

Vermont Agency of Natural Resources

LAMOILLE RIVER BASIN
Water Quality Management Plan- DRAFT

February, 2009



Terrill Gorge Kenfield Brook, Morristown

THE LAMOILLE RIVER BASIN WATER QUALITY MANAGEMENT PLAN
WAS PREPARED IN ACCORDANCE WITH 10 VSA 1253(d), THE VERMONT
WATER QUALITY STANDARDS, THE FEDERAL CLEAN WATER ACT AND
40 CFR 130.6.

Approved:

Justin Johnson, Commissioner
Department of Environmental Conservation

Date

Jonathan Wood, Secretary
Agency of Natural Resources

Date

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Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division
Waterbury, Vermont 05671-0408

TABLE OF CONTENTS

Executive Summary	1
Chapter 1. Introduction	3
Purpose of the Basin Plan and the Basin Planning Process	3
Planning at the Watershed Level.....	3
Plan Development as a Collaborative Process	3
Partners in the Lamoille River Watershed Planning Process	4
Public Participation	5
Chapter 2. General Description of the Lamoille Watershed	7
Physical Description	7
Existing Uses.....	7
Fish Habitat, Fisheries, Access, and Water-Dependent Wildlife.....	11
Other Uses of Lamoille River and Tributaries	14
Chapter 3. Water Quality in the Lamoille River Watershed	17
Identifying Water Quality Problems	17
General Water Quality Conditions.....	17
Public's Concerns Regarding Water Quality Problems.....	18
Wetlands.....	18
Lakes and Ponds	20
The River Corridor.....	29
Dams and Flow-regulated Waters.....	34
The Working Landscape, Farm and Forestland	40
Developed Lands and Water Quality	49
Chapter 4. Water Quality Protection and Restoration Opportunities.....	59
Actions to Protect and Enhance Wetlands	59
Actions to Protect and Enhance Lakes and Ponds	59
Actions to Enhance and Protect River Corridors.....	61
Actions to Improve Flow-regulated Waters	62
Actions to Address the Loss of the Working Landscape.....	63
Actions for Agricultural NPS Reduction.....	64
Actions to Address Silvicultural Practices and Water Quality.....	65
Actions to Address Construction Site Erosion	65
Actions to Improve Water Quality from Stormwater.....	66
Actions to Address Transportation Infrastructure and Water Quality Issues	67
Outreach and Education Actions.....	68
Chapter 5. listed waters Remediation and Water Quality Assessment Needs	70
Introduction	70
Part A. Impaired Waters in Need of a TMDL	70
Lake Champlain Phosphorus TMDL.....	71
Deer Brook, Georgia.....	73
Mill Brook, Fairfax	74
Unnamed tributary to the Brewster River, Cambridge	75
Stevensville Brook, Underhill	76
Part B. Impaired Waters not requiring a TMDL	77

Lamoille River- Clarks Falls Dam to Route 2.....	77
Part C. Waters in Need of Further Assessment. See Appendix for a table of these waters	77
Part D. Surface Waters with a Completed and Approved TMDL	77
Part E. Waters Altered by Exotic Species	78
Part F. Waters Altered by Flow Regulation	78
Part G. Surface Waters Altered by Channel Alteration.....	78
Chapter 6. Management Goals for Surface Waters.....	81
Background	81
Typing and Classification.....	81
Waste Management Zones	83
Fish Habitat Designations	83
Outstanding Resource Waters	83
Chapter 7. Summary and Implementation of the Basin Plan.....	84
Summary	84
Implementation of the Watershed Plan	84
Evaluating the Plan's Progress	84
References	86
Glossary	90
List of Acronyms.....	93

List of Figures

Figure 1. Major Planning Basins in Vermont.....	4
Figure 2. 2003 Detailed land use land cover map of Caspian Lake-	22
Figure 3. Eurasian watermilfoil.....	26
Figure 4. Lane's diagram (1955) from Rosgen (1996)	31
Figure 5- Wilikins Ravine, Morrisville.....	54
Figure 7.- Browns River Watershed	79

List of Tables

Table 1. Swimming as an Existing Use	8
Table 2. Recreational Boating as an Existing Use	9
Table 3. Water Supply as an Existing Use	16
Table 4. Recreational Fishing as an Existing Use.....	16
Table 5 Watershed Biological Reference Sites.....	19
Table 6. Wilderness-like Lakes in Lamoille Watershed	23
Table 7. Functions and Values of Selected Lamoille Watershed Lakes (DEC, 2001).....	28
Table 8. Lakes in the Lamoille Basin Predicted to Have Elevated Tissue Mercury Concentrations..	28
Table 9. Waters Altered by Regulated Flows in the Lamoille River Basin	43
Table 10. The Number of Agricultural Producers (farms)	46
Table 11. Lamoille Waters Affected by Agriculture.....	44
Table 12. Non point Source Phosphorus (P) Loads and Proposed Reductions for the Malletts Bay Segment (DEC, 2002).....	76
Table 13. List of Impaired Lamoille Basin Waters Needing a TMDL.....	78

Mission

The Lamoille River Watershed supports an economically vibrant agricultural and forest based working landscape. Conflicts between human activities and the natural functions and values of streams, lakes, and wetlands within the watershed will be minimized whenever possible. Basin residents will be informed and working collaboratively to protect and improve the shared water based resources. Opportunities abound for youth to learn about and appreciate the watershed (Lamoille Watershed Council, 2004).

Purpose

The principal purpose of this plan is to improve surface water quality and aquatic habitat in the Lamoille River watershed.

EXECUTIVE SUMMARY

The Lamoille River Watershed Plan describes water quality conditions and water resource opportunities in the basin and recommends actions for the improvement of problems over the next five years. The principal purpose of the plan is to improve surface water quality and aquatic habitat by guiding the Agency of Natural Resources (ANR) in its own work and in collaborative projects with the public, municipalities, and other State and federal agencies. Water quality and aquatic habitat is acceptable when it supports uses that Vermonters deem to be beneficial and it attains or exceeds the criteria in the Water Quality Standards.

There are many identified values of the Lamoille River and its numerous tributaries including but not limited to gorges, waterfalls, cascades, whitewater and flat water boating, swimming holes, fishing, aquatic and riparian area habitat, and significant wetlands. The basin is home to numerous lakes and ponds with scenic and natural features, high water quality, and rare, threatened, and endangered species.

Basin planning is one method for addressing water quality and water resource problems. Its effectiveness depends on the willingness of the local community, landowners, and State and federal entities to undertake

projects that will enhance or protect water quality. The planning process facilitates this collaborative effort. The plan enumerates carefully designed actions to achieve goals agreed upon during the planning process. Public concerns about water quality and actions that address the restoration of these waters were the focus of extensive public involvement. Within the next five years, the Agency of Natural Resources will focus its efforts in these areas in collaboration with the community and other partners. Implementation of these actions will address the greatest sources of impacts to water quality and aquatic habitat in the basin. The next basin plan will document work completed and will address any new issues that have emerged.

For this basin plan to be successful, the following water quality issues must be resolved:

Wetlands

- Protect wetlands through town and regional plans, zoning, and wetland classification upgrades through petitions submitted to the Water Resource Panel.
- Restore prior converted wetlands on idled agricultural lands.

Lakes and Ponds

- Protect high quality lakes and ponds and undeveloped shorelines.

- Enhance developed shorelines by establishing and protecting lakeshore buffer areas.
- Identify and remediate non point source pollution within lake subwatersheds.
- Prevent aquatic nuisance species spread and increase monitoring for lakes and ponds.

River Corridor Management

- Use watershed and stream geomorphic assessments in a proactive manner to direct and prioritize stream corridor protection, stream stability restoration projects, municipal pre-disaster mitigation efforts, fluvial erosion hazard mapping, and enhancement of aquatic and riparian habitats for fish and wildlife.

Flow-altered Waters

- Eliminate or reduce artificial lake and pond water level fluctuations where unnecessary or not cost effective.
- Identify small dams for stream restoration projects through selective removal or retrofitting that restore fish passage, aquatic habitat, and natural stream functions.

Conversion of Farm and Forestland

- Reduce the loss of working farm and forestland by implementing practices such as changes to zoning ordinances, estate-planning and transferring the farm educational workshops, purchase of development rights, and increasing markets for local agricultural and forest products as these land use conversions can have negative impacts to water quality and fish and wildlife habitat.

Agricultural Land

- Selectively apply agricultural best management practices to address runoff and streambank erosion associated with intensive agricultural uses.

Developed Lands

- Implement new stormwater and construction site permits, increase outreach, and implement restoration projects in priority areas in village centers and urban sectors.
- Conduct bridge and culvert assessments watershed wide to identify stream crossing structures that impede fish passage or contribute to stream instability and flood erosion hazards and upgrade crossing appropriately.
- Develop capital budgets for municipal road improvement projects.
- Assist municipalities in implementing road best management practices.

Outreach and Education

- Establish teams composed of local residents, learning institutions, businesses, and municipalities to direct and participate in assessment, restoration, and outreach efforts at the sub-watershed level.
- Build the capacity of Lamoille watershed and lake associations.

Impaired waters restoration

- Establish or continue collaborative partnerships in the restoration of waters that currently do not meet Vermont Water Quality Standards with a special emphasis on reducing phosphorous loads to Lake Champlain.

Water Management Typing

- This basin plan does not contain any water management typing (WMT) recommendations for any Class B waters. Once an agreed upon process for WMT or for an alternative to WMT is developed by the Water Resources Panel, this plan will be revised accordingly.

CHAPTER 1. INTRODUCTION

Turn your dreams into a goal and decide how to attack that goal. Break it into piece sized chunks that seem possible and then don't give up, just keep plugging away.

-John Naber, former Olympian

Purpose of the Basin Plan and the Basin Planning Process

This basin plan describes the strategies necessary to protect and improve the surface waters in the Lamoille River Basin, such that aquatic communities and habitat, swimming and fishing, and the general utility of waters will be maintained and enhanced. The Agency of Natural Resources, Department of Environmental Conservation (DEC) has collaboratively developed these strategies and will collaboratively implement them with watershed residents and other partners.

The collaborative effort started in 2001 with the identification of local concerns about the values and uses of the waters. Strategies were developed to address the local water resource concerns. The strategies in the plan are available to individuals, groups, and the Agency to assist in deciding where to focus resources and where to find resources. The strategies guide the Agency of Natural Resources, citizens, and landowners in their work, including the restoration of waters that do not presently attain the Vermont Water Quality Standards.

Implementation of strategies began during the basin planning process and will continue until the basin planning process begins again.

Planning at the Watershed Level

A watershed, or basin, is a distinct land area that drains into a particular waterbody either through channelized flow or surface runoff. A watershed

is defined by topography instead of traditional political boundaries. Because rivers join to become larger rivers, many watersheds may be considered sub-watersheds of larger watersheds. All of the waters within the Lamoille watershed drain into Lake Champlain, making the entire watershed a component of the larger Lake Champlain Basin.

The quality of surface waters in Vermont is mostly dependent upon the content and amount of surface runoff from activities taking place on surrounding land. Preparing a plan at a watershed level allows for the consideration of all contributing sources of surface water runoff to any one waterbody in the watershed.

The Agency of Natural Resources' planning efforts to improve or maintain water quality at a watershed level has been conducted since the 1970s. The state is divided into seventeen planning basins for this purpose. 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 originally approved. A planning basin may include one or more major river watersheds (Figure 1).

Plan Development as a Collaborative Process

Planning through a collaborative process with the communities in the basin, local, State, and federal governments, and private organizations is one important method to improve water quality. This method works well today because Vermont's water quality problems are, for the most part, the result of runoff from many, dispersed activities on the land (non point source pollution) and not from single point sources.

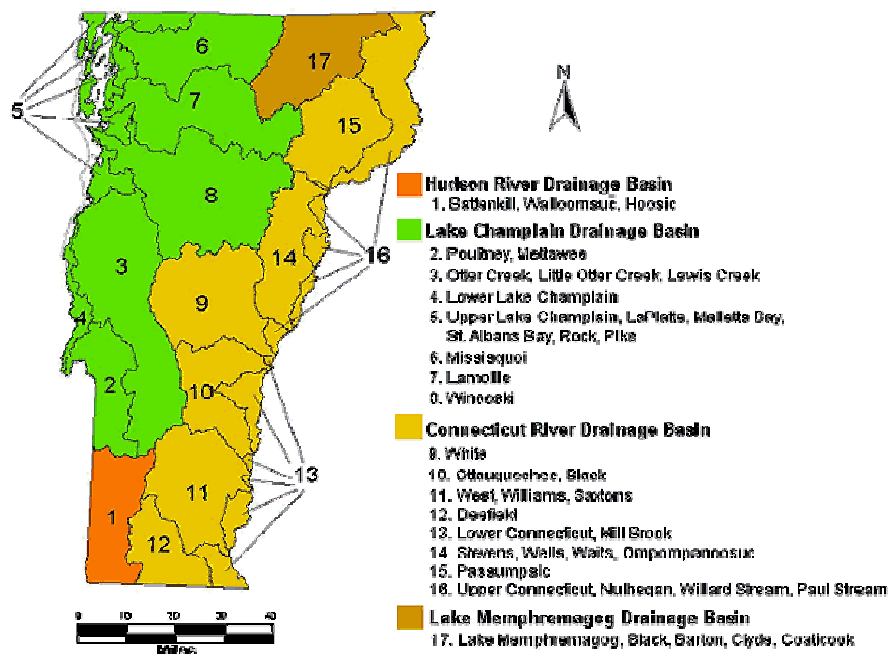


Figure 1. Major Planning Basins in Vermont.

The State cannot depend solely on regulations to stem the innumerable sources of pollutants. It must look to the interests and voluntary actions from watershed residents. Vermont already has more than 65 watershed and river groups, many of whom are involved in efforts to address water quality concerns. There are thousands of landowners also working to manage their lands to conserve Vermont's waters. Basin planning can support their efforts by providing technical and financial assistance. By documenting community-voiced problems and solutions, basin planning can better direct the resources of the State and others toward the priorities of local communities and landowners.

Another benefit of a collaborative approach is the sharing of information among resource agencies, groups, and individual citizens. This results in more realistic solutions. The involvement of the community in identifying problems and solutions increases public awareness of opportunities to promote and preserve water quality in the basin.

Partners in the Lamoille River Watershed Planning Process

Numerous individuals and organizations collaborated in the development of this watershed plan and implementation of water quality improvement projects. Some of these organizations include: Lamoille County, Chittenden County and Northwest regional planning commissions (RPCs) and Northeast Vermont Development Association; Franklin, Lamoille, Orleans, Winooski, and Caledonia Natural Resource Conservation Districts (NRCDs); USDA Natural Resources Conservation Service (NRCS); Lamoille River Anglers Association; Lamoille Watershed Association; Lamoille County Farm Bureau; Vermont Agency of Agriculture, Foods and Markets (AAFM); Central Vermont Public Service Corporation (CVPS); Morrisville Water and Light Department, Hardwick Electric, Smugglers Notch Resort; the U.S. Fish and Wildlife Service; DEC's Water Quality, Water Supply, and Wastewater Management divisions; and the Departments of Forests and Parks, and Recreation and Fish and Wildlife; municipal conservation commissions, planning commissions, select boards; and numerous watershed residents and landowners.

Public Participation

We must engage a broad cross-section of Vermonters in each watershed in developing these action plans and working to implement their own strategies for watershed improvement. The Agency will provide leadership and support this effort, but the best, most successful strategies for managing our waters will come from the people who live, work, and play in each watershed.

-Canute Dalmasse, former and late Deputy Secretary, Vermont Agency of Natural Resources

Watershed Plan Development

The premise for the development of this plan is to use a proactive, collaborative, and restoration-oriented approach to identifying solutions that emphasize voluntary actions to improve water quality. The planning process included the following steps:

- Issue identification;
- Issue prioritization;
- Strategy and solution development;
- Identification of resources and funding; and
- Implementation of water quality improvement projects.

The planning process will occur for each river basin on a five-year cycle, incorporating planning, implementation, monitoring, and evaluation. Every 5th year, the renewed plan will guide a continually evolving course of watershed improvement activities for the basin. Appendix A.3 includes a compilation of all public meetings held during the watershed plan development.

Watershed Council

The Lamoille Watershed Council was formed to represent a diverse mix of stakeholders from within the watershed. The Council members represent watershed constituents from various backgrounds including farmers, foresters, loggers, business owners, municipal officials, anglers, local watershed organizations, environmental groups, teachers, utility companies, regional planners, and a ski area among others. The DEC watershed coordinator and the Watershed Council have

developed the watershed plan and will assist in the implementation of watershed restoration projects. The Watershed Council met monthly for over two years to formulate a collaborative approach to resolving water quality issues of high priority. Council membership and meeting attendance was continually open to the public. Technical advisors provided the Council and watershed coordinator with information necessary to develop strategies to be included within the watershed plan (see Appendices for a list of Watershed Council membership and technical advisors as well as the schedule of public meetings). The Lamoille Watershed Council was integral in the development of this document. Council members:

- Encouraged constituents' participation and conducted outreach and education to inform constituents about known watershed issues;
- Developed and conducted watershed forums to identify water resources issues (assets and problems), related community needs, and potential solutions;
- Identified immediate or ongoing water quality improvement projects to be undertaken during the planning process; and
- Guided the plan through review, revision, and approval process.



Lamoille Basin public forum, Johnson

People are inherently capable of making proper judgments when they are properly informed.

-Thomas Jefferson

Panel Discussions

The Watershed Council members held a series of panel discussions, including presentations and question and answer sessions between technical persons and the Council members and residents, regarding the top Lamoille River watershed water quality issues. Panel discussion topics included impaired waters remediation, transportation infrastructure and water quality, accepted agricultural practices (AAPs) and best management practices (BMPs), logging acceptable management practices (AMPs), fluvial geomorphology (stream dynamics), surface water typing, loss of the working landscape issues, and water quality and aquatic habitat issues associated with lakes, ponds, and dams. The Council used water quality assessment information in developing strategies and prioritizing water quality issues.

CHAPTER 2. GENERAL DESCRIPTION OF THE LAMOILLE WATERSHED

Any river is really the summation of the whole valley. To think of it as nothing but water is to ignore the greater part.

-Hal Borland, This Hill, This Valley

Physical Description

The Lamoille River main stem originates in the northwest corner of the Town of Wheelock, along the east side of Vermont Route 16 at the outlet of Horse Pond. It flows 84.9 miles in a generally westerly direction until it empties into outer Mallett's Bay of Lake Champlain ten miles north of Burlington. It is a pool-riffle gravel bottom river for the majority of its length although there are smaller reaches of dune-ripple sand bottom and plane-bed cobble-boulder bottom. From its headwaters to the mouth, the river descends approximately 1,200 feet and drains a 706 square mile watershed, which is 7.5 percent of Vermont's land area. The basin occupies the major part of Lamoille and lesser parts of Franklin, Chittenden, Orleans, Washington, and Caledonia Counties (DEC, 2001).

There are a total of 24 lakes and ponds that are 20 acres or larger in the Lamoille River Basin. Caspian Lake, Arrowhead Mountain Lake, and Green River Reservoir are by far the largest with areas of 789 acres, 760 acres, and 554 acres respectively. Major tributaries to the Lamoille River include the Wild Branch (39 square miles), Green River (22 square miles), Gihon River (66 square miles), North Branch (37 square miles), Brewster River (21 square miles), Seymour River (21 square miles), and Browns River (92 square miles).

Forested land is the dominant land cover/land use in the Lamoille River watershed (71 percent). Agriculture is the second largest land use with relatively high percentage coverage of 13 percent.

Surface waters cover about 7 percent of the watershed area and wetlands about 3 percent. Transportation uses cover 4 percent of the area and other developed land occupies 2 percent.

Existing Uses

There are many identified special uses, features, and values of the Lamoille River and its numerous tributaries including waterfalls, cascades, whitewater boating stretches, and swimming holes. All surface waters in Vermont are managed to support uses valued by the public including swimming, boating, and fishing. The degree of protection afforded to these uses is based on the water's management type or class as described in Chapter 6 of this plan. In particular surface waters, however, some uses are protected absolutely if the Agency of Natural Resources identifies them as existing uses under the anti-degradation policy of the Vermont Water Quality Standards (VWQS).

The Agency identifies existing uses of particular waters either during the basin planning process or on a case-by-case basis during application reviews for state or federal permits. During the Lamoille Basin planning development DEC, focused on the following Existing Uses:

- The use of the waters for swimming;
- The use of waters for boating;
- The use of the water for water supply, and
- The use of water for recreational fishing.

It is DEC's presumption that swimming, boating, and fishing existing uses exist for all lakes and ponds in the basin. During the planning process, DEC has collected sufficient information to identify the existing uses listed in Tables 1-4. The list is not meant to be exhaustive. Existing Uses of specific waters were limited to those waters with public access (Appendix A.10). The public is encouraged to nominate other existing uses, which may be included in the basin plan or catalogued for a more thorough investigation when an application is submitted for an activity that might adversely affect the use.

Swimming as an Existing Use

There are a number of popular swimming holes both on the Lamoille River mainstem and on its tributaries. The locations described below are also generally some of the most scenic and aesthetically pleasing spots on the river. All sites listed on Table 1 are rated significant for swimming (DEC, 1992). Sites listed here are accessed through publicly owned lands such as stream crossing right-of-ways. Many locations that are privately owned with private access are not included in Table 1. Landowner permission should be sought before using these resources.

Recreational Boating as an Existing Use

A number of locations are good whitewater boating stretches in the basin. The Lamoille main stem is used extensively for flat water canoeing and kayaking by the several local outfitter businesses as well as the general public. All sites listed on Table 2 are rated significant for boating (DEC, 1989) or were otherwise brought to DEC's attention. Many canoe access areas and dam portages have been established on the main stem. Anyone boating these reaches should carefully scout routes before launching.

Drinking Water Supplies

There are approximately 84 drinking water systems within the watershed. The source types include impoundments, lakes and ponds, streams, well points, dug wells, gravel and gravel screened wells, gravel open-end casings, rock wells and springs. Currently, five surface waters within the watershed are designated as drinking water supplies (Table 3). Silver Lake and its tributaries, located in the Town of Georgia, are used as a drinking water supply for the Town of St. Albans. The unnamed tributary to the Brewster River in Cambridge is a drinking water supply for Smugglers Notch Resort. The Town of Greensboro has designated Caspian Lake as a reserve public drinking water supply in the event of an emergency. Arrowhead Mountain Lake is used as a public water system by Georgia Dairy Industrial Park. It is the only non-community (non-publicly owned) water system in the state

that is using surface water. French Hill Brook had been previously used by the Town of Johnson as a public drinking water supply. The Town has since developed an aquifer for this purpose and no longer uses French Hill Brook. Most other municipalities in the watershed use ground water wells for drinking water supplies.

Table 1. Swimming (Contact Recreation) as an Existing Use of Specific Waters within the Lamoille River Watershed.

Swimming Site Name	Town	Location
Lamoille River, Dogs Head Falls- lower pool	Johnson	Patch Road
Picnic Ledges	Wolcott	Route 15 east of village
Lamoille River, Wolcott Village	Wolcott	Route 15 in village
Terrill Gorge-Kenfield Brook	Morristown	Duhamel Road-F&W parking lot
Elmore Branch	Wolcott	East Elmore Road
Sheep's Hole-Foot Brook	Johnson	Foot Brook Road
The Ledges-Foot Brook	Johnson	Cherry Hill Road
Power House Bridge Falls-Gihon River	Johnson	School Street
Rogers Bridge-Seymour River	Cambridge	Lower Valley Road
Brewster River Gorge Swimming Hole	Jeffersonville	Route 108 turn on road south and west of Grist Mill
Codding Hollow Covered Bridge-North Branch	Waterville	Codding Hollow Road
Calavale Brook Cascades	Eden	Route 118

Table 2. Recreational Boating as an Existing Use of Specific Waters within the Lamoille Watershed.

Location	Documentation	Rating	Characteristics that support that use	Put in	Take out
Lamoille River- Greensboro Bend to Hardwick (7-8 miles)	<i>Vermont's White Water Rivers</i>	Highly Important	Class I-III, longest stretch of Class III in northern Vermont	Upstream of Greensboro Bend with portage in East Hardwick	Upstream of Hardwick Village
Lamoille River- Wolcott Ledges (1.4 miles)	<i>Vermont's White Water Rivers</i>	Highly Important	Class III can be run in wet summers and fall	Behind the Pottersville Dam powerhouse	Downstream of Wolcott Village
Lamoille River (34 miles) Morristown to Fairfax	<i>Vermont's White Water Rivers</i>	High Importance	Class II-IV, whitewater and general touring	Duhamel Road, Morristown below Cady Falls	Upstream of Fairfax Falls (many portages)
Lamoille River (4.6 miles) Fairfax to Georgia	<i>Vermont's White Water Rivers</i>	Highly Important	Class II-III, one of two rapids on large rivers in the state	Road southwest of Fairfax Village	Route 104A Georgia
North Branch (9 miles)	<i>Vermont's White Water Rivers</i>	Not rated	Class II-IV, excellent to outstanding scenery and pristine	Bog Road Bridge, Belvidere	Church Street covered bridge, Waterville
Gihon River (1.5 miles)	<i>Vermont's White Water Rivers</i>	Not rated	Serious Class IV-V used by expert paddlers	Whitcomb Island Road, Johnson	Pearl Street, Johnson
Wild Branch (7 miles)	<i>Vermont's White Water Rivers</i>	Important	Fast, twisty, and highly technical Class II-III	North Wolcott Road upstream of Wolcott-Craftsbury line at town bridge right-of-way	Route 15 at state bridge
Waterman Brook	<i>Let it Rain</i>	Not rated	Class IV-V used by expert paddlers	Waterman Road covered bridge, Johnson	River Road East, town bridge Johnson
Kenfield Brook	Vermont Paddlers Association recommendation	Not rated	Class IV- outstanding scenery	Tyndal Road, Morristown	Duhamel Road, Morristown

Table 3. Water Supply as an Existing Use within the Lamoille River Watershed.

Water Body	Location	Documentation
Silver Lake	Georgia and Fairfax	Silver Lake is the drinking water supply for St. Albans
Unnamed Tributary to the Brewster River	Cambridge	This impoundment is a drinking water supply for Smugglers Notch Resort
Caspian Lake	Greensboro	This lake is an emergency drinking water supply for the Town of Greensboro
Arrowhead Mountain Lake	Georgia and Milton	This lake is used by Georgia Dairy Industrial Park and is a non-community privately owned water system
French Hill Brook	Johnson	This stream had been the drinking water supply for the Town of Johnson until the Town developed an aquifer

Table 4. Recreational Fishing as an Existing Use of Specific Waters within the Lamoille Watershed.

Site Name/Waterbody	Location	Documentation
Fisher Bridge, Lamoille River	Route 15, Wolcott	VFWD access
Wolcott F&W Access, Lamoille River	Route 15, Wolcott	VFWD access
Town Ball Field	Off Route 15, Wolcott	VFWD access
Elmore Pond Road Bridge, Lamoille River	Elmore Pond Road, Wolcott	VFWD access
Cady Falls Bridge, Kenfield Brook and Lamoille River	Cady Falls Road, Hyde Park	VFWD access
Hog Back Road, Lamoille River	Hog Back Road, Johnson	VFWD access
Cambridge Junction Covered Bridge and Greenways Trail Access, Lamoille River	off VT Route 109, Cambridge	VFWD access
Horse Pond	Route 16, Greensboro	VFWD access
Flagg Pond	Flagg Pond Road, Wheelock	VFWD access
Wolcott Pond	Wolcott Pond Road, Wolcott	VFWD access
Elmore Pond	Route 12, Elmore	VFWD access
VFWD owned riparian lands along Lamoille River in Sheffield, Hardwick, Morristown, Hyde Park, and Johnson and along Porter Brook (direct Lamoille River drainage) in Greensboro and Hardwick, Alder Brook in Hardwick, Greensboro Brook in Greensboro and Hardwick, and Kenfield Brook in Morristown	(see description to left)	VFWD access

Fish Habitat, Fisheries, Access, and Water-Dependent Wildlife

Access

There are many sites in the watershed where concentrated angling occurs. The Vermont Fish and Wildlife Department (VFWD) owns 25 riverbank segments totaling 62,000 linear feet (almost 12 miles), which provide riparian zone protection and direct public access for fishing. Some of the fishing access areas are Fisher Bridge access in Wolcott, which is handicapped accessible, Town Ball Field access in Wolcott, Elmore Pond Road Bridge access in Wolcott, Cadys Falls Bridge in Hyde Park, Hogback Road in Johnson, Cambridge Junction Covered Bridge access and Greenways Trail access in Cambridge among others (Table 4).

VFWD acquired extensive fee ownership along several Vermont rivers from the 1950s into the 1970s. The principal purpose of these acquisitions was to ensure future public access for angling from streambanks at a time when traditional land use and ownership patterns were beginning to change, as large land ownership decreased and land posting increased. The VFWD also envisioned conservation benefits accruing from this type of public ownership: protecting water quality, fish populations, and riparian wildlife habitat by isolating the river from adjacent land uses.

In the 1990s, VFWD initiated a project to inventory the current condition of the lands and, where needed, improve wildlife habitat and public access conditions. The inventory includes identification of property boundaries, assessment of existing habitat and access conditions, and plans for future site-specific needs, such as access improvement, riparian buffer restoration, and resolution of boundary uncertainties. VFWD inventoried its streambank lands in the Lamoille River in 1998 (VFWD, 1998). Beginning in 2000, in partnership with local anglers, the Lamoille

County NRCD, and the U.S. Fish and Wildlife Service, VFWD began restoring forested buffers on the Lamoille lands. To date over 2,200 trees have been planted along approximately 7,300 feet (1.4 miles) of riverbank. VFWD continues to work with its partners to monitor and enhance plantings as needed to ensure forested buffers are restored along the Fish and Wildlife Department streambank lands in the basin.

The VFWD owns and manages several wildlife management areas (WMA) within the watershed including East Hill WMA, Wild Branch WMA, Steam Mill Brook WMA, and Sandbar WMA as well as numerous fishing accesses and streambank lands.

The Lamoille River watershed supports a variety of aquatic habitats and fish species, from the cold, high gradient, headwater trout streams in the upper watershed to the warm, low gradient, large winding river and impoundments of the lower watershed. Throughout the watershed, the Lamoille's numerous lakes and tributaries provide a diversity of fishing experiences and public access opportunities.

Fish Habitat and Fisheries

Upper Watershed (headwaters in Wheelock to Morrisville)

The upper Lamoille watershed is composed of a variety of substrate types originating from its ancient riverine and lake geology (DEC, 2001). The uppermost tributaries of the watershed upstream of the Greensboro Brook confluence are small, moderate gradient upland streams flowing through mainly forested riparian corridors. These tributaries contribute cold oxygenated water into the mainstem and are home to native self-sustaining brook trout populations, as well as slimy sculpins, blacknose and longnose dace, longnose suckers, and creek chubs. Downstream of Greensboro Brook to Hardwick, the fish

population expands to include wild and hatchery-origin rainbow trout, white suckers, and brown bullheads. The upper main stem river itself is characterized by riffle-pool habitat. Angling for brook trout is the most common fishing activity in this area, although overall fishing is relatively low.

As the Lamoille River makes its way from Hardwick towards Morrisville, it alternates between short sections of steeper cobble-dominated rapids to the occasional ledge drop to the more dominant low gradient river reaches common to valley-bottom depositional areas. These slower moving, deep river areas support populations of rainbow trout and brown trout and minnows (common shiners, fallfish). Though wild brown trout and rainbow trout dominate the fish community in this stretch of river, some wild brook trout are present and hatchery-origin trout make up a small portion of the fish population. The lower reaches of the main tributaries in this area, such as the Green River and Elmore Branch, serve as important spawning and nursery habitat for main stem resident rainbow trout and brown trout. This reach of river is a popular trout fishing area, with rainbow trout dominating the catch.

The upper Lamoille has a variety of lakes and ponds both natural and man-made dam impoundments. Notable ponds in the upper watershed include: Long Pond and Caspian Lake (Greensboro), Flagg Pond (Wheelock), Nichols Pond (Woodbury), Hardwick Lake (Hardwick), Lake Elmore (Elmore), and Green River Reservoir (Hyde Park). Caspian Lake has populations of brown, rainbow and lake trout, as well as rainbow smelt, longnose suckers, and white suckers, all of which, except lake trout, migrate seasonally into the lakes feeder tributaries to spawn. Some lakes in the upper watershed support populations of yellow perch and pumpkinseed sunfish. These species, not native to or characteristic of upper-watershed systems in Vermont, have

also been observed in stream reaches below the lakes.

Lower Watershed (Morrisville to Lake Champlain in Milton)

The first major upstream impoundment on this reach of the Lamoille River is Lake Lamoille, behind the Cadys Falls Dam in Morrisville. Warm water fish such as yellow perch, largemouth bass and pumpkinseed sunfish dominate this expansive, but relatively shallow impoundment. The reach downstream from Cadys Falls through Johnson again becomes cold-water habitat with a gradient, a diverse fish community and angling opportunities similar to those of the Hardwick-Morrisville reach. Elevated summer water temperatures from Lake Lamoille are moderated by several cool, oxygenated tributaries, most notably Kenfield Brook, Waterman Brook, and Foot Brook. These streams have high quality trout spawning and nursery habitat, contributing a significant amount of the wild trout production to the mainstem: they also provide critical cold-water refuges for trout during hot and dry periods. Another tributary, the Gihon River, also has a popular trout fishery, supported mostly by stocking. The Gihon begins at the outlet of Lake Eden, which has a warmwater fish community including smallmouth bass, yellow perch, rock bass and white suckers. A rainbow trout fishery in Lake Eden is maintained by stocking.

The character of the Lamoille River changes substantially when it reaches Cambridge. It becomes a very low gradient and widely meandering river. Trout habitat is more limited and warmwater fish such as smallmouth bass begin to appear. Wild brown trout and rainbow trout are in relatively low abundance. Trout are stocked. The best fishing opportunities are generally near the mouths of cool tributaries such as the North Branch of the Lamoille River and the Brewster River. Much of the North Branch is a moderate to high gradient stream with

populations of wild brook, brown and rainbow trout, supplemented with stocked brown trout in the reaches below Belvidere. The upper North Branch and its many high-gradient forested tributaries in Belvidere are dominated by wild brook trout. The lower Brewster River is an important spawning and nursery area for mainstem trout. It also supports a population of burbot.

The Lamoille River from the Fairfax Falls Dam to its mouth at Lake Champlain is primarily warmwater fish habitat. The river gradient increases again between Fairfax Falls and Arrowhead Mountain Lake, the largest impoundment in the drainage. The channel in this reach is wide, rocky, and relatively shallow. Smallmouth bass, rock bass, and fallfish are common, and walleye are caught occasionally. Two-year-old “trophy” brown trout are stocked below Fairfax Falls, maintaining a popular fishery.

Arrowhead Mountain Lake and the Peterson Dam impoundment are warmwater fisheries, with smallmouth and largemouth bass, walleye, northern pike and various panfish species. The final reach of the Lamoille River below Peterson Dam is largely influenced by Lake Champlain. Many Lake Champlain fish species use this reach for spawning and nursery areas, or for feeding at different times of year. Among the most notable are walleye, smallmouth bass, landlocked Atlantic salmon and the endangered lake sturgeon.

Water-Dependent Wildlife

There is a harmonious balance between plants, animals and people; between the domestic and the wild; between utility and beauty.

-Aldo Leopold

The Lamoille Basin supports an array of wildlife species, all of which are dependent on clean water to survive. Some live all or part of their lives near streams, rivers, lakes, and wetlands, using them for habitat, food sources, and travel and dispersal corridors. Wildlife and the landscape that supports them are vital parts of Vermont’s rural culture and character. Throughout Vermont’s history, plants and animals have provided food, clothing, tools, endless enjoyment, and a spiritual connection to our landscape. For many people, simply knowing that black bears roam the woods of the Lamoille watershed and that loons nest on watershed lakes and ponds enhances their quality of life. In fact, the results of a 2001 public opinion survey conducted by the U.S. Fish and Wildlife Service, show that Vermont ranked first in the nation with 60 percent of its residents that actively viewed wildlife. Today, over 240,000 Vermont residents engage in wildlife-associated activities including viewing, hunting, fishing and photography. That is 11 percent more than ski in Vermont. In 1996, residents and non-residents spent \$341 million dollars in Vermont on wildlife-associated activities. A recent survey of Vermont residents found that the protection of fish and wildlife resources, habitats and lands as well as the opportunity to participate in wildlife-related recreation was important to 97 percent of Vermont residents surveyed. This illustrates the strong connection Vermont residents have to the land and its wild inhabitants. Maintaining high quality surface waters is critical to realizing the continued survival and health of the Lamoille Basin’s wildlife (VFWD and CCRPC, 2001).

Biological Reference Sites

Biological reference sites (Table 5) are examples of reference aquatic biota compiled by DEC's BASS Lab. Biological reference sites are indicator sites of high quality water quality and can be used by ANR and its partners in prioritizing high quality waters for protection or to compare with other waters.

Table 5. Lamoille Watershed Biological Reference Sites

Location	Station	Drainage Area	Elevation	Macroinvertebrate Category ¹	Fish IBI ²	Town	WBID
Lamoille River	15.7	1754.8	300	WWMG	MW	Georgia	VT07-02
Lamoille River	80.8	55	1164	MHG	MW	Greensboro	VT07-22
Lamoille River	83.5	20	1339	MHG	MW	Greensboro	VT07-21
Browns River	0.5	225	351	WWMG	MW	Fairfax	VT07-10
Browns River	26.8	47	761	MHG	MW	Underhill	VT07-11
Browns River	31.0	6.1	1400	SMC	CW	Underhill	VT07-11
Lee River	.4	39.8	499	MHG	MW	Jericho	VT07-11
North Branch Lamoille River	12.3	50	1050	MHG	MW	Belvidere	VT07-14
Elmore Br.-Lamoille	1.7	39.4	783	MHG	MW	Elmore	VT07-08
Bailey Brook	.5	5.9	1078	SHG	CW	Hardwick	VT07-21

1. Macroinvertebrate Stream Category refers to one of three wadeable streams types as defined by the characteristics of a minimally disturbed aquatic macroinvertebrate community (DEC, 2001d).

The three categories are:

SHG - Small High Gradient streams;

MHG - Medium size High Gradient streams;

WWMG - Warm Water Moderate Gradient streams and rivers;

2. Fish IBI refers to the fish community index appropriate for the stream reach, based on the expected number of species.

Other Uses of the Lamoille River and Tributaries

Irrigation and Animal Watering

Water from the Lamoille River system is an important resource for agriculture. Farms use a combination of drilled wells, springs and surface water for livestock watering. Vegetables, cut flowers, orchards, berries, and nursery stock are all supported by limited irrigation. Recent droughts have caused uncertainty in crop pricing, feed availability and dairy herd health.

Public Water Source Protection Areas

Public water source protection began in Vermont in the late 1970's with the use of hydrogeologic methods to site new public community water supplies. A more formalized approach began in 1982 with the delineation of Wellhead Protection Areas (then called Aquifer Protection Areas or APA) for most municipal systems. Since 1985, the delineation of Public Water Source Protection Areas (SPAs) has been required for all proposed new sources for public community water systems. In order to provide for better protection of public health, every Public Community Water System, like municipalities and mobile home parks, is required to have an approved Source Protection Plan. Non-transient, Non-community Public Water Systems, like schools and factories with their own source of water, are also required to have a Source Protection Plan.

Source Protection Plans are an important part of managing and protecting public water supply sources. A Source Protection Plan identifies the potential sources of contamination in a specific area, assesses the risks of these potential sources of contamination, describes how to manage the risk from the potential sources of contamination, and discusses how to handle emergencies. Some potential sources of contamination include fertilizers, pesticides, agricultural nutrients, septic system failures, hazardous chemicals, salt storage sites, eroding streambanks, golf courses, urban runoff, logging activities, landfills, and mineral extraction sites. Separate protocols exist for

surface water systems using Lake Champlain as a Source Protection Area. These protocols evaluate the sensitivity of the intake pipes to localized runoff.

The Source Water Assessment Program, a federal requirement, requires the identification of potential sources of contamination and an identification of their risks to Transient, Non-community Public Water Systems (i.e., motels and restaurants with their own source of water), Public Community Water Systems, and Non-transient, Non-Community Public Water Systems.

Ski Area Water Withdrawals

Smugglers' Notch Resort currently operates three water withdrawals for snowmaking. They are located on tributaries to the Brewster River. Morse Reservoir, which is also a water supply reservoir and snow making pond, is located on the so-called No Named Brook watershed with a drainage area of 1.91 square miles at 2.3 million gallons. This reservoir is also the Resort's domestic drinking water supply. Another withdrawal is located at the confluence of Sterling and Madonna Brooks with a combined watershed area of 1.27 square miles. The latter withdrawal area has been in operation since 1982 with 6 million gallons. There is also a newer pond below the resort at Edwards Reservoir with 20 million gallons. Water captured at the withdrawals is stored at the resort's three reservoirs capable of containing a combined total of 28.3 million gallons (Smugglers Notch, personal communication, 2003).

Conservation flow requirements at the two water withdrawals are below the current February Median Flow (FMF) standard, having been permitted when the flow standard was much lower. Over the years, Smugglers Notch Resort has increased conservation flows in small increments in association with various projects. Currently, a conservation flow of 0.50 cubic feet per second per square mile (csm) is maintained at all sites.

Future expansion of snowmaking water supply and increases in the conservation flows at the existing withdrawals is expected to be accomplished by a new withdrawal on the Lamoille River in 2008. The Lamoille site combined with the existing withdrawals and

storage will provide adequate snowmaking water for the resort for the foreseeable future. Based on permit conditions, Smugglers must increase the conservation flow at all sites to 0.8 csm (FMF) by 2010.



North Branch of the Lamoille River, Waterville

CHAPTER 3. WATER QUALITY IN THE LAMOILLE RIVER WATERSHED

A river is the report card for its watershed.

-Alan Levere, Connecticut Department of Environmental Protection

Identifying Water Quality Problems

Water quality is acceptable when it supports uses that Vermonters have deemed to be beneficial and it attains or exceeds the criteria in the Water Quality Standards. Beneficial uses range from recreation to the support of aquatic biota. These “designated” uses have been codified in the *Vermont Water Quality Standards* (Vermont Water Resources Panel, 2008). At times, the preservation of these diverse, multiple uses may be in conflict. The State must seek a balance among conflicting uses while sustaining each use in accordance with the Standards.

The Agency assesses impacts or threats to these protected uses by using chemical, physical, and biological data, and best professional judgment based on knowledge of the waterbody and its conditions. The community is also an important resource to the Agency for identifying problems on individual water bodies or general concerns that reflect problems prevalent throughout much of the watershed.

The following documents prepared by the Agency of Natural Resources describe the results of water quality assessment of the basin:

- The Vermont Department of Environmental Conservation Water Quality and Aquatic Habitat Assessment Reports identify overall and specific water quality conditions.
- Section 303(d) 2008 List of Waters and the List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d)

identify specific surface waters with water quality problems.

The water quality problems addressed in the basin planning process are based on information from the above documents and on issues identified during public forums. Water quality information is summarized below.

General Water Quality Conditions

There are 611 river and stream miles within the Lamoille River Watershed. Approximately 68 percent of the total river miles have been assessed for their physical, chemical, or biologic health. There are 6 water reaches that are listed as impaired and, therefore, do not meet current Vermont Water Quality Standards (see Chapter 5). Most of these waters are located in the lower and middle portions of watershed. Impairments are attributed to various land uses including hydroelectric facility drawdowns, agricultural runoff, residential and urban runoff (stormwater) as well as atmospheric deposition from mid-western power plants. The major pollutants include excessive nutrients such as phosphorous and nitrogen, manure, pesticides, fertilizers, heavy metals, oil, gas, and sediments. Low levels of dissolved oxygen in the water at certain locations cause additional water quality problems. Uses and values negatively affected by these pollutants include swimming, fishing, boating, aesthetics, drinking water supplies, and aquatic biota and habitat.

In 1996 the Lake Champlain Management Conference prepared a pollution prevention, control, and restoration plan called the *Opportunities for Action, An Evolving Plan for the Future of the Lake Champlain Basin*. The plan identifies three priorities for action:

- The reduction of phosphorus pollution,
- The prevention of toxic substance pollution, and
- The management of nuisance non-native aquatic plants and animals

The Lake Champlain Basin Program (LCBP) is a federally funded initiative working in partnership with agencies, organizations, and individuals to develop and implement *Opportunities for Action*.

The Malletts Bay segment of Lake Champlain has been identified as a targeted watershed for phosphorus reduction. Implementation of phosphorus reduction measures are directed at agricultural activities, new construction, and road system best management practices; stream restoration projects; retrofitting stormwater management systems; and shoreline restoration and protection. This Lamoille River watershed plan serves as a guide to implement specific practices at the sub-watershed level.

Public's Concerns Regarding Water Quality Problems

Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest.

-Vermont Water Resources Panel, 2008

Eight public forums were held throughout the watershed to solicit residents' concerns and visions regarding water quality issues in the Lamoille River watershed. The Nominal Group Process was used to stimulate group participation. The results of a previous series of workshops held by the Browns River Watershed Council and the Lamoille County Conservation District were also considered. The top issues of the eight forums were ranked and used to direct the Watershed Council and DEC in developing basin plan strategies, securing funds, and recruiting technical advisors to improve water quality.

Watershed residents' top water quality concerns:

- Stream instability and flooding
- Stormwater management
- Agriculture and water quality
- Transportation infrastructure- including bridges, culverts, rail and road embankments, and driveway accesses

- Dams and water level fluctuation, stream instability and fish passage
- Loss of working farms and forestland

Strategies to address these top water quality issues begin on page 53.

Wetlands

Wetlands have a poor public image.... Yet they are among the earth's greatest natural assets... mankind's waterlogged wealth.

-Edward Maltby

Introduction

The Lamoille River watershed contains 2,377 wetlands mapped on the Vermont Significant Wetland Inventory (VSWI) maps, totaling over 18,454 acres (DEC, 2000). Mapped wetlands constitute more than 4% of the watershed area. Of these mapped wetlands, most are between one and five acres, although there are 53 wetlands over 50 acres. Wetland functions and values include: surface and ground water protection; water storage for flood water and storm runoff; fisheries habitat; wildlife and migratory bird habitat; hydrophytic vegetation habitat; threatened and endangered species habitat; education and research in natural sciences; recreational value and economic benefits; open space and aesthetics; and erosion control through binding and stabilizing soil.

The east to west orientation of the Lamoille River Watershed incorporates a number of biophysical regions in Vermont. These include the Northern Vermont Piedmont region to the east, the Northern Green Mountain region in the center of the watershed, and the Champlain Valley region at the western end of the watershed (Thompson and Sorenson, 2000). Each biophysical region contains wetland natural community types characteristic of that area. Functions and values for specific Lamoille Basin wetlands are included in Appendix A.5.

Wetland Classification

The Wetland Rules give the State jurisdiction over Class One and Class Two wetlands, which are shown on Vermont Significant Wetlands Inventory (VSWI) maps and are protected by the Vermont Wetland Rules. Class Three wetlands are not mapped and thus not protected under the Vermont Wetland Rules. Class Two wetlands have protected buffers of 50 feet. Class One wetlands incorporate a 100-foot buffer zone, thus ensuring greater protection of the wetland to adverse adjacent land development. Currently, no Class One wetlands exist in the watershed.

Impacts and Threats to Wetlands

The Agency of Natural Resources DEC Wetlands Section examines more than 500 new projects a year throughout Vermont that have the potential to alter wetlands. More than 650 wetland projects have been reviewed in the Lamoille River watershed since the implementation of the Vermont Wetland Rules in 1990.

Projects are examined to determine if the functions and values of the wetlands will be lost as a result of the proposed use. Wetlands are recorded as lost when the wetland is permanently destroyed from filling or draining or altered when the wetland is not permanently destroyed but is not functioning at its original level due to ditching, dredging, and partial filling or draining.

Road projects cause the greatest loss to Class Two wetlands, followed by residential development. The expansion of old roads built along river corridors and wetlands, and the construction of new roads over the past ten years has resulted in approximately two acres of known loss to Class Two wetlands in the watershed. Most residential development is at the western end of the watershed in Chittenden and Franklin Counties.

Most of the wetlands affected in the Lamoille River watershed are deciduous scrub-shrub wetlands. Speckled alder or buttonbush usually dominates these types of wetlands. Many of the emergent wetlands are prior converted agricultural fields. Wetlands that were drained and converted

to agricultural uses years ago may go straight from wet meadow to residential development because they do not contain as many protected functions and values as they did in their original state. Over two acres of broad-leaved, deciduous forested wetland have been altered by various projects since the Wetland Rules were adopted in 1990. These areas include red maple swamps and black ash swamps.

Threats to many of the important wetlands described above include logging, agricultural conversion, runoff, and residential development associated with an expanding population. In the eastern section of the watershed, the significant northern white cedar swamps are most at risk from logging. The bogs in the Northern Green Mountain region are more vulnerable to small changes in hydrology and nutrient loads.

The rapid urbanization of the landscape pushes the boundaries of natural areas to smaller dimensions, and creates more opportunities for pollution and stormwater runoff. Runoff from agriculture, silviculture, and residential development threaten both Molly Bog in Morristown and Belvidere Bog in Belvidere and Eden. The Champlain Valley region contains the most diverse and abundant wetlands, but also the most threats to these wetlands.

Lower Lamoille Wetland Inventory, Restoration, and Outreach Project

A lower Lamoille watershed wetland inventory was completed in late 2007 by the Chittenden Regional Planning Commission (CCRPC), DEC, and the ANR Clean and Clear Wetlands Specialist. The inventory indicated that 150 potential high priority wetlands exist in the Chittenden County portion of the watershed. The first phase of this project would involve working with municipalities and landowners within the Lamoille Watershed in Chittenden County. The municipalities include Milton, Westford, Essex, Jericho, and Underhill. Landowners with potential wetland restoration sites have been identified. Public meetings were held in 2008 to explain the importance of wetland

protection and restoration, landowner benefits, and how landowners can become involved

A second task for this project would be to use the 2004 EarthData imagery (1:1250 scale) and the 2003 NAIP imagery to identify other potential wetland restoration opportunities. Using the imagery mentioned above, CCRPC staff would print large municipal maps and identify potential wetland restoration opportunities (with guidance from the Wetlands Restoration & Protection Specialist). These potential sites will be roughly mapped and landowners will be identified so that outreach and/or field visits may be conducted.

Lakes and Ponds

*In the spring rain,
The pond and the river
Have become one.*

-Buson

Introduction

The Lamoille River watershed is characterized by numerous lakes, ponds and reservoirs. These provide significant opportunities for public use, recreation, and enjoyment, and they are well used for these purposes. They also support designated uses such as aquatic life, agricultural and drinking water supply, fish consumption, boating, and swimming. While the lakes and ponds of the Lamoille Basin are, in general, of high quality, not every designated use is fully supported at every lake. Uses of some lakes and reservoirs are impacted or threatened due to fluctuating water levels, mercury contamination, low pH, siltation/sedimentation, and invasive exotic species infestations (DEC, 2001). Mercury contamination and acidification of lakes and ponds in Vermont are the result of atmospheric deposition from incinerators, coal plants, and automobile pollution, most of which originate out of the state and out of the region.

The Vermont Lay Monitoring Program

The Vermont Lay Monitoring Program (LMP) is a citizen participation program in which

volunteers are trained and equipped to conduct weekly summer-time water quality sampling on lakes (DEC, 2002a). The principal objectives of the program have been to accumulate an accurate water quality database on lake nutrient levels and to inform lake residents about lake protection and biology. Currently the LMP is active on the following lakes and ponds in the Lamoille watershed: Nichols Pond in Woodbury, Green River Reservoir in Hyde Park, Caspian Lake in Greensboro, and Lake Eden and South Pond in Eden. Lake Elmore, East Long Pond,

Arrowhead Mountain Lake, and Wapanacki Pond have historically been involved in the LMP program but are now inactive. The importance of volunteer monitors can not be stressed enough in assisting the state and lake watershed residents to better understand conditions of Vermont lakes and long term lake water quality trends.

Impacts and Threats to Designated Uses in Lake and Ponds

The Lamoille River watershed is characterized by 79 lakes and ponds, comprising 4,268 acres. The designated use that is most affected by activities or conditions resulting in less than full support is fish consumption due to mercury contamination. Aquatic life is the use with the second largest number of acres not fully supported due to mercury contamination. Swimming and secondary contact use (boating or fishing) are the uses tied at third largest number of acres with less than full support. Swimming, secondary contact recreation, aquatic life use, and aesthetics are stressed on a relatively large number of acres but these areas still currently support the designated uses. Agricultural water supply uses were not assessed.

The principal cause of impacts to lakes in the Lamoille River watershed is the drawdown of water levels, which alters and stresses aquatic life use on 293 acres (Lake Lamoille and Hardwick Lake) and stresses 1,899 acres of several other lakes. Mercury contamination in fish tissue impairs 760 lake acres. Critically low pH in a tiny

Lamoille River Basin Plan- Draft -February 2009

pond impairs aquatic life use on one lake acre, but an additional 899 acres on other lakes are threatened by low buffering capacity, which could lead to episodic low pH events. Siltation impairs aquatic life use in the 194-acre Hardwick Lake, and is noted as a threat to uses on 411 additional acres. Infestations of exotic species alter 136 acres and stress an additional 437 lake acres. Appendix A.6 lists the causes of impacts to lakes in this basin.

Lakes and Ponds Top Water Quality Issues

- Conservation and protection of undeveloped shorelands and exceptional waters
- Lake watershed and shoreland land use issues
- Invasive Exotic Species
- Low pH, mercury and lead sinker impacts to wildlife
- Water level fluctuation

Conservation and Protection of Undeveloped Shorelands and Exceptional Waters

While recreational uses abound in the vast majority of Vermont's lakes, Vermonters only have a handful of lakes in which they can experience the recreational opportunities that undeveloped lakes can offer. In order to ensure that today's Vermonters and future Vermonters can have access to lakes that provide a feeling of solitude as well as stretches of undeveloped shoreline on developed lakes, it is important to have a lake protection and conservation strategy. In addition, undeveloped lakeshores provide critical water quality protection, as well as, wildlife and aquatic life habitat. Lakeshore property is highly sought after real estate, so it is only through the work of many that we will be able to ensure that any of it remains intact for all Vermonters and the fish and wildlife species that depend upon it.

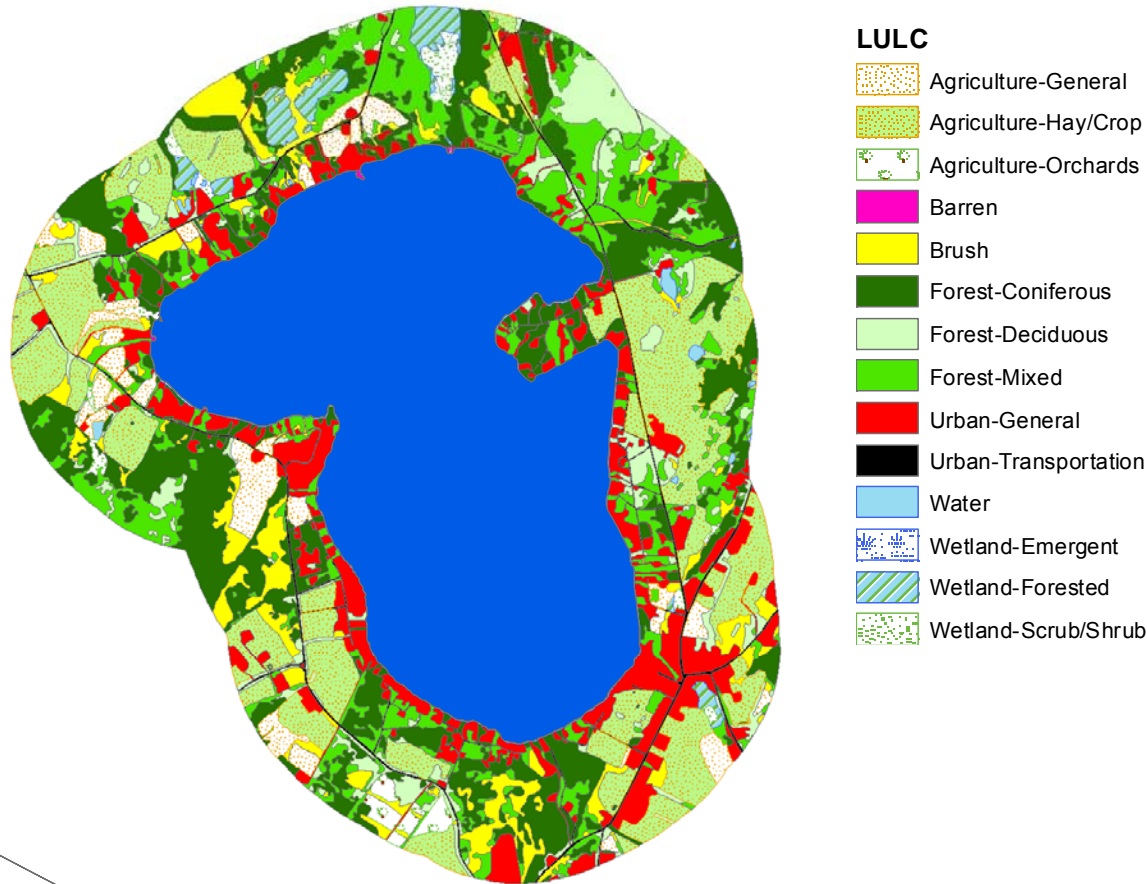
UVM and DEC have prepared littoral habitat assessments mapping 2,000 foot buffer areas using 2003 aerial photos. Lakes and ponds that have been mapped include Wolcott Pond, Lake

Eden, Zack Woods Pond, Long Pond (Greensboro), and Caspian Lake. Forty-nine percent of the shoreline of Caspian Lake is developed within 25 feet of the waterline. There are no significant (at least 1,000' long and 250' wide) stretches of undeveloped shoreline left (Figure 2).



Little Elmore Pond, Elmore

Figure 2. 2003 Detailed land use land cover map of Caspian Lake- created by University of Vermont's Spatial Analysis Laboratory.



Lake Protection Classification System

DEC's Lake Protection Classification System (DEC, 1994) defined five categories of unique lakes; which were wilderness, wilderness-like, ultra-oligotrophic lakes, lakes with unusual scenic or natural features; and lakes with rare, threatened or endangered plants or wildlife species. The LPCS identifies lakes that are unique from a statewide perspective. The current Lakes and Ponds Inventory shows eight lakes in the Lamoille watershed that meet the wilderness-like criteria. There are only nine lakes in the state that meet the highest wilderness-like rating of 10. Two of these are found in the Lamoille

watershed: Little Elmore and Zack Woods. This rating means that there are no structures on the shore and that the only structures visible in the watershed are inconspicuous when viewed from the lake. This type of lake provides a real sense of solitude, yet they are not too difficult to access with a 2WD road within 1/3 of a mile of the lake. Since the lakeshores surrounding these ponds are not conserved, they should be a priority for protection efforts. Long Pond in Greensboro and Schofield Pond have the next highest wilderness-like rating of 9. While Schofield Pond will remain this way, Long Pond is vulnerable to development and loss of this unique rating. There are four lakes in the watershed with a wilderness-like rating of 8: Green River Reservoir, Silver Lake, Tuttle Pond, and Wolcott Pond. This

rating applies to lakes that afford a sense of solitude, but they may have some inconspicuous structures along the shore. Silver Lake is a drinking supply reservoir and like Tuttle and Wolcott ponds its shoreline is not conserved. Of the eight Lamoille watershed lakes identified as providing a wilderness-like experience that is unique in Vermont six are well buffered enough so they are not sensitive to the degrading effects

of acid rain (Table 6). This make them even more valuable a resource to protect, since many of the other wilderness-like lakes in the state are sensitive to acid rain and are not in full support of aquatic uses.

Table 6. Wilderness-like Lakes in Lamoille Watershed.

Lake	Location	Wilderness-Like Rating	Conservation Status	pH Threat
Green River Reservoir	Hyde Park	8	C	
Little Elmore	Elmore	10	P	T
Long Pond	Greensboro	9	P	
Schofield Pond	Hyde Park	9	C	
Silver Lake	Georgia and Fairfax	8	N	
Tuttle Pond	Hardwick	8	N	
Wolcott Pond	Wolcott	8	P	
Zack Woods Pond	Hyde Park and Wolcott	10	N	

C= Lakeshore Conserved, P=Partial Lakeshore Conserved, N=No Lakeshore Conserved, T=Threatened

DEC's Lakes and Ponds Section has determined the lakes in Table 6 meet the wilderness-like criteria from visits to these lakes. Using GIS and the conserved lands layer provided by University of Vermont's Spatial Analysis laboratory, conservation status of the shoreline was established. It is possible that some of the lakeshores along Little Elmore have been conserved since the GIS layer was last updated; it is also possible that some of the lakeshore has been developed and that the unique rating no longer applies. Green River Reservoir and Schofield Pond are located in Green River Reservoir State Park and are entirely conserved and some of the lakeshore around Little Elmore Pond is conserved as well. Silver Lake is part of the St. Albans water supply and may be protected at the municipal or landowner level.

Ground-truthing of each lake's status as identified in Table 6 should be undertaken. DEC and the University of Vermont's Spatial Analysis Laboratory plan to identify significant stretches of undeveloped and unconserved lakeshore that are important habitat for species identified as species of greatest conservation need (SGCN) by Vermont's Wildlife Action Plan. The collaborators will be collecting habitat and species distribution data and using conservation reserve design approaches to identify lakeshore in the Lamoille watershed most critical for conservation. The work is partially funded with a grant from Vermont's Wildlife Action Plan. Priority lakes information will be shared with local landowners, citizens, town planners, lake associations, local and state-wide conservation groups that can investigate potential easement purchases, zoning regulations and other strategies to preserve the wilderness or undeveloped nature of these waterbodies.

Table 7. Functions and Values of Selected Lamoille Watershed Lakes (DEC, 2008).

	Location	Wilderness-like or Scenic	Loon Breeding Habitat	Presence of Rare, Threatened or Endangered Species	Shoreland Wetlands	Ultra-low Phosphorus
Long Pond	Greensboro	✓				
Silver Lake	Georgia and Fairfax	✓				
Green River Reservoir	Hyde Park	✓	✓			
Little Elmore Lake	Elmore	✓		✓		
Tuttle Pond	Hardwick	✓			✓	
Wolcott Pond	Wolcott	✓	✓	✓		
Zack Woods Pond	Hyde Park and Wolcott	✓	✓			
Schofield Pond	Hyde Park	✓			✓	
Hardwick Lake	Hardwick				✓	
East Long Pond	Woodbury	✓	✓			
Nichols Pond	Woodbury	✓	✓			
Caspian Lake	Greensboro					✓
Flagg Pond	Wheelock	✓			✓	
Lake Eden	Eden		✓	✓		
Lake Elmore	Elmore	✓		✓		
Horse Pond	Greensboro			✓		
Long Pond	Eden			✓		
South Pond, Eden	Eden		✓	✓		

Lake Watershed and Shoreland Land Use Issues

Watershed and shoreland land uses can have a significant and negative impact on a lake's health over time. Removal of shoreland vegetation can increase erosion of the lakeshore and reduce or eliminate the infiltration functions of the vegetation. Runoff from roofs, driveways, lawns and uphill development can increase erosion and nutrient and sediment loading to the lake. Improper design and installation of shoreline stabilization measures, such as riprap, seawalls, and grading, can actually increase erosion of that shoreland. Runoff from lawns on which fertilizers, herbicides, and pesticides are used can result in nitrogen, phosphorus, and toxins entering a lake. Runoff from eroding driveways and paths may carry nutrients and sediment to adjacent waters during rain events (DEC, 1990). Modern style lakeshore development contributes seven times the phosphorus, eighteen times the sediment and four times the runoff of an undeveloped forested site (Wisconsin Department of Natural Resources). Ideally, a minimum of a 100 foot wide naturally vegetated buffer is needed between lawns, driveways, and structures and the lake in order to prevent such nutrient pollution.

Many animal species (birds, reptiles, amphibians and mammals) rely on natural shoreland vegetation to breed, feed and over winter. Removal of the natural vegetation along a lakeshore eliminates this habitat. Overhanging branches shade shallow water and provide fish food in the form of fallen insects. Wildlife need wide undeveloped naturally vegetated lakeshores, with some species needing buffers as wide as 600 feet.

By their nature, lakes, ponds, and reservoirs accumulate sediment and nutrients over long periods of time. Human activities in lake watersheds can hasten this process, producing what lake scientists term accelerated eutrophication. This is a very common threat to lake waters throughout Vermont, and the Lamoille Basin is no exception. Excessive phosphorus and/or sediment causes algae

blooms, decreased water clarity, "nuisance" growth of native aquatic plants, and a change in the natural habitat values of a lake. Good land use management throughout watersheds protects downstream lakes and ponds from this ever-present threat. Erosion and runoff from paved or unpaved roads, developed areas, logging operations, impervious surfaces, agricultural operations, and construction activities can contribute to sediment and phosphorus accumulation in lakes and ponds. Excessive clearing of lakeshores when constructing camps or homes can significantly affect the lake by removing the filtering native vegetation. Failing septic systems result in either effluent surfacing on the ground or contaminating groundwater. Either situation can cause a human health hazard due to exposure to disease-causing bacteria, and enhances nutrient loading to lakes. Septic systems can fail due to inadequate soils, poor design or construction, inadequate maintenance, or increase from seasonal to year-round use (DEC, 1990). DEC monitors lake nutrient levels throughout the Lamoille River watershed via several projects. Principally, the Spring Phosphorus Program collects spring-overturn nutrient and physical and chemical data on Vermont lakes and ponds 20 acres in size or larger on a rotating basis. Water tests include total phosphorus and total nitrogen, alkalinity, calcium, magnesium, hardness, water transparency, temperature and dissolved oxygen levels.

Lakes with largely developed shores are candidates for shoreland management outreach and restoration projects. Other lakes with lightly developed shores may also be eligible for such projects along limited sections of the shoreland. Education to promote maintaining or restoring a natural lakeshore buffer should be undertaken. High priority lakes for shoreland restoration include: Caspian Lake, Lake Eden, and Lake Elmore.

Invasive Exotic species

Eurasian watermilfoil (Figure 3), zebra mussels, and water chestnut are invasive exotic species that currently infest a large number of Vermont lakes.

A number of other problematic exotic species (e.g. *Hydrilla verticillatum*) are literally on Vermont's doorstep. In the Lamoille basin, Eurasian watermilfoil is the only known invasive exotic species at this time. Eurasian watermilfoil is currently found in Arrowhead Mountain Lake in Georgia and Milton, Lake Elmore in Elmore, Elmore Pond Brook, Long Pond in Eden, and in the lower Lamoille River in Milton and Colchester. This plant is known for its rapid growth and ability to spread, which leads to very significant problems within a lake. Commonly found in shallow bays and along shorelines, milfoil forms dense beds that can seriously alter the recreational use of a lake, reduce the availability of fish spawning grounds, out-compete beneficial native plants, and otherwise alter a lake's natural environment. Once milfoil has infested a lake there is no known way to eradicate it.

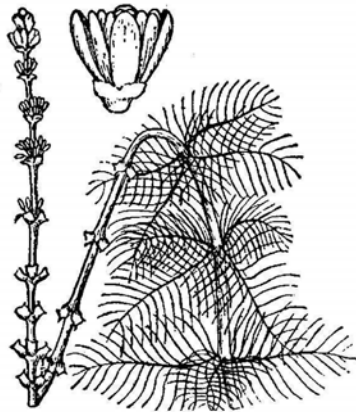


Figure 3. Eurasian watermilfoil

Spread Prevention

Two important invasive exotic species spread prevention methods include boat access greeter programs that provide courtesy inspections and public education and early detection programs like the Vermont Invasive Patrollers (VIPs) described below. Caspian Lake is the only lake in the watershed that has a boat access greeter program maintained by local residents.

VIPs monitor a local waterbody for new introductions of invasive species while also

learning about native aquatic plants and animals and their habitats. Current certified VIPs lakes include Lake Eden and South Pond in Eden.

VIP participants attend at least one basic training workshop (optional advanced workshops may also be available based on interest) and:

- Sign a Statement of Commitment promising to document survey results in accordance with standardized procedures and report them to Vermont DEC
- Conduct and submit at least two surveys during the summer for the presence of invasive plants or animals in your lake or pond (or a specific section thereof)
- Submit suspicious samples to DEC staff for positive identification

Control Methods

Appropriate Eurasian watermilfoil control methods should be evaluated on a lake-by-lake basis. To date in Vermont, control methods used have included mechanical, chemical, biological methods, habitat manipulation, and physical methods. The use of aquatic herbicides is new in Vermont. The use of the watermilfoil weevil is a potential future biological control. Mechanical methods, the use of benthic matting, and hand pulling via scuba and snorkeling equipment are the methods most often used in the state at this time. Hand pulling is a successful method of removing milfoil where it has been discovered early and densities are limited. An integrated approach using a combination of the above methodologies is recommended for successful control. A permit from the DEC is needed for most control methods with the exception of hand pulling.

Low pH and other toxins.

Acid precipitation threatens sensitive ponds in the Lamoille basin. The tiny Lake of the Clouds in Cambridge is the only waterbody that is acid-impaired in the Lamoille Basin. Several other ponds are threatened by acidification. These are Bear Pond, Big Muddy Pond, Green River Reservoir, Little Elmore Pond, Long and South

Ponds in Eden, Slayton Pond in Woodbury, Wapanacki Lake, and Wolcott Pond. Reduction of acid stresses to lakes will depend on reduction of acid-forming pollutants throughout the eastern United States, and is a problem requiring national attention. All of Vermont's acid-impaired lakes are subject to an EPA approved TMDL that identifies necessary reductions from out-of-region sources of acidity to improve the condition of these lakes.

Current gasoline marine engines can emit significant amounts of smog forming air pollution and discharge unburned oil and gasoline directly into lakes and ponds, polluting them with MtBE, benzene, and other toxic chemicals.

The contamination and subsequent mortality of loons from lead poisoning is a leading cause of loon death in Vermont. Loons ingest stray lead sinkers, and one sinker can kill a loon over time. A new state law prohibiting the sale of lead sinkers started January 1, 2006 and the use of lead sinkers was prohibited beginning January 1, 2007.

Mercury

Mercury contamination is ubiquitous in Vermont's still waters. Mercury is a 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 this atmospheric pathway that is largely responsible for mercury contamination in Vermont. The combustion of coal for energy, and incineration of municipal and medical wastes, produces the majority of mercury deposited onto the watersheds of the northeastern US and eastern Canada. All of Vermont's mercury-impaired lakes are subject to an EPA approved TMDL that identifies necessary reductions from out-of-region sources of mercury to improve the condition of these lakes.

In the atmosphere, mercury undergoes a wide variety of chemical transformations, eventually

settling to the landscape as mercury attached to particulate matter such as soot. Once on the ground, mercury migrates through watersheds, arriving eventually into receiving waters (e.g. wetlands and lakes). Mercury that is moving through watersheds is subject to myriad chemical transformations, and these are often biologically mediated. The most important of these biological transformations is the generation of methyl-mercury. Methyl-mercury is a highly toxic form of mercury, which is easily assimilated into tiny planktonic organisms at the base of aquatic food chains.

Through the processes of biomagnification, minute concentrations of methyl-mercury are passed up food chains, increasing to levels that pose a significant threat to those organisms that feed at the top of the aquatic food web. Organisms that are at risk of methyl-mercury exposure include top-level carnivorous fish such as walleye, fish eating birds such as eagles and loons, and, of course, humans. Some fish species accumulate more methyl-mercury burden than others, which is why the Vermont Department of Health (DOH) advisories are species-specific.

In addition, certain lakes appear to have conditions that result in more efficient transfer of methyl-mercury up the food chains. This is why the DOH advisories identify a select few waterbodies as having particularly elevated fish-tissue mercury concentrations, and where eating resident fish therefore carries a greater level of risk. Based on Vermont and regional research, the DOH advisories have been modified to become more lake and species specific. The following factors are associated with increased tissue mercury levels: lake acidity (natural or otherwise) and the levels of tannins in the water; presence of nearshore and upstream wetlands; water level fluctuation; and the rate at which the lake is flushed on an annual basis.

The physiological consequences of methyl-mercury contamination include liver, kidney, and central nervous system dysfunction. A recent study by the National Academy of Sciences

concluded that the children of women who consumed large quantities of mercury-tainted fish during pregnancy showed the clearest evidence of mercury poisoning. Due to mercury contamination, the DOH presently advises that people limit their consumption of a variety of fish found both in Lake Champlain, and in many other lakes statewide. The current fish advisory is available online:

http://healthvermont.gov/enviro/fish_alert/fish_alert.aspx

In the Lamoille Basin, DEC has waterbody-specific fish tissue data only from Arrowhead Mountain Lake, Caspian Lake, and Wolcott Pond. However, based on the research studies noted above, DEC can predict those lakes in which fish-tissue mercury is expected to be elevated. These are noted in Table 8, and are good candidates for further measurements of mercury in fish tissue. With regard to mercury pollution, anglers are advised to heed the advisories posted by DOH for all Lamoille Basin lakes.

Table 8. Lakes in the Lamoille Basin Predicted by DEC to Have Elevated Fish Tissue Mercury Concentrations.

Lake Name	Town	Factors enhancing likelihood of elevated fish tissue mercury
Arrowhead Mountain Lake	Milton	Fluctuating water levels.
Hardwick Lake	Hardwick	Fluctuating water levels
Green River Reservoir	Hyde Park	Acidic, tannic, and fluctuating water levels.
Long Pond	Eden	Large upstream wetland, acidic.
Lake Lamoille	Morristown	Fluctuating water levels.
Little Elmore Lake	Elmore	Acidic, large proportion of watershed as wetland.
Schofield Pond	Hyde Park	Acidic, tannic, large proportion of watershed as wetland
South Pond	Eden	Acidic, fluctuating water levels.
Lake Wapanacki	Wolcott	Acidic, upstream wetlands.
Wolcott Pond	Wolcott	Acidic, tannic, nearshore wetlands.

The River Corridor

We have rearranged the rivers at our pleasure as one might change the apples in a bowl.

-Thomas Hornsby Ferril

Introduction

Over 611 miles of rivers and streams drain the land area known as the Lamoille River watershed. The Lamoille River originates at Horse Pond and flows in a southwesterly direction to Hardwick. A number of brooks flow from the hills, mountains, and ponds of Greensboro, Wheelock and Stannard to join this stretch of river: Morrison, Mud Pond, Paine, Sawmill, Esdon, Flagg, Stannard, and Greensboro Brooks are the main named streams (DEC, 2001).

East of Hardwick, the river flows in a westerly direction where Route 15 now follows the course of the river. In Hardwick Village, the river flows westerly and then northerly. Just outside of the village, there is a dam near the junction of Routes 15 and 14 that impounds the mainstem and its tributary, Alder Brook, forming Hardwick Lake.

West of the village of Hardwick, the Lamoille River meanders westerly then northwesterly through the towns of Hardwick and Wolcott. A number of significant tributaries join the Lamoille River in the town of Wolcott including Elmore Branch, Wild Branch, the Green River, Wolcott Pond Brook, and Elmore Pond Brook.

In Morrisville and just west of the village, there are two dams. The Cadys Falls dam has the biggest effect and results in the formation of Lake Lamoille. Kenfield Brook, Centerville Brook, and Jacob Brook flow into the Lamoille River between Hyde Park and Morristown.

The river continues northwesterly through the town of Johnson and into Cambridge where it changes to a more westerly course. This section resembles the one through Hardwick and

Wolcott. Agricultural activities dominate in the river valley and hay and corn frequently come to the top of the riverbank.

The most significant tributary in this stretch is the Gihon River, which enters from the north in Johnson. The Gihon is 14 miles long and drains a watershed of 66 square miles. Other important tributaries include Foote Brook, the North Branch and the Brewster River.

From Cambridge, the Lamoille River continues its meandering course westerly through Fairfax encountering Fairfax Falls dam. Route 104 parallels this stretch of the river. Just west of the village of Fairfax, the Browns River enters from the south and increases the size of the Lamoille River substantially. The Browns River has a length of 24 miles and drains an area of 92 square miles.

From the confluence of the Browns River, the Lamoille flows westerly for almost four miles before becoming Arrowhead Mountain Lake at East Georgia. The dam that impounds the Lamoille is located downstream in Milton. Below Milton village, the river flows westerly, southerly and westerly again encountering two dams and passing through a large wetland system before entering Lake Champlain.

Impacts to the River Designated Uses

The major impacts to the Lamoille River and its tributaries involve sedimentation, habitat alteration, and channel instability (DEC, 2001). Nutrients and thermal modifications also affect a number of river miles. Riparian vegetation removal, streambank erosion, floodplain encroachments, floods, and agricultural land uses are the five top sources that affect the water quality and aquatic habitat of the Lamoille River (Ryan, 2000). Agricultural land use in the productive floodplain of the Lamoille resulted in riparian vegetation removal. The habitat alteration and flood damage is greatly exacerbated by disequilibrium stream conditions that have resulted from river channelization and the

resulting loss of flood plain access along the Lamoille and some of its tributaries such as the Wild Branch.

What is Fluvial Geomorphic Equilibrium Condition?

Streams are in dynamic equilibrium when they have achieved a “balance” with the water, sediment, and organic debris delivered from their watersheds (figure 4). Streams in equilibrium may still erode their banks, migrate over time across their valleys, and periodically experience small-scale lateral and/or vertical adjustments. Over the last century, many miles of the Lamoille’s rivers have been subjected to channel management practices such as armoring, dredging, gravel mining and channelization, for the purposes of containing high flows in the channel and to protect human investments built in the historic flood plains. In addition, flood plains have been filled to elevate land above “design” flood stages. Conflicts arise when the management practices associated with the protection of public and private property are imposed upon a naturally dynamic river system (DEC, 2008).



The Lamoille River Valley in Johnson

Fluvial Geomorphic Equilibrium is the condition in which a persistent stream and floodplain morphology is created by the dynamic fluvial processes associated with the inputs of water, sediment, and woody debris from the watershed. The stream and floodplain morphology is derived within a consistent climate; and influenced by topographic and geologic boundary conditions. When achieved at a watershed scale, equilibrium conditions are associated with minimal erosion, watershed storage of organic material and nutrients, and aquatic and riparian habitat diversity. (DEC River Corridor Planning Guide, 2008)

Phosphorus Loading from Unstable Stream Systems

Lake Champlain is currently impaired due to an over abundance of phosphorus (Chapter 5). The Lamoille River watershed is a significant tributary to Lake Champlain. The instability of river systems draining the watershed has a significant impact on the level of phosphorus loading (DEC, 2002). Eroding streambank soils may be the largest source of sediment and phosphorus entering the lake. Significant sediment sources from unstable streambanks and streambeds are responsible for some of the impaired waters on the 303(d) list including Deer Brook in Georgia and G-listed Browns River, listed as “Altered by Channel Alteration.” Sediment and other pollutants are impairing aquatic life and habitat on both waterways (Chapter 5). An inventory of the approximately 12 miles of riverbank lands owned by Vermont Department of Fish and Wildlife in 1998, found that 37% were actively eroding or slumping into the river. The report noted, “The greater alarm is that this condition appears to be representative of all 170 miles of riverbanks, both public and private, along the Lamoille’s 85 mile length.” A streambank condition inventory and map of the Wild Branch described approximately 80% of the total stream length as suffering from headcutting and/or undercutting, sloughing, or mass wasting of streambanks (LCPC, 2002).

Detailed geomorphic assessments have been completed in numerous Lamoille subwatersheds. See Appendix A.8 for a complete list of completed and scheduled assessments.

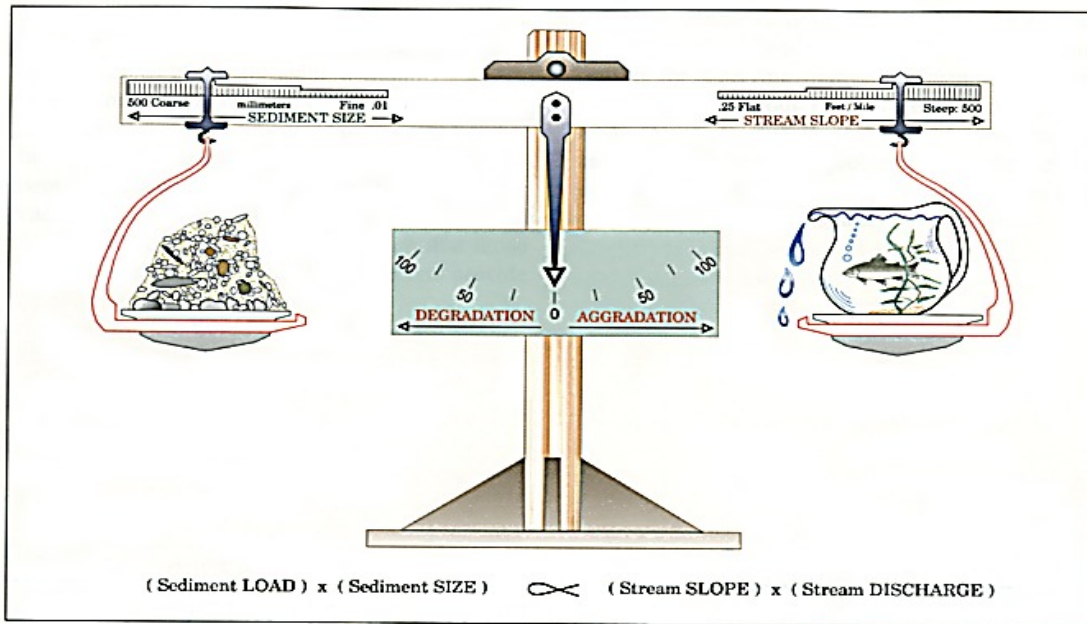


Figure 4. Lane's diagram (1955) from Rosgen (1996)

***Phosphorus** is a nutrient that poses a threat to clear and nuisance free water. Nutrients act as fertilizers, promoting rapid growth of algae and plants. Human activities can greatly increase nutrient inputs to waterways. These cultural nutrient sources accelerate eutrophication, the natural aging process of lakes where biological and chemical materials accumulate, causing lakes to become more productive. When excessive amounts of nutrients enter waterways they produce excessive amounts of algae and other aquatic plants. Algal blooms turn water green, reduce water transparency, deplete the oxygen supply, and create toxic algae and odor problems. Ultimately, these blooms alter fish and wildlife habitat, impair scenic views, reduce recreational appeal, impair water supplies, and lower property values (Lake Champlain Basin Program, 1996).*

Water quality problems resulting from stream instability include:

- Flooding and erosion damage to public and private properties, infrastructure and valuable agricultural land;

- Poor quality aquatic habitat due to excessive sediment deposition, lack of shade and in-stream cover, and channel widening that can result in water temperature increases and loss of deep pool habitats; and
- Eutrophication of Lake Champlain from excessive phosphorus loading.

Flooding- Catastrophic Water Quality Consequences

In Vermont, flooding events represent the most frequent disaster and result in the greatest damage to private property, public infrastructure and water quality (DEC, 1999). While inundation-related flood loss is a significant component of flood disasters, the predominant mode of damage is associated with the dynamic, and oftentimes catastrophic, physical movement of stream channels during storm events due to bed and bank erosion, debris and ice jams, structural failures, flow diversion, or flow modification by manmade structures. Channel adjustments with devastating consequences have frequently been documented. Such adjustments or actually re-adjustments into old alignments are linked to

historic channel management activities, flood plain encroachments, adjacent land use practices and/or changes in watershed hydrology associated with conversion of land cover and drainage activities (DEC, 2008).

The Lamoille River watershed has experienced three large magnitude flood events during the 1990s. These floods were responsible for millions of dollars in damage to both private and public properties and tons of sediment, phosphorus and other pollutants carried to Lake Champlain. Flood events in 1995, 1997, and 1998 destroyed infrastructure such as roads, bridges, culverts, homes, and agricultural lands.

Riparian Buffers –Losses and River Instability

Riparian buffers play important roles in maintaining a healthy riverine ecosystem. Vegetated buffers provide shade to reduce surface water temperatures; filter sediments, nutrients, and other pollutants from runoff; provide food, cover and substrate for amphibians, aquatic insects, and other aquatic biota provide; provide habitat to species whose life cycles include water and upland; offer cover for wildlife traveling between habitats and/or dispersing to new habitats; slow floodwaters; and reduce ice damage.

Detailed buffer inventories have been completed on the main stem. There are significant gaps of woody riparian buffers along the Lamoille and Browns River. The Lamoille County Planning Commission has recently completed a buffer inventory of the Lamoille main stem within Lamoille County. The results concluded that between 0-25 feet from top of bank 57% of the main stem has an existing woody buffer. Out of the remaining 43% of the land use within the 0-25 foot area, roughly 30% was agricultural hay or row crops and 10% was either developed (roads and buildings) or water (lakes and wetlands). Thirty two percent of the upper Lamoille River is devoid of any woody riparian buffer (Caledonia and Orleans County portion) within 0-25 feet of the top of bank. Fifty three percent of the Browns River is devoid of woody riparian buffers within the top of bank area.

Previous and On-going Assessment and Stream Restoration Projects

Browns River Watershed Assessment and Restoration

(See Chapter 5)

Riparian Buffer Plantings and Soil Bioengineering Projects

The U.S. Fish and Wildlife Service, Natural Resources Conservation Service, FEMA Project Impact, the Vermont Youth Conservation Corps, local volunteers, and the Lamoille County Conservation District identified, assessed and implemented streamside buffer programs through the *Trees for Streams*, *Conservation Reserve*, and *Partners for Fish and Wildlife* programs. New buffers were established on 47,000 linear feet or nearly 9 miles of streambank in the last 5 years (*Trees for Streams* Final Report, 2007). Riparian plant material nurseries have been established in Morristown, Johnson, and Hardwick.

Numerous banks have been treated using soil bioengineering techniques such as tree revetments. Tree revetments are softwood treetops that are installed parallel to flow on the lower portions of eroding banks. Tree revetments are temporary measures that deflect flow and encourage sediment deposition until woody vegetation can be established. A restoration demonstration project following the principles of fluvial geomorphology was implemented on Foot Brook in Johnson.



Student volunteers planting a Trees for Streams buffer on the Browns River

River corridor planning is conducted in Vermont to remediate the river instability that is largely responsible for erosion conflicts, increased sediment and nutrient loading, and a reduction in river habitat. The Vermont River Management Program (RMP) will provide funding and technical assistance to facilitate an understanding of river channel adjustments and the establishment of well developed and appropriately scaled projects and strategies to protect and restore river equilibrium (DEC, 2008).

ANR river corridor planning is not intended as a surrogate or replacement for “basin planning” or the consensus-building watershed planning process coordinated by the State. Technical river corridor plans may be adopted or incorporated within basin plans.

These objectives include:

- fluvial erosion hazard mitigation;
- sediment and nutrient load reduction; and
- aquatic and riparian habitat protection and restoration.

River protection and restoration programs are established primarily to complete “projects” which meet specific goals and objectives.

Traditionally, this means tangible actions on the ground such as:

- Protecting river corridors
- Planting stream buffers
- Stabilizing stream banks
- Arresting head cuts and nick points
- Removing berms and other constraints to flood and sediment load attenuation
- Removing/replacing/retrofitting structures (e.g. undersized culverts, constrictions, low dams)
- Restoring incised reaches
- Restoring aggraded reaches

The first set of actions may be more readily pursued without an extensive alternatives analysis. The last two actions, restoring vertically unstable streams (incised or aggrading), may require channel management practices, corridor land use changes, more extensive feasibility analyses, landowner negotiations, and time.

Local Land Use Planning and Regulation

Town planning and zoning can play a central role in mitigating flood and erosion hazards through avoidance. Towns have the ability to regulate land use, encouraging development in appropriate areas and preventing investment in hazardous areas. Pre-disaster mitigation (PDM) planning, FEH overlay districts, setbacks or buffers, and effective flood hazard zoning are all ways a community can mitigate flood and fluvial erosion hazards (DEC, 2008).

Economic loss and risks to public safety caused by flood and fluvial erosion hazards are experienced most dramatically by individuals and local governments. Local governments are also the most appropriate entities to guide and implement efforts to mitigate these hazards. Armed with a better understanding of ongoing river processes, towns can take action to reduce flood and fluvial erosion hazards, which will enhance public safety, save money, and lead to healthier rivers.

Dams and Flow-regulated Waters

There are over 65 dams of different types, sizes, and condition in the Lamoille River Watershed. Certain dams in the watershed provide renewable energy and recreational opportunities such as boating, fishing, and swimming albeit at the expense of river-based recreation. In some cases impoundments can create unique wetland aquatic communities although somewhat artificial since they are maintained by the presence of the dams. Dams can also impede streams' ability to transport flow and sediment; cause streambank erosion and flooding problems; degrade and alter fisheries habitat; create barriers to migratory fish passage; degrade water quality; and impede river-based recreational activity.



Cilley Hill Dam Browns River Jericho

Dams

Ten out of 65 dams in the Lamoille watershed are used to generate hydroelectric power directly or impound water to augment hydro flows. This renewable energy source can displace fossil fueled electric generation. Sulfur dioxide and nitrogen oxides are considered prime contributors to the production of acid rain, which adversely affects the Lamoille River watershed. Further, carbon dioxide is a prime contributor to global warming.

Dams also can create wetland habitats for threatened and endangered plant and animal species such as those found in portions of Arrowhead Mountain Lake. This impoundment

supports rare quillworts and sedges, and is used by osprey that nest on platforms installed by CVPS and the Vermont Fish and Wildlife Department (CVPS personal communication, 2003).

Major artificial impoundments within the watershed include Green River Reservoir, Lake Lamoille, and Arrowhead Mountain Lake. The dam and impoundment on Lake Elmore augments flow for the hydroelectric facility. Many Lamoille River watershed dams are small, creating ponds on residents' property for aesthetic or recreational values. Some dams in the watershed have cultural significance as they were originally built to run Vermont's early mills. The impacts of dams are described in detail below.

Impacts of Dams

Dams and hydroelectric operations change the physical, ecological and social characteristics of a river. Dams have multiple effects on rivers and riverine habitat. These changes range from a minor alteration of depth and velocity in the case of low-head, run-of-the-river dams, to a complete change from river to lake characteristics in the case of large dams. Depending on the characteristics of the reservoir and how water is discharged, downstream changes may be undetectable or significant. In the river reaches between hydroelectric dams and powerhouse tailraces, where the river flows re-enter the channel (the bypassed reach) virtually all of the flow is diverted from the river for much of the year, unless special provisions are made to provide conservation flows. Downstream of facilities, flows may be managed to enhance on-peak power production. Flow manipulation results in fluctuating flows and, at times, no flows downstream during periods when the water in the reservoir is being replenished (ANR, 2003). Structures that completely span a channel, such as dams, can significantly alter the quantity and duration of water and sediment runoff and may cause a stream to undergo both vertical and lateral channel adjustment processes (ANR, 2003). Sediment is deposited behind dams. Deposited sediments gradually fill impoundments from

upstream to downstream, changing aquatic habitats over time. This process is evident in Arrowhead Mountain Lake, where large diverse wetlands are developing on the accumulated sediments in the upstream end of the reservoir. Dams can degrade water quality by interrupting the natural sediment flow characteristics of a river, reducing natural oxygen entrainment, and increasing water temperatures. Together these effects can markedly alter the river ecology, changing the species composition and density of macroinvertebrates, fish, and other aquatic organisms (ANR, 2003). Impoundments and water withdrawals can have an impact on in-stream habitat and biota, especially during naturally low flow periods that occur in Vermont in August, September, and February (ANR, 2003). Dams can flood upstream habitat and act as barriers to upstream and downstream movement of aquatic organisms. Operations alter the natural flow regime in a way that can reduce downstream habitat quality and quantity. In addition to channel adjustments that may affect the structure of in-stream habitat, additional flow diversion from the bypassed reach of the stream can expose streambed substrates, effectively reducing the amount of habitat area available for aquatic organisms. In high-gradient streams, cobble and gravel substrates in riffles are exposed; in low-gradient streams, the decrease in water level exposes logs and snags and lowers the water away from the near-bank cover, thereby reducing available habitat.

Water temperatures within the impoundment sometimes result in summer stratification – that is, warmer water at the surface that does not mix with the cooler water at the bottom. In productive ecosystems, or where there are heavy waste loads, accumulated organic material can deplete the oxygen in deeper waters. As a result of these changes, river plant and animal communities are replaced by those that prefer a more lake-like environment. For example, a resident walleye population has become established in the Peterson impoundment as a result of the change to a more lake-like habitat, making it less habitable for cold-water species such as Brook Trout.

The majority of the major dams in the watershed are listed as *Surface Waters Altered by Flow Regulation* Part F on the List of Priority Waters (DEC 2008). The Part F sites are considered by the state to be priority waters for management action (Table 9).

Hydroelectric Dams

From a regulatory standpoint, hydroelectric dams fall into two broad categories. The first consists of those that are regulated by the Federal Energy Regulatory Commission. These facilities operate under a federal license or exemption that specifies flow and reservoir management, fish passage, recreational facilities, and other requirements. The state participates in the license and exemption processes by issuing a water quality certification under Section 401 of the Clean Water Act.

The second category includes unlicensed facilities that are regulated by the State, rather than the federal government. Most of these facilities do not have conservation flow or reservoir management requirements. Larger facilities are regulated by state statute under 10 V.S.A. Chapter 43. In addition, 10 V.S.A. § 1003 authorizes DEC to seek the cooperation of the owner of a dam if the regulation of stream flow appears contrary to the public interest. After conferring with the owner and other interested parties, the department may require the owner to change the way the dam is operated so that the public interest is protected.

In January 2008, ANR released *The Development of Small Hydroelectric Projects in Vermont, a Report to the Vermont General Assembly* as interest in renewable energy has surfaced in response to increasing awareness global climate change issues, increases in fossil fuel costs, and uncertainties of long term contracts with Hydro Quebec and Vermont Yankee. The report summarizes current hydroelectric generating operation and potential areas of capacity increases by increasing efficiencies at existing turbines or possibly retrofitting existing dams. The report also outlines the permitting process for hydroelectric development and pre-feasibility studies.

ANR is likely to recommend low impact standards for new or repowered small hydroelectric facilities in Vermont as developed by Hydroelectric Institute in Maine. The low impact standards include:

- No new dam or other barrier to aquatic organism movement and sediment transport
- Run-of-river operation
- Bypass flows necessary to protect aquatic habitat, provide for aquatic organism passage and support aesthetics
- Fish passage, where appropriate
- No change in elevation on an existing impoundment or in water level management
- No degradation of water quality, particularly with respect to dissolved oxygen, temperature, and turbidity
- No change in upstream or downstream flood profile or fluvial erosion hazard sensitivity

CVPS Operated Dams

Four CVPS-operated hydroelectric generating dams are located on the lower Lamoille River. These are the Peterson, Milton, Clark Falls, and Fairfax Falls Dams. The Clarks Falls Dam created Arrowhead Mountain Lake. The Peterson Dam is the first dam located on the Lamoille River approximately six miles from the confluence of Lake Champlain. Currently impaired waters listings of this reach of the Lamoille River include: the mouth to Clark Falls Dam due to elevated mercury in fish, Clarks Falls Dam to the Route 2 Bridge due to low dissolved oxygen, and in the Arrowhead Mountain Lake reach due to mercury (see Chapter 5). These dams are operated under a Federal Energy Regulatory Commission (FERC) license.

Morrisville Water and Light Department Controlled Dams

The Morrisville Water and Light Department owns and operates four dams in the watershed. Two dams are located on the Lamoille River main stem in Morrisville as well as dams on Lake

Elmore and Green River Reservoir. These dams are collectively known as the Morrisville Project. The Cadys Falls dam creates the impoundment known as Lake Lamoille. The Morrisville Project is licensed by FERC. The current FERC license is up for renewal in 2015. Morrisville Water and Light has recently sold its land adjacent to Green River Reservoir to the state. This land is currently being used as a primitive state campground. Morrisville Water and Light maintains ownership of land adjacent to this parcel that includes several ponds.

Hardwick Electric Department Controlled Dams

Six dams are owned by Hardwick Electric Department. Two dams are located on the Lamoille River main stem, the Pottersville Dam and Jackson Dam. The Pottersville Dam is the primary hydroelectric generating facility. The Jackson Dam impoundment forms Hardwick Lake and was formerly used to augment flows at Pottersville during periods of peak power demand. Hardwick Electric also controls smaller dams on Caspian Lake, East Long Pond, and Nichols Pond. These three waterbodies are natural lakes with artificial outlet structures, which were used to manipulate lake storage to enhance power generation at Pottersville, similar to Jackson Dam's function. The Mackville Pond dam impounds Nichols Brook and is located downstream of Nichols Pond. Substantial repairs on Mackville Pond dam were completed in 2001. East Long, Nichols, Mackville Pond, Hardwick Lake, and Caspian Lake are no longer used to augment flows at Pottersville. Nichols Pond was drawn down for safety reasons in 2006. Major repairs are planned for 2008. The new lake level would be one foot lower than the historic level. Of the dams owned by Hardwick Electric, only Pottersville is considered a hydroelectric facility, and it is unlicensed by the FERC, which has jurisdiction over most hydroelectric dams in Vermont. Current operation and future management goals of the dams include (Hardwick Electric personal communication, 2003):

- East Long Pond, Nichols Pond, Mackville Pond, and Caspian Lake- maintenance of

current level at spillway except for minimal lowering in for dam maintenance projects.

- Hardwick Lake is no longer drawn down in anticipation of large precipitation events. The lake is drawn down annually in the fall to help prevent ice jam flooding in Hardwick Village upstream.
- Pottersville (Wolcott) Dam- this dam is automated to maintain flow over the top of flashboards at approximately 30 inches.

Hardwick Lake Management

Jackson Dam creates Hardwick Lake. The dam's impoundment, which overflows the riverbeds of Alder Brook and the Lamoille River, is drained every year from fall through spring to help avoid ice jams and flooding in the Hardwick Village. This results in a highly unstable aquatic environment that prevents the establishment of a healthy aquatic community of plants, amphibians, aquatic insects and fish. The management objective for Class B waters in Vermont is to achieve and maintain a level of quality that supports aquatic biota and wildlife sustained by high quality aquatic habitat. Because of its fluctuating levels, Hardwick Lake would not be considered high quality habitat as an impoundment or as a free-flowing river (DEC, 2004).

There has been an effort by the Vermont Natural Resources Council and the Lamoille River Anglers Association to remove the Jackson dam. Removal of the dam would restore 4.4 miles of trout habitat, eliminate the extreme water level fluctuations associated with drawdowns, eliminate liability associated with the structural integrity of the dam, and improve the Lamoille River's ability to transport sediment through the impounded reach. A vote by Hardwick citizens favored maintaining the Jackson Dam. Many expressed an opinion that the impoundment plays an important aesthetic and wildlife habitat function in the community. DEC recommends removal of Jackson Dam as the best option available to both alleviate flooding and icing problems and achieve

compliance with Water Quality Standards. The current management of Hardwick Lake, with the extensive fall and winter drawdown, results in a significant degradation of water quality to the Lamoille River. DEC recommends that the Town of Hardwick wait for the next cycle of watershed planning in 5 years to decide on the designation for the reach affected by Jackson Dam to give the Town and its citizens the time and opportunity to consider all the options, with DEC's technical assistance (DEC, 2004).

A small privately owned hydroelectric dam is also in operation on the Gihon River in Hyde Park.

Greensboro Brook Small Hydro Proposal

The Town of Greensboro has proposed the development of a hydroelectric facility on the outlet of Caspian Lake on Greensboro Brook. The Town is working with ANR to develop a final design for the project.

Recent and On-going Dam Related Projects

Several statewide and Lamoille watershed initiatives are being undertaken to identify dam-related water quality issues. These actions will lead to selective stream restoration projects involving the removal or retrofitting of existing dam structures.

Legislation Regarding Dams

State legislation enacted in 2003 and 2004 began to address the ecological, social and financial impacts of dams. Act 63, the 2003 capital construction bill, stated, in part, "State policy should encourage private and municipal dam owners to remove their dams voluntarily, where appropriate. It should provide technical and financial assistance to municipalities to take care of the dams they own and to assume ownership or control of privately owned dams." Further, the legislature directed the Agency of Natural Resources to develop proposed legislation that would address "[a]mendments to existing regulatory programs for dams, permits, inspections, and procedures for emergency responses to hazardous dams" and "the financial implications of a capital budget policy that

proposes to promote the removal of dams to address public safety, hazard mitigation, and environmental concerns and that includes incentives for municipalities to own and properly maintain dams.”

The Agency submitted the mandated report, but changes to the existing dam statute (10 V.S.A. Chapter 43) were not enacted. However, the 2004 capital construction bill included a provision (Section 66) that established the “Vermont unsafe dam revolving loan fund.” The purpose of the fund is to provide grants and loans to dam owners (municipalities, not-for-profit organizations, and private individuals) for dam reconstruction, repair, removal, breaching and other activities to reduce or eliminate hazards associated with unsafe dams. A small amount of funding was appropriated for the fund and the bill set up a mechanism for future appropriations, grants or donations to be added to the fund.

Vermont Dam Task Force

The Vermont Dam Task Force is a group whose goal is to “...restore rivers through the selective removal of dams and other man-made obstructions thereby reconnecting Vermont’s natural and cultural river communities.” It is a statewide cooperative effort among federal and state agencies, and interested non-profit organizations that has been meeting regularly since late 2000. The meetings serve as a forum for discussion of issues related to broad issues affecting dams and dam removal, as well as discussion of specific dam removal projects.

Lamoille River Watershed Dam Inventory and Assessment

An inventory and assessment of all dams in the watershed was completed by ANR in the summer of 2002. Information was recorded about the type and condition of each dam, its historic and cultural aspects, and a preliminary assessment of the dam’s impact.

Johnson State College Dam Removal and Stream Restoration

An earthfill dam was constructed on the campus of Johnson State College (JSC) in the 1960s. The structure was 255 feet long and 31 feet high and located on a small tributary of the Gihon River. The spillway began to fail in 1998 and the impoundment behind the dam had been mostly drained since that time. Beginning in 2002, college authorities decided to remove the dam and worked closely with DEC to plan the project. The dam was removed in the summer of 2003. A natural stream channel was constructed in the area formerly occupied by the dam and impoundment. The project included the establishment of a woody stream buffer corridor in spring of 2004 and planned interpretative nature trail developed by JSC Environmental Science students and instructors, DEC, and the Lamoille County NRCD.

Table 9. Waters Altered by Regulated Flow in the Lamoille River Basin, 2008 Part F List of Waters.

Water Segment and Location	Flow Alteration	Remediation & comments
Lamoille River immediately below Cady Falls Dam, Morristown	Possible fish passage problem at dam (threat)	FERC re-licensing in 2015
French Brook, Johnson	Lack of flow to support habitat and aesthetics a possible fish passage problem at water withdrawal point	Town of Johnson has developed a groundwater well for drinking water and remove the dam
Lamoille River Pottersville Dam, Wolcott	Artificial and poor flow regime downstream impairs aquatic habitat; erosion. Possible fish passage threat. This is an unlicensed facility	Pursue conservation flows through appropriate state regulatory processes
Lamoille River below Morrisville Dam	No flow in bypass impairs aesthetics, recreation, and habitat	FERC re-licensing in 2015 will address low flows
Lamoille River, Hardwick Lake, Hardwick	Artificial flow regime down river. Possible fish passage problem (threat). Water level fluctuation impairs aquatic habitat and wetlands. Unlicensed facility	See Chapter 4 Actions and Jackson Dam recommendations above
Lake Lamoille, Morristown	Water level fluctuation may impair aquatic habitat	FERC re-licensing in 2015 will address this issue
Brewster River, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snowmaking water withdrawal	See Chapter 2 for the implementation of conservation flows
Sterling Brook, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snowmaking water withdrawal	See Chapter 2 for the implementation of conservation flows
Unnamed tributary to Brewster River, Cambridge	Artificial flow condition, insufficient flow below Smugglers Notch snowmaking water withdrawal	See Chapter 2 for the implementation of conservation flows
Nichols Brook- below dam on East Long Pond & Nichols Pond, Woodbury	Artificial flow regulation and condition at 2 dams	Pursue conservation flows through appropriate state regulatory processes. Nichols Pond Dam to be subject to a Chapter 43 dam order (application filed in Dec 2007)
East Long Pond, Woodbury	Water level fluctuation by hydro impairs aquatic habitat and endangered species	Use Section 1003 process or Surface Level Rules from the VT Water Resources Panel, or other regulatory process to control how the dams are operated to provide controls to provide for downstream conservation flows and proper lake level management
Nichols Pond, Woodbury	Water level fluctuation impairs aquatic habitat	A DEC Dam Order application was filed for repair work
Caspian Lake, Greensboro	Water level fluctuation has potential to impair fishery	A formal agreement such as Section 1003 or Surface Level Rules from the VT Water Resources Panel on how the dam is operated is needed to assure downstream conservation flows and proper lake level management
Hardwick Lake, Hardwick	Water level fluctuation by hydro impairs aquatic habitat and wetlands	No longer managed for hydro, lake drained for fall/winter ice control. See Chapter 4 Actions and Hardwick Electric controlled dams section above

The Working Landscape, Farm and Forestland

As Vermonters, we're proud of our quality of life. Rapid, unplanned growth leads to traffic congestion, increased travel time, and reduced family time. If we do not pursue smart growth, we risk losing the sense of community, the working landscape, and the environmental quality that makes Vermont special.

-Former U.S. Senator Jim Jeffords

Background

The Lamoille watershed's scenic farm and forestland is a working landscape that defines its heritage, enhances the local economy, and provides residents with a connection to the land. As development encroaches on remaining farm and forest lands, impervious surfaces and stormwater runoff increases, wildlife habitat is fragmented, exotic species are introduced, and fisheries and wetland habitat are degraded (DFPR and CCRPC, 2001).

Natural resource conservation, economic self-sufficiency, and the desires to preserve the watershed's rural-based culture, enhance recreational opportunities, and create aesthetically appealing landscapes are common goals in relation to the watershed's forest and farm lands conservation. Forests and farms are integral parts of a landscape that supports a variety of social and economic values in addition to vital ecological ones (VDFPR and CCRPC, 2001). Sustainable forestry and agricultural land use is a healthy alternative to uncontrolled growth.

Sustainable forestry is forest management and planning that is ecologically, economically, and socially responsible and is used to sustain healthy forests and the human communities that depend upon them. DFPR (2007)

Sustainable agriculture is a food and fiber production and distribution system that:

- *Supports profitable production;*
 - *Protects environmental quality;*
 - *Uses natural resources efficiently;*
 - *Provides consumers with affordable, high-quality products;*
 - *Decreases dependency on nonrenewable resources;*
 - *Enhances the quality of life for farmers and rural communities; and*
 - *Will last for generations to come.*
- (UVM Center for Sustainable Agriculture)

Sprawl

Sprawl is a regional land use pattern of scattered, low-density, single use development. It is a cumulative phenomenon that begins at the edge of traditional village centers and moves outward incrementally into previously rural areas. It is land consuming, automobile dependent, energy and resource-intensive, and sometimes located at a distance from existing infrastructure. Land is being developed in Vermont at about two and a half times the rate of population growth (The Champlain Initiative, 1999).

Sprawl development is occurring in the Lamoille River watershed, especially in the lower portions of the watershed. It carries significant implications for the long-term sustainability of working lands. Chittenden County is changing rapidly from a primarily agricultural community to a landscape dominated by urban and suburban development. Between 1950 and 1992, Chittenden County has lost 70 percent of its farms with only 24 percent remaining in farmland. Once farmland has been converted into houses, parking lots and shopping malls, it is fragmented and is difficult to recover for agriculture or wood products. Meanwhile, the region's best farmland is being converted to commercial and residential development at an accelerating rate. Nearly 40 percent of the land newly developed was formerly cropland and pastures. There is an increasing pressure on

farmers to sell their valuable land (CCRPC and UVM, 2001).

Effects of Development on Natural Resources

The destructive environmental impacts of sprawl-type development are many and varied. There are biological impacts such as loss of terrestrial and aquatic wildlife habitat species, human health impacts such as degraded air or water, and loss of connections to the land.

The most significant threat to wildlife and their forest habitats is parcelization and fragmentation. Fragmentation occurs when large areas of forest are made smaller or divided by roads, development or land conversion to non-forested uses. Land conversion leads to loss in natural diversity, disruption of movement, and increase in the presence of exotic species. Parcelization refers to the division of forestland into increasingly smaller parcels; some remain forested, while others are developed. Forestland may be divided because of a death in the family, burdensome taxes, and lifestyle changes (CCRPC and DFPR, 2001).

Roads fragment habitat and affect the movement of fish and various wildlife species. Roads can isolate populations of species such as black bears, stopping them from moving to fall feeding areas, or new ranges, and reducing their chances of finding mates. Vehicle collisions with wildlife kill 2,500 deer and moose annually on Vermont roads. In-stream culverts create barriers to fish migration and, can prevent access to vital spawning areas (FWD, 2000).

Forest cover, and more generally, any well-vegetated landscape, can have a significant positive influence on water quality. Trees help keep pollutants from reaching groundwater, reduce erosion, reduce stormwater runoff, aid in recharge of aquifers, regulate water temperature, supply critical nutrients, and provide an environment in which aquatic and riparian wildlife can flourish. Increases in impervious surface area from the development of roads, parking lots, sidewalks, rooftops, patios, and compacted soils

alters the storage and transportation of water which, in turn, affects the surrounding stream biology. Polluted runoff is caused from rain or melting snow flowing into waterways. Runoff becomes polluted with silt from eroding soils, oil and metals from roads and automobiles, and chemicals and animal wastes from residential lawns and farms (The Champlain Initiative, 1999). 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 the capacity of existing farmland to both produce more on less land and to maintain the pastoral nature of the landscape. When managed properly, farms protect streams and water quality, and produce far less pollution per acre than developed land (Hegman et al, 1999). While urban development represents only 3% of the total land within the basin, it contributes 18% of the phosphorous loading to Lake Champlain (The Champlain Initiative, 1999).

Agriculture in the Lamoille River Basin

(agricultural statistics provided below from AAFM personal communication, 2008).

One hundred eight dairy farms are located in the Lamoille Basin (Table 10). Some dairy farms are active producers, currently shipping milk, while the remaining inactive farms are still in business but not currently shipping milk to a bulk handler. Inactive producers who are out of business may be functioning as heifer barns or calf nurseries for neighbors, or leasing their land or buildings to other active dairy producers.

Non-dairy farms in the Lamoille Basin are well represented. The combined value of non-dairy agricultural products in the Lamoille Basin is nearly \$7 million. Agricultural processors and support industries are present in the basin because of the increased market demand for locally grown produce. Two fiberworks support the numerous sheep and llama producers. There are four farmer's markets and three poultry processors in the basin. There are also 42 Vermont-certified

organic farms, of which two are designated Community Supported Agriculture (CSA) farms, whose market area covers the entire Lamoille Basin and much of surrounding counties. These organic farms produce smaller quantities of a much greater diversity of agricultural commodities, ranging from apples to yogurt.

Horse farms are a strong presence, accounting for an estimated 2,500 horses in the basin, and maintain an estimated 10,344 acres of pasture and open land. Livestock operations, primarily beef cattle, are often profitable replacements for marginal dairy operations, especially in the higher elevation terrain where pasture and hay land are more prevalent than row crop tillable acreage.

Table 10. The Number of Agricultural Producers (farms) in the Lamoille Basin.

Type of Producer	Total Producers
Dairy	108
Beef	27
Sheep	20
Deer Herd	4
Llama/alpaca	21
Maple sugar	125 (estimated)
Horses	30 (estimated)
Poultry	2
Vegetable	3
Orchard	2
CSAs	2
Certified organic	42

Trends for the Future in the Lamoille Basin

Farmland is a slow but steadily shrinking resource in the basin. Each of the counties of the Lamoille Basin experienced a net loss of farmland, averaging 560 acres a year over a ten-year period, with Franklin, Chittenden, Lamoille, Caledonia and Orleans ranked first to last in lost farmland. This is due to the more rapid development of the I-89 corridor from Burlington to St. Albans, and the slower eastward expansion of development along Route 15 (AAFM, 2003).

Of the five counties that make up the Lamoille Basin, there is some variability in the extent of

change in farm numbers; for example Lamoille County gained 84 new farms and Chittenden County 4 new farms in the Basin, while Orleans, Franklin, and Caledonia lost a combined total of 34 farms within the basin over a 10 year period. The increase in farm numbers in Lamoille and Chittenden can be attributed to start-up vegetable, horse and non-dairy livestock farms, as well as consolidation among larger dairy operations. However, on average, the Lamoille Basin lost the equivalent of a 400 acre dairy farm a year, every year over the last 10 years, to a combination of rising production costs, lowered milk prices, farmer demographics and development pressure.

Continued access to and a sufficient amount of row crop corn land are vital to the survival of most of the current dairy operators in the Lamoille basin. Farmland shares a narrow corridor of space mostly in river bottom farmland that competes with transportation, utility and residential needs. Farmers use the land available to them as intensely as possible, in some cases planting and cultivating right up to the river's edge because of economic necessity.



The retirement of older farmers, increasing land and production costs, low food prices, competing land uses, the lack of incentives for young people to enter farming, and the fundamental restructuring of the local, national, and global economy all combine to make farming and local food production in the U.S. an increasingly difficult task. There are two general trends occurring in agriculture both at the national and local level. One is toward larger operations that produce commodities. The other direction is

toward niche and specialty food markets; toward farmers adding value to their crops with their own processing ventures; and toward locally grown agricultural products (Cantrell, 2002).

On-going Efforts to Preserve Farmland

Coalitions of state agencies and private conservation organizations have purchased conservation easements and development rights on over 36 farms in the Lamoille Basin to preserve viable farms and prime agricultural soils. The conserved acreage allows a farmer to operate more profitably with lower taxes and a decreased debt burden. The Vermont Land Trust, acting alone or in concert with the Vermont Housing Conservation Board and the Vermont Agency of Agriculture, Food and Markets (AAFM) has conserved over 3,238 acres of farmland in the basin. The VAAFM Farmland Preservation Program currently has two abutting farm properties [totaling 491 acres] in Georgia involved in pre-application for conservation easements (AAFM, 2003). Most watershed towns acknowledge the importance of working farm and forest land in their municipal plans.

Broad Strategies to Address Loss of the Working Landscape

Many farmers nearing retirement face succession choices that affect not only themselves but also the entire watershed they farm in. Joint efforts are needed to effectively address all the issues affecting Lamoille Valley farmers. To effectively manage non-point source pollution, the continued economic health of the farm is critical. Farmers must explore non-traditional funding to leverage federal and state cost-share funds. Assistance with business plans, value-added processing, succession and retirement planning, land conservation easements and other farm-related opportunities must be customized to each farmer's needs and timetable.

In the changing economic and demographic conditions of the Lamoille Basin, agriculture should be seen as a "patchwork quilt" of multiple and diverse farming systems, instead of a single farming "monoculture." Market forces offering

higher prices for vegetables, nursery crops, and organic produce of all kinds are signaling a demand that could be profitably supplied by farmers willing to implement new and diverse operations as a supplement to, or eventual replacement for, traditional dairy operations. Maintaining a meaningful farm and forestland base for the future dairy economy in the watershed may depend heavily upon non-dairy diversified farm and forest activities, that are far more profitable than the land area they take up, thus subsidizing the greater area of pasture, hay and row crop land. All activities that keep land open and in active use should be considered important to the future of the "quilt" of the Vermont landscape.

Agriculture and Water Quality

Farmers are stewards of the land. If we're not keeping the water clean, we're not doing our job.

-Loren C. Wood, Woodnotch Farm,
Shoreham, VT (AAFM, 2000)

While significant strides have been made to reduce agricultural non point sources of pollution through voluntary implementation of soil, manure, and fertilizer management practices, agriculture remains one of the most significant potential sources of water pollution.

With some exception, dairy farms throughout the Vermont and the Northeast are moving towards more intensified operations and expanded herd size. Corn silage has been the row crop of choice because it is high yielding and can provide the additional forage dry matter per acre required for increased herd sizes. Growing high yielding forages is crucial in Vermont since quality cropland is often limited. Corn silage is also a significant crop because of its high-energy content, high intake potential, and optimum dry matter at harvest. Corn silage is appealing because it's relatively low labor and machinery requirements due to a single harvest activity and because of its ability to be grown in marginal areas. In addition, since so few annual forage

crops with the superior yield potential and forage qualities of silage corn can be grown in Vermont, the opportunities for crop rotation have been limited.

Although the integration of corn silage has increased productivity and efficiency, the lack of rotation out of corn has led to a number of potentially detrimental economic and environmental consequences, ranging from increased use of pesticides, increased cost of production, decreased yields, rapid erosion of topsoil, and reduced soil health all of these factors contributing to lowered water quality. Increased erosion is often seen in silage fields because a large area of soil between corn rows is left uncovered. In addition, silage harvest results in the entire plant being removed from the field leaving little to no crop residue during the off-season. Poor soil coverage can lead to the loss of sediment-bound nutrients – especially phosphorus - and pesticides into near by surface water (Sharpley and Beegle, 2001). When fields are planted to corn silage, generally manure is applied during hydrologically sensitive periods (early spring and late fall). Spreading manure at these sensitive times increases the risk of manure run-off because soils are more easily compacted (reduces infiltration). Since up to 90% of the phosphorus transported from cropland is attached to sediment, the reduction of soil erosion would be of prime importance in minimizing phosphorus loss from agricultural land (Sharpley and Beegle, 2001). Designing cropping systems that reduce phosphorus release by minimizing soil erosion would ultimately benefit water quality.

With increased herd sizes and more year round confinement of dairy comes a greater dependence on imported phosphorus-rich grains. Increased use of grains has led to higher phosphorus levels in the soil and the increased risk of contaminated run-off. Pasture-based farms are alternative systems and have a much greater percentage of land under permanent sod which has significantly less potential for erosion and associated phosphorus run-off and use minimal phosphorus-

containing grains, soluble fertilizers, and herbicides. Similarly, these farms have increased flexibility regarding the timing of manure spreading since most of it can be applied to sod-covered hayland with multiple windows for application. However, unrestricted livestock access to surface water from pasture-based farms is a water quality concern because of pathogens, manure nutrients, sedimentation, and increased erosion of unprotected streambanks.

Inadequate animal waste structures and nutrient management results in nutrient loading to surface and ground waters and is a source of agricultural nonpoint source pollution. Of the 108 operating dairy farms in the Lamoille River watershed, 18 lack waste management systems or an improved barnyard. Older waste management systems that were installed by farmers may or may not be up to VAAFM and NRCS cost share standards. (The following information provided by AAFM personal communication, 2008)

Table 11. Waters in the Lamoille Basin that are affected by Agriculture.

	Total River Miles	Lake and Pond Acres
High	8.5	NA
Moderate	92.3	NA
Sub total	100.8	NA
Threatened	26	64

Accepted Agricultural Practices

Accepted Agricultural Practices (AAPs) are statewide restrictions designed to reduce nonpoint discharges through the implementation of improved farming techniques rather than investment in structures and equipment. AAPs are basic practices that all farm operators must follow as a part of their normal operations. The law requires that the practices must be technically feasible as well as cost effective for farmers to implement without government financial assistance. Changes to the AAPs (AAFM, 2005a) related to surface waters include:

- Streambank vegetation is to be protected from livestock trampling and equipment damage;
- Streambank areas are to be left in a natural state;
- Manure will not be stacked on unimproved sites within 100 feet of surface waters;
- All fields receiving manure applications must be soil tested at least once every 5 years;
- Manure shall not be applied within 10 feet of surface waters or within 35 feet of surface waters at points of runoff or applied in such a manner as to enter surface waters;
- Livestock will not be pastured nor manure applied within 50 feet of private wells without landowner permission;
- Animal mortalities burials must be at least 150 feet from surface waters;
- A buffer zone of perennial vegetation shall be maintained between annual cropland and surface waters of 10 feet and an additional 25 feet at points of runoff to surface waters;
- No tillage or manure spreading is to occur within the vegetative buffers;
- Wherever feasible, stabilization of farm field streambanks shall be constructed in accordance to USDA and the Secretaries of ANR and AAFM standards and specifications and shall recognize the need to reduce fluvial erosion hazards.

General and Individual Permits for Medium and Small Farms

The VAAFM has developed new rules for medium and small farms (AAFM, 2005b). The general permit is designed to ensure that all medium farms generating animal wastes comply with Vermont Water Quality Standards. Medium farms (200-699 mature dairy cows and equivalent weight of other types of livestock) are required to operate under coverage and terms of the general permit. Small farms may be required to operate

under the coverage and terms of an individual permit at the Secretary of AAFM's discretion. Requirements of the individual and general permit include proper design and storage capacity of waste storage structures, nutrient management plans, and milkinghouse and leachate runoff systems. BMPs will be required to assure that there are no direct discharges of agricultural wastes to waters of the state.

Conservation Practices In Place In The Watershed

The USDA Natural Resources Conservation Service (NRCS), AAFM, and Vermont's 14 NRCDS provide technical assistance to landowners in the planning and application of conservation practices or BMPs to address natural resource concerns. Best Management Practices (BMPs) are more restrictive than AAPs and are site specific practices to correct a problem on a specific farm. Of the 108 dairy farms currently in operation in the Lamoille River watershed, 94 have completed or are presently implementing 515 BMPs. Each year between two and eight farms are provided with cost-share funds for BMP implementation. Contributions of federal and State dollars combine to decrease the cost for the farmer/landowner to as little as 15 percent.

Conservation practices in the Lamoille Basin date back to the 1960s. Before 1996, prior to the State providing additional cost share funds, many improvements were implemented by farmers on their own or with only Federal assistance. Since 1996, over \$7,700,000 of federal, state, and landowner funds have been invested in non point source pollution control on farms in the Lamoille River basin. This investment reduced agriculture's contribution to phosphorus in the watershed by an estimated amount of 17,000 pounds per year. Additionally, these practices will reduce pathogen loading of waterways and assist farmers in better managing nutrients on their farms.

Some of the BMPs installed include: waste storage facilities, improved barnyards, roof runoff management systems, fencing animals out of waterways and providing them with stream

crossings and alternative watering systems. At the current rate of three waste management systems per year it will take approximately six years to complete implementation. In the Lamoille Basin, 135.8 acres of Conservation Reserve Enhancement Program (CREP) practices have been funded in 2002-2003, with the majority of these practices as filter strips (13), riparian buffers (6), and tree/shrub establishment (5).

Participation in these conservation programs is voluntary and not all producers are willing or financially able to invest in BMPs so there may never be full participation. Field practices are the most cost effective BMPs for their use. Storage systems contain wastes produced during the winter spreading ban or when animals are confined. Designated stacking sites for winter storage of manure, diligent investigation of nonpoint source complaints, and farmer education/outreach are the proven management strategies that AAFM and NRCD technical staff are pursuing.

It will take several years to treat all the remaining dairy farms at current funding levels for BMP installation. In that time, systems now in use will need upgrading as well. Water quality should gradually improve over time as more farms have systems in place, however. Levels of phosphorus and nitrogen in surface waters should decrease but will not be eliminated. Greater improvement over time should come now that nutrient management is a requirement of participation in Federal programs. Further near-term improvement could take place if the cost share funding programs are refocused on other types of farms and on annual practice implementation of all appropriate BMPs. The combination of BMPs such as structures, riparian treatments and buffer installation will have the greatest benefit. A “whole farm fix”, customized to each operator’s needs and land situation will better achieve the desired affect.

Equine Industry Participation

Horses lead in non-dairy agriculture animal numbers, farm numbers, and acreage. Horse

farms follow and establish quickly on farmland and pasture abandoned by dairy agriculture, particularly in the urban shadow. Horses are also kept in suburban or developed areas. Although some NRCDs have in the past presented workshops for horse owners, there is a need for watershed wide awareness of the impact of horses on water quality.

Small grazing ruminants

Sheep, llama and alpaca farms together are similar in number to horse farms, but are often smaller operations representing fewer animal units. Pasture maintenance, manure management and composting, and buffer issues are also concerns for this group of farmers.



Livestock exclusion from a Lamoille waterway

Forestry and Water Quality

Forestland covers 71% of the Lamoille River Basin. Uses of the forest include, but are not limited to, recreation, wildlife habitat and timber harvesting. Outside of areas in federal or in State ownership, forestland is owned by individuals with diverse goals allowing for a variation in management in terms of uses, strategies, timeframes, and intensity.

Larger tracts of state-owned forest land include the Mount Mansfield State Forest, Long Trail State Forest, Elmore State Park, Green River Reservoir State Park, Johnson State College’s Babcock Nature Preserve, and several wildlife management areas. The federally-owned Underhill

Firing Range encompasses 11,200 acres within the Lamoille and Winooski watersheds. Large privately owned woodland tracts include land managed by CVPS, Hardwick Electric, Morrisville Water and Light, and the Nature Conservancy. In 1997, the Nature Conservancy and the Vermont Land Trust established the Atlas Timberlands Partnership (ATP) to purchase land from the Atlas Timber Company and manage these forest holdings in the future for jobs and the environment. Over 26,700 acres of ATP land are located in north central Vermont including this basin.

Most erosion from logging operations occurs from runoff from logging roads, log landings, and stream crossings and not the logging itself. Erosion occurs when logging roads are laid out poorly on steep and wet areas and when streams are crossed at inappropriate locations. Erosion also occurs when logging occurs during wetter times of the year. Occasionally oil, gas, and hydraulic fluids leak from poorly maintained logging trucks and skidders.



Acceptable Management Practices (AMPs) For Maintaining Water Quality on Logging Jobs

In 1986, the Vermont Legislature passed amendments to Vermont's Water Quality Statutes

Title 10 V.S.A. Chapter 47: Water Pollution Control. The amendments declared that "it is the policy of the state to seek over the long-term to upgrade the quality of waters and to reduce existing risks to water quality." The revised state law requires permits for discharges of "any waste, substance or material into the waters of the state." However, individual permits are not required for any discharges that inadvertently result from logging operations if responsible management practices are followed to protect water quality.

"Acceptable Management Practices (AMP's) For Maintaining Water Quality on Logging Jobs in Vermont" was developed and adopted as rules to Vermont's water quality statutes and became effective on August 15, 1987. The AMP's are intended and designed to prevent any mud, petroleum products and woody debris (logging slash) from entering waters of the state. They are scientifically proven methods for loggers and landowners to follow for maintaining water quality and minimizing erosion.

The AMP's contain twenty-four suggested practices for loggers and landowners to follow during and immediately after logging. A violation occurs when there is a discharge and the AMP's are not in place. The AMP's have the force of law and violations can result in substantial penalties. Since adoption of the AMP's, the Department of Forests, Parks and Recreation (FP&R) has worked with representatives from the Vermont forest industry to support the Agency of Natural Resource (ANR) Enforcement Division in an effort to reduce the number and severity of discharges resulting from logging operations.

The AMP Program has been successful in keeping water quality violations from logging activity to a level that has been manageable given the number of logging operations. There is a high level of cooperation and voluntary compliance among loggers to bring their operations into compliance with Vermont's Water Quality Statutes. An MOU between the Department of Forests, Parks, and Recreation and the ANR Enforcement Division

has been an effective guide to refer to when investigating AMP cases. AMP cases referred to the ANR Enforcement Division remains low in comparison to the total number of water quality cases investigated. Vermont loggers attend AMP workshops hosted by the Logger Education to Advance Professionalism (LEAP) Program and supported by the Department of Forests, Parks & Recreation and the Vermont Forest Products Association.

AMP Activities in the Lamoille Watershed

The Department of Forests, Parks and Recreation tracks AMP case investigations state-wide. From 1999 to present, sixty-four AMP cases have been investigated by FPR field staff in the Lamoille River Basin. Thirty-three of those cases showed evidence of discharge and thirty-one did not. This means that over this approximate ten-year time span, there were an average of six cases investigated each year with half of those cases (3) showing evidence of discharge. To put this into state-wide perspective, from 1999 through 2007, the average number of cases investigated was forty-three and the average number of cases showing evidence of discharge was twenty. There is no apparent upward or downward trend in the number of cases investigated statewide. The number of statewide cases investigated range from a low of twenty-seven in 2005 to a high of fifty-eight in 1999. This is most likely due to a variety of weather and market conditions as well as social factors. Although there is not an apparent downward trend in overall numbers of cases investigated, the severity of water quality impairments associated with logging has diminished greatly since the AMP Program was established in 1987. This has been documented in the individual case reports and through observations made by the FPR District Forestry staff investigating these cases.

Lamoille Portable Skidder Bridge Program

Sediment is the major pollutant associated with logging. The AMPs allow loggers to use culverts, bridges, or poled fords to cross streams during logging. Brushed-in stream crossings are also

allowed but only under frozen winter conditions. These are temporary structures that must be removed once the logging operation has been completed. Previous studies, audits as well as AMP case reports from 1987 to present indicate that when sedimentation does occur it is usually associated with temporary stream crossings. Portable skidder bridges, when properly installed and used as temporary stream crossing structures, will reduce streambank and streambed disturbance as compared to other alternatives, thus minimizing the potential for sedimentation.

The Lamoille Portable Skidder Bridge Rental Program was initiated in 2007 and included the initial construction of three bridges. A fourth bridge was constructed during the summer of 2008. This program is a joint venture between the DEC Basin Planning Program, DFPR Forest Watershed Program and the Lamoille County NRCD. Vocational high school forestry students from the Green Mountain Technology and Career Center in Hardwick were actively involved with sawing materials for the bridges and provided manpower in assembling them. A “hands-on” bridge building workshop was held at the Green Mountain Technology and Career Center during the spring of 2007 and was attended by the forestry students as well as area loggers.

The bridges are available for rental at low costs for loggers and landowners working on privately owned lands within the watershed. Bridge materials were sawn, milled, and constructed locally which will enhance efforts to preserve the working landscape of the Lamoille watershed.



Portable Skidder Bridge construction workshop, Hardwick

Developed Lands and Water Quality

Rain does not fall on one roof alone.

-Proverb from Cameroon

Population and Housing Growth in Basin Towns

The rate of growth, and especially housing growth, has been very high in the towns of the Lamoille River watershed. The population grew 32 percent for the watershed between 1970 and 1980 and 20 percent between 1980 and 1990 (DEC, 2001a). The housing units increased 28 percent between 1980 and 1990. The towns with the highest population and housing unit increases were in the lower part of the watershed. Several upper Lamoille watershed towns also had high population increases when measured as a percentage of the earlier census.

The towns of Georgia, Fairfax and Fletcher saw the fastest rate of growth from 1980 and 1990 both in terms of population and housing units. All three towns have become bedroom communities for people traveling originally just to St. Albans and Burlington for work, but now also to Milton. Although almost all of the towns in the watershed have experienced high rates of growth from 1970 to 1990, other towns in the lower Lamoille watershed have seen especially high

growth include Cambridge, Essex, Jericho, Milton, and Underhill (DEC, 2001a).

Construction Site Erosion

Although construction activities are usually temporary, erosion from construction sites can cause significant amounts of sediment to enter adjacent waterbodies. Construction activities result in the disturbance of vegetation during the building of homes, roads, bridges, and businesses. Erosion from construction activities can cause loss of topsoil and phosphorus pollution and algae blooms in lakes and ponds. Excessive sedimentation in streams leads to stream instability as the channel beds build up or aggrade and to habitat loss due to embeddedness. Construction is more widespread in the lower sections (Chittenden and Franklin Counties) of the Lamoille watershed where development pressure is greatest.

“On a unit area basis, construction sites export sediment at 20 to 2,000 times the rate of other land uses. Suspended sediment can reduce plankton and aquatic plant growth, decrease native fish populations and species diversity, increase water treatment costs, and affect recreational activities. Deposited sediments can smother macroinvertebrate communities, destroy fish spawning and habitat areas, deplete dissolved oxygen, reduce storage and lower design life for reservoirs impoundments and ponds, increase channel aggradation (bed build up), increase streambank erosion, reduce channel conveyance capacity under bridges and culverts, and diminish recreational and aesthetic uses of waterways” (The Center for Watershed Protection, undated).



Construction site erosion and sedimentation

Construction site erosion is the first pulse in sediment load associated with urban development. A second and possibly greater sediment pulse occurs as stream banks begin to erode in response to the greater volume and frequency of stormwater flows generated by impervious cover. Typically, as a watershed is urbanized, construction activities generate more sediment when compared to natural conditions. The first response of the channel is to fill with sediment. As urbanization progresses and new construction sites are replaced with pavement and structures, sediment loads to streams diminish and flow discharges from the area increase above their original levels because of the increase in storm sewers and impervious surfaces. The channels increase their widths and depths with accelerated bank and bed erosion (Riley, 1998).

Erosion Prevention and Sediment Control

Erosion prevention should be the first priority at construction sites. Erosion prevention (seeding, erosion control matting, and vegetation) involves keeping soil in place and is far more effective than sediment control (silt fence). Construction

permits require erosion prevention and sediment control plans. These plans should reduce the erosion of disturbed land and prevent the discharge of sediment and other construction-related pollutants to waters of the State. Major components of the plan include: fitting the development plan to the site, preservation of natural drainageways, minimization of soil disturbance and vegetative cover removal, and water and runoff management.

Examples of erosion prevention techniques include:

- Preserving or establishing vegetative cover
- Erosion control blankets, or matting
- Mulch
- Minimizing disturbed areas and exposed soils
- Phasing of project disturbance and stabilization
- Clearly defining the limits of disturbance
- Preserving or enhancing riparian areas

Examples of sediment control include:

- Properly installed silt fence
- Stabilized construction entrances
- Sediment basins
- Street sweeping

State Regulations

A revised Construction General Permit (CGP) 3-9020 was issued in 2006, for discharges from construction activities involving one or more acres of land disturbance. The CGP establishes requirements, standards, prohibitions and management practices for discharges of storm water from construction activities. Permit requirements under CGP 3-9020 are based upon the risk of erosion and sediment discharge from the construction activities.

There are two categories of projects that may be authorized under the CGP 3-9020, Low Risk and Moderate Risk. Owners and operators of intended construction activities must submit a Notice of

Intent (NOI) that includes a determination of the appropriate risk category.

Applicants for projects that qualify as Moderate Risk must submit a completed NOI and an Erosion Prevention and Sediment Control Plan developed according to the newly issued manual, *The Vermont Standards and Specifications for Erosion Prevention and Sediment Control*. Applicants for projects that qualify as Low Risk must submit a completed NOI and certify that the practices in the Low Risk Site Handbook for Erosion Prevention and Sediment Control will be implemented.

In addition, approximately 700 projects a year across Vermont require Act 250 permits which ask the applicant to demonstrate that the project will not cause unreasonable soil erosion or reduce the capacity of the land to hold water so that a dangerous or unhealthy condition may result.

Outreach and Education

Current formal DEC Education and Outreach efforts related to EPSC are limited due to staffing reductions. The Stormwater Section focuses primarily on training individual designers in the context of project review, and developers and contractors during pre-construction and construction site visits.

DFPR's Urban and Community Forestry Program provides information and training for towns regarding vegetation options in urban settings. Information includes managing trees at construction sites, site assessment, and structural soils education. The Community Involvement coordinator and urban and community foresters provide assistance regionally. For the Lamoille watershed there are offices in Barre and Essex Junction.

Impervious Surfaces and Stormwater Management

Background

Development can seriously alter the local hydrologic cycle. The hydrology of a site changes during the initial clearing and grading that occurs during construction. Having lost its natural storage capacity, a cleared and graded site can no longer store rainfall and stormwater runoff. With this increase in runoff volume comes an increase in sediment load that can significantly affect the receiving water health (DEC, 2002c).

Rooftops, roads, parking lots, driveways and other impervious surfaces no longer allow rainfall to soak into the ground. Consequently, most rainfall is directly converted to stormwater runoff. The volume of stormwater runoff increases sharply with impervious cover. A one-acre parking lot can produce 16 times more stormwater runoff than a one-acre meadow each year (DEC, 2002c). Similarly, conversion of agricultural lands to impervious surfaces has a corresponding increase in surface runoff.

Impervious surfaces accumulate pollutants deposited from the atmosphere, leaked from vehicles, or windblown from adjacent areas. During storm events, these pollutants quickly wash off, and are rapidly delivered to downstream waters. Some pollutants associated with stormwater runoff include sediment, phosphorus, organic carbon, bacteria, hydrocarbons, heavy metals, pesticides, chlorides, trash and debris. These pollutants enter waterways from streambank erosion associated with urbanizing watersheds, lawn runoff, pet and wildlife waste, sanitary and combined sewer outfalls, wastewater, vehicle oil and grease, and road salt.

Stormwater runoff pollutants can adversely affect aquatic life, cause eutrophication (nutrient enrichment), lower levels of dissolved oxygen, and increase surface water temperatures. Stormwater has the potential to cause short and long-term source water contamination for public water supplies. Excessive amounts of phosphorus

can cause algae blooms that deplete oxygen levels of the water, impair aquatic biota populations, and diminish recreational opportunities such as fishing, swimming, and boating. Lake Champlain and several other water bodies across the State are currently impaired due to excess amounts of phosphorus, excess sediment loads, and/or toxic pollutants.

Collected snow poses a challenge to municipalities and businesses as roads, parking lots, bridges, and sidewalks are cleared. Collected snow is often contaminated with road salt, sand, litter, and automotive pollutants such as oil, gasoline, and antifreeze that can threaten public health and water quality.

Stream channel widening and channel instability as a result of increased flows from impervious surfaces cause culvert surcharging, property damage, and significant sediment loading or erosion to waters and lands of the state. Another problem associated with improving the condition of stormwater-impaired streams involves correcting years of neglected infrastructure maintenance. Stormwater infrastructure includes catch basins, storm drainage piping, road ditches, flood control basins, swales, ponds and sand filters.

Phosphorus and other pollutants in stormwater runoff are addressed to some extent for new developments in Vermont that must receive state stormwater discharge permits or state land use (Act 250) permits. Erosion control and stormwater management requirements are generally included as conditions in these permits, and these practices help limit new sources of sediment and phosphorus loading caused by land development. However, these permits are required primarily for large projects, and many small developments may have a significant cumulative effect on pollutant loading to Lake Champlain (DEC, 2002c).

Stormwater Discharge Permitting

DEC's Stormwater Management Program is a regulatory program charged with issuing permits

for stormwater discharges statewide, and restoring acceptable water quality in stormwater impaired watersheds. A 25 year backlog of expired stormwater has been essentially eliminated. State of the art standards for stormwater treatment systems are required for all newly permitted discharges.

DEC developed an enhanced stormwater management program in 2002, including the development of a new Stormwater Management Manual (DEC, 2001b). This manual emphasizes the importance of innovative site design, stormwater credits, and non-structural means of minimizing stormwater runoff from newly developed sites. In addition, a new Stormwater Management Rule in 2005 lowered the threshold for requiring a State Stormwater Discharge Permit to one acre of impervious surface. A total of 282 DEC Stormwater permits have been approved in the Lamoille basin.

DFPR, UVM's Sea Grant program, and VLCT are working collaboratively to assist communities plan for and divert stormwater runoff using vegetation and trees as interceptors.

Stormwater Impaired Waters

There are approximately seventeen streams in Vermont that are impaired primarily due to urban stormwater runoff, none of which are located in the Lamoille River Basin.

Federally mandated permits administered by the state

In 1987, Congress amended the Clean Water Act and directed EPA to develop a two-phased comprehensive national program for addressing stormwater discharges. EPA issued "Phase I" regulations in 1990 authorizing a NPDES permitting system for stormwater discharges from several categories of private industrial activities and municipal industrial activities serving populations of 100,000 or more. EPA issued "Phase II" regulations in 1999 that included the same categories of industrial activities but now includes smaller municipalities in urban census areas of at least 100,000 people and expanded

Lamoille River Basin Plan- Draft –February 2009

erosion control requirements to sites disturbing between 1 and 5 acres of land. As an EPA-delegated state under NPDES program, the DEC has the responsibility to administer the NPDES permit program.

There are three National Pollutant Discharge Elimination System general permits required by the Clean Water Act.

(1) Multi-Sector General Permit for Industrial Activities

The Multi-Sector General Permit (MSGP) was issued in 2006 and is a five-year permit that covers new and existing discharges of stormwater associated with certain types of industrial activity within the state of Vermont. The permit is required for private and municipal industries that have a stormwater discharge to either a separate storm sewer system or to receiving water. Typical municipal industries that will require coverage under the MSGP include wastewater treatment facilities with permitted flows greater than 1 mgd. Typical private industrial activities that will require coverage under the MSGP include auto salvage facilities, paper mills, food processing factories, manufacturing plants, and landfills. Industrial facilities that keep all of their materials and activities protected by a storm-resistant shelter in order to prevent exposure to precipitation may be eligible for a “No Exposure” conditional exclusion from permitting requirements. If a facility is not able to meet the criteria for “No Exposure” certification, then a Stormwater Pollution Plan (SWPPP) must be prepared that evaluates the potential threat of their operations to stormwater quality, develops management procedures to minimize polluting stormwater runoff, and periodically reports on the implementation of the procedures. Industrial sectors determined to have a higher potential to pollute will also be required to perform water quality monitoring of their impacts on stormwater.

(2) Phase II Municipal Separate Storm Sewer Systems

The Federal Clean Water Act requires that the U.S. Environmental Protection Agency address urban stormwater runoff in a phased approach

starting with the largest urban areas in the country based on population census data. In 2003, the U.S. Environmental Protection Agency, and the Vermont Agency of Natural Resources as the federally delegated authority issued the Phase 2 Municipal Separate Storm Sewer System (MS4) general permit.

This permit applies to the nine largest municipalities in the greater Burlington area and to other entities with separate storm sewer systems such as the University of Vermont and VTtrans. The permit requires the affected communities to address six minimum measures. The measures are:

- (1) Public Education and Outreach
- (2) Public Participation/Involvement,
- (3) Illicit Discharge Detection and Elimination,
- (4) Construction Site Runoff Control,
- (5) Post-Construction Runoff Control and,
- (6) Pollution Prevention/Good Housekeeping.

These communities have filed a notice of intent with ANR describing a stormwater management plan that meets the 6 measures. In the Lamoille River Watershed, the towns of Milton, Colchester, and Essex are subject to the MS4 general permit. All of the towns have developed stormwater management plans. VTtrans controlled sections of Routes 7 and 15 also fall under the MS4 designation. The MS4 plans include stormwater education and outreach, adopt-a-stream projects, storm drain stenciling, and waterway cleanups. These activities are compatible with the watershed plan goals of water quality improvement in urban areas.

(3) CGP-Erosion and Sediment Control (see above)

Local stormwater management opportunities

Wilkins Ravine, Morrisville

Wilkins Ravine is a small ephemeral stream located in Morrisville (figure 5). In the late 19th century, the stream ravine near Lake Lamoille was

Lamoille River Basin Plan- Draft –February 2009

dammed and diverted into a stone box culvert as a result of construction of the Lamoille Valley Railroad. As commercial and industrial development has occurred in the north end of Morrisville, stormwater runoff to the ravine has increased dramatically. Over the years the ravine has been used for dumping and has become severely eroded from stormwater runoff. Trash, sediment and, during rainstorms, large volumes of water became trapped behind the stone box culvert before passing through it and into Lake Lamoille. In addition, the unregulated discharge of stormwater has caused considerable property damage including undermining of a parking lot and the exposure of a sewer line. Approximately 76 cubic yards of sediment per year were being discharged into Lake Lamoille and the Lamoille River from the ravine (The Transcript, 2005). In 1998, a VTrans culvert upgrade on Route 100 greatly accelerated the movement of sediment into the Lamoille River. In June, 2002, the 80 feet high Lamoille Valley Railroad embankment began to fail.

The town, working in cooperation with DEC, has developed a comprehensive restoration plan for the ravine. The plan has 3 basic elements:

- (1) Stabilize and clean up the Wilkins Ravine area.
- (2) Install stormwater quality treatment controls and, where possible, quantity treatment controls in the developed area drainage network upstream of the Ravine.
- (3) Reduce the overall volume of stormwater discharging to the Ravine by retaining water on-site and infiltrating to groundwater as much clean runoff as possible.

The plan also has 12 identified tasks. As of February 2008, 11 of the tasks were completed or funded. Tasks include construction of three stormwater swirl separators in the watershed (to remove trash, oil and sediment), stormwater detention and infiltration structures, improved drainage and landscaping, and cleanup and erosion control in the Wilkins Ravine. The town

has adopted a zoning regulation to require basic stormwater controls such as the infiltration of roof tops for all new development that is not required to obtain a state stormwater permit. The plan is the result of work done by the Town of Morristown, DEC, VTrans, USDA-NRCS, Forcier, Aldrich & Associates, and many local property owners.

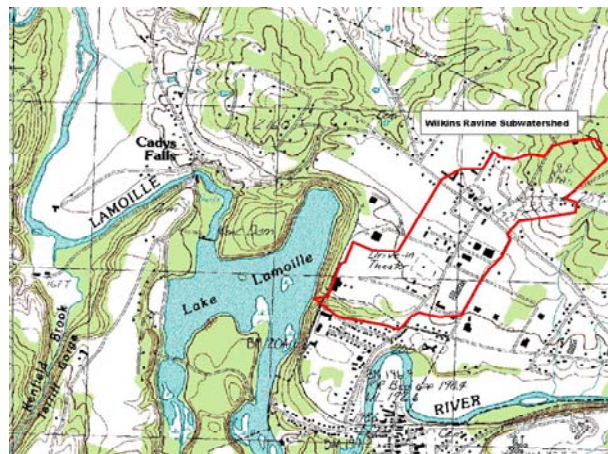


Figure 5- Wilkins Ravine, Morrisville

Morrisville Village

As a result of mapping work done by the Vermont Youth Conservation Corp (VYCC) a comprehensive map of the stormwater outfalls and drainage for the Village of Morrisville as well as the growth areas in the north end outside of the Village has been compiled (The Transcript, 2005). This work will allow for a future assessment of these outfalls for illicit discharges of wastewater and sediment and phosphorus loading to the Lamoille River. The survey also collected data on the maintenance and overall condition of the street catchbasins. All basin towns with substantial drainage infrastructure should compile similar maps and conduct these sanitary surveys.

Morrisville, Johnson, Hardwick are currently considering a collaborative partnership to purchase a catchbasin vacuum truck for cleaning storm and sewer lines. Maintenance of the basins will significantly reduce sediment and trash pollution from the drainage system to the Lamoille River on an annual basis.

Snow Disposal Runoff, Morristown

While finding a location to dispose of collected snow poses a challenge to municipalities and businesses as roads, parking lots, bridges, and sidewalks are cleared, collected snow is often contaminated with road salt, sand, litter, and automotive pollutants such as oil, gasoline, and antifreeze that can threaten public health and water quality. Simple modifications to snow removal practices go a long way toward addressing these issues. The Town of Morristown has recently identified an alternative location for the town's snow disposal in an effort to reduce this nonpoint source pollution discharge. The present site snow disposal site is on the banks of the Lamoille River in the Oxbow Park area. Relocation of the snow disposal site away from the waterway could serve as a model to other watershed towns. DEC, NRCS, and the Town of Morristown are developing a comprehensive plan for Oxbow Park that includes the establishment of a woody riparian buffer and streambank stabilization.

Transportation Infrastructure

Background

Transportation infrastructure includes roadways and embankments, road drainages, rail systems, driveways, bridges, recreation paths, airport runways, and culverts. In Vermont, the transportation infrastructure is owned and maintained by the Vermont Agency of Transportation (VTrans), municipalities, and private citizens. Municipalities maintain the majority of gravel road miles in Vermont. Vermont towns average about 46 road miles each. Vermont's town roads effectively become part of the stream network during a storm or snowmelt events due to the proximity of roads to waterways. Roadside ditches often discharge directly into streams, lakes, or wetlands.

Transportation infrastructure that is improperly designed or installed, or that has become structurally unsound or functionally deficient over time, can lead to catastrophic failures during flood

events. During the flood events of 1995, 1997, and 1998, numerous culverts and bridges failed catastrophically in the watershed. Enormous quantities of sediment entered the watershed in several towns including Hyde Park, Johnson, Wolcott, Craftsbury, Cambridge, Elmore, Stannard, and Eden. Affected streams include the Wild Branch, Rodman Brook, Foot Brook, Elmore Branch, Bunker Brook, Kate Brook, Stannard Brook, and Gihon River. Most of the damage occurred on private and municipality-owned transportation infrastructure.

Over 60 percent of infrastructure damage from the Vermont 1990s flood events was avoidable (DEC, 1999). Millions of federal, state, and private dollars have been spent on remediation of flood damage to transportation. During high water events, flood waters out-flank structures and wash out road embankments. Undersized culverts and bridge spans cause debris jam blockages and stream sediment transport discontinuity. High steep bank mass failures located along unstable stream reaches can contribute excessive amounts of sediment to waterways and, when located in close proximity to bridges and culverts, can also create debris jams responsible for catastrophic structure failures. The development of large point (gravel) bars upstream of stream crossings are indicators of an undersized structure and sediment transport discontinuity.

The state-owned transportation infrastructure has generally fared better against catastrophic failure than municipal and privately owned infrastructure due to higher flow designs, better construction and maintenance, and location in the lower portions of the watershed where valleys are wider and slopes are less steep. Private and municipal transportation infrastructure is more typically located in the upper portions of a watershed where valleys are narrower and slopes are steeper. These roads historically used as farm and logging roads, have been widened to accommodate residential growth in the higher elevations. With new homes also come additional driveway, culvert, and bridge installation. Culverts that once

were sufficient to accommodate historical land uses are undersized with development and increased impervious surfaces. As roads have been widened, they encroach upon the river's active floodplain and the river's energy is no longer dissipated on the floodplain but becomes concentrated within the channel. This causes channel instability and erosion.

Transportation-related Remediation and Outreach Efforts

The very solutions that will protect a town's investments in their roads will also prevent sediment and phosphorus pollution of surface water. Good transportation infrastructure maintenance can decrease road problems and untimely repairs, and save money.

Vermont Local Roads Program

The Vermont Local Roads Program emphasizes a 3-step process for addressing municipal transportation infrastructure for each municipality. This process includes: transportation inventory, a capital budget, and implementation of best management practices. Examples of best management practices include: road crowning, grassed and rock lined road ditches, culvert headwalls and outlet energy dissipaters, and road embankment stabilization. The "*Vermont Better Backroads Manual*" (Windham Regional Commission 1995) describes the maintenance practices that will achieve this result. The Vermont Local Roads Program has been providing technical training, information, and on-site assistance to town road managers for many years. A series of workshops for road managers and crews has been offered around the state since 1995. Many of the needed maintenance activities will prevent or reduce erosion and thus reduce water pollution and degradation of aquatic habitat.

The Capital Budget Planning Process includes the following steps:

- Inventory municipal road systems
- Assess type and cost of improvements necessary
- Determine cost effectiveness
- Prioritize sites
- Develop a 5-10 year capital inventory budget
- Update the plan annually

The 4 Principles of Better Backroads include:

1. Get water off the roads as soon as possible.
2. Stabilize and revegetate disturbed areas.
3. Divert water into vegetated areas.
4. Good maintenance saves money



A completed Better Backroads project, Walden

ANR's Bridge and Culvert Survey Protocols

ANR's bridge and culvert survey protocols (ANR, 2007 Appendix A) and database can be used for watershed-wide assessments of stream crossing structures. Survey results can be used to "red-flag" those structures that are potential barriers to fish and wildlife movement and/or flood or erosion hazards. Bridge and culvert surveys have recently been completed in the Browns River watershed and mid and upper Lamoille watershed.

ANR's Culvert Screening Tool and Stream Crossing Design Guidelines- The Vermont Culvert Compatibility Screening Tool (ANR 2007) is a specific querying tool to be used in conjunction with recently completed bridge and culvert surveys. The screening tool has been developed based upon rating five variables including percent bankfull width, sediment and debris continuity, slope, approach angle, and bank erosion. This screening tool should be helpful in assisting natural resource planners and municipalities in prioritizing stream crossing projects.

The Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont (Malone and MacBroome, 2007) provides technical guidance in the design and construction of stream and road crossings where the passage of aquatic organisms has been identified as a concern.

Vermont Interagency Bridge and Culvert Team
The Vermont Interagency Bridge and Culvert Team was recently created to develop consistency in the methods and procedures used to collect and manage highway infrastructure data inventories. An integrated training and software package is being developed that will assist municipalities in managing their road infrastructure.

VTrans Transportation Infrastructure Maintenance and Improvement
The Vermont Agency of Transportation (VTrans) maintains state owned bridges and roadways as well as railroads, airports and public transportation facilities. VTrans developed a culvert and ditching procedure in 1997, which was updated in 2002. This procedure promotes best management practices to maintain infrastructure while addressing water quality issues. The erosion control standards are being updated currently and there is an erosion control team which monitors construction sites for proper erosion control and compliance of permit conditions.

Regional Planning Commission (RPC) Bridge and Culvert Inventories

Over the years, Regional Planning Commissions (RPCs) have assisted towns with inventorying and planning for maintenance and replacement of culverts and small structures for which the town is responsible. Although many towns have had a difficult time implementing formal infrastructure management systems due to lack of staff and/or resources and funds, it will be increasingly important to do so.

Federal Emergency Management Agency (FEMA) Project Impact

Project Impact is FEMA's initiative to make communities as flood proof as possible. Lamoille County's Project Impact program involved working with several municipalities to inventory roads, bridges, and culverts, assess stream stability, identify threats to infrastructure, stabilize severely eroding stream channels, and establish riparian buffers. This project has also begun fluvial erosion hazard mapping to assist municipalities to better protect existing infrastructure and plan for future structure locations. Lamoille County was the first county in the state to become a FEMA Project Impact area.

Lamoille Rail System

The Lamoille Rail Corridor extends 93 miles from St. Johnsbury to St. Albans and runs parallel to the Lamoille River for the majority of its length. The rail division at VTrans submitted a request for discontinuance of service and to railbank the length of the corridor to the Federal Surface Transportation Board. Railbanking describes the process of transitioning the current corridor from a rail to a recreation trail while allowing for the possibility of conversion back to rail if necessary. A Lamoille Rail Corridor Consortium has been formed to oversee any changes in the corridor for rail and recreation purposes. Consortium representatives include three regional planning commissions, VAST, VTrans, and other recreation and rail interests. The Vermont General Assembly passed Section 17 of Act 56 in June of 2003 directing the State owned

railroad corridor be converted to a multi-use recreational path and trail that shall be leased to and managed by the Vermont Association of Snow Travelers, Inc. (VAST). Currently VAST is working under a Management Plan with Vermont Agency of Transportation (VTrans) to make this railroad to recreation trail conversion. The Friends of the Lamoille Valley Rail Trail, Inc. (FriendsLVRT) was chartered and incorporated in the early summer of 2006 after a Vermont Bicycle and Pedestrian Coalition meeting that brought together people interested in supporting the development of the Lamoille Valley Rail Trail (LVRT).

Scientific assessments (Ryan, 2000 and USDA, 2001) had identified the rail corridor as contributing to the instability of the Lamoille River. The rail embankment is a floodplain encroachment at several locations within the Lamoille Valley, most notably in the towns of Hardwick and Wolcott.

DEC in conjunction with its partners VTrans, NRCS, and LCNRCD have removed over 8,600 linear feet of rail bed fill since 2006 to reconnect the Lamoille River to its historic flood plain. Riparian shrub plantings in conjunction with this project include 34,600 linear feet of willow installation along the rail corridor adjacent to the Lamoille River.

VAST, DEC, VTrans, LCPC, NWRPC and other partners implemented a Lamoille Valley Railroad Rail Trail Flood Plain Encroachment Mitigation project (photo below). This project has been successful in addressing several water quality and aquatic habitat improvement objectives including:

- To mitigate floodplain encroachments, where possible, along the Lamoille River mainstem and Black Creek caused by the Lamoille Valley Railroad embankments.
- To reduce the potential of catastrophic maintenance costs due to flood and erosion.
- To provide flood and erosion mitigation benefits to private property owners and

public infrastructure within the Lamoille River and Black Creek watersheds.

- To provide for the greatest hydrologic attenuation, reduction of erosion by creating a better balance between stream power and channel boundary conditions, and maximizing sediment capture and nutrient uptake



Lamoille Valley Rail flood plain encroachment removal, Wolcott

CHAPTER 4. WATER QUALITY PROTECTION AND RESTORATION OPPORTUNITIES

Chapter 4 includes all the actions that will help achieve the goals of this plan prepared by DEC, its watershed partners, and the Lamoille Watershed Council except for those actions directly related to impaired waters, which are presented in Chapter 5. These actions are not necessarily listed or enumerated in any order of importance but higher priority actions will be labeled **H**.

Actions to Protect and Enhance Wetlands

The wetlands in the Lamoille River watershed are essential to the health and quality of the watershed. Protecting wetlands will ensure that there are fish, wildlife, recreation opportunities, and biological diversity in the Lamoille River and its tributaries.

Goal:

Protect the functions and values of existing wetlands and selectively restore human-altered wetlands.

1. Action- Protect wetlands at the municipal level through compiling wetland inventories, strengthening local zoning and stormwater regulations, and increasing outreach. –H

Encourage watershed towns to map all the wetlands in the municipality and update zoning to protect these areas and provide adequate setbacks and buffer areas. Towns can also help protect wetlands by checking the wetland maps found in each town office when development projects arise. Encourage towns to use wetland areas for education, low-impact recreation, and natural areas for residents.

Lead Partner(s): Watershed RPCs, municipalities and DEC

Potential Funding Sources: DEC staff time, Clean and Clear Initiative, 604(b) grants

Timeline: 2009-2013/Initiated

2. Action- Identify and restore idle (fallow) prior converted agricultural wetlands. –H

Increased farm herd size and milk production numbers has led to the idling of marginal hay and pastureland that may have been previously converted from natural wetlands. Prior converted wetlands that have become fallow should be identified and pursued for wetland creation and protection programs. Impaired sub-watersheds, areas under pressure for residential development, and formerly high value wetlands should be considered high priorities for restoration.

Lead Partner(s): DEC, NRCS, VAAFM, watershed NRCDs, USFWS, USDA FSA, farmers, and RPCs

Potential Funding Sources: WHIP, WRP, Clean and Clear Initiative, Partners for Fish and Wildlife Program

Timeline: 2009/Initiated

Actions to Protect and Enhance Lakes and Ponds

Comprehensive lake protection or restoration depends on managing whole watersheds and diverse land uses, and influencing individual behaviors. Some comprehensive lake protection and management strategies are discussed below, followed by actions related to specific lake water quality issues.

Goal:

Protect natural lake shorelands from unplanned development and encourage better management of highly developed lake shorelands. Minimize adverse land use activities in lake watersheds, within the lake shoreland, and within lakes and ponds themselves.

3. Action- Map wilderness, wilderness-like and undeveloped lake and pond shorelands.-H

Comprehensive mapping of undeveloped shorelands will be essential in development of protection actions of these areas.

Lead Partner(s): DEC Lake Assessment Program, VFWD, USFWS, and VFPR

Potential Funding Sources: DEC

Timeline: 2009/Initiated

Lamoille River Basin Plan- Draft –February 2009

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

Lead Partner(s): DEC, municipalities, VLCT Municipal Assistance Center, watershed RPCs, and lake associations
Potential Funding Sources: 604(b) grants and DEC and VLCT staff and volunteer time
Timeline: 2009-2013

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

Lead Partner(s): DEC, lake associations, residents, and municipalities
Potential Funding Sources: DEC staff time, lake associations, Vermont Watershed Grants, and Clean Water Act (CWA) Section 319 grants
Timeline: 2009-2013

6. Action- Promote regular maintenance of lakeshore camp septic tanks. Encourage lake homeowners to pump out septic systems on a regular basis. Inadequate and failing lakeshore septic systems can contribute to discharges of phosphorus and E. coli to adjacent waterways.

Lead Partner(s): lake associations and lakeshore homeowners
Potential Funding Sources: Individual camp owners and lake associations
Timeline: 2009-2013

7. Action- Conduct camp/landowner education, shoreland property management workshops, outreach to new lake and pond landowners

Lead Partner(s): DEC, shoreland property owners, lake associations, Federation of Vermont Lakes and Ponds
Potential Funding Sources: Vermont Watershed Grants, New England Grassroots Environmental Fund
Timeline: 2009-2013

8. Action- Expand Lamoille County NRCD's Trees for Streams Program to include lake and pond riparian areas.-H

Lead Partner(s): Lamoille NRCD and lakeshore residents
Potential Funding Sources: Vermont Watershed Grants, LCBP
Timeline: 2009/Initiated

9. Action- Initiate the Lay Monitoring Program at lakes where the program has been idle. Lake Elmore, East Long Pond, Wapanaki, and Arrowhead Mountain Lake should be considered for the LMP. Other watershed lakes and ponds could also be added depending on local interest.

Lead Partners: DEC, lake organizations and/or lake residents
Potential Funding Sources: NA
Timeline: 2009-2013

10. Action- Sample mercury levels on basin lakes predicted to have high mercury levels (Table 7)

Lead Partner(s): DEC Lakes Section and VFWD
Potential Funding Sources: DEC and VFWD staff time
Timeline: 2009

11. Action- Increase participation of watershed lake associations in the Federation of Vermont Lakes and Ponds. Joining the Federation is a good way for lake associations and residents to keep abreast of lake protection and management activities statewide. An annual

meeting in July provides both speakers on relevant lake topics, but also a chance to network and learn about other groups' experiences and successes.

Lead Partner(s): DEC and watershed lake organizations

Potential Funding Sources: no cost

Timeline: 2009-2013

Goal:

Control the spread of aquatic invasive exotics in both infested and nearby lakes and ponds through inventories, outreach, and appropriate control measures.

12. Action- Conduct outreach efforts to lake residents and day users of lakes about the threats invasive exotic species pose and applicable state laws prohibiting their transport. Use public service announcements, handouts, posters, and workshops to reach lake users. Ensure adequate information is available at public boat accesses. Develop boater education at public accesses by establishing boat access greeter programs where appropriate and hand out literature and conduct voluntary boat inspections.

Lead Partner(s): Lake associations/residents with technical and materials assistance from DEC

Potential Funding Sources: DEC and State Parks staff time, volunteer time, LCBP staff time, Aquatic Nuisance Control Grants-in-Aid (VTDEC)

Timeline: 2009-2013

13. Action- Establish Vermont Invasive Patroller Programs.-H Establish *Vermont Invasive Patrollers Programs* on lakes without known infestations. High priority for lakes with public access, downstream from known population, or located within a 10 mile radius of an infestation. Lakes and ponds with documented populations of Eurasian Water Milfoil could also benefit by monitoring any sudden expansion of existing populations and to monitor other species not already established such as zebra mussels, hydrilla, and water chestnut.

Lead Partner(s): DEC, and lake volunteers

Potential Funding Sources: DEC staff time, volunteer time, Aquatic Nuisance Control Grants-in-Aid (DEC)

Timeline: 2009-2013/Initiated

Actions to Enhance and Protect River Corridors

Watershed and stream geomorphic assessment results can guide and prioritize stream corridor protection, stream stability restoration projects, pre-disaster mitigation efforts, erosion hazard mapping, and enhance aquatic and riparian habitats for fish and wildlife.

Goal:

Use stream geomorphic and fish habitat assessments (ANR, 2007) in a proactive manner to direct and prioritize stream corridor protection, stream stability restoration projects, pre-disaster mitigation efforts, fluvial erosion hazard mapping, and enhancement of aquatic and riparian habitats for fish and wildlife

14. Action- Complete ANR's Phase 1 geomorphic assessments of major Lamoille Basin sub-watersheds.-H The Phase 1 Remote Sensing Assessment results provide baseline scientific data needed to assist communities in various river corridor protection and management goals.

Lead Partner(s): DEC, RPCs, watershed volunteers, and consultants

Potential Funding Sources: DEC River Corridor Grants, LCBP, CWA Section 319 grants

Timeline: 2009/Initiated

15. Action- Initiate or complete Phase 2 geomorphic assessments at selective sub-watersheds.-H Sub-watersheds that are impaired, reaches vulnerable to fluvial and erosion flooding hazards, and waterways exhibiting reference reach qualities should be first priorities for this assessment.

Lead Partner(s): RPCs, consultants, NRCs, and DEC

Potential Funding Sources: DEC River Corridor Plans, LCBP, and Vermont Watershed grants

Timeline: 2009-2013/Initiated

16. Action- Assist communities with river corridor management plans and fluvial erosion hazard plans and mapping in pre-disaster mitigation efforts.-H Proactive river corridor planning can prevent catastrophic flooding damage to infrastructure and the degradation of water quality and aquatic habitat. Use the DEC River Corridor Management Alternatives Analysis to determine if and what type of restoration technique approach to use for reaches undergoing adjustment process (DEC, 2002*). Fluvial Erosion Hazard Mapping is currently underway in Craftsbury, Wolcott, and Underhill.

Lead Partner(s): DEC, municipalities, and RPCs

Potential Funding Sources: DEC River Corridor Funds and PDM funds

Timeline: 2009-2013/Initiated

17. Action- Increase the establishment and enhancement of woody riparian corridors along watershed streams.-H Proactively establish and enhance riparian corridors using riparian corridor inventories and geomorphic assessment results. Sections of corridor that connect existing high quality riparian corridors should be given priority to ensure long-term stream stability, especially where such riparian areas also offer known or potential wildlife travel corridors and/or protect important aquatic habitats.

Lead Partner(s): DEC, RPCs, Lamoille River Anglers Association (LRAA) and municipalities

Potential Funding Sources: DEC River Corridor Grants, WHIP, CREP, and Partners for Fish and Wildlife Program

Timeline: 2009-2013/Initiated

18. Action- Continue the pilot effort of the expansion of the Trees for Streams program to other parts of the watershed through NRCs.-H Only the Lamoille NRC has such a program. Encourage NRCs to purchase locally grown stock material for riparian corridor projects whenever possible. Establish local volunteer planting crews at the subwatershed level.

Lead Partner(s): watershed NRCs

Potential Funding Sources: LCBP, CWA Section 319 grants, Vermont Watershed Grant

Timeline: 2009-2013/Initiated

Actions to Improve Flow-regulated Waters

The principal alteration to lakes and ponds in the Lamoille watershed is drawdown of water levels that affects aquatic life. In-stream impoundments can degrade water quality and fisheries habitat. In many cases, dams are abandoned or not maintained by their owners.

Goal:

Identify and restore stream reaches where dams impede fish movement, are responsible for decreased stream transport capacity, and/or degrade water quality.

19. Action- Selectively restore dam-altered reaches of streams within the watershed.

Continue on-going coordination of identifying dams for removal, partial breaching, and/or improved fish passage. Provide technical assistance and landowner outreach regarding dam ownership liability; identify funding opportunities; and coordinate dam removal projects, if necessary.

Lead Partner(s): DEC, Vermont Dam Task Force, VFWD, American Rivers, and consultants

Potential Funding Sources: Partners for Fish and Wildlife Program, WHIP, NOAA and American Rivers-Community-Based Restoration Program Partnership, and DEC River Corridor Grants

Timeline: 2009-2013

Lamoille River Basin Plan- Draft -February 2009

20. Action- Hardwick Electric should consider alternatives including the removal of Jackson Dam and the restoration of the affected section of the Lamoille River and Alder Brook or other alternative measures that will result in ice jam flood protection and to comply with Vermont Water Quality Standards.

Lead Partner(s): DEC, VFWD, Town of Hardwick, and Hardwick Electric Department

Potential Funding Sources: Partners for Fish and Wildlife Program, WHIP, Fish America grant

Timeline: 2009-2013

Actions to Address the Loss of the Working Landscape

Conversion of working farm and forestland to fragmented smaller parcels can result in increased impervious surface areas, stormwater runoff, streambank and bed erosion, altered hydrology, and wildlife habitat fragmentation.

Goal:

Protect existing productive forest and farmland from unplanned development that can adversely impact wildlife and aquatic habitat, water quality, and stream equilibrium.

21. Action- Hold Transferring the Farm/Forest and/or Estate Planning Workshops throughout the watershed.-H

Estate planning information will provide current farm and forest landowners with the information necessary to encourage a smooth transition of their lands to their heirs or other persons interested in maintaining an open landscape.

Lead Partner(s): UVM Extension Service, Regional Planning Commissions, County Foresters, Vermont Land Trust, farm and forest landowners especially those approaching retirement age, and VAAFM

Potential Funding Sources: UVM Extension

Timeline: 2009/Initiated

22. Action- Develop a Lamoille Valley Farm and Forest Directory and website that exhibits local farmers and secondary wood product producers and mills, farmers markets, and watershed agricultural and forest-related events.-H The web site would link to the agriculture and forest products programs to promote awareness and increase local participation.

Lead Partner(s): DEC, Economic Development Councils, local Chambers of Commerce, Vermont Fresh Network, Vermont Development Council, VAAFM, Vermont Forest Products Council, NOFA, primary and secondary producers of farm and forest products, retail markets, and NRCDs.

Potential Funding Sources: SARE grant and Sustainable Futures Fund

Timeline: 2009/Initiated

23. Action- Hold a Lamoille Valley Farm and Forest Roundtable-H The goal of the forum will be to investigate how various existing statewide programs can be most effectively applied within the watershed. Some statewide organizations and programs that can enhance efforts to protect the working landscape include: the Vermont Fresh Network, the VAAFM Buy Local program, Vermont Land Link, the Farmer-School program, NOFA FEED program, Community Supported Agriculture (CSAs) and the Vermont Land Trust.

Lead Partner(s): DEC, VDFPR, Vermont Land Trust, Economic Development Councils, Vermont Fresh Network, Vermont Forest Products Council, Woodnet, primary and secondary producers of farm and forest products, retail markets, and VAAFM.

Potential Funding Sources: SARE grant, DEC staff time

Timeline: 2009/Initiated

24. Action- Protect agricultural diversity by matching prime farmland conservation efforts with smart growth development. Assist municipalities in strengthening town plan language and zoning to protect prime and statewide significant agricultural soils from development.

Lead Partner(s): VAAFM, NRCS, Regional Planning Commissions, Vermont Forum on Sprawl, Vermont Land Trust, Vermont League of Cities and Towns (VLCT), Town Planning & Conservation Commissions in the lower Lamoille watershed.

Potential Funding Sources: VAAFM Farmland Preservation Fund, Land Trusts, and local partners

Timeline: 2009-2013

Actions for Agricultural NPS Reduction

Agricultural non point source pollution can result in nutrient and sediment discharges to adjacent waterways negatively affecting water quality, fisheries, and aquatic habitat.

Goal:

Selectively apply best management practices and increase outreach programs to reduce non point source pollution from agricultural sources.

25. Action– Hold equine industry workshops to increase participation in non point source pollution prevention.-H These workshops are especially needed in Lamoille and Chittenden Counties.

Lead Partner(s): NRCDs, NRCS, VAAFM, UVM Extension, horse owners, and equine industry-related businesses.

Potential Funding Sources: EQIP, Partners for Fish and Wildlife, and local partners

Timeline: 2009-2013/Initiated

26. Action – Hold sheep and goat farmer workshops to increase participation in non point source pollution prevention. Small ruminants management workshops are especially needed in Lamoille and Chittenden Counties.

Lead Partner(s): NRCDs, NRCS, VAAFM, UVM Extension, and sheep and goat farmers

Potential Funding Sources: EQIP, Partners for Fish and Wildlife, and local partners

Timeline: 2009-2013

27. Action- Develop a compost materials exchange and hauler directory to increase watershed participation in composting projects.-H Composting can be a tool used to improve water quality by reducing soil erosion, pathogens, soil compaction, and nutrient volume while increasing soil biological activity and organic matter. Beef, sheep, goat, horse, vegetable, and organic and grass-based dairy operations are most conducive to composting operations.

Lead Partner(s)- Composting Association of Vermont, Highfields Institute, NRCS, and VAAFM.

Potential Funding Sources- CWA Section 319 grants

Timeline- 2009/Initiated

28. Action- Develop a cover crop and crop rotation demonstration project for farmland planted to continuous corn within flood plains. Cropland susceptible to annual flood inundation and adjacent to waterways adversely affected by excessive nutrients and sediment should be priority areas for this project.

Lead Partner(s): NRCS, VAAFM, NRCDs, and UVM Extension

Potential Funding Sources: CWA Section 319 grants, SARE

Timeline: 2009-2013

29. Action- Reduce erosion and nutrient runoff from cropland and farmsteads. Erosion reduction techniques include filter strips, riparian buffers, cover crops, conversion to grass based operations, and addressing farm buildings runoff. Livestock exclusion from waterways is a high priority practice for this basin. Cropland susceptible to annual flood inundation and adjacent to waterways adversely impacted by excessive nutrients and sediment should be priority areas for this project.

Lead Partner(s): NRCS, VAAFM, farmers, NRCDS, and UVM Extension
Potential Funding Sources: EQIP, CREP, Partners for Fish and Wildlife Program and CWA Section 319 grants
Timeline: 2009-2013

Actions to Address Logging Practices and Water Quality

Conservation easements, long term management plans, and timber sale contracts are some tools that can be used to encourage the sustainable management of woodlands.

Goal:
Increase sustainable management of watershed woodlands with a special emphasis on water resource protection.

30. Action- Increase the amount of privately owned forestland under active stewardship management. Encourage landowners to develop long term management plans for woodlands with the assistance and under the direction of a forester. The management plan should include measures for the protection of forest water quality and erosion control.

Lead Partner(s): County foresters, private consulting foresters, non-profit forestry organizations (Vermont Coverts-Woodlands for Wildlife, Vermont Woodlands Association, and Northern Woodlands), VLT, and woodland owners (especially new and out-of-state owners).

Potential Funding Sources: NA
Timeline: 2009-2013

31. Action-Provide educational materials to forest landowners that promote responsible management of forest resources.

Lead Partner(s): County foresters and NRCDS

Potential Funding Source: DFPR staff time

Timeline: 2009-2013

32. Action- Hold workshops to encourage forestland owners to develop written contracts for logging operations and follow low-impact harvesting practices. Timber sale contracts should incorporate provisions that address protection of water quality and erosion control as outlined in AMP's. Focus efforts by encouraging winter logging on sensitive sites prone to erosion (steep slopes and wet soils), properly selecting stream crossing locations and proper design and location of trucks roads and skid trails.

Lead Partner(s): County foresters, UVM Extension Service, private consulting foresters, LEAP, and woodland owners.

Potential Funding Sources: NA

Timeline: 2009-2013

33. Action- Promote the use of Portable Skidder Bridges at stream crossings during timber harvesting operations.-H Promote the Lamoille Portable Skidder Bridge Rental Program to loggers and private forestry consultants.

Lead Partner(s): County foresters, private forestry consultants, loggers, NRCDS, RCD, and forest landowners
Potential Funding Sources: Clean and Clear ecosystem grant and DFPR staff time

Timeline: 2009-2013/Initiate

Actions to Address Construction Site Erosion

Although construction activities are usually temporary, erosion from construction sites can cause significant amounts of sediment to enter adjacent waterbodies.

Goal:

Increase construction contractor, developer, municipality and landowner awareness regarding construction site best management practices.

34. Action- Continue to hold erosion control workshops for area contractors/developers-H

Lead Partner(s): DEC and AGC

Potential Funding Sources: NA

Timeline: 2009-2013/Initiated

35. Action- Create an outreach program for landowners, contractors, and municipalities that are about to embark on construction projects covering erosion and sediment control site plans, necessary permits, Low Impact Development (LID) practices, and technical assistance that may be available for such projects.

Lead Partner(s): DEC, AGC, developers, contractors, and landowners and municipal officials

Potential Funding Sources: NA

Timeline: 2009-2013

36. Action- Assist municipalities with comprehensive town plans and zoning regulations that address erosion prevention and sediment control from construction sites under 1 acre in size.

Lead Partner(s): DEC, watershed RPCs, VLCT, and municipal officials

Potential Funding Sources: 604(b) grants, DFPR Urban and Community Forestry Program, DEC and VLCT staff time

Timeline: 2009-2013

Actions to Improve Water Quality from Stormwater

Increased flows associated with development following land clearing and creation of impervious surfaces can be responsible for increased bank erosion and stream instability. Runoff from impervious surfaces can convey various pollutants to adjacent waterways impairing aquatic habitat and organisms and posing risks to health

Goal:

Assist municipalities in implementing stormwater management practice implementation and outreach efforts.

37. Action- Implement Morristown's comprehensive plan to improve water quality within Wilkins Ravine.-H Full implementation of the Wilkins Ravine restoration project will address several sources of stormwater runoff and sedimentation within Morristown.

Lead Partner(s): Town of Morristown, DEC, VTrans, NRCS, the Lamoille County Solid Waste District, and Morristown north end business district and citizens

Potential Funding Sources: VTrans Enhancement grant, CWA Section 319 grants, Vermont Watershed Grants, Lake Champlain Basin Program grant, and local funds

Timeline: 2009/Initiated

38. Action- Assist municipalities in adopting Low Impact Development language in town plans and LID bylaws especially for development of sites less than 1 acre in size.-H

Lead Partner(s): Municipalities, RPCs, VLCT, UVM Seas Grant program, and DEC

Potential Funding Sources: 604(b) grants, and DFPR Urban and Community Forestry Program

Timeline: 2009-2013/Initiated

39. Action-Assess municipal snow disposal sites in the watershed for water quality protection. Map watershed municipal snow disposal sites and work with municipalities to locate alternate sites if current sites are in close proximity to waterways or flood plains.

Lead Partner(s): Municipalities, watershed RPCs, and DEC

Potential Funding Sources: local funding, 604(B)

Timeline: 2009

40. Action- Assist municipalities in the development and/or implementation of stormwater management plans required by the MS4 stormwater management rules.-H

Lead Partner(s): DEC, Towns of Milton, Colchester, Jericho, and Essex

Potential Funding Sources: EPA stormwater grants

Timeline: 2009-2013/Initiated

41. Action- Assist municipalities in the development of stormwater infrastructure maps, maintenance inventories and illicit discharges and detection (IDDE) surveys. Encourage municipalities to purchase new and/or more efficient street sweeping and catchbasin cleaning equipment.-H

Lead Partner(s): DEC, VTrans, VYCC and municipalities

Potential Funding Sources: VTrans SAFETEA, VTrans Enhancement, Section 319 Grants

Timeline: 2009-2013/Initiated

Actions to Address Transportation Infrastructure and Water Quality Issues

Goal:

Minimize conflicts between natural stream functions and existing and proposed transportation infrastructure.

42. Action- Conduct bridge and culvert assessments at stream crossings throughout the watershed using ANR's methodology.-H
A comprehensive bridge and culvert database will enable natural resource planners and transportation infrastructure managers the ability to better maintain and protect these structures from catastrophic failure.

Lead Partner(s): DEC, VFWD, RPCs, municipal highway departments and landowners and municipalities

Potential Funding Sources: DEC River Corridor Grants, Vermont Watershed Grants, LCBP, CWA Section 319 grants and Better Backroads grants

Timeline: 2009-2013/Initiated

43. Action- Replace or retrofit stream crossing structures that pose significant passage limitations to improve fish and/or wildlife passage, sediment transport and/or stream stability.-H After bridge and culvert assessments are complete use *The Vermont Culvert Compatibility Screening Tool* (Milone and MacBroom, 2007) and *Guidelines for the Design of Stream/Road Crossings for Passage of Aquatic Organisms in Vermont* (VTFW and K.K. Kozmo, 2007) documents to prioritize sites and design appropriate treatments. Retrofitting crossings can include installing culvert headwalls, armored culvert outfalls, increasing culvert sizes, upgrading round culverts to arches and bridges, and reducing culvert outlet distances to water surfaces.

Lead Partner(s): DEC, VFWD, RPCs, and municipalities

Potential Funding Sources: Town Highway (TH) Structures (bridges and culverts), TH Interstate Culverts, TH

Class 2 Roadway, Better Backroads grants, and TH Emergency (man-made or natural disasters) funding programs.

Timeline: 2009-2013/Initiated

44. Action-Identify and remediate beaver-road conflicts. As part of the bridge and culvert surveys, identify stream crossings and roads threatened by beaver activities. Selectively install beaver baffles or culvert fences as needed to remediate conflicts.

Lead Partner(s): DEC, VFWD, municipal road managers, VTrans, NRCDs, and RPCs

Potential Funding Sources: Better Backroads, WHIP, and Transportation Enhancement grants

Timeline: 2009-2013

45. Action- Hold regular Better Backroads Workshops in the watershed.-H Focus training on water quality issues such as bridge and culvert design and installation and road ditching.

Lead Partner(s): Local Roads Program, DEC, regional planning commissions, municipalities (select boards and highway superintendents) and VTrans

Potential Funding Sources: Local Roads Program

Timeline: 2009-2013/Initiated

46. Action- Increase town participation in inventories and assessment of transportation infrastructure using a Capital Improvement Budget process.-H A Capital Improvement Budget will inventory and prioritize transportation related projects for municipal officials, ultimately reducing maintenance, improving water quality and aquatic habitat, and saving funds for towns. (Also See Chapter 5 for more specific recommendations).

Lead Partner(s): DEC, VTrans, Local Roads Program, Northern Vermont RC&D, RPCs, and municipalities (select boards and highway superintendents)

Potential Funding Sources: Better Backroads grants, municipal budgets

Timeline: 2009-2013/Initiated

47. Action- Assist towns in the development of minimum standards for the design, construction, and maintenance of driveways and driveway structures within town plans and ordinances. Driveway ordinances can reduce erosion, sedimentation, and catastrophic failure of privately owned transportation infrastructure ultimately impacting municipally owned property.

Lead Partner(s): RPCs, VTrans, RCD, Local Roads Program, DEC, municipal officials (select boards, planning commissions, highway departments), VLCT Municipal Assistance Center, and RPCs

Potential Funding Sources: FEMA grants

Timeline: 2009-2013

48. Action- Identify and address specific water quality issues and conflicts associated with the Lamoille Rail Corridor and the Lamoille River during the transition from rail to recreational use. Provide technical assistance and secure funding for projects that will improve stream stability, remove flood plain encroachments, reestablish flood plain connection, increase woody riparian buffers, and provide for waterway crossings that effectively transport both stream flow and sediment.

Lead Partner(s): DEC, VTrans, RPCs, recreation corridor users, and VAST

Potential Funding Sources: VAST and VTrans corridor funds, River Corridor Grants, EPA Watershed Grants, and CWA Section 319 grants

Timeline: 2009-2013/Initiated

Potential Funding Sources:

Timeline: 2009-2013/Initiated

Outreach and Education Actions

Goal:

Increase water resource awareness among watershed residents through outreach and active participation in assessment, restoration, and protection efforts.

49. Action- Build the capacity of the new Lamoille Watershed Association.-H Recruit watershed volunteers for the new Lamoille Watershed Association to undertake collaborative watershed assessment, restoration and outreach projects.

Lead Partner(s): DEC, Lamoille Watershed Association (LWA), Lamoille River Anglers Association, and watershed NRCDs and RPCs.

50. Action- Establish Stream Teams at the sub-watershed level. Each Stream Team will be composed of local citizens, school groups and businesses acting collaboratively. Stream Teams will conduct assessments, develop restoration plans, implement protection and restoration measures, and provide outreach and education to watershed residents.

Lead Partner(s): municipalities, LRAA, LWA, area schools and businesses, RPCs, and residents

Potential Funding Sources: NA

Timeline: 2009-2013

51. Action- Compile and exhibit chemical, physical, and biological data collected by watershed organizations and residents.-H Develop a watershed water quality database and website of volunteer compiled assessment data.

Lead Partner(s): DEC, watershed schools, LWA, VFWD, and watershed NRCDs and RPCs

Potential Funding Sources: LaRosa Lab Monitoring, Vermont Watershed Grants, and LCBP grants

Timeline: 2009/Initiated

52. Action- Provide educational information regarding the stream dynamics, watershed ecology and fluvial geomorphology to various watershed organizations, schools, landowners, and state and municipal government officials throughout the watershed to provide residents with information necessary to better understand and manage basin streams.-H Develop stream dynamic curriculum for watershed schools.

Lead Partner(s): DEC, LWA, and consultants

Potential Funding Sources: staff time

Timeline: 2009/Initiated

53. Action- Install appropriately designed signage at select high profile locations along the Lamoille River and major tributaries indicating waterbody names at road crossings. Signage will improve public awareness and could promote local stewardship of waterways.

Lead Partner(s): DEC, VTrans, Municipal Highway Departments, and VFWD

Potential Funding Sources: Vermont Watershed grant

Timeline: 2009-2013

CHAPTER 5. LISTED WATERS REMEDIATION AND WATER QUALITY ASSESSMENT NEEDS

Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land.

-Luna Leopold

Introduction

The Agency of Natural Resources is responsible for maintaining water quality in each waterbody in accordance with the Vermont Water Quality Standards. Water quality is determined using biological, physical, and chemical criteria. The Agency, through the Department of Environmental Conservation, monitors surface waters for conformance with these criteria, assesses use attainment, and documents violations. Plans for remediation of water quality problems are developed and carried out by the Agency and, where appropriate, AAFM.

In the Lamoille River watershed, the Agency has identified impaired waters (Table 12), waters in need of further assessment (Appendix A.10) and waters with altered flow (Table 8). An impaired water has a measured violation of at least one criterion of the Vermont Water Quality Standards. To be called “impaired,” the violation of the Vermont Water Quality Standards must be substantiated by data collected through chemical, physical and/or biological monitoring and included in the EPA- Approved List of Impaired Surface Waters. In addition, DEC or members of the public have identified threats to a number of other river or stream reaches; however, available data on these waters are insufficient to conclusively demonstrate a violation of Water Quality Standards. The Agency has and will continue to gather more data on these waters.

Part A. Impaired Waters in Need of a TMDL

Under federal regulations and guidelines, waters impaired by a pollutant must be identified by the State and reported under Section 303(d) of the Clean Water Act. In the following section, the Agency and other State agencies propose strategies for restoring waters in the basin based largely on voluntary efforts. These efforts should be sufficient to correct the impairment, achieve Water Quality Standards, and make it possible to remove the water from the 303(d) list. If these actions fail to restore the impaired waters, the Agency will require additional actions for determining sources of pollution loads and their reduction by the date noted in the strategies listed below. One method of estimating the necessary pollutant loading reduction is by calculating a Total Maximum Daily Load (TMDL). The TMDL program is described in Appendix B.

The Vermont Center for Geographic Information (VCGI) is undertaking an ANR-funded project to delineate a number of impaired sub-watersheds throughout Vermont, primarily those that are affected by agricultural activities. The delineation of the contributing area to the sub-watershed will be characterized using digital layers for soils, slopes, roads, topography, land use-land cover datasets, and the Vermont Hydrography Dataset. This data will assist DEC in the assessment of non point pollution sources and restoration efforts by defining the spatial extent of lands that influence the impaired waters. The impaired segments of Deer Brook, Mill Brook, and Browns River sub-watersheds will be incorporated into this study.

Lake Champlain Phosphorus TMDL

Section 303(d) of the Federal Clean Water Act requires each state to identify impaired waters that do not meet water quality standards, and to establish total maximum daily loads (TMDLs) for such waters for the pollutant of concern (Vermont DEC and New York DEC, 2002). The TMDL establishes that allowable pollutant loading from all contributing sources at a level necessary to attain the applicable water quality standards. A TMDL has recently been developed for phosphorus in Lake Champlain. Phosphorus enters Lake Champlain from multiple point and non-point sources in Vermont, New York, and Quebec. Lake Champlain is divided into 13 segments for phosphorus management purposes. The Lamoille Basin is included in the outer Malletts Bay segment that has phosphorus levels in the low-mesotrophic range, 0.009 milligrams per liter (mg/l).

The [Long-Term Water Quality and Biological Monitoring Project for Lake Champlain](#) surveys the quality of Lake Champlain waters on a bi-weekly basis at 14 locations throughout the lake. Eighteen major tributaries are sampled on an event-basis as well, including the Lamoille River.

The program's large physical and chemical parameter list includes: species of phosphorus, nitrogen and organic carbon; chlorophyll-a; base cations and alkalinity; TSS; dissolved oxygen; conductivity; and pH. The program also includes biological sampling, which is primarily aimed at assessing phytoplankton, zooplankton, and macroinvertebrate communities.

Point source pollution reduction described in the Lake Champlain Phosphorus TMDL is targeted at wastewater treatment facility upgrades to decrease phosphorus loads (Appendix B). The non point source phosphorus load reductions focus on three land uses including developed land, forestry and logging, and agriculture sources. The developed land category includes all permitted stormwater discharges and other non point source loads from residential and other developed areas, gravel roads, small construction sites, and erosion of streambanks and stream channels caused directly or indirectly by land development in the watershed. The forest category includes naturally occurring background loadings, as well as non-point source runoff from forest harvesting and associated road building.

Table 12. Non point Source Phosphorus (P) Loads and Proposed Reductions for the Malletts Bay Segment (DEC, 2002).

Land Use	1991 Total Non point P Load in metric tons per year (mt/yr)	Percent P Contribution	P Load Reduction Responsibilities in mt/yr
Forestland	2.4	8.1%	0.00
Agricultural Land	13.1	43.7%	2.14
Developed Land	14.4	48.2%	2.35

This plan for the Lamoille basin is laid out to follow the format of the Lake Champlain Phosphorus TMDL as closely as possible. Chapter 4 includes the identification and remediation of water quality concerns from forest, agricultural, and developed lands as well as surface

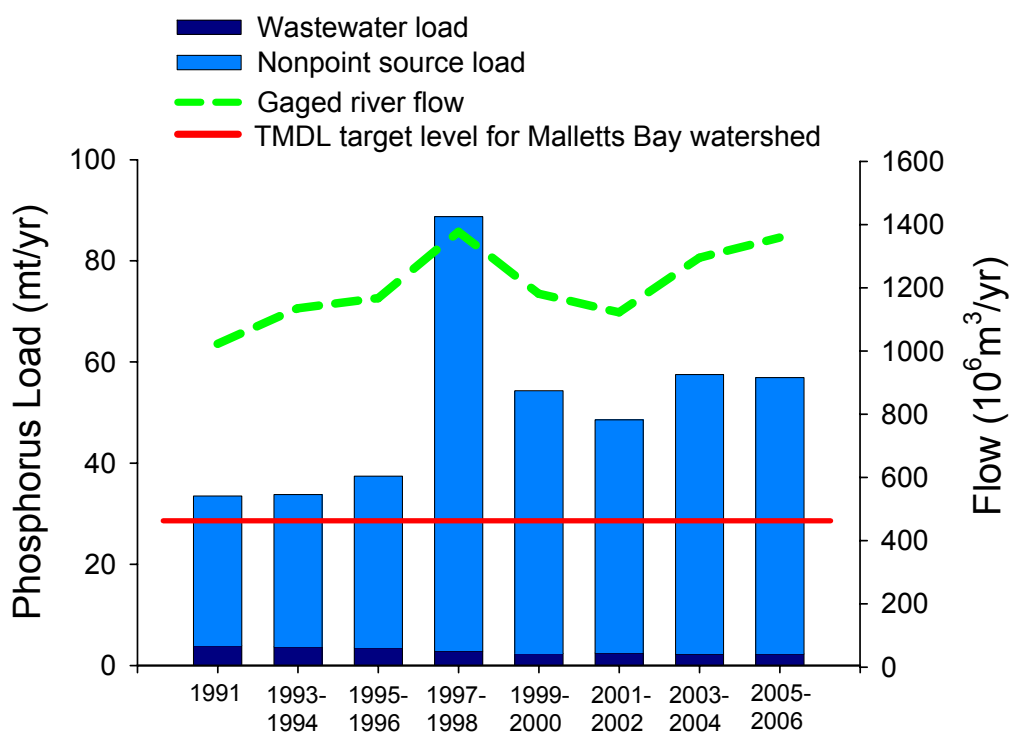
waters. Chapter 5 includes strategies to improve water quality from impaired waterways throughout the watershed. This watershed plan will be used as an implementation guide for reducing phosphorus sources to Lake Champlain from the Lamoille watershed.

Table 13. Year 2008 List of Impaired Waters in Need of a TMDL in the Lamoille River Watershed.

Segment	Pollutant	Problem
Deer Brook, mouth to 2.5 miles upstream	Sediment	Industrial Park stormwater discharge; sand pit; and corroding road culverts
Mill Brook in Fairfax, mouth to 5.0 miles upstream	Sediment, nutrients	Algae growth
Stevensville Brook (upstream from river mile 2.1 to headwaters)	Acid	Acid deposition; extremely sensitive to acidification
Trib to Brewster River (1 mile)	Metals (Iron)	Iron seeps on streambank
Hutchins Brook Tributary #4, mouth to river mile 0.3	Sediment	Asbestos mine tailings erosion, asbestos fibers
Hutchins Brook, river mile 2.0 to 3.0	Sediment	Asbestos mine tailings erosion, asbestos fibers

Figure 6.

Lamoille River Phosphorus Loading to Lake Champlain



Lamoille Basin Phosphorus Trends

The Vermont ANR tracks phosphorus loading to Lake Champlain from major tributary rivers using data obtained from the Lake Champlain Basin Program's Long-Term Monitoring Program and from U.S. Geological Survey stream flow gages. Phosphorus loads to Lake Champlain from the Lamoille River during 1991-2006 (in metric tons per year) are shown in Figure 6. For comparison, the average river flow rates for each time interval (in millions of cubic meters per year) are also shown. Average phosphorus loads and flows were calculated for two-year time intervals (after 1991).

Phosphorus loads from the Lamoille River have exceeded the target level of 28.6 mt/yr established for the Malletts Bay watershed in the Lake Champlain Phosphorus TMDL during each two-year time interval since 1991, although Malletts Bay itself is not impaired due to excess phosphorus. Wastewater discharges are a relatively small proportion of the total loads. Non point source loads are driven by rainfall and snowmelt events, and higher phosphorus loads are seen during the wetter time periods, such as 1997-1998. A statistical analysis that removed the effect of flow variations found no significant trend either upward or downward in flow-adjusted phosphorus concentrations over this time period in the Lamoille River (provisional analysis by the U.S. Geological Survey).

In summary, phosphorus loads from the Lamoille River are well above the acceptable target levels, in part because of wetter years recently. Substantial reductions in phosphorus loading are necessary throughout the watershed, particularly for non point sources.

Phosphorus monitoring at major Lamoille subwatersheds was initiated in 2008 by DEC, Johnson State College, and Lamoille NRCO. This project is scheduled to continue. Monitoring results will assist DEC and its partners in better targeting watershed restoration and protection projects that could further reduce Lamoille basin phosphorus loads to Lake Champlain.

54. Action – Meet regularly with relevant partners to determine whether implementation of the Lamoille watershed plan is achieving needs specified by the Lake Champlain Phosphorus TMDL

Lead Partner(s): ANR, Lake Champlain Basin Program and other relevant partners

Potential Funding Sources: staff time

Timeline: annually

Deer Brook, Georgia

Deer Brook is a tributary to Arrowhead Mountain Lake in Georgia. Numerous site visits and meetings were held in a collaborative effort to identify and remediate non point source pollutants to Deer Brook, which is an impaired stream. Georgia and Milton town officials, VTrans, local business owners, and DEC technical staff from Wetlands, Stormwater, Planning, and Hydrology have been involved in this process. Two pollutant discharges to Deer Brook, iron and sediment, were documented. The source of the iron discharge appears to be corrosion from two upstream 600-foot long culverts. The bottoms of the culverts are corroded and being undermined as surface water is entering below the pipe. VTrans has completed temporary repairs to one of the interstate culverts contributing to the discharge of iron to the stream. Sediment discharges were documented from an adjacent industrial park. Stormwater BMP practices and erosion control measures have already been implemented to divert stormwater runoff from an intermittent stream to a detention pond and stabilize an eroding gully.

A Phase 1 geomorphic assessment has recently been completed by the Northwest Regional Planning Commission. The assessment results will be used to direct future stream corridor restoration and protection measures by the Town of Georgia along Deer Brook.

55. Action– Complete remediation efforts in the Deer Brook watershed including replacement or repair of the interstate culvert, gully stabilization, and stormwater best management practice implementation throughout the watershed.-H Reassess the water quality and remove from the List of Impaired Waters when appropriate.

Lead Partner(s): DEC, adjacent landowners, VTrans, and Town of Georgia

Potential Funding Sources: VTrans Enhancement and CWA Section 319 grants

Timeline: 2009-2013/Initiated

56. Action- Inventory landslide hazard areas within Deer Brook watershed.

Lead Partner(s): DEC, NWRPC, and Town of Georgia

Potential Funding Sources: CWA Section 319 grants and DEC staff time

Timeline: 2009-2013/Initiated

57. Action- Assist the Town of Georgia with changes to the town plan and zoning ordinances in recognizing the inherent risks to developing within erosion hazard areas.

Lead Partner(s): DEC, VLCT, NWRPC, and Town of Georgia

Potential Funding Sources: CWA Section 319 grants and DEC staff time

Timeline: 2009-2013

Mill Brook, Fairfax

Mill Brook is located in Fairfax and is impaired by sediment and nutrient pollutants. Sediment and nutrients from agricultural activities within the watershed appears to be the cause of the water quality impairment. Possible sources of erosion from gravel pit extraction operations have also been documented.

A collaborative work group was formed for the Mill Brook watershed. Partners includes the DEC, the U.S. Fish and Wildlife Service, the St. Albans

NRCS field office, the Franklin County Natural Resource Conservation District, the Composting Association of Vermont, and the Vermont Agency of Agriculture, Food and Markets. The Franklin County Natural Resources Conservation District distributed letters to farmers summarizing the watershed water quality issues and identified voluntary cost share programs that are available. A round table meeting of landowners within the Mill Brook watershed occurred in spring of 2003. Some potential water quality problems have been identified and farmers have signed up for BMP implementation practices through federal and state cost share programs. One dairy farmer in the watershed sold a milking herd resulting in a one hundred animal unit reduction in the watershed.

The Composting Association of Vermont (CAV) and its partners were awarded a Clean Water Act Section 319 grant to initiate a pilot composting project. Initially, project partners will develop and implement a series of local meetings to educate farmers in the Lamoille River basin on the benefits of composting their manure and managing their nutrients. Participating farms will receive technical composting assistance throughout the project period. Several Mill Brook watershed farmers will be assisted in the initiation and enhancement of on-farm composting. Some landowners have already been identified as potential participants for composting projects.

The results of this project will be primarily evaluated by calculating phosphorus removed or reduced from the watershed by land application of compost by the demonstration project farmers in the Mill Brook watershed. Participants will report on the tons of manure composted per year and the amount of compost sold versus land applied. These data will be used to determine tons of phosphorus removed from the watershed. Runoff reduction evaluations will also be calculated from data that shows compost decreases in nutrient solubility.

Another goal will be to increase market demand for composted dairy manure. As part of their in-kind cost share of the project, CAV will assist

Lamoille River Basin Plan- Draft –February 2009

participants in regional market development for their compost products to ensure project success.

58. Action –Implement agricultural and Stormwater BMPs that reduce nutrient and sediment non point sources in the Mill Brook watershed.-H

Implement practices such as woody riparian buffers, filter strips, livestock exclusion from waterways, nutrient management, composting, LID practices, and cover crops with watershed farmers. Reassess the water quality and remove from the List of Impaired Waters when appropriate.

Lead Partner(s): DEC, NRCDs, CAV, NRCS, VAAFM, UVM Extension, landowners, and VLCT.

Potential Funding Sources: EQIP, Partners in Wildlife, and CWA Section 319 grants

Timeline: 2009-2013/Initiated

59. Action- Develop capital budgets for the Town of Fairfax for stream crossings and road improvement projects.

Remediation measures may include bridge and culvert upgrades, road crowning, and stone and grass lined road ditches.

Lead Partner(s): DEC, Northern Vermont RC&D, consultants, and watershed towns

Potential Funding Sources: Better Backroads and DEC River Corridor grant

Timeline: 2009-2013

Unnamed tributary to the Brewster River, Cambridge

Smugglers Notch Resort installed underground monitoring wells to determine possible sources of pollutants to an impaired tributary to the Brewster River in Cambridge. The assessment has determined that the source of the iron discharge is from the adjacent road. Iron precipitation occurrences are typically associated with areas where low pH, iron-rich glacial till soils have been disturbed and placed as fill materials at/or beneath the water table. It had been initially determined that a failing septic system was

responsible for the discharge. A meeting between DEC's watershed coordinator, Smugglers Notch Resort, and VTrans was held to develop a remediation proposal. The Cambridge Conservation Commission was awarded Section 319 grant funds to remediate the iron discharges with a lime injection treatment. The lime injection treatment was completed in 2005. Smugglers Notch Resort has also initiated plans to restore the natural stream channel of this channelized and impounded waterway. A parking lot adjacent to the stream will be relocated and grass filter and riparian buffer installed in its place. Conceptual plans also include stormwater best management practice retrofits, removal of the pond dam, replacement of culverts with a bridge or arch culvert, and restoration of the natural stream channel.

60. Action- Monitor the success of the recent treatment of iron bacteria discharge to the unnamed tributary to the Brewster River.-H

Assist the Cambridge Conservation Commission and Smugglers Notch Resort in any additional needed remediation of the iron seep discharge. Reassess the water quality and remove from the List of Impaired Waters when appropriate.

Lead Partner(s): DEC, Smugglers Notch Resort, and Cambridge Conservation Commission

Potential Funding Sources: CWA Section 319 grants

Timeline: 2009-2013/Initiated

61. Action- Complete additional restoration efforts of the unnamed tributary to the Brewster River. Assist Smuggler Notch Resort in additional remediation efforts such as the implementation of stormwater best management practices, buffer plantings, and stream channel stabilization.

Lead Partner(s): DEC, Smugglers Notch Resort, and Cambridge Conservation Commission

Potential Funding Sources: CWA Section 319 grants, Partners for Fish and Wildlife Program, WHIP

Timeline: 2009-2013

Stevensville Brook, Underhill

The Stevensville Brook is a tributary to the Browns River located in Underhill Center. The watershed is mostly forested with low density residential homes and some gravel roads. Stevensville Brook is impaired due to high acidity. A TMDL will be developed for this waterway but critical loads have not yet been determined. Causes of impairment are similar to the low pH lakes and the methodology to develop the TMDL will be similar to that of the Lake of the Clouds TMDL.

62. Action- Develop a TMDL that determines critical loads for Stevensville Brook.

Lead Partner(s): DEC and EPA

Potential Funding Sources: DEC and EPA staff time

Timeline: 2009

Hutchins Brook and Tributary and Downgradient Wetlands, Eden

The Vermont Asbestos Group (VAG) mine is an inactive asbestos mine comprising 650 acres at the headwaters of Hutchins Brook as well as the Burgess Branch of the Missisquoi River in Lowell. This summary will only focus on the impacts to Hutchins Brook watershed. Hutchins Brook is a tributary to the Dark Branch in the Gihon River watershed located in the town of Eden. The mine operated from the early 1900s to 1993 producing chrysotile asbestos leaving behind over 72 million tons of tailings. The VAG property contains asbestos dusts and fibers on the ground, in the surface waters, and in the old mill and processing buildings.

The mine tailings piles are eroding and significantly impacting Hutchins Brook and Burgess Branch as well as downgradient wetlands. The “old mine’s” 12 million ton tailing piles are impacting Hutchins Brook watershed. The wetlands complex associated with Hutchins Brook is approximately 25 acres in size, located approximately one mile downgradient of the waste pile. The wetland area appears to be

reaching its storage capacity and threatening to adversely affect adjacent water bodies.

The degree and extent of the contamination has not yet been defined. So far, the DEC’s Water Quality Division and Waste Management Divisions, Vermont Geological Survey, and the USGS have worked collaboratively to collect water, sediment, and tailings and to conduct fish and benthic studies. In 2007, these entities performed a major monitoring effort. This included 13 monitoring sites within the Gihon River watershed. All monitoring points were either on the mine site or within 4 miles downstream of the site. The results from the 2007 monitoring effort are still pending. However, previous monitoring efforts, primarily by the Water Quality Division, indicate an impairment of benthic community and fish populations in Hutchins Brook and down gradient wetlands.

Additional monitoring took place in 2008 to better define the degree and extent of contamination in downstream waters. Furthermore, additional data collection, such as meteorological and air-borne dust sampling, was completed in 2008 to better evaluate the potential threat to human health.

Given the magnitude of this site and limited resources at this time, the overall scope and duration of characterization and mitigation efforts is unknown at this time. It is likely that these efforts will span over multiple years. Right now, State agencies are at the beginning stages of characterization and mitigation efforts at this site. EPA is starting the process to determine whether this site eligible for listing on the National Priorities List (i.e., Superfund). It will be at least two years before this determination can be made.

Immediate mitigation efforts to date have focused on implementing erosion prevention and sediment control measures that provide the greatest reduction in sediment load to downstream waters with the funding resources (private and public) available. In the spring 2007,

Lamoille River Basin Plan- Draft –February 2009

VAG installed diversions in spring of 2007 to mitigate erosion along one of the tailings piles in the Hutchins Brook watershed to minimize the amount of tailing material heading downstream toward the wetlands. In October of 2007 EPA's *Emergency Rapid Response Services* contractor mobilized to the site and began work installing interim measures to stabilize the site and prevent further migration of mine waste. EPA returned to the site in the spring and summer of 2008 to continue erosion prevention and sediment control measures. The 2008 activities focused on measures in the old mine area within the Gihon Watershed. Initial EPA R work was completed in July 2008. At this time, there are no additional mitigation efforts planned. DEC and EPA are determining whether the VAG site could be eligible for the EPA Superfund program.

63. Action- Fully implement the DEC and EPA supervised remediation plan for the VAG site to stabilize erosion of the asbestos tailing pile runoff to the Hutchins Brook watershed and associated wetlands.-H

Determine the feasibility of restoration to the impacted waterways. Inform local residents and local government of the remediation plan and potential human health or wildlife impacts from the site.

Lead Partner(s): DEC, EPA, VAG property owners, and local government officials

Potential Funding Sources: DEC, EPA, and VAG

Timeline: 2009-2013/Initiated

List of Waters outside the Scope of the Clean Water Act Section 303(d)

Part B. Impaired Waters not requiring a TMDL

Lamoille River- Clarks Falls Dam to Route 2

The Clarks Falls Dam to Route 2 reach of the Lamoille River is located within the town of Milton and is impaired due to low dissolved oxygen. No TMDL is necessary for this segment

as DEC has the authority and legal means to address the dissolved oxygen problem found below Clark Falls hydroelectric facility. The authority and legal means that are available to DEC are sufficient to attain Water Quality Standards in the near future.

The new federal license for the Lamoille Hydroelectric Project was issued in June 2005. Articles 407 and 408 address post-licensing water quality monitoring and dissolved oxygen enhancement, respectively. The new license provides for conservation flows that may improve the dissolved oxygen regime sufficiently to obviate the need for specific mechanical enhancements, such as turbine aspiration.

Future operation of the four stations as described above will comply with and meet federal and state clean water act requirements. Implementation of these measures will resolve water quality issues identified by the ANR in the List of Priority Waters.

64. Action – Implement the approved FERC license conditions to address water quality impairments for CVPS operated dams and affected waters.-H

Lead Partner(s): ANR and CVPS

Potential Funding Sources: CVPS

Timeline: 2009-2013/Initiated

Part C. Waters in Need of Further

Assessment. See Appendix for a table of these waters

Part D. Surface Waters with a Completed and Approved TMDL-

Lake of the Clouds

This water was included in the Acid Lake TMDL submitted and subsequently approved by EPA in September 2003. Monitoring is on-going to track this impairment. (Note this water body was previously listed on the Part A. List of Impaired Waters in Need of a TMDL in 2002).

Lake of the Clouds is a small, high elevation pond located in Cambridge. Aquatic life use is impaired on this waterway from acidification due to the water's low buffering capacity and/or atmospheric deposition. It has long been understood that the deposition of strong mineral acids and acid forming compounds, sulfur and nitrogen compounds, from the atmosphere have been the primary source of the acidification of hundreds of lakes throughout the Northeast United States as well as other regions across the country. A Total Maximum Daily Load (TMDL) document determines annual loading limits for 30 of the acid impaired lakes identified on the Vermont 2002 List of Impaired Surface Waters (303d List) including Lake of the Clouds in Cambridge. Vermont anticipates that the ultimate source identifications and control will be spearheaded at the regional and national level.

Lamoille River- mouth to Clarks Falls Dam, Arrowhead Mountain Lake and All Surface Waters- Mercury

Vermont currently has a fish consumption advisory in effect for all state waters due to the presence of elevated mercury levels in fish tissues. Arrowhead Mountain Lake and the mouth to Clark Falls section of the main stem are impaired due to elevated levels of mercury in walleye. The combustion of coal for energy and the incineration of municipal and medical wastes produces the majority of mercury deposited onto the watersheds of the northeastern US and eastern Canada. The Agency of Natural Resources will continue pressuring US EPA to reduce emissions from out-of-state sources. The Agency's Environmental Assistance Division in the Department of Environmental Conservation will also continue its work to reduce in-state sources of mercury in the environment. Implementation of CVPS settlement agreement will reduce water level fluctuations on these waters and can reduce mercury levels influenced by drawdowns.

65. Action- Re-sample the mercury-impaired waters within the basin to update data.

Lead Partner(s): DEC and VFWD

Potential Funding Sources: staff time

Timeline: 2009

Part E. Waters Altered by Exotic Species-

- **Arrowhead Mountain Lake, Milton-** Eurasian Watermilfoil is locally abundant
- **Lake Elmore, Elmore-** Eurasian Watermilfoil is locally abundant

For Additional information See Chapter 3 Lakes and Ponds Section for background and Chapter 4 for Actions.

Part F. Waters Altered by Flow

Regulation- see Table 8 in Chapter 3 Dams and Flow Regulated Waters Section for additional information and Chapter 4 for Actions.

Part G. Surface Waters Altered by Channel Alteration

Browns River (lower-mid) miles 3.5-18.5 (15 miles), Essex and Westford. Severe streambank erosion from agricultural encroachments and the effects of historic in-stream gravel extraction. (Note this water body was previously listed on the Part A. List of Impaired Waters in Need of a TMDL in 2002).

The Browns River is listed as altered approximately through the towns of Westford and Essex (figure 7). Sedimentation and channel alterations, which are the result of former channel gravel mining, loss of riparian vegetation, streambank erosion due to agricultural encroachments, and flood events that exacerbated already unstable conditions, are listed as the problems in DEC's Lamoille Watershed Assessment (2001). The altered reach runs



Figure 7.- Browns River Watershed

through predominately agricultural land that is currently in corn, hay and pastureland. The river is a meandering riffle-pool sand bottom system with a wide valley and broad flood plain. These stream systems are extremely susceptible to instability when natural vegetation is removed. Aerial photos indicate that woody riparian buffers are sparse in much of the defined reach. Streambank erosion dominates on the outside bends even where buffers exist. There has been significant lateral movement of the channel that may be an indicator of system-wide, rather than local, instability.

A collaborative partnership has been developed between DEC, Chittenden County RPC, and relevant agricultural partners to formulate strategies to improve water quality in the impaired waters of the Browns River. Other project partners include U.S. Fish & Wildlife Service, Vermont Department of Fish and Wildlife, the Williston and Berlin USDA NRCS field offices, Winooski Natural Resource Conservation District, and Vermont Agency of Agriculture, Food and Markets. The Winooski Natural Resources Conservation District distributed letters to farmers discussing the impairments and voluntary cost share programs that are available.

A watershed assessment using the Agency of Natural Resources Phase 1 protocols is complete. The assessment identifies existing stream conditions at the watershed scale using GIS tools

and ground truth methods. Sixty-eight reaches of the main stem were delineated and evaluated on the Browns River main stem and larger tributaries. Twenty-two of the evaluated reaches, or 32%, were highly impacted by the lack of woody riparian buffers (75% of the reach had a 0-25 buffer). The assessment also identified channelization and gravel extraction as significant contributors to streambank erosion.

Bridge and culvert assessments have been completed to identify structures contributing to stream instability and hindering fish passage. Results from this assessment indicate that over 50% of the stream crossings on the Browns River and major tributaries are significantly undersized and could fail during a flash flood event. Stream crossing failures can be significant sources of sediment to waterways. Many structures were found to impede fish passage. These failing structures will be targeted for removal or repair.

A Phase 2 geomorphic assessment has been completed. This assessment indicates that reaches in between Underhill Center and the Cilley Hill Dam in Jericho are undergoing channel adjustment processes such as aggradation, degradation, widening, and planform adjustment. The channel adjustments are in response to disturbances such as gravel extraction, channelization, riparian vegetation removal, and dam influences. A River Corridor grant has been secured to develop a comprehensive river corridor plan for the entire Browns River; initiate the purchase of easements along key riparian areas; prepare a fluvial erosion hazard plan for the Town of Underhill; and develop capital budgets for stream crossings in watershed towns.

There are nine farms in the Browns River watershed including six dairies and three non-milking facilities. In 2002 and 2003, CREP was implemented on cropland along approximately 3 miles of the Browns River bank. A grass filter strip and bank armoring practices have been implemented by NRCS.

66. Action–Develop a river corridor protection plan for the Browns River.-H A river corridor management plan will provide the basis for an alternative analysis of appropriate restoration and protection measures.

Lead Partner(s): DEC, Winooski NRCD, NRCS, VAAFM, CCRPC, landowners, and watershed towns.

Potential Funding Sources:

Timeline: 2009-2013/Initiated

67. Action- Implement river corridor restoration and protection projects in the Browns River watershed.-H Remediation measures may include floodplain encroachment removals, establishment of woody riparian buffers, livestock exclusion from waterways, riparian corridor easement purchases, crop rotations and cover crops, and the use of active and passive geomorphic-based stream restoration measures.

Lead Partner(s): DEC, Winooski NRCD, watershed towns, VAAFM, landowners, and NRCS.

Potential Funding Sources: EQIP, DEC River Corridor grant, CWA Section 319 grants, Partners for Fish and Wildlife Program

Timeline: 2009-2013/Initiated

68. Action- Develop and implement capital budgets for Browns River watershed town for stream crossings and road improvement projects.-H Remediation measures may include bridge and culvert upgrades, road crowning, and stone and grass lined road ditches.

Lead Partner(s): DEC, Northern Vermont RC&D, consultants, and watershed towns

Potential Funding Sources: Better Backroads, and DEC River Corridor grant

Timeline: 2009-2013/Initiated

69. Action- Develop a Fluvial Erosion Hazard Plan and Map for the Town of Underhill.-H Underhill Center is located at the confluence of several large tributaries and the Browns River and has been adversely impacted by flood erosion damage. A fluvial erosion hazard plan and map will assist the community in identifying areas adjacent to waterways that may not be suitable for development and reduce future flood erosion damage.

Lead Partner(s): DEC, Winooski

NRCD, CCRPC, and Town of Underhill

Potential Funding Sources: DEC River Corridor grant

Timeline: 2009-2013/Initiated

CHAPTER 6. MANAGEMENT GOALS FOR SURFACE WATERS

Background

The protection or improvement of water quality and water-related uses can also occur by establishing specific management goals for particular bodies or stretches of water. The management goals describe the values and uses of the surface water that are to be protected or achieved through appropriate management. Management goals can be established through the following processes:

- Classification of waters and designation of water management types,
- Designation of existing uses of a water (Chapter 2),
- Classification of wetlands.
- Classification of waste management zone,
- Designation of waters as warm and cold water fisheries, and
- Designation of waters as Outstanding Resource Waters, and

The Agency of Natural Resources is responsible for designating existing uses on a case by case basis or through basin planning and the Vermont Water Resources Panel is responsible for adopting the other designations by rule. Once the Agency or the Panel establishes a management goal, the Agency manages State lands and issues permits to achieve all the management goals and designated uses established for the associated surface water.

Before the Agency recommends, or the Panel establishes, management goals through a classification or designation of surface waters by rule, input from the public on any proposal is required and considered. The public is also able to present a proposal for establishing

management goals for the Board to consider at any time.

When the public develops proposals regarding management goals, the increased community awareness can lead to protection of uses and values by the community and individuals.

Typing and Classification

Since the 1960s, Vermont has had a classification system for waters that establishes management goals. Setting water quality management goals is the responsibility of the Vermont Water Resources Board. These goals describe the values and uses of surface waters that are to be protected or restored through appropriate management practices. The Agency of Natural Resources works to implement activities that restore, maintain or protect the management goals. The current classification system includes three classes: A (1), A (2), and B.

Presently, in all basins, waters above 2,500 feet in elevation are classified A (1) by Vermont statute. The management objective for A(1) waters is to maintain their natural condition. Waters used as public water supplies are classified A(2). All the remaining waters are Class B waters. As part of the Water Quality Standards revisions in 2000, the system was changed to allow Class B waters be divided into three management types: B1, B2 and B3. This change was made 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 revised Water Quality Standards require that all basin plans place Class B waters into one of the three water management types. However, the Vermont Legislature passed bill H154 in 2007 that only allowed the adoption of basin plans for Basin 11 and Basin 14 without water management typing proposals. These two plans must be revised within two

years of adoption with proposed water management types or an alternative method of protecting water quality in high quality waters.

The Lamoille Basin plan does not contain any water management typing (WMT) recommendations for any Class B waters. Once an agreed upon process for WMT or for an alternative to WMT is developed by the Water Resources Panel, this plan will be revised accordingly.

Once the Vermont Water Resources Panel adopts the water management type designations for specific waters, it is the responsibility of the Agency, individuals and all levels of government to work to achieve or maintain the level of water quality specified by the designations.

In was with great effort that the Lamoille Watershed Coordinator working closely with ANR staff and the Lamoille Watershed Council developed a proposal for all Water Management Types in the watershed including all B waters. This methodology is described in Appendix A.9. Watershed municipalities were given the opportunity to provide input to Water Management Type proposals for within their towns. See Appendix A.4 for a complete list of DEC Watershed Coordinator meetings with municipal officials regarding the Water Management Typing proposal.

Biological monitoring data for fish and macroinvertebrate communities from reference sites listed in the following table were included in a statewide database used to determine measures of biological integrity describing the range of attainable biological conditions for three categories of wadeable stream (DEC, 2001). There is no implication that conditions upstream or downstream of these sites demonstrate comparable conditions. Additionally, many other stream reaches within the Lamoille River watershed

are likely to be in or close to reference condition.

Description of Proposed Water Management Types

Identification of Bodies of Water

1. Class A Waters

A. Description of existing water management type one waters. Includes all tributaries to named waters and associated wetlands within described reaches.

- All waters located above 2,500 feet in elevation by statute (see Appendix A.9). No additional waters are proposed for A1.

B. Description of existing water management type two (A2) waters. No new or additional A2 waters are proposed.

- **In the towns of Georgia and Fairfax-** Silver Lake
- **In the town of Cambridge-** unnamed tributary to Brewster River (Smugglers Notch Resort drinking water supply)
- **In the town of Johnson-** French Hill Brook from upstream end of the impoundment to the confluence of Waterman Brook (See Action 70 below)

70. Action- DEC recommends that the Town of Johnson file a Petition with the Vermont Water Resources to re-classify French Hill Brook from the upstream end of the impoundment to the confluence of Waterman Brook from an A2 Water to a B water. The Town of Johnson does not currently use this water as a public drinking water supply or have any plans to do so since transitioning to a ground water supply in 2006.

Lead Partner(s): DEC and the Town of Johnson

Potential Funding Sources: NA

Timeline: 2009

*see narrative above and corresponding plan appendices

Waste Management Zones

In addition to their present classification of B, the river reaches that receive treated effluent from wastewater treatment facilities in Hardwick, Morrisville, Jeffersonville, Fairfax, and Milton have one-mile long Waste Management Zones downstream of each facility's outfall. This zone is designated to accept the discharge of properly treated wastes that prior to treatment may contain organisms pathogenic to human beings. Throughout the zone, numeric water quality criteria for Class B waters must be achieved, but increased health risks exist. No changes to Waste Management Zones are proposed.

Fish Habitat Designations

Warm Water Fish Habitat

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

- Arrowhead Mountain Lake, Milton/Georgia
- Flagg Pond, Wheelock
- Green River Reservoir
- Halfman Pond, Fletcher
- Hardwick Lake, Hardwick
- Horse Pond, Greensboro
- Lake Elmore, Elmore
- Lamoille River from the Peterson Dam in Milton to its confluence with Lake Champlain - June 1, through September 30, only.
- Long Pond (Belvidere Pond), Eden
- Long Pond, Greensboro
- Tuttle Pond, Hardwick
- Wapanaki Lake, Wolcott

No changes to warm water fish habitat designations are proposed.

Cold Water Fish Habitat

All waters not designated as warm water fish habitat above are designated as cold water fish habitat for the Lamoille River basin in the Vermont Water Quality Standards, 2008. No changes to cold water fish habitat designations are proposed.

Outstanding Resource Waters

Outstanding Resource Water (ORW) designation identifies waters that have exceptional natural, recreational, cultural, or scenic values. Depending on the values for which designation is sought, ORW designation may protect exceptional waters through the permits for stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities. Presently, there are no ORWs designated in the Lamoille watershed. ORW is one of many tools that can be used to protect exceptional waters. Other tools include municipal zoning ordinances, easements, fee simple purchases, and Class 1 wetland designation among others.

A citizen group can propose Outstanding Resource Waters designations under 10 V.S.A. §1424a or assist the Agency in designating existing uses. DEC will work closely with local entities in pursuing ORW designation. Possible waters to consider for ORW designation could include waters that: demonstrate significant fisheries spawning and habitat areas; gorges, rapids and waterfall areas; scenic areas; rare and irreplaceable natural areas; historic resources and archeological sites; aquifer protection; habitat for threatened and endangered plants; areas having recreational, educational, and research values. No ORW waters are proposed at this time.

CHAPTER 7. SUMMARY AND IMPLEMENTATION OF THE BASIN PLAN

Summary

The Lamoille River Basin Water Quality Management Plan identifies the top water quality issues in the basin and gives guidance through actions that can be taken to address these issues over the next five years. It is a pragmatic collaborative effort that has already resulted in building working relationships with various partners in on-the-ground watershed restoration and outreach projects. The success and value of the plan will be determined by its successful implementation.

Implementation of the Watershed Plan

Water quality improvement at the basin level can be achieved through protection and restoration of waterways, modification of the adjacent land uses, and by providing outreach and education to those who live, work, and play in the watershed. Following through on as many of the action ideas listed in Chapters 4 and 5 of this plan as possible is the approach that DEC will take in implementation of this plan.

Many of the plan's implementation strategies are already being undertaken. DEC's Watershed Coordinator will lead or co-lead many actions to improve the water quality and the aquatic habitat of the watershed. Best management practices for agriculture, transportation infrastructure, logging, stormwater management and construction erosion will be undertaken to address discharges to the basin's waters. The Coordinator, working closely with watershed partners, will identify specific projects and relevant partners, secure funding sources, assist in project designs and permitting requirements, and oversee project implementation. The Coordinator and

watershed partners will determine the success of practice implementation and evaluate whether additional practices may be necessary.

The Coordinator will work closely with municipalities and regional planning commissions to improve town plans and zoning ordinances to protect high quality waters and minimize future human conflicts with those of natural ecosystems and to provide necessary outreach to landowners. The Coordinator will work collaboratively with local land trusts, the USDA NRCS and FSA, watershed NRCDS, and Agency of Agriculture to proactively identify riparian and wetland areas for the purpose of obtaining easements to protect and restore these areas.

The Coordinator will partner with the Lamoille Watershed Association, watershed lake and pond associations, area schools and colleges, RPCs, NRCDS, and state and federal agencies to identify water monitoring and assessment needs for the basin's lakes, ponds, wetlands, and stream systems. These partners will also formulate more efficient ways to share this information with one another and watershed residents.

Evaluating the Plan's Progress

DEC's Watershed Coordinator will meet with relevant watershed partners on an annual basis to specifically review the list of action items in the plan to determine if they are being implemented as scheduled and if not, to determine what is needed to make additional progress. Included in Appendix A.13 is a sample basin action implementation report card to review action implementation success. The Coordinator will also meet with relevant DEC staff and members of the Lake Champlain Basin Program to determine the plan's success as it relates to the Lake Champlain Phosphorus TMDL and Opportunities for Action. The Coordinator will meet individually with specific watershed

project partners to evaluate the success and determine needs for individual projects.

Other quantifiable measures of success can include:

- linear feet or acreage of riparian areas protected through easements,
- acreage or linear feet of riparian buffer planted,
- number of stream crossings upgraded,
- number of towns developing capital budgets for road systems,
- number of road best management projects implemented,
- number of agricultural best management practices installed,
- number of urban stormwater management practices applied,
- number of mass failures identified and remediated,
- number of wetland acres restored,
- number of flood plain acres restored,
- number of lake and pond VIP programs initiated,
- number of town plan and zoning improvements protecting waterways, and
- number of lake watershed surveys and BMPs implemented

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GLOSSARY

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

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

Acceptable Management Practices (AMP) - methods 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.

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 Lamoille River Basin. Other Basins include two or major watersheds such as the Poultney/ Mettawee Basin.

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

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

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

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

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

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

Improved Barnyards - a series of practices to manage and protect the area around the barn, which is frequently and intensively used by people, animals, or vehicles, by controlling runoff to prevent

erosion and maintain or improve water quality. Practices may include: heavy use area protection, access roads, animal trails and walkways, roof runoff management, and others.

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

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

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

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

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

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

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

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

Thermal modification - the change in water temperature

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

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

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

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

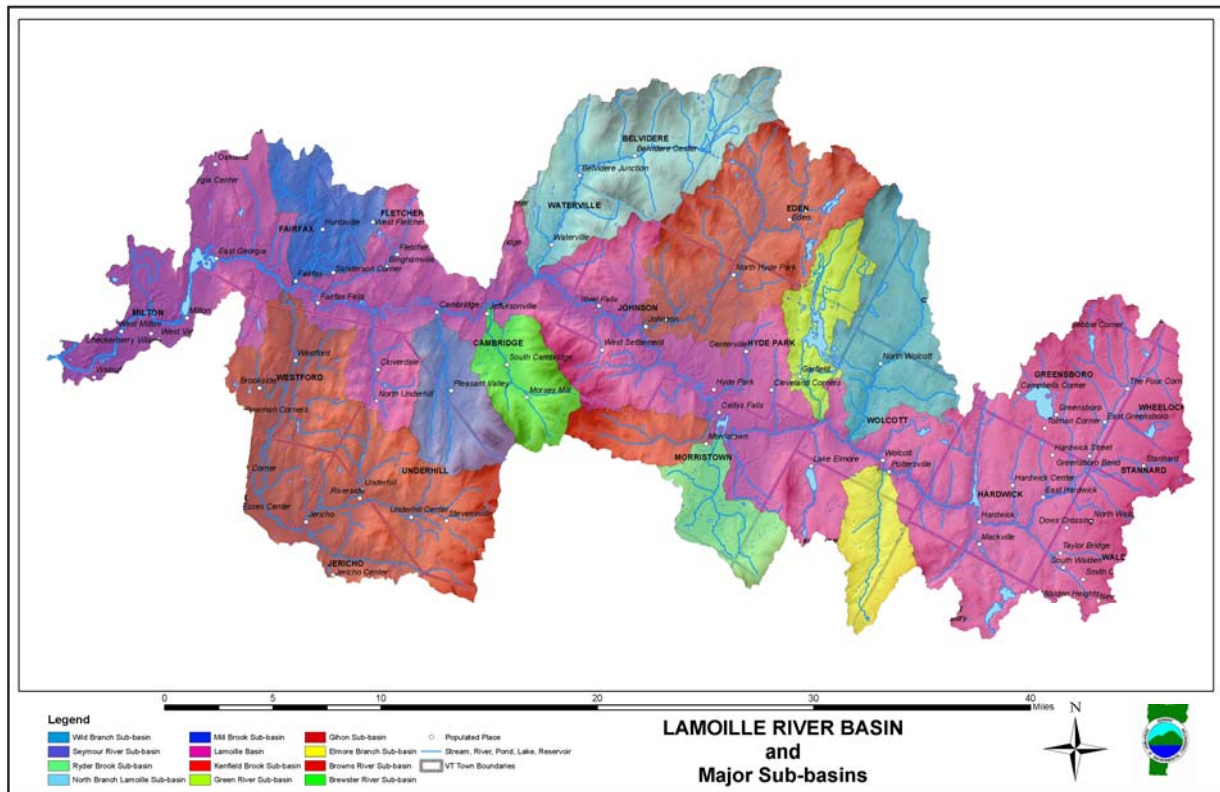
Watershed - all the land within which water drains to a common waterbody (river, stream, lake pond or wetland).

LIST OF ACRONYMS

AAP	Accepted Agricultural Practice
ACOE	United States Army Corp of Engineers
AGC	Association of General Contractors
Agency	Vermont Agency of Natural Resources
AMP	Acceptable Management Practice
ANCF	Aquatic Nuisance Control Fund
ANR	Vermont Agency of Natural Resources
BASS	Biomonitoring and Aquatic Studies Section, Vermont Water Quality Division
BMP	Best Management Practice
CAV	Composting Association of Vermont
CVPS	Central Vermont Public Service
CWA	Federal Clean Water Act
DEC or Department	Vermont Department of Environmental Conservation
DFPR	Vermont Department of Forest, Parks and Recreation
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
LCBP	Lake Champlain Basin Program
LRAA	Lamoille River Anglers Association
LWA	Lamoille Watershed Association
NNHP	Vermont Nongame and Natural Heritage Program
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
ORW	Outstanding Resource Water
PDM	Pre Disaster Mitigation
RC&D	Resource Conservation and Development Council
RPC	Regional Planning Commission
TMDL	Total Maximum Daily Load
TU	Trout Unlimited
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UVM	University of Vermont
VAAFM	Vermont Agency of Agriculture, Food and Markets
VDHP	Vermont Department of Historic Preservation
VDOH	Vermont Department of Health
VFWD	Vermont Fish and Wildlife Department
VLCT	Vermont League of Cities and Towns
VNRC	Vermont Natural Resources Council
VTrans	Vermont Agency of Transportation
VYCC	Vermont Youth Conservation Corp
WWTF	Wastewater Treatment Facility

Vermont Agency of Natural Resources

LAMOILLE RIVER BASIN Water Quality Management Plan- DRAFT APPENDICES



LAMOILLE RIVER BASIN-WATER QUALITY MANAGEMENT PLAN APPENDICIES

APPENDIX A.1 - Statutory Index.....	96
APPENDIX A.2 - Lamoille Watershed Council Members and Technical Advisors.....	99
APPENDIX A.3 - Public Meetings Held in the Lamoille River Watershed	101
APPENDIX A.4 - Municipal Meetings Regarding Surface Water Typing and Classification.....	103
APPENDIX A.5 - Functions and Values of Selected Wetlands.....	103
APPENDIX A.6 - Fluvial Geomorphology and historic river corridor management.....	105
APPENDIX A.7 - Summary of Chemical and Biological Assessments of the Lamoille River Watershed Completed or Underway.....	107
APPENDIX A.8 Fluvial Geomorphic and Other Assessments Related to the Physical Health and Stability of Streams in the Lamoille River Basin.....	109
APPENDIX A.9 - Methodology for Typing and Classification of Waterbodies in the Lamoille River Basin.....	110
APPENDEX A.10- Vermont Anti-Degradation Implementation	112
Existing Uses Determination for Use During River Basin Planning (DRAFT)	112
A.11- Lamoille Waters in Need of Further Assessment.....	116
APPENDIX A.12 - Review of Municipal Plan and Local Bylaws for Water Quality Provisions	117
APPENDIX A.13- Lamoille Basin Plan Actions Implementation Report Card- Sample	
APPENDIX A.14- Basin 7 Water Quality Management Plan Public Comments Responsiveness Summary January 2009	
APPENDIX B - Regulatory and Non-regulatory Programs that Contain BMPs Applicable to Protecting and Restoring Waters within the Basin	132
APPENDIX B.1 - Agricultural Runoff Control Programs	132
APPENDIX B.2 - Effluent Limitations and Point Source Control Programs.....	139
APPENDIX B.3 - Land Disposal (of Wastes) Program	142
APPENDIX B.4 - Construction Runoff Control Program.....	144
APPENDIX B.5 - Solid Waste Management Program	145
APPENDIX B.6 - Residual Wastes Program	147
APPENDIX B.7 - Mine Runoff Control Program	148
APPENDIX B.8 - Hazardous Waste Management Program	149
APPENDIX B.9 - Flow Regulations and Dams	150
APPENDIX B.10 - Wetlands, Dredge, and Fill Material Control Programs	151
APPENDIX B.11 - Groundwater Pollution Control Programs.....	152
APPENDIX B.12 - Fisheries Protection Regulations	154
APPENDIX B.13 - Other Important Programs	157

APPENDIX A

APPENDIX A.1 - Statutory Index

Federal and State law and regulation call for the review of specific topics in each basin plan. The following is a listing of basin planning requirements that have been extracted from the Vermont Water Quality Standards (WQS), the Federal Register and the Agency of Agriculture, Food and Markets' (DAF&M) Accepted Agricultural Practice Regulations (Effective June 29, 1995), their Best Management Practice Regulation (Effective January 27, 1996), and the Memorandum of Understanding between the ANR and the VAAF&M. The requirements below are addressed in this basin plan in the section noted in bold adjacent to each requirement.

The Vermont Water Quality Standards

1. Basin plans inventory the existing and potential causes and sources of pollution that may impair the waters. **Chapters 3 and 5**
2. Basin plans establish a strategy to improve or restore waters. **Chapters 4 and 5**
3.shall seek public participation to identify and inventory problems, solutions, high quality waters, existing uses, other water uses, and significant resources of high public interest. **Chapters 1, 2, 3, A.2 and A.3**
4.shall consider approved municipal and regional plans adopted under 24 V.S.A. Chapter 117. **Appendix A.11**
5.shall coordinate and cooperate with the Commissioner of VAAF&M, as provided for in 6 V.S.A. Chapter 215. **Chapters 2, 3, 4, and 5**
6.shall identify strategies, where necessary, by which to allocate levels of pollution between various sources as well as between individual discharges. **Chapters 4 and 5, and Appendix B.2**
- 7.....should, to extent possible, contain specific recommendations by the secretary that include, but are not limited to the identification of all known:
 - existing uses **Chapter 2**
 - salmonoid spawning or nursery areas important to the establishment or maintenance of such fisheries **Chapter 2**
 - reference conditions appropriate for specific waters **Chapter 6**
 - any recommended changes in classification and designation of waters **Chapter 6**
 - schedules and funding for remediation **Chapters 4 and 5**
 - stormwater management **Chapters 3, 4, and 5**
 - riparian zone management **Chapters 3, 4, and 5**
 - other measures or strategies pertaining to the enhancement and maintenance of the quality of waters within the basin. **Chapters 4 and 5**

8. In basins that include class B waters which have not been allocated into one or more Water Management Type or Types pursuant to Section 3-06 of the WQS, the basin planshall propose the appropriate Water Management Type or Types based on both the existing water quality and reasonably attainable and desired water quality management goals. **Chapter 6**

40 CFR, Section 130.6

9. Water Quality Management (WQM) plans....consist of initial plans produced in accordance with sections 208 and 303e of the Clean Water Act (CWA) and certified and approved updates of those plans.

10. State water quality planning should focus annually on priority issues and geographic areas and on the development of water quality controls leading to implementation measures. **Chapters 3, 4, and 5**

11. WQM plans are used to direct implementation. **Chapters 4 and 5**

12. WQM plans draw upon the water quality assessments to identify priority point and non-point water quality problems, consider alternative solutions and recommend control measures, including the financial and institutional measures necessary for implementing recommended solutions. **Chapters 3, 4, 5, and Appendix A.8**

13. State annual work programs shall be based upon the priority issues identified in the State WQM plan. **Chapters 3, 4 and 5**

14. The following plan elements shall be included in the WQM plan or referenced as part of the WQM plan if contained in separate documents when they are needed to address water quality problems:

(1) Total maximum daily loads. **Chapter 5**

(2) Effluent limitations - including water quality based effluent limitations and schedules of compliance. **Appendix B.2**

(3) Identification of anticipated municipal and industrial waste treatment works, including

(a) facilities for treatment of stormwater-induced combined sewer outfalls;

Appendix B.2

(b) programs to provide necessary financial arrangements for such works; **Appendix B.2**

(c) establishment of construction priorities and schedules for initiation and completion of such treatment works. **Appendix B.4**

(4) Nonpoint source management and control

(a) describe the regulatory and non-regulatory programs, activities and best

management practices (BMPs). (Economic, institutional and technical factors shall

be considered....)..... BMPs shall be identified for the nonpoint sources identified in

Section 208(b)(2)(F)-(K) of the CWA and other nonpoint sources as follows:

- (i) Residual waste
- Appendix B.6**
- (ii) Land disposal **Appendix B.3**
- (iii) Agricultural and silvicultural **Chapters 3, 4, 5, and Appendix B.1**
- (iv) Mines **Appendix B.7**
- (v) Construction **Chapters 3, 4, 5, and Appendix B.4**
- (vi) Urban stormwater **Chapters 3, 4, and 5**

The nonpoint source plan elements outlined in #14 above shall be the basis of water quality activities implemented through agreements or memoranda of understanding between EPA and other departments, agencies or instrumentalities of the United States in accordance with section 304(k) of the CWA.

- (5) Identification of management agencies necessary to carry out the plan and provisions for adequate authority for intergovernmental cooperation..... **Chapters 4 and 5**
- (6) Identification of implementation measures necessary to carry out the plan, including financing, time needed to carry out the plan, and the social, economic and environmental impact of carrying out the plan in accordance with 208(b)(2)(E). **Chapters 4 and 5**
- (7) Identification and development of programs for the control of dredge or fill material in accordance with section 208(b)(4)(B) of the CWA. **Appendix B.10**
- (8) Identification of any relationship to applicable basin plans developed under section 209 of the CWA. **This is the basin plan**
- (9) Identification and development of programs for control of groundwater pollution including the provisions of section 208(b)(2)(K) of the CWA. States are not required to develop groundwater WQM plan elements beyond the requirements of section 208(b)(2)(K) of the CWA, but may develop a groundwater plan element if they determine it is necessary to address a groundwater (water) quality problem [see section 130.6(c)(9) for specifics of the groundwater plan element]. **Chapter 2 and Appendix B.11**

APPENDIX A.2 - Lamoille Watershed Council Members and Technical Advisors

Council members	
Constituent Work Group	Name/Organization
Municipal officials	Judy Kinner- Milton Conservation Commission Jane Sorensen- Fairfax Planning Commission Doug Molde- Johnson Planning Commission Mark Delaney- Cambridge Conservation Commission Dave Tilton- Westford Conservation Commission
Natural Resources Conservation Districts	Allison Cardwell- Lamoille NRCD Christina Goodwin- Lamoille NRCD Pamela Stefenek- Otter Creek NRCD Andrea Turner- Caledonia NRCD Kerry O'Brien- Caledonia NRCD Abbey Willard- Winooski NRCD
Farmers	Russ Lanphear- Hyde Park Mark Boyden- Cambridge Jane Sorensen- Fairfax Don Avery- Hyde Park
Farm Bureau	Hollis Edwards- Lamoille County Mark Boyden- Lamoille County
Industries and Regional Development Organizations	Annalei Babson- NVDA
Lake Organizations	Lyle Quackenbush- Arrowhead Mt. Lake Chuck Mitchell- Green River Reservoir John Saxby- Lake Elmore John Morse- Lake Elmore Liz Palletta- Lake Eden Jeanne Palletta- Lake Eden Andy Dales- Caspian Lake Doug & Cheryl Churchill- South Pond
Educators	Sheila Tyman- People's Academy High School
Loggers/Foresters	Tim Cleveland- Hardwick Jonathan Wood- Jeffersonville Bill Samal- Belvidere
Large landowners	Glenn Gingras- Vtrans Mark Delaney- Smugglers Notch
Utilities	Mike Scarzello & John Greenan- CVPS Scott Corse & John Tilton- Morrisville Water and Light Hardwick Electric- Joe Bongiovoni and Eric Werner

Residents	Bob Selby- Johnson Simon Hurd- Eden John Hayden- Cambridge
Regional Planning Commissions	Bruce Butler & Eileen Toomey- Lamoille County Annalei Babson- NVDA Ian MacDougal- Chittenden County Bethaney Hassee- Northwest
Anglers	Joe Lane- Lamoille River Anglers Doug Molde- Lamoille River Anglers Dave Dernor- BASS
Browns River Watershed Council	Mark Fasching
Lamoille Watershed Association	Faith Ingulsrud
Technical Advisors	
Vermont Department of Environmental Conservation	Padraic Monks- Stormwater Management Mike Kline, Chris Brunell, & Barry Cahoon- River Management Susan Warren, Kellie Merrill, Neil Kamman, Ann Bove, & Mike Hauser- Lakes and Ponds Kim Greenwood & Jeff Cueto- Hydrology Shannon Morrison, Alan Quackenbush, & April Moulart- Wetlands
Vermont Department of Fish and Wildlife	Christa Alexander, Len Gerardi, Eric Sorenson, & Brian Chipman
VT Agency of Agriculture, Foods, and Markets	Phil Benedict
USDA NRCS	Tim McKay- Caledonia County Chuck Mitchell- Lamoille County Jim Eikenbury- Lamoille County Kathy Hakey and Dave Hoyt- Franklin Co. Bruce Chapell and Mike Fournier- Chittenden County
VT Dept of Forests and Parks	Ray Toolan- Lamoille County Jonathan Wood- Commissioner
Land Trusts	John Ramsay- Vermont Land Trust
Regional Planning Commissions	Bill Rossmassler- Lamoille County
Vermont Local Roads	Hank Lambert
Vermont Agency of Transportation	Heather Hibbard, Glenn Gingras, & Nelson Hoffman
Hardwick Electric	Joe Bongiovoni and Eric Werner
UVM graduate students	Vanessa Levesque and Liz Royar
DEC Watershed Coordinator	Jim Ryan

APPENDIX A.3 - Public Meetings Held in the Lamoille River Watershed

2001

March 21st- Browns River Watershed Council Public Forum, Browns River Middle School, Underhill. Hosted by the Browns River Watershed Council.

March 29th- Browns River Watershed Council Public Forum, Middle School, Westford. Hosted by the Browns River Watershed Council.

April 18th- Browns River Watershed Council Public Forum, Mt. Mansfield Union Library, Jericho. Hosted by the Browns River Watershed Council.

May 1st- Public Forum to introduce watershed planning and watershed council formation, Johnson Municipal Building.

May 23rd- Lamoille River Watershed Council Meeting, Johnson Municipal Building.

June 20th-Lamoille River Watershed Council Meeting, Johnson Municipal Building.

July 11th- Lamoille River Watershed Council Meeting and site visit- Lanphear Farm, Hyde Park.

July 23rd- Working Landscape Lamoille Watershed Public Forum watershed planning and the agricultural and forestry/logging community, co-sponsored by the Lamoille, Orleans, Winooski, and Caledonia County Natural Resources Conservation Districts, Johnson Municipal Building.

July 26th-Working Landscape Lamoille Watershed Public Forum-watershed planning and the agricultural and forestry/logging community, co-sponsored by the Lamoille, Orleans, Winooski, and Caledonia County Natural Resources Conservation Districts- Fairfax.

July 30th- Working Landscape Lamoille Watershed Public Forum- watershed planning and the agricultural and forestry/logging community, co-sponsored by the Lamoille, Orleans, Winooski, and Caledonia County Natural Resources Conservation Districts- Greensboro.

August 7th-Lamoille Watershed Public Forum-discussion of watershed planning and solicit residents' concerns regarding water quality and watershed visions, Peoples Academy, Morrisville.

August 22nd- Lamoille Watershed Public Forum- discussion of watershed planning and solicit residents' concerns regarding water quality and watershed visions, Cambridge Elementary School.

August 28th- Lamoille Watershed Public Forum- discussion of watershed planning and solicit residents' concerns regarding water quality and watershed visions, Milton Elementary School.

August 30th- Lamoille Watershed Public Forum- discussion of watershed planning and solicit the residents concerns regarding water quality and watershed visions, Hardwick Elementary School.

September 12th- Lamoille Watershed Public Forum- discussion of watershed planning and solicit the residents concerns regarding water quality and watershed visions, BFA Fairfax.

September 18th- Lake Champlain Phosphorous TMDL Panel Discussion-sponsored by the Lamoille Watershed Council- Johnson Municipal Building.

October 23rd-Lamoille River Watershed Council Meeting- Johnson Municipal Building.

November 15th- Lamoille River Watershed Council Meeting- Johnson Municipal Building.

December 13th-Lamoille River Watershed Council Meeting and Water Quality Panel Discussion- Johnson State College.

2002

January 17th- Lamoille Watershed Council meeting, Johnson

February 21st- Lamoille Watershed Council Panel Discussion- Roads and Working Landscape, Johnson

March 21st- Lamoille River Watershed Council meeting, Johnson

April 4th- Watershed Initiative Guidelines Interactive TV public forum, statewide

April 17th- Watershed Initiative Public Forum for Conservation Districts, Waterbury

April 18th- Lamoille River Watershed Council meeting, Fairfax

(2002 continued)

May 16th - Lamoille River Watershed Council meeting, Johnson
June 20th - Lamoille River Watershed Council meeting, Hyde Park
July 18th - Lamoille River Watershed Council meeting, Johnson
August 13th - Lamoille Agriculture and Water Quality technical meeting, Morrisville
August 15th - Lamoille River Watershed Council meeting, Johnson
September 19th - Lamoille River Watershed Council meeting, Johnson State College
October 17th - Lamoille River Watershed Council meeting, Morrisville
November 21st - Lamoille River Watershed Council meeting, Morrisville
December 19th - Lamoille River Watershed Council meeting, Morrisville

2003

January 16th Lamoille Watershed Council meeting, Morrisville
February 20th Lamoille Watershed Council meeting, Morrisville
March 20th Lamoille Watershed Council meeting, Morrisville
April 17th Lamoille Watershed Council meeting, Hyde Park
May 15th Lamoille Watershed Council meeting, Morrisville
June 19th Lamoille Watershed Council meeting, Morrisville
December 10th - Lamoille Watershed Council meeting, Morrisville
December 16th - Browns River Public meeting, Underhill

2004

January 14th Westford forum
June 17th - Lamoille Watershed Council meeting, Morrisville

2005

March 15th - Lamoille Watershed Council meeting, Morrisville

2008

October 20th - Lamoille Watershed Council meeting, Morrisville

2009

November 17th - Lamoille Basin Plan Release Meeting, Westford
November 18th - Lamoille Basin Plan Release Meeting, Hardwick
November 19th - Lamoille Basin Plan Release Meeting, Morrisville

Public Forums attendance totaled over 250 residents (Browns and Lamoille Watershed combined).

APPENDIX A.4 - Municipal Meetings Regarding Surface Water Typing and Classification

2003

March 13th Georgia Conservation Commission
March 24th Fairfax Select Board
April 7th Jericho Select Board
April 7th Essex Select Board
April 14th Georgia Select Board
April 16th Underhill Select Board
May 5th Milton Select Board
May 14th Greensboro Select Board
May 20th Morristown Conservation Commission
June 3rd Greensboro Planning Commission
August 5th Craftsbury Select Board
August 7th Hardwick Select Board
August 11th Walden Select Board
August 14th Woodbury Select Board
September 11th Wheelock Select Board
September 18th Hardwick Select Board
September 22nd Stannard Select Board
October 1st Sheffield Select Board
October 2nd Glover Select Board

2004

January 4th Morristown Select Board
January 7th Hyde Park Select Board
January 8th Cambridge Select Board
January 8th Johnson Planning Commission
February 2nd Waterville Select Board
February 4th Wolcott Select Board
February 5th Belvidere Select Board
February 18th Eden Select Board
March 10th Elmore Select Board
June 21st Johnson Select Board
August 19th Hardwick Select Board
September 8th Milton Select Board
November 4th Underhill Select Board
November 10th Elmore Select Board
November 16th Milton Town Manager and Engineer
November 17th Eden Select Board
December 6th Milton Select Board

2005

January 20th Milton Public Hearing on Surface Water Typing proposal
February 14th Woodbury Conservation Commission
April 7th Fletcher Select Board

APPENDIX A.5 - Functions and Values of Selected Wetlands

Wetland Complex Name and Location	Wetland Features
Northern Piedmont Region	
Greensboro Brook Wetlands, Greensboro	Long linear wetland associated with river inlets.
Long Pond Wetlands, Greensboro	A northern white cedar swamp with rare and threatened plant species.
Mt. Sarah Southeast Swamp, Greensboro	A significant northern white cedar swamp
Page Brook Swamp, Wheelock and Sheffield	Northern white cedar swamp and spruce-fir-tamarack swamp. Contains diverse vegetation, isolated location, and rare endangered plant species.
Flagg Pond wetlands, Wheelock	A significant northern white cedar swamp
Bear Mt. Pond Swamp, Walden	A significant northern white cedar swamp
Northern Green Mountain Region	
Molly Bog, Morristown	A peatland complex with four bogs, northeast kettlehole bog, spruce-fir swamp and upland forest, uncommon plant species, and one of the state's greatest diversity of mosses. Owned by UVM.
Belvidere Bog, Belvidere	Highly significant cold-water fishery habitat, water quality protection, erosion control, education, recreation, and wildlife habitat. Provides habitat for loons and endangered plant species. Rated a high quality northern bog. Large undisturbed area surrounds the complex.
White Branch wetlands, Eden	A large scrub-shrub wetlands complex.
Gihon River Wetlands, Eden	A large scrub-shrub wetlands complex.
Bear Swamp, Wolcott	A large scrub-shrub wetlands complex.
Beaver Meadow, Hyde Park	A large scrub-shrub wetlands complex.
Green River Reservoir wetlands, Hyde Park	A large scrub-shrub wetlands complex.
Lake Elmore Wetlands, Elmore	A large scrub-shrub wetlands complex.
Lake Champlain Valley Region	
Sandbar State Park Wetlands, Colchester	A very large wetland complex owned and managed by the Vermont Fish and Wildlife Department. One of the best examples of flood plain forest in the state contains extensive shallow and deep-water marshes, buttonbush shrub swamps, uncommon and rare plant species and provides nesting habitat for rare and uncommon waterfowl and wading bird species. The size, location, functions, and diversity of this wetland complex make it one of the most important wetlands in the watershed.
Mill Brook Black Spruce Bog, Fairfax	A large diverse wetland complex that provides water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.
Towne Swamp, Milton	The only red maple-northern white cedar swamp located in a deltaic sandplain landscape. It is located within the sands of the historic, preglacial delta of the Lamoille, which in addition to its largely undisturbed nature makes it an important wetland. Contains rare and threatened plant species.
Lower Lamoille Oxbow swamp, Milton	A large diverse wetland complex that provides water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.
Browns River swamp, Essex	A large diverse wetland complex that provides water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.
Browns River Wetland, Jericho	A large diverse wetland complex that provides water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.
Essex Center Swamp, Essex	A large diverse wetland complex that provides water quality protection and wildlife habitat in an environment that is becoming increasingly urbanized.

APPENDIX A.6 - Fluvial Geomorphology and historic river corridor management

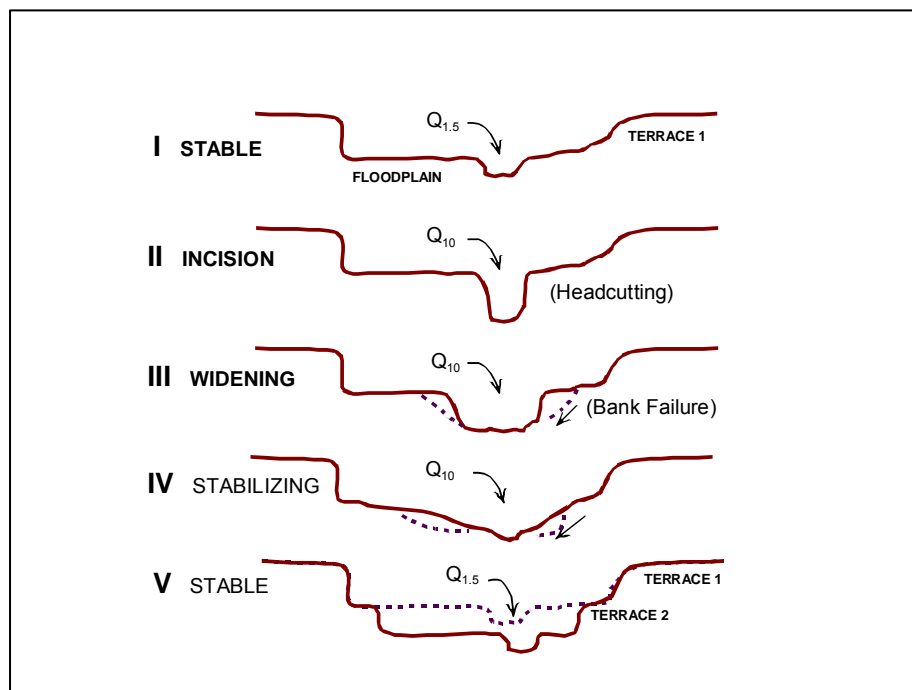
Fluvial geomorphic science explains the physical river processes and forms that occur in different landforms and geologic and climatic settings (DEC, 2002). The term “in adjustment” is used to describe a river that is undergoing change in its channel form and/or fluvial processes outside the range of natural variability.

Between the 18th and 19th centuries, the building of roads and railroads within the floodplains, land clearing for agriculture and housing, and the moving of streams to accommodate agriculture resulted in unstable river channels. Following floods large-scale channelization practices were employed to reclaim damaged lands. The 1970s and 1980s were also a period of extensive gravel mining in the Lamoille River and its tributaries. Post-

referred to as “headcutting.” Once a stream begins to headcut, it will typically erode its way through the five-stage channel evolution process, depicted in Figure (A.7), until it has created a new floodplain at a lower elevation in the landscape.

Figure A.7. Five Stages of Channel Evolution

The bed erosion that occurs when a meandering river is straightened in its valley is a problem that is compounded through its effects on other reaches of the river. Headcuts can travel upstream and into tributaries, eroding sediments from otherwise stable streambeds. These bed sediments will move into and clog areas downstream leading to lateral scour and erosion of the streambank. Channel evolution processes may take decades to play out. Landowners that have maintained wooded areas along their stream and riverbanks, or have stabilized the riverbanks with rip-rap have experienced



flood channel straightening and gravel mining has had the effect of steepening the stream channels. A steep channel in a relatively flat valley may initiate a bed degradation process

eroding banks as the river channel slopes have undercut banks as they adjusted to match the valley slopes, triggered by downstream or upstream channel disturbances.

A significant percentage of Vermont rivers have undergone channelization. Typically, channelized streams are straighter, steeper, wider, and largely devoid of instream and riparian features that maintain natural channel stability and provide a diversity of aquatic and riparian habitats (ANR, 2003). Channelization practices that were started over 100 years ago to accommodate early settlement, roads, railroads, logging, farms, mills, and other “human investments” have been periodically maintained through gravel removal, realignment, channel armoring, and post flood remediation projects. Many channels have incised, eroding downward, losing access to their flood plains that are essential to maintaining natural channel stability over time. Many miles of rivers have lost access to their flood plains run-off events resulting in a tremendous increase in channel adjustment and erosion.

While channelization continues today, many straightened reaches are now widening and aggrading. The physical adjustment processes (most commonly observed as streambank erosion) lead to the planform or meander changes that are imperative for the river system to attain a natural balance within its watershed. Each time a river has been straightened, dredged, bermed, and armored to mitigate flood damage without respect for the physical form and function of its channel and flood plain, adjustments were set in motion that, more often than not, led to further erosion. The decades that often intervene between major floods have given people the misperception that their channelization projects actually worked.

The cumulative impact of human actions have degraded physical habitat necessary to support healthy populations of some fish species and other aquatic life. Repeated channelization reduces the river bed and riparian structures upon which aquatic biota rely for shelter, food, and reproduction.

**APPENDIX A.7 - Summary of Chemical and Biological Assessments of the
Lamoille River Watershed Completed or Underway**

Assessment Title	Date	Lead Organization(s)	Waterway/Location	Protocols/Summary
<i>Biomonitoring/Biological Assessments</i>				
Macroinvertebrate & fish community diversity monitoring	5 year rotation	DEC BASS Lab	Lamoille River, Browns River, Brewster River, Lee River, Morgan Brook, Abbey Brook, Arrowhead Lake, Stevensville Brook, Mill Brook, Gallup Branch, North Branch, Basin Brook, Beaver Meadow Brook, Wild Branch, Wolcott Pond, Elmore Branch, Long Pond, Caspian Lake, Bailey Brook, Gihon River	Monitoring data is one parameter used in determining if waterways meet Vermont Water Quality Standards (impaired waters list)
Critter Watch	2002-2004	LCNRCD and River Network	Foot Brook, Johnson	River Network macroinvertebrate protocols
Macroinvertebrate monitoring	On-going	Lamoille Union H.S.	Lamoille River main stem, Hyde Park	-
Macroinvertebrate & chemical monitoring	On-going	Peoples Academy H.S.	Lamoille River main stem, Morrisville	-
Macroinvertebrate monitoring	On-going	Sterling College	Wild Branch and Eden Pond	-
Macroinvertebrate monitoring	-	BFA Fairfax H.S.	Lamoille River main stem, Fairfax	-
CHEMICAL ASSESSMENTS				
Kenfield Brook E. coli sampling	On-going	Morristown Conservation Commission	Kenfield Brook, Lamoille River (15A), Lake Lamoille, & Beaver Meadow Brook	Swimming hole E. coli sampling
LAKE ASSESSMENTS				
Spring Phosphorus	On-going rotational	DEC- Lakes Section	Lamoille Watershed lakes & ponds	Phosphorus, dissolved oxygen, clarity
Lake Assessments	On-going	DEC- Lakes Section	Arrowhead Mt. Lake, Caspian Lake, Lake Elmore, Green River Reservoir, Half Moon Pond, Wolcott Pond, Flagg Pond, Long Pond, Lake Eden, South Pond, & Lake Lamoille	Substrate, access, shoreline features, adjacent land use, pH, DO, clarity, algae, shoreline development & erosion, wilderness characteristics, natural communities, & non-native species
<i>Wetlands Assessments</i>				
Significant Wetlands of the Lamoille Watershed	2001	DEC- Wetlands Section	Lamoille River watershed wetland systems	Qualitative assessment of the Lamoille's wetlands

Assessment Title	Date	Lead Organization(s)	Waterway/Location	Protocols/Summary
<i>Hazardous Waste, Landfill, & Wastewater Treatment Facility Monitoring</i>				
Various DEC site monitoring database inventories	On-going	DEC- Waste Management & Wastewater Management Divisions	Sites throughout the Lamoille watershed	Groundwater and surface water monitoring at hazardous waste sites, wastewater treatment facilities, and landfills. Sites are summarized in the Basin 7 Report .
<i>Agricultural Related Assessments</i>				
Watershed Plan, Lower Lamoille Watershed	1992	NRCS	Lower Lamoille River watershed-downstream of the Gihon River confluence	Inventory and plan that addresses waste management system needs (phosphorus) & cropland erosion.
<i>Comprehensive Watershed Assessments & Plans</i>				
Basin 7- Lamoille River Watershed Assessment Report	2001 5- year rotation	DEC- Planning Section	Lamoille River Watershed	Comprehensive review of physical, chemical, & biological monitoring & assessments.
Lamoille River Basin Water Quality Management Plan	1976	DEC	Lamoille River Watershed	Addresses municipal wastewater facility needs and to a lesser degree non-point source pollution & lake eutrophication.

Key:

DEC- Vermont Department of Environmental Conservation **VDFW-** Vermont Department of Fish and Wildlife

DEC's BASS Lab- Biomonitoring and Aquatic Studies Section **NRCS-** USDA Natural Resources Conservation Service

RPCs- Lamoille and Chittenden County Regional Planning Commissions

APPENDIX A.8 Fluvial Geomorphic and Other Assessments Related to the Physical Health and Stability of Streams in the Lamoille River Basin

Project Name	Towns	Phase 1 Report (LCPC)	Number of Phase 2 Reaches	Phase 2	Bridge and Culvert	River Corridor Plan (RCP)
Elmore Branch	Elmore, Wolcott	✓	11	DRAFT 3/07 - convert to RCP	In DMS✓	
Gihon River	Johnson, Hyde Park, Eden	draft, as of 1/15/08	17	DRAFT 3/07 - convert to RCP	LCPC - Spring '08	
Centerville	Hyde Park	draft, as of 1/15/08	8	Started, combine with RCP	Mainstem thru Reach 15.09 in DMS (LCPC)✓	
Lamoille River Mainstem- HUC1	Cambridge, Johnson, Fairfax, Georgia, Milton		6	Started, combine with RCP	Data in DMS (BCE, LCPC)✓	
Lamoille River Mainstem - HUC2	Johnson, Hyde Park, Morristown, Wolcott, Hardwick		9	Started, combine with RCP	Data in DMS (BCE, LCPC)✓	
Browns River	Fairfax, Westford, Essex, Jericho, Underhill	✓	21	✓	Data in DMS	✓
Wild Branch	Wolcott, (Craftsbury), Eden	✓	19	Combine with RCP	Data in DMS✓	
Rodman Brook	Morristown, Hyde Park		3	Combine with RCP	Data in DMS✓	
Green River	Wolcott, Hyde Park, Eden	May '08	0		Data in DMS✓	
Elmore Pond Brook	Wolcott, Elmore		0		LCPC - Spring '08	
Foote Brook	Johnson		4	Combine with RCP	In DMS✓	
North Branch of Lamoille River	Cambridge, Waterville, Johnson, Belvidere (Montgomery)	LCPC	4		LCPC - Spring '08	
Judevine River	Cambridge, Waterville, Johnson		1		In DMS✓ with exception of lower reach	
Hunt Brook	Cambridge		3			
Brewster Brook	Cambridge		13			
Settlement/ Seymour	Cambridge		24			
Ryder Brook	Morristown					Fall '10
Kenfield Brook	Morristown					Fall'10

APPENDIX A.9 - Methodology for Typing and Classification of Waterbodies in the Lamoille River Basin

For all water quality management goals, it is assumed that agricultural and silvicultural activities that follow Accepted Agricultural Practices and Acceptable Management Practices respectively will comply with the Water Quality Standards. Once the Vermont Water Resources Board adopts the water management type designations for specific waters, it is the responsibility of the Agency of Natural Resources, individuals and all levels of government to work to achieve or maintain at least the level of water quality specified by the designations.

The proposal for typing Class B waters in the Lamoille River Basin attempts to respect the community's expectations for land use while maintaining or enhancing the waters. The Water Quality Standards (Vermont Water Resources Board, 2000) state:

“...the basin plans shall propose the appropriate Water Management Type or Types based upon both the existing water quality and reasonably attainable and desired water quality management goals.”

“...to review and consider approved town and regional plans” to assure compatibility of the criteria based proposals with local stated goals.

Methodology Used to Fulfill Existing and Reasonably Attainable Water Quality

A summary of the typing and classification methodology to fulfill the Existing and Reasonably Attainable Water Quality Management *Goal* included:

1. Compilation and evaluation of previous assessment and monitoring information using chemical, physical, and biological data, and best professional judgment regarding water quality and aquatic habitat of lakes, ponds, streams, and wetlands within the basin to determine approximate existing conditions. Data was collected from Vermont Department of Fish and Wildlife Fisheries Division and Non-game and Natural Heritage Program and DEC's Hydrology, Lakes and Ponds, Wetlands, Planning, BASS Lab, and River Management Sections.
2. All technical advisors listed above reviewed the compiled data.
3. The DEC Watershed Coordinator proposed a typing and classification draft.

Class B Waters

B1 Waters

- Most municipal and state owned lands below 2,500 feet in elevation
- Lakes and ponds that are considered wilderness or near-wilderness areas, DEC's Lake Protection Classification System (DEC, 1994)
- Surface waters adjacent to publicly owned lands that are remote, provide significant fish and wildlife habitat, natural communities, and recreational opportunities
- Surface waters that currently meet all or some of the B1 criteria or that B1 criteria are reasonably attainable
- Waterbodies that local officials and residents wish to manage as almost natural conditions and where such management is reasonably attainable

B3 Waters

All Class B waters that are presently managed for a moderate change in flows or stream habitat because of a dam, water level fluctuation, or water withdrawal (hydro facilities, ski area water withdrawal, and flood control) are proposed to be designated B3, which allows for flow alterations.

B2 Waters

- The proposal designates most current Class B waters as management type B2, which is the middle type of Class B waters. The B2 designation raises the threshold for water quality from the floor of B, which equals type B3. All waters not otherwise designated as A1, A2, B1, or B3 are proposed as B2.

Methodology Used to Account for the Desired Water Quality

A summary of the typing and classification methodology to fulfill the Desired Water Quality Management Goal included:

1. DEC Watershed Coordinator reviewed approved town plans, zoning, and regional plans to identify present and desired future land uses and to assure compatibility of proposals with locally stated goals. The effect of present and desired future land use on water quality is considered.
2. Coordinator presented the proposal to the Watershed Council to review and then made any recommended revisions.
3. Coordinator presented the proposal to local select boards and/or planning commissions, regional planning commissions, state land managers (Forests and Parks and Fish and Wildlife), utility companies, and relevant watershed organizations (*Appendix A.4*).
4. Coordinator revised the original proposal as the result of step 3.
5. Coordinator presented the revised proposal to the Watershed Council.
6. The Agency considered all of the factors above before developing the final proposal.
7. The proposal is reviewed by the public.
8. DEC and Secretary makes any necessary changes to the proposal and approves plan.
9. The typing and classification proposal is submitted to the Water Resources Board.
10. The Water Resources Board holds hearings on the proposal and makes final decisions on the proposal.

APPENDEX A.10- Vermont Anti-Degradation Implementation Existing Uses Determination for Use During River Basin Planning (DRAFT)

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. Further, Vermont's Anti-Degradation Policy requires that the existing uses and the level of water quality necessary to protect those existing uses shall be protected and maintained (Section 1-03, Vermont Water Quality Standards). 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.¹ The Agency of Natural Resources will use the following process to identify existing uses of contact recreation, fishing, boating and public drinking surface water supplies during river basin planning and the development of river basin water quality management plans.

1. The Agency will presume that all lakes and ponds that exist within a river basin have existing uses of fishing, contact recreation and boating. This simplifying assumption is being used for two principal reasons: first, the well known and extensive use of these types of waters for these activities based upon their intrinsic qualities; and, secondly, to avoid the tedium associated with the production and presentation of exhaustive lists of all of these types of waterbodies across any given river basin. This presumption may be rebutted on a case-by-case basis during the Agency's consideration of a permit application which might be deemed to affect these types of uses.
2. Each river basin plan will include a list of existing uses of contact recreation, fishing, boating in/on flowing waters and a list of public drinking surface water supplies, which will be identified using the criteria set forth below.
3. To determine the presence of an existing use of contact recreation, fishing or boating on/in flowing waters or a public drinking water supply during the river basin planning process, positive findings with respect to several conditions need to be made. The unique set of criteria for each particular existing use is set forth below.
4. The list of existing uses in each river basin plan is not intended to represent an exhaustive list of all existing uses, but merely an identification of very well known existing uses. Additional existing uses of contact recreation, boating and fishing on/in flowing waters and additional public drinking water supplies may be identified during the Agency's consideration of a permit application.

Contact Recreation in Flowing Waters

The Agency may base its determination of the presence of an existing use for contact recreation in flowing waters if it can be shown there is more than an incidental level of use of the specified water body. The application of existing use determination criteria for contact recreation shall not apply to contact recreation situations that may be occurring but at a level deemed to be incidental, irregular and/or infrequent or in situations where there is no clearly defined or previously established access to the water. In determining the presence and level of use in a specified water body, positive findings are needed for both condition 1 and 2:

Condition 1. There is documentation and/or physical evidence that people have access to the waters for contact recreation.

Documentation or physical evidence may consist of:

- a. Existence of road pull-off areas, public parking areas, and public access trails.
 - ☞ Video and/or pictures taken from adjacent roads and from the water.
- and
- b. Status of land ownership: public lands and/or public easements defining access locations
 - ☞ Previously designated public contact recreation or public beach area.

¹ As per the Vermont Water Quality Standards, "existing use means a use which has actually occurred on or after 11/28/1975, 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."

- ☞ Maps of municipal, state, or federal lands (including road rights-of-ways and bridge crossings).
- ☞ Documents referring to easements on private lands granting public access to the water for contact recreation purposes;

Condition 2. There is documentation and/or physical evidence of attractive contact recreation sites in and along the affected water.

Documentation or physical evidence may consist of:

- a. Presence of any sandy or grassy beach or rock outcropping areas where people can comfortably rest out of the water.
 - ☞ Maps, video or pictures taken along the shore land of the affected waters.
- b. Presence of area with sufficient depth, deep water holes, cascades, gorges, rock outcroppings or large boulders in or along the affected waters that create a slow and safe water area for swimming, wading, floating, tubing and/or bathing.
 - ☞ Maps, video or pictures taken of the affected waters.
- c. Presence of aesthetically pleasing waters.
 - ☞ Observations concerning water clarity and substrate composition.
 - ☞ Water quality data concerning level of human health risk (such as E.coli abundance) has been regularly collected.

Recreational Boating on Flowing Waters

The Agency may base its determination of the presence of an existing use for recreational boating if it can be shown there is more than an incidental level of use of the specified water body. The application of existing use determination criteria for boating shall not apply to those recreational boating situations that may be occurring but at a level deemed to be incidental, irregular and/or infrequent or in situations where there is no clearly defined or previously established public access to the water. In determining the presence and level of boating use in, on or along a specified water body, positive findings are needed for both condition 1 and 2:

Condition 1. There is documentation and/or physical evidence that people have access to the specified reach of water for recreational boating.

Documentation or physical evidence may consist of:

- a. Evidence of road pull-off areas, public parking areas, and public access to the waters edge for boat put-ins, take-outs and portage routes.
 - ☞ Maps (digital or hardcopy) of designated public boating access points and public pathways to the water.
 - ☞ Video and/or pictures taken from adjacent roads and from the water.
 - ☞ Video and/or pictures taken of specified access area in use.
 - ☞ Video and/or pictures taken of designated public boating access points and public pathways to the water.

and

- b. Status of land ownership: public lands and/or public easements defining access locations.
 - ☞ Maps of municipal, state, or federal lands (including road rights-of-ways and bridge crossings) detailing public boating access points and public pathways to the water.
 - ☞ Documents referring to easements on private lands that grant public access to the water for recreational boating purposes;

Condition 2. There is documentation and/or physical evidence of attractive recreational boating in, on or along the specified reach of water.

Documentation or physical evidence may consist of:

- a. Features (unique or otherwise noted) valued for recreational boating (whitewater or flat-water).
 - ☞ Video or pictures taken along the shore land of the specified waters and features.
- b. Pooled water, rapids, ledges, cascades, gorges, rock outcroppings or large boulders in or along the specified reach that create rapids or pools for boating.
 - ☞ Video or pictures taken of the specified waters.

- c. Aesthetically pleasing waters.
- ☞ Observation of water clarity and substrate composition.

Recreational Fishing in Flowing Waters

The Agency of Natural Resources fully supports and actively promotes fishing in Vermont's waters. While fishing may occur in most waters of the State, in many places this use may be occurring on merely an incidental level. As part of the river basin water quality management planning process, the Agency recognizes that fishing occurs in all lakes and ponds and in certain reaches of flowing waters (i.e. streams and rivers).

The existing uses for fishing were identified by staff using an Agency procedure developed specifically for use only during the preparation of basin plans. This procedure focuses solely on the identification of well recognized and documented existing uses with public access and therefore is not meant to be an exhaustive list of existing uses for fishing within any particular river basin. It is expected that additional existing uses for fishing will be identified in the future, both as a result of additional information gathered by staff during basin plan updates and as part of Agency reviews of permitting applications for projects that affect the basin. The Agency plans to develop an additional procedure to guide staff in further identifying existing uses in the context of permit application reviews.

The Agency may base its determination of the presence of an existing use for recreational fishing if it can be shown there is more than an incidental level of use of the specified water body. The application of existing use determination criteria for fishing shall not apply to situations where fishing may be occurring but it is being done at a level deemed to be incidental, irregular and/or infrequent or in situations where there is no clearly defined or previously established public access to the water. In determining the presence and level of use in a specified water body, positive findings are needed for both condition 1 and 2 or for either condition 3 or 4:

Condition 1. There is documentation and/or physical evidence that people have public access to the waters for recreational fishing.

Documentation or physical evidence may consist of:

- a. Existence of road pull-off areas with public parking areas, public access trails, publically accessible streambanks or similar features.
- ☞ Video and/or pictures taken from adjacent roads and from the water.

AND

- b. Status of land ownership: public lands and/or public easements defining access locations.
- ☞ Previously designated public boat launching area with vehicle parking.
- ☞ Maps of municipal, state, or federal lands (including road rights-of-ways and bridge crossings).
- ☞ Documents referring to easements on or across private lands granting public access to the water for recreational fishing purposes.
- ☞ Documentation of private ownership by 501c3 non-profit conservation organizations and/or land trusts that promote or grant public access for fishing.

AND

Condition 2. There is documentation and/or physical evidence of sites to fish in, on or along the specified reach of water.

Documentation or physical evidence may consist of:

- a. Presence of any land areas along rivers where people can comfortably engage in angling.
- ☞ Video or pictures taken along the shore land of the affected waters.
- b. Presence of pools, fish refuge areas and other habitats in, on or along the affected waters (especially rivers) that create sufficient habitat structure and diversity suitable for fish targeted by Vermont anglers.
- ☞ Video or pictures taken of the affected waters.
- c. Presence of fish populations targeted by Vermont anglers.
- ☞ Fish population surveys documenting the presence of target species.
- ☞ Survey data concerning angler use and catch rates.

- ☞ Water quality data concerning target fish suitability and sustainability has been regularly collected.

OR

Condition 3. There is documentation of reaches where special regulations for fishing have been imposed by the State of Vermont (whether stocked fish or not).

Documentation or evidence may consist of:

- a. Type, nature and subject species of special fishing regulation(s).

OR

Condition 4. There is documentation of reaches or affected waters that are stocked as a result of being identified on the State's Managed Request for Cultured Fish.

Documentation or evidence may consist of:

- a. Species being stocked and stocking history of affected waters.

Public Drinking Surface Water Supply

The Agency may base its determination of the presence of an existing use for a public drinking surface water supply if there is more than an incidental use of the specified water body as a public drinking surface water supply. The application of existing use determination criteria for public drinking surface water supplies shall not apply to non-public or domestic water supply withdrawals (e.g. single family residence) from a specified surface water. In determining the presence of an existing use of a public drinking surface water supply source in a specified water body, positive findings are needed for the following condition:

Condition 1. Documentation and/or physical evidence exists that the specified waters are used as a source for public drinking water supply.

Documentation and physical evidence may consist of:

- a. Recorded regular use of specified water body as an active public drinking water supply source.
 - ☞ Maps and documents detailing supply intake locations, permits, source protection areas and approximate number of connections or people served.
- b. Recorded use of specified water body as a designated emergency (not in active use) public drinking water supply source.
 - ☞ Maps and documents detailing supply intake locations and inclusion in source protection areas, plans or permits, etc.
- c. A physical intake for treatment and distribution of water for public drinking water supply from specified water body.

A.11- Lamoille Waters in Need of Further Assessment

Waterbody name and location	Possible problem/pollutants needing assessment	Recently completed or planned assessments and projects
Lamoille River at mouth, Colchester	Phosphorus loading to Malletts Bay segment	DEC Lakes Sections phosphorus sampling is on-going. Many plan action items will reduce P loads to outer Malletts Bay
Lower Lamoille River from Fairfax Falls dam to Arrowhead Mt. Lake	Sediment, nutrients, E. coli. Agricultural runoff and elevated levels of mercury in walleye	Buffer inventory of the main stem completed in 2004 by NWRPC. Sufficient riparian buffers can filter runoff to adjacent waterways. Implementation of the lower Lamoille FERC license hydro will address extensive water level drawdowns which may reduce mercury levels
Lamoille River: Lake Lamoille to Fairfax Falls dam	Sediment, nutrients, E. coli, bank instability, plan-form adjustment, and channel over-widening	A Phase 1 geomorphic assessment completed 2005. A Phase 2 assessment will be completed in 2009. Assessment results will better determine causes of instability and recommend appropriate treatments.
Lamoille River: Hardwick Lake to Lake Lamoille	Sediment, nutrients, E.coli., Bank instability and agricultural runoff	A buffer inventory has recently been completed by LCRPC and NVDA. A Phase 1 geomorphic assessment was completed in 2004. A Phase 2 assessment was completed in 2006. Assessment results will better determine causes of instability and recommend appropriate treatments.
Seymour River	Sediment, nutrients, bank erosion, agricultural encroachments, and channel instability	A Phase 1 is completed. Phase 2 geomorphic assessment will be completed in 2009. Assessment results will better determine causes of instability and recommend appropriate treatments.
Brewster River	Sediment, increased peak stormwater discharge, road and parking lot runoff	A new bridge has been constructed on No Name brook, which is a trib to the Brewster. A stream restoration project was implemented for an unnamed tributary to the Brewster including limestone treatment in 2005 and in 2006 showing water quality and aquatic biota improvement. A new bridge, parking lot relocation, and new stormwater management BMPs at Smugglers Notch is planned in the future.
North Branch Lamoille	Toxics, sediment, bank erosion and channel instability	Phase 1 and 2 geomorphic assessment is completed. Assessment results will better determine causes of instability and recommend appropriate treatments. MTBE discharge will require additional monitoring.
Gihon River, Eden and Johnson	Leak from underground storage tank, organics oil spills in close proximity to surface water	Recent water monitoring indicates minimal impacts to adjacent waters.
Mud Brook, Morristown	Iron precipitate from corroding culverts within earthen dam impacting aquatic biota	VDFPR has initiated some work on the earthen dam to address problems and are evaluating the removal of the artificial dam and impoundment causing discharge
Wild Branch, Wolcott and Craftsbury	Hydrology changes, watershed land use change, morphologic instability	Phase 1 and 2 geomorphic assessment complete, erosion hazard mapping, and bridge and culvert survey is completed . A fluvial erosion hazard overlay district will be developed for the Town of Wolcott to avoid future human-river conflicts. Bridge and culvert survey information will be shared with towns to develop stream crossing capital budgets for upgrades.
Stannard Brook, Stannard	Flooding related effects and erosion	Phase 1 and 2 geomorphic assessment was completed in 2001 and revised to fit updated protocols in 2005. A bridge and culvert survey of the upper Lamoille watershed completed in 2004. Bridge and culvert survey information will be shared with towns to develop stream crossing capital budgets for upgrades.

APPENDIX A.12 - Review of Municipal Plan and Local Bylaws for Water Quality Provisions

Lamoille County Towns- Reviewed by the Lamoille County Planning Commission

Town of Morristown/Morrisville

Municipal Plan- 2008

The Town of Morristown's Municipal Plan includes a very well written inventory of the town's lakes and ponds. All aspects regarding local water resources, such as a discussion of major groundwater resources, wellhead protection, and aquifer recharge areas within the town are well written. The plan does include a good inventory of rivers and streams within the town. The presence of special features and swimming holes is discussed well.

Shorelines within the town are clearly discussed in the municipal plan. There was a good amount of valuable information regarding the entire watershed. The municipal plan includes a well written review of soils that make up the town's lands.

Town of Morristown Zoning bylaws- 2000

- The Town of Morristown Zoning Bylaws contains many of the districts that should be present in order to protect water quality. These include flood hazard regulations and a wellhead protection area but the Town does not have shoreland regulations, which are used to protect water quality around lakes such as Lake Lamoille.
- The application requirements for a 'proposed site plan' require the identification of rivers, streams, water courses, drainage ditches, swamps, marshy areas, bogs, and unusual natural features. The bylaws have a 50-foot setback for public waterbodies and 100 feet from the Lamoille River in certain districts. Wetland setbacks are identified in the EPA district and are given a 50-foot setback except that the DRB can allow development within the 50-foot setback if it is determined not to have an impact. This should be changed so that no development is possible. State and federal legislation already pre-empt the local zoning and requires the 50-foot setback. Giving local permission may give the developer the impression that development is allowed when in fact it is not.
- The bylaws do not have shoreland regulations.
- The Flood Hazard regulations are good. The bylaws include a good purpose for the district and justification for the regulations.
- Permitted uses of flood hazard areas include agriculture, recreation, and non-structural residential uses such as gardens and play areas. Conditional uses could be more restrictive (requiring compensatory fill and prohibiting new structures in flood hazard area).
- Setbacks and buffers for streams could help water quality and bank stabilization.
- The WHPA regulations have a good justification for the regulations and purpose for the district.
- The discussion of permitted regulation is good but conditional uses and prohibited uses are less clear.
- Densities of one on-site wastewater field per acre is high for WHPAs.

Other Town Regulations & Ordinances

- Morristown does have subdivision regulations although they do not address water resources very well. No water features are required by the subdivision regulations to be shown on subdivision plats.
- Morristown has adopted road standards which is a benefit to water quality.
- Morristown has adopted a municipal sewage disposal ordinance which is also important to maintaining water quality.

Town and Village of Cambridge

Municipal Plan- 2003

The Town and Village of Cambridge Municipal Plan includes an incomplete inventory of the town's lakes and ponds, along with some current and historic water quality information. The plan does include a good inventory of rivers and streams within the town. The presence of special features and swimming holes, and the acknowledgement of floodplains are discussed well. Shorelines within the town are clearly discussed in the

municipal plan. There was a good amount of valuable information regarding the entire watershed. All aspects regarding local water resources, such as a discussion of major groundwater resources, wellhead protection, and aquifer recharge areas within the town are well written. The municipal plan includes a well written review of soils that make up the town's lands. The discussion of septic and sewer systems, as well as the town's water supply is well written. **No Zoning**

Town of Waterville

Municipal Plan- 2003

The water resources section of the Municipal Plan describes the Town's Fishing Resources, River and Stream Frontage, and Wetlands. It describes Taylor, Coddington, Judevine, and Streeter Brooks and Kelley River as "providing excellent brook, rainbow, and brown trout fishing and habitat for spawning and young fish." The Plan also states that "removal of natural vegetation causes elevated water temperatures and increased stream sediment, both resulting in deterioration of cold-water fisheries and spawning. Extensive development on the river will have a deleterious effect on area fishing. Planning should contain measures for pollution prevention, stream and riverbank stabilization, protection of water habitat, and protection from erosion. The Planning Board proposes a buffer zone subject to review or according to state guidelines on both sides of Kelley River and Taylor, Coddington, Judevine, and Streeter Brooks."

The Plan also states that "river and stream frontage is a valuable resource, which can help prevent water pollution, preserve wetlands, and provide for wildlife habitat, open space and scenic beauty. The Town may wish to preserve such areas for public usage and education."

Regarding wetlands the Plan states that "wetlands provide wildlife and vegetative habitat, help control erosion, improve quality of surface and groundwater, and provide invaluable beauty and education resources. Certain areas in town should be carefully considered for wetland reserves."

Town of Wolcott

Municipal Plan- 2007

The Town of Wolcott Municipal Plan includes a well written inventory of the town's lakes and ponds, along with some current and historic water quality information, and a discussion of present archaeological sites. The plan does include a good inventory of rivers and streams within the town. Consider identifying all rivers and streams within the town including their lengths. The presence of special features and swimming holes is discussed well. Shorelines within the town are clearly discussed in the municipal plan.

There was a good amount of valuable information regarding the entire watershed. All aspects regarding local water resources, such as a discussion of major groundwater resources, wellhead protection, and aquifer recharge areas within the town are well written. The municipal plan includes a well written review of soils that make up the town's lands. The discussions of septic and sewer systems and the town's water supply is well written.

Town of Wolcott Zoning Bylaws- 2001

- The Town of Wolcott Zoning Bylaws contain most of the districts that should be present in order to protect water quality including shoreland regulations and flood hazard regulations.
- Applicants are required to identify waterways on a site plan drawing but not necessarily wetlands. In future versions of the bylaws, wetlands should be required.
- The bylaws have a 150-foot setback for lakes, which is more aggressive than the recommended minimum 50-foot setback. The Wolcott Zoning bylaws require vegetative buffers around lakes but not streams, rivers, or wetlands.
- Wolcott has perhaps the best shoreland regulations in Lamoille County. The shoreland district is a very good size- lands within 500 feet of Wapanaki Lake, Wolcott Pond and Zack Woods Pond.
- As mentioned above, there is a 150-foot setback for structures and 200 feet for septic systems. Vegetation is required for the first 100 feet of shoreline.
- The Flood Hazard regulations are good. The bylaws include a good purpose for the district and justification for the regulations.
- The Town of Wolcott does not have Wellhead Protection Area Zoning regulations.

Other Town Regulations & Ordinances

- Wolcott subdivision regulations have open space provisions to ensure conservation and improvements along the banks of rivers, streams, and lakes.

- Additionally, the open space provisions are intended to protect natural drainage ways and floodwater retention areas.
- Wolcott has adopted a municipal sewage disposal ordinance which is important to maintaining water quality.

Town of Elmore

Municipal Plan- 2003

The Town of Elmore Municipal Plan does include a partial inventory of lakes and ponds within the town. The inventory of rivers and streams within the town is also incomplete.

Shorelines within the town are briefly discussed in the municipal plan, public access on Little Elmore Pond was mentioned but the issue could be more complete by addressing all accesses, fishing or not, along all shorelines. Excluding a discussion of industrial and municipal discharge locations, which could be improved by describing them as point source or non-point source. The discussion of the major surface waters within the town was satisfactory. The municipal plan includes a brief review of soils for the Worcester range area of town.

Town of Elmore Zoning Bylaws- 2000

- The Town of Elmore Zoning Bylaws contain most of the districts that should be present in order to protect water quality including shoreland regulations and flood hazard regulations. Applicants are required to identify water features on a site plan drawing.
- The bylaws have a 100-foot setback for lakes, which is more aggressive than the recommended minimum 50-foot setback, except for Lake Elmore which the town requires only a 40-foot setback. Rivers, streams, and wetlands are required to have a 50-foot setback as recommended.
- The Elmore Zoning bylaws require vegetative buffers around water features.
- The bylaws establish regulations for construction of Planned Residential Developments.
- The bylaws have very good provisions for the regulation of erosion and sediment control.
- The shoreland district is a very good size- lands within 500 feet of Lake Elmore, Elmore Pond and Hardwood Pond.
- As mentioned above, there is a 100-foot setback and 5-acre zoning (not Lake Elmore though) which are both aggressive for a district of this type.
- Like the Shoreland regulations, the Flood Hazard regulations are good. The bylaws include a good purpose for the district and justification for the regulations.
- Permitted uses of flood hazard areas include agriculture, forestry, and recreation. Conditional uses could be more restrictive (requiring compensatory fill and prohibiting new structures in flood hazard area).
- The Town of Elmore does not have Wellhead Protection Area Zoning regulations although a small area in exists on the Wolcott town line.

Other Town Regulations & Ordinances

- Elmore does not have subdivision regulations.
- Elmore has adopted a municipal sewage disposal ordinance which is also important to maintaining water quality.

Village of Hyde Park

Municipal Plan- 2001

The Village of Hyde Park does not have any identified lakes within its boundaries. The inventory of rivers and streams within the town is also incomplete. Shorelines within the town are briefly discussed in the municipal plan. There was no information in the municipal plan regarding the watershed. The municipal plan did not include a discussion of local water resources relating to major groundwater resources.

Village of Hyde Park Zoning Bylaws- 2000

- The Village of Hyde Park Zoning Bylaws contain all of the districts relevant to the district in order to protect water quality including flood hazard regulations.
- Application requirements should be listed in the bylaws and the identification of water features should be included on the list. Consider requiring the identification of all water features including, but not limited to, rivers and streams, wetlands, and lakes and ponds.

- The bylaws have a 25-foot setback for lakes and rivers in many, but not all, districts.
- The village does not have any lands which would require shoreline regulations.
- The Flood Hazard regulations are good. The bylaws include a good purpose for the district and justification for the regulations.
- There are no WHPAs in the village.

Other Town Regulations & Ordinances

- Hyde Park does not have subdivision regulations.
- Hyde Park has adopted road standards which is a benefit to water quality.
- Hyde Park has a municipal sewer system. A municipal sewage disposal ordinance applies to area outside of the sewer service area.

Town of Hyde Park

Municipal Plan- 2001

The Town of Hyde Park Municipal Plan includes an incomplete inventory of the town's lakes and ponds. The inventory of rivers and streams within the town is also incomplete. The presence of special features and swimming holes was discussed well. Shorelines within the town are briefly discussed in the municipal plan. There was a good amount of valuable information regarding the entire water shed within the town. The discussion of the major surface waters within the town was sufficient. The municipal plan includes a well written review of soils that make up the town's lands.

Town of Hyde Park Zoning Bylaws- 2001

- The Town of Hyde Park Zoning Bylaws contain all of the districts that should be present in order to protect water quality. These include shoreland regulations, flood hazard regulations, and a wellhead protection area.
- Applicants are required to show "streams and similar features" in their development proposals. A more specific requirement would be clearer for the applicant. Consider requiring the identification of all water features including, but not limited to, rivers and streams, wetlands, and lakes and ponds.
- The bylaws have a 100-foot setback for lakes, which is more aggressive than the recommended minimum 50-foot setback. Perhaps the Planning Commission could consider setbacks from rivers, streams, and wetlands as well.
- The shoreland district is a very good size- lands within 500 feet of Green River Reservoir. As mentioned above, there is a 100-foot setback and 5-acre zoning which are both aggressive for a district of this type.
- The Flood Hazard regulations are good. The bylaws include a good purpose for the district and justification for the regulations.
- Permitted uses of flood hazard areas include agriculture, recreation, and non-structural residential uses such as gardens and play areas.
- The WHPA regulations meet guidelines for permitted, conditional and prohibited uses. The current bylaws cover a 200-foot radius.

Other Town Regulations & Ordinances

- Hyde Park does not have subdivision regulations.
- Hyde Park has adopted road standards which is a benefit to water quality.
- Hyde Park has adopted a municipal sewage disposal ordinance which is also important to maintaining water quality.

Town of Johnson

Municipal Plan- 2000

The Town of Johnson Municipal Plan includes a well written inventory of the town's lakes and ponds, along with some current and historic water quality information, and a discussion of present archaeological sites. The plan does include a good inventory of rivers and streams within the town. The presence of special features and swimming holes is discussed well. Shorelines within the town are clearly discussed in the municipal plan.

There was a good amount of valuable information regarding the entire watershed. All aspects regarding local water resources, such as a discussion of major groundwater resources, wellhead protection, and aquifer recharge areas within the town are well written. The municipal plan includes a well written review of soils that make up the town's lands. The discussion of septic and sewer systems, as well as the town's water supply is well written. **No Zoning**

Town of Belvidere

Municipal Plan- 2005

The Town of Belvidere does not have any identified lakes within its boundaries. The Plan mentions Lost Pond at the headwaters of Rattling Brook and several unnamed ponds. The inventory of Lamoille watershed rivers and streams includes the North Branch, Streeter Brook, North Fork, Rattling Brook, Otter Brook, Basin Brook, and Calavale Brook. Shorelines within the town are briefly discussed in the municipal plan. The Plan describes Kelley River Falls cascades as a popular place for fishing and swimming but privately owned and not posted. The Plan also mentions the 9 mile stretch of Class II-IV whitewater boating from below Long Pond in Belvidere Corners to Waterville.

The Plan describes the Belvidere Bog as highly significant for its size, diversity, and functions including cold water fishery habitat, water quality protection, erosion control, education, recreation, and wildlife habitat (see Plan Recommendations below).

The Plan summarizes geomorphic and biological assessment results in town. The Plan summarizes the State's Surface Water Management designations and previous local efforts to reclassify the North Branch as an A1 water and states that "the Planning Commission and Select Board should consider working with DEC's watershed coordinator to establish surface water management goals of B1 for the North Branch and some of its tributaries as the water quality is such that it could support such a designation." The Plan also states that "enforcement of on-site septic and floodplain regulations would better protect this (shoreline) resource." The Plan also describes the effect of agricultural, stormwater, and logging runoff on water quality.

The Plan recommends establishing special districts to protect the natural resources of Belvidere including Belvidere Bog, the higher elevations of Laraway and Cold Hollow Mountains, and prime forest lands. Within development districts "regulations of uses adjacent to streams and rivers would go a long way to protecting water quality, wildlife habitat, and the health and safety of the public." More specifically the Plan states in the Natural Resources Goals section "for Belvidere's water resources, including its ponds, streams, rivers, wetlands, groundwater, and associated habitats to be preserved and, where degraded, improved in order to ensure water quality for drinking, recreation, and the environment."

Plan Policies language includes:

- Development near rivers and streams should be located in such a way as to minimize the number of stream crossings.
- A natural vegetative buffer 25 feet wide is required for all streams and 50 feet for the North Branch.
- All wetlands are required to have a 50 foot buffer. No filling for dredging of wetlands is permitted. Belvidere Bog should have a 100 foot buffer.
- No structures should be constructed within the flood hazard area. Filling of the flood hazard area or obstructing flow of floodwaters is also prohibited.
- No form of land waste disposal or storage of possible contaminants should be permitted in the high water table and ground water recharge areas.
- All construction where soil is to be disturbed should provide adequate erosion control so that no soil moves off site or into surface waters or wetlands.
- Agricultural and forestry must abide by AAPs and AMPs. Where an activity may have a negative impact on water quality, BMPs are recommended.

Plan Recommendations language includes:

- The Planning Commission should consider acquiring funds to have a wetland inventory of the town conducted.
- The Town should consider purchasing properties or development rights of properties with the floodplain to permanently prevent development in those areas.

- The Planning Commission should consider creating a plan for the flood hazard areas to address recreational opportunities, flood hazard protection, and the potential for implementation of water quality measures.
- Belvidere should continue to enforce On-site Septic Ordinances in order to ensure septic systems are safe and do not create a water quality problem.
- Belvidere supports the acquisition of lands within and around Belvidere Bog by local or state conservation agencies.
- The Town should petition the state to include Belvidere Bog on the Fragile Areas Registry as well as a Class I wetland so that the area is given the greatest amount of protection from any potential encroachment.

The Plan describes the importance of flood plains flood hazard areas (see Flood Hazard Zoning below).

Flood Hazard Zoning- Amended in 2006

Belvidere's Flood Hazard Zoning regulates the use and construction of structures in the flood hazard area. Flood hazard areas are associated with most of the length of the North Branch from Belvidere Center to Morgan Bridge. Development restrictions include a development set back of 25 feet from the top of bank and "recommends a naturally vegetated buffer be maintained on all perennial streams and rivers and wetlands as well and a 50 foot setback from wetlands."

Town of Eden

Municipal Plan 2007

Orleans and Caledonia County Towns

Town of Craftsbury

No Municipal Plan or Zoning Bylaws

Town of Walden

No Municipal Plan or Zoning Bylaws

Town of Glover

No Municipal Plan or Zoning Bylaws

Flood Hazard Regulations approved in 1991. Lands within the National Flood Insurance Program floodway- permits required for new construction or improvements. Agriculture and Recreation are permitted uses. Junkyards are prohibited within the floodway. Water supply and sanitary sewage systems designed to minimize or eliminate infiltration of flood waters.

Town of Greensboro

Municipal Plan- 2001

Major objectives in the plan include "preserve Caspian Lake and its surroundings as a vacation area, and to preserve the quality of Greensboro's surface water including lakes, ponds, rivers, streams, and wetlands as sources of water supply; absorption of flood water, habitats for wildlife, waterfowl, and vegetation; recreation areas; and aesthetic enjoyment."

Protection of sensitive environments through shoreline zoning, Caspian Lake and its surroundings:

- Revise Zoning Bylaws to better control logging and housing development in lake watershed.
- Prepare new Shoreline Protection Bylaws
- Update procedures for administering the septic regulations applicable to Village and Lakeshore Districts
- Sample water on a regular basis for evidence of undesirable pathogens and other pollutants
- Promote the gradual elimination of heavily polluting 2 cycle marine engines
- Maintain a Lakeshore District for each of its lakes and major ponds (Caspian, Eligo, Long Pond, Horse Pond, and two Mud Ponds)
- Encourage the Eligo Association to install and monitor a milfoil wash station
- Monitor development of new construction to ensure full compliance with zoning bylaws
- Address potential pollution from farm runoff
- Prohibit the establishment of polluting industries that would degrade water quality

- Support efforts of landowners and The Nature Conservancy to preserve Long Pond in its natural undeveloped condition
- Maintaining all rivers and streams in the natural pristine condition to maximize to the extent possible including the establishment of buffer strips to stabilize streambanks and prevent their erosion
- Preserving and protecting all of Greensboro's wetlands
- Identifying Aquifer Protection Areas and taking steps to protect groundwater from polluting activities

Flood Hazard Area and Floodway- Protect public and private investment and significant natural resources from flooding within the 100 year floodway. No development within the floodway without a conditional use permit

Zoning Bylaws- 1996

Greensboro Village District- a compact village center around the outlet of Caspian Lake .5 acre minimum lot size, protect surface and groundwater from contamination

Greensboro Bend Village District- adjacent to the Lamoille River .5 acre minimum lot size, protect surface and groundwater from contamination

Lakeshore District- lands contiguous to and in the immediate vicinity of Caspian and Eligo Lakes, maintain high water quality, scenic beauty, and public and private uses of the lakes, 150 foot set back from public waters, 1 acre minimum lot size.

Rural Residential- minimum 5 acre lot size, 50 foot setback from public waters

Rural Lands- minimum 10 acre lot size, 50 foot setback from public waters

Resource District- minimum 25 acre lot size, 50 foot setback from public waters, Long Pond minimum frontage of 500 feet and 300 feet setback, no cutting within 50 of Long Pond,

Flood Hazard Regulations- all structures and developments designed to minimize flooding damage, flood resistant materials, anchoring, maintain flood storage capacity of the channel

Town of Sheffield

Municipal plan- 1984

Summarizes soils in the southwest corner draining to the Lamoille watershed as Paxton-Woodbridge- serious limitations to septic development and moderate limitations to homesites. Woodstock-Colrain- severe to moderate septic and homesite development. Cabot-Buckland- serious limitations to septic development and moderate limitations to homesite development. **No zoning.**

Town of Hardwick

Municipal Plan- 2002

Municipal Plan language related to water resources includes: "Hardwick's surface waters- rives, ponds, streams, wetlands, and groundwater are precious and vulnerable natural resources..."

"Areas that are especially important to maintaining healthy wildlife resource include borders of rivers, lakes, streams, wetlands..."

"be good stewards of the town's other natural resources, including ground and surface waters, and unique natural features." "Protect and enhance the Lamoille River, Hardwick Lake, Mackville Pond, and other natural areas."

"maintain important fish and wildlife habitats such as wetlands, riparian zones..."

Flood Hazard Areas- mapped by the federal government along the Lamoille River, Cooper Brook, and Adler Brook. Federal regulations apply to these lands, and mandate standards that make new construction of permanent structures, or major expansions of existing structures difficult and expansive.

Zoning Bylaws- 2003

Rural Residential District- 3 acre minimum lot size. Promote agriculture, forestry, and low to moderate density residential development. The purpose of Rural Residential is to ensure the protection of environmental resources and maintain open space, the clustering of new development is strongly encouraged. Permitted uses- accessory apartment, accessory structure, agriculture, single family dwelling, forestry, group home, home child care, and home occupation.

Conditional uses- accessory structure, adaptive reuse, bed and breakfast, campground, cemetery, contractors yard, cultural facility, day care center, multi-family dwelling, 2 family dwelling, extraction of earth resources,

greenhouse/nursery, health clinic, home industry, kennel, landfill, mobile home park, residential care facility, place of worship, public facility, outdoor recreation, retreat center, sawmill, school, telecommunications facility, veterinary clinic, and warehouse/storage.

Forest Reserve District- 25 acre minimum lot size. “The purpose of Forest Reserve is to protect significant forest resources and limit development in areas with steep slopes, shallow soils, unique or fragile resources, significant wetlands...”

Permitted uses- accessory apartment, accessory structures, agriculture, seasonal camp, forestry, group home, home child care, and home occupation.

Conditional uses- accessory structure, bed and breakfast, campground, single family dwelling, extraction of earth resources, greenhouse/nursery, health clinic, kennel, public facility, outdoor recreation, retreat, and telecommunications facility.

Flood Hazard Overlay District - “The purpose of the Flood Hazard Overlay District is to (1) protect public health, safety, and welfare by preventing or minimizing hazards to life and property due to flooding (2) to ensure property owners within this area are eligible for flood insurance under NFIP.”

Section 3.12- “An undisturbed vegetative buffer shall be maintained for a minimum of 25 feet from all streams, rivers, and lakes.”

Section 3.14- No development on lands greater than 25%

Protection of Water Resources- “to prevent soil erosion and sedimentation of surface waters, maintain water quality, and protect wildlife habitat, a setback of 75 feet minimum for structures to streams, rivers, and public lakes.”

Town of Stannard

Municipal Plan- 1999

The plan recognizes that the improper disposal of household sewage as the main threat to fouling the town’s ground and surface waters. The plan also recognizes the importance of F&W’s Steam Mill Brook Wildlife Management Area. Wheelock’s Flagg Pond is also recognized for its importance for fishing and recreation for Stannard residents. It recommends development that does not adversely impact the pond. The plan also recommends conducting studies to identify sensitive and scenic areas within town.

Town of Wheelock

Municipal Plan- 2001

Some plan language includes- Wellhead Protection Areas should be delineated and protected from incompatible land uses, ensure that all sewage is treated and disposed of in a safe manner, identify natural areas, create a Conservation District which at a minimum includes natural areas and wellhead protection areas. The plan also recognizes the potential for runoff from logging and recommends training workshops for loggers and landowners and forest land protection through easements. **No Zoning Bylaws.**

Chittenden County Towns

Town of Jericho

Municipal Plan- 2006

Some language includes- “Adequate planning relative to water is critical to Jericho’s survival as a community. As a resource, water is uniquely vulnerable in that it is easily polluted and can only be restored to purity at great cost and with great difficulty.” “Maintaining the quality of Lake Champlain is therefore of paramount interest to many residents of Jericho.” “There are two river areas within Jericho that could fall under the State of Vermont criteria as outstanding water resources. These are sections of the Browns River from Old Red Mill to Old Pump Road and a section of Mill Brook along Tarbox Road. The designation as outstanding water resource indicates that these areas have significant aesthetic, cultural, natural beauty, or geologic features.”

Some language in the plan documents the importance of shorelines, groundwater recharge areas, floodways, and wetlands. Some specific wetlands include: an area north of Riverside near Route 15, an area east of Cilley Hill Road along the Browns River, an area east of Skunk Hollow Road, an area near the Foothills

Development, an area west of Jericho Center, areas within Ethan Allen Firing Range, an area east and south of Leary Road and Bentley Lane, an area east of the Vermont Research Forest, and portions of the Town’s Mobb Farm property. The Plan describes the definition of floodways and flood hazard areas.

Language in the objectives and implementation section includes- “use town resources to obtain contiguous parcels and/or greenways to connect natural areas and to protect outstanding water features.” “Establish buffer zones of undeveloped land along the boundaries of streams, wetlands, and ponds.” “Identify and protect habitats that harbor critical wildlife and plant species and support initiatives such as the Upland Project of Chittenden County.” Wellhead Protection Areas are identified and 5 community water systems.

Zoning Bylaws- 1992

Land Use Districts

River District- protects major water courses and their flood hazard areas in Jericho. In addition, the watercourses and their floodplains are an extremely important natural resource base for wildlife, recreation, and the rural atmosphere of Jericho. Development should be very limited and dwellings should not be constructed in this zone.

Conservation District- Contains significant aesthetic, recreational, and natural resources which help to maintain the rural character of Jericho. In addition, the district may have physical limitations such as steep slopes or high water table. Development shall be carefully regulated.

Agricultural District- Provides open land for agriculture, forestry, and rural housing. Prime forest and agricultural land and open space should be protected while allowing for limited, compatible development.

Wetland Overlay District- the purpose of the Wetlands Overlay District is to preserve public health and safety, wildlife, and existing and future water supplies, and control pollution by maintaining the quality and level of the water table and surface waters. Permitted uses include hunting and wildlife management.

Natural Resources Overlay District- to preserve wildlife habitat such as deeryards, natural areas, scenic resources (ridge lines), prime agricultural lands.

Town of Underhill

Municipal Plan 2004

Municipal Plan language related to water resources includes the following under Protect the Environment Section- “Protection and improvement of landscape has wide support in the Community.” In the Significant natural and fragile areas Section- “Outstanding water resources, including lakes, rivers, aquifers, shorelines, and wetlands.” As the headwaters of the Browns River commence in Underhill, we have a special responsibility for maintaining the health of the watershed, including ground water aquifers and recharge areas.” “To maintain or improve the quality of air, water, wildlife, and land resources, Vermont’s air, water, wildlife, mineral, and land resources should be planned for use and development according to the principles set forth in 10 VSA & 6086(a). Under the Watershed Protection Section-“Managing a watershed goes beyond municipal responsibilities because it is governed by geographic realities. Results of the assessment of the Browns River watershed by ANR might necessitate amending regulations, such as the establishing appropriate setbacks from the Browns River or the creation of an environmentally sensitive district.

Under the Section Identify areas to be protected the Plan language states that “an inventory of fragile areas, forests, wildlife habitats, and scenic views is an essential database for all conservation efforts. One example is the Crane Brook area, a particularly rich wetland that is a valuable habitat for bear, moose, fisher, otter, deer, waterfowl, and songbirds

Zoning Bylaws- updated 1991

Districts include Residential District and Rural Residential District. Districts that protect surface and ground water and scenic views include:

Water District- aquifer recharge in Underhill Center, 5 acre minimum lot size

Soil and Water District- high elevation aquifer recharge, 15 acre minimum lot size

Preservation District- protects scenic vistas along Pleasant Valley Road, 10 acre minimum lot size

Town of Essex

Municipal Plan- 2001

The municipal plan discusses the major watersheds in town and noteworthy wetlands (including the Hanley Lane, Osgood Hill, and Browns River wetlands). The plan describes the importance of rivers, brooks, lakes, and ponds for public health, recreation, wildlife diversity, visual sensitivity, and environmental quality.

Floodplain Zones are established along all of the town’s waterways including flood hazard areas (100 year floodways). Minimum setbacks restrict development within riparian areas.

Town of Westford

Municipal Plan- 2004

The town plan identifies the importance of the town's surface and groundwater resources. The Browns River is specifically mentioned in addressing sedimentation and streambank erosion and supporting ongoing monitoring and assessment efforts there. The plan also calls for a Browns River green belt and protection of riparian vegetation.

Zoning Bylaws- 2003

Districts include a Water Resources Overlay- wetlands, ponds, streams, and well head protection areas to protect human health by insuring clean water and minimize impacts of development on water resources. Flood Hazard District- includes lands on the National Flood Insurance Maps and permits only land development which will not impede or divert floodwaters, or otherwise increase flood hazards to the detriment of others.

Town of Colchester

Municipal Plan- 2007

The municipal plan acknowledges the importance of maintaining water quality as a community asset. It specifically identifies Malletts Bay, Outer Malletts Bay, Lake Champlain, 3 miles of Lamoille River frontage, and the town's extensive wetlands and floodplains in this context. The plan identifies dense development along these shorelines and the possibility of failed on-site sewage systems as a threat to ground and surface water quality. The plan also discusses sediment and nutrient runoff. The plan calls for long-term cost effective solutions to water quality issues. The plan recommends water quality monitoring, water resource inventories, and implement recommendations of the Colchester Water Quality Study Committee. The Plan also states "a Lamoille River Basin Plan is currently in development ...the Town should participate in this larger planning process as way of improving water quality..."

Zoning Regulations and Zoning Districts related to water resources- 2006

Watercourse Protection District- to minimize adverse impacts of development upon the sensitive natural areas adjacent to watercourses and to preserve water quality, prevent pollution, avoid erosion, and protect the ecology of streambeds and lands adjacent to watercourses. Applies to lands within 85 feet of Malletts Creek and Allen, Indian, Pond, and Sunderland Brooks and all tributaries and all other minor streams. All lands in this district are to be left in their naturally vegetative state, with the vegetative goal being a riparian forest. Minimal uses are permitted including no structures.

Wetland/Flood Plain District- similar objective as above in addition to reducing flood losses. Floodways and National Wetland Inventory wetlands are included in this district's boundaries. Uses are limited to farming and essential services excluding buildings and structures. No uses that will adversely affect soils or vegetation, impair the quantity or quality of surface and groundwater, erode soil, alter streambanks, or streambeds, or divert watercourses are permitted.

Shoreland District- to preserve the natural growth and cover of the shorelines adjacent to Lake Champlain and other waterways, to preserve the water quality and prevent pollution and to control and regulate development of the shorelines, to prevent erosion, nuisance and exploitation and to preserve the property rights of the shoreline property owners. The district is a 500 strip of land from the mean water line of Colchester Pond, Lake Champlain, and Winooski and Lamoille Rivers. Many uses are restricted and require DEC review within this district.

Franklin County Towns- municipal plans and zoning bylaws review by the Northwest Regional Planning Commission

Town of Georgia

Municipal Plan-2001

The Town Plan contains a section on its water resources which includes surface waters, groundwaters, well-head protection areas, floodplains, and wetlands. The Plan also contains a section on fragile, unique, and sensitive areas which includes sites for rare or threatened species. The section includes a number of policies on the protection of water quality, and also on protecting natural areas and critical areas from detrimental effects of development. Georgia has over seven miles of lakeshore frontage and is part of the Lake Champlain watershed. The Plan does go into great detail with regards to the Lake Champlain area. The plan recommends riparian buffers and low impact development.

Some specific plan language includes “Arrowhead Mountain Lake also provides a valuable source of water for the Georgia Dairy Industrial Park.” “Wetlands are an important part of the overall ecosystem and an important water resource.” “Protection and improvement of water quality is integral to the overall quality of all water resources.”

Zoning Bylaws- 1997

Natural Areas and Corridors- identifies unique and irreplaceable areas of natural beauty, which should remain in their natural state

Lakeshore- to maintain the natural beauty of the lakeshore, to preserve public access, and to minimize danger of pollution

Town of Fairfax

Municipal Plan- 1998

The Town Plan contains a section on natural and cultural resources which includes geology, surface waters, groundwaters, soils, critical habitat, wetlands, riparian areas, steep slopes, headwaters, shorelands, public and water supply watersheds, and floodplains. The section includes an extensive list of goals, objectives, and policies on the protection of water quality, and also on protecting natural areas and critical areas from detrimental effects of development.

Zoning Bylaws

The Town’s zoning regulations were adopted in January of 1980 and amended in 1985 and 1988. The Town is currently in the process of updating its zoning bylaws.

Town of Fletcher

Municipal Plan

The Town of Fletcher adopted its town plan in October of 1997. The previous plan was updated and adopted in 1987. The Town Plan contains an in-depth section on its natural resources which includes surface waters, groundwaters, ecologically sensitive areas, wetlands, floodplains, and shoreland and riparian areas. The section includes a number of policies on the protection of water quality, and also on protecting natural areas and critical areas from detrimental effects of development. The goals, policies, and objectives in the Fletcher Town Plan have been extremely well thought out. The Town Plan gives an excellent description of all of its water resources including uses, quality, and locations, to name a few. The Plan also takes into account all the things that can cause water quality to deteriorate.

Zoning Bylaws

The Town is currently in the process of adopting its zoning regulations which were drafted in November of 1998.

APPENDIX A.13- Lamoille Basin Plan Actions Implementation Report Card- *Sample*

Actions	Action Priority	Was action completed, initiated, or not yet initiated?	Describe project success or shortfall	Actions needed to complete task
Wetlands				
1. Wetlands protection with inventories, town plans and zoning	High	C, I	Wetlands inventory of the lower Lamoille complete and project identification and outreach begun	Secure wetland restoration and protection sites, expand inventory to mid and upper watershed, and strengthen municipal zoning efforts
2. ID and restore idle prior converted farm wetlands	High	C, I	(see number 1 above)	(see number 1 above)
Lakes and Ponds				
3. Map undeveloped lake and pond shorelines	High	C, I	DEC and UVM have nearly completed this task	Additional work should be completed in 2009
4. Review regional and town plans and bylaws related to lake protection issues	High	I	LCPC has completed this task for Lamoille County	Other areas of the watershed have yet to be completed
5. Conduct watershed NPS surveys	Medium	C, I	Some larger lake NPS surveys have been completed (Lake Eden and Lake Elmore)	Other developed lakes have yet to be completed
6. Promote regular maintenance of lakeshore camp septic systems	Medium	N	Not yet initiated	Outreach to watershed lake organizations
7. Conduct outreach efforts to lakeshore landowners regarding shoreland property management	High	C, I	Riparian buffer protection and establishment workshops held for Caspian Lake and Lake Eden	Work should continue for other developed lakes

APPENDIX A.14- Basin 7 Water Quality Management Plan Public Comments Responsiveness Summary January 2009

Comment: Consider adding a short paragraph in the Executive Summary concerning establishing Water Quality management goals and one recommendation in the plan concerning reclassification of one water (A2 to B).

Response: This change will be added to the Executive Summary.

Comment: Clarify language concerning Malletts Bay to describe that Malletts Bay itself is not impaired due to phosphorus but that actions in the plan to control sediment and phosphorus in areas draining to the Bay are actions that will help protect the Bay from becoming impaired.

Response: Malletts Bay itself is not impaired due to phosphorus but Lake Champlain as a whole is impaired due to phosphorus. The Lamoille River outlets just north of Malletts Bay and therefore is impacted by influence of the Lamoille River. Language in the basin plan will be clarified to reflect that.

Comment: Has a lakeshore land use analysis been completed on other Basin 7 lakes and ponds? If so, can you state that and include a table to that effect? If not, state that and possible add that as a new action item. Figure 2- can the figure title be amended to mention land use within X distance of the lakeshore? Can Figure 2 key be amended to include land use acres or percentage?

Response: The lakeshore land use analysis has also been completed for Wolcott Pond, Lake Eden, Zack Woods Pond, and Long Pond (Greensboro) in addition to Caspian Lake. These lakes and ponds will be added to the narrative describing the lakeshore land use analysis. UVM has mapped a 600 meter buffer for these lakes. That language will also be added to the basin plan.

Comment: Consider prioritizing plan actions that have already been initiated as high priority actions.

Response: This change will be added to the Actions sections of the basin plan.

Comment: On page 87 under “Class A waters” consider deleting “proposed” and instead use “existing.” Recommend that you add a bullet and make mention of French Hill Brook under B, doing that would make sense and lead into Action 70 recommendation.

Response: This change will be added to the basin plan.

Comment: Recommend adding language to the plan stating that no recommendations affecting any new A1 waters, no new or additional A2 waters, no changes to any existing Waste Management Zones, no changes to any warm water or cold water designation, or any Outstanding Resource Water.

Response: This language will be added to the basin plan.

Comment: Consider adding a sample “report card” that might help the reader evaluate the plan’s progress.

Response: A sample report card will be added to the basin plan.

Comment: On page 57-58 would it make sense to include the number of state permitted facilities (i.e. # of expired permits renewed, # of new permits subject to 2002 standards, #MSGP permits or no exposure certification)?

Response: This data will be added to the basin plan.

Comment: On page 62-would it make sense to update the discussion on Lamoille Rail System? Isn't the rail line banked now? Do you want to mention the Friends of the Lamoille Valley Rail Trail?

Response: The language regarding rail banking will be updated and the Friends of the Lamoille Valley Rail Trail will be added to the basin plan.

Comment: On page 81-82 the term "EPA removals" is confusing, not sure what it means and is written differently in several places.

Response: The term "EPA removals" will be clarified in the basin plan narrative

Comment: Relative to Actions for Agricultural NPS Reduction-Action 25. Hold Equine Industry Workshops....This action has both been implemented and is on-going. Pamela Stefanek, Ben Gabos, Jim Ryan partnered on a horse workshop hosted by Freedom Farm Stable on the banks of the Browns River. Equine Industry related businesses supported through donations and sessions. Pamela Stefanek, partnering with Ben Gabos, and Karen Bates has supported a booth at the "Everything Equine" Fair from 2004 to 2008, an event which is attended by 5,000 horse enthusiasts. From the booth information is shared on grazing, manure management, AAPs, mortality composting, basin planning and water quality. From these events and others, district staff has valuable time with Drs. Betsy Green and Rachel Gilker, who are now developing 'sustainable' equine education, including calculating costs of manure management in the business plan, and grazing management. Green and Gilker have also implemented two SARE grants for heavy use areas on horse farms, to decrease mud which brings to three, the number of farms in the Winooski District which have implemented improvements.

To speed progress, suggest an action be added to place an Equine Specialist in Chittenden County to work with horse owners to work toward best management practices. The 2002 Horses Count Survey found that two counties host the greatest number of horses in Vermont and one is Chittenden. Lindsey King worked with Betsy Green to compile the information for the 2002 Horses Count Survey. The purpose of the survey, commissioned by the Vermont Agency of Agriculture, was to quantify the equine industry in Vermont. The previous study had been accomplished in 1990 and documented 18,300 horses in Vermont keeping open 100,000 acres.

Given the density of horses in Chittenden County in individual with strong contacts with University of Vermont, Animal Science Equine Program, Vermont Agency of Agriculture and the Vermont Horse Council could work effectively toward water quality goals and opportunities in the equine community.

Response: The basin plan language regarding this action will be more thoroughly explained as well as adding additional language emphasizing the importance of addressing horse farms specifically.

Comment: A question about a drinking water system that is actually pulling from the River (well, almost - Arrowhead Mountain Lake). The water system name is Georgia Dairy Industrial Park - owned by Georgia Industrial Development Corporation. They are not a community water system, but they are a public water system. A source protection plan and delineation had been prepared, which involved public notice and Select Board meetings in four towns. They are the only non-community (non-publicly owned) water system in the state that is using surface water. And also the

fact that Lamoille River water is used to make baby formula (PBM is in that industrial park) is pretty impressive.

Response: Language regarding the Georgia Dairy Industrial Park will be added to the basin plan.

Comment: Consider adding an up-to-date table of completed geomorphic assessments for the basin as well as any other sub-watersheds that are scheduled for completion as a stand-alone table.

Response: This new table will be added to the Plan in the Appendices.

APPENDIX B - Regulatory and Non-regulatory Programs that Contain BMPs Applicable to Protecting and Restoring Waters within the Basin

APPENDIX B.1 - Agricultural Runoff Control Programs

State of Vermont Agricultural Programs

Accepted Agricultural Practices (AAP) are statewide regulations designed to reduce nonpoint pollutant discharges through implementation of improved farming techniques rather than investments in structures and equipment. The law requires that these practices must be technically feasible as well as cost effective for farmers to implement without governmental financial assistance.

AAPs are intended to reduce, not eliminate, pollutants associated with nonpoint sources such as sediments, nutrients and agricultural chemicals that can enter surface water and groundwater that would degrade water quality. AAPs are a group of basic farmland management activities, which will help conserve and protect natural resources. These practices will maintain the health and long-term productivity of the soils, water, and related plant and animal resources and reduce the potential for water pollution from agricultural nonpoint sources. Accepted Agricultural Practices include these practices among others: erosion and sediment control, animal waste management, fertilizer management, and pesticide management. AAPs are basic practices that all farm operators must follow as a part of their normal operations.

Implementation of AAPs by Vermont agricultural operators creates a rebuttable presumption of compliance with the Vermont Water Quality Standards. The presumption that the use of Accepted Agricultural Practices complies with Vermont Water Quality Standards may be overcome by water quality data or results from a water quality study deemed conclusive by the Secretary. These rules, however, do not exempt farmers from the obligation to comply fully with the Vermont Water Quality Standards and the provisions of the Clean Water Act.

<http://www.vermontagriculture.com/AgriculturalWaterQuality/AAP/AAP10.htm>

Best Management Practices (BMP) are more restrictive than Accepted Agricultural Practices and are site-specific practices to correct a problem on a specific farm. BMPs typically require installation of structures, such as manure storage systems, to reduce agricultural nonpoint source pollution. While farmers may realize an economic benefit from BMPs, it is unlikely that they will be affordable without governmental cost sharing.

The Vermont BMP program was created to provide state financial assistance to Vermont farmers in support of their voluntary construction of on-farm improvements designed to abate non-point source agricultural waste discharges. The program makes maximum use of federal financial assistance and seeks to use the least costly methods available to accomplish the abatement required.

The Vermont Agency of Agriculture, Food, and Markets (VAAF&M) grants are limited to a cap of 35 percent of the total actual costs of the system in cases where either the federal government or other entities cost share the system, or 50 percent on projects with no other source of cost share assistance. Combined federal, state and other cost share participation may not exceed 85 percent of the eligible costs, ensuring grant recipients pay at least 15 percent of the total cost of each BMP. Awards of funding for BMP implementation shall require that the BMP be operated and maintained under contract or agreement for the design life of the practice under contract or agreement, but not to exceed 10 years.

It is a policy of the State of Vermont to assist farmers with the implementation of BMPs that will protect and maintain water quality by reducing agricultural nonpoint source pollution. The implementation of Best Management Practices is subsequent to the implementation of Accepted Agricultural Practices.

The purpose of the **Large Farm Operations** (LFO) program is to require farms with more than 700 mature dairy cows or 1,000 beef cattle to be pro-actively managed in accordance with the accepted agricultural practices and to prohibit a direct discharge from their barnyard and environments commonly known as the facility. Farms which are following the regulations for LFOs should adhere to a technical standard to assure that they will not discharge to waters of the state. If farms chose to ignore the LFO rule or to create a discharge they are required to attain a National Pollution Discharge Elimination Systems permit. There are currently no farms in Basin 11 which require an LFO permit.

<http://www.vermontagriculture.com/LFO.htm>

The purpose of the **Medium Farm Operations** (MFO) program is to require farms with between 200 and 699 mature dairy cows or 300 beef cattle to be pro-actively managed in accordance with the accepted agricultural practices and to prohibit a direct discharge from their barnyard and environments commonly known as the facility. Farms which are following the regulations for MFOs should adhere to a technical standard to assure that they will not discharge to waters of the state. If farms chose to ignore the MFO rule or to create a discharge they are required to attain a National Pollution Discharge Elimination Systems permit. There are currently 2 farms in Basin 11 which will require an MFO permit.

http://www.vermontagriculture.com/AgriculturalWaterQuality/MFO/revisedDGP_000.htm

The **Current Use Program** (CUP) Vermont's Agricultural and Managed Forest Land Use Value Program -- known as the Current Use Program -- was created in the 1970's as a companion to legislation that required towns to list property at 100% of fair market value. Because of escalating land values, these property taxes were placing a heavy burden on owners of productive farm and forest lands. The CUP offers landowners use value property taxation based on productive value of land rather than traditional "highest and best" use of the land. The CUP includes a Land Use Change Tax as a disincentive to develop land. The tax is 20% of fair market value of a property, or, in case of the sale of part of a property, a pro rata share of the fair market value of the entire property. The program is administered by the [Vermont Department of Taxes](#).

<http://www.state.vt.us/tax/pdf/word/excel/pvr/currentuse-geninfo.pdf>

Farm Agronomic Practices Program (FAPP) provides Vermont farms with state financial assistance for implementation of soil-based practices that improve soil quality, increase crop production, and reduce erosion and agricultural waste discharges. FAPP also encourages outreach on agricultural water quality impacts and agricultural water quality regulations through educational and instructional grants. Practices eligible for assistance are: Nutrient Management Plan Update, Payments up to \$2 per acre; Cover Cropping, Payments up to \$20 per acre; Strip Cropping, Payments up to \$24 per acre; Conservation Crop Rotation, Payments up to \$25 per acre; Cross-Slope Tillage, Payments up to \$10 per acre.

<http://www.vermontagriculture.com/AgriculturalWaterQuality/FAP/documents/FAPPProgramProcedure.pdf>

Vermont Agricultural Buffer Program (VABP) Of the land currently enrolled in CREP, only 20 % is cropland. Cropland has a greater potential to contribute phosphorus and sediment to waters of Vermont and hence the VABP has been designed to allow farmers to plant harvestable permanent grasses along streams. Eligible land enrolled in the program must be planted to a perennial sod-forming crop. The ground can only be tilled to establish this mix. No manure can be applied on contracted land at anytime during contract. Non manure fertilizers can be used so long as no excessive nutrient applications are made. All buffers will be 25 feet wide. Harvesting of buffer is only allowed from June 1st to September 1st. A set rate of \$123 per acre will be provided to the participant to cover cost of establishing grassed buffer when a suitable grass is not currently planted. An additional per acre incentive payment will be paid annually at the end of growing season for each of the 5 years participant is enrolled in VABP. The annual payment will be 40% of estimated total CREP payments per acre would be in a 15 year contract with filter strips.

<http://www.vermontagriculture.com/documents/VABP.pdf>

Federal Programs (US Department of Agriculture and US Fish & Wildlife Service)

Environmental Quality Incentives Program (EQIP) provides technical, educational, and financial assistance to eligible farmers working to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. This USDA program provides assistance to landowners in complying with Federal and State laws, and encourages environmental enhancement. Protection of surface and groundwater resources is the major focus of EQIP.

The program offers cost-share payments of up to 75% of costs up to \$50,000, to implement one or more eligible practices. Five- to ten-year contracts are made with producers to use and maintain cost-shared practices and require a conservation plan be created and carried out for the length of the contract. Priority is given to livestock operations and targeted locations within the State. Applications are ranked on a point system and awarded by rank.

Conservation Reserve Enhancement Program (CREP) is a State-federal USDA conservation partnership program targeted to address specific State and nationally significant water quality, soil erosion and wildlife habitat issues related to agricultural use. The program uses financial incentives to encourage farmers and ranchers to voluntarily enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. This community-based conservation program provides a flexible design of conservation practices and financial incentives to address environmental issues. The state is considering enhancing the program to include 30-year easements on marginal pastureland where forested buffers would be required.

<http://www.vermontagriculture.com/CREPwebsite/Home/Home.htm>

Conservation Reserve Program (CRP) is a voluntary program of USDA that offers long-term rental payments and cost-share assistance to establish long-term, resource-conserving cover on environmentally sensitive cropland or, in some cases, marginal pastureland. Converting highly erodible and/or environmentally sensitive cropland to permanent vegetative cover reduces soil erosion, improves water quality, and enhances or establishes wildlife habitat. CRP contracts are for a term of 10 years. However, for land devoted to certain practices such as hardwood trees, wildlife corridors, or restoration of cropped wetlands or rare and declining habitat, participants may choose contracts of up to 15 years. Incentives include annual rental payments of up to \$50,000 per year, cost-share payments of up to 50% of the cost for establishing cover, plus special incentive payments for wetland restoration.

Wildlife Habitat Incentives Program (WHIP) is a voluntary program that provides financial incentives to develop habitat for fish and wildlife on private lands. The USDA program provides both technical assistance and cost sharing help to participants who agree to implement a wildlife habitat development plan. Participants work with USDA's Natural Resources Conservation Service to prepare a wildlife habitat development plan in consultation with a local conservation district. The plan describes the landowner's goals for improving wildlife habitat, includes a list of practices, a schedule for installing them, and details the steps necessary to maintain the habitat for the life of the agreement.

USDA pays up to 75% (usually no more than \$10,000) of the cost of installing wildlife practices. USDA and program participants enter into a cost-share agreement that generally lasts a minimum of 10 years from the date the contract is signed.

Forestry Incentives Program (FIP) of USDA provides cost-share monies to help support good forest management practices on privately owned, non-industrial forestlands nationwide. FIP is designed to benefit the environment while meeting future demands for saw timber, pulpwood, and quality hardwoods. FIP's forest maintenance and reforestation projects also provide numerous natural resource benefits, including reduced soil and wind erosion and enhanced water quality and wildlife habitat.

FIP provides up to 65% of the total costs, with a maximum of \$10,000 per person per year, to assist with the establishment of eligible practices. Private landowners of at least 10 acres and no more than 1,000 acres of suitable land are eligible for funding. Normally the length of the program is from one to 10 years. There may be certain restrictions on time limits and on certain practices to be performed. Financial assistance ranges from \$50 to \$10,000 per year, with an average of \$1,600. Funding is limited, and priority areas for participation in the program are established at the local level.

Wetlands Reserve Program (WRP) of USDA is a voluntary program offering landowners a chance to receive payments for restoring and protecting wetlands. Marginal agricultural land that is too wet to produce, previously drained wetlands or land damaged by flooding are typical sites for WRP funding. Landowners retain control over access to their property and compatible uses such as haying, grazing, timber harvest, fee hunting, and trapping may be permitted upon request. Land can be resold. The program offers landowners three options:

- 1) Permanent Easement. USDA will pay up to the agricultural value of the land and 100% of the costs of restoring the wetlands and uplands.

- 2) 30-Year Easement. USDA will pay 75% of what would be paid for a permanent easement and 75% of the restoration costs.

- 3) Restoration Cost-Share Agreement. USDA will pay 75% of the cost of restoring a wetland in exchange for a minimum 10-year agreement to maintain the restoration. No land use payment is provided.

Easements and restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the easement or agreement. Re-stored wetlands improve water quality, filter sediment, reduce soil erosion, provide habitat for wildlife and endangered species, reduce flooding and provide outdoor recreation and education opportunities.

Farmland Protection Program (FPP) of USDA provides funds to help purchase development rights to keep productive farmland in agricultural uses. Since 1960, an average of 1.0 million acres of farmland have been converted to other uses each year, often resulting in permanent loss of valuable topsoil and agricultural land. The FPP was designed to help protect quality farmland with prime, unique, or other productive soil, from urban growth.

USDA provides up to 50 percent of the costs of purchasing easements. For the FPP, a conservation easement is an assigned right prohibiting any development, subdivision or practice that would damage the agricultural value or productivity of the farmland. To be selected for participation in the FPP, a pending offer must provide for the acquisition of an easement or other interests in land for a minimum duration of 30 years, with priority given to those offers providing permanent protection.

Watershed and River Basin Planning and Installation - Public Law 83-566 (PL-566) Technical and financial assistance is provided in cooperation with local sponsoring organizations, state, and other public agencies to voluntarily plan and install watershed-based projects on private lands. The program empowers local people or decision makers, builds partnerships and requires local and state funding contributions. The purposes of watershed projects include watershed protection, flood prevention, water quality improvements, soil erosion reduction, rural, municipal and industrial water supply, irrigation water management, sedimentation control, fish and wildlife habitat enhancement and create and restore wetlands and wetland functions.

Watershed plans involving an estimated Federal contribution in excess of \$5,000,000 for construction, or construction of any single structure having a capacity in excess of 2,500 acre feet, require Congressional committee approval. Other plans are approved administratively. After approval, technical and financial assistance can be provided for installation of works of improvement specified in the plans.

Project sponsors are provided assistance in installing planned land treatment measures when plans are approved. Surveys and investigations are made and detailed designs, specifications, and engineering cost estimates are prepared for construction of structural measures. Areas where sponsors need to obtain land rights, easements, and rights-of-way are delineated. Technical assistance is also furnished to landowners and operators to accelerated planning and application of needed conservation on their individual units. There are presently over 1600 projects in operation.

Partners for Fish and Wildlife Habitat Restoration Program provides technical and financial assistance to private landowners interested in voluntarily restoring or otherwise improving native habitats for fish and wildlife on their lands. This USF&WS program focuses on restoring former and degraded wetlands, native grasslands, stream and riparian areas, and other habitats to conditions as natural as feasible. The program emphasizes the reestablishment of native vegetation and ecological communities for the benefit of fish and wildlife in concert with the needs and desires of private landowners.

The assistance that the US Fish and Wildlife Service offers to private landowners may take the form of informal advice on the design and location of potential restoration projects, or it may consist of designing and funding restoration projects under a voluntary cooperative agreement with the landowner. Under the cooperative agreements, the landowner agrees to maintain the restoration project as specified in the agreement for a minimum of 10 years. While not a program requirement, a dollar-for-dollar cost share is usually sought on a project-by-project basis.

Local Government Programs

Conservation District Technical Assistance Programs

Free technical assistance and information is provided through the conservation districts.
<http://www.vacd.org/>

Accepted Agricultural Practices Assistance- helps farmers meet the requirements of Vermont's AAP regulations. Technical assistance for manure and nutrient management, runoff potential, floodway determinations, streambank stabilization, vegetative buffer strips and soil erosion potential are all addressed by the program. Agricultural Resource Specialists (ARS) work with landowners on strategies specific to their farms and provide information and referrals for State and Federal cost-share programs.

<http://www.vacd.org/onrcd/ars.html>

Farm*A*Syst is a free drinking water protection program for farms based on voluntary assessments to determine how current practices and structures may pose a risk to drinking water. Voluntary Farm Assessments provide information that help ARS staff offer farm-specific suggestions for protecting the farm's drinking water.

<http://www.vacd.org/onrcd/farmasyst.html>

Land Treatment Planners are available to assist farmers in developing land treatment plans which provide detailed information on farm soil and water resources, recommendations for continued stewardship, and recommendations for compliance with State and Federal regulations.

<http://www.vacd.org/wncd/LTPbrochure.pdf>

Nutrient Management Planners are available to assist farmers in developing nutrient management plans and record-keeping systems in order to maximize the benefit from fertilizer and manure applications while minimizing the impact of excess nutrients on water quality.

http://www.vacd.org/wncrd/documents/SVNMP_Brochure.pdf

Non-Governmental Programs

The **Farmland Access Program** (FAP) goal is to provide qualified diversified farmers with access to good agricultural land and to assist with the start up or expansion of commercial agricultural businesses. In this way, Vermont Land Trust hopes to facilitate the creation of new farm enterprises and greater diversification within Vermont agriculture. VLT can work with Land Link Vermont to enroll farmers in a farmland database; assist farm seekers in securing business planning services through the Farm Viability Program; assist in farm purchases when seekers locate farms; and search for, purchase, conserve or sell farms in Vermont that are suitable for diversified farm operations. Minimum qualifications require candidates to have 3 to 5 years of commercial farming experience, strong agricultural references, plans to develop an agricultural enterprise that would gross \$100,000 per year within 5 years of start up, and sufficient financial resources (or ability to be financed) for start-up expenses. Our primary focus is on farms producing food and fiber that would use at least 25 acres of productive land.

<http://www.vlt.org/FarmlandAccessBrochure.pdf>

The **Farmland Preservation Program** (FPP) is focused on retaining the state's quality agricultural land base in strong farming regions of the state. The purchase of conservation easements on farmland preserves Vermont's working landscape--the open farm fields, woodlands and farmsteads that comprise the third largest sector in the state's economy and draw the visitors that make tourism the largest sector. Because of the Vermont Housing & Conservation Board's investment in conservation easements, Vermont's most productive farmland will remain undeveloped and the best soils will remain available for farming in the future. Selling conservation easements enables a landowner to keep land in agricultural use and also be compensated for the potential development value of the land, recognizing the asset value of the land. The landowner retains title to the land and agrees to the terms of a conservation easement limiting future ability to subdivide and develop the land.

<http://www.vhcb.org/Conspage.html#Anchor-Farmland-65515>

Land Link Vermont (LLV) is a farm linking program at the University of Vermont Center for Sustainable Agriculture. Land Link Vermont connects farm seekers with farmland and farming opportunities, and provides information and support on farm start-ups and succession by offering a matching service, education, referrals, and outreach. The matching service provides the linkages among farm seekers and farmland owners. Interested parties share information on goals, acreage, location, enterprises, and tenure options considered. Participants are interested in a variety of tenure options including buy/sell, lease, joint farming and other arrangements. Farm seekers are interested in a number of different farming enterprises including dairy, vegetables, small ruminants and CSA's. Through publications and on-going workshops, Land Link Vermont provides farmers, land owners and agriculture professionals with links to education on topics like estate and retirement planning, effective leases, farm financing, business planning, and direct marketing. Land Link Vermont also helps link farmers and landowners to professionals and Vermont agricultural organizations through consultation and referrals.

<http://www.uvm.edu/landlinkvt/>

The **National Fish and Wildlife Foundation** conserves healthy populations of fish, wildlife and plants, on land and in the sea, through partnerships, sustainable solutions, and better education. The Foundation meets these goals by awarding challenge grants to projects benefiting conservation education, habitat protection and restoration, and natural resource management. Federal and private funds contributed to the Foundation are awarded as challenge grants to on-the-ground conservation projects. Challenge grants require that the funds

awarded are matched with non-federal contributions, maximizing the total investment delivered to conservation projects. For every dollar that Congress provides, an average of \$3 in on-the-ground conservation takes place. The Foundation has made more than 4,400 grants, committing over \$165 million in federal funds, matched with non-federal dollars, delivering more than \$500 million for conservation.

<http://www.nfwf.org/programs.cfm>

The Nature Conservancy Conservation Easements: Land ownership carries with it a bundle of rights—the right to occupy, lease, sell, develop, construct buildings, farm, restrict access or harvest timber, among others. A landowner can give up one or more of those rights for a purpose such as conservation while retaining ownership of the remainder of the rights. Private property subject to a conservation easement remains in private ownership. Many types of private land use, such as farming, can continue under the terms of a conservation easement, and owners can continue to live on the property. The agreement may require the landowner to take certain actions to protect land and water resources, such as fencing a stream to keep livestock out or harvesting trees in certain way; or to refrain from certain actions, such as developing or subdividing the land. Conservation easements do not mean properties are automatically opened up to public access unless so specified in an easement. The terms of a conservation easement are set jointly by the landowner and the entity that will hold the easement.

<http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/>

Technical Assistance Programs through Northeast Organic Farming Association are free to farmers - made possible by a grant from the Vermont Housing Conservation Board's Farm Viability Enhancement Program. *Vegetable and Fruit Technical Assistance* provides technical assistance to organic farmers in Vermont seeking production and financial assistance on small fruit and vegetable operations. *Dairy and Livestock Technical Assistance* provides Information, Services and Support for Vermont's Organic Dairy & Livestock Community.

<http://www.nofavt.org/nofa-programs.php>

Vermont Farm Viability Enhancement Program (FVP) provides farmers with business planning and technical assistance. Developed by the Vermont Housing & Conservation Board in collaboration with the Vermont Agency of Agriculture, Food and Markets, the FVP is designed to strengthen the economic position of Vermont agriculture and to complement existing programs in farmland conservation. The Program uses consultants to provide technical assistance tailored to a farmer's needs to fulfill specific business goals. Examples include consultations on keeping better production or financial records, financial benchmark analysis, meetings with crop or animal health specialists, new farm enterprise analysis, estate and farm transfer planning, labor management, and value-added processing. The business planning process involves the farmer in an assessment of the farm operation's strengths and weaknesses and in an exploration of possible management changes that could increase profitability. On-farm consultations result in the preparation of a written business plan.

<http://www.vhcb.org/viability.html>

APPENDIX B.2 - Effluent Limitations and Point Source Control Programs

1) Design/Engineering Program

Vermont municipalities need various wastewater treatment facility and conveyance system construction and improvement projects including: original treatment facility and collection line construction; enlargement and/or refurbishment of existing facilities; implementation of nutrient removal or sludge and septage treatment improvements at existing facilities; combined sewer overflow abatement; or collection line extensions. These projects enable the municipalities to meet the effluent limits in their NPDES permit in order to meet Vermont Water Quality Standards and comply with statute; provide for centralized treatment to replace problem individual on-site systems; and provide desired wastewater treatment capacity to enable municipal growth and development.

The municipalities desire to take advantage of the state and federal capital funds appropriated for municipal pollution control projects, which we administer. We assist grant and loan recipients in developing capital planning and financing plans; assist in defining project scopes to meet the technical, regulatory, and funding requirements; assure the design of appropriate facilities; oversee facility construction; and monitor the first year's operation.

Statutory Reference

State: Title 10 VSA Chapter 55 Aid to Municipalities for Water Supply, Pollution Abatement and Sewer Separation. Title 24 VSA Chapter 120 Special Environmental Revolving Fund. Federal: Clean Water Act Title VI - State Water Pollution Control Revolving Funds.

Contacts

Design Section Supervisor, 241-3750.

Design Section, 241-3740

Financial Management Section Supervisor, 241-3734.

2) Discharge Program (Discharging Facilities and Stormwater Management)

2.A. Permits:

A discharge permit is required whenever an individual, municipality or company wants to discharge waste directly to waters of the state. Some industries are also required to treat waste before sending it to a municipal wastewater treatment facility. This section issues discharge permits and pretreatment permits. The permitting process involves a system evaluation and design being prepared by a consultant.

2.B. Operations and Management (O&M):

This group performs oversight functions of municipally owned wastewater treatment facilities, and of privately owned treatment and pretreatment facilities. In addition to performing certification and training programs, periodic discharge sampling for permit compliance checks, and laboratory evaluations. Assistance is also provided to operators and municipal officials in the proper operation, maintenance and budgeting of their wastewater facilities.

Statutory Reference

10 VSA Chapter 47

Waste Water Treatment Facilities

In the Lamoille River watershed, there are six municipal wastewater treatment facilities that discharge either to the river (Milton, Fairfax, Jeffersonville, Morrisville, Hardwick) or to a tributary (Johnson) (see table below). As of February 2000, there were 62 permitted stormwater discharges to the Lamoille River or tributaries and 22 permitted stormwater discharges to Arrowhead Mountain Reservoir.

Proposed Upgrades to Wastewater Treatment Facilities

The Lake Champlain Phosphorus TMDL includes two changes to the current phosphorus removal policy for Vermont wastewater treatment facilities. The first change is that the statutory exemption for aerated lagoon facilities with greater than 0.2 mgd permitted flow that are now exempt from the 0.8 mg/l treatment requirement will be required to remove phosphorus to 0.8 mg/l on a monthly average basis. The Hardwick wastewater treatment facility falls within this category.

The second change in the Lake Champlain Phosphorus TMDL would apply an annual load limit, calculated at an effluent phosphorus concentration of 0.6 mg/l at the currently permitted flow, to all facilities that are currently required to achieve 0.8 mg/l limit. The Johnson, Milton, Morrisville, and Wyeth (in Georgia) facilities fall within this category.

The Town of Milton has proposed extension of the current sewer line and expansion of the existing capacity. The Act 250 permit requesting the expansion is currently under appeal.

The Town of Fairfax is considering an expansion of capacity of its current facility to accommodate the town's planned growth center within the Village.

Combined Sewer Overflow (CSO) Elimination

During wet weather events, the combined volume of wastewater and stormwater runoff entering combined sewer systems often exceeds conveyance capacity. Most combined sewer systems are designed to discharge flows that exceed conveyance capacity directly to surface waters. Because CSOs contain untreated wastewater and stormwater, they can contribute microbial pathogens and other pollutants to waterways.

Hardwick was the only watershed sewage collection system that had a CSO. A sewer separation project was conducted in Hardwick and a new storm drainage system was installed in approximately 1992-1993. Two CSOs were also eliminated. The Buffalo Street Pump Station was replaced in approximately 1994-1995 with a station that does not have an overflow and the Cottage Street Bridge CSO regulator in a manhole on West Church Street was filled with concrete.

Permitted Basin Direct Discharges

Facility Name	Receiving Water	Permit ID Number/NPDES Number	Permit Expiration	Discharge Activity
Greensboro Nursing Home	Greensboro Brook	1-0301	1/01/85 Determine if future permits are needed	Well overflow
Hardwick WWTF	Lamoille River	3-1143/VT0100137	12/31/04	Sanitary Waste Outfall CSO-Cottage St Bridge CSO- Hardwick WWTF
Johnson WWTF	Gihon River	3-1149/VT0100901	3/21/04	Sanitary Waste Outfall
Morrisville WWTF	Lamoille River	3-1155/VT0100480	9/30/03	Sanitary Waste Outfall
Fairfax WWTF	Lamoille River	3-1194/VT0101087	3/30/05	Sanitary Waste Outfall
Milton WWTF	Lamoille River	3-1203/VT0100684	12/31/05	Sanitary Waste Outfall
Wyeth Nutritionals Inc	Arrowhead Mt. Lake and Perc Ponds	3-1209/VT0020702	6/30/07	Dairy Products
Jeffersonville WWTF	Lamoille River	3-1323/VT0101150	3/31/05	Sanitary Waste Outfall
Smugglers Notch-Water Treatment Plant	Brewster River	3-1409	12/31/04	Filter Backwash
Smugglers Notch-snowmaking	Brewster River	3-1416	9/30/05	Snowmaking drainage water
Kross Brewing	Morrisville WWTF	3-1442	3/31/08	Process wastewater
Manosh Corp-sawmill	Lamoille River	3-1471/VT0000914	3/30/05	Woodworking discharge
Smugglers Notch-snowmaking system drainage	No Name Brook-trib to Brewster	3-1476	9/30/05	Shutdown drainage
Rock Art Brewery	Morrisville WWTF	3-1497	3/31/08	Beverage processing
Milton General Store	Storm sewer to unnamed trib to Arrowhead Mt. Lake	3-4010	3/31/07	Treated groundwater

APPENDIX B.3 - Land Disposal (of Wastes) Program

1) Indirect Discharge Permits

DEC's 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 plants 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.

Statutory Reference: 10 VSA, Chapter 47

Smugglers Notch Resort in Cambridge currently uses a lagoon treatment system and spray applies the residuals. Smugglers Notch is proposing to construct a sequential batch reactor treatment facility as part of a resort expansion project.

2) Regional Office Permits

This section issues water supply and subsurface wastewater disposal permits required for all buildings other than single family homes and all permits for subdivisions, sewer line extensions, mobile home parks and campgrounds which have flows less than 6,500 gallons per day. If the subdivision involves 10 or more lots, Act 250 may take jurisdiction. Engineers in five regional offices examine applications and approve permits. The regional offices that cover the basin include the Essex, Barre, and St. Johnsbury.

Statutory Reference:

10 VSA Chapter 61

18 VSA Section 1218

Permitted Indirect Discharges

Facility Name	Receiving Water	Permit ID Number	Permit Expiration	Discharge Activity
L. Garamella	Groundwater	7-0212	12/31/02	Underground injection control
Smugglers Notch	Unnnamed trib to Brewster River & Brewster River	9-0024	6/30/05	Treated domestic sewage from aerated lagoon & activated sludge treatment facility sprayed in forested sprayfield
Birchwood Manor Trailer Park	Lamoille River	9-0065	6/30/06	Treated domestic sewage. Park to connect to Town WWTF
Browns River Middle School	Browns River	9-0079	6/30/06	Treated domestic sewage
Wapanaki Camp	Tucker Brook	9-0085	6/30/03 Renewal pending	Treated domestic sewage
Bourgeois Properties, Morrisville	Lamoille River	9-0089	3/31/06	Treated domestic sewage
Red Fox Alpine Lodge	Brewster River	9-0092	6/30/07	Treated domestic sewage
Mt. Mansfield Union HS	Unnamed trib of Lee River	9-0100	3/31/06	Treated domestic sewage
Lamoille Union HS	Lamoille River	9-0106	6/30/06	Treated domestic sewage
Hyde Park Municipal System	Centerville Brook	9-0122	9/30/03 Pending renewal	Treated domestic sewage
Woodbriar Manor	Unnamed trib of Lamoille River	9-0143	9/30/04	Sanitary Waste Outfall
Colonial Manor Apts.	Lamoille River	9-0168	9/30/03 Pending renewal	Treated domestic sewage
Westford North Ridge Owners Assoc	Unnamed trib of Lamoille	9-0236	6/30/03	Treated domestic sewage

APPENDIX B.4 - Construction Runoff Control Program

Sediment discharges to waterbodies is a critical stormwater issue. The Department, through the Vermont Geological Survey, developed a guidance document for erosion and sediment control related to construction activities (Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites, Vermont Geological Survey, 1982, rev. 1987). This document is frequently used by developers and their consultants for project planning and responses to Criterion 4 of the Act 250.

General Permit for Stormwater Runoff from Construction Sites

The development of an erosion control plan helps to protect water quality by preventing the discharge of sediment from construction sites, minimizing the extent and duration of soil disturbance, maintaining existing drainage ways and vegetation, and protecting riparian buffer areas from disturbance.

Any construction project that disturbs one or more acres of soil, including any disturbance of less than one acre which is part of a larger common plan that will result in a total of one or more acres of disturbance.

A General Permit to permit discharge of stormwater from construction sites; requires the development and submittal of an erosion and sediment control plan.

At least 30 days prior to the commencement of construction activity.

Where: An application can be obtained from:
Vermont Agency of Natural Resources
Department of Environmental Conservation
Division of Water Quality, Stormwater Section
103 South Main Street, Building 10 North
Waterbury, VT 05671-0408
Stormwater Hotline 241-4320
http://www.anr.state.vt.us/dec/waterq/stormwater/htm/sw_cgp.htm

APPENDIX B.5 - Solid Waste Management Program

The Solid Waste Management Program regulates the treatment, storage and disposal of solid waste, with the exception of the land management (diffuse disposal) of biosolids and septage, which is regulated by the Wastewater Management Division. In order to receive a certification, a facility must demonstrate that it complies with applicable siting, design, operation, closure and post closure requirements and standards included in the Vermont Solid Waste Management Rules. The Solid Waste Management Program also assists the Enforcement Division in illegal dumping/disposal cases.

The protection of water related resources are specifically addressed in the Vermont Solid Waste Management Rules ("SWMR"), Vermont Groundwater Protection Rule and Strategy, and Agency Procedures applicable to solid waste management facilities (with the exception of biosolids or septage diffuse disposal). These requirements are to be addressed in a solid waste facility application for certification and may be specifically addressed in the requirements of a certification issued by the Agency.

Solid Waste Disposal Facilities must be in compliance with the Vermont Ground Water Protection Rule and Strategy and the Vermont Water Quality Standards to receive certification -§6-303(d) of the SWMR, Vermont Groundwater Protection Rule and Strategy, 2/8/99 Procedure Addressing Requirements For Municipal Solid Waste Landfills To Demonstrate Compliance Of The Landfill Design With Water Quality Standards, and 2/8/99 Procedure For A Combined Solid Waste Certification and Indirect Discharge Permit.

- The SWMR identifies various types of water related resources as prohibited areas for the siting of solid waste management facilities - §6-309(c)(6), §6-502(a) and §6-1104(b)3(b)(3) of the SWMR.
- Facilities must meet performance standards in order to assure that siting of the facility will have the least possible reasonable impact on the environment, including groundwater, surface water or waters of the state. §6-503 of the SWMR. and 9/12/95 Procedure Addressing the Numerical Criteria For The Distance To Drinking Water Sources From Discrete Disposal Facilities.
- Site characterization on which a facility is to be located must address groundwater and surface water - §6-603 of the SWMR.
- Facilities must be designed and operated to protect the environment, including ground water and surface water - §6-604(a)(4), §6-606(a)(3), §6-701, §6-1104(c)(2)(E) and §6-1203&1204 of the SWMR. Most landfills must be lined with leachate collection and off-site treatment and must control run-on and run-off - §6-606(b)(2) of the SWMR and 6/9/94 Procedure Addressing Requirements For Run On/Run Off Control System for Municipal Solid Waste Landfills.
- Facilities are to be monitored as deemed appropriate to detect the discharge of contaminants to groundwater and surface water. For landfills, monitoring continues through the operational life of the landfill and the post closure period (20 years for unlined landfills that

closed since 1989, 30 years for lined landfills which operated since 1994) - §6-604(a)(4) and §6-606(a)(3) of the

- SWMR. 2/8/99 Procedure Addressing Ground Water Quality Monitoring and Ground Water. 2/8/99 Remedial Action at Municipal Solid Waste Landfills. Procedure Addressing Post-Closure Care and Post Closure Certification At Solid Waste Landfills.
- A response involving corrective action for ground water impacts by a solid waste landfill can be required - VT Groundwater Protection Rule and Strategy and 2/8/99 Procedure Addressing Corrective Action & Financial Responsibility For Corrective Action At Solid Waste Landfills.
- Any discharge that poses a threat to the environment must be reported within 24 hours to the DEC.- §6-703(c) of the SWMR.
- Facilities must be closed in a manner that prevents discharges to surface water during and after closure -§6-1001 of the SWMR.

Statutory Reference

10 VSA Chapter 159 (Waste Management)

10 VSA Chapter 48 (Groundwater Protection).

APPENDIX B.6 - Residual Wastes Program

This program in the Wastewater Management Division oversees the management of the state's residuals, such as septage and wastewater sludge. Permits are required for treatment, storage, or disposal of these residuals and for the operation or construction of such facilities.

Statutory Reference: 10 VSA Chapter 159

There are several regulatory requirements for the land application of sludge (biosolids) and septage that assist in protecting surface waters and groundwater, such as required set backs and separation distances, maximum allowed slope of site, nutrient management for site, among others. In 1998, the Solid Waste Management Rules were revised to include, along with other items, the prohibition of land application of solid waste in the area of the 100-year floodway as another measure to assist in protecting surface water quality.

APPENDIX B.7 - Mine Runoff Control Program

Sand & Gravel Pits

Non-point source pollution is a concern associated with the operation, maintenance, and closure of sand and gravel pits in Vermont. Surface runoff and erosion contribute to the sedimentation of waterbodies adjacent to sand and gravel pits. Vegetative cover can reduce erosion and sedimentation problems, enhancing aesthetic values, and improve nesting and cover areas for wildlife. Practices for the control of erosion can be found in: USDA Natural Resources Conservation Service Technical References:

A. Vegetating Vermont Sand and Gravel Pits- VT Technical Guide, Conservation Planning Application Technical Reference #10

B. Critical Area Planting-Conservation Practice Standards code 342: Technical Guide Chapter IV (www.vt.nrcs.usda.gov/standards/342vt.html)

Also refer to Hazardous Waste Management Program.

APPENDIX B.8 - Hazardous Waste Management Program

1) Hazardous Waste

The Hazardous Waste Management Program within DEC establishes the regulatory framework for all hazardous waste generated in Vermont and provides a "cradle-to-grave" tracking system for these wastes. The program establishes the standards for proper management of hazardous waste while also addressing the environmental and human health problems that arise from the mismanagement of hazardous waste. Improper management of hazardous waste can pollute vast areas of land, rivers, streams and lakes, and can lead to unacceptable human exposure to these materials. The program is a prevention program -- when it is successful, these impacts occur less frequently and with less severity.

Statutory Reference

Title 10 VSA Chapter 159, the Waste Management Act.

Specific sections include 10 VSA 6601, 6602, 6604, 6605f, 6606, 6606a, 6606b, 6607, 6607a, 6608, 6608a, 6608b, 6609, 6610a, 6612, 6615, 6616, 6617, 6618.

2) Underground Storage Tanks

All Vermonters depend on clean water. Leaking underground storage tanks (USTs) pose a substantial threat to both human health and the environment, because substances leaked from these tanks are one of the most significant contaminants polluting ground and surface water supplies. In densely developed areas, releases from underground tanks pose an additional risk, since gasoline vapors can accumulate in basements and crawl spaces, posing health hazards as well as fire dangers.

The goal of the UST Program within DEC is to protect human health and the environment by eliminating releases of hazardous materials from underground storage tanks, and fostering proper management of underground tanks in Vermont. By regulating the installation, operation, and closure of USTs, the Underground Storage Program protects the state's water resources and prevents vapor impacts to buildings.

Statutory Reference

10 VSA Chapters 59 and 159

APPENDIX B.9 - Flow Regulations and Dams

1) Dam Safety Program

The Dam Safety Section administers the State Dam Safety program, operates and maintains the Winooski Valley Flood Control Reservoirs, and periodically inspects the 85 state-owned dams and plants found throughout Vermont for their repair/improvement needs. The section operates a permit program for construction and alteration of non-hydroelectric dams (the Public Service Board regulates hydroelectric dams) to serve the public good and provide adequately for the public safety. A permit is required to alter any dam, pond or impoundment not related to generation of electric energy for public use or part of a public utility system which is or will be capable of impounding more than 500,000 cubic feet of water or other liquid, as measured to the top of the dam. Submittal of completed application form, fee, plans and specifications and design data is required. A public information meeting may be required. The section inspects privately owned dams on a resources-available basis, maintains an inventory of dams, and provides technical assistance to dam owners.

Statutory Reference

Permit program: 10 VSA Chapter 43 (Dams).

2) Hydrology Program

This program within DEC reviews all projects that may alter the natural flow of rivers and streams, such as hydroelectric projects and all manner of water withdrawals. These reviews may take place under a number of regulatory programs, including Act 250, Agency dam orders and stream alteration permits, and projects subject to federal licenses or permits (under Section 401 of the Clean Water Act). In addition, the Hydrology program evaluates projects subject to Act 250 for riparian protection provisions, erosion control measures, and general consistency with Vermont Water Quality Standards.

Statutory References

10 V.S.A. Chapter 41 (Regulation of Stream Flow)

10 V.S.A. Chapter 43 (Dams)

10 V.S.A. Chapter 151 (Act 250)

Section 401 of the Federal Clean Water Act (33 U.S.C. §1341)

APPENDIX B.10 - Wetlands, Dredge, and Fill Material Control Programs

1) Vermont Wetlands Protection

The overall goal of the program is to achieve no net loss of wetland functions and values. The program consists of three components: a regulatory component, a scientific component, and an education/outreach component. The regulatory aspects of the program include administering the Vermont Wetland Rules, making determinations of Water Quality Certification under the Clean Water Act and the Vermont Water Quality Standards, providing project review in Act 250 land use permitting, and assisting in compliance and enforcement. Inventories and scientific investigations are carried out as special grant projects and include both the Division biomonitoring section and biologists in the Fish and Wildlife Department, Nongame and Natural Heritage program. Education and outreach is provided through technical assistance and presentations to towns, stakeholder groups, conservation commissions, schools, and other Agency programs.

Statutory references:

Sections 404 and 401 of the Clean Water Act
Section 104(b) 3 of the Clean Water Act
Act 250
Title 10 VSA Chapter 37, Sec. 905 (7-9).

2) Federal Wetlands Protection

A Corps of Engineers permit is required for all work beyond ordinary highwater in or above navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403). In New England, for the purpose of Section 10, navigable waters of the United States are those subject to the ebb and flow of the tide and a few major waterways used to transport interstate or foreign commerce. Permits are required under Section 404 of the Clean Water Act for those activities involving the discharge of dredged or fill material in all waters of the United States, including not only navigable waters of the United States but also inland rivers, lakes, streams and wetlands. In inland waters, Corps jurisdiction extends landward to the ordinary high water mark or the landward limit of any wetlands. The term "discharge" in this context may include the re-depositing of wetlands soils such as occurs during mechanized land clearing activities, including grubbing, grading and excavation.

The term "wetlands," used above, is defined by Federal regulations to mean "...those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions..." (33 C.F.R. Part 328.3 (b), as published in the November 13, 1986 Federal Register). Wetlands generally include swamps, marshes, bogs and similar areas. The term "fill material," used above, is defined by Federal regulations to mean "...any material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a waterbody. The term does not include any pollutant discharged into the water primarily to dispose of waste..." (33 C.F.R. Part 323.2 (b), as published in the November 13, 1986 Federal Register).

APPENDIX B.11 - Groundwater Pollution Control Programs

1) Groundwater Protection

The Groundwater Protection Rule and Strategy is the groundwater management and protection strategy for the State of Vermont. The Rule outlines the principles, directives and goals relating to groundwater protection. The Rule also contains groundwater quality enforcement standards and outlines the four classes of groundwater. The Groundwater Coordinating Committee, an interagency committee, oversees the groundwater reclassification efforts and provides a forum for interagency coordination on groundwater issues. The DEC Water Supply Division provides administrative and technical support to the Committee. The program reviews weekly Act 250 applications for potential water supply and groundwater impacts. The Water Supply Division also serves as a clearinghouse on groundwater protection information. Through their regulatory and outreach programs, other divisions also protect groundwater and provide information on groundwater protection issues.

Statutory Reference

10 VSA Chapter 48

2) Underground Injection Control

This program within DEC regulates all non-sanitary sewage discharges to the groundwater. It is a federally delegated program. If the discharge receives a permit from another DEC program, the UIC permit is not required.

Statutory Reference

10 VSA Chapter 47

Section 1422 of the Federal Safe Drinking Water Act.

3) Public Water Supply (program also influences surface water)

The DEC Water Supply Division is responsible for the regulation of all public water systems in the state of Vermont. A public water system has fifteen connections or serves an average of twenty-five people at least sixty days a year. Examples of public water systems include municipalities, mobile home parks, schools, restaurants, motels. The major program functions involve permitting construction and operation, approving new sources of drinking water, review of monitoring data, technical and financial assistance, enforcement, source water protection, operator certification, enforcement, and inspections.

Statutory Reference

Federal Safe Drinking Water Act Amendments of 1996

10 VSA Chapter 56 Public Water Supply

10 VSA Chapter 55 Aid to Municipalities for Water Supply, Pollution Abatement, and Sewer Separation

24 VSA Chapter 120 Special Environmental Revolving Fund.

4) Well Driller Program

Any person who intends to engage in the business of drilling wells must obtain a license to do so. This includes both water well drillers and monitoring well drillers. Licensing is intended to protect public health and prevent degradation of groundwater quality through competent drillers

appropriately applying industry standard well construction and abandonment procedures in their work. A license may be renewed if appropriate continuing education is demonstrated on a three-year basis.

Statutory Reference

10 VSA Chapter 48

APPENDIX B.12 - Fisheries Protection Regulations

Statutory references

Title 10 and Chapters 101 through 123

This is where all the laws relating directly to fish and wildlife conservation are found. It also gives the authority to the Fish and Wildlife Board to set seasons, creel limits and size limits. Most of the laws pertaining to fish are found in Chapter 111 and primarily deal with the "taking of fish." One of these laws, section 4605 (placing fish in waters) allows for the control of introductions of exotic or competing fish species as well as diseases. Section 4607 (obstructing streams) prohibits the installation of a structure that prevents fish movement, such as a rack, weir or other obstruction, unless an approval has been granted by the Commissioner of Fish and Wildlife. This statute generally is applied to small streams with a drainage area less than 10 square miles; on larger streams Title 10, Chapters 41 or 43 is applied.

Title 10, Chapter 43 Dams

A certificate of public good is required before constructing any dam impounding more than 500,000 cu. ft. This law is administered by the Department of Environmental Conservation excepting projects involving the generation of hydroelectric energy. The Public Service Board assumes jurisdiction in those cases. Regarding public hydroelectric and flood control projects, the final authority lies with the Federal Energy Regulatory Commission.

Section 1084 requires the Fish and Wildlife Department to investigate the effect of any proposed project on fish and wildlife resources and to certify its findings to the Department of Environmental Conservation or the Public Service Board, prior to any hearing.

Section 1086 enumerates the several issue areas that must be explored before a determination of public good is made. Specifically included are recreational values; fish and wildlife; existing uses such as fishing; and the need for minimum stream flows.

Title 10, Chapter 47 Vermont Water Pollution Control Act

This law administered by the Agency of Natural Resources under auspices of the Federal Water Pollution Control Act (PL 92-500). Within the Water Pollution Control Act are sections 1252 and 1258 which, respectively, set up a classification system for state waters and authorize the Agency to manage waters to attain or maintain their classification, including the regulation of discharges to state waters. Under Section 1252, Water Quality Standards are promulgated by the Water Resources Board to establish numeric and narrative standards for the management of waters. The Standards also designate all waters as to their fish habitat type - either cold water or warm water. The Standards have the force of law and set up an important framework for management of physical water quality, such as dissolved oxygen, temperature, turbidity, and toxics and for protection of other important habitat and life-stage considerations, such as nutrient control, substrate integrity, and propagation. The authority to regulate stormwater discharges is included in Section 1264. Section 1263(a) regulates activities pertaining to control of aquatic nuisances (Aquatic Nuisance Control).

Title 10, Chapter 41 Regulation of Stream Flow; Subchapter 1, Section 1003

This section of the statute dealing with the regulation of stream flow empowers the Department of Environmental Conservation to call to conference any dam owner that regulates natural stream flow and to require the passage of adequate flows to support the stream fishery.

Title 10, Chapter 41 Regulation of Stream Flow; Subchapter 1, Section 1004

Section 1004 makes the Secretary the state agent with respect to the Federal Energy Regulatory Commission (FERC) dam licensing process and with respect to the Federal Clean Water Act Section 401 administration. Under Section 401, federal agencies cannot issue licenses or permits for activities that may affect water quality until such activities have been certified as meeting state water quality standards. This Section 401 process has proved to be a powerful tool in the review of projects subject to FERC and Corps of Engineers jurisdiction.

Title 10, Chapter 41 Regulation of Stream Flow; Subchapter 2 Alteration of Streams

A person may not change the cross-section of a stream or modify or alter it in any way by moving more than 10 cu. yd. of material without a permit from the Department of Environmental Conservation. This subchapter does not apply to dams subject to Chapter 43 or highways and bridges subject to section 5 of Title 19. Exemptions include personal use of 50 cu. yd. of gravel/year by riparian landowners (this gravel exemption also includes streams having drainage area of less than 10 mi²) and accepted agricultural and silvicultural practices. A permit will be granted if, among other criteria, it appears the project will not significantly damage fish life. There are also special provisions for protecting outstanding resource waters.

Title 10, Chapter 151 Vermont's Land Use and Development Law (Act 250)

This law provides for broad protection of streams, shorelines, and water quality through criteria related to erosion control, effect on public investments, necessary wildlife habitat, and retention of the natural condition of streams and shorelines. Protection of fisheries resources has been primarily protecting stream habitat by imposing buffer strips, minimum stream flows, and stream crossings which provide unrestricted fish passage. The development must meet all the criteria of the Act (6086(a)1-10), but District Commissions have considerable latitude in the decision since the criteria are loosely worded (e.g. "undue water pollution").

Title 29, Chapter 11 Management of Lakes and Ponds

This statute addresses encroachment onto lands lying under public waters such as from docks, marinas, boathouses, etc. Exceptions include water pipes <2 inches (inside diameter), buoys and duck blinds, docks of certain size, rafts, etc. Criteria for granting or denying a project include determination of public good (Section 405), which addresses impacts on fish habitat and recreation. In 1989, interim procedures for issuance or denial of encroachment included whether or not the project meets the requirements of the public trust doctrine. In a recent case the Vermont Superior Court ruled that the Department of Environmental Conservation overstepped its authority by including the public trust doctrine criteria in its interim procedures for permit denial. The interim procedures also addressed the potential cumulative effect of encroachment. In 1984, the Water

Resources Board overturned the Department's denial of a permit by concluding "... the consideration of the potential cumulative effect of possible future encroachments is neither contemplated nor authorized by 29 V.S.A. 405(6)." (LaFleur Appeal).

Although there are a number of other state laws that indirectly protect fisheries resources, such as T24 Floodplain Development and T10 Chapter 159 Solid Waste Disposal, the above are most applicable.

In addition to fisheries considerations addressed in the Federal Energy Regulatory Commission's rules, there are several other Federal regulations that can afford resource protection. Two of the most notable are:

1. Section 404 of the Federal Water Pollution Control Act amendments of 1972 give the U.S. Army Corps of Engineers the authority to regulate discharges of dredged or fill material into all waters of the U.S. including wetlands.
2. Section 10 of the Rivers and Harbors Act requires a Corps of Engineers permit for construction of any structure in or over any navigable water of the U.S. This includes dredging or disposal of dredged material, excavation, channelization or other modification. Projects can range in size from small docks to large breakwaters.

APPENDIX B.13 - Other Important Programs

(Monitoring & Assessment, Geologic Surveys, Pollution Prevention, etc)

1) Surface Water Monitoring & Assessment

The overall goal of the environmental monitoring and assessment program is to ensure that good science is used to develop an understanding of the attributes of, and the forces which affect, the physical, chemical, and biological characteristics of Vermont's aquatic ecosystems, and ensure that this information is available to be used as the basis for making, and evaluating the consequences of, environmental management decisions made or influenced by DEC. The specific objectives of this program include the following:

- Determine the present and future health of aquatic ecosystems in Vermont;
- Establish empirical limits of natural variation in aquatic ecosystems in Vermont;
- Diagnose abnormal conditions to identify issues in time to develop effective mitigation;
- Identify potential agents of abnormal change;
- Assess ecological changes resulting from the implementation of environmental management activities; and
- Identify risks to human health associated with the use of aquatic resources.

In order to accomplish these objectives, this program conducts activities to monitor and assess the chemical, physical, and biological components of aquatic ecosystems. Findings relate to both ecological and human health. Activities are conducted both in response to identified issues, activities, and potential problems; and in the framework of long-term environmental status and trends monitoring.

Statutory Reference

10 V.S.A. Chapter 47
Federal Clean Water Act

2) Geologic Surveys & Information

The Geology program conducts surveys and research related to Vermont geology, topography, and mineral resources; provides information to the public, government, industry, and other institutions which request assistance; and maintains and publishes Vermont geological information. Geologic research can illuminate the nature of ground water and the interaction of ground and surface waters that maintains stream discharge and temperature during low flow periods. Erosion studies that focus on slope stability and the sources of sediment released to rivers have direct bearing on water quality.

Statutory references

3 VSA, Chapter 53, Section 2879
10 VSA, Chapter 7, Sections 101-105

HAZUS-MH (stands for FEMA's Mitigation Division powerful risk assessment software program for analyzing potential losses from floods, hurricane winds and earthquakes) will be used to not only

to predict the potential damage from earthquake events but from flood events and the effects of riverine erosion.

3) Pollution Prevention Program

The focus of this program within DEC is to help businesses research and identify opportunities to reduce the amount of waste generated and the amount and toxicity of chemicals used in their operations. Technical assistance may be provided on-site at the facility's request. The program is also responsible for administering Vermont's Pollution Prevention Planning Requirement affecting over 100 businesses that generate hazardous waste and/or use certain listed toxic chemicals. The Program is located in the Environmental Assistance Division and shares a toll-free number with the Small Business Compliance Assistance Program that businesses and others can use to get answers to their environmental questions.

Statutory reference:

10 V.S.A. Chapter 159 Subchapter 2. Sections 6623-6632.

4) Section 319 Nonpoint Source Management

Water pollution control in Vermont, as well as in other states across the nation, has tended to focus on the larger, more obvious discharges referred to as point sources of pollution. Recently, much greater attention has been directed at the more diffuse, harder to quantify, more difficult to control pollution sources known as nonpoint sources of pollution. Pollution from nonpoint sources (NPS) is the major source of water use impairment to Vermont surface and ground water resources. NPS pollution is apparent in each of Vermont's seventeen river basins. The types and extent of water quality problems associated with these sources of pollution, however, exhibit a considerable degree of variation between and within basins. To a large extent, NPS pollution control and NPS pollution prevention centers about the watershed approach, land use and land management.

NPS implementation through Section 319 has been available to Vermont since federal fiscal year 1990, the first year funding was appropriated. Over twelve years of annual funding (FFY1990-2001), Vermont has been awarded about \$11 million, which has assisted over 100 NPS projects. Projects have been completed or are underway by a variety of interests including several towns, watershed associations and state departments, the University of Vermont and many Natural Resources Conservation Districts (refer to attached project listing). The Vermont NPS Program is involved in the following areas of concentration:

- coordination, oversight and administration of Section 319;
- influence the direction and level of NPS planning and implementation arising from other programs or funding sources (e.g. US Department of Agriculture, Lake Champlain Basin Program, Connecticut River Joint Commissions);
- assist Vermont Agency of Agriculture, Food & Markets with new agricultural NPS responsibilities (as per Act 261 of 1992);
- distribution of Clean Water Act Section 604(b) pass-through planning funds to the 12 Vermont regional planning commissions; and,
- advocate the widespread adoption of certain land management practices (especially erosion/sediment control, phosphorus management and vegetated buffer strips).

Statutory reference:

Title 10 VSA, Chapter 47, the Vermont Water Pollution Control Law

Section 319, 1987 Amendments, Federal Water Pollution Control Act (also known as Clean Water Act)

5) River Corridor Management Program

The River Corridor Management Program provides regulatory review and technical assistance to landowners, municipalities, non-governmental organizations and other agencies to help determine the appropriate stream channel and flood plain management practices necessary to resolve and avoid conflicts with river systems. The practices selected will be designed to recognize and accommodate, to the extent feasible, the stream's natural stable tendencies. The recommended conflict resolution will recognize the stream's long-term physical response to past and proposed management practices. The resulting work will provide increased property and infrastructure protection and will maintain or enhance the ecological functions and economic values of the river system. Geomorphic assessment of the Lamoille River watershed and major subwatersheds are underway (see Appendix A.8).

Statutory Reference

10 VSA Chapter 41

10 V.S.A., Chapter 32

Section 401 of the Clean Water Act

Contact

For stream alteration regulatory and technical assistance and flood damage issues:
802-879-5631.

For flood plain technical assistance:

Floodplains Management Engineer
Water Quality Division
10 North, 103 South Main St.
Waterbury, VT 05676
802-241-3759

For stream stability assessment technical assistance:

River Restoration Ecologist
Water Quality Division
10 North, 103 South Main St.
Waterbury, VT 05676
802-241-3774

6) Act 250

Act 250 provides a public, quasi-judicial process for reviewing and managing the environmental, social and fiscal consequences of major subdivisions and development in Vermont through the issuance of land use permits. Activities include review of land use permit applications for conformance with the Act's ten environmental criteria, issuance of opinions concerning the applicability of Act 250 to developments and subdivisions, monitoring for compliance with the Act and with land use permit conditions, and public education.

In an Act 250 application, applicants need to supply sufficient information for the District Commission to make findings on the ten environmental criteria. In so doing, certifications and/or approvals from other agencies and departments, utilities, regional planning commissions and local government may be necessary.

With regard to water pollution, Criterion 1 states that the project will not result in undue water or air pollution. This criterion deals with water and air pollution potential generally and such specific matters relating to water pollution as: (A) Headwaters; (B) Waste disposal; (C) Water Conservation; (D) Floodways; (E) Streams; (F) Shorelines; and (G) Wetlands.

7) Total Maximum Daily Load Program- (Vermont's Wasteload Allocation Process and Federal Requirements for TMDLs)

The primary goal of the Total Maximum Daily Load (TMDL) program is to develop solutions to restore those waters which do not meet Vermont Water Quality Standards and will not meet those standards even after all minimum required Best Practicable Treatment (BPT) alternatives are applied. In order to fulfill the requirements of the Clean Water Act, the program works in two phases and is dependent on several other programs within the Agency of Natural Resources to fulfill its goal. First, water quality monitoring data is gathered and analyzed to identify the condition of the State's waters. Those waterbodies that show a clear and documented violation of the Water Quality Standards substantiated by data collected through chemical, biological or physical monitoring are placed on the State's List of Impaired Surface Waters. The second phase is to develop TMDL plans for those waters that are Water Quality Limited Segments, defined as waters that will not achieve water quality standards even after BPTs are applied to all discharges. These plans essentially are a budget for the pollutant causing the impairment. Following investigations, all pollutant sources are identified that contribute to the impairment and each receives an allocation as to how much it can contribute to the total pollutant load. This is usually accomplished by determining from what sources reductions are necessary. The TMDL plans are structured in accordance with Clean Water Act regulations and EPA guidance. These plans involve public participation and ultimately need approval from EPA to verify their satisfaction of Clean Water Act requirements. The third phase is to implement the TMDL plan and conduct water quality monitoring in order to evaluate the effectiveness of implementation and document achievement of Water Quality Standards.

Statutory reference

Section 303(d) of the Clean Water Act
40 CFR §130.7

