# Vermont Agency of Natural Resources

# Watershed Management Division

## Batten Kill Walloomsac Hoosic

## DRAFT TACTICAL BASIN PLAN

The Hudson River Basin (in Vermont) - Water Quality Management 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.

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

Vermont Surface Water Management Strategy

Approved:

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Alyssa Schuren, Commissioner Date

Department of Environmental Conservation

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Deb Markowitz, Secretary Date

Agency of Natural Resources

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 existing water quality and reasonably attainable and desired water quality management goals. ANR has not included proposed Water Management Types in this Basin Plan. ANR 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 ANR with the acknowledgement that it does not meet the requirements of Section 1-02 D (5) of the VWQS.



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# Hudson River Basin Tactical Plan Overview

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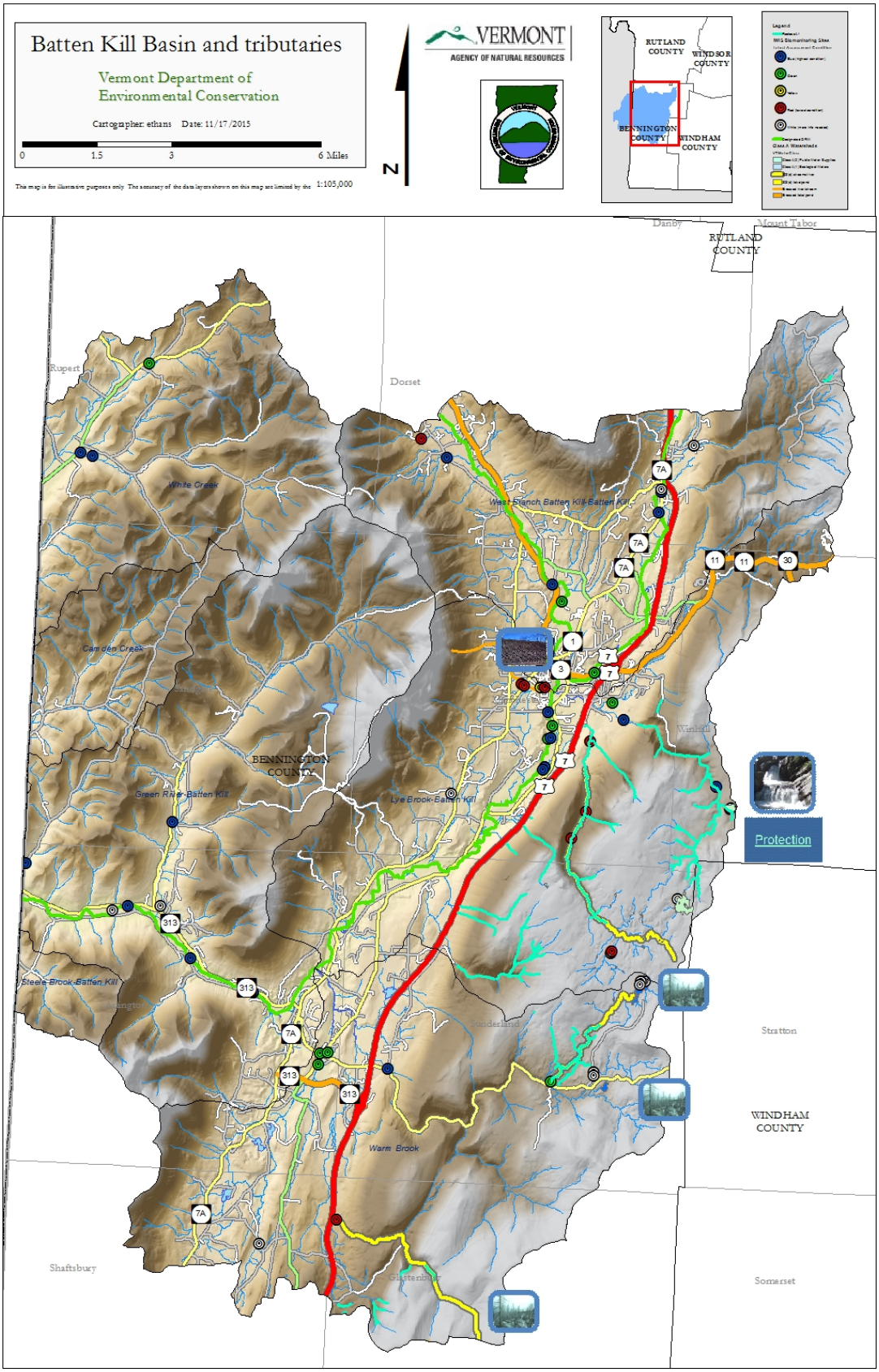



**Figure 1. Batten Kill Basin and Major Stressors**

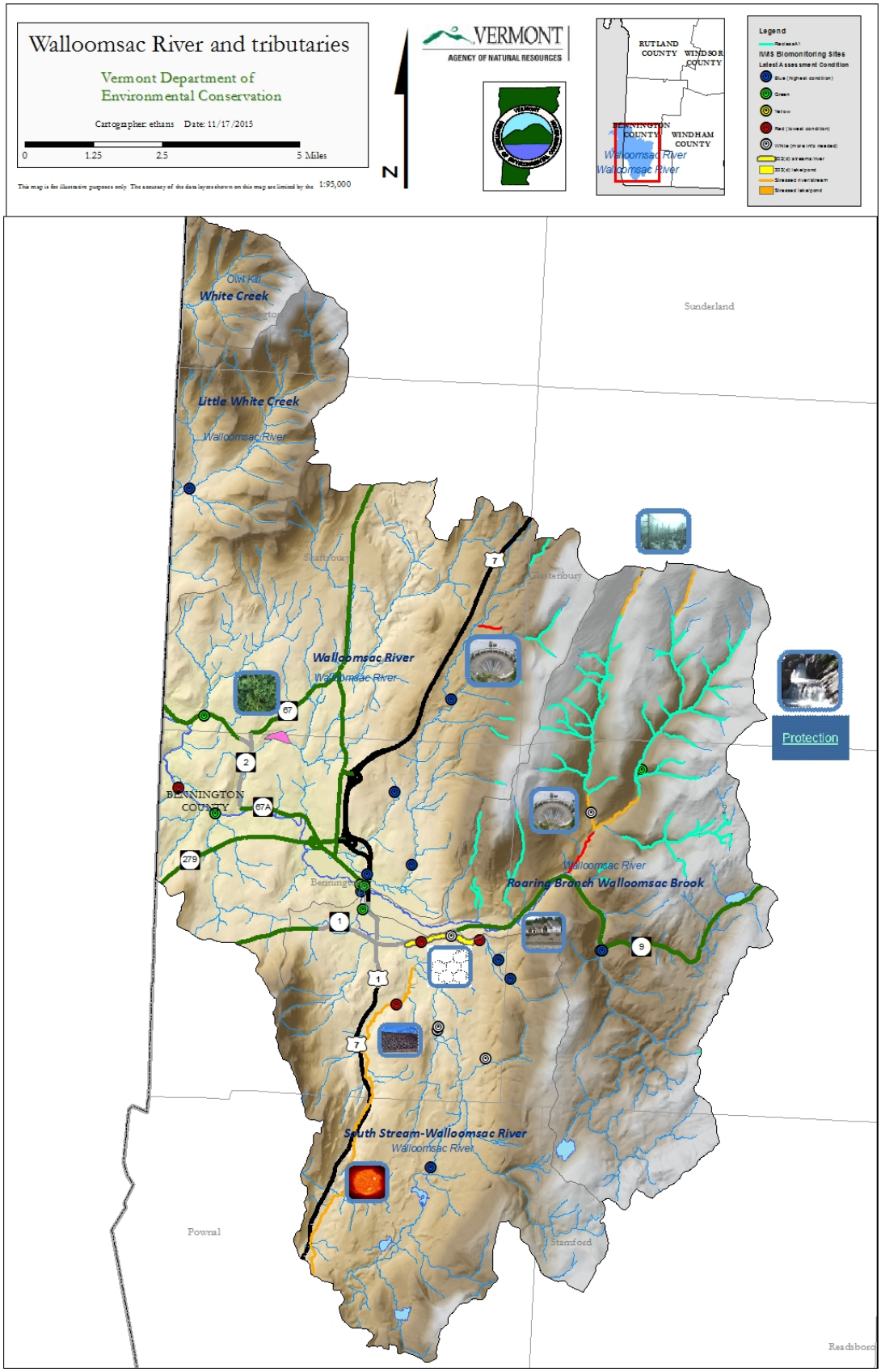



**Figure 2. Walloomsac River Basin and Major Stressors**

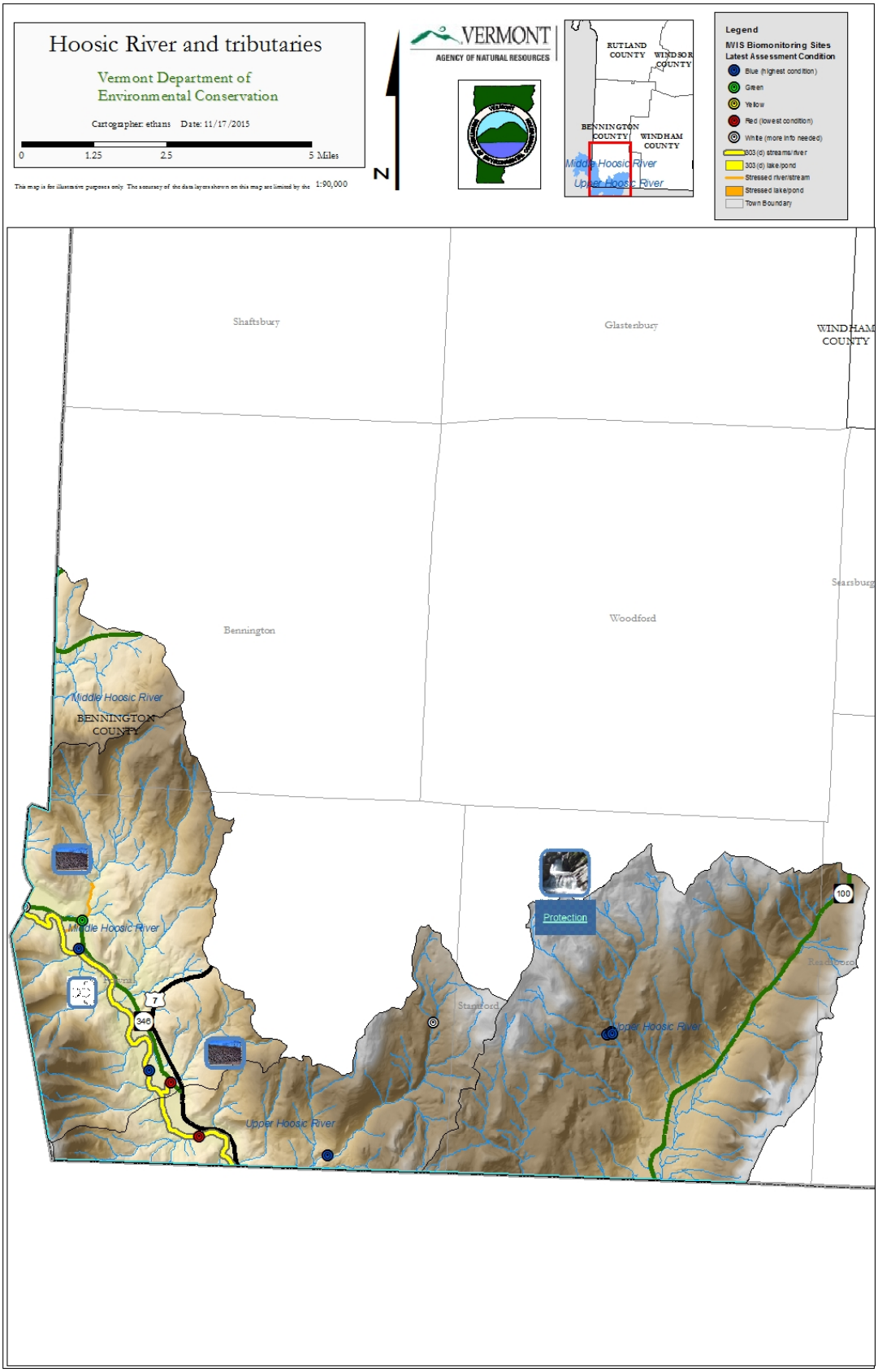



**Figure 3. Hoosic River Basin and Major Stressors**

## Executive Summary

The Hudson River Tactical Basin Plan provides an overall view of the health of the basin and defines on-going and future actions to address high-priority stressors (http://www.vtwaterquality.org/wqd_mgtplan/swms_ch1.htm). Basin 1 consists of the Batten Kill, Walloomsac, and Hoosic River Basins that all eventually flow southwesterly into the Hudson River in New York. The Basin covers just under 430 square miles of southwestern Vermont.

High priority stressors in the Hudson River Basin include Acidity (atmospheric deposition), Encroachment, Channel Erosion, Invasive Species, Thermal Modification, and Land Erosion.

The Batten Kill, Walloomsac, and Hoosic River sub-basins are significant in representing source waters in Vermont for the upper Hudson River. The protection and improvement of the Hudson River sub-basins, including the Batten Kill, Walloomsac, and Hoosic Rivers in Vermont, are reflected in the actions identified in this Tactical Basin Plan. There are also high elevation surface waters that are impaired due to acidity and elevated levels of sediment and nutrients. In addition, there is a good deal of focus on flood and erosion hazard risks in basin waterways. The heart of this plan is the implementation table in chapter 4, which includes actions to protect or restore surface waters in the basin. Below are the goals and top priority strategies to complete these actions.

The Tactical Plan actions will protect, maintain, and improve surface waters by managing the activities that result in surface water stressors, and address the attendant pollutants associated with them. These actions strategically target specific surface waters in those sub-basins (Figure 1) where their implementation would achieve the greatest benefit to water quality and aquatic habitat as well as being the most cost effective. In general, the Batten Kill, Walloomsac, and Hoosic Rivers are targeted for protection and restoration strategies while various tributaries are targeted for additional water quality and aquatic habitat monitoring and assessment work. This and all Tactical Basin Plans benefit from biennial implementation table updates. For this Hudson River Tactical Plan, ongoing efforts to build flood resiliency will be a featured priority in the first biennial review, to implement priority actions related to ongoing restoration efforts due to Tropical Storm Irene.

On August 28, 2011, Tropical Storm Irene struck the central and southern portions of the State with over 10 inches of rain in many locations. The Batten Kill and Walloomsac River Basins sustained significant flood damage in some areas due to erosion and flood inundation. This damaged or destroyed roads, bridges, culverts, private and public

property, and farmland. The flooding and erosive damage will remain visible for decades but the rivers' response has been to re-create lost floodplains, increase sinuosity and re-distribute sediment throughout the valleys. The new river channels and patterns will offer some mitigation of future flood events. This Plan will emphasize actions that will assist watershed residents and towns to remediate Irene's impacts and enhance the flood resilience of the Basin against future flood events. Future attention to building with flood resiliency in mind will also move the region toward a more sustainable co-existence with our rivers. A number of implementation actions are direct responses to the flooding in order to move in this direction.

Recreational opportunities are extensive in the Basin. The Batten Kill has been designated as an Outstanding Resource Water for fishing and is well-known for paddling.

This Water Quality Management Plan provides a watershed-wide perspective on the health and condition of the water quality and aquatic resources of the basin. As the tactical, or implementation, portion of the Vermont Surface Water Monitoring Strategy it offers clear actions to protect, maintain, and improve surface waters by managing the activities that cause the known stressor(s) and address the resulting pollutants. Priority has been given to those waters that are identified as facing the greatest challenges due to either degraded conditions already present or the exceptional quality and characteristics that should be protected.

Strategies address both overall regional water quality issues as well as specific actions on targeted waters. The goal is to carry out as many of these actions as possible over the next five years to bring improvements and protections to the regions surface waters.

## Priority Actions

### Top Ten Actions:

**Protect very high quality surface waters** throughout the Basin for re-classification and designation of these significant natural resource assets.
**Build flood resiliency into regional and municipal planning and projects**
**Minimize forest fragmentation**, especially in large intact-forested headwaters that are not already conserved.
**Reduce non-point source pollution from gravel roads** by preparing road erosion capital budgets and implementing Best Management Practices (BMPs) in the upper watersheds that address significant sediment sources (target towns include Pownal, Rupert, and Sandgate).

**Restore stream equilibrium and support improved aquatic organism passage (AOP) and habitat -** upgrade/replace high priority stream crossings with structures that are geomorphically-compatible. Actively restore aquatic habitat within both stream channels and riparian areas (priority sub-basins include headwaters of the Hoosic, including Roaring Brook and Stamford Stream).

**Protect targeted river corridors and wetlands** - protect high priority river corridors and wetlands for sediment attenuation assets, flood resiliency, and aquatic and wildlife habitat, and **Minimize flood plain encroachments** - identify and remove high priority flood plain encroachments and implement projects that connect the active river channel to its flood plain (as identified in river basin corridor plans).

**Coordinate with the Bennington County Regional Commission and towns in the Basin** to update Town Plans and Zoning Regulations to incorporate enabling language for water quality protection and remediation. Incorporate Low Impact development standards into Town Plans and Zoning Regulations to promote these stormwater mitigation strategies.

**Implement high priority agricultural BMP** needs identified through Agricultural Environmental Management assessments, especially on Small Farm Operations (SFO) throughout the basin.

**Develop and implement stormwater master plans** as well as implement the highest priority stormwater mitigation projects as identified in Basin towns via the (IDDE) projects (towns include Bennington and Manchester).

**Protect public access to watershed swimming holes, recreational boating, and fishing areas. Related to this, raise awareness of aquatic invasive plants, animals, and pathogens spread prevention in the basin.**

### Summary of Classification Opportunities.

**Water recommended for reclassification to Class A(1):**

- Beebe Pond (Sunderland) and tributaries
- Branch Pond Brook
- Bourn Brook (where not already wilderness lands)
- Lye Brook and tributaries (portion forming boundary between Lye Brook Wilderness and non-wilderness GMNF lands)
- South Fork of the Roaring Branch
- Alder Pond (Sunderland) and tributaries
- Black Brook and tributaries, upstream of confluence with Fayville Brook
- North Branch Hoosic River (Cardinal Brook)

**Wetlands Class I candidates:**

Pownal Bog

Maple Grove Swamp
Middle Pownal Road Swamp

**Wetlands proposed for study to determine Class 1 potential:**

Batten Kill headwaters

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

**Other Priority Actions**

- Incorporate River Corridors and flood resiliency strategies into regional plans and municipal planning and zoning updates.
- Work with the US Forest Service to reclassify candidate surface waters within the Green Mountain National Forest from Class B to Class A1.
- Conduct Stormwater mapping and master planning assessment on the West Branch of Munson Brook and its tributaries that address sediment and stormwater impacts.
- Implement restoration projects prioritized in River Corridor Plans for the Batten Kill, Walloomsac, and Hoosic Rivers and their tributaries
- Protect the intact-forested landscape to reduce forest fragmentation where it is not already conserved.
- Implement stormwater control projects and green infrastructure practices to reduce flows and sediment. Focus areas: Bennington, North Bennington, Manchester, Pownal
- Reduce sediment inputs and thermal stress to Jewitt Brook from land erosion and the loss of riparian habitat.

# Chapter 1 - Introduction

## Basin Description

The Hudson River Basin and its sub-watersheds are described in detail in Chapter 2.

## 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. The Tactical Planning Process is outlined in Chapter 4 of the Surface Water Management Strategy.

Many of these recommendations have been implemented or are in progress by ANR and its watershed partners. This tactical plan builds upon those original plan recommendations by promoting specific, geographically explicit actions in areas of the basin that have been identified for intervention, using on-the-ground monitoring and assessment data.

**The Vermont Clean Water Act**

In 2015 the Vermont Legislature passed Act 64, the Vermont Clean Water Act. This Act strengthens multiple statutes related to water quality in the State. The Act addresses agricultural water quality on small, medium and large farms through the Agency of Agriculture, Food and Markets. Act 64, signed into law by the Governor on June 16, 2015, amended several provisions regarding agricultural water quality. The "accepted agricultural practices" (AAPs) are renamed the "required agricultural practices" (RAPs). The AAPs and RAPs are minimum standards by which a farm must manage their agricultural operations. The revised RAPs have been changed to include requirements for:

- Small farm certification
- Nutrient storage
- Soil health
- Buffer zones
- Livestock exclusion
- Nutrient management
- Tile drainage (By: January 15, 2018)

Act 64 also establishes water quality requirements for stormwater discharges from new and existing development, industrial and municipal stormwater discharges, and runoff from municipal roads through the Department of Environmental Conservation. Through

the Department of Forests, Parks and Recreation, the Act addresses water quality runoff from forest silvicultural activities. The Act also establishes the requirement that all water quality improvement actions undertaken by the State be integrated by means of Tactical Basin Plans, and establishes partnerships with Regional Planning Commissions, Conservation Districts, and other organizations to support this work. Lastly, the Act establishes a cleanup fund to dedicate resources towards the highest priority water quality remediation actions.

Act 64 is just beginning to be implemented. Drafting procedures and legislative rule-making are in process. The resulting policies and procedures will take several years to be fully implemented, and will ensure improved water quality throughout the state. For more information, readers should review the content of the Clean Water Vermont website, at: http://cleanwater.vermont.gov/.

### Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the Hudson River Basin. These partners are non-profit, state, and federal organizations working on both private and public lands.

**The Batten Kill Watershed Alliance**

The Batten Kill Watershed Alliance (BKWA) was created in 2001 to promote good stewardship of the river and its tributaries in both Vermont and New York. The Alliance is fulfilling this mission through investments in the river system and public outreach. They have built partnerships with landowners, river users, and government agencies in both New York and Vermont. The formation of the group was motivated by stakeholder concern about the erosion and channel instability, a decline in the trout population in the 1990s, and conflicts among river users and landowners.

Alliance achievements have included investments in trout habitat improvements and better river dynamics, erosion control and bank stabilization projects, sponsorship of River Stewards, and public presentations on topics concerning the river. The most significant accomplishment has been the installation of cover and shelter structures in the river based on the latest scientific conclusion that this component of habitat is deficient in the river. There is now documented evidence that this kind of habitat improvement can increase the trout population, reversing the earlier decline. This project is ongoing in the Batten Kill in both states. The BKWA is currently involved in projects in White Creek in both NY and

VT, and we will be evaluating projects in other tributaries related to damage from tropical storm Irene.

The BKWA is governed by an eleven member board of directors that includes landowners, anglers, canoeists, and community members from both states. Alliance projects are supported by our members, and BKWA has also received grants from organizations such as Trout Unlimited chapters, Green Mountain National Forest, U.S. Fish & Wildlife Service, the Trout & Salmon Foundation, the Orvis Company, the National Fish & Wildlife Foundation, and the Environmental Protection Agency through the River Network.

**Bennington County Regional Planning Commission**

The Bennington County Regional Commission (BCRC) was created, pursuant to 24 V.S.A. Section 4341, by the seventeen towns and villages it serves and will work with and on behalf of those municipalities to build strong, resilient, and sustainable communities, to foster economic prosperity, and to promote a high quality of life for residents of the region.

This mission is accomplished through direct planning and community development assistance to town and village governments, through preparation and implementation of regional plans and studies, and through synergistic working relationships with local and regional organizations. The BCRC will work cooperatively with local governments to establish and advance regional cohesiveness, actively advocate for adherence to adopted regional policies, and facilitate effective communication between local, state, and federal levels of government.

**The Hoosic River Watershed Association (HOORWA)**

Hoorwa is dedicated to the restoration, conservation and enjoyment of the Hoosic River and its watershed, through education, research, and advocacy. Hoorwa members envision a watershed that is ecologically sound and adds to the quality of life of its residents. The Hoosic River Watershed Association is a citizen organization that looks after the Hoosic River.

**The USFS and the Green Mountain National Forest (GMNF)**

The USDA Forest Service manages the GMNF, aided by partners, other agencies, and individuals. There are two Ranger Districts: the Manchester in southwest Vermont and the Rochester-Middlebury in central Vermont. The Forest Headquarters is currently located in Rutland, Vermont.

The Green Mountain National Forest (GMNF) encompasses more than 400,000 acres in southwestern and central Vermont, forming the largest contiguous public land area in the State. Characterized by striking scenery that combines rugged mountain peaks with quintessential Vermont villages, the Forest is an attraction for many visitors. The GMNF signifies a multiple-use ethic through its role of providing ecological and science-based forestry stewardship, clean water, diverse vegetation, high-value, high-quality forest products, economical and educational contributions, and trail-based backcountry recreation.

**Bennington County Conservation District (and BCSFC)**

The Bennington County Conservation District (BCCD) is dedicated to promoting rural livelihoods and protecting natural resources in Southwestern Vermont through the active conservation and protection of

- Our streams, rivers and lakes - the clean waters they transport, the opportunities for recreation they provide, the organisms (trout! loons!) that live in them.
- The forests that cloak our Green Mountains and Taconics - the natural areas and wildlife habitats they represent, the clean air and dark skies they protect, the timber and other resources they offer.
- Our working farms - the fresh and healthy products of all kinds they make available to us, the agricultural economy they sustain, the scenic vistas they preserve.

**The Bennington County Sustainable Forestry Consortium (BCSFC)**

The Bennington County Sustainable Forest Consortium is a collaboration between landowners, foresters, loggers and other natural resource professionals. The Consortium facilitates the exchange of ideas and experiences to encourage people to care about our forests. The mission of the BCSFC is to promote responsible use and exemplary stewardship of the woodlands of Bennington County, and in so doing, to sustain the healthy ecosystems and rural livelihoods those forests support.

**Agricultural Resource Specialist (ARS) Program** is offered by the Vermont Association of Conservation Districts (www.vacd.org) and is supported by funding from the Vermont Agency of Agriculture, Food, and Markets (VAAFM). Three main services are offered to farmers:

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

**Better Back Roads Program (BBR)** provides technical assistance, grant funding, and educational workshops related to transportation infrastructure and water quality. BBR provides funding for municipalities through the Better Back Roads 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.

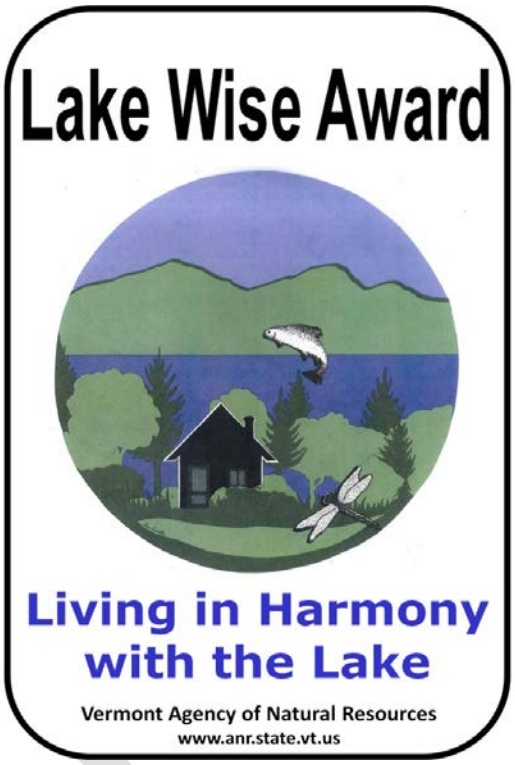
**Vermont Agency of Transportation (VTrans)** manages and maintains miles of State highway and stream crossings within the basin including Routes 4A, 22A, 30, 73, 133, 140, and Interstate 4. VTrans provides technical assistance in the form of hydraulic modeling for bridge and culvert replacements and transportation maintenance. VTrans also provides grant funding to basin municipalities including Structures and Transportation Enhancement grants.

**USDA Natural Resources Conservation Service (NRCS)** provides cost-share, technical assistance, and targeted support of agricultural best management practices. Additionally, NRCS provides funding and technical assistance for forestry and wildlife habitat projects.

**Watershed Municipalities -** there are twenty-three towns wholly or partially within the Hudson River Basin within the counties of Bennington and Rutland (Figure 4). Municipalities can protect water resources through town plan language and zoning bylaws. Additionally, towns are responsible for managing large networks of roads, drainage ditches, and stream crossings.

**ANR Internal Partners**- All Departments within ANR (Fish & Wildlife Department, Forest, Parks, and Recreation, and DEC) and Divisions within them, work collaboratively on a number of watershed assessment, restoration and protection projects. Additionally, FWD and FPR own and manage hundreds of acres of state-owned lands within the basin. Annual stewardship plans are prepared by District Stewardship Teams and includes staff from FWD, FPR, and DEC. Long Range Management Plans of state-owned properties include restoration and protection of water resources. Some specific watershed restoration projects are described in this plan.

**The Vermont Lake Wise Program**




The Lake Wise Program is offered through the Vermont Lakes and Ponds Section to provide trainings in lake friendly shoreland management to Lake Associations and shoreland property owners. Through Lake Wise, participants receive technical assistance to evaluate specific landscaping practices for fixing erosion and polluted runoff, while improving lake quality and wildlife habitat. Lake Wise participants passing all four categories for driveway; structures and septic systems; recreation areas; and shorefront receive the Lake Wise Award, which can include a beautiful Sign that can be proudly displayed on the property. Lake Associations are also awarded the "Gold Award," depending on the percentage of shoreland owners participating in Lake Wise.

The goal of Lake Wise is to improve or maintain water quality and in-lake and on-shore wildlife habitat by encouraging lake friendly landscaping practices.
http://www.vtwaterquality.org/lakes.htm

### Implementation Process

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

Actions defined in the Implementation Table will be addressed over the life of the Hudson River Basin Tactical Basin Plan. Successes and challenges in implementing Actions will be reviewed and addressed in annual meetings with watershed partners. The Tactical Plan will not be a static document. Tropical Storm Irene has taught us that DEC and its partners have to develop adaptive management techniques as new natural and anthropogenic events present themselves. In addition, the implementation of actions and Implementation table itself will be revisited biennially, and be modified accordingly to best address newly emerging information , unanticipated events, and new requirements such as are

anticipated by legislative acts such as Act 110, Act 16, and Act 64, now generally referred to as the Vermont Clean Water Act.

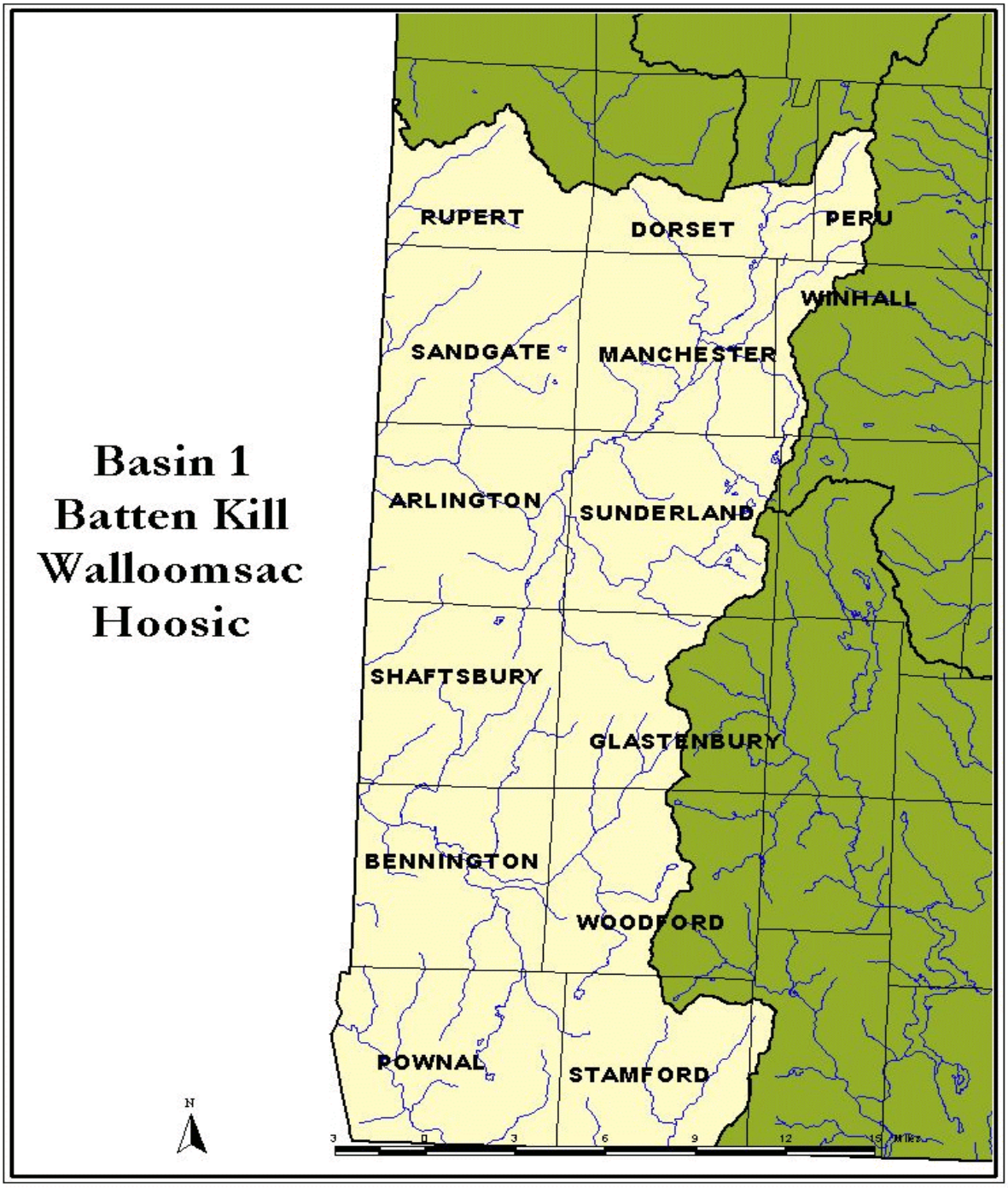



**Figure 4. Hudson River Basin (in Vermont) map with municipal delineations.**

# Chapter 2- Water Quality in the Basin

## Watershed Description

The Hudson River Basin has three major tributaries in Vermont. The watershed was broken up into three priority sub-watersheds for the purposes of presenting the information on monitoring and assessment information, priority surface waters identified in each, and priority actions to address those waters and issues.

In this plan, the following sub-watersheds are highlighted for specific intervention based on DEC's evaluation of monitoring and assessment data.

- The Batten Kill
- Walloomsac
- Hoosic

The Walloomsac River is a tributary to the Hoosic River, although broken out as a sub-basin in this Plan as the confluence of the Walloomsac and Hoosic is downstream in New York State. The Batten Kill, Walloomsac, and Hoosic River sub-basins are significant for providing the source waters of Hudson River.

**ANR Natural Resource Atlas – Tactical Basin Planning theme**

In December 2012 ANR introduced the **Natural Resource Atlas.** Much of the assessment, monitoring, and other information included in Chapter 2 is now accessible through the Natural Resource Atlas. The purpose of the **Natural Resources Atlas** is to provide geographic information about environmental features and sites that the Vermont Agency of Natural Resources manages, monitors, permits, or regulates. In addition to standard map navigation tools, the Natural Resources Atlas site allows the viewer to link from sites to documents where available, generate reports, export search results, import data, search, measure, mark-up, query map features, and print PDF maps.

The Natural Resource Atlas now includes a Tactical Basin Planning theme, which highlights the major priorities and implementation categories in each watershed planning basin. The Tactical Planning theme shows where in the basin actions will be targeted. Examples include candidate waters for protection and reclassification, high priority waters for nonpoint source mitigation, priority areas identified for aquatic habitat restoration, opportunities for additional public access to surface waters, and priority waters for additional monitoring and assessment.

## The Batten Kill

The Vermont portion of the Batten Kill watershed drains much of the northern portion of Bennington County and includes an area of approximately 200 square miles. The Batten Kill rises in East Dorset and flows south with Mad Tom Brook soon joining it from the southern slope of Mount Tabor. It flows in a southwesterly direction to Arlington and then in a westerly direction to the Hudson River in New York, which it enters at a point one mile north of Schuylerville, New York. Two hundred and seven square miles of the drainage area of the basin are located in the New York portion of the watershed. From source to mouth following the major windings, it measures approximately 55 miles. The length of the river in Vermont is approximately 24 miles.

The following river and tributary descriptions for the Vermont portion of the basin were taken in part from the United States Geological Survey, Department of the Interior Publication *Surface Waters of Vermont*.

Mad Tom Brook rises on the southern slope of Mount Tabor in the northwestern part of the town of Peru at an altitude of 2,900 feet above sea level. It flows southward and south-westward to East Dorset where it joins the beginning of the Batten Kill from the north. Its length is about 5 ½ miles and its fall is about 2,100 feet.

The West Branch rises on the northern slope of Bear Mountain in the southeastern part of Rupert at about 2,500 feet above sea level. It flows eastward about 2 miles, then turns and flows southeastward to near Manchester Center. The West Branch has a length of about 9 miles and a fall of 1,800 feet, of which 1,600 feet occurs in the first 2 miles.

Bourn Brook rises in Bourn Pond in the northeastern part of the town of Sunderland at an altitude of 2,500 feet above sea level. It flows somewhat east of north for about 2 miles and then takes a northwesterly course to its junction with the Batten Kill half a mile south of Manchester Center. Its length is about 6 miles and fall about 1,800 feet of which 1,300 feet of drop occurs within 1 ½ miles in the middle of its course.

Lye Brook rises in Lye Brook Meadows in the northeastern part of Sunderland at an elevation of 2,640 feet above sea level. It flows in a northerly direction about 5 miles, then turns abruptly and flows southwestward to its junction with the Batten Kill. Its length is 6 miles and its fall is 1,900 feet of which 1,800 feet occurs in the northward flowing stretch.

Mill Brook rises near the center of Sunderland at an altitude of 2,550 feet above sea level and flows southwestward, westward and northwestward to its junction with the Batten Kill at Sunderland. Its length is approximately 4 ½ miles and its fall about 1,920 feet, of which 1,600 feet occurs within 2 ½ miles of the head of the stream.

Roaring Branch originates at the junction of Branch Pond Brook and Alder Brook west of Kelly Stand. It is approximately 10 miles long and flows overall in a westerly direction with northerly and southerly jogs until the East Arlington area. Just north of East Arlington, Warm Brook joins Roaring Branch from the south. Roaring Branch continues north from there to join the Batten Kill.

The Green River rises in many forking branches on the western slopes of Bear Mountain in the towns of Sandgate and Manchester at an altitude of nearly 3,000 feet above sea level. It flows southwestward to Sandgate then takes a more southerly course to its junction with the Batten Kill in West Arlington. Its length is about 10 miles with a total fall of 2,400 feet from source of highest tributary to the mouth.

## Special Values and Features of Batten Kill River Waters

### *Waterfalls, Cascades, Gorges, and Swimming Holes*

Four swimming holes are listed in the 1992 Vermont Swimming Hole Study for the Batten Kill watershed: three are on the Batten Kill itself and one is on Roaring Branch. One of the sites on the Kill is the Wagon Wheel Campground swimming hole, which is accessible to guests at the campground. The river is wooded and shady on both sides and there are shallow pools, instream boulders, small rapids, and a gravel bar. The second site on the Batten Kill itself is just west of Arlington off River Road. The parking area and grassy riverbank belongs to Batten Kill Canoe but the public has been allowed access for swimming and fishing. There is a long, fairly deep pool there. The third site on the river is at the West Arlington covered bridge and is "the most popular swimming area on the Vermont segment of the Batten Kill". There is a large deep pool, good public access, a small beach, some grassy banks, and good fishing from the bridge piers. The other identified swimming hole in the Batten Kill watershed was Roaring Branch Cascade in Sunderland. This site is a series of pools and cascades with clean water, natural vegetation, and carved rocks.

In addition, the Lye Brook Falls is a cascading drop of the Lye Brook within the Green Mountain National Forest that was once referred to as the Trestle Cascade owing to the fact that an old logging railroad trestle crossed below the falls. The brook drops over the 125-foot cascade in the Town of Manchester.

### *Significant Natural Communities and Rare, Threatened and Endangered Species of the Batten Kill River Basin*

An inventory of significant calcareous fens and riverside seeps done by the Vermont Nongame and Natural Heritage Program found two rich fen communities and one

intermediate fen community in the Batten Kill watershed. The two rich fens are located in Manchester: one is a small (1.5 acre) wetland, of which a portion is rich fen, and the other is a relatively large, mostly open fen with a diversity of vegetation types and a large population of a globally rare sedge. A two-acre intermediate fen is found in Shaftsbury and an uncommon water sedge grows there.

### *Outstanding Resource Water status*

On January 8, 1991, the Vermont Water Resources Board designated all Vermont portions of the Batten Kill mainstem and the West Branch of the Batten Kill as Outstanding Resource Waters. They were designated for their exceptional natural, recreational, cultural, and scenic values. The findings of fact and conclusions of law present the case for a "high quality trout stream" due to physical and chemical qualities and a river that provides "exceptional wildlife habitat" with its productive floodplain, intact riparian zone in many places, north-south orientation for migratory birds, slow-moving waters for furbearers, and thriving food chains that begin with aquatic insects and trout.

The case is also made through the ORW designation for the exceptional recreational values including angling and canoeing. Access, aesthetics, a good fishery, and enough water in summer all contribute to the heavy use of the river for recreation. Scenic and cultural values are also presented in the ORW petition.

## Batten Kill Watershed Impacts Summary

**Table 1. Status of rivers, streams, lakes, ponds in Batten Kill Watershed**

| Stream or lake segment | Mileage & status | Pollutant | Stressor | Source | Other information |
|---|---|---|---|---|---|
| Lye Brook | RM 2.5 to headwaters (4.5 miles), ***Impaired*** – Part A list | ACID |  | ALS | Atmospheric deposition: critically acidified; chronic acidification |
| Branch Pond Brook (pond to Roaring Branch) | Branch Pond Brook (pond to Roaring Branch), ***Impaired*** – Part A list | ACID |  | ALS | Atmospheric deposition: critically acidified; chronic acidification |
| Fayville Branch RM 3.7 to headwaters | RM 3.7 to headwaters, ***Impaired*** – Part A list | ACID |  | ALS | Acidification, acid deposition |

| | | | | | |
|---|---|---|---|---|---|
| Munson Brook | 0.8 miles ***Stressed*** – | Sediment |  | Stormwater runoff, urbanization | High Embeddedness |
| West Branch | x.x miles ***Stressed*** | Sediment |  | Stormwater runoff, urbanization | High Embeddedness |
| Batten Kill mainstem | 6.2 miles ***Stressed*** | Sediment, temperature, habitat alteration |  | Stormwater runoff, urbanization | Loss of riparian veg, streambank erosion, runoff, lack of habitat features |
| Bourn Pond, Little Mud Pond, Lye Brook N, Lye Brook S, Branch Pond, Beebe Pond | ***Impaired acid ponds in the basin*** | ACID |  | ALS | Atmospheric deposition: critically acidified; chronic acidification **EPA approved TMDL September 30, 2003** |

## Assessment Information – Batten Kill and tributaries

### *Biological monitoring*

The Batten Kill's clean water is biologically important because the most diverse and productive aquatic insect communities are associated with streams with cobble or gravel bottoms and well-oxygenated water. This is especially true for mayflies and stoneflies, both major foods for trout. The consistent summer flows of the Batten Kill are also very important for aquatic insects, in particular the larger mayflies and stoneflies. Moreover, it also has a diverse and productive fish community and nationally recognized as a significant trout fishing stream.

The Batten Kill is a quick-water stream with slopes in the 15-20 feet per mile range and hence has many riffles and mild rapids. Streams with abundant riffles and good summer flows have lots of good habitat for mayflies and stoneflies and thus tend to have the highest populations of these insects. The natural vegetation along the banks of the Kill shades the channel and keeps the summer temperatures down.

The Batten Kill is, essentially, a limestone stream. The limestone is found in the upper and middle parts of the watershed. The limestone has two main effects: it neutralizes organic and inorganic acids that have deleterious biological effects, and it is itself an important nutrient for many plants and animals. Limestone streams invariably have more diverse shoreline plant communities than non-limy streams, have more abundant and diverse

stream insect communities, and thus are able to support larger and more rapidly growing fish populations.

**(Source: http://www.anr.state.vt.us/dec/waterq/bass/docs/bs_Batten Killmacro.pdf)**

**Table 2. Macroinvertebrate sampling results for Batten Kill mainstem sites**

| | rm 32.9 | rm 47.0 | rm 47.7 | rm 48.0 | rm 48.2 | rm 54.9 | rm 55.4 | rm 55.5 |
|---|---|---|---|---|---|---|---|---|
| 2003 | --- | --- | --- | vg-good | --- | --- | --- | very good |
| 2007 | --- | --- | --- | --- | --- | exc | vg-good | |
| 2008 | exc | --- | vg-good | --- | exc-vgood | --- | --- | |
| 2010 | very good | --- | --- | --- | --- | --- | very good | |
| 2012 | --- | very good | exc | --- | --- | --- | --- | |
| 2013 | very good | very good | --- | --- | very good | --- | --- | very good |

**Table 3. Batten Kill biological monitoring sites**

| Milepoint | Location description |
|---|---|
| Rm 32.9 | Located immediately below Arlington cemetery off Route 313 |
| Rm 47.0 | Located 1300m below new Manchester WWTF, above confluence with Lye Brook above old road crossing |
| Rm 47.7 | Located approximately 300m below new Manchester WWTF |
| Rm 47.8 | Located about 50m above new Manchester WWTF |
| Rm 48.0 | Below Union Street bridge about 300m below/adjacent to large sand bank slide |
| Rm 48.2 | Located immediately below Union St Bridge |
| Rm 54.9 | Below 2nd Route 7A crossing 100m going south. Low gradient reach |
| Rm 55.4 | Immediately below 1st Route 7A bridge going south |

### *Lakes in the Batten Kill Watershed*

The Vermont DEC inventory identifies 18 lakes and ponds covering 259 acres in the Batten Kill watershed. Vermont DEC's Lake Protection Classification System is one framework within which lakes can be evaluated for their special significance when compared to other lakes statewide. The Classification System identifies unique lakes based on: wilderness status; occurrence of scenic and natural features; existence of very high water quality;

and/or the presence of very rare, threatened, and/or endangered species. In the Batten Kill watershed, two ponds out of eighteen in the DEC assessment database - Bourn and Branch Ponds - are significant for one or more of these reasons.

Lye Brook Wilderness Area is the second largest Wilderness in the Green Mountain National Forest. Lakes, streams, and bogs are scattered throughout its heavily forested 15,680-acre landscape, including Bourn Pond. Bourn Pond in Sunderland is a true wilderness pond with an attractive sphagnum mat floating island. The pond supports populations of two noteworthy aquatic plants, the rare pondweed Potamogeton confervoides and the rare burreed Sparganium fluctuans. Bourn Pond is critical habitat for breeding common loon.

Branch Pond in Sunderland is outside the Lye Brook Wilderness Area but has a wilderness-like feel. The pond is undeveloped, essentially in a primitive state, but is relatively easily accessed. The pond supports two noteworthy aquatic plants, the rare pondweed Potamogeton confervoides, and the rare bladderwort Utricularia geminiscapa.

Lake Shaftsbury State Park is on an 84-acre parcel surrounding the small but picturesque Lake Shaftsbury. The area operated as a private campground/cabin resort before it became a state park in 1974. It has become a popular park facility in southwestern Vermont. There is also a developed beach, play area, and picnic area. The "Healing Springs Nature Trail" around the lake is also a popular spot.

### *Fisheries in the Batten Kill*

The Batten Kill located in Bennington County of southwestern Vermont has long been recognized as one of this state's top trout fishing streams and has been grouped with other important trout fisheries of the United States. Prior to the introduction of Brown Trout to the river around 1900, the only salmonid inhabiting the river was the native Brook Trout. Following the initial releases of Brown Trout, the species established itself as a self-sustaining wild population around which the sport fishery developed further and built upon the river's reputation as Vermont's pre-eminent trout stream. All stocking was phased out by 1976 and since then the river's fishery has been entirely dependent on wild fish production. In 1991 the river was designated by the Vermont Water Resources Board as the state's first Outstanding Resource Water. Both creel and electroshocking surveys by the Vermont Department of Fish and Wildlife (F&W) have shown a decline in the wild trout populations in the Batten Kill during the 1990s.

The Batten Kill is an exceptional fishery because of its ability to provide high-quality habitat for Brook Trout and Brown Trout. This exceptional habitat is provided by the confluence of several natural features in the same river. These features include:

comparatively high summer flows, limestone in the drainage, extensive gravel beds for spawning, good shade along the banks, stable banks only occasionally subject to serious erosion and sedimentation, consistently cold summer water temperatures, a well vegetated watershed with minimal nutrient and sediment pollution, and a naturally reproducing Brook Trout and Brown Trout fishery. The river has stable flows, cool water temperatures favorable to salmonids, good physical habitat providing necessary cover, refuges, spawning and rearing habitats, as well as the food quality and quantity necessary to support a healthy salmonid population.

The status of the Batten Kill's brook and Brown Trout fishery has been monitored since at least 1984 at several index sites. On the upper Batten Kill, there is the Batten Kill (697) Manchester (or the Vermont 11 & 30 bridge) site, and the Batten Kill (766) East Dorset (or the Vermont 7A bridge) site. On the lower Batten Kill, there was a site just outside of Arlington village referred to as the "West Mountain Site", which was scoured out by Tropical Storm Irene and now is too deep to wade and sample and another site down below the West Arlington covered bridge called "Cemetery Run", which has such poor habitat conditions that it was abandoned as a site. The two upper sites are still monitored, however, a relatively new site on the lower Batten Kill called Twin Rivers Habitat Project site is now the longterm site for the lower Batten Kill. That site has been sampled since 2005.

The Batten Kill trout fishery has been one of the state's premier wild trout streams. However in the mid-1990s, there was a "dramatic decline" that has led to much investigation and subsequent actions to bring about a recovery in this nationally-known resource. An ANR Fish & Wildlife District I Trout Population Stream Survey report for the period July 1 2013 to June 30 2014 summarizes the work to date:

In response [to the dramatic decline], the Vermont Fish and Wildlife Department (VFWD) designated the lower 20 miles of the mainstem from the now-removed Dufresne Pond Dam downstream to the New York state line as no-harvest "catch-and-release" fishing only. This took effect at the start of the 2000 open-water trout fishing season and remains in place through at least October 31, 2017. Also in 2000, an interdisciplinary team of fishery and aquatic biologists was established to review possible causes for the population decline and to make recommendations of measures that might be implemented to restore trout populations to levels that sustained quality fishing over years prior to the population decline….

Between 2000 and 2006, much work was done to investigate likely causes for the decline as well as continued management of the fishery under "catch-and-release" only fishing. Insufficient cover habitat was ultimately identified as a likely factor limiting trout abundance, particularly yearling and larger fish. Consequently, VFWD partnered with the U. S. Forest Service, Green Mountain National Forest (USFS); Batten Kill Watershed Alliance (BKWA); private landowners; towns; other state and federal government entities

and nongovernmental organizations to undertake in-stream and riparian habitat enhancements.

Beginning in 2005 cooperators began a 6-year project designed to test the "insufficient cover habitat" hypothesis at the Twin Rivers Habitat Project (TRHP) site located 1,000 ft upstream of the confluence of the Green River with the Batten Kill in Arlington. During late summer of 2006 approximately 1,191 feet of river channel was treated with large wood and stone to increase in-stream trout cover. Trout population response to habitat enhancement was evaluated annually through 2010. Results of this evaluation are reported by Cox (2011) under the F-36-R-13 Federal Aid in Sport Fish Restoration reporting segment (VFWD 2011).

A 2011 VDFW report on habitat enhancement noted that: "While no change in mean yearling trout numbers was observed between pre- and post-treatment periods at the control sites, average yearling fish numbers increased 4.9 fold in the treated pool and doubled in the treated riffle. In the pool habitat young-of-year trout numbers also doubled, and modest increases in the range of 1.6-1.8 times pre-treatment levels for fish in the 10-19.9 inch adult size range were observed. These results provide evidence that inadequate refuge habitats may be limiting trout abundance in the Batten Kill."

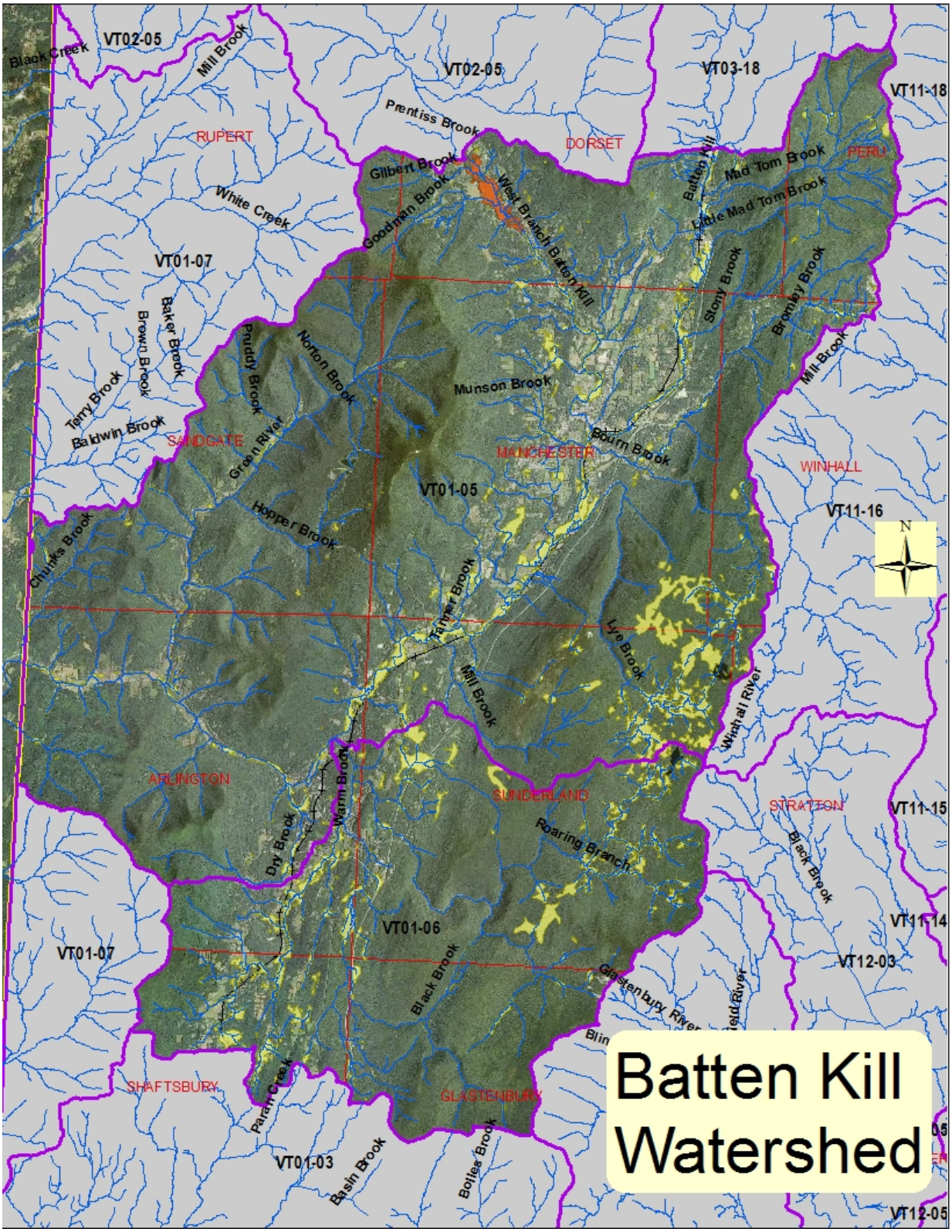
Sampling in 2013 at the upper Batten Kill Manchester site, found the total trout per mile number well up from 2010 (the last time it was sampled) and the larger trout (>152mm) also up. Sampling at the upper Batten Kill East Dorset site in 2013 also showed the number of total trout per mile up from 2012 (although this had been down from 2010). The number of larger trout was down slightly from 2012 to 2013 (although both of those years were up from 2010. Graphs showing the history from 1984 to 2013 are on page 5 of the DFW District 1 F-36-R-16 Trout Population Survey Report for the Batten Kill.

Sampling in 2013 at the lower Batten Kill TRHP site found the total trout per mile down from 2012 to 2013 but the number of larger trout up in the pool habitat section while both the total trout and larger trout numbers were down from 2012 to 2013 in the riffle habitat section. The numbers in both habitats in 2013 were still greater than the numbers in 2010 pre-Tropical Storm Irene.

"For the second consecutive year following Tropical Storm Irene flood (August 28 and 29, 2011) two trout population stations on the Roaring Branch, a tributary to the Batten Kill, were sampled to assess changes in trout population abundance and size structure before and after the flood and in response to habitat mitigation first undertaken in the fall of 2013 and to be continued in 2014. In addition to extensive flood damage, the Roaring Branch was channelized to provide gravel and stone for repair of the adjacent Kelley Stand Road which was also heavily damaged by flood waters.

Additionally, a monitoring site was setup on the East Branch just upstream of an area previously inundated by Dufresne Pond. The dam forming this on-stream impoundment was removed by the Vermont Agency of Natural Resources during the summer of 2013 restoring about 2,192 feet of channel to free flowing river and lotic habitat. The VFWD will be monitoring trout population response to habitat conversion over the next several years."

**Figure 5. Batten Kill Watershed in Vermont**



## The Walloomsac River

The Walloomsac River watershed drains much of the south-central portions of Bennington County being bounded by the Batten Kill watershed on the north and the upper Hoosic River watershed on the south. The headwaters of the Walloomsac River are located in Vermont draining 139 square miles of the state before entering New York. The Walloomsac River is a significant tributary to the Hoosic River.

The Walloomsac River begins where South Stream and Jewett Brook join just south of Bennington village. The river winds through Bennington in a northwesterly direction. Just north of Bennington village, the Roaring Branch enters from the east. As a larger river now, the Walloomsac flows northwestward through the northwest portion of the town of Bennington then into New York and to Hoosic Junction where it joins the Hoosic River. In addition to South Stream and the Roaring Branch, the major direct tributaries in Vermont include Jewett Brook, Furnace Brook, Paran Creek, and Cold Spring Brook.

### Special Values and Features of Walloomsac River Waters

#### *Waterfalls, Cascades, Gorges, and Swimming Holes*

No waterfalls or cascades were reported in the *Waterfalls, Cascades and Gorges* report done for Vermont DEC. However, a small stretch where the stream cascades over ledges was observed on South Stream above and below the Coleville Road Bridge.

#### *Significant Natural Communities and Rare, Threatened and Endangered Species of the Walloomsac River Basin*

Four sites from the Walloomsac River watershed were described in the Vermont Department of Fish and Wildlife study of significant calcareous fens and riverside seeps. One site identified is Pownal Bog north of Barber Pond, which is actually a fen community and not a bog. Six rare plants occur at the site as well as four uncommon plants and a rare moss. This two and a half acre peatland has formed in a kettlehole depression. Another small intermediate fen was briefly surveyed in Pownal although it seemed to be a transitional site and so its significance is not known.

The other two sites in the Walloomsac River watershed were found in Shaftsbury. Paran Creek Fen located south of Simeon Dean Road consists of two small rich fens that contain a population of a globally rare sedge. Serendipity Fen is a one-acre fen within a 100-acre plus wetland. It is a rich fen and also has the globally rare sedge in it.

## Walloomsac River Watershed Impacts Summary

**Table 4. Status of rivers, streams, lakes, ponds in Walloomsac Watershed**

| Stream or lake segment | Mileage & status | Pollutant | Stressor | Source | Other information |
|---|---|---|---|---|---|
| Barney Brook | mouth to RM 1.5 miles, ***Impaired*** – Part A list | Iron precipitate |  | Downstream of landfill, haz site, and constructed wetlands; silt and iron precipitate causing fish/invert impacts | Aquatic biota not supported from RM 1.5 downstream but healthy above |
| Hewitt Brook | ***Stressed*** | Arsenic and PCB's |  | Old Bennington Landfill | Monitoring is underway |
| Basin Brook | ***Altered*** by flow regulation | Possible lack of minimum flow below water supply withdrawal point (threat) |  | | WSID #5017 - North Bennington Water Dept;<br>serves as back up supply source to gravel<br>well field |
| Bolles Brook/Roaring Branch, intake to City Stream confluence | 1.0 miles, ***Altered*** by flow regulation (Part F list) | Possible lack of minimum flow below water supply withdrawal point (threat) |  | Bennington water supply | WSID #5016 - Bennington Water Dep't;<br>assessment of water withdrawal impact<br>difficult given low productivity & low ph<br>effect |
| Jewett Brook | x.x miles ***Stressed*** – Part C list | temperature |  | ALS | "fair" bugs in 2008 & 2009 – temperature thought to be the stressor |
| City Stream | | | | | |

| Stream or lake segment | Mileage & status | Pollutant | Stressor | Source | Other information |
|---|---|---|---|---|---|
| South Stream | | Nutrient enrichment | | | Hatchery – nutrient criteria issue – though scoring exc. in IBI – very high richness |
| Bickford Hollow Brook | | | | | |
| Roaring Branch | ***Stressed*** | Geomorphic instability |  | Floodplain encroachment | Historic manipulation and re-routing of river location |
| Lake Paran (Bennington) | Xx acres ***Altered*** – Part E list | Eurasian milfoil |  | Contact, secondary recreation | Weevil present |

### *Lakes and Ponds in the Walloomsac Watershed*

The Vermont DEC inventory has 6 lakes covering 193 acres in the Walloomsac watershed.

Lake Paran, lying partially in Bennington, North Bennington, and Shaftsbury and an impoundment of Paran Creek, it is an important recreation site and views of and across the lake from the dam, boat launch, park, and the old rail spur are unique in the area . In the summer months this is one of the most heavily used waterbodies in the County and the primary swimming spot in the Walloomsac watershed. The Lake Paran Association provides a safe swimming access for local families at a small annual fee. Lake Paran occupies a natural basin at the northern edge of the Village of North Bennington. The lake's current shape, coverage, and depth were established by the railroad dam that was constructed in 1850. The surface area of the lake is now 36 acres and it lies at 647 feet above Mean Sea Level.

Current uses of Lake Paran and adjacent lands include swimming, fishing, non-motorized boating, ice-skating, hiking, and aesthetic appreciation. Protection of the lake's water quality a conservation of surrounding land has been the subject of considerable effort in recent year Two invasive aquatic plants, Eurasian watermilfoil and water chestnut are known from the lake; watermilfoil was confirmed in the 1980s and water chestnut in 1998. The population fluctuates annually. Past control efforts at the town beach include benthic matting and hydroraking; no controls were implemented in recent years. Lakes staff surveyed the lake for water chestnut yearly, 1998-2014. Any water chestnut plants found were removed by hand. Water chestnut has not been found since 2013.

Because development along the shoreline could cause erosion and lead to other sources of pollution, the Village, as well as the towns of Shaftsbury and Bennington, adopted shoreline protection provisions in their land use regulations that require that a natural buffer be maintained along the shore. Fortunately, a conservation effort involving private landowners, the Vermont Land Trust, the Vermont Housing and Conservation Board, and the Sage City Syndicate has led to conservation of 56 acres and 2,976 feet of shoreline along Lake Paran and the upper portion of Paran Creek. Continued intermunicipal and regional cooperation will be necessary to ensure that water quality is not degraded by point or nonpoint discharges from upstream sources and that conserved lands are properly maintained and used.

Smaller ponds and wetlands are scattered throughout the watershed. Many ponds are adjacent to roadways and add visual interest for passing motorists. Some large wetland complexes, such as the Bradford-Putnam Wetlands or the large complex of wetlands along Jewett Brook, are best explored on foot or by kayak. All of these small water bodies add variety to the landscape, are an important foreground in many views of fields, farms, and hillsides, and harbor a variety of bird and wildlife species.

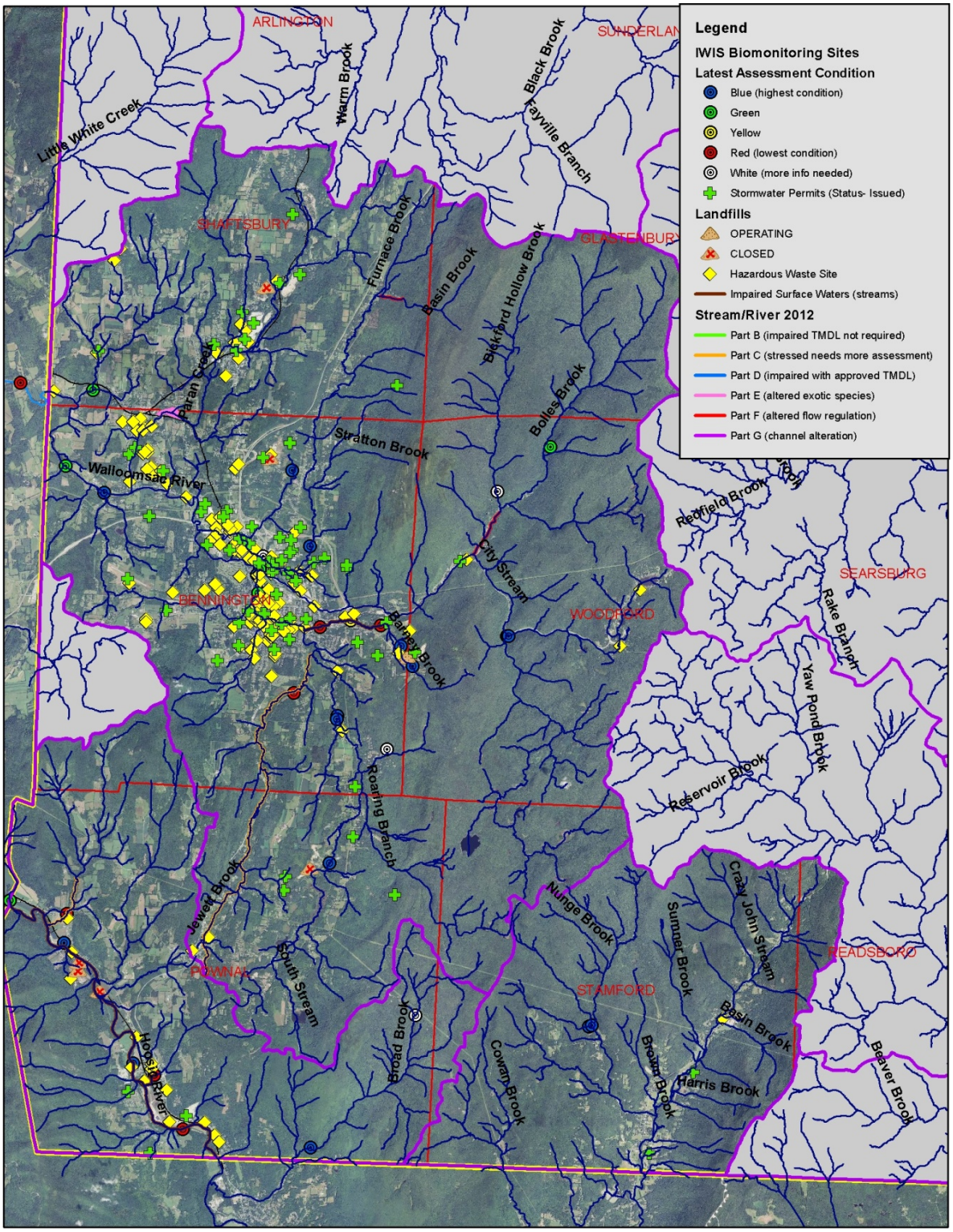
Vermont DEC's Lake Protection Classification System identifies unique lakes based on: wilderness status; occurrence of scenic and natural features; existence of very high water quality; and/or the presence of very rare, threatened, and/or endangered species. In the Walloomsac watershed, two ponds are significant for these reasons.

Big Pond in Woodford is a heavily developed lake at the headwaters of the Walloomsac River. The lake supports one rare plant species, Littorella americana, which is a low-growing aquatic plant of shallow waters.

Lake Hancock (a.k.a. Sucker Pond) in Stamford is a wilderness-like lake with difficult vehicular access.. The pond is classified as an A-2 water, and historically served as a water supply for the Town of Bennington. The Town continues to own the pond and an approximately 300 foot buffer around it, and the right-of-way over which the access road passes.

Barber Pond is a 19 acre pond just above the South Stream Management Area. The outfall drains to the management area. The pond is highly visible from South Stream/Barber Pond road and there is a Fish and Wildlife access point. The pond has a maximum depth of 20 feet and the surrounding watershed areas of roughly 170 acres. There are several camps/ homes along the lake shore.

**Figure 6. Walloomsac and Hoosic River Watersheds in Vermont (the Walloomsac is a tributary to the Hoosic)**



## The Hoosic River

The Hoosic River has its source about 2 miles northwest of Dalton, Massachusetts at an elevation of 1,500 feet above sea level. It flows through the extreme southwest corner of Vermont where it drains a small portion of southern Bennington County, an area of approximately 89 square miles. The Vermont tributaries have narrow watersheds and drain the steep slopes of the Green Mountain Range for the most part.

The North Branch of the Hoosic River begins in the town of Stamford, Vermont and flows southwestward to the city of North Adams, Massachusetts where it joins Hoosic River. Its length is 11 miles. Its principal tributary in Vermont is Roaring Brook. A number of small tributaries also flow down from the mountainsides of the Hoosic Range to join the North Branch.

### Hoosic River Watershed Impacts Summary

**Table 5. Status of rivers, streams, lakes, ponds in the Hoosic River Watershed**

| Stream or lake segment | Mileage & status | Pollutant | Stressors | Source (or use affected) | Other information |
|---|---|---|---|---|---|
| Hoosic River | 7 miles, ***Impaired*** – Part A list | PCBs |  | Former industrial use | Elevated levels of PCBs in Brown Trout from Mass sources |
| Ladd Brook | 0.4 miles ***Impaired*** – Part A list | sediment |  | Possibly gravel roads | "poor" & "fair-poor" bugs in 2008, 2009 |
| Tubbs Brook | 0.5 miles ***Stressed*** | sediment |  | Likely due to sedimentation – land erosion from backroads, etc | "fair" bugs in 2008 |

### Special Values and Features of Hoosic River Waters

#### *Waterfalls, Cascades, Gorges, and Swimming Holes*

The Waterfalls, Cascades and Gorges inventory and study described one cascade for the watershed. Roaring Brook Cascade on Roaring Brook, which is a tributary to the North Branch of the Hoosic River, is a small cascade in the town of Stamford. The feature is about 75 to 100 feet long by 15 feet wide with a total drop of about 20 feet.

### *Significant Natural Communities and Rare, Threatened and Endangered Species of the Hoosic River Basin*

A high quality stretch of riverine floodplain forest and one of the very few floodplain forest remaining in southwestern Vermont is located on the hairpin bend in the Hoosic River below North Pownal. The floodplain forest occupies about 25 acres and consists of both sugar maple-basswood-ostrich fern type and successional floodplain forest.

## Assessments undertaken in the Hudson River Basin

Several types of assessments are conducted to support tactical basin planning. In the Hudson River Basin, geomorphic assessments, water quality monitoring, and biological monitoring are ongoing. Agricultural Environmental Management assessments have been conducted in certain sub-watersheds, and Better Back Roads inventories have been undertaken in several towns. Stormwater master planning and Illicit Discharge Detection and Elimination infrastructure mapping has been undertaken or is currently in process.

**Table 6. Status of assessments for the Hudson River Basin**

| Sub-Basin | Geo-morphic Assess-ment | Water Quality Monitoring | Bio monitoring (completed / planned) | Agricultural Conservation Planning | Better Backroads/ Road Erosion Inventory | Stormwater master plan or Illicit Discharge Detection |
|---|---|---|---|---|---|---|
| Batten Kill | C | X | O/U/X | | X | X |
| Mill and White Creeks | C | | O/U | O | X | C |
| Walloomsac River | PC | X | O/X | | X | X |
| Hoosic River | PC | X | O/U | | X | |

X= proposed in plan C= Completed PC= Partial Completed O= On-going U=Underway

## 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 is critical to prioritization of riparian and fluvial process-related water quality restoration and protection projects, project design alternatives analyses, and project design criteria. SGA provides insight into the social, economic and ecological interrelationships between people and fluvial systems and as such, it is a valuable

educational tool. All of the SGA datasets collected in Vermont are compiled in the Stream Geomorphic Assessment Tool database and related Vermont

Online Bridge and Culvert Inventory Tool. These databases are used to ensure that projects are implemented in a manner consistent with and complementary to equilibrium conditions. Much of the Hudson River Basin has been subject to SGA at the Phase I or Phase II level (Figure 2), and Corridor Plans have been established for several watersheds, including the Batten Kill, White and Mill Creeks (tributaries to the Kill), the Walloomsac River and its tributary the Roaring Branch. A description of geomorphic assessment and river corridor management summaries and recommendations from specific sub-watersheds is provided in Appendix G.

Since 2005, Partners in the planning process (BCCD, BCRC, and BKWA) have conducted geomorphic assessments on basin rivers and many of their tributaries to identify priority stream reaches for protection (with assistance from VTDEC – River Management Program)

**Table 7. Stream Geomorphic Assessments in the Basin**

| Date | Watershed | Sub-Watershed | Link to report |
|---|---|---|---|
| 11/01/2006 | White Creek and Mill Brook | Batten Kill - White Creek | White Creek and Mill Brook Watersheds Phase 1 SGA |
| 12/01/2008 | White Creek and Mill Brook | Batten Kill - White Creek | White Creek and Mill Brook Watersheds Phase 2 SGA |
| 12/01/2008 | Batten Kill | Batten Kill River | Batten Kill Restoration Study |
| 3/01/2008 | Batten Kill | Batten Kill River | Batten Kill River Corridor Plan |

| | | | |
|---|---|---|---|
| 2/01/2004 | Batten Kill | Batten Kill River | Batten Kill River Phase 1 SGA |
| 12/01/2005 | Batten Kill | Batten Kill River | Batten Kill River Phase 2 SGA |
| 1/01/2009 | Batten Kill Watershed: Roaring Brook and Fayville Branches | Batten Kill River | Phase 2 Stream Geomorphic Assessment |
| 12/01/2008 | Walloomsac and Roaring Branch | Ottauquechee - Roaring Brook | Walloomsac River and Roaring Branch Corridor Plan |
| 3/01/2007 | Walloomsac and Roaring Branch | Ottauquechee - Roaring Brook | Walloomsac River and Roaring Branch Phase 2 SGA |
| 11/01/2006 | Walloomsac | Walloomsac | Walloomsac River Phase 1 SGA |
| 9/18/2012 | Walloomsac River | Walloomsac | Woodford Packard Floodplain Re-Connection Alternatives Analysis |
| 11/01/2007 | Walloomsac Woodford | Whetstone | Bolles Brook and City Stream Watershed Phase 1 SGA |
| 12/01/2008 | Walloomsac Woodford | Whetstone | Bolles Brook and City Stream Watershed Phase 2 SGA |

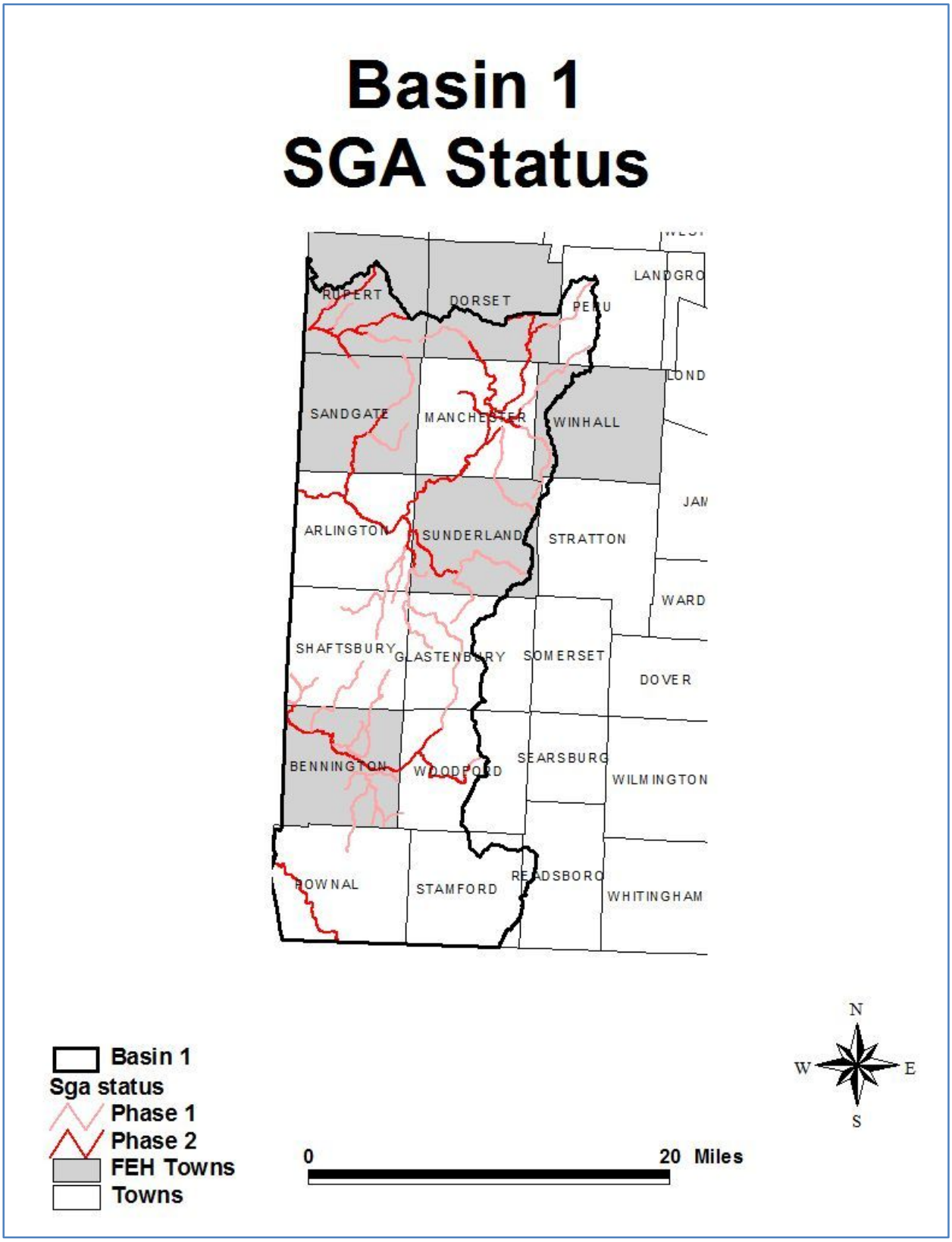



**Figure 7. Status of Geomorphic Assessments**

## General Fisheries Assessment

### Historic Batten Kill Fishery & VFWD Management

Fishing is the reason that the Batten Kill is a nationally known river.[1] Vermont has many notable trout streams; for example, the White, Willoughby and Mettowee rivers. The Batten Kill, however, prominently stands out as the State's most famous trout stream and is considered by many anglers to be one of the most technically challenging streams to fish. The Batten Kill was named one of the 100 best trout streams in the United States in 1989 (Trout Unlimited 1989). It was voted the tenth best stream in the country in a 1998 poll of Trout Unlimited members (Ross 1998). The Batten Kill has been managed as a wild trout stream since stocking of hatchery trout was terminated in 1975 and since then stocking has been discontinued in the tributaries.

In 2000 the VFWD placed the lower 20 miles of river main stem, from the New York State line upstream to Dufresne Pond dam in Manchester, under a commissioner's test waters "regulation" (#1028) in response to an unexplained decline of the Brown Trout population throughout the Batten Kill main stem. The regulation had two purposes: (1) protect the remaining wild Brown Trout population from angling mortality and possible further decline as might occur should harvest be allowed to continue; and (2) establish a period of six years during which investigative studies of the river's trout populations and habitats could be conducted to identify the likely cause(s) for the Brown Trout population decline. The test water regulation essentially eliminated harvest as a factor affecting the trout populations during the assessment period.[2] The test water was subsequently extended three times (2006, 2007, 2012). During the assessment period, 1998-2006, no less than fourteen studies and surveys were conducted investigating such topics as quantity and quality of the mainstem's trout habitat, trout population dynamics, Brown Trout seasonal movements and habitat use, trout health and genetics, water quality and macroinvertebrate assemblage characteristics, and predation on trout. In the end the one factor that stood out was the insufficiency of cover or refuge habitat in the main stem which lead to the following hypothesis:

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1 State of Vermont, Agency of Natural Resources, Vermont Department of Environmental Conservation Basin 1 Batten Kill, Walloomsac River & Hoosic River Watersheds Water Quality and Aquatic Habitat Assessment Report August 2002

2 State of Vermont, Agency of Natural Resources, Fish & Wildlife Department, BATTEN KILL TROUT MANAGEMENT PLAN 2007-2012 Prepared by: Kenneth M. Cox, Fisheries Biologist January 8, 2006

*The chronic loss of trout cover in the Batten Kill main stem resulting from past river channel alterations and encroachments, the reduction and loss of forested riparian areas by land use activities, and the removal of newly recruited in-stream large woody debris and other cover structures has degraded habitat in the river at the expense of trout populations. Inadequate cover exposes fish to increased predation and environmental stressors, such as winter mortality. By the 1990s cover has degraded to the point that the habitat is no longer capable of supporting the desired abundance of trout, particularly mid-size Brown Trout, for recruitment into the sport fishery.*

In response to this the U. S. Forest Service, Batten Kill Watershed Alliance, VFWD and other partners and cooperators initiated in 2006 habitat restoration in the main stem designed to improve cover habitat. Since its inception over two miles of the river has been treated and assessments indicate the trout population has responded to habitat improvements coupled with the restriction on trout harvest.

In 2016 the Vermont Fish and Wildlife Board voted establish the test water with amendments to full regulation status (Title 10A § 122). The regulation maintains the main stem from the New York state line upstream to the downstream side of Depot Street (Routes 11 & 30) bridge open to angling from the second Saturday in April through October 31, albeit all trout caught must be immediately released. And, closes certain tributaries of the Batten Kill to the harvest of trout from October 1 through October 31 to protect fish during the spawning season: Green River, Roaring Branch and Warm Brook, and East Branch.

In addition to the main stem trout fishery most perennial streams throughout the watershed are suitable habitat for naturally reproducing "wild" trout populations. Native Brook Trout are widely distributed providing colder water temperatures in the range of 52-61°F are maintained during the summer months. While Brook Trout thrive in the Batten Kill mainstem, they are at their greatest abundance in the upper mainstem, tributaries and high elevation streams. Brown Trout being more tolerant of slightly warmer water temperatures (optimum range 54-66°F) but may tolerate warmer temperatures up to about 80°F for short periods of time. Consequently, it is common to find Brown Trout outnumbering or even replacing Brook Trout in warmer habitats.

A study of trout movements in the Batten Kill watershed conducted in 2003-2004 demonstrated Brown Trout may migrate significant distances to spawn in the fall of the year. Average distance traveled by study fish was five miles; maximum was 15 miles. While trout residing in the main stem during the summer season may not move that far to spawn, others on the other hand may travel considerable distances up or down the

mainstem and ascended tributaries to spawn. This study and observations published in the scientific literature show that Brown Trout may home to their natal streams, i.e. stream of their "birth", to spawn as adults. This emphasizes the importance of open stream systems without passage obstructions (e.g. impassable culverts and barrier dams) interfering with the trout life cycle processes. At other times of the year trout may have a need to move to ascend cold water tributaries or spring (groundwater) inflows in the main stem that serve as thermal refugee. Leading up to the winter many trout move from their summer home range to suitable overwintering habitats.

**Existing Uses for Fishing:**

The VFWD maintains four angler access areas on the Batten Kill main stem and owns over two miles of streambank on the river providing public access to the river. Informal roadside pull-offs are numerous along the lower river also giving anglers access to river. Even though access to most of the river is over private land, the river's long history as a fishing destination has resulted in relatively little land posting (albeit landowner permission is recommended), but this tradition might be expected to change in the future as landownership and attitudes to public access continue to change. Nevertheless, fishing is an existing use on the Batten Kill main stem, in its tributaries and most tributaries to those, as well as in the White Creek sub-watershed.

In addition to stream fisheries, there are several public standing waters in the Batten Kill watershed that are managed recreational fishing. These are Bullhead Pond in Manchester and Dorset, Branch and Beebe ponds in Sunderland, and Shaftsbury Lake in Shaftsbury. Bullhead Pond is stocked annually with yearling Brook Trout and has resident populations of largemouth bass and yellow perch. Branch and Beebe ponds, located on the Green Mountain National Forest, are also annually stocked with fingerling and/or yearling Brook Trout and provide anglers with remote fishing experiences. Shaftsbury Lake is located in Shaftsbury State Park and is stocked with yearling and 2-year old Rainbow Trout and also has resident populations of largemouth bass, bluegill, pumpkinseed, rock bass, chain pickerel, and yellow perch.

**Very High Quality Waters:** VFWD trout management guidelines categorize wild trout populations on the basis of population density (pounds of trout per acre and/or numbers of trout ≥6 inches (catchable-size) per mile) thresholds. Streams or river segments which presently maintain wild trout population densities in the range of 20-29 pounds/acre and/or 200-399 trout ≥6 inches/mile (**W2**) include:

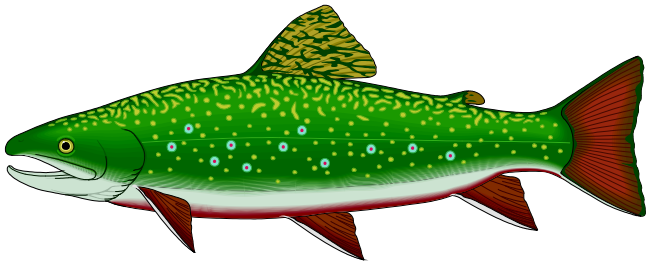
- Batten Kill main stem from New York state line upstream to confluence of West and East branches.
- Green River from confluence with Batten Kill upstream to Sandgate Village.
- West Branch from Factory Falls Dam in Manchester upstream to Marble Mill Dam in Dorset.
- East Branch from confluence with Batten Kill main stem upstream to U. S. Route 7 bridge.

**Walloomsac Fishery:**

Walloomsac is stocked with rainbow and Brook Trout.[3] Stocking of select Vermont water bodies is an annual activity for the Department of Fish and Wildlife (DF&W). While anglers enjoy the benefits of fishing such areas, the decision to stock a particular stream or lake is not just based on the sport fishing opportunities such an activity provides. The DF&W developed a management plan for trout in 1993 that helped determine which Vermont water bodies should be stocked. Stocking is generally based on several factors: the quality of the natural fish populations, restoration considerations, and the amount of angling that occurs on a body of water. Each year the DF&W fishery biologists evaluate waters around the state to determine the appropriate level of stocking. This scientifically based management is done after evaluating the fish populations and angling pressure.[4]

**Bennington Fish Culture Station**

Bennington FCS, built in 1916, is Vermont's second largest fish culture station. This culture station uses a combination of spring, artesian well, and stream water for raising brook, brown, and Rainbow Trout. The station is located two miles from downtown Bennington on South Stream Road.[5]



3 Bennington County Regional Commission, THE REGIONAL PLAN Bennington Region, Vermont, ADOPTED -- May 17, 2007pg. 32

4 State of Vermont, Agency of Natural Resources, Fish & Wildlife Department, http://www.vtfishandwildlife.com/fish_sportfish.cfm

5 Id

The maintenance of quality fisheries requires the continued assessment aquatic habitat and biota to determine the health of fisheries in the Basin, which also requires the assessment of:

*Forested riparian areas* - 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 populations.
*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 affect littoral zone habitats and can negatively affect fish and other aquatic populations.
*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.

## Other Assessments Used to develop the Hudson River Tactical Basin Plan

Transportation Infrastructure Assessments:


- Better Backroad Category "A" Road and Culvert Inventories (Towns)
- Class 4 Roads Assessment
- Water Quality Mapping and Culvert Assessment (BCRC 604 Project)
- Bridge and Culvert Inventory and Assessment for AOP and SGA

Other Assessments:

- Agricultural Environmental Assessments (AEM), ongoing (AAFM, NRCDs)
- Stormwater Mapping and Detecting and Eliminating Illicit Discharges in Bennington County to Improve Water Quality, 2016 (projected)
- Prioritizing Conservation Practices Through Flow Accumulation Modeling of Crop Field Drainage in WesternVermont (USDA-NRCS, 2009)
- VTANR Natural Resource Atlas (Biofinder) Wildlife Corridor mapping

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

### Biological integrity

There are several sub-watersheds in the Hudson River Basin that support very high water quality conditions. VTDEC assesses ecological integrity using biological assessments of macroinvertebrate and fish communities. VT Department of Fish and Wildlife assesses wild trout populations and important nursery areas to document very high quality recreational fisheries, which are typically found in surface waters that exhibit clean and cool conditions. Based on VTDEC's long-term sampling of stream locations in the Hudson River Basin, there are several streams that reliably exhibit ecological integrity consistent with very good or excellent conditions, based on these assessments (Table 3). Certain of these surface waters are candidates for reclassification to Class A(1).

**Table 8. Basin streams that support exceptional ecological integrity***

| | Name | **Basin** | **River mile (RM*)** | **Score** |
|---|---|---|---|---|
| | | | | |
| VT01-05 | Mad Tom Brook | **Batten Kill** | **1.2** | **Excellent (bugs) – 2010 Excellent-VG (bugs) - 2013** |
| VT01-05 | Bourn Brook | **Batten Kill** | **1.6** | **Very Good (fish- CW) Excellent bugs** |
| VT01-05 | Chunks Brook | **Batten Kill** | **0.9** | **Very good, excellent bugs (2008)** |
| VT01-05 | Green River | **Batten Kill** | **0.1** | **Excellent – bugs in 2007 and in 2013.** |
| VT01-04 | Batten Kill | **Batten Kill** | **32.9/ 33.3/ 34.9/ 48.2/ 54.9** | **Excellent, very good - bugs** |
| VT01-04 | Batten Kill | **Batten Kill** | **55.5** | **Excellent (fish - MW) fish in 1998 and excellent bugs in 2002, very good bugs in 2013** |
| VT01-04 | Batten Kill | **Batten Kill** | **55.4** | **Very Good (fish - MW)** |
| VT01-07 | Mill Brook | **Batten Kill** | **2.8** | **Very Good (fish, 2003)** |
| VT01-07 | White Creek | **Batten Kill** | **10.5/ 10.6** | **Very Good (both) Excellent - bugs** |
| VT01-03 | Walloomsac River | **Walloomsac** | **15.4** | **Very Good (fish - MW) 1998** |
| VT01-03 | Walloomsac River | **Walloomsac** | **10.1** | **Very good – (bugs and fish 2008 and 2013)** |
| VT01-03 | Roaring Branch Walloomsac River | **Walloomsac** | **.1** | **Very Good (fish - MW)** |
| VT01-03 | South Stream | **Walloomsac** | **1.1** | **Excellent (fish - MW)** |

| | | | | |
|---|---|---|---|---|
| VT01-03 | South Stream | **Walloomsac** | **1 (2)** | **Very Good (fish - MW) (Excellent – bugs)** |
| VT01-03 | City Stream | **Walloomsac** | **2** | **Excellent – bugs in 2008** |
| VT01-03 | Furnace Brook | **Walloomsac** | **1.5, 3.1, 7.1** | **Excellent (bugs and fish-MW – 2008 and 2013)** |
| VT01-03 | Barney Brook | **Walloomsac** | **2.2/ 2.7** | **Excellent bugs in 2008** |
| VT01-02 | Broad Brook | **Hoosic** | **2.4** | **Excellent – bugs in 2012 and 2013** |
| VT01-01 | North Branch Hoosic River (Cardinal Brook) | **Hoosic** | **1.8 (0.1)** | **Excellent – bugs in 2012 and 2013** |

*RM = river mile as measured from the mouth upstream (or from the NY stateline). CW = cold water, MW = mixed water (cold/ warm fisheries indices used for community rating score).

**Note - Biological data indicates a consensus very good or excellent condition by one or both groups of fish and macroinvertebrates. Age of data may range from 1 to 15 years, but as assessment data increases in age, other factors must be present (or compensate) for the designation to be made. These factors include a watershed in which there has been and continues to be relatively little human activity, e.g. National Forest Service lands. Also mitigating older biological assessment data is existing physical and chemical data (including geomorphic condition) that would support VHQ biota.*

## Very High Quality Lakes

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

**Table 9. Lakes and ponds in the Basin that exhibit Very High Quality based on DEC's Best Lakes analysis.** Best Lakes Scores are presented under "Supporting Data" if lakes were ranked in any of three categories, along with the rank score from 1 (lowest) to 5 (best) in each: WQ - Water Quality, BD – Biological Diversity, USNF – Unusual or Scenic Natural Features.

| Lake/pond | Location | Supporting Data |
|---|---|---|
| Bourn Pond | Sunderland (Bourn Brook) | "Best Lake"- top 10% DEC state ranking: USNF (top 5%) |
| Branch | Sunderland (Branch Pond Brook) | |

| | | |
|---|---|---|
| Hancock (Sucker) | Stamford (Stamford Stream) | |
| Miller | | "Best Lake"- top 25% DEC state ranking (biodiversity) |

**Causes and Sources of Impacts and Threats to Basin 1 Lakes and Ponds**

Impairments to lakes in this basin are related to acidification (6 lakes, 139 acres), and to the presence of non-native invasive aquatic species (1 lake, 40 acres). Threats to uses are also caused by siltation (128 acres), invasive species (99 acres), pH (82 acres), nutrients and phosphorus (60 acres), turbidity (51 acres), and the presence of algae (40 acres). Table 8 provides an accounting of the causes of impairments and threats to lakes in this drainage system.

The following sources impair or threaten lake uses in the Batten Kill, Walloomsac, and Hoosic watersheds. Atmospheric deposition of acids, as well as natural susceptibility to low pH is responsible for the acidification of 139 acres and threats to an additional 82 acres. Recreational boating and the associated release of non-native plant propagules is a primary source of the impairment of 40 acres due to the presence of these species, and threatens an additional 99 acres. Other important threats include road runoff and development.

### The Lakes and Ponds Scorecard

There are 31 lakes and ponds over 20 acres in size in the Hudson River Basin. Lake and pond water quality and habitat conditions are monitored through numerous study programs including the Spring Phosphorus and Lake Assessment Programs and by the Lay Monitoring Program among others. While many fully support the requirements of the VWQS, most lakes and ponds are affected by atmospheric deposition of pollutants from sources outside of Vermont and several lakes and ponds exhibit high levels of fish mercury.

This lake-specific information is compiled to create the Vermont Lake Score Card, which has been developed to convey a large amount of data gathered and analyzed through these monitoring efforts (Table 10). The Score Card rates Vermont lakes in terms of water quality, invasive species, atmospheric deposition, and shoreland condition. Table 11 provides an assessment of individual lakes from the Vermont Lakes Scorecard.

**Table 10. Assessment of Basin lakes and ponds from the Vermont Lakes Scorecard**

## Lakes Score Card

| | |
|---|---|
| | Good Conditions |
| | Fair Conditions |
| | Stressed or impaired Conditions |
| | Unassessed |

| **Batten Kill** | **Town** | Shoreland | Invasives | Atmospheric |
|---|---|---|---|---|
| Beebe | Sunderland | | | |
| Branch | Sunderland | | | |
| Bourn | Sunderland | | | |
| Madeleine | Sandgate | | | |
| Lye Brook - S | Sunderland | | | |
| | | | | |
| **Walloomsac River** | **Town** | Shoreland | Invasives | Atmospheric |
| Lake Shaftsbury | Shaftsbury | | | |
| Paran | Bennington | | | |
| | | | | |
| **Hoosic River** | **Town** | Shoreland | Invasives | Atmospheric |
| Barber | Pownal | | | |
| Big | Woodford | | | |
| Hancock | Stamford | | | |
| South Stream | Pownal | | | |
| Thompsons | Pownal | | | |
| | | | | |

### Very High Quality waters that support recreational fishing

Abundant wild trout populations are defined as supporting multiple age classes of one or more species of wild trout (brook, brown, Rainbow Trout) at levels generally equal to or greater than 1,000 fish/mile and/or 20 pounds/acre. It should be recognized that wild trout populations vary widely from year to year and therefore an individual population may sometimes go below or greatly exceed these values in a given year. Other waters that have not been surveyed may also support similar wild trout densities and may be identified in the future. Certain noteworthy streams are also important to support spawning and nursery habitat for the main stems of Basin 1 Rivers. Tables 11 and12, respectively, list streams supporting wild trout populations and nursery tributaries. An updated survey of recreational fishery should be conducted regularly

within the basin to update wild trout age classes, species, and quantities.

**Table 11. Basin streams supporting Very High Quality significant wild trout populations**

| Sub-watershed | Streams Surveyed | Description (entire unless otherwise described) |
|---|---|---|
| Batten Kill | Mainstem | NY state line upstream to confluence of West & East branches. |
| Green River | Mainstem | Confluence with Batten Kill upstream. |
| Bourn Brook | Mainstem | Confluence with Batten Kill upstream. |
| West Branch | Mainstem | Confluence with Batten Kill upstream. |
| East Branch | Mainstem | Confluence with Batten Kill upstream. |
| White Creek | Mainstem | New York state line upstream to confluence with Sandgate Bk. (Branch). |

**Table 12. Very High Quality spawning and nursery tributaries in the Basin**

| Sub-watershed | Streams Surveyed | Description |
|---|---|---|
| Batten Kill | Mainstem | New York state line upstream to East Dorset source. |
| Camden Creek | Terry Brook | New York state line upstream into Terry Brook. |
| Benedict Hollow Bk. | Benedict Hollow Bk. | Confluence with Batten Kill upstream. |

| | | |
|---|---|---|
| Roaring Branch | Mainstem | Confluence with Batten Kill upstream. |
| | Warm Brook | Confluence with Batten Kill upstream at least to old Hale Co. dam. |
| Mill Brook | Mainstem | Confluence with Batten Kill upstream. |
| Bourn Brook | Mainstem | Confluence with Batten Kill upstream. |
| West Branch | Mainstem | Confluence with Batten Kill upstream. |
| East Branch | Mainstem | Confluence with Batten Kill upstream. |
| White Creek | Mainstem | New York state line upstream to confluence with Sandgate Bk. (Branch). |

### Wetlands in the Basin

Wetlands in the Walloomsac Watershed -South Stream Wildlife Management Area South Stream Wildlife Management Area (WMA) is a 130-acre parcel in Pownal, which is owned by the State of Vermont and managed by the Vermont Fish & Wildlife Department. South Stream Pond is a 24-acre impoundment with emergent vegetation, such as cattails, and open water. A dam is located in the northwestern corner of the WMA where South Stream Pond drains into South Stream. There are alders on the property, but the majority of the landscape is emergent wetland that rims the length of South Stream. This is a great area for waterfowl watching. A rare plant, Hill's pondweed, is located on this WMA.

Morgan Street Wetlands Project

The Town of Bennington and partners (the Bennington County Conservation District and others) successfully acquired the so-called Morgan Street Wetlands property in 2014 through grants and donations. This 140-acre mix of open water, streams, wetland and upland is an exemplary natural area just blocks from the community's downtown.

Most of the site, about 108 acres, is a forested marsh or shrub swamp. Jewett Brook and South Stream drain the southern portion of the property. The Walloomsac River, forming at their confluence, cuts through the northern section. All three watercourses are deep enough to be navigable for at least portions of their length at least part of the year. Fish population surveys last done in 1993 documented the presence of wild brook, brown and Rainbow Trout populations in South Stream, and of wild Brown Trout populations in Jewett Brook.

In the wetland, very deep organic soils lie over sandy glaciofluvial deposits. As is typical of the western portion of Bennington County, underlying bedrock is largely metamorphosed limestone. That the land, and probably the water, on this property is "sweet" or alkaline is evidenced by the presence of several lime-loving plant species. The wetland lies like a bowl surrounded by uplands, the highest on the northeast. Early successional forest or abandoned field dominate the upland areas, though scattered giant oaks, cottonwoods and other trees are also present.

Given this mix of natural features, it is not surprising that the Morgan Street Wetland site is ranked by the Vermont Agency of Natural Resources as of a type "greatest" and "very high" in biological diversity. Having a natural asset of this quality so close to the Bennington downtown opens endless opportunities for education, natural community research, partnerships with area schools and colleges, special programs and informal outdoor recreation. While North Bennington has Lake Paran as a recreational asset, this conserved wetland offers Bennington residents their own public access to water and natural communities.

South Stream Pond and Waterfowl Management Area

South Stream Pond is a 24-acre impoundment with emergent vegetation, such as cattails, and open water. A dam is located in the northwestern corner of the WMA where South Stream Pond drains into South Stream. South Stream Wildlife Management Area (WMA) is a 130-acre parcel in Pownal, which is owned by the State of Vermont and managed by the Vermont Fish & Wildlife. There are alders on the property, but the majority of the landscape is emergent wetland that rims the length of South Stream. This is a great area for waterfowl watching.

Riparian wetlands. Like freshwater swamps, riparian wetlands are forested, inland, non-tidal wetlands, but are distinguished by their location in the floodplain along river and stream corridors. In the United States, riparian wetlands range from the bottomland hardwood forests of the Southeast to the riparian ecosystems lining the river and stream corridors of the arid Southwest. These wetlands are linear and provide

an important link between stream and river systems and adjacent uplands. Indeed, flooding from adjacent waters contributes to these wetlands' regulation of nutrients and organic matter from adjacent uplands. Riparian wetlands also are extremely productive and diverse ecosystems that provide important habitat for wildlife, particularly in the arid West where they may support the only dense vegetation within miles.170 Wetland terms that may be associated with this water resource category include: bottomland hardwood swamp, bottomland hardwood forest, floodplain forest, riparian buffer, mesicriparian ecosystem, bosque, streambank vegetation, and southern deepwater swamp.

Protecting and Preserving Wetlands

In Vermont, wetlands are defined as those areas of the state that are inundated by surface or ground water with a frequency sufficient to support plants and animals that depend on saturated or seasonally saturated soil conditions for growth and reproduction. Only 220,000 acres, or 4% of the land area in the state, have been identified as wetland. It has been estimated that since colonial times Vermont has lost more than 35% of its wetland acreage

Vermont's wetlands are extremely important resources that the Agency of Natural Resources and many other concerned groups are seeking to protect. Wetlands are worthy of protection because of the many valuable and irreplaceable functions they provide, which include: flood control, water quality protection, wildlife habitat, recreation opportunities, economic benefits, and erosion control. Since the degree to which a wetland serves these functions varies, many wetlands are vital to work in combination with each other as part of a complex, integrated system.

## Significant Natural Communities and Rare, Threatened and Endangered Species of the Basin

Natural resource elements in the Batten Kill watershed that comprise the biological diversity associated with water and wetlands include a rich fen at its headwaters; Dorset Marsh with rare to uncommon plants; some "sloping fens" in Dorset; some historical locations of Hill's Pondweed: and locations where spotted turtles and where Jefferson's salamander have been found.

Batten Kill watershed

***Significant natural communities***

An inventory of significant calcareous fens and riverside seeps done by the Vermont Nongame and Natural Heritage Program found two rich fen communities and one

intermediate fen community in the Batten Kill watershed. The two rich fens are located in Manchester: one is a small (1.5 acre) wetland, of which a portion is rich fen, and the other is a relatively large, mostly open fen with a diversity of vegetation types and a large population of a globally rare sedge. A two-acre intermediate fen is found in Shaftsbury and an uncommon water sedge grows there.

Vermont DEC's Lake Protection Classification System is one framework within which lakes can be evaluated for their special significance when compared to other lakes statewide. The Classification System identifies unique lakes based on: wilderness status; occurrence of scenic and natural features; existence of very high water quality; and/or the presence of very rare, threatened, and/or endangered species. In the Batten Kill watershed, two ponds out of eighteen in the DEC assessment database are significant for these reasons.

***Branch Pond, Sunderland*:** This pond may be the best example of a wilderness-like pond. The pond is undeveloped, essentially in a primitive state, but is relatively easily accessed. The pond supports two noteworthy aquatic plants, the rare pondweed *Potamogeton confervoides*, and the rare bladderwort *Utricularia geminiscapa*.

***Bourn Pond, Sunderland*:** This is a true wilderness pond with an attractive Sphagnum mat floating island. The pond supports populations of two noteworthy aquatic plants, the rare pondweed *Potamogeton confervoides* and the rare burreed *Sparganium fluctuans.* Bourn Pond is critical habitat for breeding common loons.

Walloomsac River watershed

***Significant natural communities***

Four sites from the Walloomsac River watershed were described in the Vermont Department of Fish and Wildlife study of significant calcareous fens and riverside seeps. One site identified is Pownal Bog north of Barber Pond, which is actually a fen community and not a bog. Six rare plants occur at the site as well as four uncommon plants and a rare moss. This two and a half acre peatland has formed in a kettlehole depression. Another small intermediate fen was briefly surveyed in Pownal although it seemed to be a transitional site and so its significance is not known.

The other two sites in the Walloomsac River watershed were found in Shaftsbury. Paran Creek Fen located south of Simeon Dean Road consists of two small rich fens that contain a population of a globally rare sedge. Serendipity Fen is a one-acre fen within a 100-acre plus wetland. It is a rich fen and also has the globally rare sedge in it.

***Big Pond, Woodford*:** This pond supports one rare plant species, *Littorella americana*, which is a low-growing aquatic plant of shallow waters.

Hoosic River watershed

***Significant natural communities***

No lakes with special significance or features have been identified in the Hoosic watershed.

A high quality stretch of riverine floodplain forest and one of the very few floodplain forest remaining in southwestern Vermont is located on the hairpin bend in the Hoosic River below North Pownal. The floodplain forest occupies about 25 acres and consists of both sugar maple-basswood-ostrich fern type and successional floodplain forest.

## Stressors, and Causes and Sources of Impairment

### Stressors and related pollutants

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 Divisions approach to addressing the stressor through monitoring, technical assistance, regulations and funding.

VTDEC uses monitoring and assessment data to assess individual surface waters in relation to Vermont Water Quality Standards and other relevant guidelines (e.g., stream equilibrium standard). The 2014 Assessment and Listing Methodology articulates three categories of surface waters where degradations are noted.

Stressed waters support designated uses, but the water quality and/or aquatic biota/ habitat have been disturbed to some degree by point or by nonpoint sources of human origin and the water may require some attention to maintain or restore its high quality. In some instances, stressed waters may have documented disturbances or impacts and the water needs further assessment to confirm impairment.


**Figure 8. List of Stressors**

Altered waters are affected by lack of flow, water level or flow fluctuations, modified hydrology, physical channel alterations, documented channel degradation or stream type change is occurring and arises from some human activity, OR where the occurrence of exotic species has had negative impacts on designated uses. The aquatic communities are altered from the expected ecological state.

Impaired waters are those surface waters where there are chemical, physical and/or biological data collected from quality assured and reliable monitoring efforts that reveal 1) an ongoing violation of one or more of the criteria in the Water Quality Standards and 2) that a pollutant of human origin is the most probable cause of the violation. Impaired waters are those that require pollution control efforts under one or more provisions of the Clean Water Act. The most common mechanism to address an impaired water is the development and promulgation of a Total Maximum Daily Load.

Specific surface waters that are in need of further assessment, and impaired waters in need of a TMDL or other Clean Water Act pollution control effort are shown in Tables 1, 4, and 5 above and the subwatershed-specific sections of this Plan. In addition, the highest priority stressors for streams in the Hudson River Basin are also shown in Tables 1, 4, and 5 and for lakes in Table 10. The specific pollutants or conditions that cause stress or impairment on the designated uses of surface waters in the Hudson River Basin that result from each stressor include nutrients (and sediment), temperature, pathogenic bacteria, and invasive species.

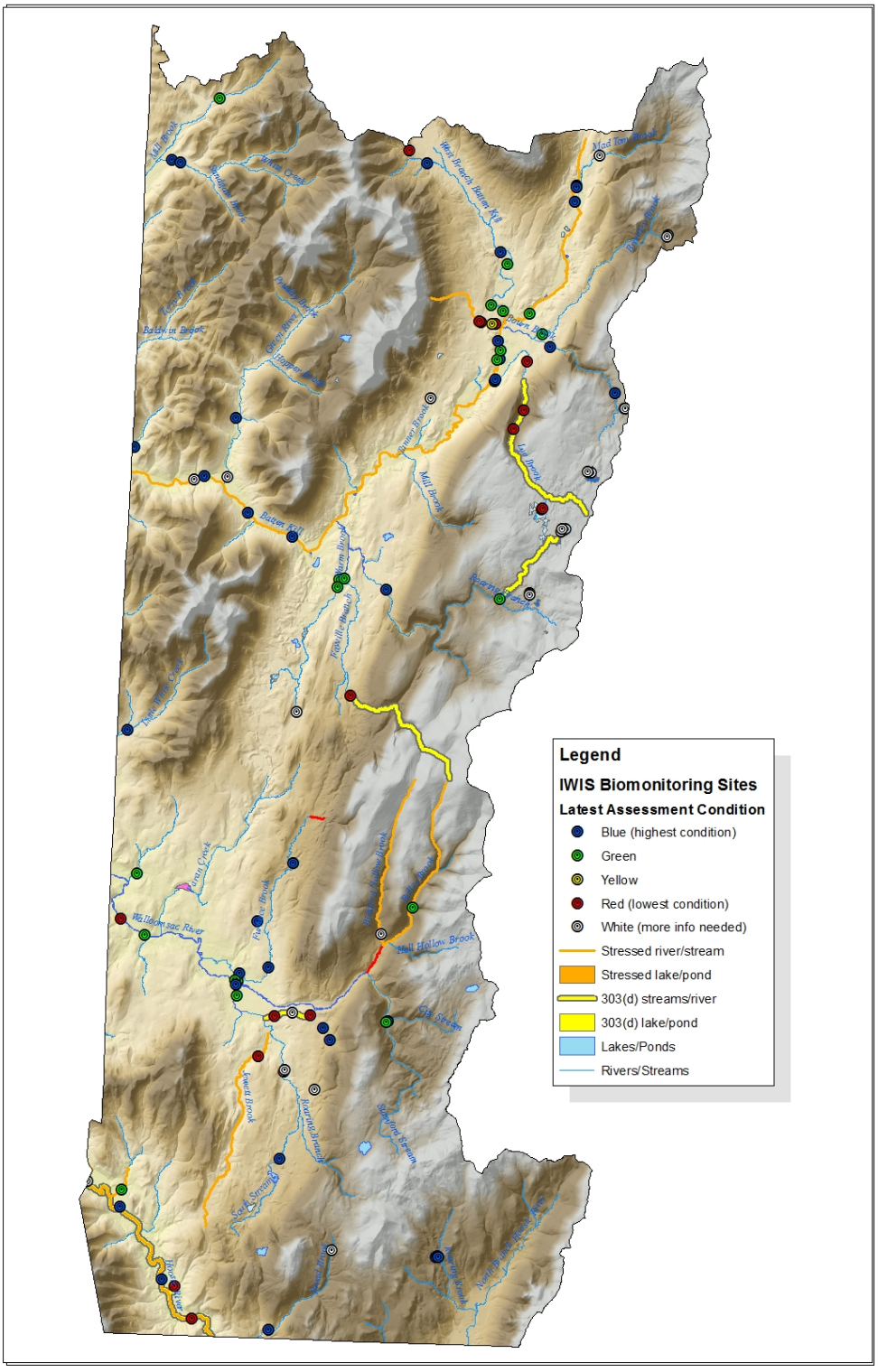



**Figure 9. Impaired, altered, or stressed waters on the Vermont Priority Waters List (Hudson River Basin)**

***"Altered" in this instance, refers to non-native invasive species present in densities sufficient to alternative biological communities. For example, overall plant density is classified as "moderate," indicating locally abundant (50% or greater coverage) growth, or "heavy," (75% or greater littoral cover overall) indicating growth in most shoreline areas.**

## Causes and Sources of Impacts to Basin 1 Lakes and Ponds

Impairments to lakes in this basin are related to acidification (6 lakes, 139 acres), and to the presence of non-native nuisance aquatic species (1 lake, 40 acres). Threats to uses are also caused by siltation (128 acres), exotic species (99 acres), pH (82 acres), nutrients and phosphorus (60 acres), turbidity (51 acres), and the presence of algae (40 acres). Table 8 provides an accounting of the causes of impairments and threats to lakes in this drainage system.

The following sources impair or threaten lake uses in the Batten Kill, Walloomsac, and Hoosic watersheds. Atmospheric deposition of acids, as well as natural susceptibility to low pH is responsible for the acidification of 139 acres and threats to an additional 82 acres. Recreational boating and the associated release of non-native plant propagules is a primary source of the impairment of 40 acres due to the presence of these species, and threatens an additional 99 acres. Other important threats include road runoff and development.

**Table 13. Lakes and ponds that are Impaired (I), Altered (A), or Stressed (S) in the Hudson River basin, along with current management approach**

| Lake | Stressor/ source | Management intervention |
|---|---|---|
| Lake Paran |  Invasive species | Eurasian milfoil control employing coordinated chemical, harvesting, and handpulling approaches |
| Lake Shaftsbury |  Invasive species | Water Chestnut discovered in Active surveying and hand-pulling |

| Lake | Stressor/ source | Management intervention |
|---|---|---|
| Lakes and ponds within 10 miles of aquatic nuisance species infested lakes and ponds (such as Paran and Shaftsbury) are susceptible to infestation |  Invasive species | Spread prevention. Support, promote, expand invasive patrollers program |
| Beebe<br>Branch<br>Bourn<br>Lye Brook – S<br>Lye Brook - N<br>Little Mud |  acidity<br>atmospheric deposition: extremely sensitive to acidification; episodic acidification | EPA approved TMDL 2003 |

## Lakes in Basin 1 that Need Further Assessment

There are 10 lakes and ponds in this drainage system identified as needing further assessment at this time. A summary of information from the Lake Assessment database is provided below. There are several very small ponds (less than 10 acres in size) in the basin for which Vermont DEC has little or no information. The accessibility of all of these smaller lakes to the public is unknown. Those 10 lakes and ponds are:

***Barber Pond, Pownal*:** Assessment is needed to determine if sedimentation is having an impact on this pond.

***Equinox Pond, Manchester*:** Vermont DEC has no information nor data on this pond, which should be reassessed during the next Basin 1 assessment cycle. There is no public access to this waterbody and is held in private ownership.

***Lake Hancock, Stamford*:** The degree to which off-road vehicles is causing sedimentation at the access should be established. The lake was last assessed by Vermont DEC in 2009. A recommendation of that assessment is to restrict access by 4WD vehicles to the immediate shoreline areas of the pond.

***Kent Hollow Pond, Sandgate*:** The question of whether this remote waterbody is a pond or simply a forested wetland remains unanswered. A site visit is necessary to determine the exact nature of this pond.

***Little Mud Pond, Winhall*:** This pond should be reassessed for acidification.

***Lake Madeleine, Sandgate*:** This pond has not been visited by Vermont DEC since the mid-1980's. It is presently posted against public access.

***Miller Pond, Arlington*:** This marshy pond is thought to be of extremely high wildlife value, and a follow-up visit to verify this is in order.

***Shaftsbury Lake, Shaftsbury*:** An assessment of trophic status is warranted on this recreational lake.

***South Stream Pond, Pownal*:** This is another waterbody for which there is an unanswered question as to whether it is a pond or wetland.

***Thompsons Pond, Pownal*:** This lake was last visited by Vermont DEC in 2002. There is limited access to a "swimming pond" just downstream of the spillway from the main pond. Water clarity is good and shoreline is fairly intact, with some areas periodically hayed. The pond association indicates that the pond supports a trout fishery.

### The Importance of Basin Planning in the Face of Tropical Storm Irene

The Hudson River Basin experienced flood damage during Tropical Storm Irene in 2011, including localized damage to major roads and bridges along significant sub-basins, especially within the southern portion of the Walloomsac River Basin in Bennington County.

The many opportunities presented by Tropical Storm Irene for the enhancement of flood resiliency are limited by funding for restoration of these areas. Given the need for protection of critical flood attenuation assets and new pollution control fixes for non-flood related problems, Basin Planning emerges as a critical prioritization tool for Vermont's restoration and resiliency efforts. In recognition of this, DEC planners and river scientists have engaged in a collaborative process with Regional Planning Commissions to map critical infrastructure damage, and prioritize restoration.

Bennington Floodplain Restoration Project before construction: failing berm looking upstream from Park Street Bridge (left) and looking downstream toward Park Street Bridge (right)

### Managing stormwater runoff

Stormwater runoff from developed lands including the road network is one of the greatest threats to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or because of snowmelt. On undeveloped lands, a portion of this runoff is absorbed into the ground through infiltration and the rest takes a slow path to nearby rivers, lakes and ponds. On developed lands, however, infiltration is reduced by impervious surfaces such as roads, rooftops, and driveways. This leads to an increased frequency and intensity of flooding as well as a greater likelihood that runoff will become contaminated with pollutants. The result is increased erosion and property damage, endangered or degraded aquatic and terrestrial habitats, and threats to public health via recreation sports and contaminated drinking water.

Stormwater runoff management is a major priority within the Hudson River Basin because of the chronic nutrient enrichment condition in the Hudson River, which is a high priority for restoration and water quality attainment by New York DEC (source: http://www.dec.ny.gov/docs/water_pdf/pwluhudasmt.pdf). While a majority of the urbanized areas of the Basin exist in New York State (including the communities of Glens Falls and Queensbury), there are urban areas and rural road networks within the Vermont portion of the basin that contribute stormwater runoff. Unmitigated runoff results in channel erosion, land erosion, nutrient loading, and even thermal stress. Although the Hudson River Basin in Vermont is predominantly rural, some developed areas do exist (Arlington, Bennington, Manchester, etc.) and are recommended for stormwater master planning to better understand and deal with the effects of stormwater runoff in the basin. Actions listed in Table 17 will address the current data gaps related to stormwater runoff.

Given the history of stormwater issues in other watersheds (Winooski and Otter Creek); it is prudent that the issue be addressed pro-actively. Many of the stormwater issues associated with developed lands can be mitigated and prevented using Low Impact Development (LID) and Green Infrastructure (GI) systems and practices. These emerging concepts strive to manage stormwater and pollutants by restoring and maintaining the natural hydrology of a watershed. Rather than funneling stormwater off site through pipes and infrastructure, these systems focus on infiltration, evapotranspiration, and storage as close to the source as possible. Typical practices include green roofs, rain gardens, cisterns, porous pavements, infiltration planters, buffer zones, and sustainable site design. These practices could go a long way towards preventing future stormwater problems.

## Forested Lands in the Basin

Logging and Forested Land

Forested lands contribute the lowest amounts of nutrients, sediment and other pollutants into Vermont streams per acre as compared to other land use. This, however, does not mean that impacts from foresty should be not be considered for possible improvements to water quality, especially because forestland makes up a significant percentage of land cover in the Basin. The major sources of NPS pollution from forested lands are erosion from logging operations and associated roads and staging areas.

Much of the erosion can be prevented by following Acceptable Management Practices (AMPs) for maintaining water quality on logging jobs in Vermont. These practices list buffers along streams and road construction guidelines among other practices that protect water quality, and provide protections for the landowner and logger if the practices are followed.

Landowners can play a large part in encouraging good silvicultural practices by working with a forester to develop a management plan. On lots over 25 acres landowners can enroll in Vermont's Use Value Appraisal Program which requires the development of a 10 year forest management plan certified by the Department of Forests Parks and Recreation (DFPR) in exchange for property tax rates based on forestland value. Landowners can also make a contract when hiring a logger stipulating certain protective practices to limit erosion.

Managing and Protecting Headwaters for Water Quality

Headwater streams make up a large proportion of the total length and watershed area of fluvial networks, and are partially characterized by the large volume of organic matter) and invertebrate inputs from the riparian forest, relative to stream size. Much of those inputs are exported to downstream reaches through time where they potentially subsidize river communities.[6] Organic matter entering headwater systems consists of leaves, woody debris, detritus, and waste products of plants and animals. Microorganisms living in the stream use this material for food, transforming the organic

6 ECOLOGICAL LINKAGES BETWEEN HEADWATERS AND DOWNSTREAM ECOSYSTEMS: TRANSPORT OF ORGANIC MATTER, INVERTEBRATES, AND WOOD DOWN HEADWATER CHANNELS1 Mark S. Wipfli, John S. Richardson, and Robert J. Naiman2

matter from an unusable form (inorganic carbon) into food for other organisms (organic carbon). This process is the basis of the food web in freshwater ecosystems.[7]

While each headwater stream is short and narrow, they collectively represent a majority of the drainage network of any watershed management unit. Consequently, it makes sense to focus on headwater streams in any watershed plan. Focusing conservation practices for forest landowners on the headwater stream level is important in watershed management for several reasons:

- Controlling soil erosion on logging trails
- Improving stream crossings
- Restoring forest riparian buffers along streams
- Stabilizing erosion-prone soils.

Protection of Headwaters

A river begins at its headwaters, a network of small upstream tributaries. When most people think of headwaters, they think of mountain creeks. In addition, headwater streams can be intermittent or perennial. Intermittent streams are those that contain flowing water only during wet periods, while perennial streams contain water year-round. Headwater streams comprise the largest total number and most linear miles of streams in the Vermont. Because they occupy a broad range of climatic and geological conditions found in the Vermont, headwater ecosystems collectively represent enormous diversity.

Headwaters supply food and critical nutrients: the headwaters are a critical food source for the entire river. Because of their intimate connection to the surrounding landscape, headwater streams deliver nutrients and organic material-like fallen leaves-to downstream regions, sustaining aquatic life downstream.

Headwaters influence downstream conditions in a number of ways. In addition to food, the headwaters provide other materials like water and sediments, essential to river health. Natural sediment delivery to streams begins with the hill slopes above intermittent and headwater stream channels. Interconnected with wetlands and groundwater, headwaters help regulate natural river flow.

While headwaters are important for their downstream influences, they are also important in their own right as geologically and biologically distinctive and diverse

7 HYDROLOGIC CONNECTIVITY AND THE CONTRIBUTION OF STREAM HEADWATERS TO ECOLOGICAL INTEGRITY AT REGIONAL SCALES Mary C. Freeman, Catherine M. Pringle, and C. Rhett Jackson2

ecosystems. Headwaters support rich and varied communities of plants and animals. While the in-stream fauna may be relatively simplified and commonly characterized by pollution intolerant animals, the biological diversity of certain groups such as amphibians is greater in headwater regions than anywhere else within a drainage basin.

A number of headwater restoration projects either have been implemented or are currently underway in the Batten Kill, Walloomsac, and Hoosic Basin. Additionally, the USFS has implemented a number of headwater restoration projects in the Green Mountain National Forest portion of the Basin. Recently, the Forest Service has proposed additional Large Woody Debris Stream Restoration Projects as part of the South of Route 9 Integrated Resource Project.

Addressing the Impacts of Forestry on Water Quality

Major land use changes over the past three centuries have dramatically changed Vermont streams. From a completely forested landscape to a mostly open one and back again, the centuries have wreaked havoc on the condition, habitat and biology of our waterways. Today 85% of the basin is re-forested. The forest industry in Bennington counties has produced thousands of board feet of sawlogs and veneer logs every year, representing highest county volumes in the state in recent years, including thousands of cords of pulpwood. This production is a major economic factor in the region and forest-related jobs are important to the local economy.

One common practice affecting stream health is the clearing of wood debris from streams. With the focus on flood resiliency and forest health in the basin, the best practice to protect streams from erosion is by enhancing a healthy riparian buffer and allowing larger woody debris to remain in the stream channel. Numerous studies document how large woody debris (LWD) influences channel morphology and plays an important role in aquatic habitat creation and maintenance.

## Agriculture in the Basin

The Batten Kill, Walloomsac, Hoosic Basin, at 272,249 acres, stretches across nearly all of Bennington County[8]. Agriculture, the dominant historical land use of the state, now maintains only a fraction of its former pastoral acreage in Bennington County and across the state, estimated at a high of 75% statewide in the 1800's.[9] Though agriculture

8 Vermont Center for Geographic Information. 2008. GIS Shapefiles: VT County Boundaries 2006, VT Subbasin Boundaries 2003. www.vcgi.org .

9 Cronon, W. 1983. Changes in the Land: Indians, Colonists and the Ecology of New England. Hill & Wang.

is now the second largest land use type in the watershed, it is far below the acreage that is forested.

While agriculture gives the landscape a rural character, it also lends it an economic base, a cultural identity and an environment that combines field, forest, pasture and village. Bennington County farms are producing beef, dairy, sheep, poultry, hay, and vegetables. Farm-owned forestland extends farm production into maple syrup and forest products. In 2002, Bennington County maintained the greatest acreage of cherries, plums, and foliage plants and one of the greatest counts of pheasants statewide.

Agriculture, as a working landscape, provides many benefits to the environment and the surrounding community. Fields and pastures provide large tracts of open space and are habitat for many species of birds and mammals. As field soils absorb rainwater more readily than paved and other impervious surfaces, fewer nutrients are released from an acre of agricultural land than from an acre of developed land. Farms recycle farm-produced wastes, such as manure and spoiled feed, into soil amendments. Farms also work to prevent runoff of soil, nutrients and pathogens through land management practices like cover cropping, filter strips, no-till and strip farming.

Agricultural activities have had an impact on the environment of the Basin for well over 300 years. The accumulated effects of animal and crop production have sent varying degrees of pollutants into the basin's waterways over the centuries. Agriculture in the watershed also has the potential to impact the environment. Though the river miles and lake acreage of the Basin affected by agriculture represent none of the total impaired and only 17% of total threatened miles and acreage, the effects of agriculture on water quality should not be ignored. Excess nutrients, pathogens and sediments all can leave the farm when erosion control methods fail or heavy rains and floods inundate fields.

Agricultural Land

Federal, State and private agencies have taken steps to protect farmland and farm water quality through many of the programs listed in the 'Programs to Address Issues' section. This land protection ensures the availability of agricultural land for future food and fiber production and provides those presently working the farm with some financial assistance to help them succeed. These programs often include assistance for installing conservation practices on the farm that reduce non-point source pollution such as fencing animals out of streams to prevent damage to streambanks and

providing them with alternative watering systems. Unfortunately, federal and state cost-share dollars for these practices are limited and competitive.

Now, more than ever, farmers are under considerable pressure to sustain economically viable and environmentally sound farming operations. Farmers must face labor issues, foreign competition, competing land use pressures, regulations concerning husbandry, genetics, food safety and stricter water quality regulations under the State's Accepted Agricultural Practices (AAP).

All farms in Vermont must meet the Accepted Agricultural Practices (AAPs) which are statewide regulatory requirements for agricultural land use practices created to reduce the amount of agricultural pollutants entering waters of the state from farmland. The AAPs were designed to reduce nonpoint pollutant discharges through implementation of improved farming techniques rather than investments in structures and equipment.

In complying with these new AAP's, farmers must address nine key water quality protection principles:

- No Direct Discharge of wastes to surface waters
- Nutrient and Pesticide Storage and setback requirements
- Nutrient and Pesticide Application, setback and soil testing requirements
- Soil Cultivation designed to minimize erosion
- Waste Management to minimize impacts to water quality
- Buffer Zones maintained on crop land
- Farm Structure design and setbacks
- Streambank Stabilization to federal standards
- Groundwater Quality impacts minimized.

Beyond the AAPs and large and medium farm regulations, many farms install Best Management Practices (BMPs), which are voluntary practices to correct a current waste management problem on a specific farm. BMPs typically involve the installation of structures, such as manure storage systems, milkhouse waste treatment, stream fencing to reduce agricultural NPS pollution, and a variety of other practices that improve water quality. The expense of installing many of these practices makes federal and state funding necessary to make them affordable for farmers.

The Batten Kill, Walloomsac, and Hoosic Basin remains rural and maintains a diverse agricultural industry. While development pressure is a concern of local towns most are committed to maintaining the rural, agricultural nature of the area. The economics of agriculture, however, will determine the future character of the basin.

## Direct discharges to surface waters in the Hudson River Basin

There are three municipal wastewater treatment facilities that are subject to NPDES discharge permits in the Hudson River Basin (Table 15). All of these facilities are subject to State of Vermont issued NPDES permits.

As part of a necessary refinement of the facility-specific phosphorus wasteload allocations, WSMD, with assistance from certain municipalities, is conducting an extensive sampling effort to document the current loading conditions for phosphorus, and determine the "reasonable potential" that WWTP's have to cause or contribute to downstream water quality impairment. Certain permit conditions for two of the below facilities are aimed at further clarifying the discharges' impact on the water quality of the receiving waters by requiring instream monitoring.

**Table 14. Hudson River Basin Wastewater Treatment Facilities and other Facilities Subject to NPDES Direct Discharge Permits**

| Facility (permit #) | Permit expiration date | Design flow MGD | IWC* 7Q10 /LMM | Treatment type | Receiving water |
|---|---|---|---|---|---|
| Bennington WWTF 3-1261 | 9/30/2016 | 5.1000 | 0.196/0.100 | Secondary/tertiary with chlorine disinfection | Walloomsac River |
| Manchester WWTF 3-1153 | 9/30/2015 | 0.6000 | 0.046/0.024 | Secondary/lagoon with chlorine disinfection | Batten Kill |
| Pownal WWTF 3-1493 | 6/30/2016 | 0.2600 | 0.005/0.002 | Sequencing batch reactor with ultraviolet light disinfection | Hoosic River |

* 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

Bennington WWTF

The facility, which was upgraded from primary treatment in 1985, consists of two primary settling tanks, four trains of RBCs and secondary clarification followed by chlorine disinfection and de-chlorination. Due to water quality considerations, the facility also has a sand filtration system that is operated in the summer months to meet effluent limits. Discharge permit conditions require upstream and downstream

nutrient and biomonitoring in the Walloomsac River to assess the impact of the discharge.

Manchester WWTF

The Manchester WWTF was initially constructed in 1979 and currently provides secondary treatment of wastewater and consists of a two cell lagoon system followed by chlorine disinfection and de-chlorination. A 20-year engineering evaluation was completed in 1999. Because of reportedly mild nutrient enrichment observed below the discharge to the Batten Kill, permit conditions require upstream and downstream nutrient and biological assessments.

Pownal WWTF

The Pownal WWTF consists of sequential batch reactor technology with ultraviolet disinfection prior to discharge to the Hoosic River. Due to the capacity of the UV disinfection system in attaining only a consistent E. coli concentration of 160 colonies/100 mls rather than the customary 77 colonies/100mls, a mixing zone of 200 feet from the outfall was established for E. coli in the Hoosic River. From a public health perspective, it was determined that there was less risk associated with the E. coli mixing zone than from toxicity risk to aquatic biota and human health of chlorinated compounds by using chlorine disinfection.

## Surface waters Used as Public Drinking Supplies in the Hudson River Basin

The Following are currently listed as waters that are managed for the purpose of public water supplies may be designated as Class A(2) Public Water Supplies:

**Batten Kill Watershed**

- An unnamed tributary to Bromley Brook (0.5 mile)
- **Village of Manchester water supply.** (No longer used). The first unnamed tributary to Bromley Brook and all waters within its watershed upstream of the Manchester Water Co. intake. The tributary is the first tributary on the right upstream of Bromley Brook's confluence with Bourn Brook. The intake is approximately 0.5 mile upstream of its juncture with Bromley Brook.

**Walloomsac River Watershed**

- Basin Brook (VT01-03 Basin Brook. WSID #5017) and Furnace Brook (5.0 miles)
    - **Village of North Bennington water supply.** Basin Brook and all waters within its watershed to and including the North Bennington Reservoir in the Towns of Glastenbury and Shaftsbury. (Furnace Brook is not a water supply).
- Bolles Brook (5.3 miles)

    - **Village of Bennington water supply.** That portion of Bolles Brook and all waters within its watershed in the Towns of Glastenbury and Woodford upstream of the Bennington water intake.
- Sucker Pond (Lake Hancock) & tributaries (70 acres)
- **Village of Bennington water supply.** Lake surface and all waters within its watershed in Stamford.
- Barney Brook (1.3 miles)
    - **Village of Bennington water supply.** That portion of Barney Brook and all waters within its watershed in the Town of Woodford upstream of the water intake.
- Unnamed tributary to South Stream (1.0 mile)
    - **Village of Bennington water supply.** That a portion tributary to South Stream and all waters within its watershed in the Town of Woodford upstream of the water intake in Bennington.

**Hoosic River Watershed**

- Roaring Branch (2.3 miles)
    - **Town of Bennington Water supply**. That portion of Roaring Branch and all waters within its watershed in the Town of Stamford upstream of the water intake in Pownal.
- Unnamed tributaries (2.9 miles)
    - **Village of Pownal water supply.** That portion of unnamed tributaries and their watersheds on Mann Hill in the Town of Pownal upstream of the water intake in Oak Hill Cemetery.
- Unnamed tributaries (Reservoir and 0.8 miles)
- Hollow Brook and Ladd Brook (1.5 miles)
    - **Village of North Pownal water supply**. (a) Reservoir Hollow Brook and reservoir and all waters within its watershed. (Reservoir is approx. 0.5 mile upstream of the Hoosic River).
    - **Village of Pownal water supply.** Ladd Brook and all waters within its watershed in the Town of Pownal.

## Chapter 3- Management Goals for Surface Waters in the Hudson 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.

## Opportunities for Reclassification

### Class A(1), A(2) and B Waters

Presently in all basins across Vermont, waters above 2,500 feet in elevation are classified A(1) by Vermont statute. In the Hudson River 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. DEC has documented that certain streams have the biological integrity to be so designated (that occur below 2500'). Surface waters currently attaining Class A(1) biological integrity and are candidates for reclassification include:

- Bourn Pond
- Beebe Pond (Sunderland) and tributaries
- Branch Pond Brook
- South Fork of the Roaring Branch and tributaries
- Pond identified by VTDEC as "ALDER" Pond (Sunderland) and tributaries
- Black Brook and tributaries upstream of confluence with Fayville Brook
- Lye Brook and tributaries (portion forming boundary between Lye Brook Wilderness and non-wilderness GMFLNF lands)
- Cardinal Brook

Surface waters used as public water supplies are classified A(2). The only class A(2) waters in Basin 01 that is not used as a water supply is Basin Brook (Walloomsac River Basin). Candidate A2 waters for reclassification include:

- Basin Brook

### Wetland Re-classification Opportunities

Wetlands proposed for Class I Wetland Classification include:

- Pownal Bog
- Maple Grove Swamp (Pownal)
- Middle Pownal Road Swamp

## Existing Uses

There are many identified special uses, features, and values of the Hudson River Basin and its numerous tributaries including waterfalls, cascades, whitewater boating stretches, and swimming holes. All surface waters in Vermont are managed to support 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. In particular surface waters, however, 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 (DEC Anti-degradation Procedure, 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 Hudson River Basin planning process, DEC has reviewed:

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. Likewise, we recognize that fishing activities in streams and rivers are widespread throughout the state and can be too numerous to document. The Vermont Water Quality Standards stipulate that existing uses may be documented in any surface water location where that use has occurred since November 28, 1975. Therefore information presented in Appendix A should be viewed as only a partial accounting of known fishing uses based upon limited criteria and does not change protection under the Clean Water Act or Vermont Water Quality Standards for waters not listed.

All surface waters in the Basin – including all rivers and streams are identified as supporting swimming and fishing as an existing use unless otherwise noted. A table of Existing uses appears in Appendix A.

## 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 the permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities.

As indicated in Section 2.B. (above), the Batten Kill has been designated as an outstanding resource water for natural, cultural, recreational, and scenic values. At the present time there are no other ORW designations in the Hudson River Basin or candidates that were brought forth during the planning process, for this basin plan.

## Very High Quality Waters

Many of the Hudson 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 (above). In addition to protecting and improving water resources by managing stressors, there is the opportunity to protect surface waters by identifying and documenting the very high quality and preserving those conditions or features through various classifications or designations. Several statewide references and reports available to 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.

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

There is currently one Class I wetland in the Hudson River Basin. The Dorset Marsh lies at the headwaters of both the Batten Kill and the Mettowee and is one of very few "Class I" wetlands in Vermont. As part of the development of this tactical basin plan, a handful of 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, and as consistent with the Vermont Wetland Rules.

Wetlands in the Hudson River basin that warrant further study for Class I potential include:

- Batten Kill headwaters

**Fish Habitat Designations (Warm Water Fish Habitat)**

All wetlands and the following waters are designated as warm water fish habitat for purposes of the Vermont Water Quality Standards:

Batten Kill, Walloomsac, Hoosic Basin

(a) Lake Hancock (Sucker Pond), Stamford

(b) Thompsons Pond, Pownal

The WQS specifies a lower minimum dissolved oxygen concentration than waters in the remainder of the basin, which are Cold-Water Habitat.

There are no proposed changes to warm water fish habitat designations at this time.

**Cold Water Fish Habitat**

All waters not designated as warm water fish habitat above are designated as cold-water fish habitat for the Hudson River Basin, as noted in the Vermont Water Quality Standards, 2010. No changes to cold-water fish habitat designations are proposed in this basin plan at this time.

## Chapter 4- Watershed Improvement Actions and the Implementation Table

The tactical plan implementation table (Table 15) identifies objectives for the Hudson River Basin, and frames-out 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 being mapped coincident with the release of this public review draft, and will be displayed online at this link. A more general description of strategies necessary to protect, maintain, enhance, or restore surface waters in this Basin is presented following the Implementation Table.

### Monitoring and Assessment Projects

| Subbasin/ Basin | Town | Stream segment | Activity/ Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| **Monitoring and Assessment** | | | | | | |
| Lye Brook/ Batten Kill | Manchester/ Sunderland | Entire Basin, Bourn and Branch Basins | Atmospheric deposition | VMC - Bourn & Branch Pond water chemistry data (nutrients) and temperature | LRTAP | USFS, VMC, VDEC |
| Lye Brook/ Batten Kill | Manchester | T3.02-A & B | Flood resiliency/ Encroachment, channel erosion | modeling of berm removal | Historic and ongoing channel management | VDEC (RMP), Manchester, BCCD, BKWA |

| Subbasin/ Basin | Town | Stream segment | Activity/ Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Lye Brook/ Batten Kill | Manchester | Biomonitoring locations (rm 1.8) | Protection | Additional monitoring | Older (1990's) biomonitoring data (confirm VHQ) | VDEC-BASS |
| Bourn Brook/ Batten Kill | Manchester | Biomonitoring locations (rm 1.6) | Protection | Additional monitoring | Older (1990's) biomonitoring data (confirm VHQ) | VDEC-BASS |
| Munson Brook/ Batten Kill | Manchester | 1 mile ***Stressed*** | Runoff from Developed Lands/ Land erosion, nutrient loading | Additional monitoring, stormwater mapping, IDDE | Impervious areas, Town of Manchester. | Town of Manchester, VDEC, BCRC; TU. Orvis Maple St. School |
| West Branch/ Batten Kill | Manchester | 0.6 miles ***Stressed*** | Runoff from Developed Lands/ Land erosion, nutrient loading | Additional monitoring, stormwater mapping, IDDE | Impervious areas, Town of Manchester | Town of Manchester, VDEC, BCRC, BCCD |
| Roaring Branch, Batten Kill | Manchester | T2.01 | Flood resiliency/ Encroachment, channel erosion | modeling of berm removal | Historic and ongoing channel management | VDEC (RMP), landowners |
| Batten Kill mainstem | Manchester | | Dufresne dam removal project/ flow alteration | Post dam removal assessment | | VDFW, TU, VDEC-BASS, BKWA |

| Subbasin/ Basin | Town | Stream segment | Activity/ Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Batten Kill mainstem | All towns in the basin | Mainstem and tributaries (esp. Green) | Invasives | Monitor for the presence of Didymo and Whirling Disease | | VDFW, VDEC, USFS, TU, BCCD, BKWA |
| Lake Shaftsbury/ Batten Kill | Shaftsbury | Entire Lake | Invasives | Monitor for the spread of Water Chestnut – pull where necessary | | VDEC-LPMPP, VDFPR; BCCD |
| Paran Creek/ Walloomsac | North Bennington | 3.0 miles | Potential industrial runoff, urban sources | Biomonitoring scheduled for fall, 2015. Water quality monitoring proposed | Unknown | Lake Paran Recreation, Inc., BCCD |
| Lake Paran/ Walloomsac | North Bennington | ***Altered*** Entire lake | Invasives - WEEVIL PRESENT; NOTED NATURAL MILFOIL DECLINE IN 1991 | Spread prevention – surveying on lakes and ponds within 10 mile radius | | VDEC, Lake Paran Recreation, Inc.. BCCD |
| Basin Brook/ Walloomsac | North Bennington | Entire basin upstream of water supply withdrawal point<br><br>***Altered*** by flow regulation | Possible lack of minimum flow below water supply withdrawal point (threat) | Discontinue/ reclassify? | WSID #5017 - North Bennington Water Dept; serves as back up supply source to gravel well field | Town of North Bennington, VDEC - GWDWPP |

| Subbasin/ Basin | Town | Stream segment | Activity/ Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Bolles Brook (includes Bickford Hollow and Hell Hollow/ Roaring Branch, intake to City Stream confluence/ Walloomsac | Glastenbury Woodford | 1.0 miles, ***Altered*** by flow regulation (Part F list) | Possible lack of minimum flow below water supply withdrawal point (threat) | Assessment of water withdrawal impact difficult given low productivity & low ph effect | WSID #5016 - Bennington Water Dep't; | Bennington, VDEC - GWDWPP |
| Barney Brook/ Wallomsac | Bennington, Woodford | RM 0.2 - 1.5 | Stressed due to leachate entering brook from Burgess Landfill and Burgess Superfund Site/ Toxics | VDEC BASS lab is working with local organizations to determine sources | Iron precipitate | Bennington, VDEC – WMD, VDEC - BASS |
| Jewett Brook/ Walloomsac | Pownal | 1.0 miles ***Stressed*** – Stressed List | Temperature/ thermal modification | Conduct thermal monitoring, riparian buffer gap analysis | Unknown (AG, developed land)<br>FAIR BIO DATA 2008 | VDFW, VDEC, TU, BCRC, BCCD, VAAFM |
| Ladd Brook/ Hoosic | Pownal | 0.4 miles ***Impaired*** – Part A list | Indication of sediment stress; potential impacts from eroding gravel roads/ Land Erosion | Road Erosion Inventory and Assessment, RERA shows high % of potential risk | Back road erosion | VDEC, Town of Pownal, Vtrans-BBR, BCCD |

| Subbasin/ Basin | Town | Stream segment | Activity/ Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Tubbs Brook/ Hoosic | North Pownal | 0.5 miles ***Stressed*** – Stressed List | Land erosion – SGA candidate? | Conduct abbreviated SGA to determine sources | Unknown, Land erosion | VDEC – RMP, Town of Pownal, BCRC |
| Hoosic | North Pownal, Pownal | **Impaired**, entire 7 mile length in Vermont | PCBs/ Toxics | Continued monitoring of No. Pownal Tannery Superfund site | | VDEC-WMD, VDEC-BASS |
| Hoosic | North Pownal, Pownal | **Impaired**, entire 7 mile length in Vermont | Encroachment, channel erosion, land erosion, nutrients, protection (flood resiliency) | River Corridor Plan | Phase 2 SGA (2009) calls out next phase | VDEC-RMP, BCRC, BCCD |

## Project Identification, Development, and Implementation

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| **Batten kill** | | | | | | |
| Mad Tom | Dorset, East Dorset | | Protection | Reclassification – A1 | BASS data (?) | VDEC, USFS, BKWA |
| Mad Tom | East Dorset | T7.01 | Channel erosion | Modeling of berm removal | Batten Kill RCP | VDEC – RMP, Vtrans |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| West Branch | Manchester | T6.01, T6.02 | Channel erosion, Land erosion, nutrient loading | Identify and implement GSI stormwater management projects for village. Encourage centralized stormwater treatment system where dense development exists. Locate treatment areas based on locations of soils with high infiltration potential | Urban sources | Town of Manchester, VDEC - ERP |
| Bromley Brook | Manchester | First tributary US from confluence with Bourn Brook | Flow alteration | Reclassification from A2 to B (abandoned) | No longer used | Manchester Water Co., VDEC - GWDWPP |
| Bourn Brook | Manchester, Bondville | (where not Wilderness lands) | Protection | Reclassification – A1 (also W&S candidate) scenic beauty, cultural significance, recreational trail | BASS data (?) | VDEC – MAPP, USFS |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Bourn Brook | Manchester | T4.01 | Encroachment | Modeling of berm removal | Batten Kill RCP | VDEC - RMP, Town of Manchester, landowners, BKWA, BCCD |
| Bourn Pond | Sunderland | Lakeshore (T4.06) | Thermal modification, land erosion, encroachment | Address unsanctioned camping encroachment into shoreline areas | Lye Brook Monitoring Coop | USFS, VDEC – LPMPP, BCCD |
| Lye Brook | Manchester, Sunderland, | Portion forming boundary between Lye Brook Wilderness and non-wilderness GMFLNF lands | Protection | Reclassification – A1 (also W&S) | BASS data (?) | VDEC – MAPP, USFS, BKWA |
| Lye Brook | Manchester | T3.02-A & B | Channel erosion, encroachment | Berm removal, river corridor easement, wetland protection | Lye Brook RCP | Town of Manchester, VDEC – RMP, |
| Lye Brook | Sunderland | headwaters | Atmospheric deposition | Acid deposition mitigation | Atmospheric deposition LRTAP | VDEC, EPA approved TMDL, USFS |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Branch Pond | Sunderland | headwaters | Encroachment, land erosion, thermal modification | Address unsanctioned camping encroachment into shoreline areas | Lye Brook Monitoring Coop | USFS, VDEC – LPMPP, BCCD |
| Branch Pond Brook | Sunderland | | Protection | Reclassification – A1 | BASS data (?) | VDEC – MAPP, USFS, BKWA |
| Roaring Branch | Manchester East Arlington | GMNF reaches | Habitat restoration/ Channel erosion, encroachment | Increase instream LWD – up to 175 pieces/ mile | TS Irene scour, So. Of rte. 9 IRP | USFS, TU, BKWA |
| Roaring Branch | Sunderland | T2.04-B & C | Protection | River Corridor easement (highest priority from SGA-RCP). Town of Sunderland has adopted FEH | TS Irene scour, So. Of rte. 9 IRP | VDEC - RMP, Town of Sunderland, landowners, BKWA, BCCD |
| Roaring Branch (South Branch, US of the Kelly Stand RD/ FR 6) | Sunderland | T2S2.01, T2S2.02 | Protection | Reclassification to A1 (below 2500') | BASS data (?) | VDEC – MAPP, USFS, Town of Sunderland, BKWA |
| Munson Brook | Manchester | RM 0.2 and upstream of Route 7A | Channel erosion, Land erosion, nutrient loading | Conduct SWMP to identify highest priorities for SW retrofit and GSI implementation (scheduled for 2016) | BASS data | VDEC – ERP, Town of Manchester, BCRC, BCCD, Orvis |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Munson Brook | Manchester | RM 0.2 and upstream of Route 7A | Channel erosion, Land erosion, nutrient loading | Identify and implement GSI stormwater management projects for village. Encourage centralized stormwater treatment system where dense development exists. Locate treatment areas based on locations of soils with high infiltration potential | BASS data | VDEC - ERP, Town of Manchester, BCCD, Orvis |
| Green River | Sandgate | Basin-wide | Land erosion | Work with towns in the Basin to implement back road BMPs to address sedimentation from gravel road runoff | RERA, BBR inventories (category A) | VDEC – SW, Vtrans – BBR, BCRC, Town of Sandgate, BCCD |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Batten Kill mainstem | Manchester | Mainstem reaches | Channel erosion, Land erosion, nutrient loading | Identify and implement GSI stormwater management projects for village. Encourage centralized stormwater treatment system where dense development exists. Locate treatment areas based on locations of soils with high infiltration potential | BASS data, VDFW | VDEC – ERP, BCCD, Town of Manchester, BKWA |
| Batten Kill mainstem | Manchester | M10, M11 | Nutrient loading | Work with Ekwanok and Manchester Country Clubs to become “VT Green Links” courses | VDEC-BASS | VDEC, Vermont Small Business Development Center, Ekwanok and Manchester Country Clubs, BKWA, BCCD |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Batten Kill mainstem | Manchester, Sunderland, Arlington | Entire mainstem | Encroachment, land erosion, thermal modification | Promote rebuffering opportunities through BCCD "Trees for Streams" program | Loss of riparian veg, streambank erosion, runoff, lack of habitat features | BCCD, VDEC – RMP, VDEC – BASS, VDFW, BKWA |
| Batten Kill mainstem | Dorset | Entire mainstem | Nutrient loading | Work with VSFHS to ensure manure management activities and watering activities are adhering to RAPs | Horse owners | BCCD, Foster Bros (?), NRCS |
| Batten Kill mainstem | Manchester | M10 | Protection | Potential river corridor easement just upstream from confluence with Bourn Brook | Batten Kill RCP | VDEC - RMP, landowners, BKWA |
| Batten Kill mainstem | Manchester | M5(E) | Encroachment, Thermal modification | Re-buffer western portion of streambank (RB) | NRCS, CREP | VAAFM, BCCD, NRCS, VLT, BKWA |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Batten Kill mainstem | All towns in Basin | All waters | Land erosion | Develop and implement stormwater management plan for private and public roads. Use Road erosion Risk layer and map points of stormwater inputs to ditches to assist in project prioritization | VDEC Erosion and RERA/ Sediment Source Risk Maps | VDEC - SW, Municipalities, Vtrans-BBR, BCRC, BCCD |
| Batten Kill mainstem | All towns in Basin | Mainstem and tributaries | Invasives | Assist in the development of, and Implement Batten Kill CISMA | BK CISMA | Principle and supporting partners of the CISMA, BCSFC |
| Batten Kill | All towns in Basin | All waters | Land erosion, encroachment, channel erosion | Identify and implement needed Better Backroads BMPs for roads identified in BBR – Category "A" inventories | VDEC Erosion and Sediment Source Risk Maps | BCRC, VDEC, Municipalities, Vtrans-BBR, BKWA, BCCD |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Warm Brook | East Arlington | Entire mainstem | Encroachment, land erosion, thermal modification | Promote rebuffering opportunities through BCCD "Trees for Streams" program | Loss of riparian veg, streambank erosion, runoff, lack of habitat features | BCCD, VDEC – RMP, VDEC – BASS, VDFW |
| Fayville Branch | East Arlington | T2S1S1.03 and T2S1S1.02-B* | Channel erosion | Berm removal *Pending alternatives analysis | Batten Kill RCP | VDEC-RMP, Town of Arlington, BCCD |
| Fayville Branch | East Arlington | T2S1S1.01-A* and T2S1S1.01-B** | Protection | Protection/ attenuation/ river corridor easement *Highest priority from SGA | Batten Kill RCP Prouty Hill RD | VDEC-RMP, BKWA, Town of Arlington, BCCD |
| Fayville Branch | East Arlington, Glastenbury | Entire basin US of Route 7 | Protection | ORW candidate for scenic values | VDEC-BASS | VDEC-BASS, USFS, BKWA |
| Black Brook (trib to Fayville Branch) | Glastenbury | Black Brook and tributaries upstream of confluence with Fayville Branch | Protection | Reclassification – A1 | BASS data (?) | VDEC-MAPP, USFS, BKWA |
| Mill Creek | Rupert | M01T1.04 | Protection | Bank stabilization using LWD revetments and riparian buffer plantings | Mill/ White RCP | BKWA, BCCD, VDEC-ERP |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Mill Creek | Rupert | Basin-wide | Land erosion, encroachment | Identify and implement needed Better Backroads BMPs for roads identified in BBR – Category "A" inventories | VDEC Erosion and Sediment Source Risk Maps | BCRC, VDEC, Municipalities, Vtrans-BBR, BCCD |
| Mill Creek | Rupert | M01T1S1.01 | Land erosion | SW LID mitigation project at Rupert Town Garage | Mill/ White SWMP/ RCP | VDEC – ERP, BCRC, Town of Rupert, BCCD |
| White Creek | Rupert | Basin-wide | Land erosion, encroachment | Identify and implement needed Better Backroads BMPs for roads identified in BBR – Category "A" inventories | VDEC Erosion and Sediment Source Risk Maps | BCRC, VDEC, Municipalities, Vtrans-BBR, BCCD |
| **Walloomsac** | | | | | | |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Paran Creek | North Bennington, Shaftsbury | Basin US of Lake Paran | Land erosion, encroachment | Identify and implement GSI stormwater management projects for village. Locate LID retrofits and treatment areas based on locations of soils with high infiltration potential | VDEC-BASS | Lake Paran Inc., VDEC-SW, Town of North Bennington, BCCD |
| Lake Paran | North Bennington | Develped lakeshore areas within 250' | Land erosion, encroachment – fostering the spread of invasives | Conduct Lakewise assessment and implement LID-GSI projects | VDFW access area, North Bennington Recreation Area | Lake Paran Recreation Inc., VDEC-LPMPP, BCCD |
| Barney Brook | Bennington, Woodford | RM 0.2 - 1.5 | Toxics | Mitigate sources of iron precipitate | Potential landfill leachate | VDEC-WMD, VDEC-BASS, Town of Bennington |
| Roaring Branch | Bennington, Woodford | GMNF reaches | Channel erosion | Increase instream LWD – up to 175 pieces/ mile | TS Irene scour, So. Of rte. 9 IRP | USFS |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Roaring Branch | Bennington | M06T3.03 | Protection, Channel erosion, encroachment | Acquire property adjacent to channel to prevent future development; modeling of fill removal to restore floodplain access | Channel Management and River Corridor Protection Plan, Roaring Branch SGA | VDEC-RMP, F&W, BCCD, Town of Bennington |
| Bolles Brook | Woodford | M6T3.05A | Land erosion, encroachment | Remove new RB berm to open access to flood chute | Woodford RCP, Roaring Branch SGA | VDEC-RMP, BCCD, Town of Bennington |
| Stamford Stream | Woodford, Stamford | Headwaters and areas around Sucker Pond/ Hancock Lake | Class 4 road erosion/ Land erosion | Work with ATV/ 4WD clubs to develop and implement back road BMPs on Stagecoach Road | So. Of rte. 9 IRP | USFS, BCCD, VDEC-ERP |
| Sucker Pond/ Lake Hancock | | Headwaters and areas around Sucker Pond/ Hancock Lake | Class 4 road erosion/ Land erosion | Controlled access points | So. Of rte. 9 IRP | USFS, BCCD, VDEC-ERP |
| City Stream | Woodford | M6T3.05S1.01A | Protection | Protect confluence area from further development/FEH | Woodford RCP | VDEC-RMP, Town of Woodford, landowners |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| City Stream | Woodford | M6T3.05S1.04D | Encroachment, land erosion | Move parking area out of river corridor | Woodford RCP | VDEC-RMP, Town of Woodford, landowners |
| Jewitt Brook | Pownal, Bennington | Approximately 1 mile downstream of Pownal Center | Thermal modification | Bank stabilization using LWD revetments and riparian buffer plantings | VDEC-BASS | VDEC-RMP, BCCD, Towns of Bennington and Pownal |
| Walloomsac mainstem | Bennington | M06, M07, M08, and tribs | Channel erosion, Land erosion, nutrient loading | Conduct SWMP to identify highest priorities for SW retrofit and GSI implementation (scheduled for 2016) | BASS data | VDEC – ERP, Town of Bennington, BCRC, BCCD |
| **Hoosic** | | | | | | |
| Broad Brook | Pownal | GMNF reaches | Habitat restoration/ Channel erosion | Increase instream LWD – up to 175 pieces/ mile | TS Irene scour, So. Of rte. 9 IRP | USFS |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Tubbs Brook | Pownal | Basin-wide | Land erosion, encroachment | Identify and implement needed Better Backroads BMPs for roads identified in BBR – Category "A" inventories | RERA groundtruthing, road inventory and assessment | Vtrans-BBR, VDEC-SW, BCRC, Town of Pownal, BCCD |
| Ladd Brook | Pownal | Basin-wide | Land erosion, encroachment | Identify and implement needed Better Backroads BMPs for roads identified in BBR – Category "A" inventories | RERA groundtruthing, road inventory and assessment | Vtrans-BBR, VDEC-SW, BCRC, Town of Pownal, BCCD |
| Hoosic | Pownal, North Pownal | Entire 7 miles segment in VT | PCBs/ Toxics | Site remediation complete, ongoing M&A indicates effective treatment, no further action proposed at this time | PCBs | VDEC-WMD, VDEC-BASS, EPA |

| Subbasin | Town | Stream segment | Stressor addressed | Project Description | Source | Potential Partners |
|---|---|---|---|---|---|---|
| Hoosic River | Pownal | M02 | Encroachment, channel erosion | Relocate berm adjacent to WWTF to accommodate a small floodplain for flow and sediment attenuation | Hoosic Phase 2 SGA | VDEC-ERP, VDEC-RMP, Town of Pownal (WWTF), BCCD |
| Hoosic River | Pownal | M06 | Protection | Bank stabilization using LWD revetments and riparian buffer plantings | Hoosic Phase 2 SGA | BCCD, HooRWA, VDEC-ERP, VDEC-RMP |
| Basin-wide | All towns | All waters Land erosion, nutrients | Land erosion, encroachment | Install riparian buffers and enhance nutrient management on agricultural land | Farm assessments | NRCS, VAAFM, UVM extension, BCCD |
| Basin-wide | All towns | All waters | Land erosion, nutrients | Identify and implement needed BMPs for agricultural fields identified as at moderate to high risk for erosion. | DEC Erosion and Sediment Source Risk Maps | NRCS, VAAFM, UVM extension, BCCD |

**Table 16. Implementation Table**

## General Watershed Strategies

**Goal:** Manage streams throughout Basin 1 towards dynamic equilibrium

**Objective:** To project and conserve the riparian corridor and preserve floodplains in (or restored to) their natural state to provide functions related reducing the number and severity of floods, helping handle stormwater runoff, minimizing non-point water pollution and storing sediment and understanding the importance values and aesthetics of floodplains.

**1). Recommendation:**

Complete River Corridor Plans for the Hoosic (mainstem), Walloomsac, Batten Kill Tributaries and sub-watersheds.

**Lead Agency/Organization**: VDEC, BCRC, BCCD
**Partners:** Towns in the basin, VDEC River Management Program
**Potential funding sources:** ERP/ CWIF
**Time frame**: Ongoing

**2). Recommendation**:

Work with towns and the Bennington Regional Planning Commission to strengthen riparian and river corridor protection language in town plans and zoning regulations:

**Lead Agency/Organization**: Bennington Regional Planning Commission, Local Municipalities
**Partners:** Towns in the basin, VTDEC – Water
Quality Division Planning
**Potential funding sources:** 604(b), VCWA
**Time frame**: Ongoing
**Benchmark:** Strengthen riparian protection language in town plans and zoning regulations for towns in the Basin

**3). Recommendation:**

Educate the general public about the importance and interconnected nature of managing our watersheds towards stream equilibrium.

**Lead Agency/Organization**: BCRC, BCCD, BKWA, HooRWA
**Partners:** Vermont DEC River Management Program

**Potential funding sources:** 604(b), VCWA
**Time frame**: Ongoing
**Benchmark:** Adoption & Enforcement of Model FEH Ordinance

**4). Recommendation:**

Restore dynamic equilibrium to county watercourses by implementing the proposed targeted projects in the river corridor plan

**Lead Agency/Organization**: BKWA, HooRWA, BCCD, VANR
**Partners:** Vermont DEC River Management Program
**Potential funding sources:** ERP/ CWIF
**Time frame**: Ongoing
**Benchmark:** Number of implementation projects

**5). Recommendation:** Adopt FEH/River Corridor ordinances in towns throughout Basin

**Lead Agency/Organization**: BCRC, BCCD, Local Municipalities
**Partners:** Vermont DEC River Management Program
**Potential funding sources:** 604(b), VCWA
**Time frame**: Ongoing
**Benchmark:** Number of communities adopting & enforcing FEH

**6). Recommendations:** Approach individual landowners about protecting river corridor, purchase easements and protect existing floodplains.

**Lead Agency/Organization**: BKWA, HooRWA, BCCD
**Partners:** Vermont ANR, VLT, TNC, TPL
**Potential funding sources:** ERP/ CWIF
**Time frame**: Ongoing
**Benchmark:** Number of River Corridor partners

**Protecting, Preserving and Maintaining Lakes and Pond**

Vermont's lakes and ponds are beautiful recreational resources as well as critical elements in the ecology and habitat of the State. Keeping them in good shape, or restoring them, involves attention to a myriad to actions of people on the landscape. All those who live, work or play on the shores or in the watersheds of lakes have an important responsibility to take steps to minimize their impact on the lake, whether it be replanting the shoreline, preventing soil erosion or practicing eco-friendly lawn care.

**Objective:**

Comprehensive lake protection or restoration depends on managing whole watersheds and diverse land uses, and influencing individual behaviors.

**Goal:** Protect natural lake shorelines from unplanned development and encourage better management of highly developed lake shorelines. Minimize adverse land use activities in lake watersheds, within the lake shoreline, and within lakes and ponds themselves

**7). Recommendation:** Map wilderness, wilderness-like and undeveloped lake and pond shorelines. Comprehensive mapping of undeveloped shorelines will be essential in development of protection actions of these areas

**Lead Agency/Organization**: BCRC, BCCD,
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants, 604(b)
**Time frame**: Ongoing
**Benchmark:** Number of shorelines mapped and identified

**8). Recommendation:** Review regional and town plans and zoning bylaws information relating to lake protection issues– Identify towns in basin with inadequate protection as plans and bylaws come up for review and revision. Much water resource protection will occur at the municipal level as Vermont does not have statewide shoreline protection. Through the on-going local planning and zoning processes, town programs can be updated to provide increasing protection of valuable shoreline resources.

**Lead Agency/Organization**: BCRC, VLCT,
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants, 604(b)
**Time frame**: Ongoing
**Benchmark:** Number of towns/municipalities increasing language in planning documents

**9). Recommendation:** Conduct lake watershed surveys in selective watershed lakes and ponds to identify nonpoint sources of pollution and the actions needed to control them. Conduct Lake and Watershed Surveys and develop a plan including a list of non-point source problems in need of addressing, education needs, and town program needs. Correct identified non-point source problems through demonstration or implementation projects.

**Lead Agency/Organization**: BCCD, HooRWA, Lake Association
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants
**Time frame**: Ongoing
**Benchmark:** Number of surveys done

**10). Recommendation:** Promote regular maintenance of lakeshore camp septic tanks. Encourage lake homeowners to pump out septic systems on a regular basis. Inadequate and failing lakeshore septic systems can contribute to discharges of phosphorus and E. coli to adjacent waterways

**Lead Agency/Organization**: Lake Association, Towns/Municipalities
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants
**Time frame**: Ongoing
**Benchmark:** Number of camp owners regularly pumping septic

**11). Recommendation:** Conduct camp/landowner education, shoreline property management workshops, outreach to new lake and pond landowners.

**Lead Agency/Organization**: BCCD, Lake Association
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants
**Time frame**: Ongoing
**Benchmark:** Number of events held.

**12). Recommendation:** Initiate the Lay Monitoring Program at lakes where the program has been idle.

**Lead Agency/Organization**: Lake Association, BCCD
**Partners:** Vermont ANR

**Potential funding sources:** Lay Monitoring Program, LaRosa Partnership, Watershed Grants
**Time frame**: Ongoing
**Benchmark:** Number of lake monitoring programs started

**Protecting and Preserving Wetlands**

In Vermont, wetlands are defined as those areas of the state that are inundated by surface or ground water with a frequency sufficient to support plants and animals that depend on saturated or seasonally saturated soil conditions for growth and reproduction. Only 220,000 acres, or 4% of the land area in the state, have been identified as wetland. It has been estimated that since colonial times Vermont has lost more than 35% of its wetland acreage

Vermont's wetlands are extremely important resources that the Agency of Natural Resources and many other concerned groups are seeking to protect. Wetlands are worthy of protection because of the many valuable and irreplaceable functions they provide, which include: flood control, water quality protection, wildlife habitat, recreation opportunities, economic benefits, and erosion control. Since the degree to which a wetland serves these functions varies, many wetlands are needed to work in combination with each other as part of a complex, integrated system.[10]

**Goal:** Maximize wetland functions as they relate to water quality

**Objective:** Use watershed plan to protect and preserve wetland functions

**13). Recommendation:**

Design, Study and Implement the Center for Watershed Managements recommendations for protecting wetlands through watershed planning.

Including:

1). Compile Wetland Information on a Watershed Basis
2). Create an Inventory of Wetlands in the Watershed
3). Review existing plans
4). Assess Local Wetland Protection Capacity
5). Identify Wetland Partners and Roles
6). Define Wetland Goals and Objectives for the Watershed
7). Define specific wetland objectives

10 STATE of VERMONT, Governors Clean and Clear Action Plan: Clean and Clear Stormwater Education: http://www.anr.state.vt.us/cleanandclear/SWed.htm

8. Identify historic wetlands coverage
9). Determine wetland functions
10). Determine individual wetland condition
11). Project effects of future land use changes on wetlands
12). Identify wetlands that fall outside of Federal and State jurisdiction
**Lead Agency/Organization**: BCCD, BCRC, BKWA, GMNF, HooRWA
**Partners:** Vermont ANR
**Potential funding sources:** Vermont Watershed Grants
**Time frame**: Ongoing
**Benchmark:** Identification and assessment of wetlands

## Watershed Projects and Assessments Completed by ANR and/or its Partners during the Planning Process

DEC recognizes that several important projects were completed during the planning process by DEC's watershed partners, either independently or with DEC support. The projects include:

### The Roaring Branch Restoration Project in Bennington

The Rivers program, in partnership with the Town of Bennington, completed Phase I and Phase II of a large flood plain restoration project along the Roaring Branch. Bennington is situated in a particularly hazardous location on an alluvial fan at the foot of the Green Mountains. The Roaring Branch is a tremendously dynamic and powerful force at times of flood, delivering astounding volumes of boulders, rock and woody debris into the urbanized area. For 150 years or more, this municipality and its residents have struggled with the river, attempting to confine it and control it with a system of earthen berms and structural levees.

Unfortunately, for village residents and town taxpayers, the river has won most of the contests, breaching and then catastrophically avulsing through the berms, inundating residential and industrial areas, and devastating public infrastructure including roads and bridges. Each flood would trigger a spasm of channel dredging and reconstruction of the temporary and inadequately confining structural elements along the channel margins. These channelization practices

did not provide long-term protection of the property and infrastructure behind the berms. Rather, these structures remained extremely vulnerable to the next flood.

In 2008, Bennington formed a partnership with the DEC and initiated a public process to adopt Fluvial Erosion Hazard (FEH) bylaws in which additional development encroachments into currently undeveloped areas of the river corridor are prohibited. The ordinance model and FEH zone map were provided by the Rivers Program. Support for the town selectboard and planning commission through the adoption process was also provided by Rivers Program staff.

In response to the town adoption of the FEH bylaws, the Rivers Program pursued ERP (formerly C&C) funds to design and construct a major flood plain restoration project. This project consisted of removing 3,500 linear feet of earthen berms, involving over 35,000 cubic yards of earth and rock excavation, construction of a new engineered, armored berm set well back from the river, and the restoration of approximately 12 acres of functioning floodplain within a critical area of the village.

The partially completed project was severely tested by Tropical Storm Irene. While the project did receive some structural damage, it otherwise performed as anticipated and, in the opinion of Bennington town officials and DEC, damages in the project area would have been orders of magnitude worse, had the project not been implemented.

The Roaring Branch caused a partial breach of the new armored berm at the transition point where the flood plain narrows from the new restored section to the upstream approach to the Park Street Bridge. This damaged area has since been reconstructed as part of the town flood recovery operations.

Based on pre-project surveyed cross sections, an estimated 550,000 cubic yards of sediment, primarily composed of gravel, cobbles and boulders, was deposited in a one mile reach of the Roaring Branch from the confluence with the Walloomsac River to the VT 9 bridge. This provides a clear indication of how hazardous a situation exists in Bennington where an active alluvial fan through an urbanized area is confined to the width of the river channel, and why the restoration and protection of any overbank portion of the active fan is a critically necessary action for the protection of public safety.

The Watershed Management Division has been working with the Town of Bennington and its engineering consultants, Milone & MacBroom to excavate a large percentage of the sediment, to remove the confining berms and to extend and complete the designed flood plain restoration project up to the Branch Street, or 'Brooklyn" bridge.

List of Acronyms:

| | |
|---|---|
| 319 | Federal Clean Water Act, Section 319 |
| 604(b) | Federal Clean Water Act, Section 604b |
| AAFM | Agency of Agriculture, Food, and Markets |
| AAPs | Accepted Agricultural Practices |
| AEM | Agricultural Environmental Management |
| AEP | American Electric Power |
| AMA | Agricultural Management Assistance Program |
| AMPs | Acceptable Management Practices (for logging) |
| ANR | Agency of Natural Resources |
| ANS | Aquatic Nuisance Species |
| AOP | Aquatic Organism Passage |
| ARS | Agricultural Resource Specialists |
| BASS | VDEC Biomonitoring and Aquatic Studies Section |
| B&C | Bridge and Culvert |
| BBR | Better Backroads |
| BCCD | Bennington County Conservation District |
| BCRC | Bennington County Regional Commission |
| BKWA | Batten Kill Watershed Alliance |
| BMP | Best Management Practices |
| CCPI | Cooperative Conservation Partnership Initiative |
| CRP | Conservation Reserve Program |
| CREP | Conservation Reserve Enhancement Program |
| CWIP | Clean Water Initiative Program (CWIF – Clean Water Initiative Fund) |
| CWSRF | Clean Water State Revolving Fund |
| DEC | Vermont Department of Environmental Conservation |
| DFPR | Vermont Department of Forests, Parks and Recreation |

| | |
|---|---|
| DFW | Vermont Department of Fish and Wildlife |
| DPW | Department of Public Works |
| DWSRF | Drinking Water State Revolving Fund |
| EBTJV | Eastern Brook Trout Joint Venture |
| EQIP | Environmental Quality Incentive Program |
| EPA | Environmental Protection Agency |
| ERP | Ecosystem Restoration Program |
| EU | Existing Use |
| FAP | Farm Agronomic Practices |
| FEH | Fluvial Erosion Hazard |
| FERC | Federal Energy Regulatory Commission |
| FPR | Department of Forests, Parks, and Recreation |
| FSA | Farm Service Agency (USDA) |
| GIS | Geographic Information System |
| GSI | Green Stormwater Infrastructure |
| IDDE | Illicit Discharge Detection (and) Elimination |
| LFO | Large farm Operation |
| LID | Low Impact Development |
| LiDAR | Light Detection and Ranging |
| LIG | Local Implementation Grants (LCBP) |
| LIP | Landowner Incentive Program |
| LTP | Land Treatment Planner |
| LWD | Large Woody Debris |
| MAPP | Monitoring, Assessment and Planning Program |
| MFO | Medium Farm Operation |
| NEMO | Nonpoint Education for Municipal Officials |
| NMP | Nutrient Management Plan |
| NEGEF | New England Grassroots Environmental Fund |
| NFWF | National Fish and Wildlife Foundation |
| 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 |

| | |
|---|---|
| (NY) DEC | New York Department of Environmental Conservation |
| 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 |
| SEP | Supplemental Environmental Program |
| SFO | Small Farm Operation |
| SGA | Stream Geomorphic Assessment |
| SPA | Source Protection Area |
| SVNMP | Southern Vermont Nutrient Management Program |
| SWCD (NY) | Soil and Water Conservation District (New York) |
| SWMP | Stormwater master plans |
| TFS | Trees for Streams |
| TMDL | Total Maximum Daily Load |
| TNC | The Nature Conservancy |
| TU | Trout Unlimited |
| USDA | United States Department of Agriculture |
| USDA – NRCS | US Department of Agriculture – Natural Resource Conservation District |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| USFS | United States Forest 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 |
| VANR | Vermont Agency of Natural Resources |
| VCWA | Vermont Clean Water Act |
| VDEC | Vermont Department of Environmental Conservation |
| VDHP | Vermont Department of Historic Preservation |
| VDH | Vermont Department of Health |

| | |
|---|---|
| VEM | Vermont Emergency Management |
| VFB | Vermont Farm Bureau |
| VFWD | Vermont Fish and Wildlife Department |
| VGS | Vermont Geological Survey |
| VHCB | Vermont Housing and Conservation Board |
| VHQW | Very high quality waters |
| 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 |
| VRC | Vermont River Conservancy |
| WWLG | Warm water low gradient |

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## 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.

**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

**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.

**Improved Barnyards** - a series of practices to manage and protect the area around the barn, which is frequently and intensively used by people, animals, or vehicles, by controlling runoff to prevent erosion and maintain or improve water quality. Practices may include: heavy use area protection, access roads, animal trails and walkways, roof runoff management, and others.

**Mesotrophic –** An intermediate level of nutrient availability and biological productivity in an aquatic ecosystem.

**Natural condition** - the condition representing chemical, physical, and biological characteristics that occur naturally with only minimal effects from human influences.

**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.

**Riparian vegetation** - the native or natural vegetation growing adjacent to lakes, rivers, or streams.

**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.

**Thermal modification** - the change in water temperature

**Turbidity** - the capacity of materials suspended in water to scatter light usually measured in Jackson Turbidity Units (JTU). Highly turbid waters appear dark and "muddy."

**Waste Management System** -a planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas and silage leachate, in a manner that does not degrade air, soil, or water resources. The purpose of the system is to manage waste in rural areas in a manner that prevents or minimizes degradation of air, soil, and water resources and protects public health and safety. Such systems are planned to preclude discharge of pollutants to surface or ground water and to recycle waste through soil and plants to the fullest extent practicable.

**Water Quality Standards** - 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).

## Hudson River Basin Plan Appendices

Appendix A. Existing Use Tables

Appendix B. Review of Town Plans and Zoning Regulations

Appendix C. Lakes and Ponds Assessment for the Hudson River Basin

Appendix D. Detecting and Eliminating Illicit Discharges in Rutland County to Improve Water Quality

Appendix E. Vermont's Agricultural Environmental Management (AEM) Program for the Hudson River Basin

Appendix F. Medium and High Priority Basin Class 4 Road Sites for Restoration

Appendix G. Hudson River Basin River Corridor Planning Summaries and High Priority Project Recommendations

Appendix H. Regulatory and Non-regulatory Programs that contain BMPs Applicable to Protecting and Restoring Waters in the Hudson River Basin

Appendix I. Hudson River Basin Plan Public Comments and Responsiveness Summary

## Appendix A – Existing Use Tables

| Surface Water | Location of Use | Watershed | Town | Documentation of Existing Use |
|---|---|---|---|---|
| Batten Kill | Mainstem | Batten Kill | All towns | Popular flatwater boating river |
| Mad Tom Brook | From just west of Dorset and Peru town line | Batten Kill | Dorset | Archives VPC trip reports |
| Little Mad Tom Brook | From just west of Dorset and Peru town line | Batten Kill | Dorset | Archives VPC trip reports |
| Bourn Brook | Off of TH 26 east if the town line | Batten Kill | Winhall and Manchester | http://www.nicholasgottlieb.com/2013/11/13/bourne-brook/ |
| Lye Brook | Entire Lower Gorge | Batten Kill | Sunderland and Manchester | Archives VPC trip reports |