

# **Basin 10 Water Quality Management Plan**

**Ottawaquechee River  
& Black River**

**Vermont Agency of Natural Resources**

**May 2012**

A component of the

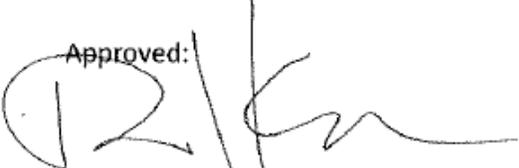


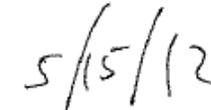
*Cover photo:* White Current Dam and Covered Bridge, North Hartland



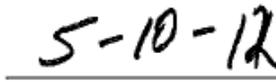
**Agency of Natural Resources**  
**Department of Environmental Conservation**  
**Watershed Management Division**  
**1 National Life Drive, Main 2**  
**Montpelier, VT 05620-3522**

THE WATER QUALITY PLAN FOR THE OTTAUQUECHEE RIVER AND BLACK RIVER, BASIN 10 WAS PREPARED IN ACCORDANCE WITH 10 V.S.A. § 1253(d), THE VERMONT WATER QUALITY STANDARDS, THE FEDERAL CLEAN WATER ACT AND 40 CFR 130.6, WITH THE EXCEPTION OF THE INCLUSION OF WATER MANAGEMENT TYPING RECOMMENDATIONS.

Approved:   
David Mears, Commissioner  
Department of Environmental Conservation

  
Date

  
Deborah Markowitz, Secretary  
Agency of Natural Resources

  
Date

The Vermont Agency of Natural Resources is an equal opportunity agency and offers all persons the benefits of participating in each of its programs and competing in all areas of employment regardless of race, color, religion, sex, national origin, age, disability, sexual preference, or other non-merit factors.

This document is available upon request in large print, Braille or audiocassette.

VT Relay Service for the Hearing Impaired  
1-800-253-0191 TDD>Voice - 1-800-253-0195 Voice>TDD

# Basin 10

Elevation Model  
High: 4381  
Low: 69



# Basin 10 Towns

## Black River

Andover\*  
Baltimore  
Cavendish  
Chester  
Ludlow  
Mount Holly  
Plymouth  
Reading  
Shrewsbury  
Springfield  
Weathersfield  
West Windsor\*

## Ottauquechee River

Barnard  
Bridgewater  
Hartford  
Hartland  
Killington  
Mendon\*  
Plymouth  
Pomfret  
Reading  
Shrewsbury  
Stockbridge\*  
Woodstock

\* Towns with < 3 sq. mi. in Basin 10





# Table of Contents

Chapter 1	Introduction to Basin 10 Planning.....	9
Chapter 2	Description of Basin 10 .....	15
Chapter 3	Uses and Values of the Black and Ottauquechee Rivers .....	17
Chapter 4	Specific Waters with Water Quality Concerns.....	25
Chapter 5	Impaired Waters and Emerging Problems .....	35
Chapter 6	Plan Implementation – Resolving State and Local Water Quality Concerns .....	45
Chapter 7.	Establishing Management Goals for Surface Waters .....	117
List of Acronyms.....		126
Glossary .....		129
Appendix .....		133

***List of Figures:***

***Figure 1.1 – Vermont’s 17 Planning Basins***

***Figure 6.1 – Windsor County Farms and Land in Production.***

***List of Tables:***

- TABLE 4.1 - Causes of Impacts or Threats to Basin 10 Rivers and Streams**
- TABLE 4.2 - Sources of Impacts or Threats to Basin 10 Rivers and Streams**
- TABLE 4.3 - Lake Acres Altered or Stressed Due to Causes**
- TABLE 5.1 - 2010 303(d) LIST OF WATERS, PART A**
- TABLE 5.2 - PART D. SURFACE WATERS WITH COMPLETED AND APPROVED TMDLs**
- TABLE 5.3 - 2010 LIST OF PRIORITY SURFACE WATERS OUTSIDE THE SCOPE OF CLEAN WATER ACT SECTION 303(d) PART C**
- TABLE 6.1 - Windsor County: Farms and Farmland**
- TABLE 6.2 - River Corridor Protection Opportunities for the Black River Main Stem and Tributary Reaches Ranked Very High**
- TABLE 6.3 - Highest Priority Bridge & Culvert Structure Replacements Black River Main Stem and Tributary Reaches**
- TABLE 6.4 - Bridge and Culvert Crossings on Patch Brook and Buffalo Brooks Ranked High Priority for Replacement**

# **A Vision For Basin 10**

**The waters and lands of the Black and Ottawaquechee River watersheds will be of sufficient quality to support the people, wildlife and landscape uses that we value most.**

**The Basin 10 Watershed Council has identified these as:**

- canoeing, kayaking, and other boating
  - swimming in clean fresh water
- fishing, particularly for trout and cold water species
  - enjoying lakes and ponds
  - enjoying diverse aquatic wildlife habitat
- family enjoyment of the outdoors & recreational areas
  - aesthetic enjoyment & tourism benefits of rivers, streams, lakes, ponds and wetlands
- preservation and use of natural and water resources
  - snowmaking and hydropower
- history & cultural heritage – covered bridges, old mills, old mill ponds

# Executive Summary

## Vermont Agency of Natural Resources Basin 10 Water Quality Management Plan for the Ottauquechee River and Black River

Basin 10 consists of two major watersheds in southeastern Vermont - the Ottauquechee River watershed and the Black River watershed. Both rivers flow from the spine of the Green Mountains down into the Connecticut River.

The Basin is currently 93.8% undeveloped land meaning only 6.2% is built. This offers basin residents a myriad of opportunities to protect the water quality, habitat conditions and valued uses of the waterways. The challenge is however, that due to historical settlement patterns a large amount of the developed land is in the valleys and along the waterways. So the land most impacted by development is the same land most critical to water quality and aquatic habitat condition.

This Water Quality Management Plan attempts to make clear, attainable recommendations for actions to improve and protect these waters and offer strategies to achieve them. The recommendations and strategies are meant to spark actions by the State and collaborating partners, municipalities, private organizations, and individuals to work on watershed issues.

The most prevalent and pressing community and State concerns regarding surface water quality are addressed. The goal being to help communities decide how to restore waters most affected by polluted run-off and protect waters and adjacent areas threatened by pollution. Local concerns for water quality, uses and values have been identified and issues have been prioritized and discussed to assist local planners and decision-makers in directing available funding resources toward environmentally and economically sound implementation strategies.

Far beyond any other recommendation made during the planning process, none was more strongly emphasized than the need for **riparian buffers**. It is clearly understood by watershed council members that the lack of buffers is a major cause of water quality and habitat problems in the Basin, and that the simplest, most efficient and most cost effective way to improve and protect surface water quality is to implement coordinated buffer improvements throughout the Basin. The Plan Implementation Table identifies areas where restoration of buffers is in keeping with geomorphic assessments and known adjustment processes.

Of the nine waters known to be in need of further assessment, seven have **sediment** as the suspected pollutant. Silt and sediment are by far the most visible causes of water quality problems noted in the Basin and impact over thirty miles of river and 132 lake acres.

Impacts from **flow alteration** at the eighty-nine dams in the Basin cause stress to rivers and streams. Forty-two dams are in use for hydroelectric power generation, flood control, recreational lake impoundments, water supply reservoirs and other purposes. Many of the remaining dams however are obsolete and serve no current purpose. Their presence in rivers and streams blocks aquatic organism passage, prevents sediment from passing downstream, increases water temperature and causes disequilibrium in the ecological function of the river system.

These pollutants along with **pathogens** and excess **nutrients** are entering rivers from land development, road runoff, removal of riparian vegetation and a number of other sources. Basin lakes face contamination and threats from atmospheric deposition of mercury, metals and acid rain as well as habitat alterations from varying flow levels.

Fortunately there are few impaired waters in the Basin. These include waters impacted by stormwater runoff from resort development, municipal combined sewer overflows and wastewater treatment facilities and landfill runoff. There is even one successful removal of a stream from the impaired waters list. Soapstone Brook in Ludlow was recently de-listed following diligent stormwater management practice implementation in the watershed.

The Watershed Council members offered many recommendations and strategies for water quality improvements, 96 of which are included in the Plan. In selecting the ten most important recommendations to focus on, priority falls on those that immediately address threats to humans and our build environment and those that can remedy significant environmental threats.

### **Top 10 Recommendations**

- Complete a full set of River Corridor / Fluvial Erosion Hazard (RC/FEH) & Special Flood Hazard (SFH) area maps for Basin 10.
- Provide outreach to select boards, zoning administrators, planning commissions, etc. on planning and zoning strategies for minimizing encroachments into River Corridor and SFH areas.
- Plan for the future of current infrastructure in the hazard zones.
- Breach or remove the Springfield Reservoir Dam in Weathersfield which has been listed as being in Poor Condition or Damaged since 1969.
- Prevent further buffer loss. Preserve and enhance existing buffers. Focus areas include: No. Branch Black, Twenty Mile Stream, Barnard Brook and the main stem of the Black and Ottauquechee.
- Control invasive plants in riparian buffers to allow native woody vegetation to become established.
- Maintain and expand bacteria monitoring program to cover the entire Basin, focus on locations where contact recreation commonly occurs.
- Work with local groups to locate hazardous materials left behind by TS Irene and coordinate their removal.
- Increase awareness of Non-point Source Pollution and the Accepted Agricultural Practices within the equine community, with special focus on Kedron Brook.

- Work with towns to address the highest priority bridge and culvert structures for replacement as identified in the Black River Corridor Plan, including re-sizing culverts to better accommodate flood-flows.

The river's physical stability and habitat, especially after the havoc caused by recent intense storm events, must also be addressed. Through geomorphic assessment work river corridor protection plans have been developed or are in progress. Opportunities for watershed protection whether through active restoration practices or riparian and corridor protection should be seized upon when the occasions present themselves. Land along these waterways is under constant threat of encroachment such as development, roadways, agriculture and myriad other demands for human occupied space. It is imperative that rivers be provided the room they require to reach or maintain a stable state of fluvial geomorphic stability.

The completed Black River Corridor Plan identifies locations in Ludlow, Cavendish and Weathersfield where opportunities for river corridor protection exist that, if protected from further development or channelization, can provide room for river channel movement to occur and floodwaters to access floodplains. If protected, these pockets of open space can act as natural pressure relief valves for a raging river shielding downstream areas from erosion damage.

Protection of waters that remain in excellent condition is a priority to insure they are not degraded by future actions. Recommendations for protection of these ecologically important resources for their water quality, the habitat and aquatic life they support and the significant special features they possess are proposed for re-classifications and possible Outstanding Resource Water (ORW) designation.

**Waters that consistently exceed Water Quality Standards include Tinker Brook, the Ottauquechee North Branch, and Patch and Jewell Brooks.**

ORW potential exists at Cavendish Gorge, Buttermilk Falls, Lake Ninevah and Woodward Reservoir. Re-classification of two wetlands to Class 1 is recommended as they meet all the Class 1 criteria, these are Totman Hill fen in South Pomfret and Eshqua Bog in Hartland.

Restoration of impaired and threatened waters and habitats, partnered with protection of high quality waters and ecologically significant areas, will yield a future watershed condition supportive of the functions and values expressed by the local community and the State mandate to protect and enhance the natural resources of Vermont for current and future generations.

The Basin 10 Water Quality Management Plan aspires to further these desires.



# Chapter 1 Introduction to Basin 10 Planning

## Basin 10

**Basin 10** consists of two major watersheds in southeastern Vermont - the Ottauquechee River **watershed**<sup>1</sup> and the Black River watershed. Both rivers flow from the Green Mountain range near Killington peak down to the Connecticut River, the Black meeting it at Hoyt's Landing in Springfield and the Ottauquechee reaching it in North Hartland.

The Ottauquechee River has a mainstem length of 38 miles and drains an area of 223 square miles and the Black River, with a mainstem length of 40 miles, drains an area of 202 square miles. There are 19 lakes and ponds in the Basin that are 20 acres or larger covering approximately 1,610 acres. The North Springfield Reservoir, North Hartland Reservoir, Echo Lake, Lake Rescue, Lake Ninevah and Woodward Reservoir are the largest bodies of water in Basin 10, each being at least 100 acres in size.

The Basin is currently 93.8% undeveloped land while only 6.2% is built. This offers basin residents a myriad of opportunities to protect the water quality, habitat conditions and uses of the waterways. The challenge is however, that due to historical settlement patterns a large amount of the developed land is in the valleys and along the waterways. So the land most impacted by development is the same land most critical to water quality and aquatic habitat condition.

## Purpose of This Basin Plan

The Basin 10 Water Quality Management Plan looks at the current condition of the two watersheds and lays out recommendations and strategies that will guide the Agency and surface water partners in managing these **waters** to further improve water quality and to protect and enhance the resources and uses the community values. Swimming, fishing, boating, wildlife and scenic enjoyment, and snowmaking and hydropower are all identified by watershed residents as important uses.

Each Basin Plan must spell out clear, attainable goals and tailor strategies to achieve these goals. The goals must be stated for the Basin as a whole and for the individual watersheds. The recommendations and strategies in this plan are meant to spark actions by the State and collaborating partners, municipalities, private organizations, and individuals to work on watershed issues.

Vermont Agency of Natural Resources (VANR) programs will use the solutions and strategies in this plan to guide decisions regarding allocation of technical and financial resources. In addition, VANR's review of permit applications for potential impact to water resources is directed by the management goals for State surface waters adopted during this planning process.

---

<sup>1</sup> **Bold** references are defined in the Vermont Surface Water Management Strategy Glossary, [http://www.vtwaterquality.org/wqd\\_mgmtplan/swms\\_glossary.htm#eco](http://www.vtwaterquality.org/wqd_mgmtplan/swms_glossary.htm#eco).

In general, a basin plan provides an overview of a watershed's health and a description of the prospective and ongoing steps to restore and protect its **waters**. In the Basin 10 planning initiative the Ottauquechee Natural Resources Conservation District (ONRCD), the Southern Windsor County Regional Planning Commission (SWCRPC) and the Two Rivers Ottauquechee Regional Commission (TRORC) in a cooperative effort with the VANR, specifically its Department of Environmental Conservation (VDEC), have involved a wide range of stakeholders to develop a document purposefully designed to help maintain and improve surface water quality for the two watersheds.

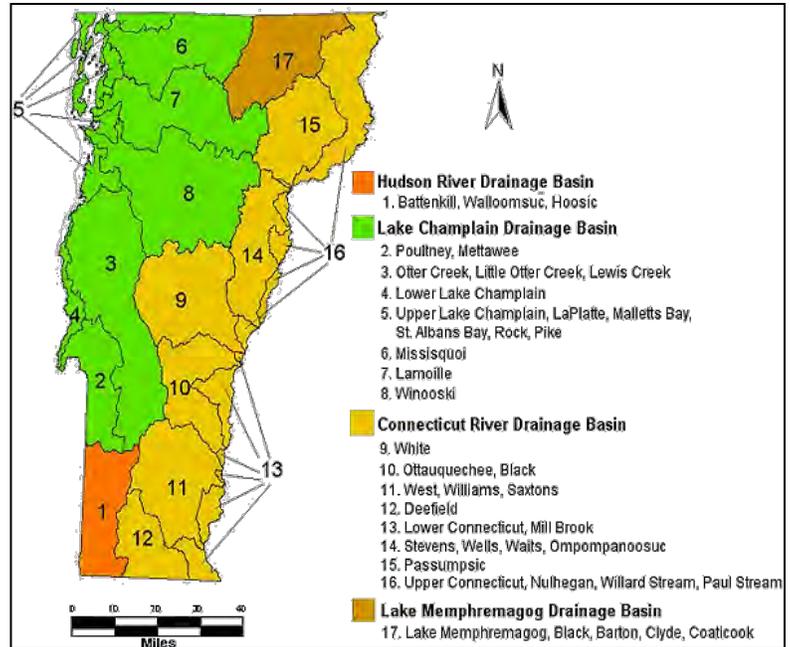


Figure 1.1 – Vermont's 17 Planning Basins

The Basin 10 Management Plan addresses the basin community's and the State's most prevalent and pressing concerns regarding surface water quality. The basin plan helps communities decide how to restore waters most affected by polluted runoff and protect waters and adjacent areas threatened by pollution. Local concerns for water quality, uses and values have been identified and issues have been prioritized and discussed to assist local planners and decision-makers in directing available funding resources toward environmentally and economically sound implementation strategies.

## Planning at the Watershed Level

A watershed, or basin, is a distinct land area that drains into a particular waterbody either through channel flow or surface runoff. Preparing a water quality management plan at a watershed level allows for the consideration of all contributing **sources** of surface water **runoff** to the waterbody.

The Agency has conducted water quality assessment and improvement efforts at a watershed level since the 1970s. The state is divided into 17 planning basins for this purpose, with each basin including one or more major river watersheds (Figure 1.1). The Agency is responsible for preparing basin plans for each of the 17 major basins and updating them every five years after the plan is adopted.

## The Basin Planning Process

The basin planning process is described in the Vermont Watershed Initiative Guidelines for Watershed Planning, 2007 prepared through a collaboration of a public Statewide Watershed Framework Committee and the Vermont Department of Environmental Conservation (VDEC). It is also part of the overarching Vermont Surface Water Management Strategy<sup>2</sup> (SWMS) which is the Watershed Management Division's statewide plan for the management of Vermont's surface waters.

Basin planning is an on-going process designed to be compatible with the **Vermont Water Quality Standards** (WQS) and other applicable state and federal laws. In general, the planning process serves to integrate topics of special local concern with topics of special state importance, and make management recommendations on these topics.

The State basin planning process includes the following steps:

- 1) Issue identification and prioritization
- 2) Strategy and solution development
- 3) Allocation of resources and funding, and
- 4) Implementation

As specified in the Guidelines, the planning process is meant to occur on a five-year cycle, incorporating planning, implementation, monitoring and evaluation. About every fifth year, the renewed plan will steer a continually evolving course of watershed improvement activities for Basin 10.

Future iterations of the Basin 10 Plan will follow the Tactical Plan<sup>3</sup> format designed as part of the SWMS. Tactical plans will contain objectives, prioritized strategies, benchmarks and tasks for priority basins and sub-basins where there are the most serious water quality problems or where surface waters in excellent condition and valuable aquatic features exist that deserve greater protection. Tactical Basin Plans will rely on the SWMS for background information about surface water stressors and pollutants, and the programs and efforts underway statewide and across all basins to address them. The reader is encouraged to review the SWMS at <http://www.vtwaterquality.org/swms.html>. In the body of this Basin 10 Plan, the reader will note links to information contained in the SWMS, including detailed descriptions of pollutants, impacts of landscape activities on the integrity of surface waters, and relevant regulatory, technical assistance, and funding programs. Consistent with the intent of Tactical Basin Planning, the implementation tables in this Plan (Chapter 6) will be continually updated as new information about Basin 10 surface water issues or implementation actions are brought to light.



In the spring of 2007, the Agency sent out an open invitation through press releases, calendar listings and through local organizational partners, to the community throughout Basin 10, to participate in the development of a water quality management plan. The community members that came together as a watershed council represented a diverse mix of stakeholders from within the basin. They included

---

<sup>2</sup> Vermont Surface Water Management Strategy: <http://www.vtwaterquality.org/swms.html>

<sup>3</sup> Tactical Basin Planning: [http://www.vtwaterquality.org/wqd\\_mgtplan/swms\\_ch4.htm](http://www.vtwaterquality.org/wqd_mgtplan/swms_ch4.htm)

farmers, foresters, business owners, municipal officials, resort industries, anglers, local watershed and lakeshore organizations, environmental groups, teachers, and regional planners.

Beginning in early 2008 a steering committee made up of the VDEC Watershed Coordinator, the two regional planning commissions and the Natural Resources Conservation District in the Basin began forming a strategy for developing the Basin 10 plan. Initial public forums held in the spring of 2008 gathered input from the basin community on the uses and values they wanted the plan to protect.

The steering committee expanded to include the two active watershed groups the well-established Black River Action Team (BRAT) and the newly formed Ottauquechee River Group (ORG). These organizations provide invaluable local connections and landowner involvement in the planning process.

Full watershed council meetings began in June of 2008. Each meeting addressing a topic the council members wanted more information on and developing recommendations for the plan from each discussion. These recommendations were refined and prioritized, strategies and actions have been developed to turn each recommendation into an action that can be implemented by interested organizations.

## **Implementing the Plan**

Since Partners were already aware of some project work that needed to be done, implementation of the Basin Plan began at the same time the planning process began. Partners immediately sought funding to begin efforts to protect and improve water quality. Implemented and on-going projects are described in Chapter 5.

The Basin 10 Water Quality Management Plan serves:

- as a guide for the VANR, the U.S. Environmental Protection Agency (USEPA) and other federal, state, and local agencies in their efforts to protect and improve State waters to the level required by the Vermont Water Quality Standards;
- as a guidance document for collaborating partners, as well as any individual or group that works on watershed issues; and
- as a record of the current state of the basin and the uses and values of the waters.

Watershed groups and interested parties will be able to use the information in the plan to:

- improve their understanding of the watersheds and water-based resources and promote watershed education efforts;
- consider and implement project ideas related to water quality or water resources;
- identify technical or financial resources for project implementation;
- identify the technical or financial needs of potential partners;
- support grant proposals;
- provide guidance to local and regional planning and zoning processes;
- provide guidance to state land use regulatory processes.

## The importance of basin planning in the face of Tropical Storm Irene

Tropical Storm Irene concentrated six to ten inches of rain on the narrow river valleys of Basin 10. With soils already saturated from a wet August, the rivers quickly filled to capacity and rose into and beyond their recognized floodplains. With so much standing in their paths, the massive energy, ripped out roads, bridges, culverts and buildings. While all areas of Vermont experienced the storm, Basin 10 is one of the hardest hit areas in the state.

The Ottauquechee River discharged over 4000 cubic feet per second (cfs) of water at North Hartland, over ten times its normal flow rate. Similarly the Black River at North Springfield reached 4000 cfs, thirteen times greater than normal.<sup>4</sup>

We can expect to see the intensity and extensiveness of these storms repeated in the future with greater frequency as Vermont's climate warms, so the Agency of Natural Resources has been considering how we can best adapt to protect the most vulnerable resources, areas, and sectors in the state through an adaptation plan<sup>5</sup>. Much of the adaptation plan's white paper on water resources focuses on preparing for a greater frequency of intense rain events which is also reflected in strategies listed in the Vermont Surface Water Management Strategy<sup>6</sup> as well as the Basin 10 plan. All three of these documents address the loss of the natural landscape to urbanization and increased runoff from developed lands, improving infrastructure to handle more intense storms (such as increasing the size of culverts), and most importantly, minimizing conflicts with the river corridor which together can reduce the impacts from future flood events.

Faced with what we have learned from Irene, it is in our financial, ecological and human safety interests to rebuild in ways that will reduce damages from the next storm. Development and implementation of hazard identification and mitigation plans are part of the solution and the Agency, regional planning commissions and other partners will provide assistance to communities to produce robust plans to reduce conflicts with rivers and improve infrastructure, in particular culverts must be able to handle these greater flows. We must also consider fluvial geomorphic principals when rebuilding our infrastructure adjacent to rivers. To paraphrase Barry Cahoon, stream alteration engineer for the Agency of Natural Resources;

*We cannot isolate ourselves from rivers, confine rivers to where we perceive they are "supposed to be, belong, or always were", or ignore the message we have been given, that the rivers often need the space we have chosen to take away from them. With all that we have invested over generations, in our homes, our commerce, and our public infrastructure, we have created tremendous conflict with the physical imperatives of rivers when rivers are energized by storm events, now of increasing frequency and magnitude. Some strategic separation and confinement of these incredibly powerful and dynamic natural systems is needed to protect these investments, but this work must be done in a way that embraces an informed recognition and implementation of fluvial conflict reduction options for the benefit of this and future generations, and the rivers themselves.*

Concerns have been expressed regarding the removal of large amounts of gravel from rivers for reconstruction work. For more information on gravelling impacts and practices see:

- [Stream Gravel Removal Policy](#)
- [River Gravel Excavation: When, Why and Where it Should or Should Not Be Done](#)

---

<sup>4</sup> Flow rates may be influenced by flood control dams

<sup>5</sup> <http://www.anr.state.vt.us/anr/climatechange/Adaptation.html>

<sup>6</sup> <http://www.vtwaterquality.org/swms.html>



## Chapter 2 Description of Basin 10

The two watersheds that make up Basin 10 - the Ottauquechee River watershed and the Black River watershed – begin on the eastern flank of Killington and Pico peaks. Both rivers flow into the Connecticut River. Most of the Black and Ottauquechee Rivers' drainage is located in Windsor County, but the basin also includes lands in Rutland County. Following are brief descriptions of each of these two major rivers and their significant tributaries.

### Ottauquechee River Watershed

The Ottauquechee River has a mainstem length of 38 miles and drains an area of 223 square miles in east central Vermont. It originates on the eastern slopes of the Green Mountain Range in the town of Killington in Rutland County from its source northwest of Kent Pond. Its major headwater stream is Roaring Brook.

The Ottauquechee River flows to its confluence with the Connecticut River, at the northern extremities of North Hartland village. The North Branch, Broad Brook, Pinney Hollow Brook, Barnard Brook and Kedron Brook, are its major tributaries.

### Black River Watershed

The Black River, which has a mainstem length of 40 miles, is formed at the outlet of Black Pond in the town of Plymouth. With its tributaries, the Black River drains an area of 202 square miles in Rutland and Windsor Counties.

From its source at the outlet of Black Pond, the Black River flows through Lakes Amherst, Echo and Rescue and forms Lake Pauline (Reservoir Pond). The tributaries Patch Brook, Branch Brook, Jewell Brook, Twenty Mile Stream, the North Branch, and Great Brook join it before it enters the Connecticut River at Hoyt's Landing in Springfield.

### Lakes and Ponds

There are a total of 19 lakes and ponds of 20 acres or larger in the Ottauquechee and Black River Basins totaling approximately 1,610 acres. North Springfield Reservoir, North Hartland Reservoir, Lake Rescue, Lake Ninevah, Woodward Reservoir and Echo Lake are the largest bodies of water in Basin 10, each being at least 100 acres in area. Others of note include Amherst Lake, Stoughton Pond, Deweys Mill Pond, Lake Pinneo, the Knapp Brook ponds, Colby Pond, Black Pond, Lakota Lake and the Pogue.

Several deserve mention for their special features.

**Black Pond**, Plymouth: This 20 acre private pond constitutes the headwaters of the Black River. Despite being relatively close to VT Route 100, it has a secluded feeling, and the majority of the shoreline is forested. There exists an unusual cluster of boulders on the shoreline which provide for scenery of statewide significance.

**Echo Lake**, Plymouth: This 104 acre lake has supported two rare native species of watermilfoil: *Myriophyllum alterniflorum*, which was last observed in 1985, and *M. farwelli*, which was last seen in 1990.

**Kent Pond**, Killington: At one time, 99 acre Kent Pond was characterized by poor water quality, with algae growth identified throughout the pond. However, recent assessments show far better water quality conditions and decreased spring phosphorus levels. It does however host a Eurasian watermilfoil population.

**Woodward Reservoir**, Plymouth: This impounded lake has an adjacent palustrine wetland characterized by a floating bog mat. This is a significant feature, and is rare in the Black and Ottauquechee River Basin.

**Lake Ninevah**, Mount Holly: This 171 acre, high elevation lake is significant for a variety of reasons. While the lake is developed along approximately one third of its northern shoreline, the remainder is undeveloped forested land. The watershed of the lake is also completely forested. The southern portion of the lake is bordered by a 56 acre wetland which has significant habitat value for both wildlife and other aquatic biota. Indeed, the lake is a long-term loon (*Gavia immer*) nesting site. In 1986, the rare watermilfoil *M. farwelli* and the rare pondweed *Potamogeton obtusifolius* were also observed.



Photo courtesy of C. Beresin

**The Pogue**, Woodstock: This small 11 acre pond has become part of the Marsh-Billings-Rockefeller National Historic Site, and as such is now under the protection and stewardship of the National Park Service.

**Deweys Mills Pond**, Quechee: This impoundment was originally created by construction of a dam on the Ottauquechee River in the early 1900s. In the 1970s, a dike was built to separate the impoundment from the river. The current 56 acre impoundment is managed specifically to support waterfowl and wildlife uses. The pond is characterized by dense **macrophyte** cover, with significant shallow areas. Eurasian watermilfoil has become a problem in the pond, chemical treatment is planned.

## Chapter 3 Uses and Values of the Black and Ottawaquechee Rivers

Humans have been using the Black and Ottawaquechee Rivers and the regions lakes and ponds for thousands of years and although uses over time have changed humans continue to actively “use” these waters. Uses have evolved from the ancient ones of food supply and transportation to historic industrial uses as power generation and waste elimination systems to today’s uses for recreation and aesthetics. While our uses today may seem more benign than the previous set, they are not without their consequences.

In identifying the present uses, watershed council members recognized a myriad of active and passive recreational activities as being important to them, the most prominent being fishing, swimming and boating. But the rivers and their landscapes are also important for the opportunities they create for hiking, wildlife viewing, picnicking, aesthetic enjoyment of the riverscapes, and the history they record on the landscape.

More utilitarian uses remain important as well. Drinking water supplies and groundwater recharge areas remain important as many public water systems share connections with surface water recharge areas. Hydropower production and flood control are important services these rivers provide. Irrigation for agriculture, fire protection and snowmaking water withdrawals, and waste elimination all continue to be surface water uses.

Less obvious but no less important are the broader landscape values such as providing unique habitats - floodplain, wetlands, vernal pools, coldwater and warm water fisheries and other diverse types of habitats and the natural communities that depend on them. Bald Eagles, Great Blue Herons, Spotted Salamanders, and Wood Turtles, to mention a few, all make their homes in and along these waters.

The Basin’s floodplains provide water and debris storage during high water events protecting human life, property and infrastructure. While its **riparian** buffers, trees, shrubs and grasses filter runoff water before it reaches the rivers keeping the waters cleaner and offering wildlife travel corridors between fragmented habitats.

Watershed council members identified the following uses and values of Basin 10 waters and watershed lands and expressed their desire that these be preserved and improved:

- canoeing, kayaking, and other boating
- swimming – “We want the water to be clean!”
- fishing, particularly for trout and cold water species
- lakes and ponds
- bird watching – a habitat free of toxins is important, including a significant Great Blue Heron rookery
- diverse wildlife habitat – aquatic and terrestrial – fish, salamanders, eagles, heron rookery, turtles
- natural resources preservation and use
- forests and forestry
- family enjoyment of the outdoors and recreational areas
- undeveloped areas

- aesthetic & tourism – riverscapes, pastoral landscapes
- history – covered bridges, woolen mills, etc.
- unique quality of life

## Exceptional Uses and Values of the Basin Rivers & Lakes

### Fisheries

Wild trout populations occur in the main stems of both rivers and in most tributaries. Brook Trout tend to dominate streams in more head water areas where forest canopy cover maintains water temperatures suitable to this species. Generally, Brook Trout are replaced by Brown and/or Rainbow trout in streams at lower elevations.

Wild populations require that the habitat meets the needs of all life stages of their development: adult, embryo, fry and juvenile. Regardless of trout species, many aspects of habitat are important, including water temperature, dissolved oxygen, **pH**, water depth and velocity, base flow, cover (refuge habitat), substrate composition, nutrient and pollution levels, and habitat connectivity. Protection, restoration and enhancement of habitat in these waters are essential to maintain abundant and healthy wild trout populations as well as the existing uses of these waters.

Fish species of greatest conservation need (SGCN) occurring in the Black River basin are Brook Trout (naturally reproducing populations) and **anadromous** Atlantic Salmon. Other SGCN that occur in the Connecticut River and have access to the lower Black River (downstream of Lovejoy Dam in Springfield) are Redbreast Sunfish and native anadromous Sea Lamprey and American Shad.

Fish population surveys have been conducted by the Vermont Department of Fish and Wildlife (VFWD) throughout much of the Basin, from 1953 to the present. Data from these surveys support statements made above: (1) wild Brook Trout populations are widely distributed throughout the basin wherever suitable habitat exists; and (2) Brook Trout are generally supplanted by Brown Trout and Rainbow Trout, in the lower elevation streams where suitable habitat conditions are maintained; and (3) sections of the Black River main stem and the North Branch are stocked with trout because the current temperature regime is not suitable for abundant wild populations.

With some exceptions (noted below) angler use of wild trout populations found throughout Basin 10 is managed under general statewide regulations (10 V.S.A. App. § 122. Fish Regulation). Where habitat is not suitable to support sustainable wild trout populations or such populations are not abundant enough

#### A note on Sea Lamprey:

Native Sea lamprey of the Connecticut River basin were extirpated from Vermont about 200 years ago at about the same time anadromous Atlantic salmon and American shad were eliminated from the basin as a result of the construction of dams and the degradation of spawning and nursery habitats. The retrofitting of dams on the river, including the Vernon dam in 1981, restored lamprey access to spawning waters. Currently, sea lamprey spawn in the Connecticut River main stem at least as far upstream as Wilder dam, as well as many of the tributaries along the way, such as the West, Williams, Black and White rivers.

At the present time the sea lamprey population in the Connecticut River basin appears to be on a path to recovery. Unlike the landlocked sea lamprey inhabiting Lake Champlain, the anadromous Connecticut River population does not feed in freshwater and, therefore, does not feed on other Vermont fishes.

to meet angler use, cultured (hatchery) trout may be stocked. Public waters within the basin that have stocked fisheries managed under special regulations (i.e. not statewide general regulations) are:

- Black River from Connecticut River boundary to top of Lovejoy Dam in Springfield.
- Black River along Route 131 in Weathersfield and Cavendish, from Downers Covered Bridge upstream (approximately 4 miles) to the next bridge (Howard Hill Bridge) across the river.
- Stocked waters under general fishing regulations include:
  - Black River, Ludlow
  - Black River, Springfield
  - North Branch, Reading-Cavendish-Weathersfield
  - Great Brook, Chester-Springfield
  - Ottauquechee River, Bridgewater Corners to Taftsville

The following lakes and ponds are stocked with trout. Applicable regulations may be species specific. Most of these waters also support warm water fish species.

- Amherst Lake, Plymouth
- Colby Pond, Plymouth
- Echo Lake, Plymouth
- Kent Pond, Killington
- Knapp Pond No. 1, Reading-Cavendish
- Knapp Pond No. 2, Reading-Cavendish
- Ninevah Lake, Mount Holly
- Rescue Lake, Ludlow
- Stoughton Pond, Weathersfield
- Woodward Reservoir, Plymouth

#### Warm Water Fisheries<sup>7</sup>

- Black River from the Lovejoy Dam in Springfield to its confluence with the Connecticut River
- Deweys Mill Pond, Hartford
- Lake Ninevah, Mount Holly
- Lake Pinneo, Hartford
- North Hartland Reservoir, Hartland/Hartford
- North Springfield Reservoir, Springfield/Weathersfield
- Ottauquechee River from the North Hartland Dam in Hartland to its confluence with the Connecticut River.

---

<sup>7</sup> **Warm water fisheries:** Those that support fish populations able to tolerate water temperatures above 80°F for long periods of time. Typical examples: centrarchid fishes (large and smallmouth bass, sunfishes) and ictalurids (bullheads and catfishes).

## **Swimming**

Swimming holes along both the Black and Ottauquechee Rivers are numerous and well used. Although many areas are used by local residents some sites are distinguished by their long history of use and their popularity.

The Black River hosts Twenty-Foot Hole on the North Branch in Reading, and Buttermilk Falls in Ludlow, on Branch Brook. Also on the Black are Tolles Hill Dam, a USACE recreational area in Perkinsville, and Flat Rock on the Black River opposite Mill Road just north of the Route 106 river crossing in Perkinsville.

The Ottauquechee has popular spots at the Quechee Covered Bridge in Quechee village, the base of the Quechee Gorge, Woodstocker's swimhole along River Road in Taftsville which has a rope swing and at the Elm Street bridge access downtown. Hartland residents use the sandy beach below the Martins Mill Covered Bridge and Harlow Brook at the Harlow Brook Trailhead culvert crossing under Clay Hill Road.

A number of youth summer camps are located on the Basin's lakes, ponds and reservoirs.

## **Boating**

Paddling is popular on both rivers. Especially well run on the Ottauquechee is the reach from West Bridgewater to Woodstock which is documented by VANR as a Highly Important Class II run. The Black River from below the Cavendish gorge to the Upper Falls covered bridge is similarly classified.

The VFWD's Hoyt's Landing access at the mouth of the Black River in Springfield allows for boating access to both the lower Black and the Connecticut rivers. Motorized boating is limited to the mouth of the Black River from Hoyt's Landing and the mouth of the Ottauquechee accessed from the Connecticut River. The USACE provides boat launches at Stoughton Pond via the Plains Road access, North Springfield Lake by way of Maple Street in Perkinsville and at the North Hartland Reservoir providing easy access to the lower Ottauquechee on up to the Quechee gorge. Car top boat rentals are available at Deweys Pond above the gorge which can be used throughout the Ottauquechee River.

## **Wildlife Habitat**

Beyond the expected uses of lakes and ponds in the Basin for recreational swimming, fishing and boating, these waters are providing wildlife habitat for many species of animals and plants.

The following lakes and ponds are known to be providing nesting and/or migration stopover habitat for waterfowl and other birds listed as SGCN in Vermont's Wildlife Action Plan.

### Black River Watershed

- Black Pond – American Black Duck
- Echo Lake – Osprey
- Hoyt's Landing wetland complex – American Black Duck, Blue-winged Teal
- Knapp Brook ponds and wetlands – Common Loon, American Black Duck
- Lake Ninevah – Common Loon, Bald Eagle, American Black Duck, Pied-billed Grebe, Osprey
- North Springfield Reservoir – Bald Eagle, American Black Duck, Osprey

### Ottawaquechee River Watershed

- Dewey’s Mills Pond – Osprey
- Kent Pond – Common Loon, American Bittern, American Black Duck, Pied-billed Grebe, Osprey
- Lake Pinneo – American Black Duck, Pied-billed Grebe, Osprey, Blue-winged Teal
- North Hartland Reservoir – Bald Eagle, Osprey
- The Pogue – American Black Duck
- Woodward Reservoir – Common Loon, American Black Duck, Osprey

Only 11 of the Basin’s lakes and ponds are naturally occurring, six of these have had dams added to increase the size and depth of the lakes.

Black River Watershed	Ottawaquechee River Watershed
Amherst Lake – Plymouth (natural with artificial control)	Lakota Lake – Barnard (natural with artificial control)
Echo Lake – Plymouth (natural)	Line Pond – Barnard (natural with artificial control)
Lake Ninevah – Mt Holly (natural with artificial control)	Macawee Pond – Reading (natural with artificial control)
Reading Pond – Plymouth (natural)	The Pogue – Woodstock (natural with artificial control)
Tiny Pond– Ludlow (natural)	View Pond – Woodstock (natural)
Woodward Reservoir – Plymouth (natural with artificial control)	

### **Exceptional Natural Habitats and Natural Communities**

Four distinct and important natural wetland communities are present in the Basin. These are providing unique habitat features and conditions for water-dependant plant and animal populations.

**Dwarf Shrub Bogs** are open peatlands with acidic water (pH of 3.5 to 5.0) that is very low in dissolved minerals and nutrients. Bogs may receive water and nutrients only from precipitation, however most Dwarf Shrub Bogs in Vermont also receive some mineral enrichment from surface or groundwater, at least at their margins. The permanently saturated, acid conditions severely limit decomposition in bogs, resulting in significant accumulation of poorly decomposed sphagnum peat. Dwarf Shrub Bogs typically have well-developed microtopography, with tall hummocks and moist hollows.<sup>8</sup>

An example of a Dwarf Shrub Bog in Basin 10 is:

Woodward Reservoir (Plymouth).

**Red Maple-Sphagnum Acidic Basin Swamps** occur in poorly drained basins and generally have deep, peaty, permanently saturated organic soils. Most swamps are small, have small watersheds and occur in small perched basins. Red Maple-Sphagnum Acidic Basin Swamps are acidic with pH ranging from 3.7-5.8 and low in dissolved minerals. Although they receive surface water runoff, there are generally no inlet or outlet streams and no evidence of groundwater seepage at the swamp margins. They have well-developed mossy hummocks and hollows that are also moss covered and generally lack standing water.

---

<sup>8</sup> Sorenson, Eric R. and Thompson, Elizabeth H., *Wetland, Woodland, Wildland*, Vermont Department of Fish and Wildlife and The Nature Conservancy, 2005.

The tree canopy is dominated by red maple, the shrub layer is well developed and herbaceous cover is typically high and dominated by cinnamon fern. The bryophyte cover is typically near 100 percent across both hummocks and hollows and is strongly dominated by sphagnum moss.<sup>9</sup>

Examples of Red Maple-Sphagnum Acidic Basin Swamps in Basin 10 include:

- Downers Corners Swamp (Weathersfield)
- Kirk Meadow Swamp (Chester)

**Rich Fens** typically occur on a gentle slope and have shallow peat accumulations of less than three feet, although in some cases the peat is considerably deeper. Peat tends to be mostly decomposed, but sedge and moss fragments are still recognizable. The peat is saturated throughout the growing season, and there may be small, shallow pools scattered over the generally concave surface of the fen. Areas of groundwater seepage are usually evident at the upslope margins of Rich Fens where there may be small pools or springs adjacent to the sharp transition to upland forest. This seepage water moves slowly across the fen through the upper layers of peat. It is rich in calcium and has pH ranging from 5.8 to 7.4. Rich Fens occur only in areas of calcium or carbonate-rich bedrock.<sup>10</sup>

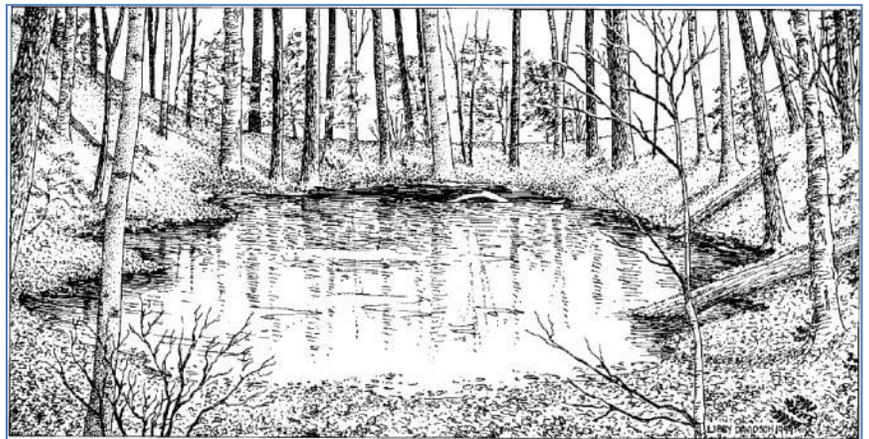


Showy Lady's Slipper -  
*Cypripedium reginae*  
Photo courtesy of USDA

Examples of Rich Fens in Basin 10 include:

- Totman Hill Fen (Pomfret)
- Churchill Road, former VINS Bragdon Nature Preserve (Woodstock)
- Eshqua Bog (Hartland)

**Vernal pools** are small, temporary bodies of water that occur in forest depressions. These depressions are typically underlain by a relatively impermeable layer, such as compact basal till, bedrock, or hardpan. Consequently, runoff from melting snow and spring rains fills these depressions with water that persists into the summer. Water depths are usually less than four feet. They typically become dry during the summer but may fill with water again as a result of fall rains. Vernal pools generally lack both stream inlet and outlet, although water may flow out of the pools during springs with especially heavy rains or rapid snow melting. Most vernal pools are less than one half acre and all have very small watersheds.<sup>11</sup>



Vernal Pool  
Illustration from *Wetland, Woodlands, Wildland*

Examples of Vernal Pools in Basin 10 include:

<sup>9</sup> E. Sorenson, personal communication.

<sup>10</sup> Sorenson, Eric R. and Thompson, Elizabeth H., *Wetland, Woodland, Wildland*, Vermont Department of Fish and Wildlife and The Nature Conservancy, 2005.

<sup>11</sup> Ibid

Woodstock mapped sites  
Bull Hill (aka The Continental Divide) (Bridgewater)  
Cloudland Brook Pool (Pomfret)  
Thistle Hill Pool (Pomfret)  
Dana Hill Pool (Pomfret)

A detailed description of important wetlands in the Basin can be found in Appendix A.3.  
For a list of important wetlands to be considered for re-**classification** see Chapter 7.

### Rare, Threatened and Endangered Species

Three federally and state endangered species are present in the Basin. Barbed-bristle Bulrush, *Scirpus ancistrochaetus*, makes one appearance in the town of Chester, while the Dwarf Wedgemussel, *Alasmidonta heterodon*, has populations in both Springfield and Hartland. While not aquatic animals four state endangered bat species are present in a cave in Plymouth. Historical records document the Indiana Bat, *Myotis sodalists*, and current surveys show the Little Brown Bat, *Myotis lucifugus*, the Northern Long-eared Bat, *Myotis septentrionalis*, and the Tri-colored Bat, *Perimyotis subflavus*. The spread of White-nosed syndrome may impact these populations.



USFWS

Dwarf Wedgemussel  
(*Alasmidonta heterodon*)



Barbed-bristle Bulrush (*Scirpus ancistrochaetus*)  
Photo by B. Popp

For a list of Rare, Threatened and Endangered species in Basin 10 see Appendix A.5.



# Chapter 4 Specific Waters with Water Quality Concerns

## Identifying Water Quality Problems

Basin planning is an ongoing process, designed to be compatible with the Vermont Water Quality Standards and other applicable state and federal laws. The primary focus of the Basin 10 Plan is to address surface waters, recognizing that a separate process exists for groundwater protection. Within the context of this plan, findings contained in the *Vermont Water Quality Assessment Report (305B)*<sup>12</sup>, the *2010 Section 303(d) List of Waters*<sup>13</sup>, the *2010 List of Priority Surface Waters*<sup>14</sup> and other pertinent documents and studies are presented and assessed relative to aspects of Basin 10 planning.

In seeking to identify water quality problems, water is evaluated as to its suitability for a particular use based on selected physical, chemical, and biological characteristics. The uses evaluated include:

Drinking water	Aquatic life support, wildlife & habitat
Swimming	Aesthetic, scenic, cultural characteristics
Fishing & fish consumption	Agriculture – animal watering and irrigation
Boating	

The State carries out several kinds of monitoring through its different departments to make water quality determinations. These can be found in the Vermont Surface Water Management Strategy.<sup>15</sup>

The collection, analysis and evaluation of water quality monitoring data and other information represent the assessment of a water's condition. The assessment of a water is most accurate when judgments about the water's condition are made using chemical, physical and/or biological data of known reliability collected through monitoring. While not as reliable as data collected through monitoring, an assessment of a water's condition can also take into account professional opinion, direct observations or other qualitative information.

The Vermont Water Quality Standards provide the basis used by the VDEC in determining the condition of surface waters including whether the water meets (attains) or does not meet (exceeds or violates) certain criteria. The assessment of a water's condition within the context of the Water Quality Standards requires consideration of the water's classification and management **type**, a variety of designated or existing uses, and a series of criteria which can be numerical or narrative. The outcome of an assessment conducted by the Department is to categorize Vermont's surface waters as either "full support," "stressed," "altered," or "impaired." Over time, the Department is gradually reducing the number of waters characterized as "unassessed."<sup>16</sup>

---

<sup>12</sup> [http://www.vtwaterquality.org/mapp/docs/305b/mp\\_305b-2010.pdf](http://www.vtwaterquality.org/mapp/docs/305b/mp_305b-2010.pdf)

<sup>13</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_303d\\_final\\_approved\\_2010.pdf](http://www.vtwaterquality.org/mapp/docs/mp_303d_final_approved_2010.pdf)

<sup>14</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_2010\\_State\\_Lists\\_final.pdf](http://www.vtwaterquality.org/mapp/docs/mp_2010_State_Lists_final.pdf)

<sup>15</sup> <http://www.vtwaterquality.org/swms.html>

<sup>16</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_assessmethod.pdf](http://www.vtwaterquality.org/mapp/docs/mp_assessmethod.pdf)

As required by the federal Clean Water Act, Vermont must assess its **nonpoint source pollution** problems and submit these assessments to the US Environmental Protection Agency (USEPA). *The Basin 10 Black River and Ottauquechee River Watersheds, Water Quality and Aquatic Habitat Assessment Report*<sup>17</sup> was updated in 2000. The report includes a list of waters within the basin which, without “additional action to control nonpoint source pollution, cannot reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements of this [CWA] Act”. It also identifies the different types of pollution that contribute to the impairment of waters, describes the procedures for identifying and implementing control measures for reducing pollution, and identifies some of the state and local programs currently working to abate pollution. Updated individual waterbody reports were done in 2010 and bi-annual 303(d) lists are based on these.

General causes and potential sources of listed impairments from nonpoint source pollution to the rivers and lakes in the Basin are identified in the *Basin 10 Assessment Report*. **Causes** are the pollutants or conditions that threaten or have an impact on the aquatic biota, the aquatic habitat, the fishery, fishing, fish consumption, swimming, boating, drinking water supply or other uses of the river or stream. The report identifies the top causes of riverine water quality or aquatic habitat problems in Basin 10. These are listed in Table 4.1 along with the miles of river or stream that they affect. **Sources** are the land uses, human activities, or occurrence of conditions responsible for the causes named above, these are the origin of the impacts on river or stream water quality or aquatic habitat. For example the cause of a poor fishery may be heavy **sedimentation** of the river bottom, while the source of the sediment is a washed out riverbank along a dirt road. Table 4.2 lists the primary sources of river and stream impacts and threats in the basin identified in the report.<sup>18</sup>

## Causes of Impacts or Threats to Basin 10 Rivers and Streams



**Flow alteration** is the major cause of impacts to river and stream aquatic habitat in Basin 10 due to the presence of two USACE flood control dams, eight hydroelectric dams, water withdrawals for snowmaking and a multitude of smaller dams. Dams are also in use for recreational lake impoundments, water supply reservoirs and other purposes. Eighty-nine dams are identified in the Basin, which is the third highest number of dams per basin out of the seventeen Vermont basins.

Alteration of the **natural flow** regime due to dams changes the physical and ecological characteristics of a river. Dams have multiple effects on rivers and riverine habitat as well as channel and shoreland stability and floodplain function.

Flood control measures store the waters of high flow events which are essential to river processes that move sediment through the river system. The fluctuating flows through the hydroelectric dams contribute to sediment accumulation above and channel bed and bank erosion below the dams. The sediment degrades aquatic habitat and water quality and disrupts geomorphic processes.

While lakes are not as dynamic as rivers, lake systems also have annual cycles to which the plants and animals that inhabit them have adapted. Lake levels naturally fluctuate over the course of the year with higher levels in the spring and often gradually lowering water levels as the summer progresses. Rapid or frequent lowering of water levels is not normally found in natural systems. Some reservoirs are

---

<sup>17</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_basin10.assessment\\_report.pdf](http://www.vtwaterquality.org/mapp/docs/mp_basin10.assessment_report.pdf)

<sup>18</sup> Ibid

operated with substantial dewatered zones at various times of the year, depending on uses such as hydropower or flood control. Many Vermont lakes have a dam on the outlet which has raised the water level of a natural lake between 3 and 10 feet. This creates an area of **littoral** zone exposed to freezing and results in a change to the habitat in that area. Most immediate is the exposure and stress or death of animals that lack the mobility to move down with the water: mussels, macroinvertebrates, small fish and fish eggs. Any species that have already hibernated may be unable to move. Aquatic plant communities in the dewatered zone can also be degraded, as can wetlands associated with the lake. The end result can be a zone bordering the lake that lacks healthy littoral (shallow water), riparian and wetland communities.

A table of dams located in the Basin can be found in Appendix A.6 of the Basin 10 Black River and Ottauquechee River Watersheds Water Quality and Aquatic Habitat Assessment Report<sup>19</sup>.

For a detailed discussion on the impacts of dams see:

[http://www.vtwaterquality.org/wqd\\_mgtplan/swms\\_appC.htm#\\_Toc278376137](http://www.vtwaterquality.org/wqd_mgtplan/swms_appC.htm#_Toc278376137)



**Sedimentation** from sources of excessive [channel erosion](#) and [land erosion](#) is the second greatest cause of impairment but it is by far the largest threat to stream and aquatic community health. Almost eighty miles of river and stream aquatic habitat are threatened by sedimentation. Bank erosion, land development, road runoff, and removal of riparian vegetation all are sources of increased sedimentation.

Channel erosion is a natural process that benefits stream and riparian ecosystems. However, excess sediment can negatively affect **aquatic biota** primarily in two ways: suspended sediment, comprised of fine silts that float in the water column, making the water turbid (or muddy); and by embedded sediment, comprised of silts, sands, and small gravel that are “packed in” around larger substrates, like cobbles and boulders, in the channel bed. Suspended sediment can affect aquatic biota that breathe with gills (such as fish, larval salamanders, and many aquatic insects). Gills can be coated with sediment or physically damaged by sediment, both resulting in a reduction of oxygen uptake from the water. Turbidity, caused by sediment suspended in the water, can decrease photosynthesis reducing algal growth that provides food for aquatic invertebrates and also reduces visibility for fish seeking food.

Embedded sediment reduces the available habitat for fish, amphibians, and aquatic invertebrates by filling in the spaces between the gravel and cobble on the channel bed. These spaces provide refuge, cover, spawning, and foraging habitat for the aquatic life. Sedimentation can result in the suffocation of eggs and newly hatched fish and amphibians. Spawning fish may be unable to penetrate the stream bed to prepare nests.

From <http://www.anr.state.vt.us/site/html/buff/buffer-tech-final.pdf>



**Pathogens** are disease-causing bacteria, viruses, and protozoa. The waterborne pathogens that are of concern in Vermont surface waters are those that come from fecal matter of humans and other warm-blooded animals. These pathogens may cause gastrointestinal problems and pose a more serious health risk to people who have weakened immune systems. The presence of pathogens as indicated by *E. coli* bacteria impair the third greatest number of miles and

---

<sup>19</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_basin10\\_assessment\\_report.pdf](http://www.vtwaterquality.org/mapp/docs/mp_basin10_assessment_report.pdf)

threaten the fourth greatest number in Basin 10. The use affected by this pollutant is swimming. Municipal point sources and combined sewer overflows with some agricultural land use activities are the sources of the bacteria and pathogens.

Other causes of water quality degradation in the Basin include:



**Thermal modification** or temperature changes that increase the water temperature above natural conditions. Water temperature in rivers and streams does vary by season, over the course of a day, and along the length of a river. However, certain land uses, activities, discharges, and the physical condition of the aquatic ecosystem can influence water temperatures beyond natural variation to cause thermal stress.



**Nutrient loading** results from excess quantities of both nitrogen and phosphorus. Both are naturally occurring and essential for plant growth and both are found in many substances, such as lawn and garden fertilizers and animal and human waste. They can enter waters from point sources, such as municipal wastewater treatment plant discharges, and nonpoint sources, such as runoff from farm fields and lawns. When nutrients enter a body of water they can cause algal blooms and excessive growth of aquatic plants. As these plants die off the bacteria that decompose them can deplete the **dissolved oxygen** levels in the water harming fish and other aquatic organisms. The algal blooms also limit human uses of the water and may contain blue-green algae which may occasionally become toxic posing a serious human health issue because if ingested in large quantities.

**Habitat Alterations** are any activities that change the physical structure of the stream channel, its bed or the landscape adjacent to it such as channelizing or impounding (damming) the stream, armoring the banks, destroying wetlands, and deforesting the riparian areas. These changes cause impacts to the functions and values of these natural areas, including a decline in water quality, loss in habitat (both aquatic and terrestrial), disruption of **equilibrium** (or naturally stable) conditions, loss of flood attenuation, or reduction of ecological processes.

### **Organic Enrichment**

Several types of non-erosional nutrient loading contribute to accelerated bacterial growth by providing organic waste as a food source. Bacteria will decompose these organic materials using dissolved oxygen (DO), thus reducing the available DO for fish and other aquatic organisms. The more organic waste present, the more bacteria there are decomposing this waste and using oxygen, so the demand for oxygen will be high and the DO level will be diminished.

These pollutants are coming from a number of sources all of which are a direct result of human activity on the landscape.

**TABLE 4.1****Causes of Impacts and Stress to Basin 10 Rivers and Streams**

Causes of Impacts and Stress	Miles Impacted	
	Impaired	Stressed
Temperature	1.9	37.3
Sedimentation/Siltation	5.9	30.8
Nutrients	2.6	30.3
Other habitat alterations		11.5
Pathogens (E. coli)		10.6
Metals	1.4	4.8
Flow alterations	5.2	
Organic enrichment/Low D.O.		4.6
Oil and grease		4.6
Stormwater (flow,sedmt,mixed pollutants)	1.2	

**TABLE 4.2****Sources of Impacts and Stress to Basin 10 Rivers and Streams**

Sources of Impacts and Stress	Miles Impacted	
	Impaired	Stressed
Removal of riparian vegetation	2	31.7
Road/bridge impacts/runoff	1.2	13.2
Developed land runoff (urban/suburban)		14.1
Channelization		11.5
Golf courses	0.5	10.5
Land development	1.2	8
Agriculture		7.2
Impoundment	6.1	1
Pasture land - horses		6
Flow regulation/modification	5.1	
Municipal point sources		4.6
Combined sewer overflows		4.6
Streambank modification/destabilization	0.7	3.5
Onsite wastewater systems (septic tanks)		3
Resource extraction	0.2	
Landfills		0.2
Flow mod. - hydroelectric	0.1	

## Causes of Impacts or Threats to Basin 10 Lakes and Ponds

Lakes and ponds are similarly evaluated to determine the causes of water quality problems and how many acres are impacted by pollutants and source activities. For Basin 10 lakes atmospheric deposition of mercury, a highly toxic metal, impacts the greatest area. Invasive Eurasian watermilfoil, flow alterations and the widespread sedimentation also have the significant impacts.



**Mercury** (Hg) contamination is ubiquitous in Vermont's still waters. Mercury, a heavy metal, is emitted to the atmosphere by a wide variety of emissions sources, is readily bio-accumulated to hazardous levels in fish and fish-eating wildlife, and is a pollutant of global impact and concern. Mercury is a naturally occurring metal used in a wide variety of applications ranging from the production of household bleach to the mining of gold. Mercury is released into the environment either directly to water via waste systems, or much more commonly, directly to the atmosphere. It is carried down to the ground with precipitation. It is this atmospheric pathway that is largely responsible for mercury contamination in Vermont. The combustion of coal for energy production, and incineration of municipal and medical wastes, produces the majority of mercury deposited onto the watersheds of the northeast. Once on the ground, mercury migrates through watersheds, arriving eventually into surface waters.<sup>20</sup>

Due to well-documented contamination of lakes to varying degrees by mercury in waters, sediments, and aquatic biota, the Vermont Department of Health (VDH) considers fish consumption to be impaired on a statewide basis. DEC does not, however, subscribe to this notion because most fish species can be safely consumed from most Vermont waters. Fish consumption use is considered impaired only when contaminant data exists for a specific species from the particular waterbody. This approach is consistent with current EPA guidance. The VDH issues fish consumption advisories for high risk persons (women of child bearing age and children under 6 years of age) and low risk populations. However, most waters in Vermont support fish populations that are a healthy, sustainable food resource.

For information of fish consumption warnings due to mercury see:  
[http://healthvermont.gov/enviro/fish\\_alert/documents/Fish\\_Alert\\_2007.pdf](http://healthvermont.gov/enviro/fish_alert/documents/Fish_Alert_2007.pdf)

Atmospheric deposition is also the source of the acid rain causing critically low pH levels in some Basin 10 lakes and ponds that is impacting aquatic habitat.

---

<sup>20</sup> [http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp\\_mercury.htm](http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_mercury.htm)

**TABLE 4.3**

**Lake Acres Altered or Stressed Due to Causes**

Assessment category	Use affected→ CAUSE of Impact↓	Aesthetic	Aquatic Biota, Wildlife, and Aquatic Habitat	Boating, Fishing, and Other Recreational Uses	Fish Consumption	Swimming and Other Primary Contact Recreation
Impaired	There are no impaired lakes in Basin 10					
Altered	Flow alteration	215	215	215	--	215
Stressed	Eurasian Watermilfoil, <i>Myriophyllum spicatum</i>	491	491	491	--	491
	Exotic Species	58	59	58	--	58
	Mercury in Fish Tissue	--	--	--	1755	--
	Noxious Aquatic Plants - Algae	24	24	19	--	24
	Noxious Aquatic Plants - Native	19	19	19	--	19
	pH		316		--	
	Sedimentation/ Siltation	128	109	127	--	132

**Specific Altered or Stressed Lakes**

**Kent Pond**, Killington: This 99 acre lake has a 10 acre infestation of Eurasian watermilfoil. As the infestation in these acres is very dense, aesthetics, swimming, boating, and aquatic life uses are only partially supported.

**Lake Ninevah**, Mt. Holly: This 171 acre lake is characterized by an alkalinity of less than 12.5 mg/l (as CaCO<sub>3</sub>). Aquatic life uses are considered partially supported for the entire lake acreage due to acid sensitivity. Eurasian watermilfoil was found in this lake but the infestation had been categorized by the Vermont DEC Watershed Management Division as controlled, however a population was discovered in 2010 and removed. Active monitoring for re-emerging plants is on-going. Rapid response and aggressive control programs have so far kept the population from re-establishing. Lake Ninevah has a warm water fishery.

**North Hartland Reservoir**, Hartland: This 215 acre flood control reservoir is operated by the USACE and is the only lake in Basin 10 included in the 2010 List of Priority Waters. It is on the Part F. list due to extreme water level fluctuations which result from the reservoir’s operations as a hydroelectric production, aquatic life uses are not supported.

**North Springfield Reservoir**, Springfield: This 290 acre flood control reservoir is operated by the USACE. Due to extreme water level fluctuations which result from the reservoir's operations, aquatic life uses are not supported. The reservoir had a population of invasive water chestnut that has been eradicated. The lake is being monitored for its presence.

**Woodward Reservoir**, Plymouth: This 106 acre impounded lake has one acre with dense growth of invasive Phragmites. This area, while still fully supporting designated uses, is classified as stressed for aquatic life support.

**Colby Pond**, Plymouth: This small 20 acre pond was assessed in the mid-1980's. At that time, its low alkalinity of less than 12.5 mg/l (as CaCO<sub>3</sub>) was determined to threaten aquatic life uses on the pond.

**Echo Lake**, Plymouth: This 104 acre recreational lake has experienced significant shoreline development in the past decade. At last count, there were 35 houses within 150 feet of the shoreline, many of which have un-buffered shorelines. While water quality remains good and stable as measured by the spring phosphorus sampling (mean spring **total phosphorus** is 7 µg/l), the level of development on Echo Lake poses a threat to its high quality from runoff and waste disposal. Correspondingly, aesthetic, swimming, boating, and aquatic life uses are considered threatened for the lake's entire acreage. This lake has a coldwater fishery including Lake Trout.

**Knapp Brook Ponds 1 and 2**, Cavendish: These two undeveloped ponds (25 and 35 acres) are characterized by alkalinity values below 12.5 mg/l (as CaCO<sub>3</sub>). Correspondingly, due to acid sensitivity, aquatic life uses are considered threatened for the full acreage of each lake.

**Reading Pond**, Reading: This small 22 acre pond was assessed in the mid-1980's. At that time, its low alkalinity of less than 12.5 mg/l (as CaCO<sub>3</sub>) was determined to threaten aquatic life uses on the pond. An undocumented dam on the pond failed in 2006 releasing a large volume of water and causing severe erosion along Reading Brook and a sediment plume in Echo Lake. The size of Reading Pond is now significantly smaller than it was.

**Lake Rescue**, Plymouth: Eurasian watermilfoil was found in this lake in 1998. Presently, the infestation is categorized by the Vermont DEC Watershed Management Division as controlled. Rapid response and aggressive control programs have eliminated the population. Active monitoring for re-emerging plants is on-going. Lake Rescue has a coldwater fishery. There are over 170 houses within 150 feet of the lake, many of which have un-buffered shorelines which poses a threat to water quality from runoff and waste disposal.

## **River Corridor Assessment and Management**

A comprehensive geomorphic assessment has been conducted on the Black River and portions of its major tributaries (North Branch, Twentymile Stream, Branch Brook, Patch Brook, and Buffalo Brook). This Stream Geomorphic Assessment (SGA) and the resulting River Corridor Plan (RCP) provides information on the current condition of targeted river reaches and identifies the processes that the river is undergoing to adjust to historic and on-going disturbances to its channel. The RCP identifies conservation projects geared to improve water quality and return the river to a more balanced channel condition.

Broken down by river reach, the RCP recommendations include protecting the river corridor through conservation easements with willing landowners, planting riparian buffers, , monitoring head-cuts, potentially removing streamside berms, removing or replacing improperly sized bridges and culverts, mitigating stormwater, removing old and unused dams and abutments, and other restoration practices. The SGA and RCP are available at: <http://www.vtwaterquality.org/rivers.htm>.

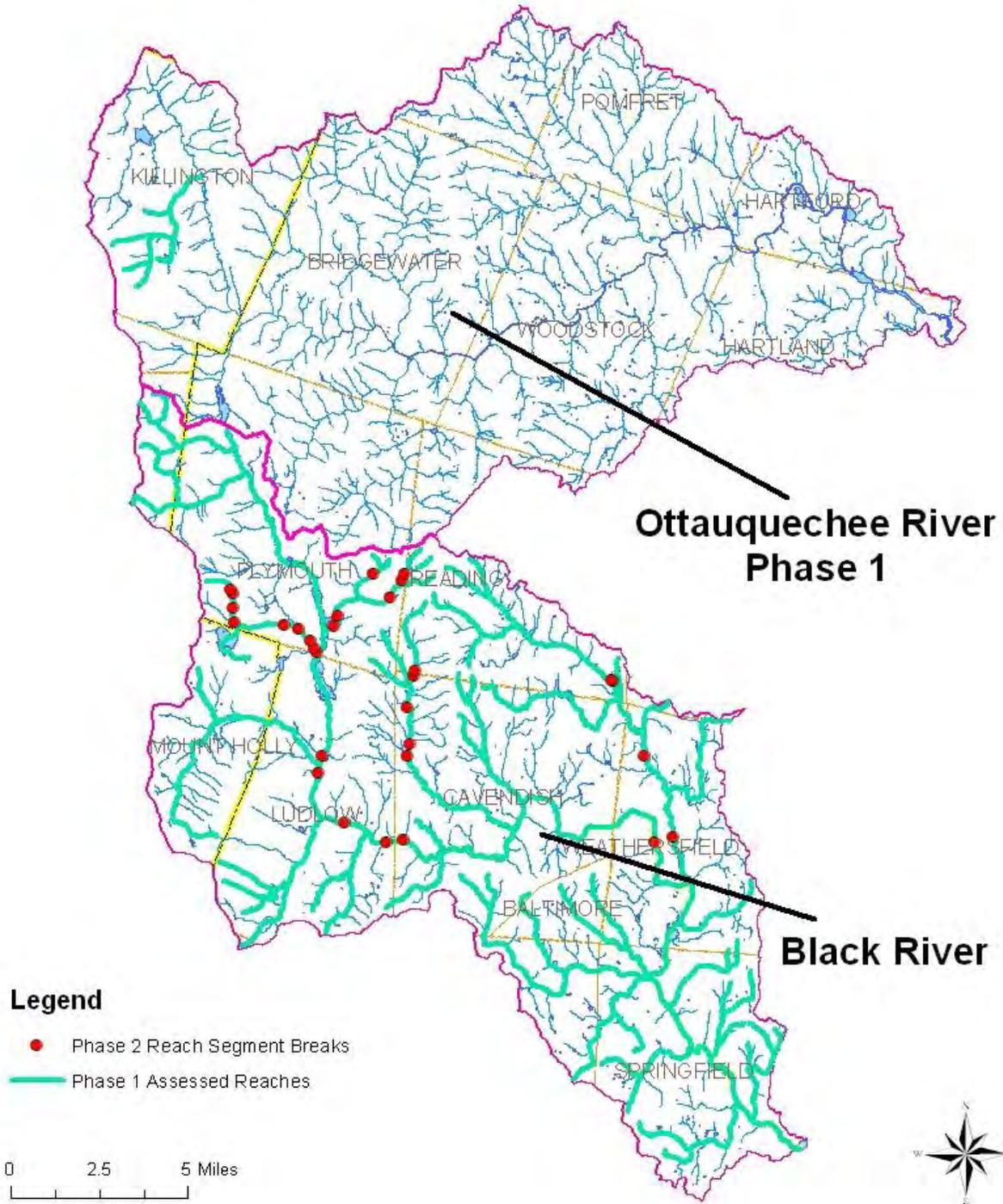
A similar assessment is being conducted on the Ottauquechee River beginning in 2010. Two Rivers-Ottauquechee Regional Commission also completed the Ottauquechee River Tributary Bridge Survey for Bridgewater and Plymouth, Vermont in June 2008.

Nearly every stream and river in Vermont is undergoing change. Sometimes these changes are natural or imperceptible. Other times, and more often, streams and rivers are adjusting to channel, floodplain, or watershed changes imposed in years past by human activity. Understanding the natural tendencies of a stream, its current condition, and what changes may be anticipated in the future is invaluable to making sound protection, management, and restoration decisions.<sup>21</sup> These studies provide the information necessary to develop sound remediation projects aimed at improving the water quality and physical condition of both rivers.

---

<sup>21</sup> [http://www.vtwaterquality.org/rivers/html/rv\\_geoassess.htm](http://www.vtwaterquality.org/rivers/html/rv_geoassess.htm)

# Basin 10 Geomorphic Assessment Reaches



For a complete list of physical, chemical, and biological assessments either completed or underway in Basin 10 see Appendix A.4.

# Chapter 5 Impaired Waters and Emerging Problems

## Impaired and Listed Waters

Under USEPA guidance and federal regulations, **impaired waters**, meaning those that do not meet Vermont Water Quality Standards, must be identified by the State and reported under Section 303(d) of the Clean Water Act. All waterbodies identified as impaired in the State's 303(d) list are scheduled for the development of a **Total Maximum Daily Loads** (TMDL) pollution source control plan.

If the waterbody is identified as impaired but has regulatory measures in place that are likely to bring it into compliance with Vermont Water Quality Standards, it is not required to have a TMDL but may have an alternative water quality remediation plan in its place. All other impaired waterbodies where no legal remedies exist must be listed and scheduled for Total Maximum Daily Load development.

Water quality assessments and TMDLs are the result of extensive monitoring efforts by VDEC, VFWD, USEPA and many volunteer monitoring programs. The Monitoring, Assessment and Planning Program (MAPP) within the Watershed Management Division takes the monitoring data, interprets water quality studies, stream, lake, and wetland information, and permit compliance data and develops statements of lake or stream condition. These are used to determine if individual waters meet the Vermont Water Quality Standards. For this purpose, MAPP maintains an evolving Assessment and Listing Methodology<sup>22</sup> that is compliant with Federal Clean Water Act guidance, and that is used to develop lists of waters that are “impaired” or otherwise stressed. MAPP also develops TMDL plans, which identify the reductions in pollutants necessary to restore impaired waters.

A TMDL is the calculation of the maximum amount of a pollutant that a waterbody can receive and still meet WQS. In a broader sense, a TMDL is a plan that identifies the pollutant reductions needed to bring a waterbody back into compliance with Vermont's WQS. The TMDL plan also develops a strategy to implement the needed reductions. TMDLs can be calculated for correcting water pollution from specific **point source** discharges or from myriad pollution sources from throughout a watershed.

Basin 10 currently has six waterbodies that are listed as impaired waters, only one of which has a completed and approved TMDL.

---

<sup>22</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_assessmethod.pdf](http://www.vtwaterquality.org/mapp/docs/mp_assessmethod.pdf)

**TABLE 5.1**  
**2010 303(d) LIST OF WATERS**  
**PART A - IMPAIRED SURFACE WATERS IN NEED OF A TMDL**

Waterbody ID	Segment Name/ Description	Pollutant(s)	Use(s) Impaired	Surface Water Quality Problem(s)	TMDL Completion Priority
VT10-04	Wetland Draining to Small Stream to Ottauquechee River (Bridgewater)	METALS IRON	ALS	Bridgewater Landfill; Leachate Entering Surface Water via Wetland	M
VT10-06	E. Branch Roaring Brook, RM 0.1 to RM 0.6	STORMWATER, IRON	AES, ALS	Stormwater Runoff, Land Development, Erosion	L
	Roaring Brook, RM 3.5 to RM 4.2	STORMWATER	AES, ALS	Stormwater Runoff, Land Development; Erosion	L
VT10-11	Black River; from Mouth to 2.5 Mi Upstream (Springfield)	E. COLI	CR	Combined Sewer Overflows	L
VT10-14	Tributary to Jewell Brook - Ludlow	IRON	AES	Evidence Of Ludlow Landfill Leachate Entering Surface Water	M

AES – aesthetics

ALS - aquatic life support

CR - **contact recreation** (i.e. swimming)

L - low

M – medium

RM – river mile

WWTF – wastewater treatment facility

**TABLE 5.2**  
**PART D. SURFACE WATERS WITH COMPLETED AND APPROVED TMDLS**

Waterbody ID	Segment Name/ Description	Pollutant(s)	Previously Identified Problem	Status
VT10-14	BLACK RIVER, BELOW LUDLOW WWTF FOR APPROX. 0.5 MILES	PHOSPHORUS	NUTRIENT ENRICHMENT FROM WWTF	EPA APPROVED TMDL MAY 1, 2001

### **Waters Removed from 303(d) List**

As waters are improved by positive work in the watershed and they come back into compliance with the WQS they are removed from the impaired waters list. There has been one recent successful de-listing of an impaired stream in Basin 10.

Soapstone Brook in Ludlow which had been listed for the metals iron and arsenic and for sediment, was impaired for aesthetics and aquatic life support beginning in 1996. **Active restoration** projects undertaken by Rio Tinto / Luzenac America have stopped surface runoff from reaching the brook and the aquatic life has re-established at levels rated as “excellent.”

“Recent biomonitoring supports delisting this segment since Water Quality Standards biocriteria are now attained. **Macroinvertebrate** monitoring in 1993 indicated a rating of “fair” from which the stream was listed on the 303(d) Impaired Waters List. Recent macroinvertebrate monitoring in 2007 shows considerable water quality improvement to a community rating of “excellent”.”

FROM: 2010 INTERIM LIST - WATERS FOR SECTION 303(d) DE-LISTING,  
 Subpart IO - Waters proposed for Part A de-listing because the waters now meet standards

**Waters in Need of Further Assessment**

Waters needing further assessment are listed in Vermont 2010 List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d), Part C<sup>23</sup>. These waters are considered “stressed” but sufficient data has not been collected to confirm a violation of the WQS. Part C waters are high priority for assessment and monitoring.

**TABLE 5.3  
 2010 LIST OF PRIORITY SURFACE WATERS OUTSIDE THE SCOPE OF CLEAN WATER ACT  
 SECTION 303(d)  
 PART C. SURFACE WATERS IN NEED OF FURTHER ASSESSMENT**

Waterbody ID	Segment Name/Description	Pollutant(s)	Use(s) Impaired	Surface Water Quality Problem(s)
VT10-01	Ottawaquechee River, Taftsville Dam To Hartland Reservoir	E. COLI, NUTRIENTS	CR, ALS	Failed/Failing Septic Systems; Fertilized Turf, Horse Farms
VT10-06	Falls Brook (3 Miles)	SEDIMENT	ALS	Land Development; Erosion; Streambank Destabilization
	West Branch Of Roaring Brook & Upper Roaring Brook (Approx. 3 Miles)	SEDIMENT	AES, ALS	Land Development; Erosion; Road Runoff
VT10-07	Kedron Brook - Woodstock	SEDIMENT, NUTRIENTS, E. COLI	AES, ALS, CR	Horse Recreation Activity; Pasture; Road Runoff; Loss Of Riparian Vegetation; Golf Course
VT10-10	Barnard Brook	SEDIMENT, TEMPERATURE	ALS	Source(S) Need Further Assessment
VT10-11	Gulf Stream Brook	SEDIMENT	2CR	Gravel Road Maintenance
VT10-14	Black River, 2.5 To 7.5 Miles Above Mouth	SEDIMENT, NUTRIENTS, E. COLI	AES, ALS, CR	Contributions From Urban Runoff, Land Development
VT10-14	Jewell Brook	ARSENIC	ALS, CR, 2CR	Arsenic In Sediment From Former Mill
VT10-16	No. Branch Black River Above Stoughton Pond	SEDIMENT, NUTRIENTS, E. COLI	AES, ALS, CR	Source(s) Need Further Assessment; Notable Erosion

AES – aesthetics  
 ALS - aquatic life support  
 CR - contact recreation (i.e. swimming)  
 CR2 – **secondary contact recreation** (fishing, boating)

<sup>23</sup> [http://www.anr.state.vt.us/dec/waterq/mapp/docs/mp\\_2008.State\\_Lists\\_Final.pdf](http://www.anr.state.vt.us/dec/waterq/mapp/docs/mp_2008.State_Lists_Final.pdf)

## Addressing Impaired Waters

**VT10-04** and **VT10-14** are both impaired due to landfill leachate runoff into wetlands and then into their respective streams. The source of both is from old closed landfills in Bridgewater and Ludlow respectively. The Bridgewater site is a capped landfill with monitoring wells in place which are tested on a regular timeframe. No groundwater contamination is evident. However the wetland below the landfill is iron-red with leachate and elevated levels of iron are present. The wetland drains to a small brook and into the Ottauquechee River.

This site is part of a study being conducted by UVM and the Solid Waste Management Division which will develop remediation strategies for the leachate runoff. These will be incorporated into this plan in the future.

The Ludlow landfill leachate also forms an iron-red wetland below the site which channels into Jewell Brook. Neither is impacting the larger waterbody they reach as flow volumes in the Ottauquechee River and Jewell Brook are large enough to dilute the contaminants to minute levels. Both of these sites are medium priority level for TMDL development.

Both wetlands are scheduled to be assessed by the Wetlands Section over the summer of 2012 to determine the level of impact. Once data is compiled remediation strategies will be developed in partnership with the Solid Waste Management Program.

**VT10-11**, the lower Black River below Springfield is impaired for *E. coli* from the combined sewer overflows in the town. Springfield has been actively disconnecting its CSOs over the past decade investing over \$11 million in new stormwater and sewer drainage systems. The Springfield impairment is addressed in the Vermont Statewide Total Maximum Daily Load (TMDL) for Bacteria-Impaired Waters<sup>24</sup> as part of Appendix – CSO & WWTF Waterbodies.<sup>25</sup>

**Progress toward CSO Elimination:** Originally there were approximately 25 combined sewer overflows in the Springfield WWTF collection system. Eleven CSOs have been physically eliminated and thirteen remain.

**Schedule of Compliance:** Springfield is under an Enforcement Order to abate these overflows and completed a CSO abatement project in 2010. An effectiveness study will be initiated this summer and completed by the end of 2012.

**VT10-06**, East Branch Roaring Brook, (RM 0.1 to RM 0.6) and Roaring Brook, (RM 3.5 to RM 4.2) are impaired due to stormwater runoff, land development and erosion from impacts of land use around Killington ski area. Development of a TMDL is ranked as low as these waters will be addressed through a Water Quality Remediation Plan (WQRP) rather than a TMDL plan. Mountain watersheds including Roaring Brook and East Branch of Roaring Brook differ substantially from urbanized “lowland” watersheds in terms of density of development, geographic position, hydrology, impairment source, and land ownership. EPA regulations recognize that alternative pollution control requirements may obviate the need for a TMDL if other pollution control requirements are stringent enough to implement applicable water quality standards within a reasonable period of time. In VT10-06 VDEC has determined that a WQRP is the best implementation strategy.

---

<sup>24</sup> [http://www.vtwaterquality.org/mapp/htm/mp\\_tmdl.htm](http://www.vtwaterquality.org/mapp/htm/mp_tmdl.htm)

<sup>25</sup> [http://www.vtwaterquality.org/mapp/docs/mp\\_19cso\\_wwtf.pdf](http://www.vtwaterquality.org/mapp/docs/mp_19cso_wwtf.pdf)

**VT10-14**, the 0.5 mile of the Black River below the Ludlow WWTF, is under a TMDL for phosphorus which limits the level of discharge of phosphorus to 0.8 lbs/day during the months from May through October<sup>26</sup>.

From:  
TOTAL MAXIMUM DAILY LOAD for TOTAL PHOSPHORUS  
BLACK RIVER at LUDLOW, VT  
Waterbody ID: 10-14  
February, 2001

The Black River at Ludlow TMDL was developed for total phosphorus in an effort to control organic enrichment in the river and prevent impairment of biological communities.

Based on a matrix of several criteria developed by the VT DEC to determine the condition of the macroinvertebrate community.... It was concluded that the WWTF effluent was having an unacceptable enrichment effect on the aquatic community and phosphorus loading was determined to be the specific problem.

The allocations for this TMDL have been developed for the summer growing season only. It is during the summer months that algal productivity is the greatest and has the greatest potential to negatively impact the biologic communities. Also, summer months normally result in the lowest instream flows that act to magnify the impact from the largest phosphorus source, the Ludlow WWTF. Therefore, phosphorus allocations have not been prepared outside of the context of the summer growing season, May through October, because other external environmental conditions (light, temperature, etc.) significantly limit the possibility for excessive algal production and community impairment.

The load allocation for all background and nonpoint sources of phosphorus have been combined into a single allocation for low flow summer conditions.

Total Phosphorus Allocation (summer)	
Combined Nonpoint Source / Background	0.8 pounds/day

## Permitted Direct and Indirect Discharges

Some discharges of pollutants into surface waters are allowed through state and federal permit. These are usually industrial, municipal, and other facilities that discharge treated wastes to surface waters. All of these discharges must be authorized through a federal National Pollutant Discharge Elimination System (NPDES) permit. The NPDES programs traditionally focused on reducing direct discharge pollutants in industrial process wastewater and municipal sewage treatment plant discharges. NPDES permits and programs now cover many discharges including concentrated animal feeding operations (CAFOs), combined sewer overflows (CSOs), pretreatment, sanitary sewer overflows (SSOs), and stormwater. The State of Vermont, Department of Environmental Conservation's Direct Discharge Permit and Stormwater sections are authorized to administer the NPDES program.

<sup>26</sup> [http://www.anr.state.vt.us/dec/waterq/mapp/docs/mp\\_BlackLudTMDL\\_FinalComplete.pdf](http://www.anr.state.vt.us/dec/waterq/mapp/docs/mp_BlackLudTMDL_FinalComplete.pdf)

There are 40 Direct Discharge permits within Basin 10. See Appendix B.2 for the complete list. Included in these are seven municipal wastewater treatment facilities. Discharging to the Black River are facilities in Cavendish, Ludlow and Springfield. Discharging to the Ottauquechee River are Quechee, South Woodstock (to Kedron Brook), Taftsville and Woodstock village.

The Indirect Discharge Permit Section issues permits for land-based sewage treatment and disposal systems greater than 6,499 gallons per day, including septic tanks and leachfields and also treatment facilities and spray disposal systems, all of which use soil as part of the waste treatment process. Following primary and/or secondary treatment, the soil provides final effluent renovation and polishing before it reaches groundwater and, eventually, surface water. This is in contrast to direct discharge systems, which may discharge through a pipe directly to surface waters.

The Indirect Discharge Section also issues permits for the land application of food processing wastes generated during the production of cheese and ice cream, as well as other dairy and food products. Land application on farm fields or by discharge to manure pits returns some of the nutrients in the waste back to the land.

See Appendix B. 3 for detailed information on permitted indirect discharges in Basin 10.

## Emerging Threats to Surface Waters



*Billings Farm buffer planting  
Ottawaquechee River*

**LACK of BUFFERS** – Far beyond any other recommendation made during the planning process, none was more strongly emphasized than the need for riparian buffers. It is clearly understood by watershed council members that the lack of buffers is a major cause of water quality and habitat problems in the Basin, and that the simplest, most efficient and most cost effective way to improve and protect surface water quality is to implement coordinated buffer improvements throughout the Basin.

**SEDIMENT** - Of the nine waters listed as being in need of further assessment, seven have sediment as the suspected pollutant. Silt and sediment are by far the most common visible causes of water quality problems noted in the Basin. In Basin lakes, siltation is the cause of 132 stressed acres and sediment is impacting or threatening over 36 miles of rivers and streams.



*Lake Rescue after Tropical Storm Irene  
Photo courtesy of VTrans*

**FLOW ALTERATION IMPACTS** – Of the eighty-nine dams in the Basin, forty-two are in use for hydroelectric power generation, flood control, recreational lake impoundments, water supply reservoirs and other purposes. Two are not in use and fifteen are breached. Many of these dams however are obsolete and serve no current purpose. Their presence in rivers and streams blocks aquatic organism passage, prevents sediment from passing downstream and causes disequilibrium in the ecological function of the river system.



*Lower Slack dam  
Black River, Springfield*



*Japanese knotweed*

**INVASIVE SPECIES** – Japanese knotweed, Eurasian watermilfoil, Rusty crayfish, Common reed / Phragmites and Purple loosestrife are all well established in the Basin and attempts have been made to control all of them. Fortunately populations of Eurasian watermilfoil and water chestnut have been successfully controlled in some lakes. However the battle with other invasives has not fared so well and riparian areas and some ponds are inundated with exotic species.

**KEDRON BROOK** is listed as being in need of further assessment due to high levels of sediment, *E. coli* and nutrients likely caused by horse recreation activity; pasture; road runoff; loss of riparian vegetation; and golf course activity along the brook. The Green Mountain Horse Association has already responded by improving three of the steam crossing on its facility.



*Newly installed stable river crossing at Green Mountain Horse Association*



Oil spill clean-up

**LOWER BLACK RIVER** – Springfield Oil Spill - A deliberate release of diesel fuel into a storm drain leading to the Black River was caused by vandals on August 8, 2010. Approximately 4000 gallons were released into the river of which about 2000 gallons were recovered over the following two weeks. A coordinated effort on the part of VDEC’s Compliance & Enforcement Division, the Waste Management Division’s Spill Response Team, and Watershed Management Division’s Biomonitoring and Aquatic Studies Section and Planning Section helped in keeping the extent of the spill from worsening and tracking its impact on aquatic life.

## **Recommendations to Address Emerging Threats to Surface Waters**

**BUFFERS:** *Recommendations that address buffer implementation, buffer ordinances and zoning regulations and statewide buffer legislation should be given high priority.*

**SEDIMENT:** *Recommendations that address channel and land erosion, stormwater runoff, agricultural runoff and buffer implementation are key to stemming the further deposition of sediment in the Basin's lakes and waterways. These should be given high priority for implementation.*

**FLOW ALTERATION IMPACTS:** *Recommendations that address evaluation and removal of unused and obsolete dams and impassable culverts that are ecological impediments should be high priority.*

**INVASIVE SPECIES:** *Recommendations that address the spread prevention and control of exotic invasive species should be a high priority.*

**KEDRON BROOK:** *Recommendations that focus on addressing sediment, bacteria and nutrient issues should be focused on this important sub-watershed in partnership with ONRCD, GMHA and the Town of Woodstock.*

**LOWER BLACK RIVER – Springfield Oil Spill:** *Recommendations that focus on continued monitoring and assessment of the river's condition and aquatic life and projects to enhance aquatic life support should be a priority in this river reach.*

# Chapter 6 Plan Implementation – Resolving State and Local Water Quality Concerns

In undertaking the Basin Planning process, the members of the Watershed Council were tasked with bringing forth their water quality issues and concerns and developing recommendations on how these should be addressed. Many of the concerns necessitated gathering background information to fully understand the nature of the problem and the water quality and habitat impacts they fuel. For many topics this included research into the current strategies available for addressing the problem. Finally, in developing the recommendations to include in the plan, the strategies had to be appropriate for this Basin and these two watersheds.

The Watershed Council chose to focus on the following areas of concern:

Agriculture	Lakes and Ponds
Buffers	Recreation
Dams	Roads
Fisheries	Stormwater
Floods and Flood Hazards	Town Planning and Zoning
Forests	Uses and Values of Surface Waters
Groundwater and Source Protection	Water Quality Conditions
Invasive Species	Wildlife and Travel Corridors

Throughout the Basin Planning process a number of recurring issues emerged. The lack of riparian buffers was brought up in regards to a number of topics as was the impact of gravel road erosion on water quality. The need for further education and outreach on water quality issues, causes of pollution, and ways to address the problems were also of significant concern. These issues are addressed by the Watershed Council under several of the topic areas.

The recommendations, strategies and actions are all approached at the watershed scale, meaning that they are meant to be applied to the entire watershed landscape. Some however, are specific projects that address specific needs. While hundreds of excellent suggestions were made throughout the watershed council meetings those included here are ones with the greatest support, the greatest likelihood of success at addressing the problems and the most appropriate to these watersheds and communities.

## Projects - On-Going & Completed

As the planning process progressed, and even prior to its inception, work on the ground was already taking place or was quickly identified as being necessary in several issue areas. These projects were seized upon by local groups and were supported by the State and partner organizations. Several were in process and have been completed by State agencies as well.

### Pinney Hollow Brook Dam Removal

Lead: USFWS, VDEC

Pinney Hollow Brook is a tributary in the Ottauquechee watershed, a key habitat area for brook trout in Vermont. An abandoned concrete dam on Pinney Hollow Brook served to block movements of

important game species. The dam was partially breached, providing fish passage at some flows. Removal of the dam enhanced fish passage and restored historic conditions to the watershed. As a result, this project opened approximately 2 miles of habitat, enhancing habitat connectivity for Eastern Brook trout and American eel, among other species. Pinney Hollow Dam was built to create a swimming hole for a long-defunct CCC camp.

Edited from: <http://www.fws.gov/fisheries/fwco/fishpassage/R5/region5.html>



*Pinney Hollow Dam*



*Dam breached*

### **Springfield Stormwater System Survey**

Lead: VDEC, Stormwater Section

VDEC Stormwater Section working with the Town of Springfield has located and mapped the connections between all the storm drains in the town proper and located where these discharge to the Black River or its tributaries. The stormwater system, having been built in stages over many years, has never been traced and it has been impossible to track where combined sewer, cross-connections and illegal connections had been added. The information will be used in the next phase of the study which will monitor the discharge water from the outfall pipes and attempt to trace the flow of any that carry contaminants back to the source.

### **Stream Geomorphic Assessments (SGA)**

Lead: VDEC, Watershed Management Division  
Southern Windsor County RPC (SWCRPC)

The Black River mainstem and its major tributaries along with the tributaries leading to Round Pond, the northern end of Lake Rescue, have been assessed by South Mountain Research & Consulting. The SGA includes Phase 1 & 2 assessments and a River Corridor Plan (RCP) laying out the priority projects chosen to lead to better geomorphically stable conditions in the watershed. **Fluvial Erosion Hazard/River Corridor** Areas were also mapped for



*Streambed erosion  
Black River, Ludlow*

all towns on the waters that were assessed and meetings held to provide this information to town officials for use in their future planning and zoning. The SGA and RCP are available at: <http://www.vtwaterquality.org/rivers.htm>. Recommendations from the RCP are included in the tables in Chapter 6.

Lead: VDEC, Watershed Management Division  
Two-Rivers-Ottauquechee Regional Commission (TRORC)

In 2010 Two Rivers-Ottauquechee Regional Commission began coordinating the Phase 1 and 2 SGA study and Corridor Plan development for the Ottauquechee River. As mentioned above, TRORC completed the Ottauquechee River Tributary Bridge Survey for Bridgewater and Plymouth, Vermont in June 2008.

### **Low Impact Development Outreach to Towns**

Lead: Southern Windsor County RPC &  
Two-Rivers-Ottauquechee Regional Commission

The RPCs also conducted outreach to its member towns on **low impact development** (LID) strategies and how to incorporate LID requirements into town zoning regulations to help curb stormwater runoff to waterways and improve water quality. The RPCs also reviewed town policies to see what barriers to implementing LID practices existed and evaluated how to get beyond these to improve LID implementation.

### **Ottauquechee River Group (ORG)**

Lead: ORG

The Ottauquechee River Group was formed in 2008 in response to the need for active participants from the Ottauquechee River in the basin planning process. ORG has taken on a number of projects first and foremost being re-establishing the long defunct water quality monitoring program on the river in 2010; conducting river clean-up days; and co-organizing with ONRCD an 800' riparian buffer planting on an agricultural field of the Billings Farm Museum.



*Billings Farm buffer planting*

### **Buffer Plant Nursery**

Lead: Ottauquechee NRCD & Black River Action Team

On land donated by Luzenac/Rio Tinto at their Ludlow facility, a stock of native plants has been established for use by local conservation groups to ensure that plants are on hand when buffer projects present themselves. The stock is also available for landowners who wish to plant buffers on their riparian areas.

## **Knotweed Control Workshop**

Lead: Ottauquechee NRC

Over fifty landowners received training in identifying and controlling Japanese knotweed using mechanical and chemical methods.



## **Black River Action Team (BRAT)**

Lead: BRAT

BRAT is a local volunteer group

that has been doing river clean-ups since 2000. The organization has grown to involve members throughout the Black River watershed doing educational programs for youth and adults, buffer plantings and more. Since joining the basin planning Watershed Council, BRAT has spearheaded:

*Knotweed Control workshop participants*

- a visual assessment of the mainstem of the Black River by volunteers to gather information on the river's overall condition and lay the foundation for determining where and what types of in-depth studies need to be done. Sites for clean-up projects, erosions control buffer plantings and future watershed planning efforts are all supported by the data gathered in the assessment.
- two buffer planting projects in the Town of Springfield
- lead two rain-barrel construction workshops to help homeowners keep stormwater out of the river
- creation of a Japanese knotweed informational brochure
- coordinated Clean Water Day on the river
- establishing a volunteer water quality monitoring program

## **Lake Rescue Sediment Control Projects**

Lead: Lake Rescue Association (LRA) & Town of Ludlow

LRA has been working diligently for a number of years to address sedimentation accumulating in Round Pond, the northern end of Lake Rescue. Working with the Town of Ludlow DPW and the Better Backroads program erosion control projects have been implemented on numerous roads, sediment basins have been constructed and ditches have been rock lined on roads surrounding the lake. Outreach and education to lakeshore landowners on property management and buffers is also a strong focus. Completed projects include:

- stabilization of town road ditch just off Ellison Road and installation of settling basins in the State fishing access area;
- lower East Lake Road installation of stone lined ditch and catch basin;
- Ellisons Lake Road installation of 350 feet of stone lined ditch and stone catch basin at outlet of cross-culvert;
- projects in progress include a sediment core study to determine the origin of the sediment accumulating in Round Pond and Lake Rescue and a demonstration lakeshore buffer installation. LRA also coordinated with VWQD to create a new depth survey chart of the lake.

### **Better Backroads Projects (BBR)**

Town of Cavendish - Replace and realign culverts on Twenty Mile Stream Road in Cavendish

Town of Cavendish - Stabilization of ditches and banks on Howard Hill Road in Cavendish

Town of Hartford - Planning for transportation improvements that will include water quality improvements

Town of Pomfret - Inventory of town culvert erosion issues; results will be used to prioritize and budget for correction of problems

Town of Springfield Culvert Inventory and Stormwater Assessment - Inventory of town road erosion issues; results will be used to prioritize and budget for correction of problems

Town of Weathersfield - Inventory of road erosion issues and development of capital budget plan



*Road ditch sediment control basin installed near Lake Rescue by LRA & BBR*

### **Woodstock Snow Dump Management**

Lead: Ottauquechee NRCD  
Town of Woodstock

Concerns expressed to the ONRCD spurred a meeting between District and Town staff meeting with the VDEC Watershed Coordinator to discuss how to better manage runoff from a large snow dump area on the banks of the Ottauquechee River. Simple measures put in place the following winter allowed the snow to melt while preventing sediment, salt and litter from entering the river. The Town is now working to move the snow dump to a lot away from the riverbank and re-develop the riverfront into a recreational park.

### **Kedron Brook Horse Crossing Improvements**

Lead: Ottauquechee NRCD  
VACD  
GMHA

Kedron Brook is listed as being in need of further assessment due to high levels of sediment, *E. coli* and nutrients likely caused by horse recreation activity; pasture; road runoff; loss of riparian vegetation; and golf course activity along the brook. Following a basin planning outreach meeting with landowners, community concern and partner support resulted in three grants from the VAAF to install improved stream crossings to fix at least seven crossings through the brook.

### **Skidder Bridge Rental Program**

Lead: Ottawaquechee NRCD

Portable skidder bridges are used by loggers to cross upland streams during logging operations without disturbing the streambed and causing erosion and sediment to enter the stream. With a large donation of lumber and labor from the Marsh-Billings-Rockefeller National Historic Park, the Park and ONRCD are hosting a training workshop for loggers and foresters on construction and use of skidder bridges. ONRCD will initiate a bridge rental program. Loggers now have access to a bridge in the District for use during their logging operations at minimal rental fees.

### **Springfield Reservoir Dam**

Lead: VDEC, Basin Planning

The deteriorating condition of the Springfield Reservoir Dam is a concern as the Town is under order to check the water level and structure daily to ensure its safety. The Watershed Coordinator organized a meeting between the two towns, Springfield and Weathersfield, to discuss the future of the dam and site and cooperation between the towns in the event of an emergency. The meeting resulted in the Southern Windsor County RPC writing an Emergency Action Plan for the towns as none existed. Springfield continues to hold discussions on the future of the dam and land.

### **Forests and Water Quality Outreach**

Lead: VDEC, Basin Planning  
VFPR

Working together the Windsor County Forester and the Watershed Coordinator have presented workshops on forests and water quality protection for landowners and teachers. As part of the *Forests for Every Classroom* series teachers were provided a training workshop on how forests and proper forest management provide clean water and protect water resources and forest landowners were offered a workshop, demonstration and educational walk on the same topic.

## Recommendations

The recommendations in this plan have been developed by Watershed Council members throughout the planning process and are presented here in two categories – stressor and non-stressor-related recommendations.

The SWMS sets goals and objectives for surface waters of Vermont. The goals define the Watershed Management Division’s vision for surface waters of Vermont. The objectives, when met, should result in attainment of the goals. The Strategy discusses how 10 major **STRESSORS** are managed by the Division’s many surface water management programs, in support of the Strategy’s objectives.

A **STRESSOR** is defined as a phenomenon with quantifiable deleterious effects on surface waters resulting from the delivery of pollutants (or the production of a pollutant within 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 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.

Of the ten stressors addressed in the SWMS nine are relevant to Basin 10, these are:

Excessive Channel Erosion	Non-Erosion Nutrient Loading
Encroachment	Pathogens
Flow Alteration	Thermal Stress
Invasive Species	Toxic Substances
Land Erosion	

**NON-STRESSOR** related recommendations are those that address topics of concern that council members brought forth for discussion. These formed the focus of numerous planning meetings. The Non-Stressor topics include:

Agriculture and Water Quality Issues	Stormwater & Low Impact Development
Buffers	Town Planning and Zoning
Forests	Uses & Values Protections
Groundwater Source Protection	Wildlife
Lakes & Ponds	

Recommendations are presented in table format with the recommendation statement followed by a table of strategies and actions that implement the recommendation. Tasks for the strategies are listed as are potential funding options. A set of primary partners is identified who are the most likely to undertake the tasks. The table also provides a list, by code number, of the other stressor or non-stressor related topics that are addressed by the given strategy. See the table below for code numbers.

The SWMS lays out priority strategies for addressing each stressor on a statewide basis. The strategies listed here are more detailed and applicable to Basin 10 waters. Key state strategies can be seen by Stressor at: [http://www.vtwaterquality.org/wqd\\_mgtplan/swms\\_ch2.htm](http://www.vtwaterquality.org/wqd_mgtplan/swms_ch2.htm)



- indicates Recommendations of the HIGHEST PRIORITY.

## Stressor / Topic Code Numbers

Stressor	No.	Non-Stressor Topic	No.
Excessive Channel Erosion	1	Agriculture and Water Quality Issues	10
Encroachment	2	Buffers	11
Flow Alteration	3	Forests	12
Invasive Species	4	Groundwater Source Protection	13
Land Erosion	5	Lakes & Ponds	14
Non-Erosion Nutrient Loading	6	Stormwater & Low Impact Development	15
Pathogens	7	Town Planning and Zoning	16
Thermal Stress	8	Uses & Values Protections	17
Toxic Substances	9	Wildlife	18

The codes numbers above indicate the stressor or topic area addressed in the following recommendation tables. The number order does not imply any priority ranking.

### Excessive Channel Erosion

Channel erosion is a natural process that benefits stream and riparian ecosystems. Erosion in naturally stable streams (i.e., in equilibrium condition) is evenly distributed and therefore minimized along the stream channel. Erosion is also a dynamic process, where the movement, sorting, and distribution of sediment and organic material create a diversity of habitats. When streams are not in equilibrium, excessive erosion occurs in some channel locations, while excessive deposition occurs at other locations up and down the stream profile. Some habitats become scoured of beneficial woody debris and sediment, while others may become smothered. Where stream disequilibrium is prevalent in a watershed, nutrients (e.g. phosphorus) attached to eroded sediments, becomes a significant stressor.

**Sediment as a Pollutant:** Fine sediment from eroded soils, when it accumulates on the bottom of a waterbody, results in sedimentation. The suspension of fine sediment in the water column causes **turbidity** which degrades habitat, e.g. reducing visibility for predators. Sedimentation smothers necessary rocky or riffle habitat for the invertebrates that provide an important source of food for fish. Some smaller species of fish also rely on the crevice space between rocks as a primary habitat. Sedimentation can cover spawning substrate and suffocate fish eggs by preventing water circulation and oxygenation. Additionally, the accumulation of sediment over spawning gravel may even deter fish from spawning at all. Fish species like walleye, trout and salmon rely on clean gravel for spawning.

### Recommendations to Address Excessive Channel Erosion

**1. Recommendation: Reduce stormwater inputs to waterways to decrease excess volume and velocity.**

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Promote broader understanding of personal stormwater impacts thru education on rainbarrels and raingardens, esp. in Springfield, Ludlow & Woodstock	- Hold workshops - Do demonstrations	Watershed, Clean & Clear	ONRCD, watershed assoc's, VDEC	1, 3, 5, 6, 8, 15	
<b>B</b>	Discourage development in floodplains	- Work with town zoning - Provide outreach	604(b)	RPCs, VLCT	2, 8, 11, 16, 18	
<b>C</b>	Promote LID standards in town planning, zoning and development projects	- Work with town zoning - Hold workshops - Do demonstrations	604(b), ERP	RPCs, VLCT	15, 16	
<b>D</b>	Review stormwater controls at Hartness Airport	- Provide technical assistance and recommendations - Implement BMPs	SW Mitigation, ERP	VDEC	8, 9	

**2. Recommendation: Implement a highly visible community project to bring attention to stormwater and LID issues.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Complete one LID stormwater project in Springfield	- Meet with partners to review stormwater data and select project - Acquire funding - Implement project	319, Watershed, ERP	RPCs, VDEC, watershed assoc's	1, 3, 5, 6, 8, 9, 15, 16	

**3. Recommendation: Address erosion issues at:**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Barnard Brook near Rte 12, address erosion issues and failing banks	- Assess causes of erosion - Determine & implement mitigation strategy	SW Mitigation, BBR, TE, ERP	VTrans, VDEC, Woodstock & Pomfret DPW	1, 3, 5, 8, 10, 11, 18	

<b>B</b>	Seavers Brook Road, Springfield, slow flow in paved ditch	- Assess causes of erosion - Determine & implement mitigation strategy	BBR, ERP	Springfield DPW, VDEC	1, 3, 5, 8, 9, 15	
----------	---	---	----------	-----------------------	-------------------	--

**4. Recommendation: Address road erosion and road impacts.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Ensure towns have sheds for salt and sand piles	- Work with towns on funding for sheds	SW Mitigation, ERP, 319	RPCs, ONRCD, VDEC	9	
<b>B</b>	Ensure all road ditches are properly lined with stone or mulched & seeded, depending on slope, to prevent erosion	- Work with town road agents on Local Roads workshops - Provide education on erosion and WQ impacts of ditch runoff	BBR, Watershed, ERP	VDEC, RPCs, ONRCD	1, 5, 8, 9	
<b>C</b>	Encourage towns to retrofit parking lots, etc. with LID practices including tree boxes	- Provide information on LID BMPs - Provide technical assistance with grant funding	604(b), 319	RPCs, VDEC, ONRCD	1, 3, 5, 8, 9, 15	
<b>D</b>	Educate about driveway erosion, distribute flyers	- Provide driveway erosion flyers to watershed assoc's - Work with towns on driveway access ordinances & standards	604(b), Watershed, ERP	VDEC, ONRCD, RPCs, watershed assoc's,	1, 3, 5, 8, 9, 15	

**5. Recommendation: Work with towns to create capital budget plans for planned culvert replacements as they are required to do.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Conduct bridge and culvert assessments at stream crossings using ANR's methodology with trained personnel	- Focus areas: Plymouth, Woodstock, Pomfret	ERP	RPCs, VDEC	1, 3, 5, 16, 18	
<b>B</b>	Assist towns in writing BBR grants for capital budget planning			RPCs, VLRP, VDEC	3, 5, 16, 18	

<b>C</b>	Encourage towns to consider all options for bridge and culvert replacement, esp. natural bottom culverts, to address erosion, flow and AOP issues			VFWD, RPCs, VLRP, VTrans, VDEC	1, 3, 5, 16, 18	
<b>D</b>	Encourage towns to design culverts and bridges to accommodate hydraulic, geomorphic and ecological processes			VFWD, RPCs, VLRP, VTrans, VDEC	1, 3, 5, 16, 18	

## Encroachment

Encroachment is a term used to describe the placement of structures, roads, railroads, improved paths, utilities, and other development, the placement of fill, the removal of vegetation, or an alteration of topography into natural areas such as floodplains, river corridors, wetlands, lakes and ponds, and the buffers around these areas. Such encroachments cause impacts to the functions and values of those natural areas, such as a decline in water quality, loss in habitat (both aquatic and terrestrial), disruption of equilibrium (or naturally stable) conditions, loss of flood attenuation, or reduction of ecological processes.

Encroachments within river corridors and floodplains are vulnerable to flood damages. Placing structures in flood prone areas results in a loss of flood storage in floodplains and wetlands and heightens risks to public safety. Moreover, encroachments often result in the use of channelization practices -- such as bank armoring, berming, floodwalls, and channel straightening – to protect these investments. The removal of vegetation to improve viewsapes or access, and the removal of woody debris from rivers to facilitate human use can increase resource degradation and the property’s susceptibility to flood damages, causing higher risks to public safety. Such practices result in greater channel instability, excessive erosion, and nutrient loading by concentrating flows and increasing stream velocities and power.

### Recommendations to Address Encroachment

 **6. Recommendation: Complete a full set of Fluvial Erosion /River Corridor & Special Flood Hazard Area maps for Basin 10.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status

<b>A</b>	Pursue additional stream geomorphic assessment and river corridor planning to provide data & understand causes of stream instability and identify strategies to allow streams to regain equilibrium.	- Focus on un-assessed tributaries	ERP	VDEC-RMP, RPCs, ONRCD	1, 2, 5, 6, 11, 16	
<b>B</b>	Do preliminary RC/FEH maps to include in this Plan * Maps should be continuous from town to town	- Work with RMP to create maps	Watershed, ERP, 604(b)	VDEC-RMP, RPCs	2, 16	Maps completed for Ludlow & Cavendish
<b>C</b>	Work with towns to set appropriate / allowed land uses for each area	- Meet with towns to discuss RC/FEH maps	604(b)	VDEC, RPCs	2, 16	

**7. Recommendation: Identify important river corridor lands and target conservation and education efforts to these landowners.**

	<b>Strategy – Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Secure river corridor conservation easements to protect corridors and buffer habitat	- Select appropriate sites for conservation - Educate landowners - Seek TE funding	TE, ERP	RPCs, watershed assoc's, VDEC	2, 11, 17, 18	

**8. Recommendation: Provide outreach on best practices to “save your own riverbank.”**

	<b>Strategy – Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Offer workshops on buffers – functions, values, planting, maintenance, etc.		Watershed, ERP	ONRCD, watershed assoc's, VDEC, VFWD	1, 2, 5, 8, 11, 17, 18	
<b>B</b>	Offer technical assistance to landowners on stabilization issues, focus areas include Woodstock village , N. Branch Black,		Watershed, ERP	ONRCD, watershed assoc's, VDEC, VFWD	1, 2, 5, 11	
<b>C</b>	Enhance the native plant nursery and offer stock to basin landowners for private buffer projects		Watershed, ERP	ONRCD, watershed assoc's	1, 2, 5, 8, 11, 17, 18	



**9. Recommendation: Provide outreach to select boards, zoning administrators, planning commissions, etc. on planning and zoning strategies for minimizing encroachments into RC/FEH and SFH areas.**

	<b>Strategy – Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Work with towns to protect river corridors from the destabilizing effects of further building and encroachment along streams and rivers.		base	VDEC-RMP	2, 11, 16	
<b>B</b>	Attend town board meetings to provide information and technical assistance on planning and zoning ordinance options		604(b)	RPCs, VDEC, VFWD , VLCT	2, 16	
<b>C</b>	Encourage towns to adopt RC/FEH zones into town zoning and discourage further encroachment into mapped NFIP floodplains and FEH zones		604(b)	RPCs, VDEC, VLCT	2, 16	
<b>D</b>	Provide regulatory review and technical assistance to landowners and municipalities to determine appropriate channel management practices and stream crossing designs that minimize or resolve land use conflicts with river systems as well as support ecological function and services of riverine systems		base	VDEC, VFWD	2, 16	

**10. Recommendation: Use land banking or private land set-asides to mitigate for development of buffer areas when planting is not possible.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Incorporate mitigation into development plans where state and town permits are required	- Contact Town of Williston for guidance - Research other similar programs		Town planning commissions and development review boards, VDEC permittees, Act 250 Environmental Review Boards	2, 11, 16, 17, 18	



**11. Recommendation: Plan for the future of current infrastructure in the hazard zones.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Ensure Hazard Mitigation Plans are up to date in all Basin towns		604(b)	VDEC, RPCs	2, 16	
B	Encourage towns to join NFIP	Non-participating towns: Baltimore Killington Pomfret	604(b),	VDEC, RPCs, VLCT	2, 16	
C	Work with town DPWs to identify threatened infrastructure for planned capital improvements		604(b), BBR	VDEC, RPCs, VLCT, BBR	2	

## Flow Alteration

Flow alteration is any change in the natural flow regime of a river or stream or water level of a lake or reservoir induced by human activities. The four principal causes are:

1. water withdrawals for water supply, snowmaking, industrial uses or agriculture;
2. hydroelectric power;
3. flood control; and
4. manipulation of lake and reservoir water levels to support certain recreational uses or manage adjacent infrastructure.

In rivers and streams, the flow regime is a dominant ecological factor in determining their form and function. The type and amount of habitat and the diversity and abundance of species that can utilize that habitat are significantly affected by the flow regime.

Depending on the nature of the flow alteration, channel and shoreland stability and the integrity of adjacent floodplain function may be affected. Sediment flows are disrupted in river impoundments; “starving” downstream reaches of sediment and leading to major channel incision and disequilibrium. The magnitude, frequency, duration, and timing of flow are dominant factors in riverine ecosystems. Alteration of the natural flow and water level patterns may result in direct stress to aquatic organisms to the point where native species richness, abundance and distribution decline. Hydropower dams and water withdrawal structures create habitat discontinuity, restricting the movement of migratory fish and resident organisms.

Many Vermont lakes have a dam on the outlet which has raised the water level of a natural lake between 3 and 10 feet. In some cases the water level may be drawn down, for varying reasons. This creates an area of littoral zone exposed to freezing and results in a zone bordering the lake that lacks healthy shallow water, riparian and wetland communities. Most immediate is the exposure and stress or death of animals that lack the mobility to move down with the water: mussels, macroinvertebrates, small fish and fish eggs. Any species that have already hibernated may be unable to move. Aquatic plant communities in the dewatered zone can also be degraded, as can wetlands associated with the lake.

### **Recommendations to Address Flow Alteration**

 **12. Recommendation: Springfield Reservoir Dam in Weathersfield has been listed as being in Poor Condition or Damaged since 1969. This dam should be breached or removed.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Support town in its efforts to breach the dam	- Attend meetings - Provide information and do outreach on dam condition		VDEC, SWCRPC	3	
<b>B</b>	Work with the town to seek funding for the breach or removal work		ERP, USFWS, NOAA/AR	VDEC, SWCRPC	3	

**13. Recommendation: Support dam removal and identify suitable dams to remove.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Update Vermont Dam Inventory through SGAs or independent research work	- Work with TNC on database updating	ERP, 604(b)	VDEC, VFWD, TNC, RPCs	3	
<b>B</b>	Assess structural condition of all dams and evaluate removal status		ERP	VDEC, TNC	3, 18	

<b>C</b>	Provide education and outreach on the impact of dams on water quality and aquatic habitat to build community support for removal	- Report on the condition of a dam, the potential area of impact and the estimated costs of repair as part of the case for removal	Watershed, ERP, 604(b)	VDEC, VFWD, RPCs, town boards, watershed assoc's	3	
<b>D</b>	Remove at least one dam	- Seek local support and outside funding for removal if condition warrants	ERP, USFWS, NOAA/AR	VDEC, USFWS	3, 18	

**14. Recommendation: Support the maintenance of historic dams if the ecological significance of removal is low and they are at the top of the watershed where they created wetlands and do not provide spawning habitat.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Seek local support and outside funding for dam maintenance and retrofitting if condition warrants		Historic Preservation, Watershed, ERP	RPCs, town boards, watershed assoc's	17	
<b>B</b>	Assign party responsible for dam maintenance and schedule periodic inspections			town boards, VDEC	17	

**15. Recommendation: Inspect the privately owned dam on the upper Patch Brook (Segment M40T5.04-C, -72.7284, 43.4861) and assign a hazard rating. In the event of dam failure, a considerable volume of water and sediment would be released to downstream reaches of the Patch Brook.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Research to determine the construction details and purpose of the dam		base	VDEC – Facilities Engineering Div.	3	
<b>B</b>	Conduct inspection and assign hazard rating		base	VDEC – Facilities Engineering Div.	3	

**16. Recommendation: Create a set of recommendations for building in a floodplain below a dam.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Craft recommendations for personal safety and property protection for those living below dams	- Ensure that all dams have a EAP <sup>27</sup> in place and signed	planning grants, 604(b)	RPCs, town planning commissions, RMP, VEM	2, 3, 16	
<b>B</b>	Distribute outreach materials to those in emergency drainage area in event of a dam breach		planning grants, 604(b)	RPCs, town planning commissions	2, 3, 16	

## Invasive Species

Aquatic invasive species are non-indigenous plants, animals, algae, fungi or pathogens – disease causing organisms like viruses and bacteria – that threaten the diversity and survival of native species or the ecological stability of infested ecosystems, or commercial, agricultural or recreational activities dependent on these natural resources. They are a form of biological pollution.

At least 49 aquatic non-native species are known in Vermont and myriad terrestrial species, a significant number of these have become invasive. Many of the state's waters, especially lakes, have a history of impacts related to these invasions.

Preventing new aquatic invasive species from being introduced and becoming established in Vermont is critical, not only to limit the future cost of managing invasive species but also to protect the integrity of Vermont's ecosystems.

Some of the invasives of concern in the Basin include:

- |                          |  |
|--------------------------|--|
| Japanese Knotweed        | Water Chestnut   |
| Common Reed – Phragmites | Rusty Crayfish   |
| Purple Loosestrife       | Rudd   |
| Eurasian Watermilfoil    | and although not currently present, in any Basin 10 waters, Didymo |

<sup>27</sup> Emergency Action Plan

Known populations of aquatic invasives include:

<b>Deweys Mill Pond</b>	Hartford	Eurasian watermilfoil	<b>(<i>Myriophyllum spicatum</i> L.)</b>
		Rudd	<b>(<i>Scardinius erythrophthalmus</i>)</b>
North Hartland Lake	Hartland	Eurasian watermilfoil	
<b>North Springfield Lake</b>	Springfield	Water chestnut (Controlled)	<b>(<i>Trapa natans</i>)</b>
<b>Black River</b>	Springfield	Rusty Crayfish	<b>(<i>Orconectes rusticus</i>)</b>
		Eurasian watermilfoil	
		Curly leaf pondweed	<b>(<i>Potamogeton crispus</i>)</b>
		Purple loosestrife	<b>(<i>Lythrum salicaria</i>)</b>
<b>Ottawaquechee River</b>	Hartland	Purple loosestrife	
<b>Vondell Reservoir</b>	Woodstock	Rudd	

Rusty Crayfish have become established in the very lower reaches of the Black River but are being contained by the dams in Springfield. Common reed or phragmites (*Phragmites australis*), is ubiquitous throughout the Basin.

Terrestrial and riparian invasives are a threat to streambank stability and wildlife resources. One species is of particular concern throughout the region. Japanese knotweed (*Fallopia japonica*), often called false bamboo is commonly found along waterways and has become the dominant species along substantial stretches of rivers and streams throughout the Basin. This fast-growing perennial spreads vegetatively by even tiny plant fragments. Its rapid early spring growth out-competes native plants creating an almost impenetrable monoculture along large stretches of both rivers. Japanese knotweed is a major water quality concern due to its perennial life cycle. Dying back completely in the winter, knotweed leaves no substantial vegetation to protect the streambank from erosion during spring high water. The resulting severe erosion and bank undercutting exposes the plant's roots and breaks off fragments which travel downstream and start new infestations.



Japanese Knotweed (*Fallopia japonica*)

Habitat impacts of Japanese knotweed result as it displaces native plants depleting wildlife food sources and degrading streambank habitat. The lack of insects feeding on streamside vegetation also depletes fish food supplies. The dense stands formed prevent taller trees from becoming established along banks obstructing their growth from providing shade and their roots for stabilizing the bank soils. Knotweed is also having recreational impacts as its dense growth impedes access to the river for anglers and boaters.

## Recommendations to Address Invasive Species

### ★ 17. Recommendation: Control invasive plants in riparian buffers to allow native woody vegetation to become established.

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Offer guidance on removal of invasive plants		AIS Grant-in-Aid, Watershed, ERP	VDEC, ONRCD, watershed assoc's	4	
B	Provide spread prevention guidelines		AIS Grant-in-Aid, Watershed, ERP	VDEC, ONRCD, watershed assoc's	4	
C	Encourage and assist with buffer planting		AIS Grant-in-Aid, Watershed, ERP	VDEC, ONRCD, watershed assoc's	4, 5, 11, 18	
D	Work with land trust <b>easement</b> monitors on ID and reporting		ANS Grant-in-Aid, Watershed, ERP	VDEC, ONRCD, watershed assoc's	4	
E	Monitor and work to control Phragmites on Woodward Reservoir	- work with lake residents to ID plant location - involve residents in control efforts	ANS Grant-in-Aid	VDEC, ONRCD, watershed assoc's, Farm & Wilderness	4, 14	

### 18. Recommendation: Expand the VIP program to establish more complete monitoring coverage involving boaters / paddlers and other water users.

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Offer VIP workshops on invasive plant and animal identification and survey techniques		ANS Grant-in-Aid	VDEC, watershed assoc's	4	
B	Recruit more lakes and rivers into the monitoring program				4	Active programs on Lakes Rescue, Ninevah & No. Springfield Reservoir

<b>C</b>	Actively survey for new infestations on Basin lakes		ANS Grant-in-Aid	watershed assoc's	4	
<b>D</b>	Provide an easy reporting and tracking system		ANS Grant-in-Aid	VDEC	4	

**19. Recommendation: Educate on invasives spread prevention – aquatic, riparian and terrestrial.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Establish a Greeter Program for Basin lakes	- staff boat launch sites and provide ANS education	ANS Grant-in-Aid, Watershed	VDEC, ONRCD, watershed assoc's	4	
<b>B</b>	Create a Clean Boat = Clean Water program	- Provide boat cleaning stations at heavily used boat launching sites - Enhance outreach coverage at boat launch areas	ANS Grant-in-Aid, Watershed	VDEC, watershed assoc's	4	
<b>C</b>	Provide education programs on invasives spread prevention and control	Reach out to: - landscapers, nursery owners and Master Gardeners - realtors and property managers - general public	ANS Grant-in-Aid, Watershed, ERP	VDEC, ONRCD, TNC, watershed assoc's, paddling groups	4	
<b>D</b>	Offer various outreach formats to reach a broader audience	- A, B & C may take the form of workshops, booklets, field guides or other formats - Work with TNC to promote and offer "Wise on Weed" trainings - Offer New England Wildflower Foundation video program on invasives for rent			4	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

**20. Recommendation: Strengthen regulatory authority over the control of invasive species.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Add species to the state quarantine list to prevent further spread including Japanese and Common barberry, Russian and Autumn olive, Winged euonymus, Yellow iris, Black Swallow-wort and others			VDEC, AAFM, Vermont Invasive Exotic Plant Committee	4	
<b>B</b>	Enhance the power of regulators to control and enforce the Noxious Weeds quarantine			VT legislature	4	

**21. Recommendation: Re-establish the Community Forestry program formerly run through the NRCD's to provide smaller landowners with technical help on invasives.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Fund and establish program	- Seek permanent funding - Hire staff	Capital, ERP, Watershed	VDFPR, NRCDs	4	

**22. Recommendation: Work with town and state highway departments to prevent further spread of invasives.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Sponsor <i>Invasives 101: Invasive Plant Management</i> , the Vermont Local Roads workshop in various locations around the Basin		ANS Grant-in-Aid, Watershed	ONCRD, TNC, VLR, VDEC, VTrans	4	
<b>B</b>	Provide invasive plant identification guides to road crews for carrying in maintenance trucks		ANS Grant-in-Aid, Watershed, ERP	ONCRD, TNC, VLR, VDEC, VTrans	4	

<b>C</b>	Work with VTrans to establish <b>Best Management Practices</b> for invasives spread prevention in road maintenance work			VDEC, TNC, VLR, VTrans	4	
----------	---	--	--	------------------------	---	--

**23. Recommendation: Expand the Ottauquechee Cooperative Invasive Species Management Area (CISMA) to reach the entire Basin.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Establish a reporting system to ID, geographically locate and track populations	- provide training on the use of TNC's iMapInvasives <sup>28</sup> for reporting invasive population locations	ANS Grant-in-Aid, Watershed	TNC, VINS, VDEC, watershed assoc's	4	
<b>B</b>	Create an atlas of invasives and write BMP's for invasives control focused on management and spread prevention		ANS Grant-in-Aid, Watershed	TNC, VINS, VDEC	4	
<b>C</b>	Establish an invasive species coordinator at the district level to work on outreach and control		ANS Grant-in-Aid, Watershed	TNC, VDEC	4	

## Land Erosion

Land erosion becomes a water quality stressor when sediment and soil on the surface of the land are dislodged and moved eventually reaching surface waters. Land erosion is a natural process caused by wind and precipitation, but can be greatly increased through human activities. These include activities that eliminate the buffer vegetation or increase runoff from developed lands; construction activities; agriculture; and forest management.

### Recommendations to Address Land Erosion



**24. Recommendation: Prevent further buffer loss. Preserve and enhance existing buffers.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide incentives to discourage landowners from mowing buffers or altering riparian areas		CREP, ERP, Watershed	VDEC, ONRCD	1, 2, 4, 5, 6, 8, 11, 17, 18	

<sup>28</sup> iMapInvasives database and training can be accessed at: [www.vtinvasives.org](http://www.vtinvasives.org)

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>B</b>	Educate and involve road crews in buffer management along roadways		BBR, ERP, Watershed	VDEC, VLRP, VTrans, ONRCD	1, 4, 5, 8, 11, 17, 18	
<b>C</b>	Incorporate buffer plantings into existing riprap		CREP, BBR, ERP, Watershed	VDEC, VLRP, VTrans, ONRCD	1, 4, 5, 6, 8, 11, 17, 18	
<b>D</b>	Expand the state's river conservation easements program on both rivers and lakes	- Priority areas: No. Branch Black, Twenty Mile Stream, Barnard Brook	ERP	VDEC, VRC, CF, VLT	1, 2, 8, 11, 17, 18	
<b>E</b>	Expand the native plant nursery to make stock available to Basin landowners		ERP, Watershed	VDEC, ONRCD	1, 2, 4, 5, 6, 8, 11, 17, 18	
<b>F</b>	Expand planting programs such as Trees for Streams in the Basin	- Priority areas: No. Branch Black, Twenty Mile Stream, Barnard Brook	ERP, Watershed	VDEC, AAFM, ONRCD	1, 2, 4, 5, 6, 8, 10, 11, 17, 18	

**25. Recommendation: Enforce buffer regulations.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Enforce the <b>AAP</b> buffer requirements, expand their width and require at least shrub coverage		AAFM	VDEC, VAAFM	1, 2, 4, 5, 6, 8, 10, 11, 17, 18	

**26. Recommendation: Establish a portable skidder bridge program in the Basin.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Hold a portable skidder bridge construction workshop		Watershed, ERP	ONRCD, VDFPR, VDEC	1, 5, 18	Completed
<b>B</b>	Establish a bridge rental program		Watershed, ERP	ONRCD, VDFPR, VDEC	1, 5, 18	Completed

**27. Recommendation: Educate town boards on the options for implementing erosion control language into planning and zoning documents.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status

<b>A</b>	Provide town boards with model ordinances for buffers, road and bridge standards, highway access policies, culvert dimensions, etc.		Watershed, ERP	VLCT, VLRP, VTrans, RPCs	5, 15, 16	
<b>B</b>	Provide a model road maintenance policy with standards for snow clearing from roads (not bare pavement) and gravel size (larger gravel is better for water quality) to minimize sand and salt runoff from winter roads			VLRP, VTrans	5, 15, 16	

**28. Recommendation: Use protective measures when doing infrastructure work around lakes and waterways to prevent erosion.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Fabric, mulch, re-plant, seed or hydroseed all cleared areas and ditches		BBR	VTrans, town road crews, utility companies, etc.	1, 4, 5, 11, 15	
<b>B</b>	Use spare and selective cutting of vegetation near waterways and lakes		BBR	VTrans, town road crews, utility companies, etc.	1, 4, 5, 8, 11, 14, 18	
<b>C</b>	Encourage towns to retrofit parking lots, etc. with LID practices including tree boxes		TE, Watershed, ERP	VLRP, VTrans, town road crews, utility companies, etc.	1, 3, 5, 8, 15	

**29. Recommendation: Work with towns to better train road crews to minimize erosion from gravel road maintenance.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Encourage towns to host & participate in the Local Roads program and the training workshops offered		VLRP, BBR	watershed assoc's, VLRP, VTrans, VDEC, VFWD, RPCs	1, 3, 4, 5, 8, 11, 18	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>B</b>	Provide technical assistance to town and private property owners when replacing, retrofitting, or installing new stream crossing structures to improve or ensure AOP, sediment transport and stream stability, and improve protection of road networks		VLRP, BBR	VLRP, VTrans, VDEC, VFWD, RPCs	1, 3, 4, 5, 8, 11, 18	
----------	--	--	-----------	--------------------------------	-----------------------	--

**30. Recommendation: Provide outreach on best farming practices for floodplains.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Offer farm workshops on: - No-till farming - Cover cropping - Soil conservation practices for floodplains - Corridor easements for land protection		ERP, Watershed, SARE, AAFM	ONRCD, AAFM, USDA/NRCS	2, 5, 6, 10, 11	

**31. <sup>a29</sup> Recommendation: Exclude livestock from streambank and shoreline areas and establish alternate water sources, particularly in areas that are at high risk for nitrate leaching, phosphorus loss and soil erosion.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase technical and financial assistance to farms willing to exclude livestock from surface waters	Focus area: Kedron Brook	USFWS, VAAFM, VDEC, NFWF, TNC	VAAFM, VACD, ONRCD, SVNMP, FSA, USFWS, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 10, 11, 18	In Progress
<b>B</b>	Increase education on the benefits of livestock exclusion from surface waters		USFWS, VAAFM, VDEC, NFWF, TNC	VAAFM, VACD, ONRCD, SVNMP, FSA, USFWS, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 10, 11, 18	

<sup>29 a</sup> – Indicates a recommendation proposed by Agriculture Working Group of the Watershed Council

<b>C</b>	Identify and prioritize high risk streambank and shoreline areas that would benefit from livestock exclusion	Focus area: Kedron Brook	USFWS, VAAFM, VDEC, NFWF, TNC	VAAFM, VACD, ONRCD, SVNMP, FSA, USFWS, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 10, 11, 18	
----------	--	--------------------------	-------------------------------	--	---------------------------	--

**32. <sup>a</sup> Recommendation: Increase awareness and implementation of farm soil health improvement practices.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide additional technical assistance to farmers on cover cropping, crop rotation, composting, conservation tillage, and soil sampling techniques		NRCS, VAAFM, VANR, UVM Ext	VAAFM, ONRCD, SVNMP, UVM Ext, NRCS, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 9, 10, 11, 18	
<b>B</b>	Provide increased financial support to farmers willing to adapt such newer technologies to their farms		NRCS, VAAFM, VANR, UVM Ext	VAAFM, ONRCD, SVNMP, UVM Ext, NRCS, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 9, 10, 11, 18	
<b>C</b>	Provide local workshops on soils, soil sampling and soil health to farmers		NRCS, VAAFM, VANR, UVM Ext	VAAFM, ONRCD, SVNMP, UVM Ext, NRCS, NOFA-VT, VFB, Farm Operators	1, 5, 6, 7, 8, 9, 10, 11, 18	

**33. <sup>a</sup> Recommendation: Increase voluntary farm buffer establishment, as appropriate, along surface waterways and upland wetlands.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase financial support to farmers willing to install buffers through programs like CREP and VABP	Focus areas: Kedron Brook, No. Branch Black, Twenty Mile Stream	EPA, USFWS, VAAFM, VDEC, NFWF, TNC	ONRCD, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB	1, 2, 3, 4, 5, 6, 7, 8, 11, 18	
<b>B</b>	Work with state, federal and local organizations to establish these buffers		EPA, USFWS, VAAFM, VDEC, NFWF, TNC, ERP, Watershed	ONRCD, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, watershed assoc's	1, 2, 3, 4, 5, 6, 7, 8, 11, 18	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>C</b>	Provide education on the value and need for buffers		EPA, USFWS, VAAFM, VDEC, NFWF, TNC, ERP, Watershed	ONRCD, VAAFM, VFWD, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, watershed assoc's	1, 2, 3, 4, 5, 6, 7, 8, 11, 18	
<b>D</b>	Increase funding for projects like 'Trees for Streams'		EPA, USFWS, VAAFM, VDEC, VDFPR, NFWF, TNC, ERP, Watershed	ONRCD, VAAFM, FSA, NRCS, VDEC, watershed assoc's	1, 2, 3, 4, 5, 6, 7, 8, 11, 18	

## Non-Erosion Nutrient Loading

Non-erosion based nutrient loading results from direct application of nutrients to lands (e.g., fertilizer application) that may be subsequently washed into surface waters without any attendant land erosion, or from direct or indirect discharges (e.g., wastewater treatment facilities). Phosphorus and nitrogen are the two major nutrients of concern for Vermont's surface waters. In most of Vermont's surface



waters, as in most fresh water systems, phosphorus is considered the limiting nutrient; nitrogen tends to be the limiting nutrient in salt water or brackish systems.

Nutrients that are directly delivered to surface waters are typically in a chemical form that is more biologically available and therefore readily assimilated by algae. These tend to have more immediate and localized impact when excess quantities of nutrients are discharged.

## Recommendations to Address Non-Erosion Nutrient Loading

### 34. Recommendation: Work with farmers to control nutrient runoff from farmland.

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase the number of small and medium farms following nutrient management plans		USDA EQIP, AAFM/FAP	ONRCD, VACD, SVNMP, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB	6, 7, 9	
<b>B</b>	Increase the number of small and medium farms using cover crops		USDA EQIP, AAFM/FAP	ONRCD, VACD, SVNMP, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB	5, 6, 7, 9	

<b>C</b>	Prevent the spreading of fertilizer in buffers		USDA EQIP, AAFM/FAP	ONRCD, VACD, SVNMP, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB, watershed assoc's	6, 7, 9, 11	
<b>D</b>	Increase the number of small and medium farms basing fertilizer application quantities on soil test results		USDA EQIP, AAFM/FAP	ONRCD, VACD, SVNMP, VAAFM, FSA, NRCS, VDEC, UVM Ext, NOFA-VT, VFB	6, 7, 10	

**35. Recommendation: Increase the capacity of agricultural technical assistance providers and programs.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Increase and make secure the funding for Agricultural Resource Specialists, Land Treatment and Nutrient Management Planners		AAFM, NRCS	VACD, VAAFM, USDA/NRCS & FSA, ONRCD	5, 6, 7, 8, 9, 10, 11	
<b>B</b>	Secure continued funding for the NRCD <i>Trees for Streams</i> program and expand the program		AAFM, ERP, Watershed	VACD, VAAFM, USDA/NRCS & FSA, ONRCD	2, 4, 5, 6, 7, 8, 9, 10, 11, 18	
<b>C</b>	Further promote the CRP, CREP and WRP programs			VACD, VAAFM, USDA/NRCS & FSA, ONRCD, UVM Ext., VFB	2, 4, 5, 6, 7, 8, 9, 10, 11, 18	
<b>D</b>	Expand the coverage of the new agricultural extension agents beyond the Lake Champlain Basin to provide direct technical assistance to producers in Basin 10 with agronomic assistance and treatment designs		AAFM, NRCS	VACD, VAAFM, USDA/NRCS & FSA, ONRCD	4, 5, 6, 7, 9, 10, 11	
<b>E</b>	Expand and focus the Agricultural Environmental Management (AEM) outreach program	Focus areas: Kedron Brook, No. Branch Black, Twenty Mile Stream	AAFM, VACD	VACD	4, 5, 6, 7, 9, 10, 11	

**36. Recommendation: Educate lakeshore property owners on sources of nutrients and their relationship to excessive plant growth within the lake.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Address land development runoff, lawn maintenance and other potential nutrient sources in outreach efforts	- Address nutrient / plant growth relationships and nutrient control methods	Watershed, ERP	VDEC, ONRCD, watershed assoc’s		
B	Promote buffer planting to reduce sediment runoff leading to nutrient loading		Watershed, ERP	VDEC, ONRCD, watershed assoc’s		
C	Distribute “Don’t P on the Lawn” brochure		Watershed, ERP	VDEC, ONRCD, watershed assoc’s		

**37. <sup>a</sup> Recommendation: Continue outreach to farmers on the Accepted Agricultural Practices.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Work with farmers through education and outreach on the AAPs		VAAFM, VANR	ONRCD, SVNMP, VAAFM, UVM Ext, NOFA-VT, VFB		
B	Encourage development of peer advisory groups for problem solving agricultural resource concerns			ONRCD, SVNMP, VAAFM, UVM Ext, NOFA-VT, VFB, Farm Operators		

**38. <sup>a</sup> Recommendation: Develop innovative and emerging technology which will result in improved water quality while maintaining the economic integrity of the agricultural land base in the basin.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Increase awareness/ development of improved manure storage/handling practices and farm wastewater treatment		NRCS, VAAFM, VANR, UVM Ext, TNC, TU, NOFA	ONRCD, SVNMP, VACD, VAAFM, NRCS, VANR, UVM Ext, CVPS, NOFA-VT, VFB	6, 7, 10	
B	Investigate and coordinate alternative funding sources for projects		NRCS, VAAFM, VANR, UVM Ext, TNC, TU, NOFA	ONRCD, SVNMP, VACD, VAAFM, NRCS, VANR, UVM Ext, CVPS, NOFA-VT, VFB		

**39. <sup>a</sup> Recommendation: Continue to work with farmers to develop and implement nutrient management plans regardless of farm acreage.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase funding for farmers to create their own nutrient management plans (including alternative sources)		VAAFM, VANR, NRCS, NOFA	VACD, VAAFM, NRCS, UVM Ext, NOFA-VT, VFB	6, 7, 10	
<b>B</b>	Increase technical assistance for farms to develop & implement nutrient management plans	- Use IJC project as potential model	VAAFM, VANR, NRCS, NOFA	VACD, VAAFM, ONRCD, SVNMP, NRCS, UVM Ext, NOFA-VT, VFB	6, 7, 10	
<b>C</b>	Provide education on need for NMP including economic benefits		VAAFM, VANR, NRCS, NOFA	VACD, VAAFM, ONRCD, SVNMP, NRCS, UVM Ext, NOFA-VT, VFB	6, 7, 10	

**40. Recommendation: Decrease impacts and optimize efficiencies of wastewater discharges and onsite systems on water quality.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase awareness of home septic system maintenance on water quality and encourage improved management	- Conduct seminars on septic system maintenance - Distribute informational materials to homeowners - Encourage regular testing of private well water sources	Watershed, 604(b)	Watershed Assoc's, ONRCD, RPCs, municipal health offices, VDEC	6, 7, 9	
<b>B</b>	Identify surface waters in each basin that may benefit from wastewater management planning		Watershed, 604(b)	Watershed Assoc's, ONRCD, RPCs, municipal health offices, VDEC	6, 7, 9	

## Pathogens

Waterborne human pathogens are disease-causing bacteria, viruses, and protozoa. The pathogens that are of concern in Vermont surface waters are those that come from fecal matter of humans and other warm-blooded animals. These pathogens may cause gastrointestinal problems and pose a more serious health risk to people who have weakened immune systems. Untreated surface waters containing fecal matter may pose a risk to human health when ingested through drinking water or inadvertently through contact recreation.

The primary indicator of fecal material in water used in most freshwater monitoring efforts is the enteric bacterium *Escherichia coli*. *E. coli* is a common component of the bacterial flora of humans and other warm-blooded animals. When detected in rivers, lakes, ponds, streams, or drinking water, *E. coli* may indicate that fecal material has made its way into the water. While in rare cases, some strains of *E. coli* are pathogenic in and of themselves, the presence of *E. coli* is used in monitoring programs to indicate that other more common feces-borne pathogens may also be present.

### Recommendations to Address Pathogen

#### **41. Recommendation: Work with USACE and municipalities to control animal waste along river trails.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide pooper-scooper bag stations and trash receptacles		USACE	USACE, watershed assoc's	7	

#### **42. Recommendation: Conduct outreach on septic system maintenance to landowners esp. lakeshore owners.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Distribute WQD handout on lake septic systems, adapt it for riverfront landowners		ERP, Watershed	VDEC, ONRCD, watershed assoc's	6, 7, 14	
<b>B</b>	Conduct bracketed monitoring where the source of contamination is in question		ERP, Watershed	VDEC, ONRCD, watershed assoc's	6, 7	
<b>C</b>	Conduct IDDE monitoring of stormwater discharges if wastewater connections are suspected		ERP, Watershed	VDEC, ONRCD, watershed assoc's	6, 7	Underway in Springfield

**43. Recommendation: Work with farmers to control manure runoff from farmland.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase the number of small and medium farms following nutrient management plans		USDA EQIP, AAFM/FAP	VAAFAM, NRCS, ONRCD	6, 7, 10	
<b>B</b>	Increase the number of small and medium farms using cover crops		USDA EQIP, AAFM/FAP	VAAFAM, NRCS, ONRCD	5, 6, 7, 10	
<b>C</b>	Prevent the spreading of manure in buffers		USDA EQIP, AAFM/FAP	VAAFAM, NRCS, ONRCD	6, 7, 10, 11	
<b>D</b>	Increase the number of small and medium farms basing manure application quantities on soil test results		USDA EQIP, AAFM/FAP	VAAFAM, NRCS, ONRCD	6, 7, 10	

**44. Recommendation: Increase the capacity of federal and state buffer implementation programs.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase and make secure funding for the NRCD <i>Trees for Streams</i> program and expand the program		CRP, CREP, WRP, WHIP, Ag Buffer Program, C&C Ag Fencing Program	USDA/NRCS & FSA, VAAFAM, ONRCD	2, 4, 5, 6, 7, 8, 10, 11, 18	
<b>B</b>	Further promote the CRP, CREP, WRP, WHIP and Ag Buffer programs		CRP, CREP, WRP, WHIP, Ag Buffer Program, ERP Ag Fencing Program	USDA/NRCS & FSA, VAAFAM, ONRCD	2, 4, 5, 6, 7, 8, 10, 11, 18	



**45. Recommendation: Maintain and expand bacteria monitoring program to cover the entire Basin, esp. focus on locations where contact recreation commonly occurs.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>A</b>	Expand the capacity of the volunteer monitoring programs	- Hire staff or intern program coordinators	LaRosa Partnership, Watershed, private foundations	Watershed Assoc's, VDEC	6, 7	
<b>B</b>	Continue LaRosa Partnership Program and expand capacity		LaRosa Partnership, Watershed, private foundations	Watershed Assoc's, VDEC	6, 7	

## Thermal Stress

Thermal stress is a term used to describe a temperature change that is severe enough to cause unfavorable and even lethal conditions to aquatic organisms, their populations, community structure, or ecosystem. Certain land uses, activities, discharges, and the physical condition of the aquatic ecosystem can influence water temperatures beyond natural variation to cause thermal stress.



Temperature can be a physical, biological, or chemical stressor. Physically, higher water temperatures reduce levels of dissolved oxygen, potentially creating a condition of hypoxia. Low oxygen levels can kill or affect species' life cycle functions, and can reduce species diversity and population sizes. Biologically, higher temperatures directly affect the metabolic rates of aquatic biota, disrupt their life cycle thermal cues, and have an impact on their capacity to resist disease. And chemically, higher temperatures can alter concentrations of substances in water, which can have an impact on the ability of fish to withstand chemical exposure.

### Basin 10 Recommendations to Address Thermal Stress Issues

#### **46. Recommendation: Educate landowners on personal property impacts to thermal pollution.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Inform on the percentage of riparian land in private ownership of buffers and the water quality implications of un-buffered private shorelands		Watershed, CREP, T4S	VDEC, VDFPR, VFWD, ONRCD	8, 11	

<b>B</b>	Provide buffer planting guidelines and information on sources of materials and plant stock		Watershed, CREP, T4S	VDEC, VDFPR, VFWD, ONRCD	8, 11	
<b>C</b>	Provide information on <b>AMPs</b> and <b>AAPs</b>		Watershed, CREP, T4S	VDEC, VDFPR, VFWD, ONRCD	1, 5, 6, 7, 8, 10, 11, 13	

**47. Recommendation: Promote dam removal projects as a means to address thermal pollution from impounded water.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide outreach on the benefits to dams removal to thermal stress and aquatic habitat		Watershed, NOAA/AR	VDEC, VFWD, VACD, ONRCD	8, 11	

Also see Recommendations:  
8, 13, 24, 25, 43

## Toxic Substances

Toxic substances can be defined as broad group of chemicals capable of causing harm to plants and animals including humans. There are several classes of toxic substances that have the potential to affect surface waters in Vermont. For the purposes of this Plan, toxic compounds have been grouped into five categories: atmospherically-deposited compounds; organic and inorganic contaminants that result from industrial, manufacturing or other point and non-point discharges from facilities; pesticides; contaminants of emerging concern (CECs); and biological contaminants. These groupings reflect the commonality of management options that are applied to address each contaminant group.

### Recommendations to Address Toxic Substance



**48. Recommendation: Work with local groups to locate hazardous materials left behind by TS Irene and coordinate their removal.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Survey rivers & riverbanks for hazardous materials	- Provide mark-able maps for public distribution for use in documenting locations - Provide instruction on reporting locations to state		VDEC, watershed assoc's, municipal boards and commissions	7	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>B</b>	Compile data and coordinate removal work	- Work with Hazardous Waste Div. to ensure removal of hazardous materials		VDEC	7	
----------	--	---	--	------	---	--

**49. Recommendation: Keep right of way (ROW) spraying away from waterways to prevent pesticides from entering waters.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Work with VTrans, utility companies, rail lines and other ROW holders to prevent spraying near water			VTrans, VDEC, watershed assoc's	9, 11	
<b>B</b>	Educate landowners on submitting no spray forms to VAAFM for utility ROW spraying near water			VTrans, VAAFM, VDEC, watershed assoc's	9, 11	

**50. Recommendation: Decrease the use of road salts to protect both surface and groundwater resources or change to a less damaging salt formula.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Bring the Local Roads workshop on Winter Road Maintenance to Basin 10 towns to train road crews on sand and salt spreader calibration and the proper amounts of salt required for effective road maintenance		BBR, Watershed	VTrans, VDEC, ONRCD, watershed assoc's, town DPWs	9	
<b>B</b>	Work with VTrans to encourage the bulk purchase of alternative salt formulas by towns to lower costs		ERP, Watershed, VTrans	VTrans, VDEC, ONRCD, watershed assoc's	9	
<b>C</b>	Seek alternatives to salts working with CRREL and VLCT		ERP, Watershed, VTrans	CRREL, VLCT, VDEC	9	
<b>D</b>	Decrease the use of calcium or magnesium chloride on dirt roads after grading which contributes to high chloride levels in runoff and in waterways			VTrans, VDEC, ONRCD, watershed assoc's, town DPWs	9	

**51. Recommendation: Prevent lawn care practices from negatively impacting water quality.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Offer workshops on alternative healthy lawn care practices		Watershed, ERP	VDEC, ONRCD, watershed assoc's	4, 5, 6	

**52. Recommendation: Identify watershed towns with unprotected salt and sand storage facilities and work to secure these facilities.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Conduct an inventory of town storage facilities		ERP, Watershed, SWM	ONRCD, watershed assoc's, VDEC	9	
B	Work with towns with unprotected storage piles to secure funding for new structures		ERP, Watershed, SWM	ONRCD, watershed assoc's, VDEC	9	
C	Install covered structures to prevent leaching on salt and sediment into waterways		ERP, Watershed, SWM	ONRCD, watershed assoc's, VDEC	9	

**53. Recommendation: Seek alternative ways to manage and treat snowdump meltwater and runoff.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Expand and broadly distribute the "Alternatives to Snow Dumping" paper by VDEC		Watershed, ERP	VDEC, ONRCD, watershed assoc's	9, 15	
B	Develop BMP's for snowdumps		Watershed, ERP, VTrans	VDEC, VTrans	9	
C	Review town snow dump locations and practices for water quality impacts and make recommendations for best practice improvements		Watershed, ERP, VTrans	VDEC, VLRP, ONRCD, watershed assoc's	9	
D	Work with towns to relocate snowdumps away from streambanks	Focus Areas: Woodstock, Springfield	Watershed, ERP	VDEC, ONRCD, watershed assoc's	9, 15	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

**54. <sup>a</sup> Recommendation: Prevent pesticide movement/loss to surface waters.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Expand technical assistance on pesticide use, safety and alternatives and IPM		USFWS, VAAFAM, VDEC, NFWF, TNC	VAAFAM, VACD, ONRCD, FSA, NRCS, VDEC, UVM Ext, VFB	9	
<b>B</b>	Support outreach programs to garden/lawn care professionals and residents on IPM		USFWS, VAAFAM, VDEC, NFWF, TNC	VAAFAM, VACD, ONRCD, FSA, NRCS, VDEC, UVM Ext, VFB	9	

**55. Recommendation: Develop plans for prioritizing remediation of inactive landfills that are causing impairments.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Work with Waste Management Division on leachate clean-up plans for Bridgewater and Ludlow landfills		ERP, EPA	VDEC WQD & WMD, municipalities	7, wq9	
<b>B</b>	Assess the condition and impact on the wetland environment			VDEC Wetlands Section	6, 7, 9, 13, 18	

## Non-Stressor-related Recommendations

Non-Stressor Topic	No.
Agriculture and Water Quality Issues	10
Buffers	11
Forests	12
Groundwater Source Protection	13
Lakes & Ponds	14
Stormwater & Low Impact Development	15
Town Planning and Zoning	16
Uses & Values Protections	17
Wildlife	18

### Agriculture and Water Quality

The agriculture section of this plan has been developed by the Agriculture Working Group of the Watershed Council in numerous meetings of farmers and other agricultural interests. For the complete Agriculture Report see: APPENDIX A.7 – Agriculture in Basin 10

The goal of this agricultural section is to provide recommendations and supportive data on agricultural water quality improvements for inclusion in the most recent DEC Basin 10 Water Quality Management Plan. The recommendations outline preferred types and methods of agricultural improvements and point out the changes to infrastructure and funding mechanisms that will be necessary if agriculture is to remain economically and environmentally viable. The continuance and improvement of local agriculture as a viable business must be considered a priority in order for the agricultural community to afford both installing practices that will result in improved water quality and contribute to the maintenance of Vermont's valuable pastoral landscape.

Agriculture gives the Ottauquechee/Black watersheds (B10) of Windsor & Rutland Counties, a rural character; it also lends it an economic base for trade and tourism, a cultural identity and an environment that combines field, forest, pasture and village.<sup>30</sup> Agricultural census data for 2007 shows that Windsor County maintained the greatest square feet of vegetable transplants, one of the greatest amounts for maple syrup, the greatest count of horse farms, beef, sheep, alpaca, llamas and quail, and one of the greatest counts of turkeys and goats in the state.<sup>31</sup> Agriculture, the dominant historical land use of the region, is now the second largest land use type in the basin, though far below the primary land use of forestry, it covers 9% of the landscape.

<sup>30</sup> Wood, N., C. Halbrecht, K. Liang & Q. Wang. 2000. Interdependence of Agriculture and Tourism: Quantifying the Value of the Agricultural Working Landscape in Vermont. Presented at the Am. Agricultural Economics Ass. Meeting, Tampa, FL. August 2, 2000. <http://ageconsearch.umn.edu/bitstream/21814/1/sp00wo02.pdf>.

<sup>31</sup> National Agricultural Statistics Service. 2009. Census of Agriculture, Vermont Data. [www.agcensus.usda.gov/Publications/2007/Census\\_by\\_State/Vermont](http://www.agcensus.usda.gov/Publications/2007/Census_by_State/Vermont).

Agriculture, as a working landscape, also provides many benefits to the environment. The diversified farming typical of Vermont provides tracts of open space, shelterbelts and forage for many species of birds and mammals.<sup>32</sup> As field soils absorb rainwater more readily than paved and other **impervious** surfaces, fewer nutrients are released to surface waters from an acre of agricultural land than from an acre of developed land.<sup>33</sup> 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.

Agriculture in the watershed also has the potential to negatively affect the environment. Though the river miles and lake acreage of Basin 10 affected by agriculture represent 9% of the total impaired and only 2% of total threatened miles and acreage, the effects of agriculture on water quality should not be ignored.<sup>34</sup> Excess nutrients, pathogens and sediments all can leave the farm when erosion control methods fail or heavy rains and floods inundate fields.

Agriculture has helped to sustain society in the northeast for over 200 years.<sup>35</sup> While soil conservation has been a national effort for over 70 years, it is only within the past 20 years, following the Section 319 amendment to the Clean Water Act, that non-point source pollution from agricultural lands has begun to be purposefully addressed.<sup>12</sup> It will take a great deal of time, work and investment on the part of federal, state and local organizations, as well as farmers, to control the cumulative effects of over two centuries of impact on the environment of Basin 10.

Before 1996, prior to state or federal conservation programs, many farmers, on their own, implemented water quality improvements and many continue to do so. Unfortunately, the amount of money spent on these practices is unknown. From 1997 to 2008, nearly \$448,000 federal, state and landowner dollars were invested in non-point source pollution control practices on farms in Windsor County (\$9.7 million federal and \$3.2 million landowner dollars statewide during 1996-2007)<sup>36</sup>. An additional \$970,000 dollars is planned for best management practices in Windsor County. Each year an average of 3.6 farms in the county are provided with cost-share funds for BMP implementation. Contributions of federal and state dollars can combine to decrease the cost for farmer to 15% (for a typical \$200,000 manure pit project, this is still \$30,000 for a landowner).

Cost-share funds for these 'Best Management Practice' (BMP) improvements to farm structures and land based practices are derived from USDA-NRCS, USDA-FSA, USFWS and VAAFM programs. BMP's are designed to reduce non-point source pollution of waterways from sediment, pathogen and nutrient loading and assist farmers in better managing farm nutrients.<sup>37</sup> Structural BMP's include waste storage facilities, improved barnyard and roof-runoff systems. Land-based BMP's include Land Treatment Planning, Nutrient Management Planning, spring development, fencing, streambank stabilization and alternative watering systems.

## STATUS & TRENDS

---

<sup>32</sup> Carlson, C.A. 1985. Wildlife and agriculture: can they coexist? *J. of Soil and Water Conservation*. 40, 3: 263-266.

<sup>33</sup> USGS. 1996. Nutrients in the Nation's Waters: Identifying Problems and Progress. Fact Sheet FS-218-96.

[pubs.usgs.gov/fs/fs218-96/](https://pubs.usgs.gov/fs/fs218-96/).

<sup>34</sup> Vermont Agency of Natural Resources. 2000. Basin 10 Water Quality Assessment Report. Department of Environmental Conservation, Water Quality Division.

<sup>35</sup> Ebeling, W. 1979. *The Fruited Plain: The Story of American Agriculture*. University of California Press.

<sup>36</sup> Environmental Working Group. 2008. EWG Farm Bill 2007: Policy Analysis Database.

[farm.ewg.org/sites/farmbill2007/region1614.php?fips=50000](http://farm.ewg.org/sites/farmbill2007/region1614.php?fips=50000).

<sup>37</sup> Yates, A.D., R.C. Bailey, J.A. Schwindt. 2007. Effectiveness of best management practices in improving stream ecosystem quality. *Hydrobiologia*. 583:331-344.

**Farms & Acreage:**

The number of farms in Windsor County increased 44% from 1987 to 2007 (compared to a statewide increase of 19%). However, the number of farmed acres in either crops or pasture decreased 21% (compared to a statewide decrease of 34%).<sup>3</sup> Loss of open space to development is evident along many of the major roads in the watershed (Table 6.1).

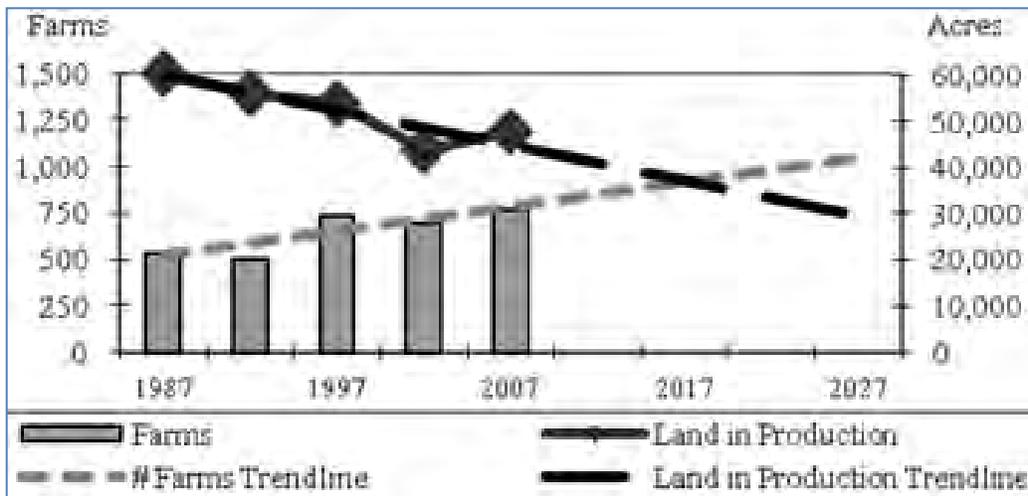
**TABLE 6.1 Windsor County: Farms and Farmland.**

	1987	1992	1997	2002	2007
Total # Farms	534	505	734	697	767
Acres in Farms	97,430	89,785	99,353	89,952	95,972
Crop + Pasture Acres	60,435	56,142	53,847	43,739	47,719

**Land Use Change:**

Projecting the NASS data out to 2027, at the present rate of loss, there will be fewer than 30,000 acres in agriculture in all of Windsor County. Note that this forecast does not necessarily take into account the compounding factors of economics, climate and the future regulatory environment. The predicted decrease would leave less than 5% of the land base of the county in agriculture by 2027 (Figure 6.1). This continued loss of over half of the county’s farmland would dramatically change the cultural and environmental qualities of the area (recall that the 2001 estimate of agricultural land in B10 alone was 9%<sup>6</sup>). In addition, these smaller farms will leave fewer larger patches of open land, possibly affecting grassland birds and even tourism.

Figure 6.1. Windsor County Farms and Land in Production.



The loss of agricultural land also has a negative implication for water quality. Per acre, urban land has been shown to have a greater adverse impact on surface water quality than agricultural land<sup>38</sup>. The increase in pavement and other impervious areas can increase runoff and carry toxic pollutants into waterways. Increased development means greater disturbance to soils, greater impact on natural resources and greater stress on existing farmland to both produce more on less land and to maintain the

<sup>38</sup> Hanmer, R. 2006. Food for Thought; Save a Farm, Save the Bay. Bay Journal. V.16, no. 7. <http://www.bayjournal.com/article.cfm?article=2921>.

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

pastoral landscape. This becomes increasingly difficult with the concurrent increase in the cost of farming due to higher land costs and higher tax rates.

For the full Agricultural Report on Basin 10 see Appendix A.7.

## **Recommendations to Address Agricultural Water Quality**

**56.<sup>a</sup> Recommendation: Prioritize agricultural water quality BMP programs to areas in need of improvement due to unmet resource concerns.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Research/compile BMP practice locations throughout B10 and identify areas in need of AEM assessment and additional BMP practices		NRCS, VAAFM, VANR, NFWF, TNC	ONRCD, VAAFM, FSA, NRCS, VANR, UVM Ext, Watershed Groups, VFB, Farm Operators	5, 6, 7, 8, 10	

**57.<sup>a</sup> Recommendation: Compile agricultural statistics by watershed.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Work with state and federal agencies to begin compiling agricultural statistics in a more flexible format		USEPA, VAAFM, VDEC	VACD, VAAFM, VDEC, FSA, NRCS, NOFA-VT, ONRCD		



**58.<sup>a</sup> Recommendation: Increase awareness of NPS Pollution and the AAPs within the equine community.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Hold equine industry workshops on NPS Pollution and the AAPs	Focus area: Kedron Brook	USEPA, USFWS, VAAFM, VDEC, NFWF, TNC	ONRCD, UVM Ext, VAAFM, VDEC, VFB	5, 6, 7, 10	
B	Research and compile information on numbers and locations of horses		USEPA, USFWS, VAAFM, VDEC, NFWF, TNC	ONRCD, UVM Ext, VAAFM, VDEC, VFB	10	

<b>C</b>	Provide technical assistance to the equine community to increase participation in nonpoint source pollution prevention		USEPA, USFWS, VAAFM, VDEC, NFWF, TNC	ONRCD, UVM Ext, VAAFM, VDEC, VFB	5, 6, 7, 10	
----------	--	--	--------------------------------------	----------------------------------	-------------	--



**59.<sup>a</sup> Recommendation: Increase funding opportunities for water quality BMP and equitable distribution of the funds statewide.**

	<b>Strategy – Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Estimate the cost of BMP agricultural water quality projects and their contribution to meeting the state’s goal in reducing phosphorus and nitrate pollution and develop cost projections towards achieving optimum nutrient containment	- Compare BMP project cost estimates and nutrient reduction from similar states. - Research better estimates of N and P reduction for BMP practices.	NRCS, VAAFM	NRCS, VAAFM	10	
<b>B</b>	Work with USDA to increase funding for programs such as EQIP, CRP, CREP, and WHIP		VAAFM, VANR	VACD, VFB, ONRCD, VAAFM, VANR, FSA, NRCS, UVM Ext, NOFA-VT, Farm Operators	2, 4, 5, 6, 7, 8, 10, 11	
<b>C</b>	Work with VAAFM to increase funding for programs such as VABP, NMPIG and FAPP		VACD, VDEC	VACD, VFB, ONRCD, VDEC, FSA, NRCS, UVM Ext, NOFA-VT, Farm Operators	2, 4, 5, 6, 7, 8, 10, 11	
<b>D</b>	Work with USFWS to increase funding for PFW to install alternative watering systems, riparian buffers and fencing		VAAFM, VANR	VACD, VFB, ONRCD, VAAFM, VANR, FSA, NRCS, UVM Ext, NOFA-VT, Farm Operators	2, 4, 5, 6, 7, 8, 10, 11	
<b>E</b>	Work with state, federal and local organizations on statewide equitability		VACD, VAAFM, VANR	VACD, VFB, ONRCD, VAAFM, VANR, FSA, NRCS, UVM Ext, NOFA-VT, Farm Operators	10	
<b>F</b>	Recognize and target funding for watersheds threatened due to nutrients		USDA, VAAFM, VANR	NRCS, VAAFM, VACD, VFB, ONRCD, VANR, FSA, UVM Ext, NOFA-VT	10	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

**60.<sup>a</sup> Recommendation: Increase implementation of water quality BMP.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Work with farmers, state/federal agencies, private industry and utilities to design and implement barnyard improvement, innovative biosolid and agricultural waste management practices		FSA, NRCS, VAAFM, CVPS, UVM Ext	VAAFM, NRCS, ONRCD, SVNMP, FSA, UVM Ext, NOFA-VT, VFB, CVPS, Farm Operators	2, 4, 5, 6, 7, 8, 10, 11	

**61. Recommendation: Strategically apply BMPs and increase outreach programs to reduce nonpoint source pollution from agricultural sources.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide technical assistance to non-dairy livestock owners to increase participation in nonpoint source pollution prevention programs and practices including grass-based operations		EQIP, 319, AAFM, VACD	NRCDs, NRCS, VAAFM, UVM Ext.	10	
<b>B</b>	Promote & implement sustainable manure management practices, e.g. composting, separation, incorporation and methane digestion		EQIP, USFWS PFW, 319, SARE, CREP, ERP, VT-BMP, WHIP, Watershed	NRCDs, NRCS, VAAFM, UVM Ext, Composting Association of Vermont, Highfields Institute	5, 6, 7, 10	
<b>C</b>	Promote & implement practices to reduce runoff from farmsteads, such as bunker silage, milk house waste, barn roof runoff		EQIP, 319, SARE, CREP, ERP, VT-BMP, WHIP	NRCDs, NRCS, VAAFM, UVM Ext, VACD	5, 6, 7, 10	
<b>D</b>	Promote & implement cover crop and crop rotation practices, filter strips, riparian buffers for farmland		EQIP, USFWS PFW, 319, SARE, CREP, ERP, VT-BMP, WHIP	NRCDs, NRCS, VAAFM, UVM Ext, VACD	2, 4, 5, 6, 7, 8, 10, 11	

<b>E</b>	Assist farmers in developing and implementing nutrient management planning regardless of farm size, including reduction of P content in feed		EQIP, AAFM, USFWS PFW, 319, SARE, CREP, ERP, VT-BMP, WHIP	NRCDs, NRCS, VAAFM, UVM Ext, VACD	5, 6, 7, 10	
----------	--	--	---	-----------------------------------	-------------	--

**62.<sup>a</sup> Recommendation: Continue outreach to farmers on the AAPs.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Work with farmers through education and outreach on the Accepted Agricultural Practices		VAAFM, VANR, 319	VACD, ONRCD, SVNMP, VAAFM, UVM Ext, NOFA-VT, VFB, Farm Operators	10	
<b>B</b>	Encourage development of peer advisory groups for problem solving agricultural resource concerns		VAAFM, UVM Ext.	VACD, ONRCD, SVNMP, VAAFM, UVM Ext, NOFA-VT, VFB, Farm Operators	10	

**63.<sup>a</sup> Recommendation: Develop innovative and emerging technology which will result in improved water quality while maintaining the economic integrity of the agricultural land base in the basin.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase awareness, development & implementation of improved manure storage/handling practices and wastewater treatment		NRCS, VAAFM, VANR, UVM Ext, TNC, TU, NOFA	ONRCD, SVNMP, VACD, VAAFM, NRCS, VANR, UVM Ext, CVPS, NOFA-VT, VFB, Farm Operators	5, 6, 7, 10	
<b>B</b>	Investigate and coordinate alternative funding sources for projects		NRCS, VAAFM, VANR, UVM Ext.	NRCS, VAAFM, VANR, UVM Ext.	10	

**64.<sup>a</sup> Recommendation: Prevent agricultural pesticide movement/loss to surface waters.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Continue technical assistance on pesticide use, safety and alternatives and IPM		VAAFM, VANR, NFWF, VACD	VAAFM, ONRCD, FSA, NRCS, VANR, UVM Ext, VFB	9, 10	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>B</b>	Support outreach programs to garden/lawn care professionals and citizens on IPM		VAAFM, VDEC, NFWF, VACD	VAAFM, VACD, ONRCD, FSA, NRCS, VDEC, UVM Ext, VFB	9, 10	
----------	---	--	-------------------------	---	-------	--

**65.<sup>a</sup> Recommendation: Exclude livestock from streambank and shoreline areas and establish alternate water sources, particularly in areas that are at high risk for nitrate leaching, phosphorus loss and soil erosion.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Increase technical and financial assistance to farms willing to exclude livestock from surface waters		USFWS, VAAFM, 319, ERP, NFWF, TNC	VAAFM, VACD, ONRCD, SVNMP, FSA, FWS, NRCS, VANR, UVM Ext, NOFA-VT, VFB, Farm Operators	2, 5, 6, 7, 8, 10, 11, 18	
<b>B</b>	Increase education on the benefits of livestock exclusion from surface waters		USFWS, VAAFM,	VAAFM, VACD, ONRCD, SVNMP, FSA, USFWS, NRCS	10	
<b>C</b>	Identify and prioritize high risk streambank and shoreline areas		VAAFM, 319, ERP	VAAFM, VACD, ONRCD, SVNMP, VDEC	10	

**66. Recommendation: Protect forest and farm land to maintain a landscape that protects wildlife and aquatic habitat, water quality and stream equilibrium.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide education on the value of the working landscape and the floodplain benefits it provides	- assist in developing directories that provide information about obtaining local products	SARE, Sustainable Futures Fund, UVM Ext	RPCs, NRCDS, Economic Development Councils, Vermont Development Council, VAAFM, VT Forest Products Council, NOFA, UVM Extension Service, VDFPR, VLT, VAAFM, Vermont Family Forests	10, 12, 17, 18	

<b>B</b>	Coordinate with farm and forest land conservation efforts to promote compensation to farmers for allowing stream processes to occur on their lands	<ul style="list-style-type: none"> <li>- encourage transferring the farm/forest and/or estate planning workshops to keep lands from development</li> <li>- encourage creation of new or expansion of existing town forests</li> <li>- encourage ecological forestry and river corridor practices</li> </ul>	SARE, Sustainable Futures Fund, UVM Ext., VDEC-RMP	RPCs, NRCs, Economic Development Councils, Vermont Development Council, VAAF, VT Forest Products Council, NOFA, UVM Extension Service, VDFPR, VLT, VAAF, Vermont Family Forests	10, 12, 17, 18	
----------	--	---	--	---	----------------	--

## **Recommendations to Address Buffer Issues**

A buffer is a naturally vegetated width of land between the water's edge of a river, lake, stream or wetland, and adjacent land uses. It is composed of a mix of trees, shrubs, ground cover and undisturbed ground. Multiple layers of vegetation make up a buffer:

- tree canopy
- understory trees
- shrubs of different heights
- low growing groundcover
- "duff," the decomposing organic matter on the forest floor

These layers treat runoff entering the buffer from uphill as well as allow for maximum absorption of rainfall and numerous shallow water and shoreland habitat values.

Naturally vegetated buffers along shorelines provide numerous benefits, from protection of water quality and aesthetic beauty, to the functioning of a healthy ecological landscape. A naturally vegetated shore provides bank stability through a complex mix of root depths and patterns whereas mown grass has shallow roots and cannot withstand the erosive forces of waves and high water.

Removing shore trees and shrubs exposes the adjacent shallow water to more sun and to increased sediment and phosphorus runoff, leading to more algae growth and less water clarity. Trees hanging over the water shade the shallows keeping them cool, fallen trees and branches, known as "woody debris" supporting a broad spectrum of aquatic species that form the ecological food web and refuge habitats of aquatic systems including micro- and macroinvertebrates, game and nongame fishes, reptiles and amphibians, birds and mammals.

**The need for buffers is both the biggest concern expressed and the most often recommended solution proposed throughout the basin planning process regardless of the topic discussed.**

The benefits of buffers to improve so many of the stressors to water quality, provide water quality protection and improve habitat conditions is far beyond any other strategy available. Buffers help address channel erosion, encroachment, land erosion, non-erosion nutrient loading, pathogens, and thermal stress, as well as wildlife habitat, forest, wetland, lake and pond water quality protection, groundwater source protection, and stormwater and agriculture water quality issues.

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

Many buffer recommendations are included throughout the specific stressor and topic areas. Those listed here cover buffers in a broader sense.

**67. Recommendation: Buffers are needed throughout the landscape (forest, agriculture, backyards, shoreland).**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Educate on the functions and values of buffers as they apply to all land uses		Watershed, 604(b), ERP	ONRCD, VACD, watershed assoc's, RPCs, VDEC, VFWD	11	
B	Create a social marketing campaign making buffers a "cause"		Watershed, ERP	ONRCD, VACD, watershed assoc's, VDEC	11	
C	Create incentives, both social and financial, to encourage buffer installation and expansion		ERP, AAFM	AAFM, VDEC, VACD	11	
D	Implement buffers on the town zoning level		Watershed, 604(b),	RPCs, VDEC, VACD, ONRCD	2, 4, 5, 6, 7, 8, 11, 13, 14, 16, 17, 18	

**68. Recommendation: Create site specific guidelines for buffers to balance economic, social and environmental needs.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Where buffers are not possible, substitute other LID practices based on DEC Stormwater Manual such as rain gardens, reduced impervious surfaces, and other infiltration techniques			VDEC Stormwater Section	1, 2, 3, 5, 7, 8, 9, 13, 15	



**69. Recommendation: Create a corridor conservation plan for buffer implementation to coordinate plantings on each river and along lakeshores.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Conduct SGA's on all major rivers and tributaries and create RCPs	Priority areas include: Gulf Stream, Barnard Brook, Kedron Brook, Twentymile Stream	ERP	RPC's, VDEC, ONRCD	11	

<b>B</b>	Target buffer installation projects to highest priority locations	- Route 4 corridor - Work with foresters and other private land managers on buffers - Work to establish buffer zones in town and state regulation	ERP, Watershed, TU	ONRCD, VDEC, watershed assoc's	1, 2, 4, 5, 8, 11, 13, 14, 16, 17, 18	
<b>C</b>	Encourage River Corridor and lakeshore conservation protection through easements	- Work with landowners on easement acquisition	ERP, Watershed	VDEC, watershed assoc's	1, 2, 5, 6, 8, 10, 11, 13, 14, 16, 17, 18	

## **Recommendations to Address Forest Issues**

The purest water comes from forested landscapes. As rainwater filters through the porous duff, organic layers and soils of the forest floor it is cleansed by the bacteria and fungi living within it. As it passes through the layers of soils, gravels and sediments as it makes its way into the aquifer it is filtered of naturally occurring contaminants. To protect water resources in the most economical way, we can conserve our forestlands.

Keeping forests healthy and productive enables landowners to keep forest as forests. Managing forestlands sustainably with water quality best management practices in place protects the forest, provides wildlife habitat, and protects both surface and groundwater quality.

### **70. Recommendation: Expand the county forester program staff to allow for more on-site visits and outreach to landowners.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Work with the legislature and Agency administration for increased funding and staffing for more on-site visits		VDFPR budgeting	ONRCD, watershed assoc's, VDFPR	12	

### **71. Recommendation: Provide more learning opportunities to smaller landowners on forest management.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Re-establish the Backyard Forestry Program		USFS grants, ERP	ONRCD, VDFPR	12	

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

<b>B</b>	Offer outreach on the recent changes to the Use Value Program allowing beneficial uses such as buffers and wetlands		USFS grants, Watershed	ONRCD, VDFPR	12	
<b>C</b>	Provide information on the value of forests for water quality protection		USFS grants, ERP, Watershed	ONRCD, VDFPR	12	

**72. Recommendation: Promote NRCS Conservation Activity Plans (CAP) funding for developing forest management plans.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Provide outreach on CAP and the value of forest management plans		NRCS budgeting, USFS grants, Watershed	NRCS, ONRCD, VDFPR	12	

**73. Recommendation: Promote sustainable forest management with a special emphasis on water resource protection.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Promote active stewardship management of forest resources through education		USFS grants, VDFPR budgeting, Watershed, ERP	VDFPR, USFS, private consulting foresters, non-profit forestry organizations, NRCDs, UVM Ext.	12	
<b>B</b>	Encourage forest landowners to develop written contracts for logging operations that reduce erosion by following AMPs and low-impact harvesting practices			VDFPR, USFS, private consulting foresters, non-profit forestry organizations, NRCDs, UVM Ext.	12	
<b>C</b>	<i>Promote the use of portable bridges at stream crossings during timber harvesting operations</i>		VDFPR budgeting, USFS grants, Watershed, ERP	ONRCD, VDFPR	1, 5, 12, 18	

## **Recommendations to Address Groundwater Source Protection Issues**

We in Vermont often do not appreciate the exceptional resource we have at our ready disposal with the plentiful groundwater below our soil. In *Running Pure: The importance of forest protected areas to drinking water: A research report for the World Bank / WWF Alliance for Forest Conservation and Sustainable Use*<sup>39</sup>

it states “Inhabitants of the city of Paris, for example, mainly drink water extracted from the Seine while Londoners rely on the River Thames (and it is estimated that most water from the taps has already been drunk and recycled 6-7 times).” This is not such a pleasant concept to those of us accustomed to tapping into pure Vermont groundwater.

“Protecting groundwater is imperative because groundwater is currently used for drinking water by approximately 70% of all Vermonters. About 46% of the state’s population is self-supplied (private wells), while about 24% is served by public water systems that use groundwater. The rest (30%) rely on surface water as their source of drinking water.

...

Each day in Vermont 50 million gallons of groundwater are withdrawn. Withdrawals from public and private groundwater sources account for 33 million gallons per day. Agricultural use accounts for 2 million gallons of groundwater withdrawn daily, another 12 million gallons are used for commercial and industrial purposes, and the remaining, 3 million gallons withdrawn, are used for mining and the generation of thermoelectric power.”<sup>40</sup>

There is a clear and direct interaction between groundwater and surface water and what occurs on the land can directly impact the quality of the groundwater we later extract for drinking water use. In 2008 the Vermont legislature designated groundwater as a public trust resource to ensure that this resource remains available for all Vermonters.

Groundwater and surface water meet at discharge and recharge points. Groundwater recharge occurs wherever surface water infiltrates into the ground. This happens in wetlands, lakes, ponds, forests, fields, lawns, and any porous surface. Therefore any contamination occurring and being picked up by the water can be transported with it into the groundwater. Preventing this contamination from reaching groundwater is the goal of the following recommendations.

---

<sup>39</sup> <http://assets.panda.org/downloads/runningpurereport.pdf>

<sup>40</sup> <http://www.vermontdrinkingwater.org/GWPRS/VTOuncePrevention2005.pdf>

**74. Recommendation: Encourage villages to have either a public water supply system or a public wastewater system in order to protect drinking water quality.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Educate on the threat posed by many private septic systems and wells co-located on small village lots	- Expand the distribution of "An Ounce of Prevention" to a broader audience	DWSRF	town water dept's, VDEC - WSD	13	
B	Develop or update Source Protection Plans where public water supplies exists		DWSRF	town water dept's, VDEC – WSD, RPCs	13	
C	Where appropriate begin a process of SPA protection	- Locate lands within SPA zones 1&2 and prioritize these for purchase or easements protection - Locate lands within SPA zone 3 as above	DWSRF	town water dept's, VDEC - WSD	13	

**75. Recommendation: Investigate and map where town water resources are located.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Map existing aquifers of sufficient quality for drinking water use		DWSRF, Watershed	VGS, town DPW & planning commission	13	

**76. Recommendation: Assist VDEC's Source Water Protection Program in their on-going work with town governments and road maintenance departments to establish "low-salt" zones along roads within source protection areas.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Work to establish low-salt application zones in SPAs		VDEC-WSD, VTrans	VDEC, RPCs, municipalities, resort maintenance departments	13	



**77. Recommendation: Work with towns having Class A(2) waters that are no longer used for drinking water supply on reclassification to non-drinking water status.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status

<b>A</b>	Work with town boards on re-classification	- Provide information to towns on reasons for re-classification - Assist in drafting re-classification petition	VDEC-WSD & WQD	VDEC	13, 16	
<b>B</b>	Submit re-classification petition to Water Resources Board	<u>Black River</u> Grant Brook, Springfield Reservoir <u>Ottawaquechee River</u> Carlton Hill Reservoir			13, 16	

## **Recommendations to Address Lake & Pond Issues**

Basin 10 has some important lakes and ponds that offer a diversity of uses and values from habitat for threatened and endangered species to offering exceptional recreational opportunities. However a number of these are stressed by impacts from surrounding land use changes.

Overall water quality in Basin 10 lakes is good with a few exceptions. The major challenge to lake water quality is the lack of riparian buffers along the shore allowing sediment and nutrients to enter lakes from erosion. This is filling in the lake bottoms creating shallow weedy areas changing the habitat and uses of the lakes. Additionally invasive plant growth in the water and along the shorelines is impacting many on the lakes.

Poorly managed lakeshore development and dramatic changes in the footprint of lakeshore residences is impacting lake conditions. Rapid responses to these changes are necessary to stem permanent changes to lake environments.

### **78. Recommendation: Map current lake depths to compare to old maps to determine amount of recently accumulated sediment in lakes.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Conduct new bathymetric surveys	- Include lakes: Amherst, Colby, Echo, Kent, Knapp 1 & 2, Ninevah, Rescue, Woodward	VDEC, Watershed, ERP	VDEC, watershed assoc's	14	
<b>B</b>	Create new depth charts		VDEC, Watershed, ERP	VDEC, watershed assoc's	14	



**79. Recommendation: Start or re-start Lay Lakes Monitoring Program throughout Basin.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Promote program and recruit volunteers		Watershed	watershed assoc's, VDEC	14	
B	Establish permanent monitoring program	Current programs on: Ninevah, Pinneo, Rescue, Woodward,	Watershed	watershed assoc's, VDEC	14	

**80. Recommendation: Provide outreach on lakeshore septic systems.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Distribute Lakeshore Septic System brochure on a regular basis		Watershed	watershed assoc's, VDEC	6, 7, 14	
B	Hold workshops on lakeshore property best practices that include septic maintenance as a topic		Watershed	watershed assoc's, VDEC	6, 7, 14	

**81. Recommendation: Educate on how to avoid water quality conflicts by training those in development businesses.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Train real estate, development and construction personnel on best practices to prevent pollution		Watershed	ONRCD, watershed assoc's	14	
B	Create a voluntary certification program to inform property owners on hiring well-trained contractors for project work		Watershed	ONRCD, watershed assoc's	14	

**82. Recommendation: Protect natural lake shorelands from poorly planned development, improve management of developed lake shorelands and minimize adverse land use activities in lake watersheds.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
--	-------------------	-------	----------------	---------------------------------	--------------------------------	--------

<b>A</b>	Map and prioritize undeveloped lake and pond shorelands for protection		604(b), Watershed, NEGEF	VDEC Lake Assessment Program, RPCs, NRCDs, lake associations	14	
<b>B</b>	Review and strengthen regional and town plans and zoning bylaws relating to lake protection issues		604(b), Watershed,	RPCs, lake associations	14, 16	
<b>C</b>	Conduct lake watershed surveys on selected lakes and ponds to identify nonpoint sources of pollution and the actions needed to control them	Include: Amherst, Echo, No. Springfield Reservoir	604(b),	RPCs, NRCDs, lake associations, VDEC Lake Assessment Program	14	
<b>D</b>	Conduct camp/landowner education, shoreland property management workshops	- Promote regular maintenance of lakeshore camp septic systems. - Conduct outreach to new landowners, preferably as part of a lakeshore protection program and distribute the " <i>Vermont Lake Guide</i> "	Watershed, NEGEF	RPCs, NRCDs, lake associations, VDEC Lake Assessment Program	14	
<b>E</b>	Expand NRCD's Trees for Streams Program to include lake and pond riparian areas		Watershed, 319, ERP, NEGEF	NRCDs, lake associations	2, 4, 5, 6, 8, 11, 14, 17, 18	

## **Recommendations to Address Stormwater & Low Impact Development Issues**

Stormwater runoff, precipitation and snowmelt carrying suspended and dissolved particles and pollutants, flows over roofs and roads, parking lots and sidewalks, and every other hard surface down storm drains and into the nearest stream to the river or lake. While some stormwater infiltrates into the ground, much of it ends up in one of our surface waters.

Water runs off these impervious surfaces quickly, so there is little opportunity for it to infiltrate into the soil to recharge groundwater supplies. Stormwater adds not only pollutants to our waters it also adds volume to our rivers and streams which causes them to flow with more speed and force. The higher, faster water levels cause more erosion, create more sediment and silt and cause greater property damage. Keeping stormwater from entering waterways, allowing it to infiltrate where it falls, and keeping it from picking up pollutants as it flows overland are all ways of protecting water quality and stream conditions.

**83. Recommendation: Educate on the impact of stormwater on water quality and practices to improve it.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Develop & distribute outreach materials on stormwater and LID for broad distribution		ERP, 604(b), Watershed, NEGEF	ONRCD, RPCs, watershed assoc's	1, 3, 5, 7, 8, 9, 15	
B	Develop & distribute landowner best practices materials for broad distribution		ERP, 604(b), Watershed, NEGEF	ONRCD, RPCs, watershed assoc's	1, 3, 5, 7, 8, 9, 15	
C	Sponsor rainbarrel making and raingarden workshops		ERP, Watershed, NEGEF	ONRCD, watershed assoc's	1, 3, 5, 7, 8, 9, 15	
D	Sponsor rainbarrel sales and/or coupon programs		ERP,	ONRCD, watershed assoc's	1, 3, 5, 7, 8, 9, 15	

**84. Recommendation: Encourage schools to get involved with stormwater on their grounds.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Work with Springfield High School to address parking lot issues		Watershed, NEGEF	high school natural resource programs, ONRCD, watershed assoc's	1, 3, 7, 8, 9, 15	
B	Involve horticulture programs in growing raingarden and buffer plants		Watershed, NEGEF	high school natural resource programs, ONRCD, watershed assoc's	11, 15	

Also see Recommendation: Reduce stormwater inputs to waterways to decrease excess volume and velocity.  
1,

**85.<sup>a</sup> Recommendation: Minimize urban and rural practices that contribute to poor water quality.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Identify and assess stormwater impacted reaches along Basin mainstems and tributaries for development of appropriately located stormwater retention practices		319, ERP, Watershed	VDEC, ONRCD, watershed assoc's, RPCs	15	

<b>B</b>	Educate homeowners and developers on effects of fertilizers/pesticides, impervious surfaces, stormwater runoff		319, ERP, Watershed	VDEC, ONRCD, watershed assoc's, RPCs	9, 15	
----------	--	--	---------------------	--------------------------------------	-------	--

**86. Recommendation: Decrease the volume and pollutant load of stormwater runoff from pre and post construction.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Work with municipalities to adopt local stormwater standards including Low Impact Development language in town plans and bylaws especially for development of sites less than 1 acre in size		604(b)	RPCs, VLCT,	15, 16	
<b>B</b>	Create pre-construction outreach programs for landowners, contractors, and municipalities covering erosion and sediment control site plans	Include: - necessary permits - Low Impact Development (LID) practices - technical assistance - distribution of the ANR Erosion Prevention and Sediment Control (EPSCs) guidelines	604(b), VDEC SWD, ERP, EPA stormwater	RPCs, VLCT, VDEC, watershed assoc's, NRCDs	16	
<b>C</b>	Assist landowners and municipalities to increase treatment of stormwater from existing impervious surfaces and increase infiltration using LID practices,	Practices such as - bio-infiltration - cisterns or rain barrels - increase permeability thru green space - lake friendly lawn care	604(b), DFPR Urban and Community Forestry Program, ERP, EPA stormwater	Municipalities, RPCs, VLCT, VDEC, watershed assoc's, NRCDs	16	

<b>D</b>	Where applicable, assist municipalities in the development and implementation of stormwater management plans and water quality improvement projects	Projects may include development of - stormwater infrastructure maps - maintenance inventories - illicit discharges and detection (IDDE) surveys - improvement of housekeeping practices including purchase of efficient street sweeping and catchbasin cleaning equipment Focus on: Springfield, Ludlow, Woodstock	604(b), ERP, EPA stormwater	Municipalities, RPCs, VLCT, VDEC, watershed assoc's, NRCDs	15, 16	
----------	---	--	-----------------------------	--	--------	--

**87. Recommendation: Promote the use of alternatives to impervious surfaces for development, especially in high elevation watersheds, to decrease the input of excess hydrologic volume and decrease sediment runoff.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Provide outreach on pervious pavement, raingardens, tree boxes and other pervious alternatives		TE, ERP, Watershed	VDEC, RPCs, ONRCD, watershed assoc's	16	
<b>B</b>	Install a demonstration project in the Basin		TE, ERP, Watershed	VDEC, RPCs, ONRCD, watershed assoc's	16	

**Recommendations to Address Town Planning and Zoning Issues**

Town planning and zoning is a means of addressing water quality on a local level for the long-term. When towns choose to write water quality protections into town plans and zoning ordinances they express their desire for clear water in their community.

Placing language to protect and improve water quality and natural resources in the town plan is necessary prior to establishing zoning ordinances as the latter must support town plan goals. Municipal and regional planning commissions can move water quality protections forward by incorporating conservation measures into local land use regulations such as flood regulations, subdivision regulations, ordinances, and permits. Policies supporting buffers and setbacks from streambanks, wetlands and lakes, discouraging development in floodplains and RC/FEH zones, encouraging LID standards, imposing

driveway access and curb cut standards, and setting road and bridge standards, all protect water quality, natural resources and wildlife habitat.

APPENDIX A.9 - Municipal Planning and Water Resources Review – provides a table of Basin 10 towns and the planning and zoning in place for the protection of water resources. This can be used by local boards and commissions to find and address gaps in local water resource policy protections.

**88. Recommendation: Work with towns to incorporate stronger water quality concepts into town plans and zoning.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Incorporate Basin Plan concepts and strategies into Regional Plans		RPC base funding, 604(b)	RPCs, town planning commissions	16	
<b>B</b>	Introduce Basin Plan concepts to town planning commissions for inclusion in town plans		RPC base funding, 604(b)	RPCs, VDEC	16	

**89. Recommendation: Review the effectiveness of current town plans and zoning regulations for water quality protections and offer planning and zoning technical assistance to watershed towns.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
<b>A</b>	Prioritize work with towns with the fastest housing unit growth		RPC base funding, 604(b)	RPCs, VDEC, town conservation commissions	16	
<b>B</b>	Introduce model VLCT ordinances such as the LID/Stormwater & Riparian Buffers ordinances		RPC base funding, 604(b)	RPCs, VLCT, town conservation commissions	16	
<b>C</b>	Encourage town and regional plans to take advantage of and incorporate basin plan and stream geomorphic assessment information		RPC base funding, 604(b)	RPCs, VDEC, town conservation commissions	16	

## **Recommendations to Address Uses and Values Protections**

Vermont’s water quality standards lay out Existing and Designated Uses of waters that must be protected, these include uses such as supporting aquatic biota and wildlife and their habitat, the use of the waters for recreation and fishing and the use of the water for water supply and commercial industry. But there are other important “uses” and values placed on our waters by those who live, work and play in and along them. These waters are important in other more intangible ways and in some very practical and necessary ways. Protecting these uses is important to the livelihood and leisure of Basin residents. One factor identified in several Basin towns is limited access to waters for recreation.



### **90. Recommendation: Establish more points for public access to waters, e.g. there is only one in Woodstock.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Survey and document known public access sites		ERP, Watershed, 604(b)	RPCs, VDEC, VRC, town conservation commissions	17	
<b>B</b>	Work with consenting landowners on permanent public access easements	- Establish the status of landowner consent of each site - Seek funding to purchase and secure conservation easements for important access sites in need of protection	ERP, Watershed, 604(b)	RPCs, VDEC, VRC, VLT, UVLT, town conservation commissions	17	

### **91. Recommendation: Carefully examine and promote the reclassification of appropriate waters to increase their level of protection.**

	<b>Strategy - Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Survey and document potential very high quality or important waters and wetlands for ORW, Class A or other protections	See Suggested waters in Chapter 7	ERP, Watershed, 604(b)	RPCs, VDEC, VRC, town conservation commissions	17	
<b>B</b>	Focus areas include: Woodward Reservoir and North Branch Ottauquechee		Watershed, ERP, 604(b)	Watershed assoc’s, RPCs, VDEC	17	



### **92. Recommendation: Work to document the data needed and to reclassify Eshqua Bog and Totman Hill fen as Class 1 wetlands.**

	Strategy – Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Gather required data	<ul style="list-style-type: none"> <li>- compile species and natural community information</li> <li>- document wetland functions</li> <li>- map site on VCGI</li> </ul>	VDEC base, TNC base	TNC, VDEC, VFWD, VDEC-IT, Town of Pomfret	18	
B	Submit petition to WRP		VDEC base, TNC base	TNC, VDEC, VFWD	18	

## **Recommendations to Address Fish and Wildlife Issues**

The interconnectness of water quality and wildlife habitat conditions, whether it is aquatic or terrestrial habitat, is often overlooked. Aquatic species such as fish and macroinvertebrates depend on water quality conditions for obvious aspects of their survival. They also depend on physical habitat conditions such as appropriate substrate for spawning, pools and riffles for sheltering and feeding, livable temperature ranges, etc.

For reasons as simple as the need to escape extreme floods or as complex as maintaining genetic diversity, fish and wildlife living in or along streams need to be able to move unimpeded through the watershed. Through the combined effects of dams and poorly designed stream crossings, passage along streams is often blocked forcing animals to cope with these restrictions. Many existing stream crossings are barriers to movement of fish and wildlife. Some stream crossings that did not restrict passage when originally constructed have become barriers as the result of streambank erosion, stream channel changes or mechanical breakdown of the structure. A study conducted by the VFWD of **aquatic organism passage** (AOP) through culverts showed less than six percent were found to provide full passage of aquatic organisms.

Terrestrial wildlife also depends on aquatic conditions requiring clean water for drinking, feeding, and breeding. Many species are semi-aquatic or semi-terrestrial spending part of their life in each environment. While many live on land, salamanders, frogs and toads must lay eggs in the water. Waterfowl must nest on land but survive on the water. Even moose are go-between animals.

Poor management of the riparian habitat in and along waterways, lakes, and ponds impacts water quality. Managing riparian corridors for water quality ultimately provides wildlife habitat benefits by providing wildlife travel corridors and breeding and sheltering habitat where wildlife requires it. The larger the animal the wider the travel corridor required for it to be comfortably sheltered.

Multiple benefits accrue for numerous natural resources from riparian buffers and river corridor protection. The wider the buffer the more water quality protection it provides, the more wildlife it supports and the greater the groundwater recharge and protection benefit.

For more information on AOP see: [http://www.vtfishandwildlife.com/fisheries\\_AOP.cfm](http://www.vtfishandwildlife.com/fisheries_AOP.cfm)

**Stressor - No.** Channel Erosion-1 Encroachment-2 Flow Alteration-3 Invasive Species-4 Land Erosion-5 Non-Erosion Nutrient Loading-6 Pathogens-7 Thermal Stress-8 Toxic Substances-9 **Non-Stressor Topics** Agriculture-10 Buffers-11 Forests-12 Groundwater Source Protection-13 Lakes & Ponds-14 Stormwater & Low Impact Development-15 Town Planning and Zoning-16 Uses & Values-17 Wildlife-18

**93. Recommendation: Conduct natural communities mapping.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Provide base maps with current data to town conservation commissions		604(b), SWG, Watershed	RPC's, VFWD, town conservation commissions	18	
B	Provide information on how to do surveys for rare, threatened and endangered species and natural communities		604(b), SWG, Watershed	RPC's, VFWD, town conservation commissions	18	
C	Work with interested town conservation commissions on surveying and mapping		604(b), SWG, Watershed	RPC's, VFWD, town conservation commissions	18	

**94. Recommendation: Provide outreach and education on the role of riparian areas in habitat fragmentation and connectivity.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Provide outreach to landowners on managing their riparian buffers for wildlife	- Include list of resources, programs and incentives for landowners to address habitat issues, i.e. WHIP, LIP, SWG, etc.	Watershed, SWG	ONRCD, watershed assoc's, VDEC, VFWD	18	
B	Provide education to realtors on maintaining buffers when building		Watershed, SWG	ONRCD, watershed assoc's, VDEC, VFWD	18	
C	Develop and distribute educational materials on "how to manage your shoreline" to landowners or purchasers, to allow connectivity to other important habitat areas		Watershed, SWG, ERP	ONRCD, watershed assoc's, VDEC, VFWD	18	



**95. Recommendation: Promote large woody structures as an important habitat features in lakes and streams.**

	Strategy - Action	Tasks	Budget Funding	Lead (and) Primary Participants	Addresses Stressor / Topic No.	Status
A	Using SGA and lake habitat assessment data locate areas with low large wood counts		SWG, Watershed, ERP, WHIP, PFW	ONRCD, TU, VFWD, town conservation commissions	18	

<b>B</b>	Conduct outreach on the habitat benefits of large wood and management practices that maintain natural recruitment of wood		SWG, Watershed, ERP, WHIP, PFW	ONRCD, TU, VFWD, town conservation commissions	18	
<b>C</b>	Install large wood demonstration projects where appropriate	- Obtain landowner consent for habitat enhancement work	SWG, Watershed, ERP, WHIP, PFW	ONRCD, TU, VFWD, town conservation commissions	18	

**96. Recommendation: Protect the functions and values of existing wetlands and selectively restore human-altered wetlands.**

	<b>Strategy – Action</b>	<b>Tasks</b>	<b>Budget Funding</b>	<b>Lead (and) Primary Participants</b>	<b>Addresses Stressor / Topic No.</b>	<b>Status</b>
<b>A</b>	Protect wetlands at the municipal level	- compile wetland inventories - strengthen local zoning and stormwater regulations - increase educational outreach	ERP, 604(b), USFWS	RPCs, municipalities, VFWD, VDEC, NRCDs, NRCS	18	
<b>B</b>	Identify and restore altered wetlands		ERP, WHIP, WRP, USFWS PFWP	RPCs, municipalities, VFWD, VDEC, NRCDs, NRCS	18	
<b>C</b>	Provide education on the integral role of temporal wetlands, e.g. vernal pools and beaver ponds, in a healthy watershed and tools for protection	- encourage landowners to map location of temporal wetlands in forestry management plans - identify and remediate beaver-road conflicts to safeguard beaver ponds while protecting transportation infrastructure	ERP, 604(b), USFWS PFWP, BBR	RPCs, municipalities, VFWD, VDEC, NRCDs, NRCS, municipal road managers	18	

## Grant Funding Sources

319 – Clean Water Act Section 319  
604(b) – Clean Water Act Section 604(b)  
Ag Buffer Program – AAFM  
Ag Fencing Program – AAFM  
ANS Grant-in-Aid – Aquatic Nuisance Species  
ARRA-LID – American Redevelopment and Recovery Act – Low Impact Development  
Base – organizational base funding  
BBR – Better Backroads  
CF – Conservation Fund  
CREP – Conservation Reserve Enhancement Program  
CRP – Conservation Reserve Program  
CVPS – Central Vermont Public Service  
DWSRF – Drinking Water State Revolving Fund  
EPA – Environmental Protection Agency  
EQIP – Environmental Quality Incentive Program  
ERP – Ecosystem Restoration Program  
FAP – Farm Agronomic Practices  
FEMA PDM-c – Federal Emergency Management Program Pre-Disaster Mitigation  
FSA – Farm Service Agency  
Historic Preservation – VT Historic Preservation  
LaRosa Partnership – VDEC Lab Grant  
NEGEF – New England Grassroots Foundation  
NFWF – National Fish & Wildlife Foundation  
NOAA/AR – National Oceanic & Atmospheric Administration / American Rivers  
NOFA – Northeast Organic Farmers Association  
NRCS – Natural Resources Conservation Service / USDA  
Planning – VT state planning grant  
Private foundations  
RPC base funding – Regional Planning Commission town funding  
SARE – Sustainable Agriculture Research & Education  
Sustainable Futures Fund  
SW Mitigation – Stormwater Mitigation Fund – Federal Highway Administration  
SWG – State Wildlife Grants - federal  
T4S – Trees for Streams  
TE – Transportation Enhancement Grant - Federal Highway Administration  
TNC – The Nature Conservancy  
TU – Trout Unlimited  
USACE – US Army Corps of Engineers  
USFS grants – US Forest Service  
USFWS – US Fish & Wildlife Service  
USFWS PFW – Partners for Wildlife  
UVM Ext – UVM Extension Service  
VAAFM – VT Agency of Agriculture, Food & Markets  
VANR – VT Agency of Natural Resources  
VDFPR – VT Department of Forests, Parks & Recreation

VLRP – VT Local Roads Program  
VSJF – VT Sustainable Jobs Fund  
VT-BMP – AAFM Best Management Practices  
VTrans – VT Agency of Transportation  
Watershed – VT Watershed Grant / License Plate Grant  
WHIP – Wildlife Habitat Incentive Program  
WRP – Wetlands Reserve Program

## Proposed Priority Projects for Stream Corridor Protection

Stream geomorphic studies have been completed in the Black River and its major tributaries, including North Branch of the Black, Twentymile Stream, Branch Brook, Patch Brook, and Buffalo Brook. The following are projects that have been developed and prioritized from the Black River Corridor Plan and Addendum (available online at <https://anrnode.anr.state.vt.us/SGA/finalReports.aspx>). The highest priority projects are listed in Table 6.2. Reach locations are indicated on the following maps.

### River Corridor Plan Projects

#### BLACK RIVER

**TABLE 6.2. River Corridor Protection Opportunities for the Black River Main Stem and Tributary Reaches Ranked Very High**

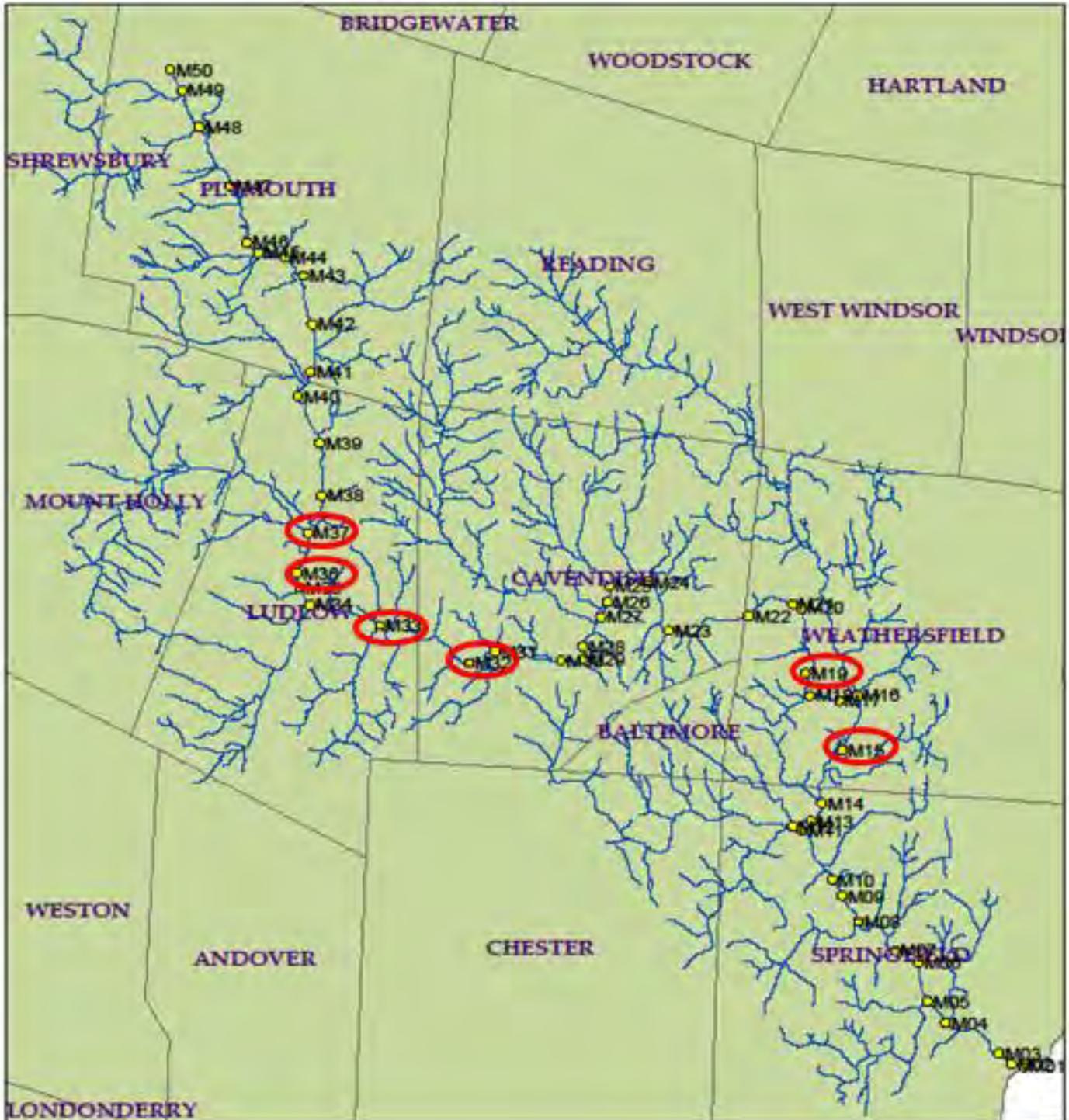
Each V indicates a score for one of the following strategic factors:

- Protection Upstream of Constrained or Altered Reaches
- Protection Downstream of Constrained or Altered Reaches
- Key Sediment Attenuation Area
- Channel-contiguous wetlands
- Alluvial Fan or Point of Marked Valley Slope Reduction
- Downstream from Major Tributary or Other Large Sediment Source
- Moderate or Major Departure from Equilibrium
- Accompany Passive or Active Restoration, Incised/Aggraded

Reach / Segment	Town	Priority	
Black River main stem			
M37-A	Ludlow	Very High	√ √ √
M36-B	Ludlow	Very High	√ √
M36-A	Ludlow	Very High	√ √ √
M33-A	Ludlow	Very High	√ √
M32-C	Ludlow	Very High	√ √ √
M32-B	Cavendish	Very High	√ √
M32-A	Cavendish	Very High	√ √ √ √ √
M15T1.07	Weathersfield	Very High	√ √ √ √
M15T1.06-B	Weathersfield	Very High	√ √
M15T1.06-A	Weathersfield	Very High	√ √
M15T1.05	Weathersfield	Very High	√ √ √
M15T1.03-B	Weathersfield	Very High	√ √
M19-A	Weathersfield	Very High	√ √ √ √ √
Branch Brook			
M36T4.01	Ludlow	Very High	√ √ √ √
Twentymile Stream			
M26T2.10-A	Cavendish	Very High	√ √ √
M26T2.08-B	Cavendish	Very High	√

# Black River Watershed

Mainstem Reach Breaks



0 0.5 1 2 3 4  
Miles





## Planting Stream Buffers

High-priority opportunities to increase buffer widths and continuity are located along the following reaches which are closer to equilibrium condition and have good or reasonable floodplain access:

- reaches of the North Branch tributary (M15T1.06 and sections of M15T1.10);
- reaches of the Twentymile Stream (M26T2.07, M26T2.06); and
- reaches of the Black River main stem (M33-A, M30, and M19-A).



**TABLE 6.3. Highest Priority Bridge & Culvert Structure Replacements  
Black River Main Stem and Tributary Reaches**

Channel	Reach /Segment	Town	Road	Structure Type	Constriction Status	Other Issues	Priority
Twentymile Stream	M26T2.10-C	Reading	Twenty mile Stream Rd	Bridge	62%	Stepped footers (LB); sharp approach angle.	High
	M26T2.10-A	Cavendish	Twenty mile Stream Rd	Culvert	36%	Sediment (steep riffle) obstructing inlet. Culvert is perched with 0.8 ft cascading flow at outlet (potential fish passage issue). Downstream scour pool. Partially failing stream bank armoring – LB, downstream.	Very High
	M26T2.07	Cavendish	Farm road / trail	Bridge	36%	Sharp approach angle; Downstream scour pool.	High
	M26T2.05	Cavendish	Heald Road	Bridge	45%	Stepped footers (RB); Downstream scour pool.	High
North Branch	M15T1.11-A	Reading	Route 106	Bridge	102%	Sharp approach angle; Located at significant reduction in valley slope; sediment (steep riffle) partially obscuring structure inlet. Site of previous ice jam flooding.	Very High
	M15T1.09	Cavendish	Private driveway	Bridge	92%	Streambed scour causing undermining at RB abutment (upstream and downstream) and LB abutment (downstream). Timber “piers” reinforcing bridge decking near LB and RB abutments.	High
	M15T1.05	Weatherfield	Little Ascutney Rd	Bridge	41%	Sharp approach angle; RB abutments cracked and displaced. Stepped footer	High

						(RB). Streambed scour undermining RB and LB abutments. Downstream scour pool. Above conditions persist following Fall 2008 replacement of bridge decking.	
--	--	--	--	--	--	---	--

**Passive restoration** through corridor protection is recommended as a High to Very High priority for incised reaches in relatively undeveloped sections of the study area to support meander redevelopment and floodplain building. Naturally-enhanced attenuation at transition points of reduced valley gradient and/or confinement (perhaps enhanced by natural LWD recruitment and/or beaver activity) will accomplish channel restoration within reasonable timeframes at much lower cost and higher success rates, if the corridor is protected and society refrains from further channel management (e.g., M26T2.10-A, M26T2.09, M26T2.07, M15T1.07, M15T1.06-B). A Very High priority is also assigned to reaches located downstream or immediately upstream of constrained / channelized reaches.

The possibility for active restoration does exist along appropriate sections of the Black River main stem segments M32-C and M32-B between Ludlow and Proctorsville and reach M30 between Proctorsville and Cavendish. At present, development is relatively minor along these segments. It would be technically feasible to lower the elevation of the left bank along these sections in order to reconnect the incised channel with a floodplain and provide increased flow and sediment attenuation. At a minimum, corridor protection in these segments should be pursued to limit the likelihood for further development on the channel that would then be at risk of fluvial erosion hazards. In reach M30, in particular, it is important to protect the river’s access to abandoned meanders and flood chutes in the river valley that could provide important flow and sediment attenuation during high-magnitude flood events.

M32-A of the Black River (at the upstream end near Winery Road)

This reach is an important sediment attenuation area, and is a Very High priority for river corridor protection to support passive restoration.

M15T1.07 of the North Branch (downstream of the Ascutney Basin Road bridge)

This reach is a key sediment attenuation area, and is a Very High priority for passive restoration through river corridor protection.

M15T1.03-B of the North Branch (downstream of Amsden Falls, upstream of Stoughton Pond)

This segment is a key sediment attenuation area, and is a Very High priority for river corridor protection.

There are opportunities to improve management of stormwater runoff and reduce erosion along road ditches and at culvert outlets. Road maintenance practices to mitigate for stormwater and sediment runoff may include: stabilization of road surfaces (different gravel materials), improvement of roadside ditches (excavation, stone lining and/or seeding and mulching), alternative grading practices (turnouts, check-basins); re-orientation of culvert crossings; protection of culvert headers; and gully stabilization.

Two high priority wetland restoration projects have been identified along the study reaches:

- Restoration of prior-converted wetlands along North Branch reaches M15T1.06 and M15T1.05 in Weathersfield
- Restoration of prior-converted wetlands along Twentymile Stream reaches M26T2.08, M26T2.07, and M26T2.06-C in Cavendish

### TRIBUTARIES - Patch Brook and Buffalo Brook

Passive restoration through corridor protection is recommended as a High to Very High priority for incised reaches in relatively undeveloped sections of the study area to support meander redevelopment and floodplain building. Naturally-enhanced attenuation at transition points of reduced valley gradient and/or confinement (enhanced by natural LWD recruitment) will accomplish channel restoration within reasonable timeframes at much lower cost and higher success rates, if the corridor is protected and society refrains from further channel management.



**TABLE 6.4 Bridge and Culvert Crossings on Patch Brook and Buffalo Brooks Ranked High Priority for Replacement due to incompatibility with physical stream processes**

Channel	Reach/Segment	Town	Road	Structure Type	Constriction Status	Other Issues	Priority
Patch Brook	M40T5.04-B	Plymouth	Patch Brook Road	culvert	24%	SB	Very High
Patch Brook	M40T5.03-A	Plymouth	Dublin Road	bridge	53%	stepped footers, A, DA	Very High
Patch Brook	M40T5.02-A	Plymouth	Tatro Road	bridge	46%	stepped footers, DA, SB	Very High
Patch Brook	M40T5.01-B	Plymouth	Dublin Road	bridge	87%	A, DA, SA, SB	Very High
Patch Brook	M40T5.01-B	Plymouth	Library Road	bridge	48%	DA	Very High
Buffalo Brook	M41T6.06	Plymouth	forest road	culvert	49%	perched	Very High
Buffalo Brook	M41T6.01-B	Plymouth	Scout Camp Road	bridge	46%	A, DA, DB, SB	Very High
Reading Pond Brook	M41T6.02S1.02-B	Plymouth	Reading Pond Road	culvert	58%	DA, SB	Very High

Note: Constriction status is calculated as structure span divided by bankfull width, expressed as percent.

Abbreviations: A = Alignment; DA = Deposition above; DB - Deposition below; SA = Scour above; SB = Scour below

#### In the Patch Brook watershed:

Review the potential for improved road maintenance and drainage practices along Patch Brook Road between Townsend Barn Road intersection and Dublin Road. Road maintenance practices to mitigate for stormwater and sediment runoff may include: stabilization of road surfaces (different gravel materials), improvement of roadside ditches (excavation, stone lining and/or seeding and mulching), alternative grading practices (turnouts, check-basins); re-orientation of culvert crossings; protection of culvert headers; and gully stabilization.

Given the constraints of this narrow valley setting, which may limit the feasibility of stormwater retention practices, an evaluation should be made to determine alternatives and their social feasibility for abandonment or relocation of Patch Brook Road out of the Patch Brook valley – through connections to other existing roads or redevelopment of Class 4 road segments, where feasible.

#### In the Buffalo Brook watershed:

Work with landowners, including the State of Vermont Forest & Parks, to evaluate the potential for reduced sediment production and improved sediment retention within the lower reaches of Buffalo

Brook (M41T6.02-B) and Reading Pond Brook (M41T6.02S1.01-A) through implementation of stormwater management practices along the abandoned forest road sections.

Projects could include:

- Construction of water bars, broad-based dips, and turn-outs to direct surface water off the road (and away from the channel) onto terraces where stormwater can slowly infiltrate;
- Other projects consistent with Vermont's Acceptable Management Practices for
- Maintaining Water Quality on Logging Jobs in Vermont (2006);
- Possible "re-wilding" of these mostly abandoned forest road segments on State and private lands, where landowners are willing; and
- Possible introduction of boulders or large woody debris or other engineered structures in eroded sections of road which have been periodically occupied by the river – in order to increase roughness elements, slow flood waters and trap sediments.



# Chapter 7. Establishing Management Goals for Surface Waters

## Existing and Designated Uses

It is the policy of the State of Vermont to protect and enhance the quality, character and usefulness of its surface waters, prevent the degradation of high quality waters, and prevent, abate or control all activities harmful to water quality. **Existing Uses** (EU) are documented as part of the basin planning process to provide an expandable record of uses that “have 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.” EU listing is used in the permit review process to provide documentation to permit reviewers in upholding the anti-degradation rule of the WQS which requires that the Existing Uses and the level of water quality necessary to protect those Existing Uses shall be protected and maintained (§ 1-03, WQS). All proposed discharges must ensure there is no degradation of water quality that will diminish an established Existing Use.

Determinations on the presence of an Existing Use can be made during basin planning or on a case-by-case basis such as during consideration of a permit application. In this initial documentation of Existing Uses the Agency of Natural Resources has chosen to address four areas from the factors for consideration listed below. These are contact recreation (swimming), boating, fishing and public surface water drinking supplies. Other factors will be addressed in future plans and may be addressed sooner on a case-by-case basis during consideration of a permit application. All Class A(1), A(2), or B waters are presumed to support aquatic life use as an existing use, unless waters are documented to be biologically impaired.

The VANR uses a list of specific criteria to identify Existing Uses during river basin planning and the development of river basin water quality management plans. The listed Existing Uses and criteria can be found in Appendix A.8. These criteria have been developed for use during the basin planning process in order to ensure that EU identification in basin planning is done in a transparent, consistent and repeatable manner in each river basin plan across the state. ANR has recently developed a procedure on the evaluation of EU in the context of anti-degradation review, for use during permit review. These procedures are being continually re-examined to consider options for enhanced protection where merited.

During the planning process in Basin 10, the Department of Environmental Conservation has collected sufficient information to identify the Existing Uses listed in Appendix A.8. The list is not meant to be comprehensive. The Existing Uses included are limited to those with access points on public lands or those on private lands with documented landowner permission. The public is encouraged to nominate other Existing Uses which will be cataloged for a more thorough investigation on a case-by-case basis during the permit review process for an activity that might adversely affect the use and will be included in future basin plans as appropriate. Recommendations for EU determination should be made in writing to the Secretary of the Agency of Natural Resources.

The following factors are considered when identifying Existing Uses (see VWQS Section 1-03 B):

- Aquatic biota and wildlife that use or are present in the waters;

- Habitat that supports existing aquatic biota, wildlife or plant life;
- The use of waters for recreation or fishing;
- The use of waters for water supply or commercial activity that depends directly on the preservation of an existing high level of water quality; and
- With regard to the factors considered under the first two bullets above, evidence of the use's ecological significance in the functioning of the ecosystem or evidence of the use's rarity.

**Designated** Uses are 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. The Designated Uses of all Vermont waters are:

- Aquatic biota/habitat
- Contact recreation
- Secondary contact recreation
- Aesthetics
- Drinking water supply
- Agricultural water supply

All state waters are managed to meet the listed Designated and Existing Uses.

## Classification and Typing

Since the early 1970s, Vermont has had a classification system for surface waters that establishes management goals. These goals describe the uses and values of surface waters that are to be protected or restored through appropriate management. Once classified, the waters must be managed to obtain and maintain the designated classification. The original system included Classes A and B. Class A waters are divided into two subclasses: A(1) and A(2). As part of the Vermont Water Quality Standards revisions in 2000, Class B waters were divided into Water Management Type B(1), Type B(2) and Type B(3). These types are based on both existing water quality and reasonably attainable and desired water quality goals.

### Classification System

#### CLASS A1 Waters

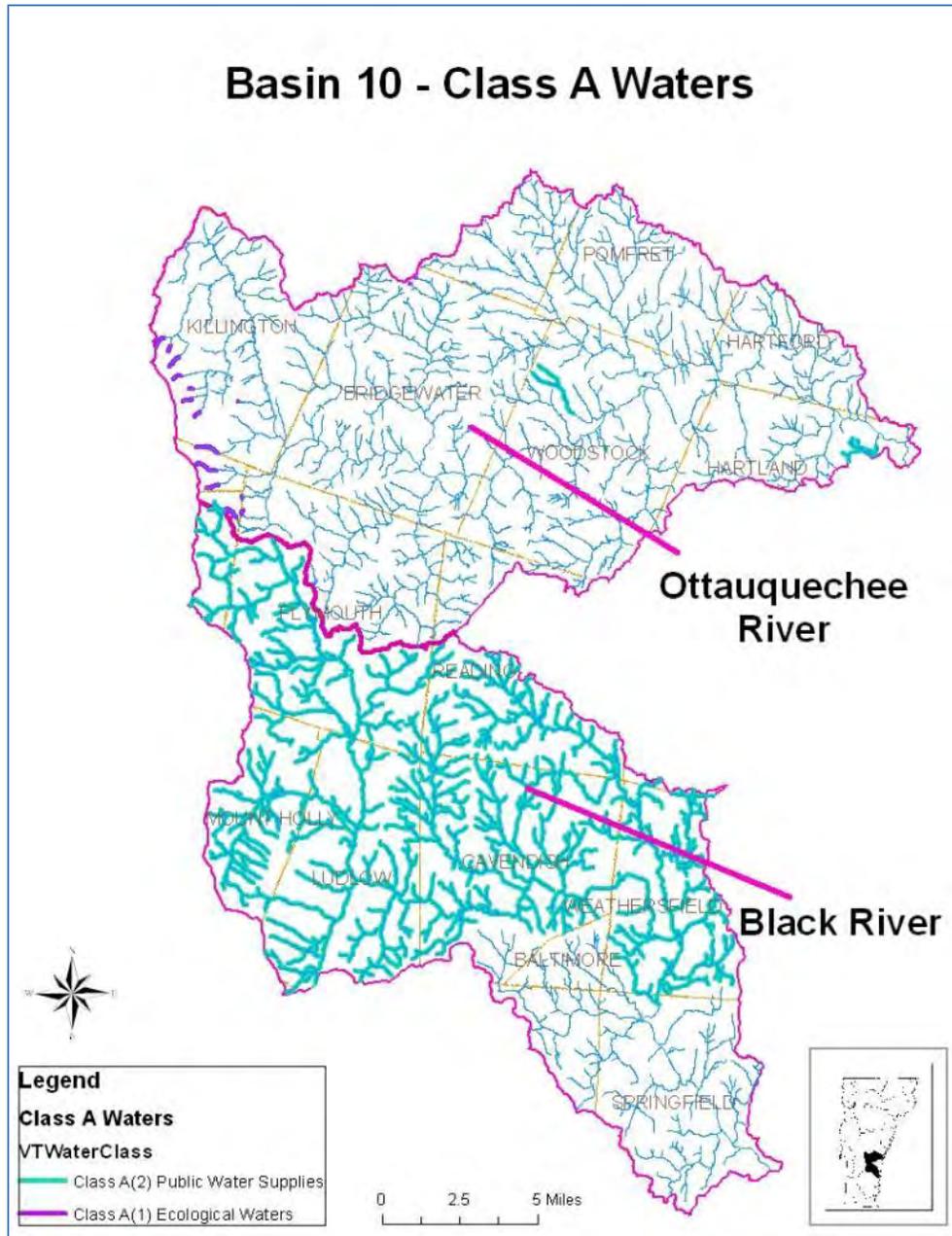
Presently all waters above 2,500 feet and those waters so designated by the State, are classified A(1) by Vermont statute. The management objective for A(1) waters is to maintain their natural condition. Basin 10 has numerous waters above 2,500'.

#### CLASS A2 Waters

Waters used as public water supplies, regardless of elevation, are classified A(2). The following waters are classified as A(2):

- Grant Brook, Village of Ludlow water supply.
- Springfield Reservoir Brook, Village of Springfield water supply.
- Springfield Reservoir and tributaries, Village of Springfield water supply.
- Spring and unnamed tributary to the Ottauquechee River, Village of North Hartland water supply.

- Cox, Vondell and Carlton Hill Reservoirs, Village of Woodstock water supply.



### Drinking Water Supply and Source Protection

The Water Supply Division of the VDEC has a federally approved Source Water Assessment Program. This program includes many of Vermont's pre-existing requirements for protection of public groundwater and surface water sources, and incorporates several new elements necessary to meet the federal requirements of the Source Water Assessment Program. The Source Water Assessment Program was developed with the help of a Technical and Citizen's Advisory Committee which included

representatives from state agencies, independent consultants, environmental groups, and water system representatives.

## **Drinking Water Supplies**

Public drinking water sources from surface waters are classified in the VWQS as Class A2 waters. Five surface water bodies are classified as A2 waters. Four are held for emergency use only. The fifth is no longer in use or held for emergency use and is recommended for reclassification to Class B.

### Ottauquechee River

Spring and unnamed tributary to the Ottauquechee River – 0.3 miles

Class A2 - Designated 11/16/67

Village of North Hartland water supply. (Reserved for emergency use). A spring and unnamed tributary to the Ottauquechee River and all waters within its watershed upstream of the water intake. The spring and brook are located approx. 1 mile north-northwest of North Hartland Village.

Cox, Vondell and Carlton Hill Reservoirs – Approx. 2.5 miles (Stream only)

Class A2 - Designated 11/16/67

Village of Woodstock water supply. (Private. Reserved for emergency use. Carlton Hill no longer in the system). Cox, Vondell and Carlton Hill Reservoirs – Approx. 2.5 miles (Stream only).

### Black River

Grant Brook (Off Jewell Brook) – Approx. 3.2 miles

Class A2 - Designated 3/30/66

Village of Ludlow water supply. (No longer in use). Grant Brook and all waters within its watershed upstream of the flood control dam.

**Recommendation: Reclassify to Class B.**

Springfield Reservoir Brook – 1.8 miles

Class A2 - Designated 3/30/66

Village of Springfield water supply. (Reserved for emergency use). Springfield Reservoir Brook and tributaries and all waters in its watershed upstream of Springfield Reservoir.

Springfield Reservoir and tributaries – 9.8 acres

Class A2 - Designated 3/30/66

Village of Springfield water supply. (Reserved for emergency use). Springfield Reservoir all waters within its watershed.

Beyond those surface waters classified as A2 Drinking Water Supply in Basin 10 there exist numerous groundwater source protection areas for community water supplies. This plan does not make recommendation for groundwater resources.

## **Public Water Systems**

Vermont's Source Water Assessment and Protection Program includes different requirements for the three different types of public water systems. In Vermont, a Source Protection Plan (SPP) includes the

delineation of the protection area, an inventory of the potential contaminants of concern in that area, and an assessment of the susceptibility of the drinking water source to contamination. These are required under the federal program. Vermont also requires a management plan for the potential risks and a contingency plan.

The three types of public water systems include:

A Public Community (C) Water System which could be a municipality, mobile home park, or retirement community which serves at least 25 residents year round or has at least 15 service connections.

A Non-transient, Non-community (NTNC) Public Water System which could be a school, factory, or office building with their own source of water that serves at least 25 of the same people more than six months per year.

A Transient, Non-community (TNC) Public Water System which could be a restaurant, motel, or campground which serves 25 or more people a day more than 60 days a year.

In Basin 10 there are 103 Community, 23 NTNC and 132 TNC systems.

### **CLASS B Waters**

All the remaining surface waters in Basin 10 are currently Class B.

The division of B waters into three management types was reorganized by the WRP to furnish a greater level of protection to existing higher quality waters and to recognize attainable uses that could be supported by improvements to existing water quality. The **typing** system for Class B waters is, for the most part, a continuum of acceptable conditions of water quality criteria such as aquatic biota, aquatic habitat and recreational opportunities. A simplification of the B1, B2 and B3 designations would be to say that the spectrum from B3 to B2 to B1 is described as representing “good,” “better” and “best” aquatic conditions.

All Class B waters are managed to achieve and maintain a level of quality that fully supports the following designated uses in addition to those listed under the individual types below:

- Public water supply - Suitable for use as a source for a public water supply with filtration and disinfection;
- Irrigation of crops and other agricultural uses - suitable, without treatment, for irrigation of crops used for human consumption without cooking and suitable for other agricultural uses.

### **Current Status of the Basin 10 Typing Proposal**

As of late 2007 activities working toward typing have been deferred statewide due to the passage of H. 154. The legislature, the Agency of Natural Resources and the Water Resources Panel are at work to determine the final guidance upon which the typing process will be based. As a result this Plan contains no recommendations regarding Water Management Typing for any surface water in the basin.

## Warm Water and Cold Water Designations

Beyond the classification and water management type assigned for each waterbody, lakes, ponds, rivers and streams are designated as either warm or cold water fisheries habitat in the Vermont Water Quality Standards. Dissolved oxygen requirements for warm water fisheries are lower than for cold water fisheries.

### Warm Water Fish Habitat

1. All wetlands, except those designated as cold water fish habitat below, and the following waters are designated as warm water fish habitat:
2. Warm Water Fisheries
  - (a) Black River from the Lovejoy Dam in Springfield to its confluence with the Connecticut River - June 1 through September 30 only.
  - (b) Deweys Mill Pond, Hartford
  - (c) Lake Ninevah, Mount Holly
  - (d) Lake Pinneo, Hartford
  - (e) North Hartland Reservoir, Hartland/Hartford
  - (f) North Springfield Reservoir, Springfield/Weathersfield
  - (g) Ottauquechee River from the North Hartland Dam in Hartland to its confluence with the Connecticut River.

### Cold Water Fish Habitat

1. All waters not designated as warm water fish habitat above are designated as cold water fish habitat.
2. Wetlands may also be designated as cold water fish habitat; however there are no wetlands so designated in Basin 10.

## Other Surface Waters with Noteworthy Characteristics

### Very High Quality Waters

Many waters in Basin 10 exceed water quality standards for particular biological attributes, parameters and/or habitat quality. These waters should be protected in a manner that maintains the present uses and values these waters provide. Such waters include:

#### Ottawaquechee River

- North Branch and its tributaries

#### Black River

- Jewel Brook  
- Tinker Brook

Monitoring data needs to be gathered to document the conditions in waters expected to exceed WQS such as the North Branch, Barnard Brook, Curtis Hollow Brook, Richmond Brook, Broad Brook,

Whetstone Brook in the Ottawaquechee watershed and Buffalo Brook, Reading Brook, Great Roaring Brook, Alder Meadow Brook, Tracer Brook in the Black River watershed.

Waters may be reclassified from B to A(1) through petition to the Water Resources Panel.

## Outstanding Resource Waters (ORW)

ORW are waters which can be designated by the Water Resources Panel through a local petition process. ORWs display outstanding qualities that are determined to deserve a higher level of protection. ORW designation may be based on any one or more of the following features:

- (1) existing water quality and current water quality classification;
- (2) the presence of aquifer protection areas;
- (3) the waters' value in providing temporary water storage for flood water and storm runoff;
- (4) the waters' value as fish habitat;
- (5) the waters' value in providing or maintaining habitat for threatened or endangered plants or animals;
- (6) the waters' value in providing habitat for wildlife, including stopover habitat for migratory birds;
- (7) the presence of gorges, rapids, waterfalls, or other significant geologic features;
- (8) the presence of scenic areas and sites;
- (9) the presence of rare and irreplaceable natural areas;
- (10) the presence of known archeological sites;
- (11) the presence of historic resources, including those designated as historic districts or structures;
- (12) existing usage and accessibility of the waters for recreational, educational, and research purposes and for other public uses;
- (13) studies, inventories and plans prepared by local, regional, statewide, national, or international groups or agencies, that indicate the waters in question merit protection as outstanding resource waters; and
- (14) existing alterations, diversions or impoundments by permit holders under state or federal law.

Currently, there are no ORWs in Basin 10.

### Waters Recommended for Future ORW Consideration

Participants in the planning process identified waters in the basin that might be considered for ORW designation due to their special characteristics, excellent water quality or unique habitat and community composition. The waters for further discussion include:

<b><u>Water:</u></b>	<b><u>Consideration:</u></b>
<b>Black River</b>	
Cavendish Gorge,	- scenic area (8)
Black River	- geologic features (7)
<hr/>	
Twenty-Foot Hole,	- scenic area (8)
North Branch Black River	- recreation (12)
	- geologic features (7)
<hr/>	

Buttermilk Falls, Branch Brook	- scenic area (8) - recreation (12) - fish habitat (4) - geologic features (7)
Lake Ninevah (loon) (rare watermilfoil <i>M. farwelli</i> and rare pondweed <i>Potamogeton obtusifolius</i> ) ( bog plants)	- wildlife habitat (5) (6)
<b>Ottauquechee River</b> North Branch Ottauquechee River	- fish habitat (4)
Woodward Reservoir (loon, Dwarf Shrub Bog)	- wildlife habitat (6)

## Wetland Classification

Based on an evaluation of the extent to which a wetland provides functions and values it is classified at one of three levels:

- Class I: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection
- Class II: Merits protection, either taken alone or in conjunction with other wetlands
- Class III: Neither Class One or Class Two wetland

### Class 1 Wetland Designation

There are currently no Class 1 wetlands in Basin 10, however there are two wetlands that meet the criteria for re-classification to Class 1, these are:

- Pomfret: Totman Hill fen, South Pomfret
- Hartland: Eshqua Bog

### Class 2 Wetland Designation

These Class 3 wetlands that should be evaluated for re-classification as Class 2:

- Killington: River Road wetlands. Extensive wetlands with many strong wetland functions due to the stream (e.g., erosion control, flood storage, fish habitat, wildlife habitat) and a strong aesthetic value due to their visibility from a public road
- Killington: south of Rte 4. Headwater wetland along stream that flows north into Kent Pond
- Killington: SE of Kent Pond along Thundering Brook Headwaters. 30+ acre open meadow/forested wetlands
- Killington: between River Rd and 100N. 30 acre open water/forested wetland along tributary to Black River
- Barnard: Lakota Lake. 11+ acres of wetlands split between inlet and outlet of lake, outlet is Richmond Brook

- Barnard/Pomfret: Stage Road. 35 acres of riparian wetlands, much of it surrounded by forest, some agriculture, some development
- Cavendish: Heald Branch. 12+ acre wetlands along stream + 15 acres mapped as hydric soil which may also be wetlands
- Cavendish: Stevens Rd and Greenbush Rd. 60 acre wetland, 3 streams, surrounded by forest
- Reading/Cavendish: Twenty Mile Stream. 24 acre riparian wetland complex along Meadowbrook Farm Road
- Reading: Reading Pond. Surrounded by forest, 2 streams through pond, 10 wetland acres mapped plus 4+ acres of wetland shoreline on west and south shore plus pond shallows are wetland
- Reading: Alder Meadow Brook. Nice headwater 10 acre+ wetland at top of hill visible from road, plus more wetlands along stream including a complex just north of South Puckerbrush Road
- Reading: near 795 Grasshopper Lane. 35 acre wetland with 2 streams and a beaver complex present for decades. May have fen. Surrounded by intact forest and a little rural agriculture. Upstream at headwater of stream is a second wetland complex about 12 acres and surrounded by forest
- Weathersfield: Downer's 4 corners. NE corner is 12 acre wetland that has a state ranked community
- Springfield/Weathersfield: North Springfield Reservoir. Riparian wetland complex. There are also other rare/endangered species in the reservoir area. An important wetland area but not Class 1 candidate because it is influenced by manmade impoundment and has invasives and development; a good spot to restore perhaps?
- Springfield: French Meadow Road. 64 acre forested/open water wetland
- Springfield: Spoonerville. Has one S241 ranked (threatened) wetland community
- Springfield: delta of Black River entering into CT River. About 5 acres of wetland with several RTE species (plant, mudpuppy) in area
- Chester: Amsden Hill Road. 41 acres plus S2 ranked plant, surrounded by forest to the north

The Agency will support the development of petitions for re-classification and ORW status by providing guidance and relevant information for designation of these waters, should there be public support.

---

41 **S2**: Rare, generally 6 to 20 occurrences believed to be extant and/or some factor(s) making it vulnerable to extirpation in the state

## List of Acronyms

319	Federal Clean Water Act, Section 319
604(b)	Federal Clean Water Act, Section 604b
AAP	Accepted Agricultural Practice
Agency	Vermont Agency of Natural Resources
AMA	Agricultural Management Assistance Program
AMP	Acceptable Management Practice
ANS	Aquatic Nuisance Species
AOP	Aquatic Organism Passage
AR	American Rivers
ARRA	American Reinvestment & Recovery Act
ARS	Agricultural Resource Specialist
B1	Class B Water Management Type 1
B2	Class B Water Management Type 2
B3	Class B Water Management Type 3
BASS	Biomonitoring and Aquatic Studies Section, Vermont Water Quality Div
BBR	Better Backroads
BMP	Best Management Practice
BRAT	Black River Action Team
C&C	Clean & Clear Program
CISMA	Cooperative Invasive Species Management Area
CWSRF	Clean Water State Revolving Fund
CRREL	Cold Regions Research and Engineering Laboratory / US Army Corps of Engineers
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CRWC	Connecticut River Watershed Council
CVPS	Central Vermont Public Service Co.
CWA	Federal Clean Water Act
DPW	Department of Public Works
DWSRF	Drinking Water State Revolving Fund
EQIP	Environmental Quality Incentive Program
EU	Existing Use
FAP	Farm Agronomic Practices
FEH	Fluvial Erosion Hazard
FERC	Federal Energy Regulatory Commission
FSA	Farm Service Agency (USDA)
GIS	Geographic Information System
IDDE	Indirect Discharge Elimination
LID	Low Impact Development
LIP	Landowner Incentive Program
LTP	Land Treatment Planner
LWD	Large Woody Debris
MAPP	Monitoring, Assessment and Planning Program
NEGEF	New England Grassroots Environmental Fund
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration

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
ONRCD	Ottauquechee Natural Resources Conservation District
ORG	Ottauquechee River Group
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
SGA	Stream Geomorphic Assessment
SPA	Source Protection Area
SVNMP	Southern Vermont Nutrient Management Program
SWCRPC	South Windsor County Regional Planning Commission
SWG	State Wildlife Grant
T4S	Trees For Streams
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TU	Trout Unlimited
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
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
VDEC	Vermont Department of Environmental Conservation
VDFPR	Vermont Department of Forests, Parks and Recreation
VDHP	Vermont Department of Historic Preservation
VDH	Vermont Department of Health
VEM	Vermont Emergency Management
VFB	Vermont Farm Bureau
VFWD	Vermont Fish and Wildlife Department
VGS	Vermont Geological Survey
VINS	Vermont Institute of Natural Science
VIP	Vermont Invasive Patrollers
VLCT	Vermont League of Cities and Towns
VLRP	Vermont Local Roads Program
VLT	Vermont Land Trust

VNNHP	Vermont Nongame and Natural Heritage Program
VNRC	Vermont Natural Resources Council
VRC	Vermont River Conservancy
VSA	Vermont Statutes Annotated
VTrans	Vermont Agency of Transportation
VYCC	Vermont Youth Conservation Corp
WHIP	Wildlife Habitat Incentive Program
WQRP	Water Quality Remediation Plan
WQS	Water Quality Standards
WRP	Water Resources Panel
WWTF	Wastewater Treatment Facility

# Glossary

**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 of silvicultural activity generally approved by regulatory authorities and practitioners as acceptable and common to that type of operation. AMPs may not be the best methods, but are acceptable.

**Active Restoration** - a strategy of restoring or managing rivers to a geomorphic state of dynamic equilibrium through an active approach that may include human-constructed meanders, floodplains, and bank stabilization techniques. Typically, the active approach involves the design and construction of a management application or river channel restoration such that dynamic equilibrium is achieved in a relatively short period of time. Active riparian buffer re-vegetation and long-term protection of a river corridor is essential to this alternative.

**Anadromous** – a fish species that feeds and grows to maturity in the ocean, then migrates into freshwater rivers and lakes to spawn.

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

**Basin** - one of seventeen planning units in Vermont. Some basins include only one major watershed after which it is named such as the White River Basin. Other Basins include two or major watersheds such as Basin 10 including the Black and Ottauquechee Rivers.

**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.

**Causes** – the pollutants or conditions that stress, impair or otherwise have an impact on the aquatic biota, the aquatic habitat, swimming, fishing, the fishery, boating, drinking water supply, fish consumption or other uses of the river or stream.

**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.

**Contact recreation (Primary)** – this water classification protects people from illness due to activities involving the potential for ingestion of, or immersion in, water. Primary contact recreation usually includes swimming, water-skiing, skin-diving, surfing, and other activities likely to result in immersion. (EPA Water Quality Standards Handbook, 1994)

**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.

**Dissolved Oxygen** – the concentration of free molecular oxygen dissolved in water.

**Easement** – a restriction placed on a piece of property to protect its ecological and open-space values. It is a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place now and in the future. In a conservation easement, a landowner voluntarily agrees to donate or sell certain rights associated with his or her property, such as the right to subdivide, and a private organization or public agency agrees to hold the landowner's promise not to exercise those rights.\*

**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 erosion hazard** - refers to the endangerment of human investments and public safety resulting from land use choices and expectations that conflict with the dynamic and oftentimes catastrophic physical adjustments of stream channel and flood plain dimensions, elevations, locations and longitudinal slope, in response to rainfall/runoff events and sometimes ice jams. (contrast with flood inundation hazard)

**Fluvial geomorphic equilibrium** - the condition in which the physically dynamic nature of fluvial systems is freely expressed over time in response to the range of watershed inputs and climatologic conditions, and as influenced by topographic, geologic, and existing human imposed boundary conditions.

**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, or conditions that cause lack of full support for any given designated use for the water's class or management type.

**Impervious** – a surface that does not allow water or other liquids to penetrate through

**Littoral** – the shoreline zone of a lake where sunlight penetrates to the bottom and is sufficient to support rooted plant growth.

**Low Impact Development** - a set of innovative stormwater management techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source through small, cost-effective landscape features located at the lot level. These include practices such as raingardens, bioretention facilities, dry wells, filter/buffer strips, grassed swales, and rain barrels.

**Macroinvertebrate** – animals without backbones and large enough to see with the naked eye.

**Macrophyte** – a rooted aquatic plant that grows in or on the water.

**Natural flow** - the flow past a specified point on a natural stream that is unaffected by stream diversion, storage, import, export, return flow, or change in use caused by modifications in land use.

**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.

**Passive Restoration** - a strategy of allowing rivers to return to a state of dynamic equilibrium through a passive approach that involves the removal of constraints from a river corridor thereby allowing the river, utilizing its own energy and watershed inputs, to re-establish its meanders, floodplains, and self-maintaining, sustainable equilibrium condition over an extended time period. Active riparian buffer re-vegetation and long-term protection of a river corridor is essential to this alternative.

**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.

**Riparian** – located on the banks of a stream or other body of water.

**Riparian Buffer Zone** - the width of land adjacent to lakes or streams between the top of the bank or top of slope or mean water level and the edge of other land uses. Riparian buffer zones are typically undisturbed areas, consisting of trees, shrubs, groundcover plants, duff layer, and a naturally vegetated uneven ground surface, that protect the waterbody and the adjacent riparian corridor ecosystem from the impact of these land uses.

**Runoff** - water that flows over the ground and reaches a stream as a result of rainfall or snowmelt.

**Secondary contact recreation** – this water classification is protective when immersion is unlikely. Examples are boating, wading, and rowing. These two broad uses can be logically subdivided into an almost infinite number of subcategories (e.g., wading, fishing, sailing, power-boating, rafting.). Often fishing is considered in the recreational use categories. (EPA Water Quality Standards Handbook, 1994)

**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.

**Sources** – the land uses, human activities, or occurrence of conditions that are the origin of the causes of impairments, impacts or stresses on river and stream in the basin.

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

**Total maximum daily load (TMDL)** - the calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet Vermont Water Quality Standards.

**Total phosphorus** – the total amount of phosphorus dissolved in solution (reactive) and in particulate form.

**Turbidity** - the capacity of materials suspended in water to scatter light usually measured in Nephelometric Turbidity Units (NTU). Highly turbid waters appear dark and “muddy.”

**Type / Typing** - a category of water management requirements based on both the existing water quality and reasonably attainable and desired water quality management goals. Through the basin plan all Class B waters must be allocated into one or more Water Management Types pursuant to § 3-06 of the Vermont Water Quality Standards.

**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, wetlands 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).

Source:

\* - The Nature Conservancy -

[http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/files/consrvtn\\_easemnt\\_sngle72.pdf](http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/files/consrvtn_easemnt_sngle72.pdf)

# Appendix

*Under separate cover*