- Upper Connecticut Mitigation and Enhancement Fund
USDA -United States Department of Agriculture
USEPA -United States Environmental Protection Agency
USFWS -United States Fish and Wildlife Service
USGS -United States Geological Survey
UVA -Use Value Appraisal program, or Current Use Program
UVM -University of Vermont
VAAFM -Vermont Agency of Agriculture, Food and Markets
VABP -Vermont Agricultural Buffer Program
VAOT-Vermont Agency of Transportation
VANR -Vermont Agency of Natural Resources
VDEC - Vermont Department of Environmental Conservation
VDFPR -Vermont Department of Forests, Parks and Recreation
VDHP -Vermont Department of Historic Preservation
VDH -Vermont Department of Health
VEM -Vermont Emergency Management
VFWD Vermont Fish and Wildlife Department
VGS Vermont Geological Survey
VINS Vermont Institute of Natural Science
VIP -Vermont Invasive Patrollers
VLCT -Vermont League of Cities and Towns
VLRP -Vermont Local Roads Program
VLT -Vermont Land Trust
VWRB -Vermont Water Resources Board

References:

Army Corps of Engineers, New England Division. 1976. *Miller Run and Ayers Brook Vermont – Connecticut River Basin Situation Report.* Waltham MA.

Benoit, J, Carter, M, and Goclowski, Matthew. 2013. *Leach Stream Phase 1 Geomorphic Assessment.* Produced under contract with the Essex County Natural Resources Conservation District, St Johnsbury VT

Colton-Stevens, T. 2009. *Phase 1 Stream geomorphic Assessment Moose River; Essex and Caledonia Counties - Final Report.* Essex County Natural Resources Conservation District, St Johnsbury VT

Colton-Stevens, T. 2009*. *Phase 2 Stream geomorphic Assessment Moose River; Essex and Caledonia Counties Concord and St Johnsbury Vermont - Final Report.* Essex County Natural Resources Conservation District, St Johnsbury VT

Colton-Stevens, T. 2008. *Executive summary to River corridor restoration and protection grants program - Final Report.* Essex County Natural Resources Conservation District, St Johnsbury VT

Deacon J. 2006. *Assessment of Total Nitrogen in the upper Connecticut River Basin in New Hampshire, Vermont and Massachusetts, December 2002-Septermber 2005.* U.S. Department of the Interior, USGS.

Dedam, J. 1998. *The Millers Run Stream Habitat improvement Project 1994-1997*. Caledonia County Natural Resources Conservation District, St Johnsbury VT.

FB Environmental Associates, Inc. 2010. *Final Report New Hampshire Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters.* Prepared for the New Hampshire Department of Environmental Services, Concord NH.

Fields, J. 2006. *Fluvial Geomorphology Assessment of Northern Connecticut River Tributaries Final Report* Prepared for Connecticut River Joint Commissions Charlestown, New Hampshire.

Fisk, J. 2007. *AMC River Guide New Hampshire/Vermont, 4th edition.* Appalachian Mountain Club, Boston MA.

Fitzgerald Environmental Associates LLC. 2014. *Lower Passumpsic River Tributaries River Corridor plan.* Produced under contract with the Caledonia County Natural Resources Conservation District, St Johnsbury VT.

Fitzgerald Environmental Associates LLC. 2013. *Lower Passumpsic River Tributaries Phase 1 Stream Geomorphic Assessment Report.* Produced under contract with the Caledonia County Natural Resources Conservation District, St Johnsbury VT.

Fitzgerald Environmental Associates LLC, 2010. 2009. *Millers Run River Corridor Plan- Burke and Lyndon Vermont.* Produced under contract with the Caledonia County Natural Resources Conservation District, St Johnsbury VT.

Gerhardt, Fritz. 2010*. *Significant Ecological Features and Restoration Scenarios for the Johnson Farm, Canaan and Lemington, Vermont.* Prepared for the Vermont Land Trust

Gerhardt, Fritz. 2010. *Restoring Floodplain Forests along the Upper Connecticut River: Restoration Plans for the Smart and LeFoll Farms.* Prepared for Essex County Natural Resources Conservation District.

Gerhardt, Fritz. 2009. *Restoring Floodplain Forests along the Upper Connecticut River: Restoration Plan for the Irwin Farm in Maidstone, Vermont.* Prepared for Essex County Natural Resources Conservation District.

Gerhardt, Fritz. 2008. *Review of Ecological Research on Aquatic and Riparian Habitats along the Main Stem and East Branch of the Nulhegan River, Vermont.* Prepared for the Vermont River Conservancy.

Jenkins J. and P. Zika, 1992. The Whitewater Rivers of Vermont: *The Biology, Geography and Recreational Use*. Vermont Agency of Natural Resources.

Jenkins, J. and P. Zika, 1985. *The Waterfalls, Cascades, and Gorges of Vermont*. VT Agency of Environmental Conservation.

Kimball, K. and Poppenwimer, C. 2013. *Upper Connecticut River Mitigation and Enhancement Fund Priority Riparian Areas in the MEF Service Area - Report and Recommendations.* Appalachian Mountain Club.

Kratzer, J. 2013. *Passumpsic and upper Connecticut Watershed Fisheries.* Vermont Fish and Wildlife Department

Marks, C. Lutz, C. and Olivero-Sheldon, A. 2011. *Ecologically important floodplain forests in the Connecticut River watershed.* The Nature Conservancy, Connecticut River Program. 44pp.

Moore R. et al. 2004. *Estimation of Total Nitrogen and Phosphorus in New England Streams Using Spatially Referenced Regression Models.* U.S. Department of the Interior. USGS in cooperation with EPA and New England Interstate Water Pollution Control Commission.

New England Interstate Water Pollution Control Commission et al. 2007. *Northeast Regional Mercury Total Maximum Daily Load.* Produced by New England state Departments of Environmental Conservation in cooperation the New England Interstate Water Pollution Control Commission.

New Hampshire Fish and Game Department. 2005. *New Hampshire Wildlife Action Plan.* New Hampshire Fish and Game Department. Concord NH.

Nongame and Natural Heritage Program. 1990 *Exceptional natural habitat and rare plant and animal species of Essex County Vermont.* Vermont Agency of Natural Resources, Vermont Fish and Wildlife Department, Nongame and Natural Heritage Program. Montpelier VT.

NVRCDC. 2009. Vermont *Better Backroads Manual*. George D. Aiken & Northern Vermont Resource Conservation and Development Council.

O'Brien, K. 2009. *East Branch Passumpsic River Corridor Plan- Burke and Lyndon Vermont.* Caledonia County Natural Resources Conservation District, St Johnsbury VT.

O'Brien, K. 2009*. *Millers Run River Corridor Plan- Burke and Lyndon Vermont.* Caledonia County Natural Resources Conservation District, St Johnsbury VT.

Sorenson, E. et al. 1998a. *Floodplain Forests of Vermont- Some Sites of Ecological Significance.* Vermont Agency of Natural Resources, Vermont Fish and Wildlife Department, Nongame and Natural Heritage Program.

Sorenson, E. et al. 1998b. *Northern White Cedar Swamps and Red Maple Northern White Cedar Swamps of Vermont: Some Sites of Ecological Significance.* Vermont Agency of Natural Resources, Vermont Fish and Wildlife Department, Nongame and Natural Heritage Program.

US. Environmental Protection Agency, 2012. *National Lakes Assessment. Washington, D.C.* http://water.epa.gov/type/lakes/lakessurvey_index.cfm

VAOT. 2013. *Town Road and Bridge Standards, January 23, 2013.* Vermont Agency of Transportation

VT AAFM. 2005. *Accepted Agricultural Practice Regulation, Effective Date: January 25, 2005*. Vermont Agency of Agriculture, Food and Markets. Montpelier VT.

VDEC. 2013. *Gauging the Health of Vermont Lakes: Results of the 2007 National Lake Assessment. Vermont Agency of Natural Resources.* Vermont Department of Environmental Conservation, Watershed Management Division. Montpelier VT.

VDEC. 2012a. *State of Vermont Year 2012 303(d) List of Water*. Prepared for USEPA by Vermont Department of Environmental Conservation Watershed Management Division. Montpelier VT.

VDEC. 2012b. *State of Vermont Year 2012 List of Priority Surface Waters Outside the Scope of Clean Water Act Section 303(d)*. Prepared for USEPA by Vermont Department of Environmental Conservation, Watershed Management Division. Montpelier VT.

VDEC. 2012c. *Interim Anti-degradation Implementation Procedure*. Vermont Department of Environmental Conservation, Watershed Management Division. Montpelier VT.

VDEC. 2012d. *Vermont Surface Water Management Strategy*. Vermont Department of Environmental Conservation, Watershed Management Division Montpelier VT.

VDEC. 2011. *Northern Connecticut River and Direct Tributaries ~Basin 16~Water Resources, Water Quality, and Aquatic Habitat Assessment Report*. Vermont Department of Environmental Conservation, Watershed Management Division. Montpelier Vt. Montpelier VT.

VDEC. 2009. *Passumpsic River watershed- Water Quality and Aquatic Habitat Assessment Report*. Vermont Department of Environmental Conservation, Watershed Management Division. Montpelier VT.

VDEC. 2008. *Draft Vermont Anti-Degradation Implementation - Existing Use Determination For Use During River Basin Planning*. Vermont Department of Environmental Conservation, Montpelier VT.

VDEC. 2003. *Total Maximum daily loads: 30 Acid Impaired Lakes.* Vermont Department of Environmental Conservation, Water Quality Division. Montpelier VT.

VDEC. 1994. *Lake Protection Classification System.* Vermont Department of Environmental Conservation, Water Quality Division. Montpelier VT.

VDEC. 1992. *Passumpsic River watershed Comprehensive River Plan*. Vermont Department of Environmental Conservation, Water Quality Division. Montpelier VT.

Vermont Fish and Wildlife Department. 1993. *The Vermont Management Plan for Brook, Brown, and Rainbow Trout.* Vermont Department of Fish and Wildlife. Montpelier VT.

Vermont Geological Survey. 1987. *Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites*. Agency of Natural Resources, Montpelier VT.

VT DFPR. 2005. *Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont. 8th Printing 2005*. Vermont Department of Forests, Parks and Recreation.

VT NRB, 2011. *Vermont Water Quality Standards*. Vermont Natural Resources Board, Vermont Water Resources Panel.

Wilson, A. 1992. AMC Quiet Water Canoe Guide. Appalachian Mountain Club, Boston, MA.

Glossary

10 V.S.A., Chapter 47 - Title 10 of the Vermont Statutes Annotated, Chapter 47, Water Pollution Control, which is Vermont's basic water pollution control legislation.

Accepted Agricultural Practices (AAP) - land management practices adopted by the Secretary of Agriculture, Food and Markets in accordance with applicable State law.

Acceptable Management Practices (AMP) - methods to control and disperse water collecting on logging roads, skid trails and log landings to minimize erosion and prevent sediment and temperature changes in streams. AMPs may not be the best methods, but are acceptable.

Aquatic biota - all organisms that, as part of their natural life cycle, live in or on waters.

Basin - one of fifteen planning units in Vermont. Some basins include only one major watershed after which it is named such as the Lamoille River Basin. Other Basins include two or major watersheds such as the Poultney/ Mettawee Basin.

Best Management Practices (BMP) - a practice or combination of practices that may be necessary, in addition to any applicable Accepted Agricultural or Silvicultural Practices, to prevent or reduce pollution from nonpoint source pollution to a level consistent with State regulations and statutes. Regulatory authorities and practitioners generally establish these methods as the best manner of operation. BMPs may not be established for all industries or in agency regulations, but are often listed by professional associations and regulatory agencies as the best manner of operation for a particular industry practice.

Classification - a method of designating the waters of the State into categories with more or less stringent standards above a minimum standard as described in the Vermont Water Quality Standards.

Designated use - any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water as set forth in §§ 3-02 (A), 3-03(A), and 3-04(A) of the Vermont Water Quality Standards.

Existing use - a use that has actually occurred on or after November 28, 1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring

Fluvial geomorphology - a science that seeks to explain the physical interrelationships of flowing water and sediment in varying land forms

Green Infrastructure - A wide range of multi-functional, natural and semi-natural landscape elements located within, around, and between developed areas at all spatial scales.

Green Stormwater Infrastructure (GSI) - Systems and practices that restore and maintain natural hydrologic processes in order to reduce the volume and water quality impacts of the built environment while providing multiple societal benefits.

Impaired water - a water that has documentation and data to show a violation of one or more criteria in the Vermont Water Quality Standards for the water's class or management type.

Low Impact Development - An innovative land planning and engineering design approach which seeks to maintain a sites pre-development ecological and hydrologic function through the protection, enhancement, or mimicry of natural processes.

Nonpoint source pollution - waste that reaches waters in a diffuse manner from any source other than a point source including, but not limited to, overland runoff from construction sites, or as a result of agricultural or silvicultural activities.

pH - a measure of the hydrogen ion concentration in water on an inverse logarithmic scale ranging from 0 to 14. A pH under 7 indicates more hydrogen ions and therefore more acidic solutions. A pH greater than 7 indicates a more alkaline solution. A pH of 7.0 is considered neutral, neither acidic nor alkaline.

Point source - any discernible, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which either a pollutant or waste is or may be discharged.

Reference condition - the range of chemical, physical, and biological characteristics of waters minimally affected by human influences. In the context of an evaluation of biological indices, or where necessary to perform other evaluations of water quality, the reference condition establishes attainable chemical, physical, and biological conditions for specific water body types against which the condition of waters of similar water body type is evaluated.

Sedimentation - the sinking of soil, sand, silt, algae, and other particles and their deposition frequently on the bottom of rivers, streams, lakes, ponds, or wetlands.

Water Quality Standards (WQS) - the minimum or maximum limits specified for certain water quality parameters at specific locations for the purpose of managing waters to support their designated uses. In Vermont, Water Quality Standards include both Water Classification Orders and the Regulations Governing Water Classification and Control of Quality.

Waters - all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs and all bodies of surface waters, artificial or natural, which are contained within, flow through or border upon the State or any portion of it.

Watershed - all the land within which water drains to a common waterbody (river, stream, lake pond or wetland).

Appendix A – Existing Use Tables

Swimming as an Existing Use

There are relatively few popular swimming holes with public access on rivers in the Passumpsic and upper Connecticut River basin.

Table A.1. Name and location of swimming sites in the Passumpsic and upper Connecticut River basin

Swimming Sites Name, Waterbody	Town	Location
Emerson Falls swimming hole - Sleepers River	Saint Johnsbury	Off of Emerson Falls Road above and below the waterfall.
East Burke village swimming hole – East Branch Passumpsic River	Burke	Swimming hole used by mountain bikers in the village
East Burke park swimming hole – East Branch Passumpsic River	Burke	Lightly used swimming hole on the East Branch of the Passumpsic River.
Capon Brook	Cannan	downstream of Rt 102 culvert

Recreational Boating as an Existing Use

The Passumpsic and upper Connecticut River basin has a number of important recreational boating rivers. These include the Nulhegan, which is part of the Northern Forest Canoe Trail that runs from Old Forge, New York to Fort Kent, Maine. In addition to this the Moose, Passumpsic River, and East Branch of the Passumpsic River are popular boating rivers. The Conneticut River is also a popular boating river and is supported by the Connecticut River Paddlers Trail although this is not listed as an existing use in this plan because this is considered a New Hampshire water.

Table A.2 . Waters used for recreational boating in the Passumpsic and upper Connecticut River Basin

Location	Documentation	Rating (DEC, 1989)	Characteristics that support use	Put in	Take out

Location	Documentation	Rating (DEC, 1989)	Characteristics that support use	Put in	Take out
Nulhegan River headwaters to Connecticut River	Vermont's White Water Rivers/Northern Forest Canoe Trail	Highly Important	Flat water to Class-IV rapids. Inclusion on the Northern Forest Canoe Trail. Very remote and scenic river scenery.	Route 105 Brighton	Debainvile Access Connecticut River confluence in Bloomfield
Moose River Victory through St Johnsbury	AMC River Guide, Vermont's White Water Rivers	Highly Important	Flat water to Class III rapids. Remote stream with wetland scenery through Victory Bog.	Victory Basin WMA	Fred Mold Park
East Branch Passumpsic River (11 miles)	Vermont's White Water Rivers	Important	Class I and II rapids rural scenery.	Rt. 114 Bridge in Newark	Lily Pond Road/Passumpsic River access
Passumpsic River West Branch confluence to Connecticut River	AMC River Guide, Passumpsic River boating guide	Not rated – primarily flat water boating but well used for most reaches		Lily Pond Road	Connecticut River access in Barnet

Recreational Fishing as an Existing Use

There are many sites in the watershed where angling occurs. The State of Vermont and partners have ownership or public access easements of many large parcels with fishing use and other waters have been identified as having fishing intensity and access to justify stocking by the Department of Fish and Wildlife as listed in Table A.3 below. The Department of Fish and Wildlife has identified other streams with fishing use through Creel surveys and direct correspondence with anglers and game wardens and these are listed as having an existing use for fishing if there is access to the stream through road crossings. The agency acknowledges that this list is far from complete and that there are many other small streams where fishing use takes place and such use would be identified in any permit process where fishing use was threatened.

Table A.3. Recreational Fishing as an existing use of specific waters within the Passumpsic and upper Connecticut River Basin.

Site Name/Waterbody	Location	Documentation
Keyer Brook	From Clay Brook Road to mouth	Fishing use and road access
Carr Brook	From above Carr Brook Ln to Below Rt 2 Crossing	Fishing use and road access
Nulhegan River	From Nulhegan pond to mouth.	Fish stocking sites
Nulhegan River East Branch	From North side of Sable Mountain to Route 105	Fish stocking sites Fishing use and public access easement lands
Broulliard, Fisher, Murphy, and Spaulding Brooks	Entire lengths	Fishing use and public access easement lands
Nulhegan River Black Branch	Peanut Dam Road	Fish stocking sites public access easement lands and road access
North Branch Nulhegan River	Entire length	Fishing use and road access
Tim Carroll Brook	Entire length	Fishing use and road access
Paul Stream	Entire length	Fish stocking sites and West Mountain WMA
Madison Brook	Entire length	Fish stocking sites, West Mountain WMA, public access easement
Granby Stream	From West Mountain WMA to Bridge crossing Granby Stream 2.1 up Granby Stream Road	Fish stocking sites
Moose River	From East and West Branch confluence to mouth	Fish stocking sites
West Branch Moose River	Entire length	Fishing use and public access easement
East Branch Moose River	Entire length	Fishing use and public access easement
Bog Brook	Entire length	Fishing use and Victory WMA
Line Brook	Entire length	Fishing use and public access easement
East Branch Passumpsic River	From Lost Nation Road to West Branch Confluence	Fish stocking sites
Dish Mill Brook	From Pinkam Rd to mouth	Fishing use and road access
Jack Brook	Along Jack Brook Road	Fishing use and road access
West Branch	From West Burke Village to mouth	Fish stocking sites

Site Name/Waterbody	Location	Documentation
Passumpsic		
Calendar Brook	King Georges Rd to mouth	Fishing use and road access
Roundy Brook	From uppermost Brook Rd crossing to mouth	Fishing use and road access
Millers Run	From Chesley Hill St in Sheffield to mouth	Fish stocking sites
Fall Brook	Entire Length	Fishing use and road access
Square Brook	Entire Length	Fishing use and road access
Passumpsic River	Entire Length	Fish stocking sites
Water Andric	Entire Length	Fishing use and road access
South Wheelock Branch	Entire Length	Fishing use and road access
Simpson Brook	From Daniels farm Rd to mouth	Fishing use and road access
Sleepers River	From Emerson Falls to Mouth	Fish stocking sites
Joes Brook	From Route 5 to Mouth	Fish stocking sites
Steam Mill Brook	Entire length	Fishing use and Steam Mill Brook WMA
Rake factory Brook	Entire Length	Fishing use and road access

Drinking Water Supplies as an Existing Use

Drinking water systems within the watershed include impoundments, lakes, ponds, streams, well points, dug wells, gravel, and gravel screened wells, gravel open-end casings, rock wells and springs. Waters within the watershed that are designated as drinking water supplies are listed in Table A.4. Most other municipalities in the watershed use ground water wells for drinking water supplies

Surface waters used for public drinking water supplies are Stiles Pond in Waterford which is still in active use and the Danville Reservoir on a tributary to Brown Brook which is currently used as an emergency water supply.

Table A.4. Water Supply as an existing use within the Passumpsic and upper Connecticut River Basin.

Water Body	Location	Extent	Documentation
Stiles Pond	Waterford	Stiles Pond	Town of St. Johnsbury water supply
Danville	Danville	Tributary to Brown	Danville emergency water supply

Reservoir		Brook	

Appendix B – Biological Assessments in Basin 15 and 16 along with Very High Quality waters, Potential Very High Quality waters, A(1) candidates and potential A(1) candidate waters.

Table B.1. Macroinvertebrate and Fisheries community assessments in Basin 15 and 16.
Bold Blue = Class A(1) condition/ *Blue italics= potential Class A(1) water* **/ Bold green= Either macroinvertebrate or fish indicate very high quality water/** *Italics Green = Either macroinvertebrate or fish suggest potential very high quality water* **/** ***Orange Bold italics = potential issues*** **/ Grey highlight = impaired /** ~~~~~~~~ shows possible change in condition between stream stations ----- shows possible in condition change over time.

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
Passumpsic River and minor tributaries				
Barnes Brook 0.1	9/16/2005	*Excellent*	*Excellent*	*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Passumpsic River 6.7	9/10/2012	*Ex-Vgood*		
Passumpsic River 6.7	9/8/2010	*Vg-Good*		*Macroinvertebrate and fish community*
Passumpsic River 6.7	9/6/2005	*Very Good*		*assessment suggest potential very high quality*
Passumpsic River 6.7	9/21/2000	*Excellent*		*water*
Passumpsic River 6.7	9/9/1992	*Very Good*		Impaired due to E. *coli* from combined
Passumpsic River 6.7	10/3/1991	*Ex-Vgood*		sewer overflow
Passumpsic River 6.7	9/19/1990	Fair		
Passumpsic River 6.7	9/29/1988	Poor		
Passumpsic River 6.7	9/29/1987	Fair		
Passumpsic River 8.6	9/10/2012	**Ex-Vgood**		**Macroinvertebrate community**
Passumpsic River 8.6	9/8/2010	**Excellent**		**assessment indicates very high quality**
Passumpsic River 8.6	9/21/2000	**Very Good**		**water**
Passumpsic River 8.6	9/29/1988	Good		Impaired due to E. *coli* from combined sewer overflow
Passumpsic River 12.9	9/21/2000	*Very Good*		*Macroinvertebrate community assessment*
Passumpsic River 18.3	9/10/2010	*Very Good*		*suggest potential very high quality water*
Roberts Brook 0.1	9/8/2006	Good	Very Good	Macro assessment included high levels of sand and embeddedness and conductivity (457 uhmos/cm. Brook trout number is low for unknown reason but sculpins were ok
Roberts Brook 0.1	9/8/2005	Good	Poor	
Simpson Brook 0.4	9/5/2006	*Vg-Good*	***Poor***	2006-There is no apparent reason that would explain the very low density of fishes here.
Simpson Brook 0.4	9/16/2005	*Ex-Vgood*	***Poor***	
Simpson Brook 1.5	9/5/2006		Good	
South Wheelock Branch 5.2	*9/20/2005*		*Excellent*	*Fish community assessment suggest potential very high quality water*
Joes Brook and Water Andric				
Joes Brook 6.3	8/19/2003		Good	
Joes Brook 8.6	8/29/1989		Good	

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
Joes Brook 10.5	6/27/2012	**F-Poor**		The substrate composition shows a high percent sand-fines 49% deposited in the reach- primarily due to a recent sediment discharge from the GMP water conduit failure.
Joes Brook 10.6	8/30/1989		Good	
Joes Brook 10.8	6/27/2012	*Very Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Joes Brook 14.7	8/24/2004	*Very Good*		
Steam Mill Brook 5.5 *Steam Mill Brook 5.5*	*9/8/1999* *9/23/1992*	*Excellent* *Excellent*		*Possible A(1) conditions - Data from over 10 years ago*
Water Andric 0.8	9/2/2010	Good		
Water Andric 3.3	*9/21/2000*	*Very Good*	*Excellent*	*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Water Andric 6.5	9/10/2012 *9/2/2010*	Good Good	*Excellent* *Excellent*	*Fish community assessment suggest potential very high quality water*
Water Andric 6.6	*9/10/2012*	*Very Good*	*Excellent*	
Sleepers River watershed				
Burroughs Brook 0.9	*9/21/2000*	*Very Good*		Data from over 10 years ago. *Macroinvertebrate community assessment suggest potential very high quality water*
Burroughs Brook 2.8	*10/8/1999*	*Excellent*		
Burroughs Brook 2.9	*9/23/1992*	*Excellent*		
Houghton Brook 0.8	*9/12/2005*		*Very Good*	*Macroinvertebrate community assessment suggest potential very high quality water*
Houghton Brook 1.6	*9/8/2010*	*Very Good*	*Excellent*	*Macroinvertebrate and fish community assessment suggest potential very high quality water*
North Brook 0.4	*9/12/2005*		*Excellent*	
Pope Brook 3.2	***10/8/1999***	***Fair***		Macro assessment suggests sediment stress at reach but this may be related to high flow 3 weeks prior to sample. Data is from over 10 years ago
Pope Brook Trib 0.1	*9/7/1999*	*Excellent*		*Macroinvertebrate community assessment suggest potential very high quality water*
Roy Brook 0.1	9/21/2005		Good	
Roy Brook 1.3	*10/23/2012*	*Very Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Sleepers River 0.4	9/8/2010	Vg-Good		Macro assessment included some suggestions of nutrient enrichment but low levels of algae and sand.
Sleepers River 1.1 Sleepers River 1.1	9/6/2005 9/29/1987	Vg-Good Good		2005 - Macro assessment indicated minor enrichment and substrate was high in sand and ebmeddedness.
Sleepers River 1.6	9/29/1987	Good		Data from over 10 years ago
Sleepers River 4.4	9/6/2005	Vg-Good		Low levels of nutrients based on WQ sampling and sand makes up 10% of substrate.

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
Millers Run Watershed				
Nation Brook Trib 3 0.8	9/4/2013	**Excellent**		**Class A(1) Conditions**
Nation Brook Trib 3 0.8	9/11/2012	**Excellent**	**Very Good**	2010 - Moderately low density of brook trout.
Nation Brook Trib 3 0.8	9/17/2011	**Excellent**	**Very Good**	
Nation Brook Trib 3 0.8	9/17/2010	**Excellent**	**Very Good**	2009- No IBI scored because of only one native species. Very small drainage.
Nation Brook Trib 3 0.8	10/12/2009	**Very Good**		
Millers Run 5	9/16/2005	Vg-Good		
Millers Run 6.9	9/23/2004	*Ex-Vgood*		*Macroinvertebrate community assessment suggest potential very high quality water*
Millers Run 6.9	9/9/1995	*Very Good*		
Millers Run 6.9	9/18/1991	*Excellent*		
Millers Run 7	9/9/1995	Good		Data is from over 10 years ago
Millers Run 10.9	9/9/1995	Good		Data is from over 10 years ago
Millers Run 11	9/12/1995	*Excellent*		Data is from over 10 years ago.
Millers Run 11.6	9/20/2005	*Very Good*	*Excellent*	*Macroinvertebrate and fish community assessment suggest potential very high quality water*
West Branch of the Passumpsic River watershed				
Arcadia Brook 2	9/17/2009	Good		Potential sediment stress
Calendar Brook 4.8	9/13/2010	*Excellent*	Good	*Fish community assessment suggest potential very high quality water*
Calendar Brook 5.3	9/22/2005	*Excellent*	Good	
Calendar Brook 5.5	8/18/2009			Total Density is low and Brook trout density low
Calendar Brook 11.2	9/11/2012	Good		
Calendar Brook 11.2	9/12/2011	Ex-Vgood		
Calendar Brook 11.2	10/12/2009	Good		
Calendar Brook 11.2	10/9/2006	Very Good		
Calendar Brook 11.4	9/4/2013	Excellent		
Calendar Brook Trib # 24 0.5	10/9/2006	Vg-Good		
Calendar Brook Trib 22 0.4	9/4/2013	**Excellent**	**Excellent**	
Calendar Brook Trib 22 0.4	9/11/2012	**Excellent**	**Excellent**	
Calendar Brook Trib 22 0.4	9/12/2011	**Excellent**	**Excellent**	**Class A(1) Conditions**
Calendar Brook Trib 22 0.4	9/13/2010	**Very Good**		
Calendar Brook Trib 22 0.4	10/12/2009	**Excellent**		
Calendar Brook Trib 22 0.4	10/9/2006	**Excellent**		
Clark Brook 0.1	10/9/2006	G-Fair		Low density cause for low community assessment
Clark Brook 0.2	9/4/2013	**Very Good**	**Excellent**	
Clark Brook 0.2	9/11/2012	**Ex-Vgood**	**Ex-Vgood**	
Clark Brook 0.2	9/12/2011	**Ex-Vgood**	**Excellent**	**Macro invertebrate community assessment indicates very high quality water**
Clark Brook 0.2	9/13/2010	**Very Good**	**Very Good**	
Clark Brook 0.2	10/12/2009	**Very Good**		
West B. Passumpsic River 3.4	9/14/2010	*Excellent*		
East Branch of the Passumpsic River				
Bean Brook 4.8	9/14/2010	*Ex-Vgood*		
Bean Brook 4.8	10/1/1987	Vg-Good		

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
Bean Brook 5.2	8/1/1990		*Very Good*	
Bean Brook 5.2	10/1/1987	*Very Good*		Data over 10 years old
Dish Mill Brook 0.8	9/7/2006	***G-Fair***		Macro assessment suggests elevated levels of sand and scour.
Dish Mill Brook 1.3	9/14/2010	***G-Fair***	**Excellent**	2010 - Macro assessment suggests negligible nutrient enrichment stress but frequent scour flows which may depress primary productivity and disrupt the macro community. This is a typical small coldwater stream assemblage of brook trout and slimy sculpin at expected densities- "Excellent" biological integrity.
Dish Mill Brook 1.3	10/1/2007	***Very Good***		
Dish Mill Brook 1.3	9/7/2006	***G-Fair***		
Dish Mill Brook 1.3	9/7/2005	***G-Fair***		
Dish Mill Brook 1.3	9/8/1992	Very Good	**Excellent**	**Fish community assessment indicates very high quality water**
Dish Mill Brook 1.3	9/27/1989	Very Good	**Excellent**	
Dish Mill Brook 1.3	9/30/1988	Very Good		
Dish Mill Brook 2.1	10/1/2007	*Excellent*		*Possible Class A(1) Conditions*
Dish Mill Brook 2.1	9/15/1994	*Excellent*		
Dish Mill Brook Trib 2 0.1	10/1/2007	***Fair***		Evidence of sediment issues
Dish Mill Brook Trib 2 0.1	9/7/2006	***Good***		
Dish Mill Brook Trib 2 0.1	9/7/2005	***Fair***		
Dish Mill Brook Trib 2 0.1	9/30/1988	***Fair***		
Dish Mill Brook Trib 2 0.2	*9/14/2010*	*Excellent*	*Excellent*	Site is just upstream of previous site which had shown evidence of sediment issues in 2007 but differences in community assessment may be due to location or years that these sites were assessed. *Macroinvertebrate and fish community assessment suggest potential very high quality water*
E. Branch Passumpsic River 1.7	*9/23/2004*	*Vg-Good*		*Macroinvertebrate and fish community assessment suggest potential very high quality water*
E. Branch Passumpsic River 1.7	*9/6/1996*	*Excellent*		
E. Branch Passumpsic River 1.7	*9/9/1995*	*Excellent*		
E. Branch Passumpsic River 1.7	*10/15/1994*	*Excellent*		
E. Branch Passumpsic River 3.8	9/7/2005	**Excellent**		**Macroinvertebrate community assessment indicates very high quality water**
E. Branch Passumpsic River 3.8	8/2/1990	**Excellent**		
E. Branch Passumpsic River 5.3	9/12/2012	**Excellent**		**Macroinvertebrate community assessment indicates very high quality water**
E. Branch Passumpsic River 5.3	9/23/2007	**Very Good**		
E. Branch Passumpsic River 5.3	10/3/2005	**Excellent**		
E. Branch Passumpsic River 5.3	8/3/2001	**Vg-Good**		
E. Branch Passumpsic River 5.3	9/23/1992	**Excellent**		
E. Branch Passumpsic River 5.7	9/12/2012	Good		
E. Branch Passumpsic River 5.7	9/23/2007	Vg-Good		
E. Branch Passumpsic River 5.7	9/10/2001	Very Good		
E. Branch Passumpsic River 5.7	9/9/1992	Excellent		
E. Branch Passumpsic River 8.9	9/14/2010	**Ex-Vgood**		**Macro invertebrate community**

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
E. Branch Passumpsic River 8.9	10/3/2005	**Excellent**		**assessment indicates very high quality water**
E. Branch Passumpsic River 9.5	*9/9/1992*	*Excellent*		*Macroinvertebrate community assessment suggest potential very high quality water*
Flower Brook 1.7	9/15/1993	Good		
Moose River Watershed				
Chesterfield Valley Brook 0.1	*9/13/2007*	Good	*Excellent*	*Fish community assessment suggest potential very high quality water*
Moose River 0.1	*9/6/2005*	*Very Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Moose River 0.1	*9/21/2000*	*Very Good*		
Moose River 1.7	*9/6/2005*	*Very Good*		
Moose River 1.7	*8/2/1990*	*Good*		
Moose River 3.9	*9/22/2004*	*Ex-Vgood*		
Moose River 14.3	*9/7/1999*	*Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Moose River 14.3	*9/4/1997*	*Excellent*		
Moose River 14.3	*9/6/1996*	*Very Good*		
Moose River 14.3	*9/15/1993*	*Excellent*		
Moose River 23.2	*9/15/1993*		*Very Good*	*Fish community assessment suggest potential very high quality water*
Moose River 26.8	9/10/2013		*Good*	*Possible Class A(1) Conditions*
Moose River 26.8	9/13/2012	*Excellent*	*Very Good*	
Moose River 26.8	10/25/1984		*Very Good*	
Rogers Brook 0.6	*9/13/2010*	*Excellent*	Good	*Macroinvertebrate community assessment suggest potential very high quality water*
Stiles Brook 0.1	*9/8/2005*	*Ex-Vgood*		
Connecticut River Direct Tributaries north of the Nulhegan River				
Connecticut River 357.3	*09/17/2012*	*Excellent*		*Macroinvertebrate community assessment suggest potential very high quality water*
Connecticut River 357.3	*10/17/2007*	*Good*		
Connecticut River 357.3	*9/16/1992*	*Excellent*		
Halls Stream 0.5	*9/16/2010*	*Very Good*		
Keyer Brook 1.0	*09/18/2012*	*Good*		*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Keyer Brook 1.0	*9/16/2010*	*Excellent*	*Very Good*	
Keyer Brook 1.0	*9/4/1997*	*Excellent*		
Keyer Brook 1.0	*9/16/1992*	*Good*	*Very Good*	
Leach Brook Trib 0.5	9/4/1997	Good		
Morrill Brook 0.1	*9/23/2003*	*Ex-Vgood*	*Very Good*	*Macroinvertebrate community assessment suggest potential very high quality water*
Blodgett Brook 0.7	9/15/1993	**Very Good**	**Fair**	
Mill Brook (Bloomfield) 1.6	9/18/12		*Very Good*	*Possible Class A(1) Conditions*
Mill Brook (Bloomfield) 1.6	9/16/2010	*Excellent*	*Good*	
Mill Brook 2.2 (Lemington)	9/4/1997	Good		
Mill Brook 2.2 (Lemington)	9/15/1993	Good		
Mill Brook 2.2 (Lemington)	9/16/1992	Good		
East Branch Nulhegan watershed				
Brouillard Brook 0.1	8/31/2000	Good	**Excellent**	*Fish community assessment suggest potential very high quality water*
East Branch Nulhegan River 0.7	*9/17/2012*	*Vg-Good*		

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
East Branch Nulhegan River 0.7	*9/16/2010*	*Excellent*		*Possible Class A(1) Conditions*
East Branch Nulhegan River 0.7	*8/31/2000*	*Very Good*		
East Branch Nulhegan River 0.7	*9/4/1997*	*Excellent*		
East Branch Nulhegan River 0.7	*9/16/1992*	*Good*	*Very Good*	
East Branch Nulhegan River 2.9	*9/9/2005*	*Excellent*		*Possible Class A(1) Conditions*
East Branch Nulhegan River 9.9	*8/31/2000*	*Excellent*		*Possible Class A(1) Conditions*
Mink Brook 0.3	8/31/2000	Good	*Very Good*	*Fish community assessment suggest potential very high quality water*
Black Branch Nulhegan watershed				
Black Branch Nulhegan River 2.3	9/17/2012	Good		
Black Branch Nulhegan River 2.3	8/31/2000	Very Good		
Black Branch Nulhegan River 2.6	8/31/2000	*Ex-Vgood*		*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Black Branch Nulhegan River 13.2	9/15/2009	*Excellent*	Good	
Bluff Mtn Brook 0.1	9/6/2000	*Very Good*		
Clay Hill Brook 6.2	8/30/2000	*Very Good*		
Goupee Brook 1.5	9/18/2012	**Very Good**		**Macroinvertebrate community assessment indicates very high quality water**
Goupee Brook 1.5	9/6/2000	**Very Good**		
Logger Branch 1.4	9/6/2000	*Excellent*	Good	
North Branch and Main stem Nulhegan watershed				
North Branch Nulhegan River 0.8	9/15/1993	**Excellent**		**Macroinvertebrate community assessment indicates very high quality water -** Priority for future evaluation
North Branch Nulhegan River 4.4	9/22/2009	**Excellent**	**Very Good**	
North Branch Nulhegan River 10.5	8/30/2000	Good		
Nulhegan River 0.2	10/16/2008	**Excellent**		**Class A(1) Conditions**
Nulhegan River 0.2	8/30/2000	**Excellent**		
Nulhegan River 0.2	9/16/1992	**Excellent**		
Nulhegan River 0.3	9/10/2013		**Very Good**	**Class A(1) Conditions**
Nulhegan River 0.3	9/17/2012	**Excellent**	**Very Good**	
Nulhegan River 0.3	9/13/2011	**Excellent**		
Nulhegan River 0.3	9/16/2010	**Excellent**		
Nulhegan River 0.3	9/15/2009	**Excellent**	**Very Good**	
Nulhegan River 4.5	8/31/2000	**Excellent**		**Class A(1) Conditions**
Nulhegan River 13	9/17/2012	**Excellent**		**Class A(1) Conditions**
Nulhegan River 15.1	9/8/2006	**Ex-Vgood**		**Class A(1) Conditions**
Palaeagapetus Brook 1.6	8/30/2000	*Excellent*		*Macroinvertebrate community assessment suggest potential very high quality water*
Paul John Brook 2.8	*9/6/2000*	*Excellent*		
Stevens River 0.1	*9/13/2011*	*Very Good*		*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Tuffield Willey 1.6	8/30/2000	Good		
Yellow Alder Brook 0.4	9/6/2000	Good		

Stream station	Date	Macro community Assessment	Fish community assessment	Comments
Yellow Branch Nulhegan River 0.1	9/6/2000	*Excellent*		*Macroinvertebrate community assessment suggest potential very high quality water*
Yellow Branch Nulhegan River 7.6	9/6/2000	Good		
Paul Stream Dennis and Wheeler Pond watersheds				
Dennis Pond Brook 0.6	9/7/2000	*Very Good*	Good	*Macroinvertebrate community assessment suggest potential very high quality water*
Notch Pond Brook 2.3	*8/23/2000*		*Excellent*	*Fish community assessment suggest potential very high quality water*
Wheeler Stream 1.2	9/1/2000		Good	
Granby Stream 0.1	9/7/2000	*Excellent*	*Very Good*	*Macroinvertebrate and fish community assessment suggest potential very high quality water*
Granby Stream 2.9	8/20/2003	*Very Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Madison Brook 0.8 **Madison Brook 0.8** **Madison Brook 0.8**	9/13/2013 09/17/2012 9/7/2000	**Excellent** **Very Good** **Very Good**	**Excellent** **Very Good**	**Macroinvertebrate and fish community assessment indicates very high quality water**
North Branch Paul Stream 2.7 **North Branch Paul Stream 2.7**	09/17/2012 9/7/2000	**Very good** **Excellent**		**Macroinvertebrate community assessment indicates very high quality water**
Paul Stream 0.1 *Paul Stream 0.1*	9/15/1993 9/16/1992	*Excellent* *Excellent*		*Potential A(1) – priority for future assessment*
Paul Stream 4.8	9/7/2000	*Excellent*		
Paul Stream 7.8	9/7/2000	*Excellent*		
Paul Stream 8.8	9/15/2009	*Excellent*	*Good*	
Paul Stream 12.8	9/7/2000		*Fair*	
Paul Stream 14.5	8/24/2000		*Good*	
Paul Stream 15.9	9/15/2009	*Excellent*		
Connecticut River Direct between Paul Stream and Passumpsic River				
Washburn Brook 0.3 Washburn Brook 0.3	09/13/2012 9/16/2010	Excellent Excellent	 Excellent	**Class A(1) Conditions**
Hudson Brook 0.1	9/21/2005	*Very Good*		*Macroinvertebrate community assessment suggest potential very high quality water*
Mink Brook 2.7	9/22/2000	*Very Good*		
Neal Brook 0.3	9/8/2005	*Very Good*		
Carr Brook 0.4	9/21/2005	Good		
Miles Stream 0.6 **Miles Stream 0.6** **Miles Stream 2.1**	9/13/2012 9/23/2003 9/13/2010	**Ex-Vgood** **Excellent** **Excellent**	 Good 	**Macroinvertebrate community assessment indicates very high quality water**
Scales Brook 0.1	***9/26/1999***		***Fair***	

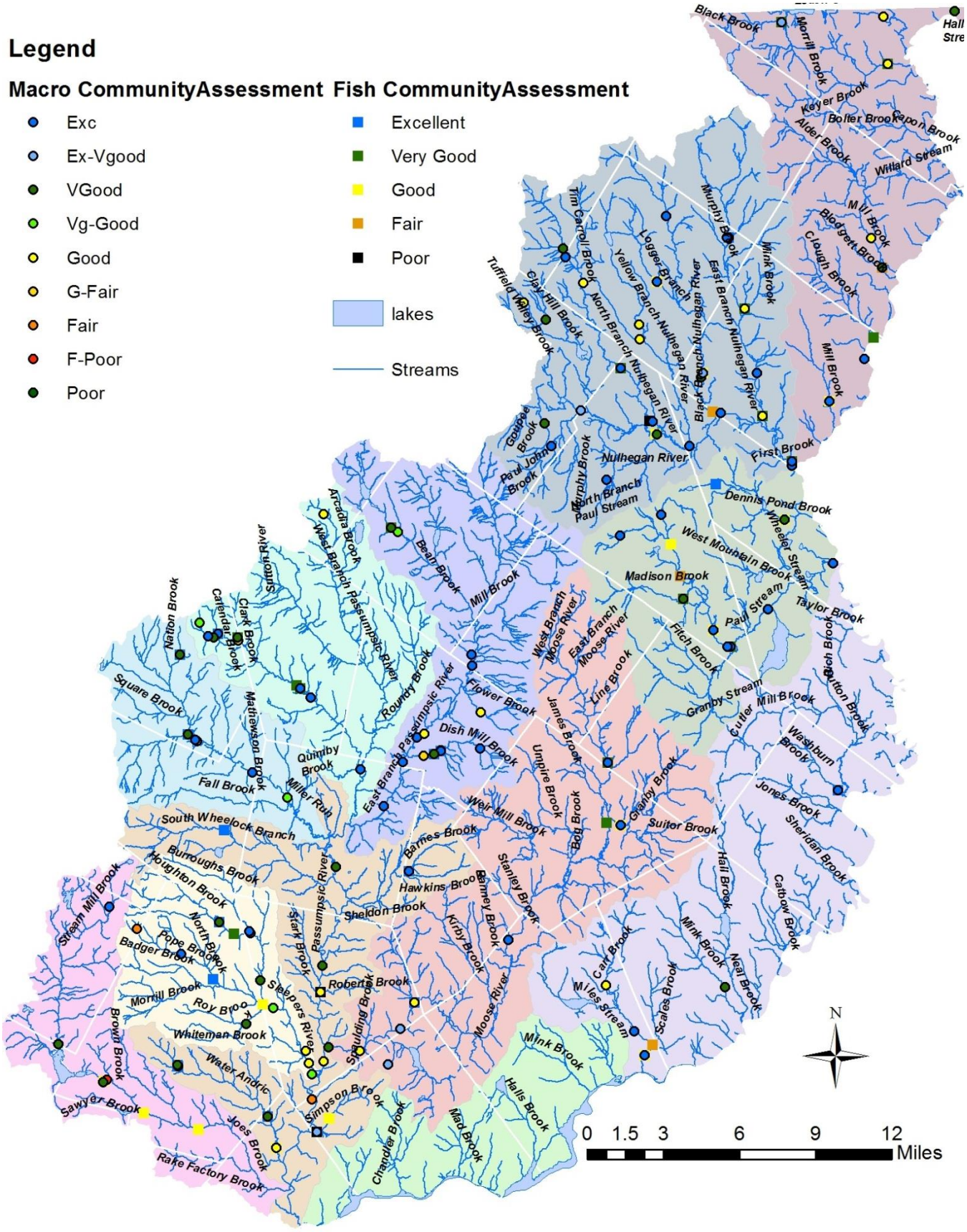

Figure B.1. Macroinvertebrate and fisheries community assessments in Basin 15/ 16.

Appendix C – Didymo and Aquatic Invasive Species and Fish and Wildlife Pathogen Precautions.

As recreational or professional users of Vermont's aquatic resources, we all have the potential to spread aquatic invasive species, didymo, and fish and wildlife pathogens from stream to stream and watershed to watershed. Responsible stewards of our state waters take precautions to minimize the spread of these threats.

Follow these 'Best Practices' to minimize the spread of aquatic invasive species, didymo, and fish and wildlife pathogens. This approach is modeled after New Zealand's widely-used 'Check, Clean, Dry' strategy. While designed to address the spread of didymo, these practices will help to minimize the spread of aquatic invasive species and fish and wildlife pathogens as well.

BEST PRACTICES for minimizing the spread of didymo, other aquatic invasive species, and fish and wildlife pathogens while using Vermont's waters:

- All Users - Disinfect your gear, boat, and everything else that comes in contact with the water before traveling between different bodies of water or watersheds. For disinfection procedures, visit
- http://www.anr.state.vt.us/dec/waterq/lakes/htm/ans/lp_didymo.htm
- All Users - If you move around to fish, boat, play or work, construct and use a simple, portable disinfection kit.
- All Users - When possible, fish, boat, play or work in a single waterbody in a single day, rather than traveling between multiple water bodies without appropriate precautions.
- All Users - Visually inspect your boat, gear and equipment before entering and leaving the water. Remove all plants, plant fragments, animals, mud or other debris and discard in the trash.
- Anglers - When practical, fish in a downstream direction. This doesn't mean you can't wade upstream a bit to fish that nice run upstream – think on a watershed scale. By fishing at the mouth of a large river in the morning, then going to the headwaters in the afternoon without disinfecting your gear, you've potentially spread didymo upstream to the whole stream, which may not be infected. Most algae and aquatic invasive species can't swim upstream.
- Anglers - Consider the use of easily disinfected wading gear.

- Anglers, Guides, Outfitters - Designate waders/boots/canoes/tubes etc… for different watersheds or have multiple sets available for same-day travel, when needed.
- Canoeists, Kayakers, Boaters, Tubers - Remove drain plug and drain any water prior to leaving boat loading/unloading area. Don't move water between waterbodies.

For more information regarding aquatic invasive species, contact Ann Bove at

(802) 490-6120 or ann.bove@state.vt.us

Appendix D – Partners in the Basin.

Agricultural Resource Specialist (ARS) Program is offered by the Vermont Association of Conservation Districts (www.vacd.org) and is supported by funding from the VAFFM. Three main services are offered to farmers:

- Accepted Agricultural Practices Assistance (AAPA)
- Agricultural Environmental Management (AEM)
- Farm Well Water Testing (FWWT)

Better Backroads Program provides technical assistance, grant funding, and educational workshops related to transportation infrastructure and water quality. BBR provides funding for municipalities through the Better Backroads Grants. Grant funding can be used to undertake road erosion inventories and capital budgets and to implement transportation infrastructure best management practices (BMPs) that address road erosion and improve water quality and aquatic habitat.

Caledonia County Natural Resources Conservation District (CCNRCD) is a locally-led and operated organization that promotes and supports soil and water conservation. The mission of the District is to "help provide conservation assistance to the people living in the area through education programs and partnerships with federal, state, and local entities involved in natural resources management." The conservation district has led stream geomorphic assessment efforts, Trees for Streams programs, illicit discharge and detection programs, bridge and culvert assessments and efforts to support towns in reducing erosion from back roads.

Connecticut River Joint Commissions (CRJC) was created through a merging of New Hampshire's Connecticut River Valley Resource Commission and Vermont's Connecticut River watershed advisory commission. CRJC's mission is to preserve and protect the visual and ecological integrity and sustainable working landscape of the Connecticut River Valley, and to guide its growth and development through grassroots leadership. The Headwaters and Riverbend subcommittees of the CRJC cover the Passumpsic and upper Connecticut River basin and are made up of appointees from riverfront towns to voice the interests of local business local government, conservation, agriculture, recreation and riverfront landowners.

Connecticut River Watershed Council (CRWC) advocates for the entire, four-state Connecticut River watershed. The Council works to protect water—the river, its tributaries, lakes, fish; and the land, plants, and creatures connected to that water. The CRWC is active in project identification, dam removal efforts and the annual source to sea clean-up campaign and water quality sampling.

Essex County Conservation District (ECNRCD) is a locally-led and operated organization that promotes and supports soil and water conservation. The mission of the District is to "help provide conservation assistance to the people living in the area through education

programs and partnerships with federal, state, and local entities involved in natural resources management." ECNRCD has led stream geomorphic assessment efforts, extensive Trees for Streams and lakeshore buffer programs, has created a conservation nursery and works with farmers and towns in the basin to address water resource concerns.

New Hampshire Department of Environmental Services (DES) Water Division Like VDEC, New Hampshire DES Water Division protects the state's surface water through its active lakes and rivers monitoring programs, biological and chemical analyses of rivers and water bodies, and regulatory programs. The Water Division also oversees lake and river volunteer monitoring programs, a public beach and swimming pool inspection program, and an acid rain monitoring program. The Connecticut River is located primarily in the State of New Hampshire, however, sections of the river, particularly those behind the Moore and Comerford Reservoir, are Vermont waters and so the states of Vermont and New Hampshire work collaboratively on management of the river and its watershed. NHDES is envisioned as one active partner in the implementation of the water quality monitoring network recommended by this Plan.

Northeast Vermont Development Association (NVDA) is an association of 55 towns in Northeast Vermont. NVDA is governed by a Board of Representatives appointed by each of our member towns. The Commission's staff provides technical services to local, state and federal levels of government and to the Region's non-profits and businesses. NVDA watershed-related programs include:

- Emergency Management
- GIS Services
- Land Use Planning
- Transportation Planning

Trout Unlimited (TU) has a mission to conserve, protect and restore North America's coldwater fisheries and their watersheds. Trout Unlimited, through its Home Rivers Initiative covering the northern Connecticut River watershed, has been working to restore the watershed by replacing inadequate culverts completing tree plantings and streambank stabilization projects along with instream habitat restoration projects.

The Nature Conservancy (TNC) is a non-profit organization whose mission is to conserve the lands and waters on which all life depends. The Nature Conservancy has a Connecticut River conservation team that works across state lines to understand the river as the center of the largest freshwater ecosystem in New England.

Passumpsic Valley Land Trust (PVLT) is a non-profit organization with a mission to conduct conservation activities related to the Passumpsic River and its watershed, with a focus on the recreational, educational, ecological and historic assets afforded by these resources. PVLT has completed a number of conservation projects along rivers and

uplands in the Passumpsic River watershed. PVLT also owns and is pursuing the removal of the East Burke Dam.

The Vermont Land Trust has been a lead organization in the protection and restoration of lands along the Connecticut River along with significant wetland habitats in the basin and with a focus of conserving working lands.

The Vermont River Conservancy has lead conservation efforts in the Nulhegan River watershed and along the Connecticut River and is a key partner in the Connecticut River Paddlers Trail.

United States Fish and Wildlife Service – Silvio O. Conte National Fish and Wildlife Refuge was established to conserve the abundance and diversity of native plants and animals and their habitats in the 7.2 million acre Connecticut River watershed in Connecticut, Massachusetts, New Hampshire and Vermont. The Nulhegan Basin Division includes a large ownership of lands in the Nulhegan watershed.

Upper Connecticut River Cooperative Invasive Species Management Area (UCCISMA) was formed in 2010 by a core group of natural resource professionals interested in collaborating on the early detection and management of invasive species in the uppermost sub-watersheds of the Connecticut River. With an immense area in excess of 900,000 acres, the Upper Connecticut River Watershed CISMA includes nine major tributaries of the Connecticut River spaning portions of both northern Vermont and New Hampshire and representing a significant and crucial portion of the headwaters. Early detection and responsiveness is critical to this region as it remains relatively pristine and free of invasive species to this date.

USDA Natural Resources Conservation Service (NRCS) provides cost-share, technical assistance, and targeted support of agricultural best management practices.

Vermont Agency of Natural Resources Internal Partners All Departments within VANR, Fish & Wildlife Department (VFWD), Forest, Parks, and Recreation (VFPR), and VDEC and Divisions within them, work collaboratively on a number of watershed assessment, restoration and protection projects. Additionally, VFWD and VFPR own and manage thousands of acres of state-owned lands within the basin. Annual stewardship plans are prepared by District Stewardship Teams and includes staff from VFWD, VFPR, and VDEC. Long Range Management Plans of state-owned properties include restoration and protection of water resources.

Vermont Agency of Agriculture Food and Markets (VAAFM) is a key partner in working to reduce pollution associated with agriculture in the basin. VAAFM administers both large and medium farm regulations and enforces the Acceptable Agricultural practices. The Agency also works with agricultural producers through funding programs to address water quality issues related to barnyard and field practices.

Vermont Agency of Transportation (VAOT) manages and maintains miles of State highway and stream crossings within the basin and provides technical assistance in the form of hydraulic modeling for bridge and culvert replacements and transportation maintenance. VTrans also provides grant funding to basin municipalities including Structures and Transportation Enhancement grants and hosts the Better Backroads program

Watershed Municipalities- The Passumpsic and upper Connecticut River basin encompasses 18 towns completely and another 14 towns with a significant area and another three towns with less than one percent of the town in the basin as shown in Figure 2.

Appendix E- Passumpsic and Upper Connecticut River Corridor and Bridge and Culvert Assessment Summaries and High Priority Actions

River corridor planning is conducted in Vermont to address the river instability that is largely responsible for erosion conflicts, increased sediment and nutrient loading, and a reduction or modification in river habitat. River corridor planning is recommended as a component of watershed planning and is structured to achieve specific river management goal to manage toward, protect, and restore the fluvial geomorphic equilibrium condition of Vermont rivers by resolving conflicts between human investments and river dynamics in the most economically and ecologically sustainable manner to achieve the objectives of fluvial erosion hazard mitigation; sediment and nutrient load reduction; and aquatic and riparian habitat protection and restoration.

Figure E.1. Stream geomorphic assessments conducted in the Passumpsic and Upper Connecticut River Basin through May 2014.

Stream Geomorphic assessments (SGA) at the Phase 1 and Phase 2 level are a key step in understanding conditions and priority actions in a watershed to achieve these goals working closely with key partners including non-profit organizations, towns, regional planning commissions and individual landowners. River science is a complex and evolving field and this appendix does not attempt to provide background and so individuals interested in more information are recommended to visit the Vermont River Management web site; http://www.anr.state.vt.us/dec/waterq/rivers.htm and also to read a recently published guide called *Living in Harmony with Streams* that was published in 2012 by the Friends of the Winooski River and White and Winooski River Conservation Districts. This appendix is intended to be a brief summary of the results of the many Stream Geomorphic Assessments completed in the Passumpsic and Upper Connecticut River basin and key actions identified in these documents.

Table E.1. Stream Geomorphic Assessments in the Passumpsic and Upper Connecticut River Basin.

Date	Subwatershed	Link to report
5/01/2014	Lower Passumpsic River Tributaries river Corridor Plan	Lower Passumpsic River Tributaries River Corridor Plan
2/14/2014	Dish Mill Brook	Dishmill Brook River Corridor Plan
2/12/2014	West Branch Passumpsic in Burke	West Branch Passumpsic & Sutton River Corridor Plan Addendum
9/30/2013	Lower Passumpsic River Phase 1 geomorphic assessment	Lower Passumpsic Tributaries Phase 1 Report
9/08/2013	Leach Creek –Phase 1	Leach Stream Phase 1 Geomorphic Assessment
8/19/2010	West Branch Passumpsic	West Branch Passumpsic River & Calendar Brook Corridor Plan
2/23/2010	Nulhegan	River Corridor Plan for the Nulhegan River: Stone Dam Road to Connecticut River
10/01/2009	Millers Run	Millers Run Corridor Plan
1/01/2009	East Branch Passumpsic River	East Branch Passumpsic River Corridor Plan

January 2008	Willard, Keyer and Capon Brooks	Connecticut River Watershed Project: Bolter, Keyer, & Willard Stream Assessment
January 2006	Connecticut River above Moore Reservoir	Connecticut River Phase 2 Stream Geomorphic Assessment
11/01/2006	Moose River Phase 1	Moose River Phase 1 Geomorphic Assessment
11/01/2006	Moose River Phase 2	Moose River Phase 2 Geomorphic Assessment Report

Passumpsic River watershed

As of January of 2013 Phase 1 and Phase 2 stream geomorphic assessments have been completed on four major tributaries in the Passumpsic River Watershed; Millers Run, the East and West Branch by the Caledonia County Natural Resources Conservation District (CCNRCD) and the Moose River by the Essex County Natural Resources Conservation District (ECNRCD). The CCNRCD has completed a Phase 1 assessment of another 48.5 miles of tributaries in the lower Passumpsic River basin in 2013 and completed 25 miles Phase 2 stream geomorphic assessments in 2014 (see Figure E1 and Table E1.)

With the exception of the Moose River that is generally in good geomorphic condition, the assessed tributaries in the Passumpsic River are impacted by many of the same stressors and are going through similar processes, which include past incision and subsequent and ongoing planform adjustments in lower reaches. Causes of this incision vary slightly between these watersheds with the Millers Run having unique hydrologic changes associated with the construction of interstate 91 and the East branch showing impacts of the East Burke Dam. Gravel mining seems to be a major cause of incision in both the East Branch and Calendar Brook watersheds and straightening and encroachment are common causes of incision in all of these watersheds. The Phase 2 assessments on the Sleepers River, Joes Brook, Water Andric, and Sheldon and Wheelock Brooks also show significant impacts to these streams from channel straightening, dredging, berming and corridor encroachment.

The magnitude of these adjustments also differs between watersheds with the lower Millers Run and East Branch Passumpsic River below the East Burke dam showing the most extensive adjustments, followed generally by the lower Calendar Brook, the lower West Branch and Dish Mill Brook. The timing of the adjustments also differs between these rivers with the Millers Run showing evidence of instability back to the 1970's (Army Corps of Engineers 1976) and adjustments on the East Branch Passumpsic becoming most apparent after a 2002 flood – although it appears that the incision was caused by gravel

mining back in the 60's which this flood then exacerbated. Storms in 2011 seemed to hit the Water Andric particularly hard and initiated a number of mass failures. There was a major effort in the 1990's to address erosion on lower reaches of Millers Run through bioengineering techniques (Dedam, J. 1998) and an assessment of these efforts has shown that while some of these projects may have reduced erosion in specific locations, the dynamic nature of this river in its current state of active adjustment left many of these projects far from the active river channel. This emphasizes the need to provide rivers the space required to allow their adjustment to allow them to return to equilibrium conditions. The lowest reach of Millers Run is also the only reach in the upper watershed with a reference reach as a type E stream where high levels of sinuosity and continued channel movement is expected due to its low gradient. Finally, nearly 48 miles of streambank were mapped through Phase 2 stream geomorphic assessments as having less than a 25 foot buffer which can increase runoff and rates of streambank erosion.

Table E.2. Summary of causes of channel adjustment in Passumpsic River watersheds with completed Phase 2 SGA's

River and location	Straightening	Changes in Hydrology/sediment	Gravel extraction	Undersized structures	Encroachments/ bank armoring
Millers Run lower reaches	Along Route 102 in middle reaches	Increased flow due to interstate construction	Not listed in Phase 2 report	Reaches T204 and T208	Route 102, and bridges, T202 berm
West Branch/ Calendar Brook lower reaches	Along Lower Calendar Brook/ West Branch along Railroad		3 sites in Lower Calendar Brook	*T3.03, T3.06, T3.12* - three structures total	Lower Calendar Brook/ RR along West Branch
East Branch below E. Burke dam	Middle reaches	East Burk dam reduces sediment transport – 2002 flood- stormwater	8 documented locations in watershed	T101, M101	Lower reaches T102 Berm.
Dish Mill Brook	Along Mountain Rd	Stormwater and sediment from development	Limited	T101 (bridge and culvert)	Berm M101, Mountain Rd, Development
Sleepers River, Whitman, Badger, North Brooks	Noted as high impact on most reaches of the Sleepers River	USGS Weir's trap sediment, Mass failures,	Dredging noted as high impact on reaches T3.06, T3.10	Badger Brook at Badger hwy, Whitman brook Seven structures	Road Encroachments and Armoring on most segments

River and location	Straightening	Changes in Hydrology/sediment	Gravel extraction	Undersized structures	Encroachments/ bank armoring
Water Andric		Major 2011 runoff event initiated mass failures		Penny Ln and Route 2	Water Andric Road
Sheldon Brook	T401, T402	Mass Failures on T4.02 and T4.03b	Low impact in lowest reach	Sheldon Brook Rd	Encroachments and Armoring
Wheelock Brook	In lowest two reaches	Limited	Not noted	I-91 South Wheelock Rd	Lowest Reach impacted by I-91, and T4.03 due to encroachment of Wheelock Road
Moose River Only reach 13B	Limited	Limited	Limited		Concord Village

River protection and restoration projects in the Passumpsic River watershed.

Stream Geomorphic Assessments also identify potential restoration or protection projects that can help to reduce future erosion losses and minimize sediment and improve habitat quality through moving the river towards its equilibrium condition. The East and West Branches of the Passumpsic and Millers Run are all above the village of Lyndonville which has chronic flooding issues, and so restoring and maintaining flood storage capacity in these three watersheds is a top priority. All three of these rivers show signs of bank erosion in the lower reaches which indicate a process of developing new floodplain at a lower elevation. This erosion is a major concern for landowners where this threatens houses or other infrastructure and it can also be a concern for landowners loosing productive farmland or yard. However, allowing this adjustment process to proceed unabated in as much of these reaches as possible will allow new floodplain to be created. The creation of this new floodplain is a key step in allowing these rivers to return to an equilibrium condition which over time provides the most flood storage, highest quality aquatic habitat, and reduced loss of property.

The most effective way to allow rivers and streams in this basin to return to equilibrium conditions is to enact river corridor zoning to prevent the development of infrastructure that will inevitably come in conflict with these rivers going through this adjustment process. Currently, the town of Burke is evaluating the adoption of zoning that would address river corridors. In addition to this, it is a priority for river corridor zoning to be considered by other towns above and including Lyndon, and should be considered by all towns in the basin to increase flood resilience as shown in Figure E.2.

In key locations the protection of the river corridor can be done through the purchase of channel management rights and priorities for such projects where Phase 2 assessments have been completed as shown in Figure E.2. There are a limited number of active

restoration projects that have been recommended in the Phase 2 assessment reports which would help to provide flood storage in these three tributaries. These projects are often more expensive than passive approaches listed previously but in certain circumstances may be cost effective. Permitting for the removal of the East Burke dam is already proceeding and other priorities are for the removal of berms that were identified on the East Branch on reach T102. In addition to this work on stormwater and sediment attenuation in the Dish Mill Brook watershed is a focus of collaboration between the Town of Burke and Q Burke along with the CCNRCD and VDEC. Another opportunity in the East Branch and West Branch watersheds is to consider the development of new floodplain where there is ongoing gravel extraction adjacent to the river but this is controversial due to the potential sediment discharge from gravel pits through such efforts.

There are a number of problematic bridges in each of these tributaries, however the high cost of replacing these mean that increasing their span will probably have to wait until the bridges are being rebuilt for other reasons such as is the case for the replacement of the bridge over Dish Mill Brook in East Burke Village. All four tributaries, including the Moose River, have areas where buffer plantings would provide benefits to rivers and priority plantings are identified in the Phase 2 assessments and shown in Figure E.3.

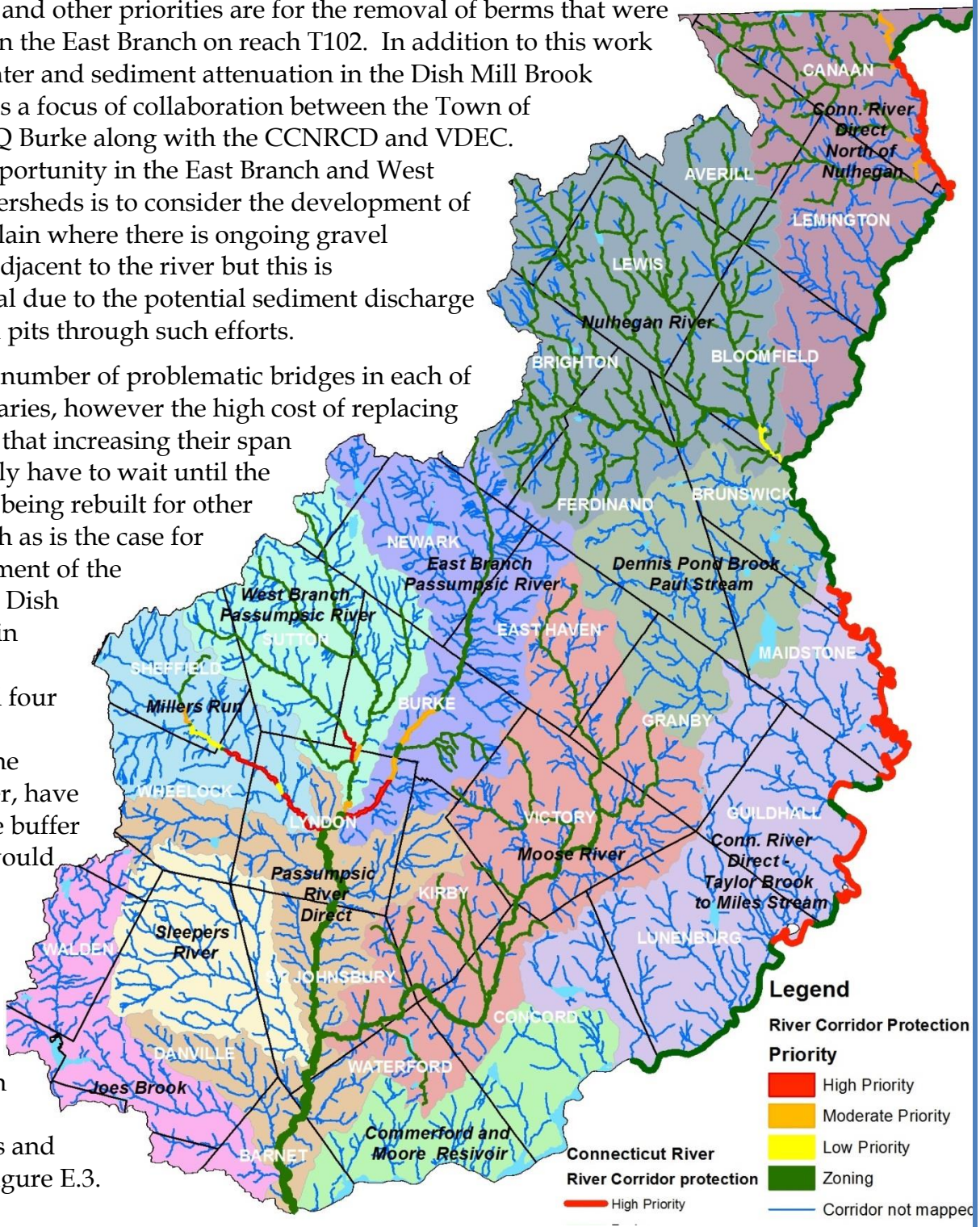

Figure E.2. Mapped river corridors with priorities for river corridor protection and zoning as identified in Phase 2 geomorphic assessments and floodplain restoration report.

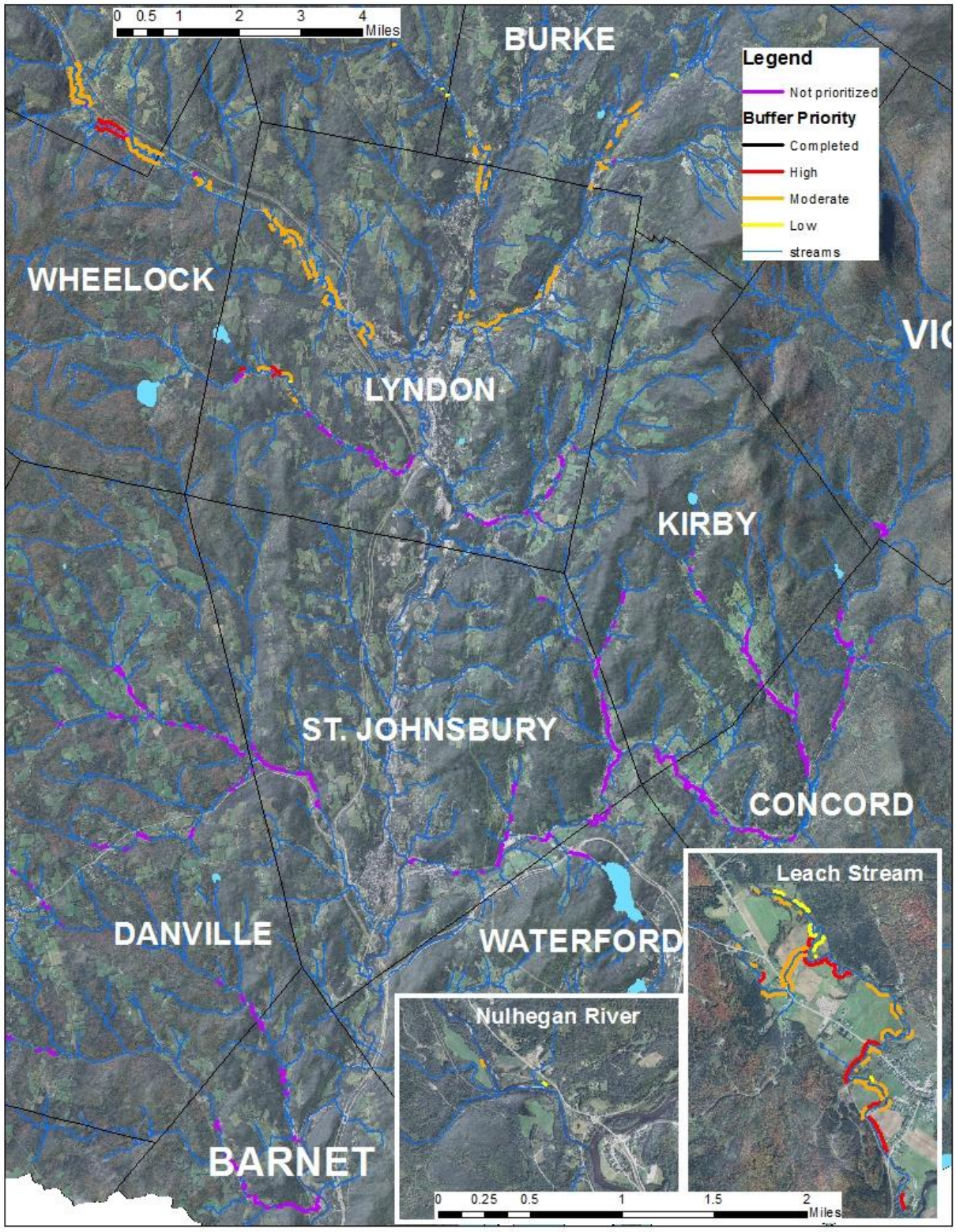

Figure E.3. Areas with less than 25 foot buffers as identified during Phase 1 or Phase 2 stream geomorphic assessments showing priority for buffer plantings.

Priority projects in the Passumpsic Basin.

River corridor zoning: River corridor zoning is a priority for all areas of the watershed due to the importance for Branches and Millers Run due to potential for long term floodplain restoration. The Town of Burke is currently evaluating the inclusion of protections of the river corridor in Town zoning. See Figure E2 above to see general priorities and approximate river corridor extents.

River Corridor Protections: Along with River corridor protections in town zoning the protection of key locations of River Corridor is recommended in river corridor plans. These are shown in Figure E.2.

Buffer plantings: Restoring natural vegetation along streams provides many important functions including: stabilization of stream banks, improving habitat in streams and riparian areas, reducing nutrients. Locations that have been prioritized for buffer planting projects are shown in Figure E.3 with total lengths shown in table E.3 for the Passumpsic and upper Connecticut River watersheds.

Table E.3. Potential buffer planting projects in the Passumpsic and upper Connecticut River basin

Passumpsic Watershed

Priority	Miles
High	1.4
Moderate	12.7
Low	0.6
Not Prioritized	33.2
Total mapped	47.9

Upper Connecticut River Watershed

Priority	Miles
High	1.3
Moderate	2.1
Low	0.6
Total mapped	4.0

Active gravel pit floodplain restoration: There may be opportunities for the creation of new floodplain by allowing gravel pits adjacent to the river to excavate down to the level of a new floodplain with strict erosion controls, extensive buffer plantings and long term protections for new floodplain lands. This concept needs to be considered carefully as prevention of erosion into the river may not be possible in which case short term impacts would outweigh long term benefits of floodplain creation. Gravel pits which might be possible for this are along the East and West Branch Passumpsic River and the Passumpsic River.

Table E.4. Priority active restoration projects identified in River corridor plans

River and Segment	Project description	Partners	Funding/status
East Branch	East Branch Dam removal.	PVLT/	UCMEF / permitting for project ongoing
East Branch *T1.02C*	Removal of berm	CCNRCD/ Landower	Land owner not currently interested
East Branch *T1.01* *M101*	Bridge replacement Lily pond bridge, and Rt 114 Dish Mill Brook Bridge	Burke/ AOT	Rt 114 Dish Mill Brook bridge being replaced with longer span.
Dish Mill Brook	Conduct alternatives analysis for	CCNRCD	

M1.01A	removal of berms		
Dish Mill Brook *M1.02B*	Gully Remediation		
Dish Mill Brook *M1.03*	Provide stormwater treatment from Mountain Road	Burke, CCNRCD, VDEC	ERP, Better Backroads/
Dish Mill Brook Tributary *T1.01*	Remove trail bridge and replace Mountain Road culvert	Burke, Kingdom Trails, Road Association	
Dish Mill Brook Tributary *T1.01*	Improving erosion and sediment control in vicinity of trail crossing	Q Burke/ Kingdom Trails, Road Association	
West Branch *T3.03, T3.06, T3.12*	Bridge constrictions (railroad and town bridges)	Burke/ VAOT	Town, State bridge funding/no immediate plans.
West Branch *T3.12a*	Remove cars in corridor	Burke/ CCNRCD	
West Branch *T3.12c*	Alternatives analysis for bridge abutment and dam removal	CCNRCD/ CWC, Trout Unlimited	
Sutton River *T3.S3.01*	Stormwater management	Burke/ CCNRCD	
Millers Run *T2.02*	Berm Removal	CCNRCD/ Landowner	

Upper Connecticut River SGA reports

Less is known about streams in the upper Connecticut River watershed because of the limited extent of Phase 1 assessments and even fewer Phase 2 stream geomorphic assessments. Many of the smaller direct tributaries to the Connecticut River haven't had any assessment completed and Leach Stream, Nulhegan River, Willard Stream, Keyer and Bolter brooks have had Phase 1 assessments while much of the Connecticut River main stem and the lowest 5 reaches of the Nulhegan have had assessments completed at the Phase 2 level. The Phase 1 assessments for Willard, Bolter and Keyer Brooks were completed using older assessment protocols and so some information associated with this assessment is not available (such as areas with no buffers).

Many of the streams in this basin are similar (with maybe the exception of Keyer Brook, Leach Stream and of smaller tributaries in Waterford and Concord) in that they have largely forested headwaters with sparse development as they get lower in elevation and then farmland as the streams flow across the broader Connecticut River valley before joining the Connecticut River. The transition of these streams from high gradient mountain valleys to the flat Connecticut River valley is a dynamic location and the most heavily developed so these areas are where many of the human and river conflicts occur, as is the case with Leach Stream, Willard, Capon and Keyer Brooks and many of the other unassessed tributaries. Because of the dynamic nature of these reaches, these have been identified as priorities for river corridor protection.

The assessments of the Nulhegan River show that for the most part the upper watershed is forested and with the exception of historical modifications associated with logging and log drives (on the East Branch Nulhegan in particular) this upper watershed is in good geomorphic condition. The protection of the upper watershed also presents an opportunity for the conservation of an intact stream system if protections can be established for the River Corridor in lower reaches. The Vermont River Conservancy has been working to conserve and in a few locations restore buffers along the lower reaches of the river and these efforts are expected to continue.

John Fields completed a Phase 2 stream geomorphic assessment for most of the length of the Connecticut River above the Moore Reservoir working with the Connecticut River Joint Commissions. This assessment showed that unlike the tributaries, much of the Connecticut River main stem has been encroached upon and straightened as historical floodplain forests were cleared for agricultural uses and log drives. Recommendations for addressing ongoing erosion along the main stem are to focus on restoring floodplain forests in a number of locations as have been identified by a study of floodplain restoration sites in the Connecticut River watershed completed by the Nature Conservancy which is described in Chapter 2 of this plan and shown in Figure E.2. In addition to these floodplain restoration and protection efforts, towns along the Connecticut River can improve local flood hazard regulations and other zoning regulations to limit future encroachment on the banks of the Connecticut River.

Culvert Assessments in the Passumpsic and Upper Connecticut River Basin

The CCNRCD and Vermont Fish and Wildlife Departments have completed VANR Bridge and Culvert assessments of most culverts in the Passumpsic watershed and culverts within the West Mountain WMA. Undersized or poorly installed culverts can increase sediment loading and pose a risk to public health when they fail or act as a barrier to sediment movement, which causes erosion downstream of the structure. Culverts can also act as a barrier to aquatic organism passage (AOP) and this can have impacts as fish and other species need to move to gain access to colder water habitats, feeding and spawning locations, and for natural dispersal. The Vermont Agency of Natural Resources has developed a bridge and culvert assessment and screening tools that provide a first cut as to the need for replacement or retrofit to restore fish passage or address geomorphic issues. This tool provides an initial assessment of AOP as well as geomorphic compatibility as shown in Table E.5.

A total of 530 bridges and culverts have been assessed in the basin with 75 percent listed as having reduced AOP passage, 1 percent at passable only by adult trout, and 24 percent impassible to all AOP. Not a single culvert in the basin was listing as providing full aquatic organism passage. Thirty-seven percent of culverts were missing data necessary to evaluate geomorphic compatibility. Of the culverts that were assessed for geomorphic compatibility just 2 percent were rated as fully compatible, 26 percent as mostly

Table E.5. Screening criteria for AOP and Geomorphic Compatibility

VT Aquatic Organism Passage Coarse Screen	
Full AOP for all organisms	No outlet drop or obstructions to culvert with sediment through structure and depth at outlet greater than 0.3ft.
Reduced AOP for all organisms	Cascade at culvert outlet and sediment not present throughout structure and depth at outlet greater than 0.3ft.
No AOP for all aquatic organisms except adult salmonids	Free fall between 0 and 1 ft, or with downstream pool greater than 1 ft depth, and depth at outlet greater than 0.3ft.
No AOP for all aquatic organisms	Free fall greater than 1 ft, or less than 1 ft with downstream pool present or outlet less than 0.3 ft deep
Vermont Geomorphic Compatibility Screen	
Fully Compatible	Structure fully compatible with natural channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. A similar structure is recommended when replacement is needed.
Mostly Compatible	Structure mostly compatible with current channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. Minor design adjustments recommended when replacement is needed to make fully compatible.
Partly Compatible	Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility.
Mostly Incompatible	Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.
Fully Incompatible	Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.

compatible, 44 percent partly compatible, 24 percent mostly incompatible and 3 percent fully incompatible. For the Passumpsic River watershed, it is a priority to provide this information to towns as part of the road inventory and capital budget process and to assist in identifying grant funding to address the most significant AOP and geomorphically incompatible structures. These screening tools provide a first cut analysis of priorities so field visits to identified culverts are needed to fully assess culvert condition along with coordination with road commissioners to match town priorities and funding along with the priorities and funding of potential grant sources.

The only bridge and culverts assessed in the upper Connecticut River watershed are on the West Mountain WMA lands as part of a long-range management planning process. These data will aid in the prioritization of culvert upgrades and replacements on these State lands. In addition to this, assessments of culverts in the towns Concord and Canaan and the remainder of the Leach Stream watershed are a priority in the upper Connecticut River Basin due to the extensive road networks in these towns; however, bridge and culvert assessments following VANR protocols of all structures in this basin should be completed over time.

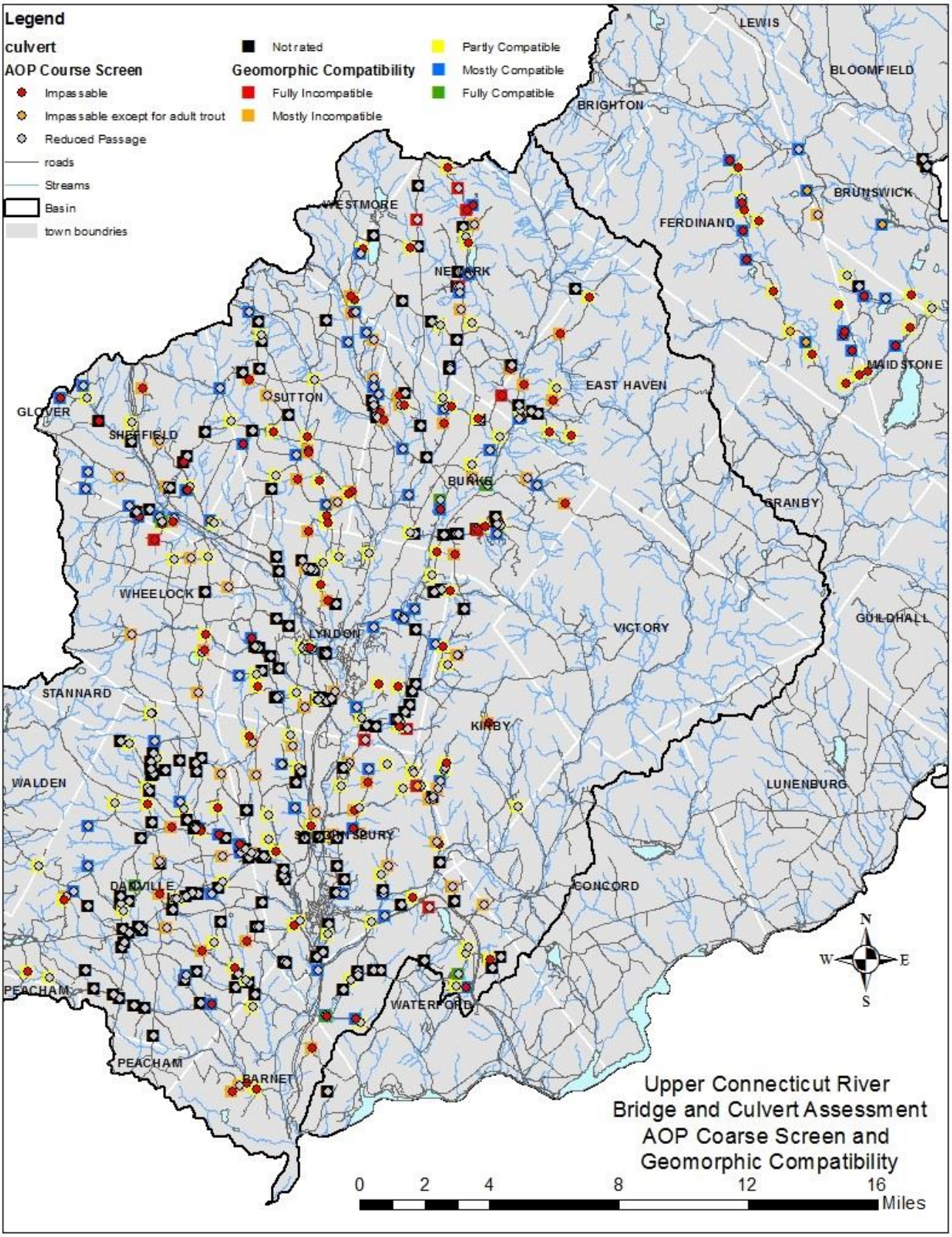

Figure E.4. Culvert Assessment results for the Passumpsic and upper Connecticut River Basin

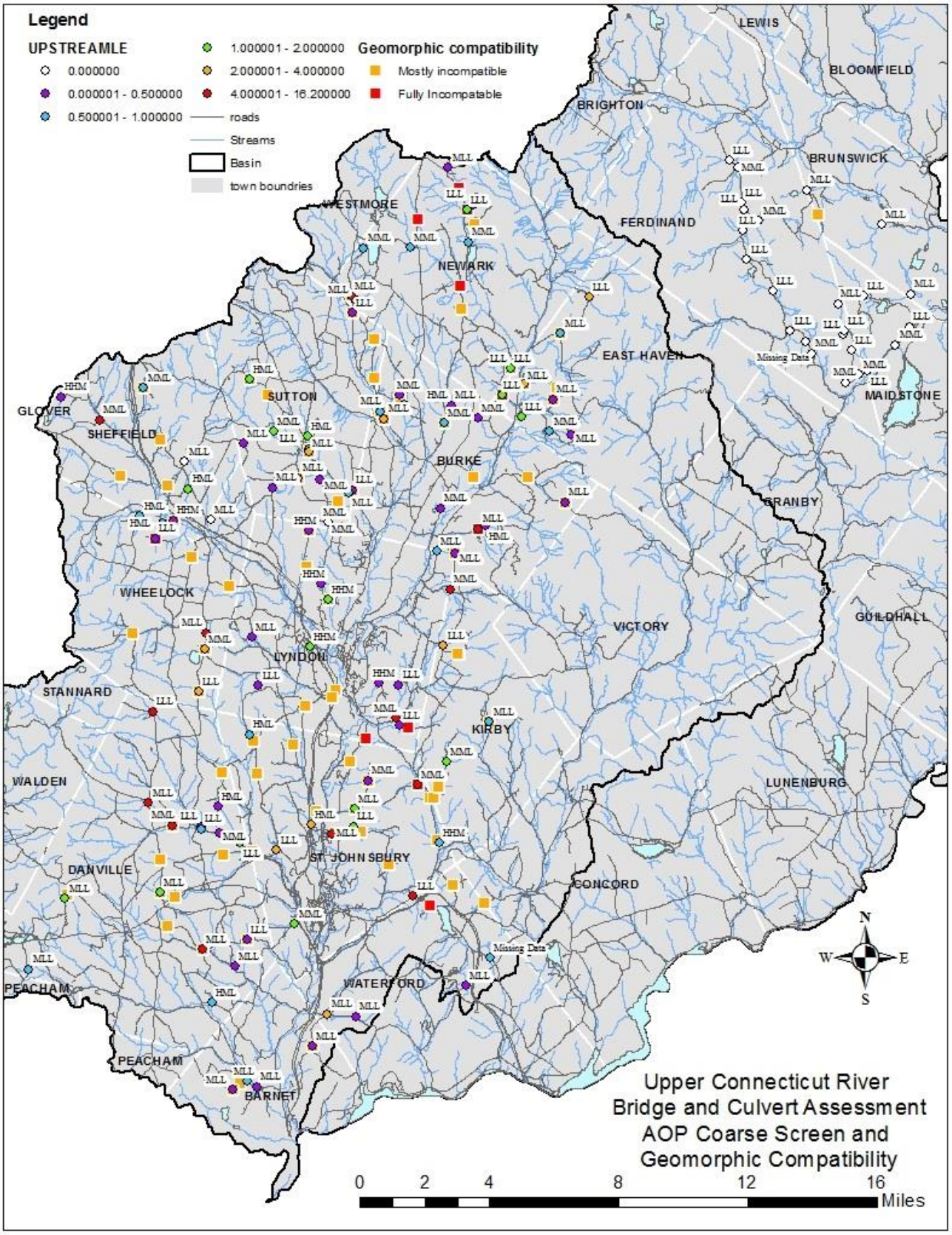

Figure E.5. Priority bridges and culverts for evaluation for replacement or retrofit based on mileage of upstream opened up on culverts with No AOP or No AOP except salmonids as well as culverts listing as fully or mostly geomorphically incompatible (Mileage not available for culverts in Paul stream watershed.)

Appendix F - Regulatory and Non-regulatory Programs Applicable to Protecting and Restoring Waters in the Passumpsic and upper Connecticut River basin.

The Vermont Surface Water Management Strategy maintains a continually updated roster of regulatory and non-regulatory technical assistance programs.

Regulatory programs may be accessed at:

http://www.vtwaterquality.org/wqd_mgtplan/swms_appA.htm

Non-regulatory programs may be accessed at:

http://www.vtwaterquality.org/wqd_mgtplan/swms_appD.htm

Appendix G – Responsiveness summary

Vermont Department of Environmental Conservation
Agency of Natural Resources

Responsiveness Summary to Pubic Comments Regarding:
Passumpsic and Upper Connecticut River Tactical Basin Plan.

On April 2nd, 2014 the Vermont Department of Environmental Conservation (DEC) of the Agency of Natural Resources (ANR) released a final draft of the Passumpsic and Upper Connecticut River Tactical Basin Plan for public comment. The public comment period, which ended on May 8thst, included two public meetings. The meetings were held in Brunswick, Vermont on April 17thst and in St Johnsbury, Vermont on April 22th 2014.

The DEC prepared this responsiveness summary to address specific comments and questions and to indicate how the plan has been modified. The comments below follow the outline of the final draft plan. Comments may have been paraphrased or quoted in part. The full text of the comments is available for review or copying at the Saint Johnsbury Regional Office of the Department of Environmental Conservation, Suite 201, 1229 Portland Street, Saint Johnsbury, Vermont 05819.

Chapter 1- Introduction

Comment: The list of partners in Chapter one breaks up the flow of the plan and there are many partners missing from this List.

Response: The section listing partners in Chapter was expanded to include a number of missing partners and moved to Appendix D.

Chapter 2 – Water Quality in the Basin

Comment: Studies on floodplain restoration on the Connecticut River should be referenced in the plan and listed in the references section.

Response: Three reports regarding floodplain restoration on the Connecticut River and one on water quality in the Nulhegan River watershed were added to the references of the plan.

Chapter 3- Management Goals for Waters in the Passumpsic and Upper Connecticut River Watershed

Comment: Reclassification of waters to A1 or designation of the Nulhegan river watershed as an ORW such should not be done if this would limit the use of the basin or Silvo O. Conti National Fish and Wildlife Refuge lands for things such as snowmobiling, hunting, maintenance of existing roads and trails, the development of footpaths and camp sites, in-

stream habitat restoration projects, and continued logging operations with appropriate BMP's.

Response: Reclassification of the Nuhegan or designation as an ORW would have limited impacts on the uses of the watershed identified above. With regards to ORW designation some activities such as permitting of new crossings for VAST trails or roads may include more stringent protections, as could projects that go through the Act 250 permitting process. With regards to reclassification as an A1 water the primary regulatory impact is that on-site disposal of sewage from systems with a capacity greater than 1000 gallons per day are not allowed in Class A1 watersheds.

Comment: Concern exists for limitations on land management that may occur as part of a reclassification to Class 1 wetlands with regards to the Moose and Yellow Bogs where the basin plan recommends study to determine if reclassification to Class 1 wetlands is warranted. There are specific concerns about silviclutural operations, road maintenance and invasive species management with herbicide.

Response: In Class 1 wetlands silvicultural operations are only an allowed use if the sivicultural activity complies with a plan approved in writing by the Commissioner of the Department of Forests Parks and Recreation. However, with regards to road maintenance and habitat management work, changes in wetlands classification should not cause significant changes with the exception of the potential for a wider buffer associated with the Class 1 wetland. Herbicide use in is an allowed use if a plan is approved by the Wetlands Program for both class 1 and class 2 wetlands so the reclassification doesn't change land managers ability to control invasive species using herbicide.

Comment: The Brunswick Planning Commission should be kept in the loop regarding any reclassification of wetlands in Town so this information can be included in town planning documents.

Response: The Wetlands Program will keep the planning commission and town officials in the loop with regards to any possible wetlands reclassification.

Chapter 4- Watershed Improvement Actions and Implementation Table

Comment: Consultants should be listed as partners on many of the action items

Response: Consultants were added to many of these actions as recommended.

Comment: Burke Conservation Commission and Caledonian County NRCD are interested in supporting water quality sampling.

Response: Both groups have been added to the strategies related to water sampling.

Appendix A – Existing use tables

Comment: The Connecticut River Paddlers Trail and popularity of canoeing on the Connecticut River should be highlighted in the Plan.

Response: The Connecticut River Paddlers Trail has been added to the discussion of boating as an existing use in the basin although the Connecticut River was not assessed for existing uses since it is a New Hampshire Water. The Paddlers Trail and new map was also added to the section on unique basin characteristics.

Appendix E- Passumpsic and Upper Connecticut River Corridor and Bridge and Culvert Assessment Summaries and High Priority Actions

Comment: The Phase 2 stream geomorphic assessment of streams in the Lower Passumpsic River watershed was published after the completion of the draft plan should be integrated into the final Tactical Plan.

Response: Maps of areas of completed Phase 2 Stream Geomorphic Assessments and the summary of stream geomorphic assessments in the basin were updated based on this report in Appendix E.

Comment: The Basin Plan should address stabilization of the large mass failure on the Connecticut River in Brunswick at the Hooke Farm because of the massive amounts of sediment this contributes to the Connecticut River.

Response: The Agency of Natural Resources recognizes the significant amount of sediment contributed to the Connecticut River by this large mass failure. Erosion at this site has been going on for a number of years and there are many factors in the watershed that are likely contributing to this issue including: berming on the opposite bank of the Connecticut River which has removed floodplain access and a historical flood chute, riprap that has been used upstream of the site, and historical straightening of the Connecticut River as was identified by John Fields in the 2006 stream geomorphic assessment. Because of these factors and the scale of the mass failure, the cost of stabilizing this site, if possible, would be substantial and likely to outweigh the benefits. The landowner of the site is encouraged to work with our stream alteration engineer in to discuss options.