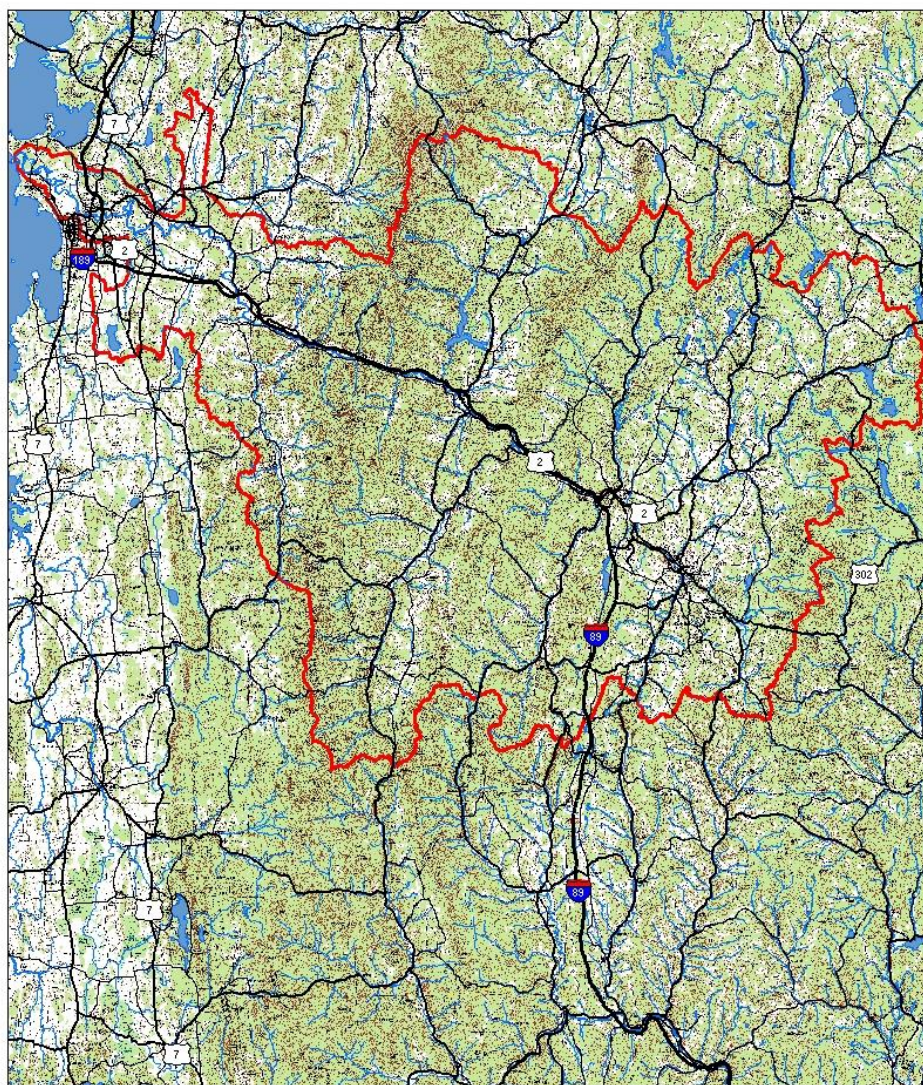


Basin 8 - Winooski River Watershed

Water Quality and Aquatic Habitat

Assessment Report



Winooski River watershed

**Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division
Monitoring Assessment and Planning Program**

June 2017

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Organization of the Winooski River Assessment Report

The last Winooski River Water Quality and Aquatic Habitat Assessment Report was done in April 2008. The information in this report is largely an update of that report's information. Some topics were covered in a fair amount of detail in 2008 and that information is still relevant. For more information on the following topics, refer to the [2008 Winooski River assessment report](#):

- Waterfalls and cascades from the Waterfalls, Cascades and Gorges Report
- Swimming holes and Boating stretches from various sources
- Some Geomorphic Assessment Phase II results

The following report on the Winooski River watershed is a compilation of information and data gleaned from numerous sources. The information comes from state agencies especially the Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation Watershed Management Division but also from the Waste Management Division and ANR Department of Fish and Wildlife. There is also information from watershed organizations, lay monitoring groups, and environmental consultants.

In the DEC Stream Assessment Database, the Winooski River watershed is divided into 20 river or stream waterbodies. Lakes and ponds are identified also within those 20 waterbodies. For purposes of this report, however, the waterbodies have been combined and the watershed is portrayed in nine sections. See Table 1 below for the waterbody number, name, and the portion of the watershed in which that waterbody is discussed.

Table 1. Waterbodies Assigned to Winooski River Subwatershed Areas

WBID	Waterbody Name	Portion of the Watershed
08-01	Lower Winooski River mainstem	Lower Winooski River watershed
08-02	Tributaries to Lower Winooski	Lower Winooski River watershed
08-03	Lower Mid-Winooski River mainstem	Lower Winooski River watershed
08-04	Tributaries to Lower Mid-Winooski	Lower Winooski River watershed
08-05	Upper Mid-Winooski River mainstem	Upper Winooski River watershed
08-06	Tributaries to Upper Mid-Winooski	Upper Winooski River watershed
08-07	Upper Winooski River mainstem	Upper Winooski River watershed
08-08	Tributaries to Upper Winooski	Upper Winooski River watershed
08-09	Winooski River headwaters	Upper Winooski River watershed
08-13	North Branch Winooski River	Upper Winooski River watershed
08-14	Kingsbury Branch Winooski River	Upper Winooski River watershed
08-10	Huntington River	Huntington River watershed
08-11	Lower Little River	Little River watershed
08-12	Upper Little River	Little River watershed
08-15	Jail Branch Winooski River	Stevens Branch watershed
08-16	Stevens Branch Winooski River	Stevens Branch watershed
08-17	Dog River	Dog River watershed
08-18	Mad River mainstem	Mad River watershed
08-19	Lower Mad River tributaries	Mad River watershed
08-20	Upper Mad River tributaries	Mad River watershed

General Description

The Winooski River begins in the northeast corner of Washington County in the town of Cabot then flows for approximately 90 miles first southwesterly from Cabot to Montpelier and then northwesterly from Montpelier, going from the east side to the west side of the Green Mountains, through Bolton Gap. It enters Lake Champlain in the town of Colchester just north of Burlington. The Winooski River has a drainage area of approximately 1,080 square miles or about 11.9 percent of Vermont. The basin occupies all of Washington County, a little less than half of Chittenden County and small parts of Lamoille and Orange Counties. For a river length of 33 miles from the mouth to Jonesville, the valley is not more than 12 miles wide, but just to the east at Bolton where the river cuts through the Green Mountains, the valley spreads out to a width of over 30 miles.

The Winooski River has seven important tributaries, three of which enter from the north: the Little River joining below the village of Waterbury; the North Branch joining at the city of Montpelier; and Kingsbury Branch joining in East Montpelier. The four branches flowing from the south are the Huntington River coming in at the village of Jonesville, the Mad River joining in Middlesex; the Dog River entering just west of the city of Montpelier, and the Stevens Branch just north of Montpelier.

The land use and land cover of the Winooski watershed is very diverse. It includes cities such as Burlington, South Burlington, Winooski, Barre, and Montpelier; farmland in Cabot and other headwater towns; forested mountainland but also developed ski resort areas of Stowe and the Mad River valley; and rural residential areas in Richmond, Huntington, Northfield, and East Montpelier, as just some examples of the diversity. There are stretches of flashy streams; concentrations of hazardous waste sites; large-scale development on steep slopes; several large reservoirs and dams; many, many miles of gravel roads, and numerous other challenges to the health of the watershed streams.

Housing development rates in most of the towns of the Winooski River watershed were high from 1990 to 2000 and again from 2000 to 2010. Williston, which had a huge 62% increase from 1990 to 2000, had a less extreme increase from 2000 to 2010 at 20%. Over 1700 new housing units have been added to the landscape, mostly former farmland, in this watershed town alone in the last 20 years and this doesn't include the commercial and industrial development.

Bolton, Fayston, South Burlington, and Stowe, also had high rates of housing growth at 46%, 33%, 30%, and 29% respectively. Bolton's numbers are unusual in that it showed a 24% decline from 1990 to 2000 before the 46% increase from 2000 to 2010. That three of the four towns with the highest growth rates are towns with rural and steep lands is a concern for water quality protection. Also, unfortunately for water quality and other natural resource protection, as well as for the accomplishment of stated goals in many town plans, the lowest growth of housing and population was in the cities of Barre City, Montpelier, and Burlington. Housing growth from 2000 to 2010 ranged from 1% to 3% in these three cities. See Table A.1 of Appendix A for Housing Unit numbers and percent change rates between censuses.

Physical Assessments done in the Winooski River Watershed

Numerous geomorphic assessments and corridor plans have been done on streams and rivers of the Winooski River basin. Some of the results of these assessments were included in the 2008 Winooski River WQ and AH Assessment Report but those that were done in 2008 and since that year obviously were not described at that time. Direct links to these documents are below. A number of riparian buffer planting projects and other projects have been done using the information contained in the reports below.

Table 2. Geomorphic assessment reports for Winooski River watershed streams

Basin	Report date	Stream or River	Report Link	Author
Winooski	12/01/2006	Alder Brook	Alder Brook Phase 1 and 2 SGA	Fitzgerald Environmental
Winooski	4/11/2008	Allen Brook	Allen Brook Watershed Departure Analysis and Project Identification Summary	Fitzgerald Environmental
Winooski	3/01/2009	Dog River	Dog River River Corridor Plan	Bear Creek Environmental
Winooski	9/14/2009	Huntington River	Huntington River Watershed Corridor Plan	Arrowwood Environmental
Winooski	12/01/2005	Huntington River	Huntington River Watershed Phase 1 SGA	Arrowwood Environmental
Winooski	1/01/2006	Huntington River	Phase 2 SGA Huntington River Watershed	Arrowwood Environmental
Winooski	10/01/2008	Kingsbury Branch	Kingsbury Branch of the Winooski River Watershed River Corridor Plan	Bear Creek Environmental
Winooski	6/02/2010	Kingsbury Branch	Pekin Brook Corridor Plan, Calais, VT	Bear Creek Environmental
Winooski	6/28/2010	Little River	Little River Corridor Plan	Bear Creek Environmental
Winooski	1/01/2008	Mad River	Mad River Headwaters Phase 2 SGA	Fitzgerald Environmental

Winooski	3/01/2008	Mad River	Mad River Phase 1 and 2 SGA	Field Geology Services
Winooski	1/01/2008	Mad River	Upper Mad River Corridor Plan	Fitzgerald Environmental
Winooski	2/01/2008	Muddy Brook	Muddy Brook Phase 1 and 2	Fitzgerald Environmental
Winooski	3/01/2009	North Branch Winooski	North Branch Winooski Corridor Plan	Johnson Company
Winooski	5/01/2007	North Branch Winooski	North Branch Winooski Phase 1 SGA	Winooski Conservation District
Winooski	3/01/2007	North Branch Winooski	Upper Winooski Watershed, North Branch and Lower Stevens Branch Phase 1 SGA	Winooski Conservation District
Winooski	9/01/2007	Richmond tribs	Winooski River tributaries in Richmond Phase 1 SGA	Fitzgerald Environmental
Winooski	3/01/2009	Stevens Branch	Stevens Branch and Jail Branches of the Winooski River Corridor Plan	Redstart Consulting
Winooski	4/01/2004	Stevens Branch	Stevens Branch in Williamstown and Barre City Phase 2 SGA	Lori Barg
Winooski	10/01/2007	Sucker Brook	Sucker Brook Phase 1 and 2 SGA	Fitzgerald Environmental
Winooski	10/12/2010	West Branch Little River	Upper West Branch Little River Corridor Plan, Stowe, VT	Bear Creek Environmental
Winooski	5/01/2007	West Branch Little River	West Branch Little River in Stowe Corridor Plan	Lamoille County Regional Planning Commission
Winooski	11/01/2005	West Branch Little River	West Branch Little River Phase 2 SGA	Bear Creek Environmental
Winooski	3/30/2006	Winooski - Cabot	Phase 2 SGA, Winooski River Watershed, Town	Bear Creek Environmental

			of Cabot, VT	
Winooski	6/01/2006	Winooski - Cabot	Winooski River in Cabot Corridor Plan	Bear Creek Environmental
Winooski	11/01/2004	Winooski - Cabot	Winooski River in Cabot Phase 1 SGA	Bear Creek Environmental
Winooski	12/01/2006	Winooski - Cabot	Winooski River in Cabot Phase 2 SGA	Bear Creek Environmental
Winooski	3/19/2014	Winooski - Montpelier to Cabot	Great Brook River Corridor Plan	Bear Creek Environmental
Winooski	1/01/2008	Winooski - Montpelier to Cabot	Upper Winooski Corridor Plan	Friends of the Winooski River
Winooski	4/01/2007	Winooski - Montpelier to Cabot	Upper Winooski Phase 2 SGA	Winooski Conservation District
Winooski	3/31/2010	Winooski - Montpelier to Cabot	Upper Winooski River: Plainfield to Montpelier, River Corridor Plan	Round River Design
Winooski	2/01/2009	Winooski Mid, Alder to Montp	Joiner Brook, Bolton River Corridor Plan	Bear Creek Environmental
Winooski	6/01/2007	Winooski Mid, Alder to Montpelier	Mid-Winooski Watershed Chittenden, Washington, and Lamoille Phase 1 SGA	Bear Creek Environmental
Winooski	12/15/2015	Winooski Mid, Alder to Montp	Middle Winooski River Corridor Plan	Bear Creek Environmental
Winooski	8/01/2006	Winooski, Mouth to Alder Brook	Lower Winooski Phase 1 and 2 SGA	Field Geology

Surface Waters with Impacts

The table below has all water segments that are on the 2016 303(d) impaired list of waters (Part A), the other Priority Waters Lists (Parts B, D, E F), or the Stressed Waters List.

Table 3. Miles or Acres of Impact to Winooski Watershed Streams or Lakes

River or Stream Segment	Status	Pollutant or Problem	Source	Other information
VT08-01 Winooski River, mouth to Winooski dam	10.5 miles Impaired Part A List	<i>E. coli</i>	Burlington CSOs	
VT08-02 Sunnyside Brook (Trib 8 to Sunderland Brook)	1.2 miles Impaired Part A List	Chloride		Added to the list in the 2016 cycle
VT08-02 Muddy Brook Trib#4 & Trib to Trib#4	0.9 miles Impaired Part A List	Chloride	From industrial and commercial land runoff	Toxics present too from Commerce St plume
VT08-02L01 Shelburne Pond	452 acres Impaired Part A List	Phosphorus		
VT08-05 Winooski River above Montpelier WWTF discharge	2.0 miles Impaired Part A List	<i>E. coli</i>	Montpelier CSOs	
VT08-07 Winooski River, Plainfield	0.7 miles Impaired Part A List	<i>E. coli</i>		Added to the list in the 2016 cycle
VT08-07 Winooski River, Marshfield, rm 72.8 up to Mollys Brook	10.0 miles Impaired Part A List	<i>E. coli</i>		Added to the list in the 2016 cycle
VT08-09 Winooski River, Cabot, Mollys Falls Brook up to rm 83.8	1.0 miles Impaired Part A List	<i>E. coli</i>		Added to the list in the 2016 cycle
VT08-11L02_02 Waterbury Reservoir littoral area	100 acres Impaired Part A List	Sediment		401 Water Quality Certification issued in 2014 but awaiting full implementation
VT08-12 Inn Brook	0.3 miles Impaired Part A List	Iron	Iron seeps from soils disturbed for development	This stream has been on the impaired waters since 2006.
VT08-12 Big Spruce Brook	0.5 miles Impaired Part A List	Iron	From soil disturbance from ski area development	This stretch added in the 2016 cycle.
VT08-13 Lower North Branch Winooski River	1.0 miles Impaired Part A List	<i>E. coli</i>	Montpelier CSOs	

VT08-16 Gunner Brook, below Farwell St. Dump	0.5 miles Impaired Part A List	Sediment, metals, nutrients, stormwater in lower section		Fish are “fair” or “poor” but macro-invertebrate community passing.
VT08-20 Clay Brook	0.5 miles Impaired Part A List	Stormwater, iron	Ski area development	First on impaired waters list in 1992
VT08-02 Tributary to Winooski River	0.4 miles Impaired Part B List	Metals	South Burlington landfill	First listed in 2002
VT08-08 Muddy Brook in East Montpelier	0.1 miles Impaired Part B List	Iron	CV landfill leachate	
VT08-12 West Branch Little River, rm 7.5 to 8.0	0.5 miles Impaired Part B List	Sediment, stormwater runoff	Ski area development, road	
VT08-16 Trib #23 to Stevens Branch below Williamstown WWTF outfall	0.5 miles Impaired Part B List	Nutrients	Williamstown WWTF	Outfall was moved to Stevens Branch with WWTF upgrade
VT08-01 Winooski River, mouth to Winooski Dam	10.5 miles Impaired Part D List	Mercury in fish tissue	Atmospheric deposition	Vermont Dept of Health advisory
VT08-02 Allen Brook, rm 2.4 to rm 5.0 Talcott Rd	2.6 miles Impaired Part D List	Stormwater	urban and suburban runoff	EPA approved TMDL in 8/2008 - identified as impaired since 1992
VT08-02 Allen Brook,	2.6 miles Impaired Part D List	<i>E. coli</i>		EPA approved TMDL in 9/2011.
VT08-02 Sunderland Brook, rm 3.5 to rm 5.3	1.8 miles Impaired Part D List	Stormwater		EPA approved TMDL in 8/2008 - identified as impaired since 1992
VT08-02 Centennial Brook, mouth to rm 1.2	1.2 miles Impaired Part D List	Stormwater		EPA approved TMDL in 9/2007- identified as impaired since 1996
VT08-02 Morehouse Brook, mouth to rm 0.6	0.6 miles Impaired Part D List	Stormwater		EPA approved TMDL in 9/2007- identified as impaired since 1998
VT08-09 Winooski River Cabot village	1.0 miles Impaired Part D List	<i>E. coli</i>		Added to the impaired list in the 2016 cycle
VT08-10 Huntington River	0.5 miles Impaired Part D List	<i>E. coli</i>		EPA approved TMDL in 9/2011
VT08-18 Mad River, mouth to Moretown	6.2 miles Impaired Part D List	<i>E. coli</i>		EPA approved TMDL in 9/2011

VT08-01 Winooski River, lower section	0.5 miles Altered Part E List	Eurasian water milfoil		The 0.5 miles is a place holder – length of the stretch with moderate milfoil isn't known.
VT08-02L01 Shelburne Pond	452 acres Altered Part E List	Curly-leaf pondweed		Pop confirmed in 1996; no control
VT08-11L02_02 Waterbury Reservoir littoral area	100 acres Altered Part E List	Brittle naiad		
VT08-04 Joiner Brook	2.9 miles Altered Part F List	Artificial and insufficient flow	Bolton Valley water with-drawal	
VT08-05 Winooski River at & above Middlesex 2 dam	2.0 miles Altered Part F List	De-watering of bypass, impoundment, fluctuation causing stream-bank erosion	Middlesex #2 hydro	
VT08-06 Tyler Brook, below Waterbury Village waterwithdrawal	0.1 miles Altered Part F List	Artificial and inadequate flow	Waterbury water supply withdrawal	
VT08-06 Merriam Brook below Waterbury Village waterwithdrawal	0.1 miles Altered Part F List	Artificial and inadequate flow	Waterbury water supply withdrawal	
VT08-09 Mollys Falls Brook	2.0 miles Altered Part F List	Artificial flow condition, bypass waterfall, temp.	Mollys Falls Hydro	GMP has an MOA with ANR to address problems – this is an un-licensed facility
VT08-09 Sucker Brook below Peacham Pond	1.0 miles Altered Part F List	Artificial flow condition	Mollys Falls Hydro	GMP has an MOU with ANR to address problems
VT08-09L05 Peacham Pond	340 acres Altered Part F List	Water level fluctuation		
VT08-09L05 Mollys Falls Reservoir	397 acres Altered Part F List	Water level fluctuation		
VT08-11 Lower Little below hydro dam	2.6 miles Altered Part F List	Artificial flow condition		
VT08-11L02 Waterbury Reservoir	839 acres Altered Part F List	Water level fluctuation		401 WQ Certification issued 2014 but awaiting full implementation
VT08-16 Benjamin Falls Brook, from Berlin Pond to mouth	0.6 miles Altered Part F List	De-watering of brook	Montpelier & Berlin water supply with-drawals	

VT08-20 Mill Brook	2.1 miles Altered Part F List	Artificial and insufficient flow	Mad River Glen snow-making water withdrawal	
VT08-20 Slide Brook	0.8 miles Altered Part F List	Artificial and insufficient flow	Mount Ellen snowmaking water withdrawal	
VT08-01 Winooski River, mouth to Alder Brook	21.2 miles Stressed	Sediments, nutrients, temp., stormwater, toxic compounds	Developed land runoff, agriculture, industry	10.2 miles impaired by <i>E. coli</i> and 10.3 miles stressed by lampricide use are subsets of these 21.2 miles
VT08-01 Winooski River, mouth to dam in Winooski	10.3 miles Stressed	Lampricide	Fishery management	Potential loss of American brook lamprey (T), reduction of other species
VT08-04 Goose Pond Brook, mouth to headwaters	1.5 miles Stressed	Acidity	Atmospheric deposition	
VT08-05 Winooski River, below Middlesex dam & above Montpelier CSOs	11.0 miles Stressed	Sediment, nutrients, stormwater runoff	Developed land, transportation, channelization	
VT08-06 Graves Brook, mouth upstream	0.3 miles Stressed	Sediment	Residential, ag, riparian encroachment	
VT08-06 Thatcher Brook	10.0 miles Stressed	sediment	Streambank erosion, past channelization	
VT08-07 Winooski River below Marshfield 6 hydro	10.0 miles Stressed	low d.o.	Hydro facility	
VT08-07 Winooski River, Stevens Branch up to Mollys Falls Brook	20.4 miles Stressed	sediment, turbidity, nutrients, physical alterations, <i>E. coli</i>	Streambank erosion, road runoff, channel in-stability	Source of <i>E. coli</i> not yet known
VT08-08 Blanchard Brook	0.3 miles Stressed	Enrichment from urban effects likely, temperature?	Needs investigations.	Fish community "fair", "poor", "fair" in 2013, 2014, 2015 – upstream at rm 0.4 "good"
VT08-09 Winooski River, from Mollys Falls Brook upstream	6.0 miles Stressed	Sediment		
VT08-11 Gold Brook, mouth to headwaters	5.0 miles Stressed	Sediment, physical alterations	Land development, roads, former mining	

VT08-11 Little River, from West Branch down to Reservoir	5.5 miles Stressed	Urban runoff, sediment		
VT08-12 Little River, upstream of the West Branch confluence	3.3 miles Stressed	Sediments, nutrients		
VT08-12 Little Spruce Brook	0.1 miles Stressed	sediment, physical alteration	Ski area development	
VT08-12 Long Trail Tributary	0.1 miles Stressed	sediment, acidity	Ski area development	pH shock in springtime
VT08-12 Sterling Brook	7.0 miles Stressed	acidity		
VT08-12 West Branch Little River, rm 7.0 to 7.5	0.5 miles Stressed	sediment	Ski area development	
VT08-12 West Branch Little River, rm 8.0 to headwaters	1.3 miles Stressed	Sediment, acidity		This stretch should be re- moved from stressed in 2018. Last 2 bug samples "good".
VT08-13 Hancock Brook	4.0 miles Stressed	acidity		
VT08-13 Minister Brook	3.0 miles Stressed	acidity		
VT08-14 Kingsbury Branch, from outlet of North Montpelier Pond to mouth	3.5 miles Stressed	elevated temperatures		
VT08-15 Jail Branch, Barre City and below	1.5 miles Stressed	Sediment, nutrients, <i>E. coli</i>		
VT08-15 Jail Branch, Washington/Orange area	unknown miles Stressed	<i>E. coli</i>		This stretch should be re- moved from stressed category in 2018. Un- known informa- tion used to id this (added between 2000 and 2002).
VT08-16 Stevens Branch	5.8 miles Stressed	Sediment, nutrients, <i>E. coli</i>		
VT08-17 Dog River, Riverton canoe access downstream ½ mile	0.5 miles Stressed	<i>E.coli</i>		
VT08-18 Mad River, Warren dam up to Route 100	0.5 miles Stressed	sediment		

Upper Winooski River watershed

General Description

The Upper Winooski River watershed as defined in this assessment report is the Winooski River mainstem from its headwaters downstream to the mouth of the Little River in Waterbury including the Kingsbury Branch and North Branch. The watershed drains much of the towns of East Montpelier, Calais, Plainfield, Marshfield, Cabot, and Woodbury as well as Montpelier, Middlesex, and Worcester.

The Winooski River originates in headwaters that flow from wetlands and ponds near the Cabot/Walden town line. The two branches formed from the headwater streams join about a mile upstream of Cabot village becoming what is officially labelled as the Winooski River. The river flows generally south through the western half of Cabot and into the town of Marshfield. In Marshfield, Mollys Falls Brook enters the Winooski. Peacham and Mollys Falls Ponds on Mollys Falls Brook are part of a hydroelectric system described briefly below. Drainage from the Mollys Falls Brook subwatershed enlarges the Winooski River, however, because of the hydro operation, there is altered flow to the Winooski River. Mollys Falls Brook has a length of six and a half miles and a watershed of 26 square miles.

Below the mouth of Mollys Falls Brook, the Winooski River flows southwesterly winding its way through a fairly broad valley to the northern tip of Plainfield. In Plainfield, it flows westerly for about a mile and a half then turns northerly, enters East Montpelier, and then turns south again after the Kingsbury Branch comes in. The Kingsbury Branch has a length of about 12 miles and a watershed of 53 square miles.

Next the river flows westerly again through East Montpelier and at the Berlin, Montpelier, East Montpelier junction, the Stevens Branch enters from the south. The Steven Branch watershed is treated separately below starting on page 24.

From the Stevens Branch mouth in the town of Berlin, the Winooski River flows through the City of Montpelier where it is confined and lacks most of its riparian vegetation. The North Branch of the Winooski River enters the mainstem in downtown Montpelier.

The North Branch of the Winooski River originates in a large wetland complex in the valley east of the Worcester Mountains in Elmore. It flows overall south through Worcester, Middlesex, and then Montpelier where it joins the Winooski River. Named tributaries include: Barnes Brook, Russ Pond Brook, Catamount Brook, Hancock Brook, Worcester Brook, and Minister Brook. In Middlesex, the North Branch is impounded and known as Wrightsville Reservoir. Martin Brook and Long Meadow Brook are tributaries in this stretch. Below the dam, the North Branch flows through Montpelier and into the Winooski River. The North Branch is approximately 18 miles long.

After the North Branch joins the Winooski River and just downstream of Montpelier below the interstate crossing, the Dog River enters from the south. See the separate Dog River watershed description starting on page 38.

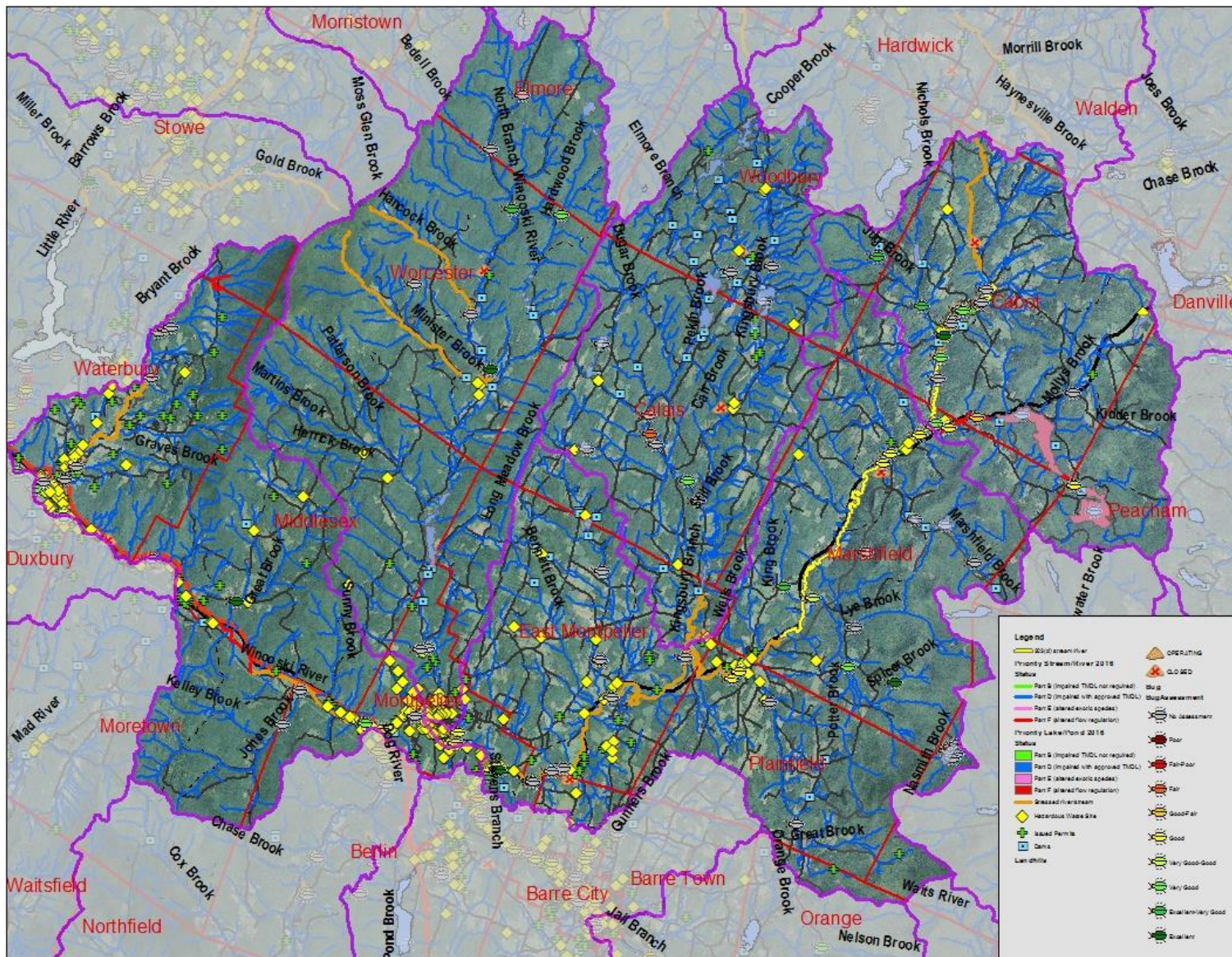


Figure 1. Upper Winooski Watershed with Assessment Information and Status

The Winooski River continues northwesterly first forming the Middlesex/Berlin border and then the Middlesex/Moretown border. Below Middlesex village, the river goes through Middlesex Gorge, a deep gorge with a hydroelectric dam. Below the gorge, the Mad River joins the Winooski from the southwest. See the Mad River watershed description below.

The Winooski River continues northwesterly still forming the Waterbury/Moretown and the Waterbury/Duxbury borders. First the four-mile long Crossett Brook and its tributaries from the south then the ten-mile long Thatcher Brook and its tributaries from the north then the large Little River watershed also from the north all add their flow to the Winooski River. A separate Little River watershed description begins on page 52.

Uses and Values

Swimming and Boating

The *Waterfalls, Cascades and Gorges of Vermont* (WC&G) study describes four cascades or falls in the Upper Winooski watershed. The *Vermont Swimming Hole Study* identified two small swimming holes on tributaries in the Upper Winooski River watershed. One site is on Nasmith Brook in Plainfield and the other is on the Kingsbury Branch in Calais.

The Waterfalls, Cascades and Gorges of Vermont report describes two sites on the North Branch of the Winooski River: North Branch Falls in Worcester consists of a falls 40 to 50 feet wide and about nine feet high and Wrightsville Gorge is an 80-foot deep gorge that is below the outlet of Wrightsville dam.

The Vermont Swimming Hole Study identified five sites in the North Branch watershed: three of the sites on the North Branch itself and two sites on tributaries: one site, North Branch Falls is also listed in the W,C&G report; a second site, North Branch East, is located upstream of North Branch Falls; and North Branch Gorge is the third site described in the *Vermont Swimming Hole Study* on the North Branch itself. The two swimming holes described on tributaries to the North Branch are on Minister Brook and Hancock Brook.

The Whitewater Rivers of Vermont report identifies the 24 mile stretch of the Winooski River from Marshfield to Montpelier as a boatable quickwater stream with several stretches of Class II whitewater as well as several dams.

More information on these special places are in the named reports as well as the earlier 2008 Winooski River Watershed Assessment Report.

Fishery

Winooski headwaters to the confluence with Molly's Brook

Wild brook trout are abundant in the Winooski mainstem upstream of Cabot Village. Temperature and habitat conditions deteriorate downstream of the village primarily due to a lack of riparian habitat. In 2014, a maximum temperature of 82°F was observed above the Green Mountain Power Co (GMP) powerhouse and the temperature reached at least 75°F on 22 days between June and October. The GMP hydro-electric generation results in extreme daily fluctuations in flow as well as rapid temperature changes of >5°F.

Consultants for GMP have come up with recommendations for improvements in the hydro-electric system's operations to address both flow and temperature issues.



Photo 1 – Winooski River mainstem and riparian area downstream of Cabot Village

Confluence with Molly's Brook to confluence with Kingsbury Branch

On the Winooski mainstem in this section, there is a mix of wild brown trout, rainbow trout, and brook trout with supplemental stockings of brook trout and rainbow trout to provide additional angling opportunity and account for low wild trout levels. Local habitat conditions vary widely within this reach resulting in an uneven distribution of wild trout. Unregulated hydroelectric generation substantially alters natural flow, dissolved oxygen, and temperature regimes within this reach.

Wild trout populations have been slow to recover following a 2005 fish kill along roughly 7 miles of the mainstem below Cabot Village. In 2012, the deteriorating Marshfield 8 dam was removed to prevent failure and allow aquatic organism passage upstream of Marshfield.

The Vermont Department of Fish and Wildlife owns three parcels of riparian land along mainstem in Plainfield and Marshfield.

Confluence with Kingsbury Branch to Stevens Branch

In this section of the Winooski, there is a mix of wild brown trout and rainbow trout with supplemental stockings of rainbow trout and brown trout. Again the trout populations vary with the local habitat conditions. Several dams fragment and degrade the habitat within this reach. In 2015, a maximum temperature of 80°F was observed in the Winooski mainstem and the temperature reached at least 75°F on 21 days between June and October. The large size of the river prevents direct population sampling although angler creel surveys were conducted in 1999 and 2015.

The Vermont Department of Fish and Wildlife owns extensive riparian land along the Winooski River directly above the dam in East Montpelier.

Confluence with Stevens Branch down to Little River mouth

On the Winooski mainstem from the Stevens Branch mouth to the Little River mouth, low numbers of wild brown trout and rainbow trout exist within this reach with supplemental stockings of brown trout and rainbow trout to provide additional angling opportunity and account for low wild trout levels due to poor habitat conditions. The large size of the river limits direct population sampling, although angler creel surveys were conducted in 1999 and 2015. The Middlesex dam fragments and degrades habitat within this reach.

Some Tributaries

The Kingsbury Branch has wild brook trout in East Calais and upstream. The access is limited and the sampling conditions are difficult from East Calais to mouth. The surface area of North Montpelier Pond increases water temperatures downstream.

In the North Branch, wild brook trout exist in the upper elevations (>1000') only. Brook trout are stocked along the mainstem in Worcester above Wrightsville Reservoir. Warm temperatures limit wild trout abundance especially downstream of Wrightsville Reservoir where surface water release prevents temperature moderation. In 2012, a maximum temperature of 86°F was recorded below the dam and the temperature reached at least 75°F on 67 days between July and October.

Streams proposed for reclassification to B1 for fishing

VT Department of Fish and Wildlife assesses wild trout populations and important nursery areas to document very high quality recreational fisheries. Abundant wild trout populations are defined as supporting multiple age classes of one or more species of wild trout at levels generally equal to or greater than 1,000 fish/mile and/or 20 pounds/acre. Other waters that have not been surveyed may also support similar wild trout densities and may be identified in the future. Certain noteworthy streams are also important to support spawning and nursery habitat.

Table 4. B1 Waters for recreational fishing in the upper Winooski watershed

Stream or river stretch	Fishery
Winooski River above Cabot Village	wild brook trout
Molly's Brook (Above Marshfield Dam)	Wild brook trout and brown trout
Kidders (Hooker) Brook	Wild brook trout and brown trout
Jug Brook	Wild brook trout
Beaver Meadow Brook	Wild brook trout
Nasmith Brook	Wild brook trout, brown trout and rainbow trout. Important spawning tributary for mainstem trout populations above Plainfield dam
Great Brook	Wild brook trout, brown trout and rainbow trout. Important spawning tributary for mainstem trout populations below Plainfield dam.
Sodom Pond Brook (Trib to Kingsbury Branch)	Important spawning tributary for mainstem trout populations
Dugar Brook (Kingsbury Branch Trib)	
Hancock Brook (trib to North Branch)	Wild brook trout
Minister Brook (trib to North Branch)	Wild brook trout

Martins Brook (trib to North Branch)	Wild brook trout and brown trout
Patterson Brook (trib to Martins Brook)	Wild brook trout and brown trout
Herrick Brook (trib to Martins Brook)	Wild brook trout and brown trout
Jones Brook	Wild rainbow and brook trout. Important spawn-ing tributary for mainstem trout populations.
Crossett Brook	Wild brook trout, brown trout, and rainbow trout. Important spawning tributary for mainstem trout populations.
Thatcher Brook	Wild brook trout, brown trout, and rainbow trout. Important spawning tributary for mainstem trout populations.

Ponds:

- Coits Pond – chain pickerel, largemouth bass, yellow perch, brown bullhead, VDFW access
- West Hill Pond – largemouth bass, chain pickerel, yellow perch, brown bullhead, VDFW access.
- Molly's Falls Pond (Marshfield Reservoir) – northern pike, smallmouth bass, largemouth bass, yellow perch, rainbow trout (stocked), brown trout (stocked), brown bullhead. VDFW access. The late fall and winter drawdown impacts littoral zone productivity and may affect spawning tributary access.
- Peacham Pond – brown trout (stocked), smallmouth bass (found in 2014), yellow perch, rainbow smelt, VDFW access. The late fall, winter drawdown impacts littoral zone productivity and may affect spawning tributary access.
- Molly's Pond – chain pickerel, yellow perch
- Buck Lake – smallmouth bass, yellow perch, brown bullhead, pumpkinseed, VDFW access.
- Greenwood Lake – brown trout (stocked), smallmouth bass, yellow perch, chain pickerel, brown bullhead, pumpkinseed, VDFW access.
- Valley Lake – smallmouth bass, yellow perch, chain pickerel, brown bullhead, pumpkinseed, VDFW access.
- Cranberry Meadow Pond – smallmouth bass, yellow perch, pumkinseed.
- Nelson Pond – lake trout (wild & stocked), rainbow trout (stocked), brown trout (stocked) rainbow smelt, smallmouth bass, yellow perch, chain pickerel, brown bullhead, pumpkinseed, VDFW access
- Mirror Lake (No. 10 Pond) –rainbow trout (stocked), rainbow smelt, smallmouth bass, yellow perch, chain pickerel, brown bullhead, pumpkinseed, F&W access.
- Woodbury Lake - rainbow trout (stocked), brown trout (stocked), smallmouth bass, largemouth bass, rainbow smelt, smallmouth bass, yellow perch, chain pickerel, brown bullhead, pumpkinseed, VDFW access
- Curtis Pond – largemouth bass, chain pickerel, yellow perch, brown bullhead, pumpkinseed, black crappie, channel catfish, VDFW access.
- Bliss Pond – largemouth bass, yellow perch, chain pickerel, brown bullhead.
- North Montpelier Pond – chain pickerel, yellow perch, brown bullhead, pumpkinseed.
- Wrightsville Reservoir – Largemouth and smallmouth bass, yellow perch, chain pickerel, pumpkinseed, brown bullhead. VDEC Access area.

Biological Monitoring

Table 5. Biological sampling results for the Upper Winooski and tributaries - 2008 to 2016

Wbid	River Stream	River -mile	Date	Assessment – macroinvertebrates	Assessment-fish
VT08-05	Winooski River	42.6	9/4/2008	good	----
VT08-05	Winooski River	42.6	9/14/2010	very good	----
VT08-05	Winooski River	42.7	9/4/2008	good	----
VT08-05	Winooski River	42.7	9/14/2010	good-fair	----
VT08-05	Winooski River	42.7	9/9/2015	very good	----
VT08-05	Winooski River	42.9	9/4/2008	good	----
VT08-05	Winooski River	42.9	9/9/2015	very good	----
VT08-05	Winooski River	54.3	9/1/2010	very good	----
VT08-05	Winooski River	54.3	9/9/2015	very good	----
VT08-05	Winooski River	54.7	9/9/2015	good	----
VT08-07	Winooski River	59.8	9/10/2010	excellent	----
VT08-07	Winooski River	70.7	9/21/2010	good	----
VT08-07	Winooski River	70.7	9/22/2015	good	----
VT08-07	Winooski River	70.9	9/21/2010	good	----
VT08-07	Winooski River	70.9	9/22/2015	good	----
VT08-07	Winooski River	81.6	9/21/2010	good	----
VT08-07	Winooski River	81.6	9/21/2015	good	----
VT08-07	Winooski River	81.8	9/21/2010	good	----
VT08-07	Winooski River	81.8	10/23/2012	very good-good	----
VT08-07	Winooski River	81.8	10/5/2013	good	----
VT08-07	Winooski River	81.8	9/21/2015	good	----
VT08-09	Winooski River	82.7	9/21 & 8/18/2015	good	very good
VT08-09	Winooski River	82.8	9/21 & 8/19/2015	very good	poor ³
VT08-09	Winooski River	83.8	9/21/2010	very good	good
VT08-09	Winooski River	83.8	9/21/2015	very good	----
VT08-09	Winooski River	84.7	9/21/2015	excellent	----
VT08-09	Winooski River	84.7	7/12/2016 ¹	excellent	----
VT08-09	Winooski River	85.7	9/21/2010	exc-very good	excellent
VT08-09	Winooski River	85.7	7/12/2016	very good	----
VT08-06	Great Brook	0.8	10/13/2015	excellent	fair
VT08-08	Blanchard Brook	0.1	8/29 & 9/18/2013	good	fair
VT08-08	Blanchard Brook	0.1	10/2/2014	very good-good	poor
VT08-08	Blanchard Brook	0.1	9/21/2015	good	fair
VT08-08	Blanchard Brook	0.4	8/25/2016	good	good
VT08-08	Guernsey Brook	0.9	7/26/2010	----	very good
VT08-08	Guernsey Brook	0.9	9/22/2015	excellent	very good
VT08-08	Guernsey Brook	0.9	9/12/2016	exc-very good	very good
VT08-08	Nasmith Brook	2.7	9/22/2015	very good	----
VT08-08	Nasmith Brook	2.7	9/12/2016	very good	---- ⁴
VT08-08	Spicer Brook	0.4	9/21/2010	excellent	very good
VT08-09	Jug Brook	1.4	9/21&22/2015	exc-vgood	---- ²
VT08-09	Jug Brook	3.0	9/17/2013	exc-vgood	---- ³
VT08-09	Mollys Brook	0.1	9/22/2015	good	ua

VT08-09	Mollys Brook	0.5	9/21 & 7/19/2015	good	poor
VT08-09	Mollys Brook	1.5	9/21 & 7/17/2015	good-fair	fair
VT08-09	Mollys Brook	5.5	7/16/2015	----	excellent
VT08-14	Pekin Brook	0.9	8/28/2014	very good	good
VT08-14	Pekin Brook	2.9	10/6/2011	fair	poor
VT08-13	North Branch Winooski River	11.0	9/21/2015	excellent	----
VT08-13	North Branch Winooski River	16.1	8/30/2012	excellent	fair
VT08-13	North Branch Winooski River	16.1	9/3/2013	excellent	good
VT08-13	North Branch Winooski River	16.1	9/22/2014	excellent	----
VT08-13	North Branch Winooski River	16.1	9/21/2015	excellent-very good	good
VT08-13	North Branch Winooski River	16.1	9/1/2016	excellent-very good	----
VT08-13	Hardwood Brook	1.6	9/3/2013	very good	ua

1 Assessment notes state: "While this assessment was conducted outside the index period in mid July, the results indicate a community of excellent biological integrity. The metrics are relatively similar to an assessment conducted in late summer of 2015 by VTDEC that also resulted in an excellent rating."

2 Brook trout only. The rm 1.4 site had a really good abundance of trout in the sample.

3 Lower confidence in this assessment call.

4 Fish community assessment comment "nice population of brookies"

Table 6. Biological sampling site locations in the upper Winooski watershed

WBID	Stream or River	Station	Town	Description
VT08-05	Winooski River	42.6	Waterbury	About 200 meters below the Waterbury WWTF effluent
VT08-05	Winooski River	42.7	Waterbury	About 100 meters below the Waterbury WWTF effluent – not fully mixed.
VT08-05	Winooski River	42.9	Waterbury	Below Winooski St bridge in Waterbury, above the WWTF about 0.2 miles
VT08-05	Winooski River	54.3	Montpelier/Berlin	Below Montpelier WWTF and Dog River, behind the Creamy stand
VT08-05	Winooski River	54.7	Montpelier	Above Montpelier WWTF & above interstate, between two gravel bar islands
VT08-07	Winooski River	59.8	East Montpelier/Berlin	Adjacent to Route 2 on Berlin-East Montpelier line, below U-32 HS hill
VT08-07	Winooski River	70.7	Plainfield	Below the Plainfield WWTF, in completely mixed area
VT08-07	Winooski River	70.9	Plainfield	Immediately above Plainfield WWTF
VT08-07	Winooski River	81.6	Marshfield	Below Marshfield WWTF & 1st trib (from Marshfield Pond)
VT08-07	Winooski River	81.8	Marshfield	Below confluence with Knob Hill Brook about 100 meters
VT08-09	Winooski River	82.7	Marshfield	Across from McCrillis Road, below GMP powerhouse about 0.4 miles

VT08-09	Winooski River	82.8	Marshfield	Immediately above GMP generation station above Marshfield
VT08-09	Winooski River	83.8	Cabot	Just below storage building in Durrant Cemetery in Lower Cabot, about 0.9 miles below the Cabot WWTF
VT08-09	Winooski River	84.7	Cabot	In Lower Cabot above Sawmill Road, above WWTF outfall
VT08-09	Winooski River	85.7	Cabot	About 0.25 miles below Cabot Creamery & stormwater discharge pipe at creamery
VT08-06	Great Brook (Middlesex)	0.8	Middlesex	Upstream of McCullough Hill Road bridge about 75 meters
VT08-08	Blanchard Brook	0.1	Montpelier	About 100 meters upstream of Barre Road, about 50 meters upstream of culvert
VT08-08	Blanchard Brook	0.4	Montpelier	Sampled upstream of the overhead lines and poles and the big bend in the stream. Park behind the main building of Vermont College & walk downslope to brook.
VT08-08	Guernsey Brook	0.9	Marshfield	Above confluence with King Brook
VT08-08	Nasmith Brook	2.7	Marshfield	100 meters above Holt Road, above Black Brook
VT08-08	Spicer Brook	0.4	Marshfield	Access from private road just past where road takes a 90 degree turn
VT08-09	Jug Brook	1.4	Cabot	About 50 meters above Blodgett Road in Cabot
VT08-09	Jug Brook	3.0	Woodbury	Above tributary from the pond to the north
VT08-09	Mollys Brook	0.5	Marshfield	Immediately above the Rte 232 bridge Marshfield
VT08-09	Mollys Brook	1.5	Cabot	Above Porter Road crossing Cabot
VT08-09	Mollys Brook	5.5	Cabot	Above Route 2 bridge in Cabot
VT08-14	Pekin Brook	0.9	Calais	Adjacent to Pekin Brook Road about 100 meters
VT08-14	Pekin Brook	2.9	Calais	Pekin Brook Road at Stevens Farm between Jack Hill Road and Singleton Road
VT08-13	North Branch Winooski River	11.0	Worcester	Route 12 to cemetery, follow trail to wetland then stream
VT08-13	North Branch Winooski River	16.1	Worcester	Adjacent to Route 12 in Worcester
VT08-13	Hardwood Brook	1.6	Worcester	Adjacent to Eagle Ledge Road above small trib from south

Table 7. Biological monitoring needed in the Upper Winooski watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-04	Crossett Brook	Rivermile (rm) 3.8	Rm 3.8 was sampled in 1995 (“excellent”) but no sampling since
VT08-06	Graves Brook	Rm 0.1	Bugs sampled in 2000. Habitat sounded poor. Re-check this site.
VT08-06	Jones Brook	Rm 0.1 or 1.1 (or both)	These two sites were sampled in the past (distant past – need new data)
VT08-06	Thatcher Brook	Several sites	Several were sampled in the past – the most recent were in 2005 (rm 0.1 & rm 0.5) and before that the 1990s. Important to have current monitoring.
VT08-08	Sodom Pond Brook	Rm 3.9	This site was last sampled in 2005; was very good-good. Need a more recent sample for bugs & fish.
VT08-13	Martins Brook	1 or 2 sites	This stream with 2 named tributaries in Middlesex has never been sampled.
VT08-13	North Branch	1 bug site below Wrightsville Reservoir	Don’t have lower biological sampling sites – could use bugs and fish down in Montpelier
VT08-14	Hancock Brook	Re-sample rm 0.2	This site was last sampled in 2005 – bugs and fish. Good to re-sample.
VT08-14	Minister Brook	At least one site.	This stream was sampled for fish in 1984! Never been sampled for bugs.
VT08-14	Kingsbury Branch	At least one site	There are no macroinvertebrate samples from this stream.

Aquatic Community Health in Specific Streams

In addition to the information below, the [2008 Winooski River watershed assessment](#) report has information on the upper Winooski River mainstem, Kingsbury Branch, Pekin Brook, Great Brook (Plainfield), Mollys Brook, Minister Brook, Crossett Brook, Thatcher Brook, and Graves Brook.

Upper Winooski River

The Winooski River mainstem was sampled 29 times over 15 locations from 2008 to 2016. The site locations were from rm 42.6 in Waterbury up to rm 85.7 in Cabot. Overall this Winooski River has an aquatic community that meets Class B water quality standards and, up in its headwaters in Cabot, as well as in locations throughout, the aquatic community is in “very good” to “excellent” condition.

Pekin Brook

Pekin Brook is a tributary to the Kingsbury Branch of the Winooski River. It is a meandering stream for much of its length and flows through alder swamps some of which are beaver-influenced. The loss of one hillside farm, buffer plantings, a stream conservation easement, and shrub wetlands have resulted in a natural corridor for this brook for much of its length. The macroinvertebrate community was “very good” in 2014

and the fish community “good”. The late 1990s fish community sampling found the uncommon burbot but recent sampling has not.

Nasmith Brook

Nasmith Brook is a six-mile long stream draining a 15 square mile largely forested watershed that joins the Winooski River in Marshfield. Rm 0.3 was sampled back in 2007 and the macroinvertebrate community was “very good-good” then. In 2015 and 2016, both the macroinvertebrate and fish communities were sampled upstream farther at rm 2.7 above Holt Road. In 2015, the macroinvertebrate community was “very good” and in 2016, it was “very good” again. The fish community couldn’t be assessed with the IBI as there were only brook trout present, but in 2016, there was “a nice population of brookies”.

Great Brook (Plainfield)

Great Brook was sampled in 2015 and had an “excellent” macroinvertebrate community. The fish community assessment was “fair”. These results are logical given the clean, clear water of the brook but the extremely unstable channel and altered habitat.

Guernsey Brook

Guernsey Brook in Marshfield had a “very good” fish community in both 2010 and 2015 sampling and “excellent” macroinvertebrate community in 2015. Another macro-invertebrate sample is needed in order to re-classify this brook to B1 for aquatic life.

Mollys Brook

Mollys Brook below the reservoir has a macroinvertebrate community just meeting the water quality standards but a fish community that does not meet the standards. This stretch of stream on the flow-altered list of waters for lack of adequate flow and high temperatures.

North Branch Winooski River

This stream known for its scenic valley, swimming holes, kayak runs, and fishing spots also has consistently excellent aquatic macroinvertebrate communities and a good fish community. If infrastructure (roads, guard rails, utility poles and lines) can be minimized and managed well then this stream should be considered for Outstanding Resource Water designation.

Hazardous Waste Sites

Cumberland Farms/Former Uttons Site

The Cumberland Farms site (DEC site #99-2692) and the former Utton's Muffler site (DEC site #96-1953) are considered one hazardous waste site under the Cumberland Farms name as CFI purchased the former Utton's site in 2005. Both sites had contaminated soils and groundwater due to underground storage tanks. In addition to quarterly groundwater sampling for many years, a corrective action feasibility study was conducted in 2009. As part of the CAFI, additional monitoring wells were installed (several across the Route 2 on the banks of the Winooski River) and multi-phase extraction pilot test wells were also installed.

Groundwater was sampled four times per year through 2011 until a January 2012 letter from Vermont DEC requested that monitoring activities be conducted on a semi-annual basis. The latest sampling was done in November 2015 and the conclusions from the current consultant (GES of Windsor Connecticut) include:

- Groundwater elevations in all wells checked were similar to those measured in the 2013 and 2014 sampling;
- Groundwater flow is still across and off-site to the northeast-east direction towards the Winooski River, which is about 60 to 70 feet from the property line;
- Detected VOC concentrations are above the VGES and are within the range of historical data in monitoring in wells MW-3ut and MW-13;
- The dissolved phase VOC plume has migrated beyond the property boundary as indicated by historical VOC detections in monitoring wells MW-3, MW-4, MW-5, MW-6, MW-10, MW-11 and MW-12;
- During the November 2015 sampling event, LNAPL was detected in groundwater monitoring well MW-7.

Walker Motors site

Petroleum contamination at the Walker Motors hazardous waste site (DEC site #2003-3108) was discovered during removal of a fuel oil underground storage tank next to the autobody shop in April 2003. A separate contamination plume was found adjacent to the parts department of the main facility during removal of a second fuel oil tank. Some soil has been excavated from the area north of the autobody shop and monitoring wells are in place and sampled quarterly initially.

Ten groundwater monitoring wells were sampled in September 2005. The VGES were exceeded for one or more petroleum-related compounds in six of the ten wells: three wells near the parts department, two wells near the autobody shop soil excavation area; and one well in the swale between Route 2 and the railroad tracks toward the Winooski River.

Twelve groundwater monitoring wells were sampled in December 2005. VGES were exceeded for one or more petroleum products in six of the twelve wells. All six wells were onsite: off-site monitoring wells MW-15 and MW-19 had no volatile organic compounds (VOCs) detected. No VOCs were detected in surface water samples, SW-1 and SW-2, collected along the swale and railroad tracks downgradient of the site across Route 2 towards the Winooski River.

In 2008, seven groundwater monitoring wells were sampled; six groundwater monitoring wells were properly abandoned; and five could not be located (these were previously damaged or destroyed). Of the seven groundwater monitoring wells sampled, two had contaminants above the VGES. Measurable free product was found in three wells at the autobody shop and one well at the parts department in 2008. No VOCs were detected in SW-1, a swale surface water monitoring location across Route 2 from the site, and no sheens were seen there.

Contaminated soils were encountered during the construction of the Route 2/Route 302 roundabout in 2009.

Annual groundwater monitoring and quarterly free product removal continued in 2009 and then Vermont DEC Waste Management asked for reduced monitoring: biennial groundwater monitoring and semi-annual free product recovery starting in Spring 2010. The 2010 and 2011 monitoring of nine wells found three with contaminants above the VGES; only trace amounts of free product; and no sheens or VOCs in SW-1 and SW-2 at the swale and along the RR tracks respectively.

The 2012 and 2013 monitoring found improved results with no free product found in any of the wells gauged those two years; two wells of nine sampled had VOCs above the VGES but these were down 23 to 39% from the most recent previous samples. No sheens were seen in the swale (SW-1 location). This site is no longer sampled unless a sheen is observed.

Sampling did not occur for several years but resumed in September 2016 by ATC Group Services (who bought ECS). Only three wells were sampled because there was insufficient water in some wells and other wells were paved over in 2013. Benzene was above the VGES in MW-6A and PD-3. Naphthalene was above the VGES in all three wells. There was no water in the swale and no sign of an oily sheen and so this area across Route 2 closer to the Winooski River was not sampled.

Stevens Branch Watershed

General Description

The Stevens Branch is 14.7 miles long; drains a watershed of 129 square miles; and flows through three towns on its way to join the Winooski River east of Montpelier. The Stevens Branch is first named downstream of Cutter Pond in Williamstown. The river flows north into Williamstown village with several tributaries adding flow from both the east and west. The outfall of the Williamstown wastewater treatment facility (WWTF) is now on the Stevens Branch versus one of these small tributaries.

North and downstream of Williamstown, the brook flows northeasterly for a few miles in Williamstown then into the town of Barre where it flows through South Barre and into Barre City. Martin Brook, Cold Spring Brook, and several unnamed tributaries join the Stevens Branch in this segment. Then in Barre City, the 14-mile long Jail Branch with its 49 square mile watershed joins the Stevens.

The Stevens Branch, now as a larger stream, flows through the western side of Barre City where it is channelized to protect all the adjacent development (roads, commercial and industrial buildings, houses). North and downstream of the city, there is the Barre WWTF and below the plant, the river flows for another three miles. The 3-mile stretch includes a 2.6-mile long waste management zone designation below the WWTF.

Uses and Values

Waterfalls, Cascades, Gorges, and Swimming Holes

The *Waterfalls, Cascades and Gorges of Vermont* report describes two sites with cascades or falls in the Stevens Branch watershed. The *Vermont Swimming Hole Study* has no sites listed for the Stevens Branch or Jail Branch, however, an accident brought to light a popular swimming hole on the Jail Branch called Spaulding Falls.

Fishery of Stevens Branch watershed

On the Stevens Branch, the fishery is exclusively wild brook trout above Route 63 in South Barre and downstream, the brook supports a mix of wild brook, brown and rainbow trout. Despite urbanization and associated impacts, the branch still supports good levels of wild trout populations in areas. Gunner Brook has wild brook, brown and rainbow trout. It is an important rainbow and brown trout spawning tributary for Stevens Branch populations.

On the Jail Branch, a tributary to the Stevens, the upper reaches in Washington support exclusively wild brook trout. From East Barre to the mouth, the stream supports a mix of wild brook, brown and rainbow trout. There is very low trout abundance below the East Barre dam and the reason is not yet known.

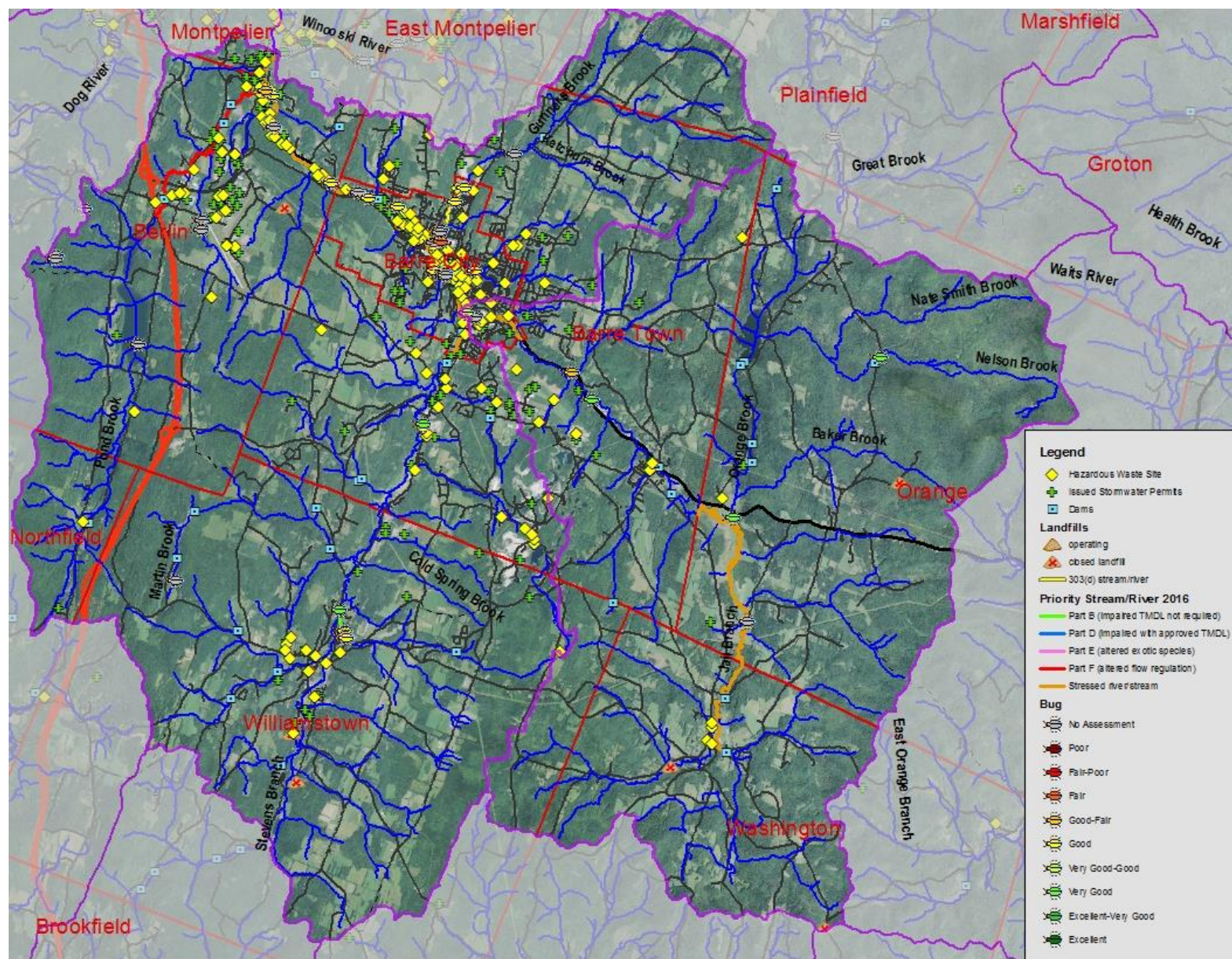


Figure 2. Stevens Branch watershed with Assessment Information and Status

Biological Assessment in the Stevens Branch and tributaries

Sampling Results, Site Locations, and Sampling Needed Tables

Macroinvertebrate and fish community sampling results on the Stevens Branch are as follows:

Table 8. Biological sampling results for the Stevens Branch & Tributaries - 2008 to 2016

Wbid	River/Stream	River-mile	Date	Assessment – macroinvertebrates	Assessment-fish
VT08-16	Stevens Branch	0.6	9/10/2010	good	----
VT08-16	Stevens Branch	2.2	9/9/2010	good	very good
VT08-16	Stevens Branch	2.8	9/9/2010	good-fair	----
VT08-16	Stevens Branch	2.8	9/23/2015	good	very good
VT08-16	Stevens Branch	3.3	9/9/2010	very good-good	very good
VT08-16	Stevens Branch	3.3	9/23/2015	good	----
VT08-16	Stevens Branch	11.9	9/24/2015	very good	very good
VT08-16	Pond Brook	0.1	10/19/2012	good-fair	----
VT08-16	Gunner Brook	0.2	9/10/2010	fair	good
VT08-16	Gunner Brook	0.8	9/23/2011	poor	fair
VT08-16	Gunner Brook	0.8	8/30/2012	good	fair
VT08-16	Gunner Brook	0.8	9/17/2013	good	poor
VT08-16	Gunner Brook	1.1	9/23/2011	exc-very good	poor
VT08-16	Gunner Brook	1.1	8/30/2012	very good-good	fair
VT08-16	Gunner Brook	1.1	9/17/2013	good	----
VT08-16	Potash Brook	0.4	10/16/2012	good	
VT08-16	Stevens Branch Trib 23	0.3	9/1/2010	good-fair	----
VT08-16	Stevens Branch Trib 23	0.3	8/30/2012	fair	----
VT08-16	Stevens Branch Trib 23	0.3	9/24/2015	good	----
VT08-16	Stevens Branch Trib 23	0.4	9/1/2010	good-fair	----
VT08-16	Stevens Branch Trib 23	0.5	9/24/2015	good	----
VT08-15	Jail Branch	0.1	9/18/2015	very good-good	----
VT08-15	Jail Branch	2.2	9/23/2015	good-fair	----
VT08-15	Jail Branch	2.8	9/18/2015	very good	----
VT08-15	Nelson Brook	2.3	9/23/2015	very good	Ua
VT08-15	Nelson Brook	2.3	8/25/2016	exc-very good	Ua ¹
VT08-15	Orange Brook	0.2	8/29/2013	very good	----

1 - Unable to assess due to BKT being only species present. Same result as 2015 sampling.

Table 9. Biological sampling sites locations in the Stevens Branch watershed

WBID	Stream or River	Station	Town	Description
VT08-16	Stevens Branch	0.6	Berlin	Above small bridge near the AOT Highway Garage
VT08-16	Stevens Branch	2.2	Berlin	Off Route 302 (Barre Montpelier Road), on Berlin-Barre line, adjacent to farm market and railroad
VT08-16	Stevens Branch	2.8	Barre City	Below WWTF across from Arnholms Motel
VT08-16	Stevens Branch	3.3	Barre City	Above WWTF adjacent to Route 302, across from ice rink
VT08-16	Stevens Branch	11.9		Approximately 75 meters below confluence with Stevens Branch Trib 23
VT08-16	Pond Brook	0.1	Berlin	Below Route 302, immediately below footbridge from AOT building
VT08-16	Gunner Brook	0.2	Barre City	Below third bridge (Seminary Street) up from Stevens Branch
VT08-16	Gunner Brook	0.8	Barre City	Adjacent to the old Farwell St dump/new ball field
VT08-16	Gunner Brook	1.1	Barre City	Just above the old Farwell St dump about 30 meters
VT08-16	Potash Brook	0.4	Barre City	Immediately upstream of Park Street
VT08-16	Stevens Branch Trib 23	0.3	Williamstown	Below WWTF effluent about 20 meters
VT08-16	Stevens Branch Trib 23	0.4	Williamstown	Above WWTF effluent and below WWTF groundwater drain pipe
VT08-16	Stevens Branch Trib 23	0.5	Williamstown	Above WWTF ground drainage pipe and facility about 20 meters
VT08-15	Jail Branch	0.1	Barre City	About 100 meters above the confluence with the Stevens Branch. Next to substation.
VT08-15	Jail Branch	2.2	Barre Town	About 50 meters below Honey Brook mouth, about 40 meters below covered bridge.
VT08-15	Jail Branch	2.8	Barre Town	At rip-rap bend next to Route 302, about 400 meters above Route 302 bridge.
VT08-15	Nelson Brook	2.3	Orange	Below Bennetts Mill Road and culvert about 75 meters.
VT08-15	Orange Brook	0.2	Orange	About 75 meters downstream of Route 302, a few hundred meters upstream of the Jail Branch

Table 10. Biological monitoring needed in the Stevens Branch watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-15	Orange Brook	Rm 0.2	Bugs sampled at this location in 2013 – “very good”. Good to have another sample plus 1 fish sample.
VT08-15	Gunners Brook	Rm 2.3 and rm 0.4 and 1 more site farther up	Rm 2.3 last sampled in 2000 (good), rm 0.4 sampled in 2002 (fair), and 1 above rm 2.3 if suitable.
VT08-16	Pond Brook	1 site	Above Berlin Pond would be good if there is a suitable site
VT08-16	Stevens Branch	Rm 4.8	This site was last sampled in 1996. Still sheens and staining from Barre Coal Tar site. Very important to sample again.
VT08-16	Stevens Branch Trib 23	Rm 0.3	Re-sample rm 0.3 now that the Williamstown WWTF outfall has been moved to the Stevens Branch itself vs this small tributary

Aquatic Community Health in Specific Streams

There are descriptions of some of the Stevens Branch watershed streams in the 2008 basin assessment report that are not repeated here and there is no new biological information so the reader is referred to that earlier report. Some of the streams include: Baker Brook, Honey Brook and tributaries, and Sterling Brook along Sterling Hill Road.

Jail Branch

The headwaters of the Jail Branch begin in the hills of Washington. The stream flows north through Washington village; meanders northerly through Orange; and then northwesterly into Barre through shrub swamp and old field behind the U.S. Army Corps of Engineers East Barre flood control dam. Orange Brook and its tributaries, Baker Brook, Nelson Brook, and Nate Smith Brook enter the Jail Branch before it flows into Barre. The Jail Branch continues a northwesterly flow through East Barre and Honey Brook and its tributaries enter from the north. Then the Jail Branch flows into the southern part of Barre City before it joins the Stevens Branch. The Jail Branch receives runoff from a number of sources during its journey especially through the urban area of Barre City.

The most recent macroinvertebrate sampling on the Jail Branch at rm 0.1 was in 2015 and despite the urban and altered environment, the community was assessed as “very good-good”. The community composition did have a shift towards taxa that indicate nutrient enrichment, high macro algae cover, turbidity significant for low base flow conditions, a silt rating of 3 out of 5 and embeddedness of 60%. It would be good to sample this location fairly regularly.



Direct roadside storm water discharge from Boynton St in Barre City



Granite processing waste pit within the riparian area on Boynton St.

Two more upstream sites on the Jail Branch, rm 2.2 below the confluence of Honey Brook and rm 2.8, were also sampled in 2015. The rm 2.8 site was “very good” and the community and results very similar to that found here ten years ago in 2005. At rm 2.2, the assessment was “good-fair” with high embeddedness and percent sand and the community low in abundance. This site should be sampled again.

Gunner Brook

The macroinvertebrate community of Gunners Brook has met standards at several sites since 2011 but the fish community has been rated “fair” and “poor”. Brook trout are lacking and at times, it is only non-native brown or rainbow trout found or large numbers of the tolerant black-nosed dace. The habitat in Gunners Brook is not good affecting the fish community and its diversity (or lack of).

Stevens Branch Trib #23

Since the late 1980s, the macroinvertebrate community at rm 0.3 below the Williamstown WWTF has not met standards a number of times and nutrient stress was the cause. The outfall of the WWTF was moved in 2016 to the Stevens Branch versus to this small tributary and so the macroinvertebrate community health should improve.

Stevens Branch mainstem

At rm 2.8 below the Barre City WWTF, the macroinvertebrate community was sampled in 2010 and 2015. It improved slightly to “good” in 2015 from “good-fair” in 2010 thus meeting class B expectations, but it did show moderate enrichment stress still in 2015.

At rm 3.3 above the WWTF, the macroinvertebrate community has been sampled periodically since 1987. In 1991 and 2001, the reach was rated “good-fair” with high BI values showing nutrient enrichment stress. It was sampled again in 2010 and rated “very good-good” with all metrics at their highest level ever. In 2015, the reach is assessed “good” due to a moderately elevated BI value.

Water Quality Monitoring

The Four Rivers Partnership of the Friends of the Winooski River samples a number of sites for *E. coli* and more recently, phosphorus, turbidity, and chlorides, in central Vermont. They sampled three sites for water quality in the Stevens Branch watershed in 2015 – Spaulding Falls on the Jail Branch, an unnamed tributary to the Stevens behind Macdonalds off Route 302, and Pond Brook just before it enters the Stevens Branch adjacent to the Vermont Agency of Transportation facility.

Spaulding Falls on the Jail Branch

The Spaulding Falls site was sampled for *E. coli*, total phosphorus, and turbidity in 2015. The *E. coli* geometric mean was below the 126 mpn/100ml standard this year for the first time in the six years of *E. coli* sampling here. The total phosphorus, however, was just above the standard at Spaulding Falls in 2015 as it was also in 2014.

Unnamed tributary

The unnamed tributary behind Macdonalds was only sampled for chlorides and in 2015 had high levels. Four samples taken during low flow, dry conditions had results ranging from 541 to 596 mg/liter. Follow-up bracketed sampling is planned.

Pond Brook

The Pond Brook site was also only sampled for chlorides and had a range of values from 46 to 118 in the 2015 sampling season.

Hazardous Waste Sites

Below are updates on most of the hazardous waste sites that were discussed in the 2008 Winooski River assessment report. The Williamstown landfill is not re-visited in this report.

Farwell Street Dump

The Farwell Street Dump (DEC site # 77-0027) near Gunners Brook was first in use as a municipal dump by the City of Barre in 1947. It was used as an open dump for 27 years and then closed in 1974. The dump took all of Barre's trash including granite industry waste, capacitors and resin from an electric facility, and solvents from a dry cleaning facility. Numerous site investigations and sampling events have occurred at this site since 1970: the most recent took place in 2000 and 2001 by Weston Solutions Inc. Superfund Technical Assessment and Response Team 2000 (START). The “Final Expanded Site Inspection Report for Farwell Street Dump, Barre, Vermont” dated September 2002 summarizes their findings.

In May 2001, START personnel collected seven soil/source samples from six potential source areas at the Farwell Street Dump, three leachate/seep samples from two locations on the banks of Gunners Brook, and eight sediment samples from seven locations in Gunners Brook. *"No organic compounds were detected above SQLs (sample quantification limits) in sediment samples. Two inorganic substances, arsenic and mercury, were detected in the sediment samples at concentrations greater than three times the reference sample concentration or greater than or equal to the reference sample's sample detection limit (SDL). Two volatile organic compounds (VOCs), 11 semi-volatile organic compounds (SVOCs), two pesticides, and two inorganic elements, including lead and zinc, were detected in soil samples at concentrations greater than three times the reference sample concentration or greater than or equal to the reference sample's SQL or SDL. Four VOCs were detected in leachate samples above SQLs, and three of these VOCs were detected at concentrations exceeding Vermont standards for ambient groundwater quality. Endrin aldehyde was the only pesticide detected above its SQL in leachate samples. Aluminum, chromium, and iron were detected in leachate samples at concentrations equal to or exceeding Vermont standards for ambient groundwater quality."*

Stone Environmental Inc did water quality and sediment monitoring sampling in Gunners Brook in November 2011 and produced a report presenting the results in February 2012. Stone sampled in four locations along the brook with Loc-4 being upstream of the dump location; Loc-3 and Loc-2 being adjacent to the dump area; and Loc-1 being slightly downstream of the dump (but adjacent to the land that is Hope Cemetery).

Some of the summary results include:

- Loc-3 PAH sediment sample concentrations above the Sediment Quality Guidelines (SQG) Threshold Effects Concentration (TEC). A possible source of the PAHs is a pile of recycled asphalt that was staged there versus the Farwell Street dump;
- Concentration of nickel exceeded the SQGs TEC at all four locations and so "it is unlikely that the former dump is the source of these metals";
- Vinyl chloride was found in sediment pore water from Loc-3 at a concentration over four times the Vermont Groundwater Enforcement Standard (VGES);
- Other VOCs were above the lab reporting limits but not above their VGES at Loc-3;
- Total iron was above the Vermont Water Quality Standards (standard for the protection of aquatic biota-chronic criterion) in surface water samples at all four sites;
- Arsenic and cadmium concentrations were above the VGES at the leachate seep site L-Up;
- Manganese concentrations exceeded VGES at both seep locations L-Up and L-Down;
- Some VOCs were above the lab reporting limits at L-Up and L-Down.

Barre Coal Tar site

The Barre Coal Tar site (DEC site # 770206) is a significant source of contaminants to the Stevens Branch. This site was the location of coal gasification from the late 1800s until 1954 and then it served as a liquid propane storage facility from 1954 to 1983. Two aboveground liquid propane tanks were discovered to be leaking in 1983. This same year, coal tar was found to be discharging to the Stevens Branch. The propane tanks were removed in 1986.

In 1987, the results of a subsurface investigation warranted the installation of a groundwater pumping and bioventing system. At this same time, concrete barriers were placed along the north bank of the Stevens Branch to collect seepage of the coal tar. In 1990, the site owners went bankrupt and DEC took over the recovery system. Some time later, the system deteriorated and was discontinued.

In 1997, EPA and START (Superfund Technical Assistance and Response Team) did a Removal Program Preliminary Assessment/Site Investigation. In November 2000, EPA and START monitored a state-led demolition of a building on the site and studies of site soils contamination. In 2001, Twin State Environmental sampled and found volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and a number of metals in sediments and soils. Benzene, toluene, ethylbenzene and xylenes were found in groundwater.

Most recently, EPA and START, with representatives from Vermont DEC and the U.S. Fish and Wildlife Service present, sampled sediments, surface water, and sediment pore water at two different times - August 31 to September 2, 2005 and November 2 and 3, 2005. The sediment sample results were compared to NOAA Screening Quick Reference Tables (SQuiRTs) threshold effects level (TELs) and/or the NJ DEP Guidance for Sediment Quality Evaluations chronic values. The surface water sample results were compared to the EPA Maximum Contaminant Levels (MCL) and the Vermont Water Quality Standards (effective July 2000).

In September 2005, four VOCs (all in sediment sample SD-08) exceeded the SQiRTs/NJ DEP screening values and fourteen SVOCs exceeded the screening values at two to nine of the sediment sampling sites. No VOCs were above the MCL or standards in the surface water samples although ten SVOCs exceeded the Vermont water quality standards in one to nine surface water samples. Two VOCs in the soil pore water samples exceeded Vermont groundwater standards. In November 2005, two VOCs in SD-08 exceeded the screening values and eleven SVOCs exceeded the screening values at one to five sediment sampling sites. No VOCs or SVOCs were above the surface water standards. Two VOCs in the soil pore water samples exceeded Vermont groundwater standards on this date as well. "A sheen and petroleum odor were observed/noted when sediment was disturbed along Stevens Branch downstream of the site at sediment locations SD-03 and SD-08." A persistent and fairly strong petroleum odor was noted again in September 2007 in this same area when water chemistry and macroinvertebrate sampling was conducted by Vermont DEC Water Quality Division. No sheens were seen.

It is important to note that the reference sample for the site is located about 1100 feet upstream and does itself show the presence of VOCs and SVOCs. However, "analytical results of the sediment and sediment pore water samples collected during both sampling events indicated that impacts to Stevens Branch from subsurface coal tar product seeps originating from the Barre Coal Tar site continue to be documented."

A number of years went by with no work at the site. In 2016, the mayor and officials in Barre City noted problems with homeless people using the site and starting fires there. That instigated a clean-up project at the site. ECS consultants were hired to do the clean-

up. About two weeks before the actual demolition and debris removal was to occur in mid-July 2016, the remediation shed that held the oil-water separator (OWS) with residual liquid and oily sludge was burned down. These materials went into the soils of the site.

Environmental Compliance Services, Inc. (ECS) did the remainder of the site clean-up and produced a report in September 2016. The following is excerpted from that report:

It was anticipated that ECS would oversee the proper closure and removal of the OWS in the remediation shed and the work would be performed by Accuworx USA of Barre, VT (Accuworx). However, due to the fire outlined above, the OWS was empty and burned. Therefore, no waste was present and no cleaning was required. The remnants of the OWS were disposed off-site as solid waste...

ECS oversaw the removal of all other remnant remediation equipment in the shed, including the compressor, air-liquid separator, electrical conduit, and various miscellaneous equipment/materials. The liquid in the air-liquid separator (approximately 700 gallons) was removed by Accuworx utilizing a vacuum truck and stored in plastic totes. On 14 September 2016, ECS sampled the liquid for volatile organic compounds (VOCs) by US EPA and semi-volatile organic compounds (SVOCs) by US EPA Method 8270, which is an analytical suite approved by VT DEC in an email dated 12 September 2016.

Results indicate that low level VOCs were detected, including 4-Methyl-2-pentanone (MIBK, 7.0 micrograms per liter or ug/l), naphthalene (3.7 ug/l), toluene (1.2 ug/l), 1,2,4-trimethylbenzene (TMB, 4.6 ug/l), 1,3,5-TMB (1.9 ug/l), and o-Xylene (2.7 ug/l). All detections were well below Vermont Groundwater Enforcement Standards (VGES), where available. No SVOCs were detected. Based on these results, VT DEC approved of returning the liquid to the groundwater on site via overland flow in an email dated 28 September 2016, which will be completed by Accuworx on 04 October 2016. Once all components were removed from the shed, they were transported off-site by Accuworx as scrap to Bolduc Metal Recycling in Middlesex, VT. The remnants of the shed were demolished by Accuworx utilizing a medium-sized excavator. During demolition activities, a spent carbon drum was identified in the debris which required proper off-site disposal as coal tar waste utilizing an overpack.

ECS also oversaw the removal of overland piping and insulation boxes associated with the former injection/recirculation system. No subsurface injection points were removed as requested, but rather cut and capped just below the surface, which included thirteen injection wells that were located during the project. Additional wells that could not be located may still be present. All the above materials... were transported off-site by Accuworx as solid waste.

Accuworx also utilized a skid steer with a brush hog attachment to brush hog the area. All small to medium-sized trees except along the tree line of the Stevens Branch were felled utilizing a chain saw. Other than removing recreational jumps that were installed by local youths utilizing empty barrels, no subsurface work or grading was performed in accordance with the requested plan.

Unifirst Plant site

At the former Unifirst Plant site on Brush Hill Road in Williamstown (DEC site #77-0087), contamination was first documented in 1983. Numerous monitoring wells were installed and many samples taken of groundwater, springs, seeps, drinking water supplies, and surface water over that past decades. There has also been ongoing indoor and outdoor air monitoring. A tributary to Rouleau Brook, which goes to the Stevens Branch, is the surface water being monitored.

The latest surface water sampling, for which results were in the files, was in 2014 (surface water sampled every other year now) at four locations along the tributary to Rouleau Brook. The latest sampling of Seep 1A, which is closest to Rouleau Brook, was in 2015. The 2014 report stated the following about the surface water sampling:

“The laboratory results indicate that a trace of target compound PCE was detected at WQ-1 and WQ-4, and a trace of target compound TCE was detected at WQ-4. Concentrations of all detected compounds are estimated below method detection limits. Traces of PCE have occasionally detected at WQ-1, most recently in July 2007, and less frequently at WQ-4 (last in July 2000). This is the first trace of TCE to be reported at WQ-4. The appearance of these target compounds may be due to relatively high flow, minor excavation and grading work at the Elementary School, or from the nearby groundwater treatment system that discharges into the Rouleau Brook.”

The 2015 annual report gave the following information about Seep 1A.

“SEEP-1A: PCE and TCE were both detected, at slightly higher concentrations compared to October 2014.” From Table 2: PCE was measured at 3.1 ug/liter and TCE was measured at 2.2 ug/liter. (The VGES is 5.0 ug/liter.)

South Barre MiniMart

The South Barre MiniMart/Barre Home Supply hazardous waste site (DEC site #96-1970) is located between Route 14 and the Stevens Branch in South Barre and there are several businesses located on the site including a laundramat, hardware store, minimart that sells gasoline and an automotive repair shop. The east part of the site is paved and relatively flat while the western side slopes to a drive and parking area used by the car repair shop. The land drops sharply to the Stevens Branch.

From the DEC Site Management Activity Complete letter:

“The site was initially placed on the State’s Hazardous Sites list in April, 1996, following a Phase II Environmental Site Investigation conducted by ATC Environmental, Inc. dated April 2, 1996 in which soil and surface water contamination was discovered. Results of Phase II sampling indicated soil contamination was limited to one location where surface soil staining had been visible. 8,450 parts per billion (ppb) of xylene and 5,800 parts per million (ppm) total petroleum hydrocarbons (TPH) were detected in one soil sample. Elevated levels of contaminants were not detected in any other soil samples collected. Groundwater was not encountered during the investigation. Three surface water samples were taken from the adjacent Stevens Branch during the 1996 Phase II investigation. Selenium was the only compound detected in one sample at concentrations exceeding risk based guideline levels.

In February, 2011, the site was determined to be eligible to utilize American Recovery and Reinvestment Act (ARRA) funds to conduct the additional work requested in August 1997. In April, 2011, an Initial Site Investigation was conducted by Stone Environmental. In order to conduct a complete site investigation, the two out of service 6,000 gallon and 8,000 gallon gasoline (USTs) systems were removed.

Numerous soil samples were collected from the tank pits, piping trench, and former pump island. No VOCs were detected when screened with a PID. Three soil samples were also collected and laboratory analyzed for VOCs. No contaminants were detected in the laboratory results. Three sediment samples were taken on July 1, 2011 and analyzed for RCRA 8 Metals. No compounds were detected at concentrations in excess of the Vermont Sediment Quality Guideline levels.

Groundwater was not detected during the April 2011 Initial Site Investigation.”

The conclusion of the SMAC letter is that “little to no risk is posed to sensitive receptors in the area from any residual contamination which may remain at the site... And.. it appears that this site does not pose an unacceptable risk to human health or the environment.”

Former Howe Cleaners

The Depot Square (formerly Howe Cleaners) hazardous waste site (DEC site #99-2631) was contaminated from years of dry cleaning chemicals and waste. A March 2006 report from the consultants for the site owners concluded that "a significant mass of PCE remains directly beneath the concrete floor of the current pool room/former equipment room of the former Hower Cleaners building. The presence of this significant contaminant source mass will continue to generate the elevated vapor levels seen within the subject building and the extensive dissolved phase contaminant plume if unremediated." The contaminant plume is towards the Stevens Branch. MW-106A, which is between the contaminated source and the river, had high levels of tetrachloroethene, trichloroethene, and cis-1,2-dichloroethene on sampling dates in March 2005, June 2005, November 2005, and March 2006. No VOCs were detected, however, in the two surface water samples collected from the Stevens Branch in March 2006.

A notice to the land records in Barre was done by Vermont DEC Waste Management Division in January 2011, which in part stated that:

Subsurface soil, groundwater, and soil vapor contain contamination at levels which far exceed State guidelines and standards. Due to the small 9 Depot Square property footprint, the contaminant plume has also impacted several neighboring properties. In March, 2010, a Corrective Action Feasibility Investigation was completed for the site by environmental consultants, Heindel and Noyes, Inc.

More recently a Corrective Action Plan (CAP) prepared by Nobis Engineering, Inc. (Nobis) presented remedial action. Following that Environmental Compliance Services, Inc. (ECS) did monitoring and detailed pre-characterization activities as part of the Enterprise Alley/Depot Square redevelopment (#2011-4142). Construction of some of the remediation systems “and initial monitoring activities were completed in February 2016 and were presented by ECS ..in a report entitled Corrective Action Plan (CAP) Construction

Phase Completion Report, dated 09 March 2016.”

“From February to June 2016, ECS performed O&M of the two SVE systems, performed the first round of ISCO injections and performance monitoring (Phase 1A), and performed the first round of groundwater monitoring following ISCO injections. From July to December 2016, ECS performed O&M of the two SVE systems, performed the second and third rounds of ISCO injections and performance monitoring (Phase 1B/2A and Phase 1C/2B), and performed the second round of groundwater monitoring following ISCO injections.”

From the groundwater monitoring, it appears that the chemical oxidation treatment is working, however, contaminant levels are still above the Vermont groundwater enforcement standards. The soil vapor extraction system is also working but only in some areas – not in all. There is ongoing remediation and monitoring.

Bonacorsi and Sons site

The Bonacorsi and Sons property hazardous waste site (DEC site# 2002-3048) was contaminated petroleum hydrocarbons and chlorinated hydrocarbons (tetrachloroethylene and its breakdown products) from a service station and a former drycleaning operation on the site. It was originally monitored quarterly per a Corrective Action Plan.

From January 2005 to January 2006, a Vapor Extraction System/Air Sparge operated onsite and from November 2005 to April 2007, a VES/AS system also operated offsite. These two systems removed 13.64 gallons of petroleum hydrocarbons. These were then dismantled to focus on In-Situ Chemical Oxidation for the PCE and related chemicals. The pilot phase of the ISCO occurred from May to July 2008 and removed “an encouraging 95% of the mass according to the proposed Work Plan for Phase II (December 28, 2009).

Quarterly groundwater monitoring occurred through 2010 then the monitoring became semi-annually for two years. Groundwater monitoring didn't occur in 2013 or 2014 but in 2015, there was the “Groundwater & Vapor Mitigation System Monitoring Report, Bonacorsi & Sons, Barre, Vermont” dated November 17, 2015 by Weston and Sampson. Their July 2015 sampling found PCE in all 8 groundwater samples with 6 samples above the VGES; TCE detected in 6 of the 8 samples with two VGES exceedences; cDCE detected in 3 of the 8 samples with one well exceeding the VGES; and vinyl chloride detected in one sample many times the VGES.

Berlin Mobil Short Stop site

The Berlin Mobil Short Stop site (DEC site# 94-1690) is located on Route 302 in Berlin. Four site monitoring wells and a culvert, which drains the site, were sampled in April 2006. The groundwater flow on this site is northeasterly into the Stevens Branch. Three of eight compounds tested exceeded the VGES in MW-2 while 5 of 8 compounds exceeded the standards in MW-4. These two wells are between the facility and the river. However, MW-6, which is closest to the river only had a trace of MTBE in the sample. “MW-1 and the culvert samples were both clean.” The culvert catches water from a curtain drain that is upslope of the facility as is MW-1.

This site was sampled most recently in September 2016. Monitoring wells 2 and 3 were sampled. Monitoring well 4 didn't have enough water and monitoring wells 5 and 6 have been destroyed. Monitoring well 2 had total TMBs and naphthalene above the Vermont groundwater enforcement standards.

Quarry Hill Quick Stop

The Quarry Hill Quick Stop site (DEC site# 1998-2388) had both groundwater and surface water contamination when initially investigated. The following brief history is directly from the SMAC letter dated January 7, 2011 just severely shortened.

- *During the May 9, 1998 removal of three gasoline USTs contaminated soil was observed.*
- *On October 22, 1998 four groundwater monitor wells were installed in order to investigate the degree and extent of contamination on site. Elevated VOC levels up to 153 ppm were noted in soil samples at all monitor well locations. One or more of the following gasoline chemicals: benzene, MTBE, naphthalene, and trimethylbenzene were found in monitor wells MW-1, -3, and -4. MW-2 contained 0.1' of free product. The stream adjacent to the property contained benzene above the Vermont Surface Water Quality Standard.*
- *Between August 2001 and June 2004 a multiphase extraction system was operated and removed 8300 pounds of gasoline as vapor. Additional remediation efforts included limited soil excavation, the injection of oxygen reducing compound (ORC™), surfactant injection, and chemical oxidant injection.*
- *In 2007 additional chemical oxidant injections were performed. Following this work active site remediation was discontinued and annual groundwater monitoring was implemented.*
- *On April 6, 2009 seven of the monitor wells were sampled; one contained contamination above the VGES, three below the VGES, and three contained no detectable contamination.*
- *On March 31, 2010 six monitor wells were sampled. Three had contamination below the VGES and 3 had no detectable contamination... No further sampling was required and monitor well closure was requested for the remaining wells.*
- *Following completion of remediation, confirmatory were samples were collected from the stream and no more VOC contamination was found.*

The SMS gave this site a Site Management Activity Completed designation.

Dog River Watershed

General Description

The Dog River is approximately 20 miles long and drains a watershed of about 94 square miles. It originates from several intermittent streams off the west side of the Northfield Mountains. The river flows southeasterly down off the mountains and foothills until it reaches the valley in which Route 12A runs. The river then begins a northerly flow in the vicinity of Roxbury village. After flowing north for approximately two miles, the river, now in the town of Northfield, begins an easterly flow. Felchner Brook enters from the north in this stretch. After another approximately two miles, the river begins to flow northeasterly and then northerly.

Stony Brook then joins the Dog from the north and Bull Run joins from the south. Stony Brook is five and a half miles long and drains a nine square mile watershed. Bull Run is approximately six miles long and drains a ten square mile watershed. Downstream about one-half mile, Sunny Brook and its watershed also joins the Dog River. The Dog River is substantially larger after these tributaries join it.

As a larger river now, the Dog River flows north into Northfield's downtown where Union Brook joins it. The Dog continues north into Northfield Falls where Cox Brook enters. Cox Brook is about five and a half miles long and drains an eleven mile watershed. After Northfield Falls, the river flows into the town of Berlin and then continues north and northeasterly for over six miles until the Dog River enters the Winooski River near Montpelier Junction. Chase Brook and a number of unnamed tributaries enter the Dog River in the town of Berlin.

Uses and Values

Waterfalls, Cascades, and Gorges and Swimming Holes

The Waterfalls, Cascades, and Gorges of Vermont report lists one site in the Dog River watershed and that is Northfield Falls on Cox Brook. This site is upstream of the covered bridges in Northfield Falls and consists of a set of cascades but there are no pools for swimming. It is used lightly as a picnicking or gathering spot.

The Vermont Swimming Hole Study describes two swimming holes in the Dog River watershed – one on the Dog River itself and one on Stony Brook, a tributary. The site on the Dog River is in Riverton at a closed bridge on a road west of Route 12. The other site is on Stony Brook below an old bridge foundation where there are step cascades and several pools.

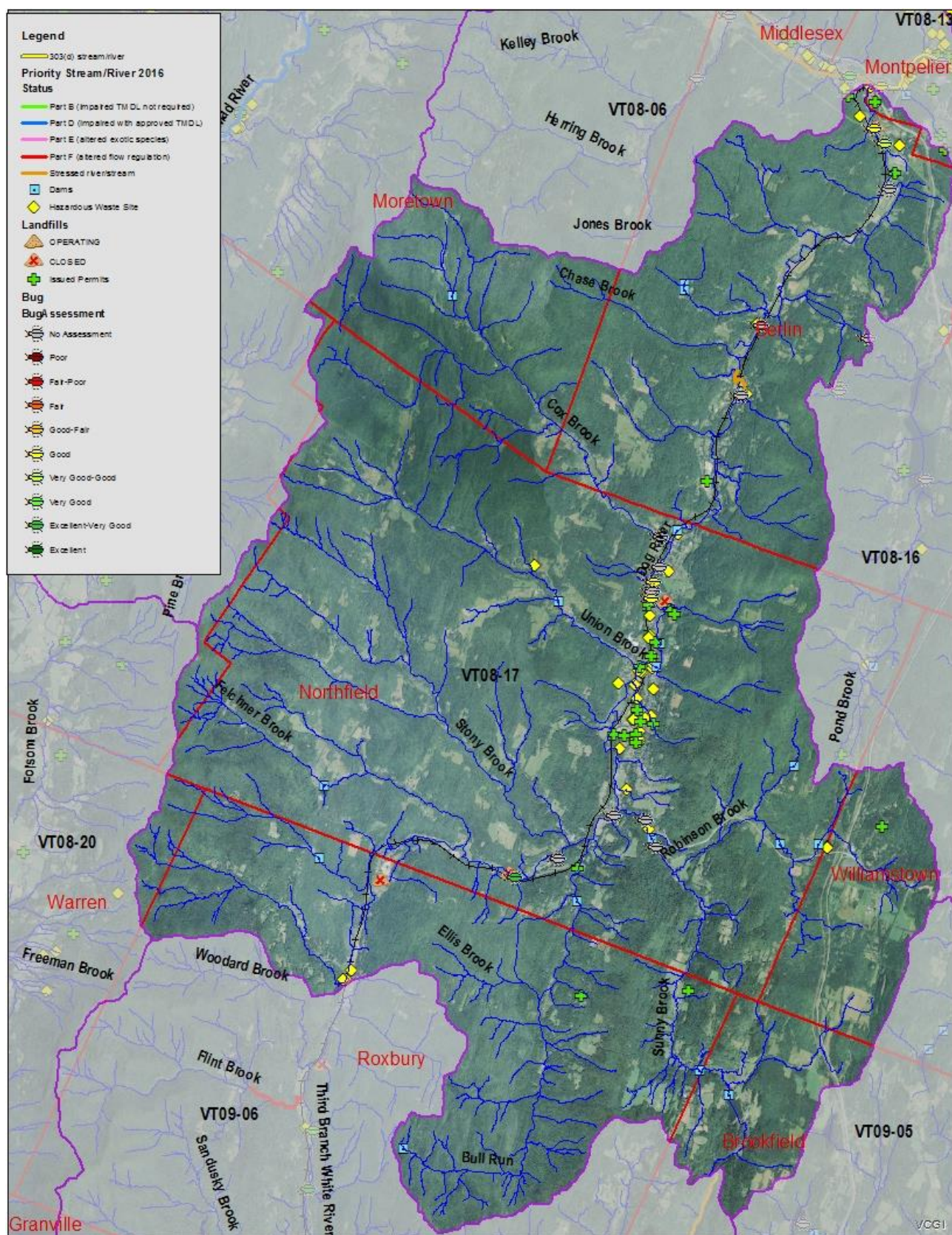


Figure 3. Dog River watershed showing stream assessment information and status

Fishery

The Dog River mainstream and all tributaries are managed as “wild trout waters”. There are exclusively wild brook trout above Route 12A in Roxbury and a mix of wild brook trout, brown trout and rainbow trout downstream. Wild rainbow trout and brown trout dominate below Northfield Falls.

In 2001, following a year of a full season angler creel survey and several trout population surveys to gather good baseline data, special regulations (reduced harvest) were set for the 4.3 mile long stretch on the Dog River from the West Berlin railroad bridge to the first Route 12 bridge above the mouth in Berlin. The regulations were to improve the size structure of the wild trout in the river.

Baker Pond has largemouth bass, yellow perch, pumpkinseed, and brown bullhead. The Vermont Department of Fish and Wildlife owns surrounding land, the dam and an access area on the pond.

Table 11. B1 Waters for recreational fishing in the Dog river watershed

Stream or river stretch	Fishery
Dog River – entire mainstem	Wild brook trout, brown trout, and rainbow trout
Felchner Brook	Wild brook trout and brown trout below the falls & wild brook trout only above the falls.
Stony Brook	Wild brook trout and rainbow trout
Bull Run	Wild brook trout, brown trout and rainbow trout
Sunny Brook	Wild brook trout, brown trout and rainbow trout
Robinson Brook	Wild brook trout, brown trout, and rainbow trout
Union Brook	Wild brook trout
Cox Brook	Wild brook trout and rainbow trout. The dam was removed in 2008 to allow for upstream fish movement
Chase Brook	Wild brook trout, brown trout and rainbow trout. Managed as a rainbow trout spawning water with special regulations that close fishing until June 1.

Biological Monitoring and Assessment

Sampling Results, Site Locations, and Sampling Needed Tables

Since 2008, only the Dog River itself has been monitored. There are some biological monitoring results for Sunny Brook, a tributary, from 2003 and 2004 but otherwise the tributaries of this watershed need some biological monitoring. See Table 14 below for potential biological sampling sites.

Table 12. Biological sampling results for the Dog River & Tributaries - 2008 to 2016

Wbid	River/Stream	River -mile	Date	Assessment – macroinvertebrates	Assessment -fish
VT08-17	Dog River	0.7	9/22/2010	good	----
VT08-17	Dog River	0.9	9/1/2015	very good-good	----

VT08-17	Dog River	8.8	9/22/2010	very good-good	----
VT08-17	Dog River	8.8	8/31/2015	good	----
VT08-17	Dog River	9.0	9/22/2010	exc-very good	----
VT08-17	Dog River	9.0	8/31/2015	good	----
VT08-17	Dog River	14.8	9/1/2015	exc-very good	very good
VT08-17	Dog River	14.8	9/2&8/25/2016	excellent	very good

Table 13. Biological sampling sites locations in the Dog River watershed

WBID	Stream or River	Town	Station	Description
VT08-17	Dog River	Berlin	0.7	Upstream from the recreation field under the utility line
VT08-17	Dog River	Berlin	0.9	Above power station bridge about 500 meter
VT08-17	Dog River	Northfield	8.8	100 meters below the Northfield WWTF
VT08-17	Dog River	Northfield	9.0	200 meters above the Northfield WWTF
VT08-17	Dog River	Northfield	14.8	Above the golf course

Table 14. Biological monitoring needed in the Dog River watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-17	Cox Brook	2 sites – one lower down and one farther up stream	Rm 0.3 was sampled (bugs) in 2005 but no assessment was given. Since then the dam has been removed near the sampling site
VT08-17	Union Brook	At least one site	No biomonitoring has been done on this tributary
VT08-17	Sunny Brook	Two sites (repeat of one done earlier – 2003 and 2004) & another	Repeating either the rm 0.5 or rm 0.9 site and then another site farther upstream would be ideal
VT08-17	Bull Run	At least one site	No biomonitoring has been done on this named tributary
VT08-17	Stony Brook	At least one site	No biomonitoring has been done on this named tributary
VT08-17	Felchner Brook	At least one site	No biomonitoring has been done on this named tributary

Water Quality Monitoring

E. coli, turbidity, phosphorus sampling

Two sites on the Dog River are part of the suite of sites sampled by the Four Rivers Partnership of Friends of the Winooski River – one site in Riverton and the other at the Montpelier Recreation fields. The two sites are sampled for phosphorus, turbidity and *E. coli*.

Phosphorus levels at the two Dog River sites (the mean in dry conditions) were just below and just above 10 ug/liter (the standard is 15 ug/L for cold water streams). Turbidity, also sampled in dry conditions was low for both sites.

For *E. coli* sampling results, the geometric mean of the samples taken in 2015 were above the 126 mpn/100mL standard for both Dog River sites and this has been the case for the Riverton site since sampling started there in 2012 and for the Montpelier Recreation Fields site since 2011 (the 2010 sampling mean was far below the 126 standard.)

Hazardous Waste Sites

Nantanna Mill site (2014-4566)

A sheen was reported on the Dog River near the town garage on August 16, 2014. Further investigation found two additional locations. There was no definitive source found but when river bottom sediments were stirred up next to the Nantanna Mill property, there was heavy sheening and a fuel odor.

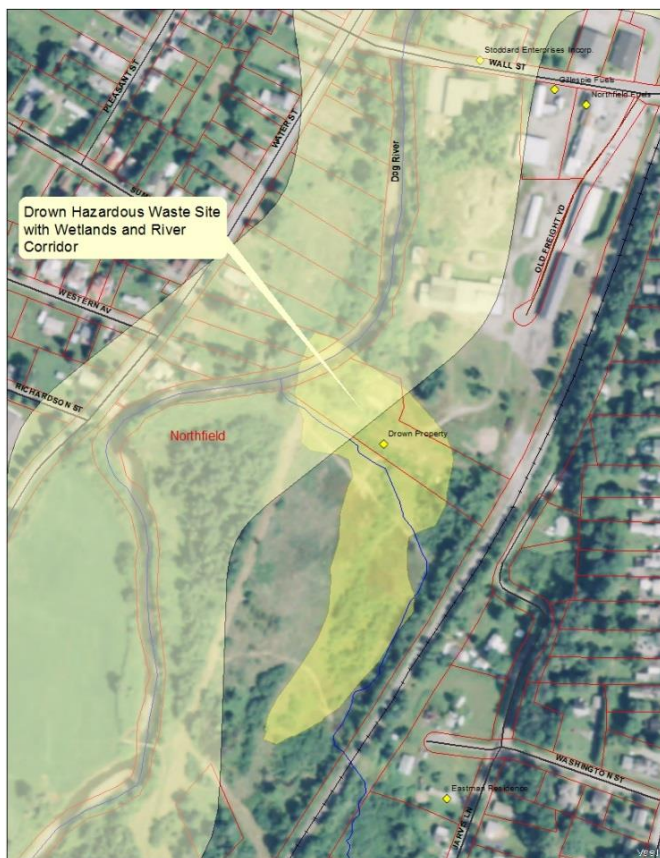
Site investigations were conducted in August with borings and groundwater monitoring wells. Groundwater monitoring found VOCs above the laboratory detection methods but below the VGES. There were detectable concentrations of total petroleum hydrocarbons with all in excess of the soil screening values for a residential property and two above the soil screening values for an industrial property.

The Nantanna Mill property has old sewer mains beneath part of the mill building where it connects to a manhole and newer sewer main. There are multiple floor drains and sewer connections in the onsite building. More investigation and assessment work is required of the property owner.

Drown Property (2013-4371)

Environmental Compliance Services, Inc. (ECS) performed a Phase I Environmental Site Assessment of the Drown property at 11 Wall Street in Northfield in 2013. The stated purpose of their assessment “was to identify and record existing, potential or suspected conditions that may impose an environmental liability to, or restrict the use of, the property and to identify evidence of a release or a potential release of oil and hazardous materials (OHM).” Environmental Compliance Services then did an update of their September 2013 Phase I Environmental Site Assessment in June 2014 for the town of Northfield, which had received the property. In addition to the historical land use research, three soil samples were taken in locations that the town wanted sampled:

“In the “Granite Shed” sample, the PAH benzo(a)pyrene exceeded the Industrial EPA Regional Screening Level (RSL). The PAHs benzo(a)anthracene and benzo(b)fluoranthene exceeded the Residential RSL. Arsenic exceeded the Industrial RSL in all three samples. Although the arsenic concentrations in the “Sawmill” and “Granite Shed” samples could potentially be within the range of background concentrations in Vermont (generally less than 10 milligrams per kilogram (mg/Kg)), which often exceed the Industrial RSL, the concentration in the “L Drown” sample was 50 mg/Kg, which is elevated above background concentrations. There were no other exceedences of applicable soil standards, although other PAHs, metals, TPH, and VOCs were detected. No PCBs were detected above laboratory reporting limits in any of the three samples.”



The property is now owned by MJM Properties, LLC, which is an abutting landowner. It appears that MJM Properties may not plan to do any active development of this property, but instead purchased it to avoid neighbor issues. MJM Properties was aware of the Hazardous Waste Exemption Agreement and the work plan prior to its purchase.

Part of the property is mapped wetland and all of the property is in the floodplain. Wetland restoration potential could be explored with the current owner and the DEC hazardous waste section.

Figure 4. Drown Hazardous Waste Site

Mad River Watershed

General Description

The Mad River is 26 miles long and drains an area of 143 square miles. It flows south to north in a valley bounded on the west by the Green Mountains and on the east by the Northfield Mountains.

The Mad River originates in Granville Notch in the town of Granville and begins a northerly flow in a narrow, forested valley. It turns westerly along the Granville/Warren town line then flows primarily north again going into the town of Warren. Austin Brook enters the Mad from the west just downstream of the Warren town line and then in less than a mile, Mill Brook, which drains Blueberry Lake, joins the Mad River from the east. Then in another approximately half a mile, Stetson Brook joins the Mad River from the west.

The Mad River continues flowing north in a relatively narrow valley until it reaches the village area of Warren. Lincoln Brook comes out of the mountains into the Mad River from the west; Freeman Brook comes into the Mad in Warren Village from the east; and then downstream of the village, Bradley Brook joins the river from the west. Further north and downstream still, Clay Brook with its tributary, Rice Brook, enters the Mad River from the west.

The Mad River continues its northerly journey into the town of Waitsfield where first Charles Folsom Brook then Mill Brook with Slide, Lockwood, and Chase Brooks rising in Fayston to the west and then High Bridge Brook from the east enter the Mad River. Further downstream but still in Waitsfield, Pine Brook joins the Mad River then Shepard Brook with French and Deer Brooks also enters.

The Mad River continues northerly still and Welder Brook with Cunningham Brook and Dowsville Brook rising in Duxbury enters the Mad in Moretown. Further downstream, the Mad River is impounded by a dam and then not far below the dam, the Mad River joins the Winooski River.

Uses and Values

Waterfalls, Cascades, and Gorges and Swimming Holes

The Waterfalls, Cascades, and Gorges of Vermont report describes only Moretown Gorge on the Mad River, which is visible from the road and road bridge on a portion of the gorge.

The *Vermont Swimming Hole Study* lists nineteen swimming holes on the Mad River and its tributaries including Moretown Gorge described above. The authors of the swimming hole inventory conclude that the Mad River watershed “has as high a concentration of fine swimming holes as any stream in the state.” Of the nineteen documented in the study, fifteen are on the mainstem and four are on the tributaries – a table of the sites identified in this watershed is included in the [2008 Winooski River assessment report](#) on page 31.

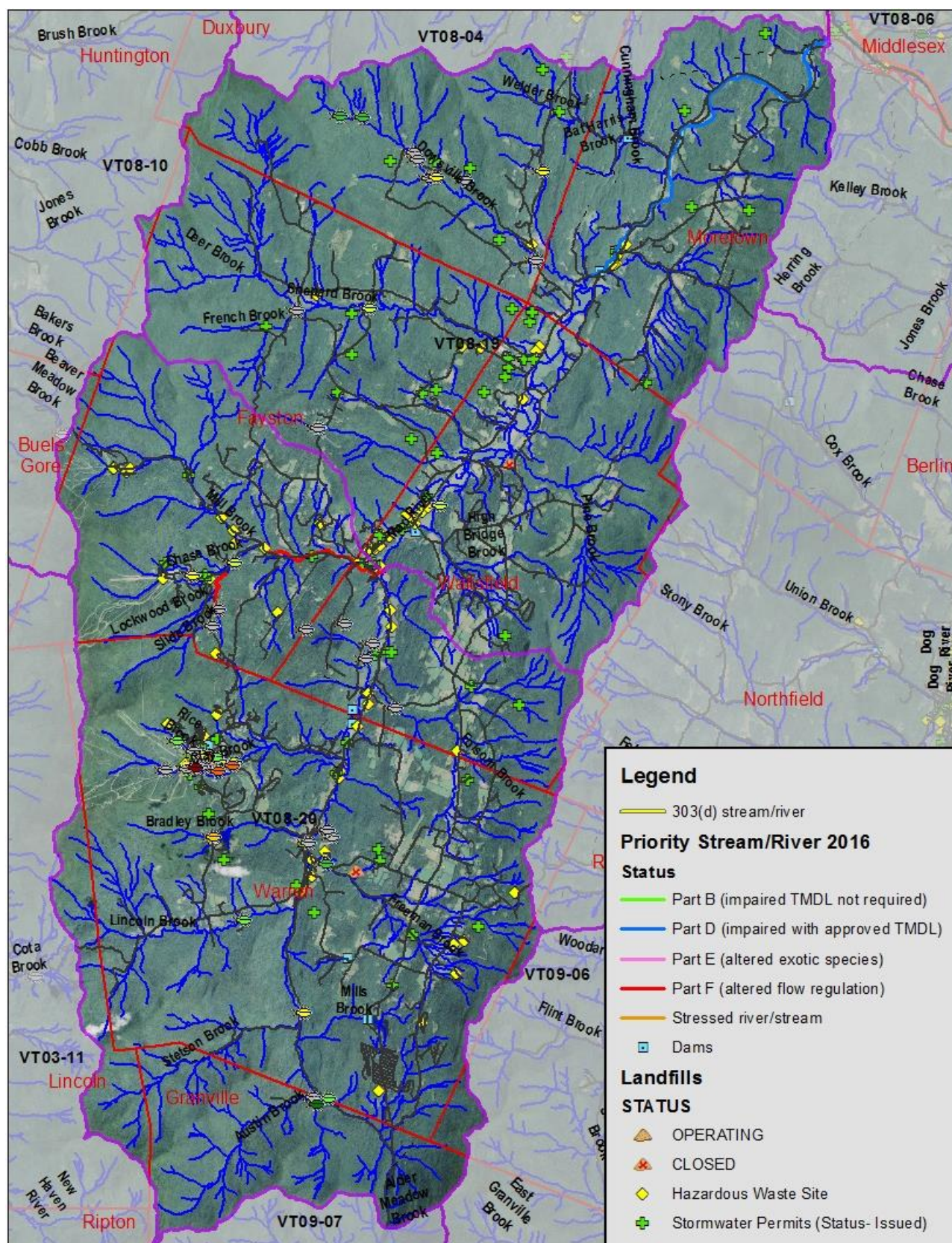


Figure 5. Mad River watershed with assessment information

Boating

The Whitewater Rivers of Vermont report describes two stretches of the Mad River for good boating. The first stretch is from Warren to Moretown about 12 miles in length. The second stretch described in the Whitewater Report is from Moretown Gorge down to the Winooski River about seven miles. It is also popular for fishing.

Fishery

The upper reach of the Mad River supports wild brook, brown and rainbow trout and is managed for wild trout. Below Warren village, increasing temperature and habitat deficiencies limit trout production to “pocket populations” associated with large pools or nearby tributaries. Rainbow trout are stocked here to supplement the recreational fishery. Dams in Warren and Moretown fragment and degrade habitat.

The Mad River above Warren Village can generally be described as having excellent trout habitat typical of high gradient, forested upland streams. This upper reach (Warren Village and upstream) has the highest trout populations in the river. Between Warren Village and Waitsfield, the Mad River loses gradient and is characterized by wide, shallow riffles or flats with occasional deep pools. Overall, the riparian area is generally well vegetated although some long stretches lack streamside vegetation where wild trout populations were found to be low. Below Waitsfield Village, the Mad River is also characterized by wide shallow riffles or flats, a high proportion of fine substrate (sand, silt) and a poorly vegetated riparian area. Wild trout populations are low although pockets of good habitat may hold greater trout densities.

Blueberry Lake contains largemouth bass, bluegill, stocked brook trout, brown bullhead and rudd.

Table 15. B1 Waters for recreational fishing in the Mad River watershed

Stream or river stretch	Fishery
Mad River above Warren Village	Wild brook trout
Austin Brook	Wild brook trout and rainbow trout
Freeman Brook	Wild brook trout and rainbow trout
Lincoln Brook	Wild brook trout
Bradley Brook	Wild brook trout
Clay Brook?	Wild brook trout
Rice Brook	Wild brook trout
Folsom Brook	Wild brook trout, brown trout and rainbow trout
Mill Brook	Wild brook trout and rainbow trout
Chase Brook	Wild brook trout
Slide Brook	Wild brook trout
Shepard Brook	Wild brook trout, brown trout, and rainbow trout
Dowsville Brook	Wild brook trout, brown trout and rainbow trout

Biological Monitoring and Assessments

Sampling Results, Site Locations, and Sampling Needed Tables

Table 16. Biological sampling results for the Mad River & Tributaries - 2008 to 2016

Wbid	River/Stream	River-mile	Date	Assessment – macroinvertebrates	Assessment-fish
VT08-18	Mad River	12.1	9/1/2015	very good-good	----
VT08-18	Mad River	21.9	9/3/2010	very good	good
VT08-18	Mad River	21.9	8/31/2015	good	excellent
VT08-19	Dowsville Brook	2.9	9/2&3/2010	exc-very good	excellent
VT08-19	Dowsville Brook	2.9	9/3/2013	good	excellent
VT08-19	Dowsville Brook	3.9	10/24/2008	excellent	----
VT08-19	Dowsville Brook	3.9	9/1/2009	exc-very good	----
VT08-19	Dowsville Brook	4.1	9/4/2009	exc-very good	----
VT08-19	Dowsville Brook Trib 1	1.7	10/24/2008	very good	----
VT08-19	Dowsville Brook Trib 1	1.7	10/2/2009	good	----
VT08-19	Shepard Brook	4.3	9/3/2013	very good-good	very good
VT08-20	Bear Wallow Brook	0.2	8/31/2015	excellent	----
VT08-20	Bear Wallow Brook	0.2	9/19/2016	excellent	----
VT08-20	Clay Brook	1.8	9/1/2015	fair	----
VT08-20	Clay Brook	1.8	9/21/2016	fair	----
VT08-20	Clay Brook	2.0	9/5/2008	good-fair	----
VT08-20	Clay Brook	2.0	9/20/2009	very good-good	----
VT08-20	Clay Brook	2.0	9/16/2010	fair	----
VT08-20	Clay Brook	2.0	8/27/2011	very good-good	----
VT08-20	Clay Brook	2.0	9/3/2012	good-fair	----
VT08-20	Clay Brook	2.0	9/5/2013	fair	----
VT08-20	Clay Brook	2.0	9/8/2014	fair	----
VT08-20	Clay Brook	2.0	9/17/2015	fair	----
VT08-20	Clay Brook	2.0	9/21/2016	fair	----
VT08-20	Clay Brook	2.1	9/5/2008	good-fair	----
VT08-20	Clay Brook	2.1	9/20/2009	fair	----
VT08-20	Clay Brook	2.1	9/16/2010	fair	----
VT08-20	Clay Brook	2.1	8/28/2011	good-fair	----
VT08-20	Clay Brook	2.1	9/3/2012	fair	----
VT08-20	Clay Brook	2.1	9/5/2013	fair-poor	----
VT08-20	Clay Brook	2.1	9/8/2014	fair, fair-poor	----
VT08-20	Clay Brook	2.1	9/17/2015	fair poor	----
VT08-20	Clay Brook	2.1	9/29/2016	fair	----
VT08-20	Clay Brook	2.3	9/19/2008	fair-poor	----
VT08-20	Clay Brook	2.3	9/1/2015	poor	----
VT08-20	Rice Brook	0.1	9/1/2015	very good-good	----
VT08-20	Rice Brook	0.3	9/19/2008	good	----
VT08-20	Rice Brook	0.3	9/18/2009	very good-good	----
VT08-20	Rice Brook	0.4	9/5/2008	good-fair	----
VT08-20	Rice Brook	0.4	9/20/2009	good-fair, good	----
VT08-20	Rice Brook	0.4	8/27/2011	good	----

VT08-20	Rice Brook	0.4	9/5/2013	good-fair	----
VT08-20	Rice Brook	0.4	9/17/2015	very good	----
VT08-20	Rice Brook	0.6	9/5/2008	very good	----
VT08-20	Rice Brook	0.6	9/20/2009	very good	----
VT08-20	Rice Brook	0.6	8/27/2011	very good-good	----
VT08-20	Rice Brook	0.6	9/5/2013	good-fair	----
VT08-20	Rice Brook	0.6	9/8/2014	good	----
VT08-20	Rice Brook	0.6	9/17/2015	good	----
VT08-20	Rice Brook	0.6	9/21/2016	fair	----
VT08-20	Rice Brook	0.7	9/19/2008	good	----
VT08-20	Rice Brook	0.7	9/18/2009	very good-good	----
VT08-20	Rice Brook	0.7	9/8/2014	very good	----
VT08-20	Rice Brook	0.7	9/21/2016	good	----
VT08-20	Rice Brook	1.1	9/19/2008	good	----
VT08-20	Rice Brook	1.1	9/18/2009	very good	----
VT08-20	Freeman Brook	0.4	8/31/2015	excellent-very good	----
VT08-20	Lincoln Brook	0.9	8/31/2015	very good	----

Table 17. Biological sampling sites locations in the Mad River watershed

WBID	Stream or River	Station	Town	Description
VT08-18	Mad River	12.1	Waitsfield	Below Waitsfield Elementary School, across a cornfield
VT08-18	Mad River	21.9	Warren	Off Charley Ashley Road, just above the Route 100 bridge crossing
VT08-19	Dowsville Brook	2.9	Duxbury	Behind brown house at 1953 on Dowsville Road
VT08-19	Dowsville Brook	3.9	Duxbury	About 20 meters off of a main logging road below a logging bridge
VT08-19	Dowsville Brook	4.1	Duxbury	Located 15 meters below the uppermost logging road crossing below an area called Beaver Meadow
VT08-19	Dowsville Brook Trib 1	1.7	Duxbury	About 50 meters below a log landing off Route 100
VT08-19	Shepard Brook	4.3	Duxbury	Located 15 meters above Randall Bridge crossing
VT08-20	Bear Wallow Brook	0.2	Granville	Located 100 meters above Forest Service Road crossing
VT08-20	Clay Brook	1.8	Warren	Above confluence with Rice Brook about 50 meters
VT08-20	Clay Brook	2.0	Warren	Below a proposed 22 acre leachfield for Sugarbush, above the existing South Village leachfield
VT08-20	Clay Brook	2.1	Warren	Below Inferno Road about 150 meters and above the 22 acre leachfield site
VT08-20	Clay Brook	2.3	Warren	About 50 meters above Inferno road bridge below small maintenance shed at the edge of Sugarbush parking lot

VT08-20	Rice Brook	0.1	Warren	Immediately above confluence with Clay Brook
VT08-20	Rice Brook	0.3	Warren	Below Access Road and Sugarbush WWTF about 200 meters
VT08-20	Rice Brook	0.4	Warren	Below Access Road and WWTF about 100 meters
VT08-20	Rice Brook	0.6	Warren	Above Sugarbush WWTF and below parking lot tributary
VT08-20	Rice Brook	0.7	Warren	Above parking lot tributary about 50 meters and adjacent to tennis courts
VT08-20	Rice Brook	1.1	Warren	Above condominium development and old snowmaking pond dam
VT08-20	Freeman Brook	0.4	Warren	Downstream of bridge on Brook Road
VT08-20	Lincoln Brook	0.9	Warren	Below Lincoln Brook Rd off of Lincoln Gap Rd

Table 18. Biological monitoring needed in the Mad River watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-19	Welder Brook	1 site on brook	There are no biomonitoring sites on this brook
VT08-19	Pine Brook	1 site along brook	There are no biomonitoring sites on this brook
VT08-19	High Bridge Brook	1 site	There are no biomonitoring sites on this brook
VT08-20	Mill Brook	2 sites	One above Slide Brook confluence and one below
VT08-20	Folsom Brook	1 site at rm 0.8	Last sampled in 2000
VT08-20	Austin Brook	1 site at rm 0.2	Last sampled in 1999
VT08-20	Unnamed Trib to Mad River, east of Blueberry Lake development	1 or 2 sites	Never been sampled.
VT08-20	Bradley Brook	Re-sample at rm 1.7	Sampled in 1994 ("excellent") then again in 2006 (only "good-fair"). Needs to be checked again.

Specific River and Streams Discussion

There are quite a few biological monitoring results for Clay and Rice Brooks in part because sampling occurs as part of a Water Quality Remediation Plan for these streams that is being conducted by Sugarbush Resort. In addition, there is sampling of both brooks indirect discharge locations.

Earlier sampling occurred on a number of the upper Mad River tributaries but newer biological assessment information is not available in this 2008 to 2016 time frame. Information on the aquatic community health of Shepard Brook, Dowsville Brook, Dowsville Tributaries #1, #5, #7, Kewvasseur Brook, Bradley Brook, Chase Brook, and Slide Brook can be found in the 2008 Winooski River assessment report and at the Watershed Management Division's website where the information is available:

<https://anrweb.vt.gov/DEC/IWIS/>.

Clay Brook

Clay Brook begins on the slopes of Lincoln Mountain between Lincoln Peak to the south and Cutts Peak to the north. Rice Brook and several unnamed tributaries join Clay Brook before its confluence with the Mad River. The Clay Brook aquatic community is impaired due to the development at Sugarbush ski area and has been for twenty-five years.

The macroinvertebrate community at sites on Clay Brook from 1991 through 2006 (8 samples) have been either fair or poor (with “good-fair” achieved in 2006 at two sites) between rivermiles 1.8 and 2.3. From 2006 to the present (2016), the aquatic community has remained impaired getting “fair”, “fair-poor” or “poor” assessments. There were brief indications of improvement at the rm 2.0 site on two different years but that improvement did not hold.

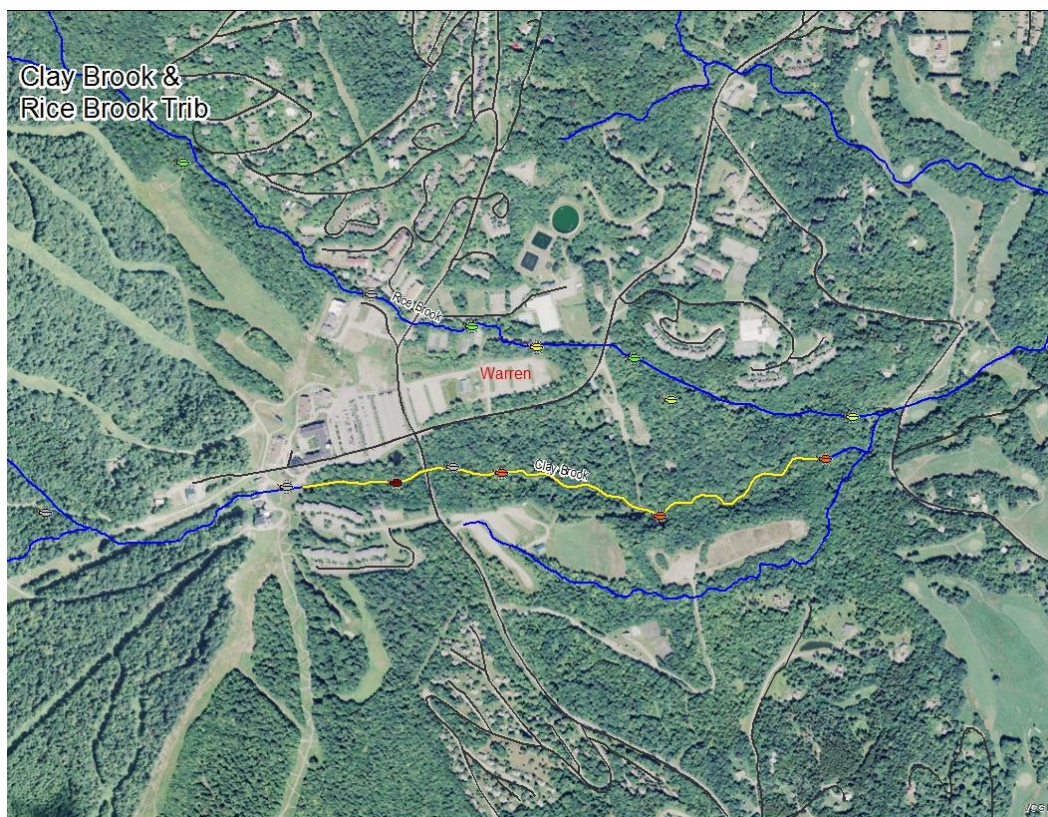


Figure 6. Clay and Rice Brooks and Adjacent Development

A Water Quality Remediation Plan dated October 2008 was written by consultants with goals and plans for remediating both Clay Brook and Rice Brook. The plan states that: “Sugarbush is committed to revising their WQRP as necessary if the current implementation strategy for improving quality standards proves to be unsuccessful.” The WQRP needs to be updated with respect to BMPs and new goals for attainment for Clay Brook.

Rice Brook

Rice Brook originates on the southeastern slope of Lincoln Mountain in Warren and flows southeasterly to Clay Brook. Rice Brook measures about 1.3 miles on the USGS topographic map.

The macroinvertebrate community on Rice Brook has been sampled extensively from 1993 to the present at five sites. Rice Brook was on the Impaired Waters List from the 1990s until the 2010 assessment cycle when it was removed due to consistently improved biological condition. Monitoring since 2010 has continued to show an aquatic community meeting standards (see Table 16 above).

Other Brooks

Bear Wallow Brook, Freeman Brook, and Lincoln Brook all had one macroinvertebrate sample showing a very good to excellent community. An additional sample of both the macroinvertebrate and fish communities could provide the information needed to re-classify these streams at a higher level.

Water Quality Monitoring

In 2016, a consultant compiled and reviewed the data and information that has been collected since 1985 from over 50 sites in the Mad River watershed. That report on the “Water Quality Conditions in the Mad River Watershed, Vermont 1985 – 2015” can be found [here](#).

Hazardous Waste Sites

Information on the Keith & Keith Drycleaner site (770085) is provided in the 2008 Winooski River assessment report and not repeated here. The Keith & Keith source contamination was removed from the site and the groundwater contamination dropped below the VGES in 2009 sampling. The site was SMACed (Sites Management Activity Completed) in 2009.

Little River Watershed

General Description

The Little River begins where Sterling Brook and Moss Glen Brook join in the northern part of the town of Stowe. Flowing south and southwesterly, the river soon meanders through a large wetland complex that is largely shrub swamp. It winds to and through the village of Stowe where the West Branch of the Little River joins it.

The West Branch is a substantial stream in and of itself. It begins on the eastern slopes of Mt. Mansfield and flows for 10 miles draining a 29 square mile watershed before joining the Little River in Stowe Village. Ranch Brook and Peterson Brook are two of the West Branch's main tributaries.

Below the West Branch confluence, the Little River is much larger. It flows southwesterly from this junction and then turns abruptly to the west for about a mile, makes another large turn, and flows southwesterly again soon leaving Stowe and flowing into the town of Waterbury. Gold, Barrows, and Miller Brooks join the Little River in this stretch.

Downstream of the Stowe/Waterbury town line, the Little River flows into the impoundment that is the Waterbury Reservoir. The status of the reservoir and its hydro-electric dam project is given below. Cotton Brook and Stevenson Brook flow into the reservoir from the west.

From the Waterbury Dam, an Army Corps of Engineers structure, the Little River flows another two and a half to three miles entering the Winooski River just downstream of the village of Waterbury.

Uses and Values

Waterfalls, Cascades, and Gorges and Swimming Holes

The Waterfalls, Cascades and Gorges of Vermont report describes three gorges or falls in the Little River watershed in Stowe: Sterling Brook Gorge, Bingham Falls, and Moss Glen Falls II and *The Vermont Swimming Hole Study* describes these three same sites as well as a fourth site in Stowe known as Fosters. These known swimming spots are described in more detail in the 2008 Winooski River assessment report and the Waterfalls, Cascades & Gorges and Swimming Hole studies.

Fishery

On the Little River mainstem, there are wild brook trout in the higher elevations and wild brown and rainbow trout below the confluence with West Branch. The river above the reservoir provides spawning habitat for migrating brown trout, rainbow trout, rainbow smelt and other species.

Downstream of Waterbury Dam, the river supports wild brown and rainbow trout. In the past, populations have been limited by regular and extreme flow and temperature fluctuations associated with the hydroelectric release. In December 2014, the Agency issued a new water quality certification and FERC issued the new license in February 2016 for the hydroelectric project. The certification and license require the facility to operate in true run-of-river mode after the replacement of a turbine runner, construction of a bypass flow valve, and the replacement of the Tainter gates. GMP is scheduled to begin construction to replace the runner and install the bypass flow valve in the Fall 2017. Replacement of the gates is responsibility of the State as owner of the dam and funding for this work is being sought.

Table 19. B1 Waters for recreational fishing in the Little River watershed

Stream or river stretch	Fishery
Alder Brook	Wild brook trout
Stevenson Brook	Wild brook trout, brown trout and rainbow trout. Rainbow smelt spawn within the confluence to Waterbury Reservoir.
Miller Brook	Wild brook trout, brown trout and rainbow trout.
Gold Brook	Wild brook trout, brown trout and rainbow trout
West Branch?	Wild brook trout above the confluence with Ranch Brook and wild brook trout and brown trout below.
Ranch Brook	Wild brook trout

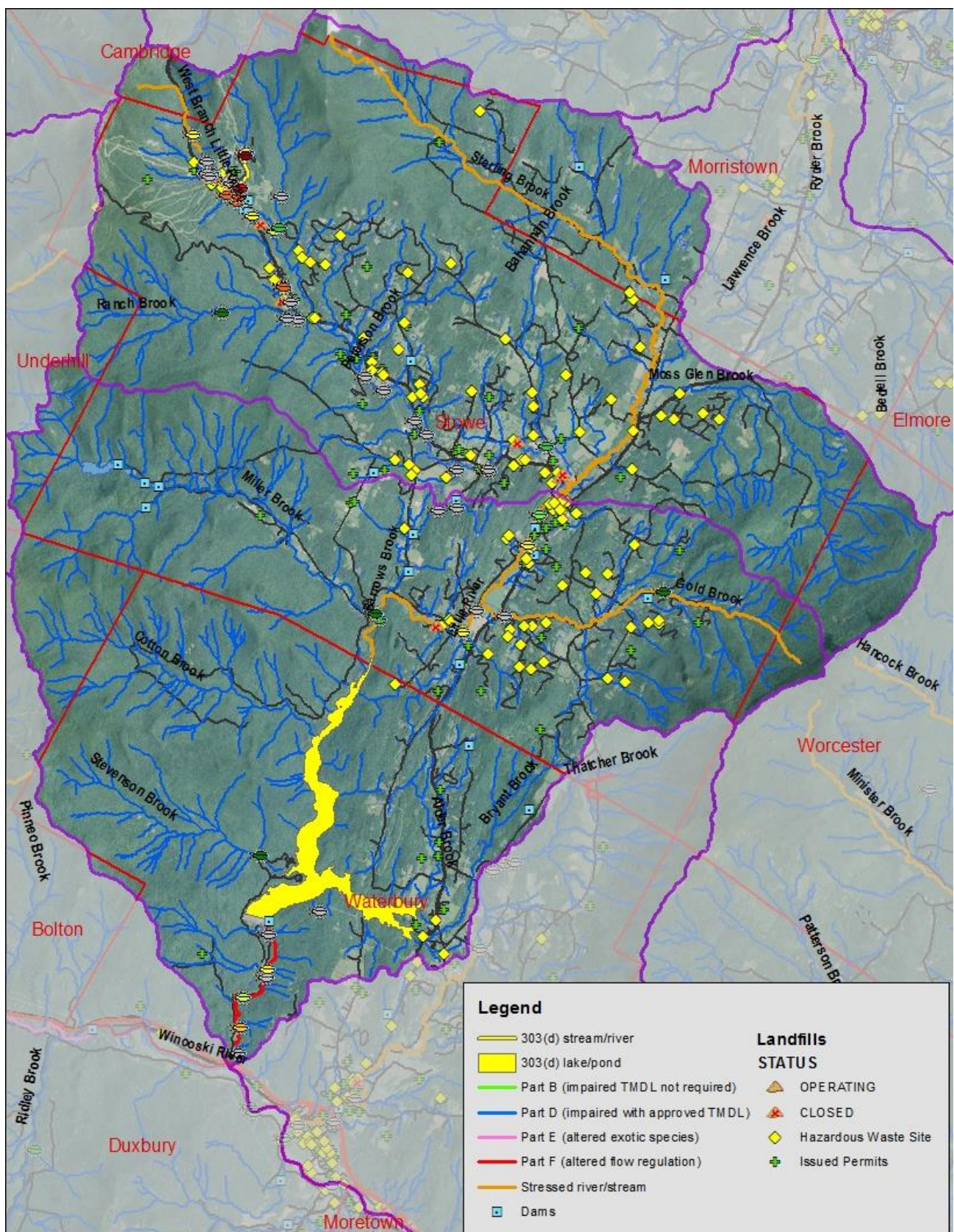


Figure 7. Little River Watershed and Assessment Information and Status

Biological Monitoring and Assessments

Sampling Results, Site Locations, and Sampling Needed Tables

Table 20. Biological sampling results from the Little River Watershed 2008 - 2016

Wbid	River/Stream	River-mile	Date	Assessment – macroinvertebrates	Assessment-fish
VT08-11	Little River	0.7	9/30/2008	good-fair	good
VT08-11	Little River	1.4	9/1/2009	very good-good	very good
VT08-11	Little River	2.2	9/30/2008	fair	good
VT08-11	Little River	2.2	9/1/2009	good	good
VT08-11	Little River	7.1	9/6/2013	good	poor
VT08-11	Little River	7.6	9/30/2008	excellent-very good	----
VT08-11	Little River	11.8	9/27/2010	excellent-very good	----
VT08-11	Little River	11.8	9/23/2015	good	----
VT08-11	Little River	12.2	9/23/2015	very good	----
VT08-11	Gold Brook	3.0	9/23&22/2015	excellent	excellent
VT08-11	Gold Brook	3.0	9/1/2016	excellent	excellent
VT08-11	Miller Brook	0.1	9/30/2008	excellent	----
VT08-11	Stevenson Brook	0.4	9/4/2008	excellent	very good
VT08-12	Big Spruce Brook	0.2	9/12/2008	fair	----
VT08-12	Big Spruce Brook	0.2	9/10&26/2009	good (x2)	----
VT08-12	Big Spruce Brook	0.2	9/27/2010	fair-poor	----
VT08-12	Big Spruce Brook	0.2	9/21/2011	fair	----
VT08-12	Big Spruce Brook	0.2	9/16/2012	fair	----
VT08-12	Big Spruce Brook	0.2	9/19/2013	fair	----
VT08-12	Big Spruce Brook	0.2	9/22/2014	fair	----
VT08-12	Big Spruce Brook	0.2	9/25/2015	fair	----
VT08-12	Big Spruce Brook	0.3	9/12/2008	fair-poor	----
VT08-12	Big Spruce Brook	0.3	9/10/2009	fair	----
VT08-12	Big Spruce Brook	0.3	9/27/2010	poor	----
VT08-12	Big Spruce Brook	0.3	9/21/2011	poor	----
VT08-12	Big Spruce Brook	0.3	9/16/2012	good	----
VT08-12	Big Spruce Brook	0.3	9/19/2013	fair-poor	----
VT08-12	Big Spruce Brook	0.3	9/22/2014	fair-poor	----
VT08-12	Big Spruce Brook	0.3	9/25/2015	fair-poor	----
VT08-12	Big Spruce Brook	0.8	9/25/2015	poor	----
VT08-12	Big Spruce Brook	0.9	9/25/2015	good	----
VT08-12	Inn Brook	0.6	9/6/2013	fair	----
VT08-12	Pinnacle Brook	0.2	9/12/2008	good	----
VT08-12	Pinnacle Brook	0.2	9/10/2009	very good-good	----
VT08-12	Pinnacle Brook	0.2	9/27/2010	very good-good	----
VT08-12	Pinnacle Brook	0.2	9/21/2011	good	----
VT08-12	Pinnacle Brook	0.2	9/16/2012	excellent	----
VT08-12	Pinnacle Brook	0.2	9/19/2013	excellent-very good	----
VT08-12	Pinnacle Brook	0.2	9/22/2014	very good	----
VT08-12	Pinnacle Brook	0.2	9/25/2015	excellent-very good	----
VT08-12	Pinnacle Brook	0.2	9/23/2016	very good	----

VT08-12	Ranch Brook	1.5	9/4/2008	excellent	----
VT08-12	Ranch Brook	1.5	9/1/2009	excellent-very good	----
VT08-12	Ranch Brook	1.5	9/7/2010	excellent	----
VT08-12	Ranch Brook	1.5	10/14/2010	very good	----
VT08-12	Ranch Brook	1.5	9/9/2011	good	----
VT08-12	Ranch Brook	1.5	10/25/2011	excellent	----
VT08-12	Ranch Brook	1.5	8/30/2012	excellent	----
VT08-12	Ranch Brook	1.5	10/24/2012	good	----
VT08-12	Ranch Brook	1.5	9/6/2013	very good-good	----
VT08-12	Ranch Brook	1.5	9/22/2014	good	----
VT08-12	Ranch Brook	1.5	9/23/2015	excellent	----
VT08-12	Ranch Brook	1.5	9/1/2016	exc-very good	----
VT08-12	Ranch Brook	1.5	10/17/2016	excellent	----
VT08-12	West Branch	1.0	9/23/2015	excellent-very good	----
VT08-12	West Branch	6.5	9/12/2008	good-fair	----
VT08-12	West Branch	6.5	9/10&11/2009	very good (avg)	----
VT08-12	West Branch	6.5	9/27/2010	fair	----
VT08-12	West Branch	6.5	9/9&21/2011	fair ¹	----
VT08-12	West Branch	6.5	8/30&9/16/2012	very good (avg)	----
VT08-12	West Branch	6.5	9/19/2013	good	----
VT08-12	West Branch	6.5	9/22/2014	good	----
VT08-12	West Branch	6.5	9/25/2015	very good-good	----
VT08-12	West Branch	6.5	9/23/2016	very good-good	----
VT08-12	West Branch	7.3	9/7/2010	fair	----
VT08-12	West Branch	7.4	9/23/2016	good	----
VT08-12	West Branch	7.5	9/12/2008	fair	----
VT08-12	West Branch	7.5	9/10&26/2009	good (x2)	----
VT08-12	West Branch	7.5	9/27/2010	poor	----
VT08-12	West Branch	7.5	9/21/2011	poor	----
VT08-12	West Branch	7.5	9/16/2012	good	----
VT08-12	West Branch	7.5	9/19/2013	good-fair	----
VT08-12	West Branch	7.5	9/22/2014	good-fair	----
VT08-12	West Branch	7.5	9/25/2015	fair	----
VT08-12	West Branch	7.5	9/23/2016	fair	----
VT08-12	West Branch	8.0	9/12/2008	fair	----
VT08-12	West Branch	8.0	9/10/2009	fair	----
VT08-12	West Branch	8.0	9/27/2010	poor	----
VT08-12	West Branch	8.0	9/21/2011	poor	----
VT08-12	West Branch	8.0	9/16 & 10/24/2012	good	----
VT08-12	West Branch	8.0	9/19/2013	fair	----
VT08-12	West Branch	8.0	9/22/2014	good-fair & fair	----
VT08-12	West Branch	8.0	9/25/2015	fair	----
VT08-12	West Branch	8.0	9/28/2016	good-fair	----
VT08-12	West Branch	8.8	9/9&21/2011	good ²	----
VT08-12	West Branch	8.8	9/16/2012	fair	----
VT08-12	West Branch	8.8	9/19/2013	good-fair	----
VT08-12	West Branch	8.8	9/22/2014	good	----
VT08-12	West Branch	8.8	9/25/2015	good	----
VT08-12	West Branch	8.8	9/23/2016	good	----

1 9/9-good-fair-DEC and 9/21-fair-BCE and fair chosen as the assessment

2 9/9-very good-DEC and 9/21-fair-BCE and so averaged to good – a result in line with others post Tropical Storm Irene.

Table 21. Biological sampling sites locations in the Little River watershed

WBID	Stream or River	Rm ¹	Town	Description
VT08-11	Little River	0.7	Waterbury	Above first group of house on Little River Road
VT08-11	Little River	1.4	Waterbury	About 0.2 miles below USGS gauge station, below gorge area
VT08-11	Little River	2.2	Waterbury	Above USGS station and gorge about 100 meters.
VT08-11	Little River	7.1	Stowe	Just above Moscow road bridge crossing 100 meters.
VT08-11	Little River	7.6	Stowe	About 300 feet below confluence with Miller Brook
VT08-11	Gold Brook	3.0	Stowe	Above culvert on Bryan Road
VT08-11	Miller Brook	0.1	Stowe	About 300 feet above confluence with the Little River, below bridge on Moscow Road
VT08-11	Stevenson Brook	0.4	Waterbury	Above bridge in Little River State Park
VT08-12	Big Spruce Brook	0.2	Stowe	Above the confluence with the West Branch about 100 meters. Below the Little Spruce tributary mouth.
VT08-12	Big Spruce Brook	0.3	Stowe	About 50 m above confluence with Little Spruce. Below golf cart bridge 50 m
VT08-12	Big Spruce Brook	0.8	Stowe	Below upper bridge about 100 meters
VT08-12	Big Spruce Brook	0.9	Stowe	Above upper bridge.
VT08-12	Inn Brook	0.6	Stowe	Above the first private road below the Inn
VT08-12	Pinnacle Brook	0.2	Stowe	Several hundred feet above confluence with the West Branch Little River
VT08-12	Ranch Brook	1.5	Stowe	Below first bridge crossing in Masnfield State Park about 50 meters
VT08-12	West Branch	1.0	Stowe	Above Weeks Hill Road bridge near intersection with Mayo Farm Road
VT08-12	West Branch	6.5	Stowe	Immediately above the Pinnacle Brook confluence with the West Branch. Above Bingham Falls.
VT08-12	West Branch	7.3	Stowe	Adjacent to Route 108 just inside Smugglers Notch State Park, upstream of Big Spruce Brook
VT08-12	West Branch	7.5	Stowe	Above first rip-rap area below Stowe parking lot – old main entrance to Mansfield base lodge
VT08-12	West Branch	8.0	Stowe	Below confluence of Longtrail Trib, above southwest discharge from Stowe parking lot
VT08-12	West Branch	8.8	Stowe	Below Vermont State Picnic area 100 meters at the Long Trail crossing of the Little River

1 = rivermile

Table 22. Biological monitoring needed in the Little River watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-11	Stevenson Brook	Rm 0.4	Excellent and very good for bugs and fish in 2008. Another sample just to have a recent sample confirming vhf.
VT08-11	Cotton Brook	At least 1 site	This relatively large, named tributary north of Stevenson & south of Milers Brook has not been sampled.
VT08-11	Miller Brook	Rm 0.1	The macroinvertebrate community was “excellent” in 2008. Sample both communities another time.
VT08-11	Gold Brook	Rm 0.4	This site was last sampled in 2005 and the bugs were “very good”. A more recent sample would be good.
VT08-12	West Branch Little River	Two sites on lower section of river	There are many samples over the years at the upper impaired sites but the lower sites, rm 3.7 or rm 4.2 haven’t been sampled for 20 years.
VT08-12	Sterling Brook	At least one site	This named tributary has not been sampled.
VT08-12	Moss Glen Brook	At least one site	This named tributary has also not been sampled.

Specific River and Streams Discussion

Gold Brook

Gold Brook originates on the west slope of the Worcester Mountains and flows westerly for about 5 miles to join the Little River downstream of Stowe village. This was sampled in both 2015 and 2016 at rm 3.0 and had both “excellent” macroinvertebrate and fish communities both years. This stream in its upper reaches should be considered for re-classification to a higher level.

Stevenson Brook

Stevenson Brook originates on the slopes of Ricker and Woodward Mountains (the peaks are on the Bolton/Waterbury line) and flows southeasterly through forest into Waterbury Reservoir. Two macroinvertebrate community samples (2007 and 2008) and five fish community samples (from 2000 through 2008) had assessments from very good to excellent all seven times. A more recent sample would be useful but this stream should be re-classified to A1.

Miller Brook

Miller Brook begins at the outlet of Lake Mansfield, an artificial lake owned by the Mt. Mansfield Trout Club. The brook winds down the mountain valley flowing through several beaver wetlands. It flows into the Little River just upstream of Waterbury Reservoir.

A microburst in Nebraska Valley in July 2004 sent a surge of water down Miller Brook to the Little River. Culverts were unable to handle the water and sediment and blew out.

Road erosion and runoff contributed to damage. Site visits of Miller Brook in May 2006 noted additional eroding banks and new material on point bars. Excessive grading on a town road has resulted in gravel pushed and washed into tributaries to Miller Brook. However, a macroinvertebrate sample in 2008 indicated a community in “excellent” health. Another, more recent, sample of macroinvertebrates and fish would be informative.

West Branch Little River

The West Branch Little River begins on the eastern slopes of Mount Mansfield and flows easterly for just over $\frac{3}{4}$ mile. It then turns south and flows down the narrow valley that begins at Smugglers Notch. As it flows south-southeasterly, Sterling Pond Brook enters from the east; Ranch Brook joins from the west; and the Peterson Brook joins from the northeast. The West Branch joins the Little River mainstem in Stowe village.

The West Branch of the Little River watershed has extensive development, and often on steep slopes, subjecting the river to inputs of sediment, an altered flow regime, more flashy conditions, corridor encroachments, and when flooding occurs, severe manipulation following the flood event.

A section of the West Branch Little River for approximately $\frac{1}{2}$ mile from rm 8.0 down to about rm 7.5 is impaired and was listed on the 2012 Part B list as aquatic biota/habitat impaired due to hydrologic scour from stormwater flows and a flashy system, low alkalinity (pH), and turbidity and siltation from land development runoff. (See table above for recent biological assessments.)

Macroinvertebrate sampling at rm 7.5 in 2015 and 2016 found that abundance was “very low” and below Class B expectation. The percent composition of *Oligochaeta* remains elevated indicating that sediment is a contributing stress at the reach. The low density may also be caused by greater hydraulic scour in this reach as compared to other reaches. Several dominant taxa indicate the reach is slightly more dominated by rapidly colonizing taxa. Sediment and scour appear to be the two principle stressors on the reach.

Turbidity numbers, silt ratings, and embeddedness are among a number of the parameters monitored by Bear Creek Environmental for Stowe Mountain Resort. Each year the results are summarized in a monitoring report under the Water Quality Management Plan, the latest reviewed for this assessment being the fall 2015 through spring 2016 monitoring.

Table 2. Habitat Assessments. Silt within substrate, and Embeddedness of cobble

Site	West Branch Rm 6.5		West Branch Rm 7.5		West Branch Rm 8.0	
	Silt rating	Embed.	Silt rating	Embed.	Silt rating	Embed.
9/2008	3	4	3	4	4	3
9/2010	3	4	4	3	4	3
9/2014	2	4	2-3	4	2	4
9/2015	3	4	2-3	4	2	4
9/2016	2	4	3	4	3	4

Silt rating: 0 = none; 5 = chocolate. Embeddedness: 5 = excellent (0-5%); 4 = very good (5-25%); 3 = good (25-50%); 2 = fair (50-75%); 1 = poor (>75%).

Storm event monitoring has occurred at a number of sites over a number of years. The table below has the ranges found for the last three seasons of monitoring for the West Branch as well as Big Spruce and a few other small streams. The monitoring took place following a rain storm or a thaw or a combination of both. Overall, the turbidity values are low for most precipitation events although the functioning, or maintenance, of Outlet 1, the sediment basin outlet near the Mansfield Parking area, seems to have the highest turbidity values, and high values more frequently, than other locations. Improvements need to be made at this location to prevent the turbid runoff from getting into the West Branch.

Table 3. Storm Event Turbidity Values (used as a means to determine sources of runoff)

	6/11/2013 – 4/15/2014 ¹	6/25/2014 – 4/17/2015	6/1/2015 – 3/10/2016
Rm 8.2 (Barnes camp)	0.91 to 86.8	0.95 to 1.75	0.40 to 8.43
Rm 8.0 (above Mansfield Basin)	2.4 to 71.5	1.5 to 5.31	0.74 to 15.4
Sw basin discharge			
Rm 7.5 (above Big Spruce Brook mouth)	1.23 to 55.00	1.25 to 7.11	0.70 to 27.0
Rm 6.5 (above Pinnacle Brook mouth)	4.61 to 157.00	5.35 to 15.20	1.23 to 10.30
Big Spruce Rm 0.9	1.15 to 14.3	0.92 to 7.37	1.00 to 7.51
Big Spruce Rm 0.7	1.77 to 16.2	1.34 to 8.96	1.59 to 6.30
Big Spruce Rm 0.3	2.3 to 26.2	3.9 to 16.1	1.89 to 33.7
Big Spruce Rm 0.2	2.5 to 84.4	3.3 to 15.9	2.35 to 46.2
Little Spruce Brook Rm 0.1	1.91 to 31.2	11.00 to 19.90	1.04 to 38.8
Outlet 1 - Sediment Basin near Mansfield Parking Area	3.1 to 166	9.6 to 436	3.61 to 607
Outlet 2 – Snowmaking Pond	7.25 to 175	0.33 to 14.9	1.20 to 13.1
Outlet 3 – Big Spruce Basin	12.5 to 113.0	9.4 to 118.0	2.16 to 22.9
Outlet 4 - Exit Basin	7 to 31.3	8.79 to 288	1.14 to 12.7
Ski Club Brook Upstream	8.23. to 57.0	6 to 33.4	2.2 to 16.1
Ski Club Brook Downstream	6.75 to 171	7.05 to 64.3	2.04 to 81.5
Long Trail Trib 1	2.21 to 79.2	1.45 to 6.05	1.04 to 10.3
Gondola Brook	1.58 to 54.6	0.99 to 4.14	0.65 to 7.85

1 Date range for the season's samples

Big Spruce Brook

Big Spruce Brook has been sampled at rm 0.2 since 2000 and at rm 0.3 since 2006. The macroinvertebrate community failed Class B aquatic biota standards at rm 0.2 in all years sampled but for 2007 and 2009 and failed Class B aquatic biota standards at rm 0.3 in all years but for 2012.

Big Spruce Brook was initially proposed for the 303(d) impaired waters list in 2010 but it was moved from this list to the Part B impaired list – waters that do not a TMDL developed in order to correct the problem causing the impairment. An Agency of Natural Resources 1272 order and Stowe Mountain Resort's commitment to correcting the pollution problems led to the 2010 Part B listing.

Inn Brook

Inn Brook is a small stream that begins on the lower slopes of Mount Mansfield and flows easterly for about one-half mile and then southerly for another 1.3 miles into Ranch Brook. Where the stream flows south, it is along the Mountain Road of Stowe.

Macroinvertebrate sampling in Inn Brook at rm 0.6 in 2013 found a “fair” macroinvertebrate community. Notes from the field included “a lot of thick iron deposits... samplers hands were orange, micro algae assessment is mostly iron precipitate”. It had been “poor” at this location during four earlier samples taken between 2000 and 2006. The rm 0.6 site is below a pond and a culvert that carries the stream under a parking lot.

The biological analysis included that the abundance was low but well within the stream type’s (SHG) expectation. ‘The richness and EPT richness have slowly improved from when first assessed in 2000. EPT is now the only failing metric and it is just below the threshold... The stream bed is still coated in iron precipitate, and Total Fe is high >2000 ug/l... Iron continues to be the most significant stressor in this stream reach.’

A site at rm 0.7 was set up to be a control although it appears to have its own issues because the assessment there was “fair” in 2006. It is above the small pond but below a small dam.

Ranch Brook

Ranch Brook headwaters begin near the ridgeline of Mount Mansfield and come together to flow easterly as Ranch Brook at around 1900 feet elevation. Ranch Brook flows east for about 3.5 miles into the West Branch Little River. Ranch Brook is a clear, high gradient reference stream and has many small cascades.

Ranch Brook has been sampled for macroinvertebrate community health since 2000 and the macroinvertebrate community health is sometimes “good” but usually is assessed from “very good” to “excellent”.

There has been a gage on Ranch Brook as well as the West Branch since 2000 as part of a paired watershed study and information on runoff and hydrology from the gaging is available from the USGS at: https://waterdata.usgs.gov/vt/nwis/uv?site_no=04288230.

Pinnacle Brook

Macroinvertebrate sampling has occurred on the reference stream, Pinnacle Brook, since 2000 when the macroinvertebrate was first assessed as “excellent” at rm 0.2. Since that year, the community has been “good” four times; “very good-good” five times; “very good” two times; “excellent-very good” twice and “excellent” one other time.

Assessment comments in 2015 for Pinnacle Brook include: “[T]his local reference reach has been very good to excellent most years sampled. It remains in very good-excellent condition in 2015. Abundance dipped to its lowest in 2011, after several high flow events, but has remained in the reference expectation since 2012. Richness and EPT taxa are high, and six out of 10 dominants are water quality sensitive taxa. Of note is the high percent *Dolophilodes* - a scour sensitive taxa...”

Huntington River Watershed

General Description

The Huntington River mainstem is approximately 21 miles long and drains a watershed of about 66 square miles. It begins with upland streams that flow down the western slopes of the Stark Mountains in Buels Gore and join the northerly flowing Huntington River in Starksboro. Continuing north, Stave, Beaver Meadow, and Bakers Brooks also flow off the western slopes of the mountains and meet the Huntington River in Starksboro.

The river continues north into the town of Huntington. Jones Brook and Cobb Brook join from the east; Carpenter Brook joins from the west; and Brush Brook enters from the east below Huntington Center. The river winds northerly still with Hollow Brook joining from the west and a number of unnamed brooks coming in from the east and west. The river winds into Richmond and shortly begins a northeasterly flow and continues in this general direction until it meets the Winooski River at Jonesville.

Uses and Values

Waterfalls, Cascades, and Gorges

Waterfalls, Cascades and Gorges of Vermont describes two sites on the Huntington River. Huntington Gorge is a well known site - for its carved rocks and potholes, great swimming, spectacular beauty, and popularity as a gathering spot but also for the danger at the upper part of the gorge where a number of people have drowned. The lower part has a beautiful pool and good swimming and sunning opportunities. It is a very significant recreational site. Seven Falls of the Huntington consists of cascades, small falls and pools in a series.

Swimming

The Vermont Swimming Hole Study describes seven swimming holes on the Huntington River, two of which are already mentioned above. In addition, the study describes five other swimming holes listed below.

The Hanksville Swimming Hole is a small swimming hole downstream of Seven Falls that is locally popular with families. The Horseshoe Bend Swimming Hole is further downstream of the two Hanksville swimming spots near a parking area for the Audubon Center trails. Downstream farther, the Audubon River Trail Swimming Hole or Audubon Hemlock is on a wooded bend in the river a few minutes in from the road on Audubon Center trails.

A third swimming hole accessed from Audubon Center land is the River Loop Trail Swimming Hole or Lower Audubon swimming hole. The last swimming area described in the swimming hole study is the Huntington Gorge Cascade Chain, which is directly below Huntington Gorge.

Boating

The Whitewater Rivers of Vermont Report describes a stretch of the Huntington that starts in Hanksville and ends just before Huntington Gorge. The stretch is about ten miles.

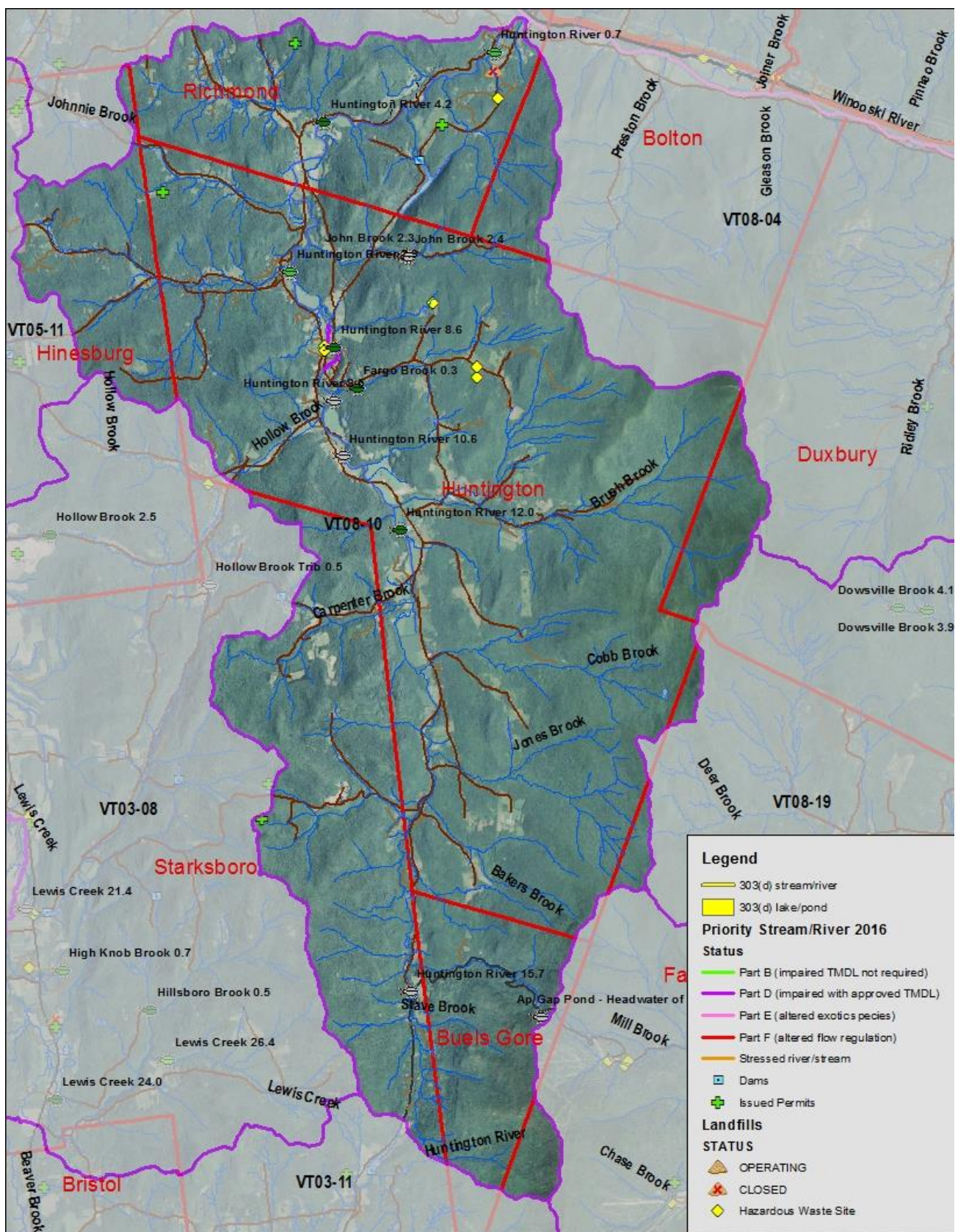


Figure 8. Huntington River watershed

Biological Monitoring and Assessments

Sampling Results, Site Locations, and Sampling Needed Tables

Table 19. Biological sampling results for the Huntington River & Tributaries - 2008 to 2016

Wbid	River/Stream	River-mile	Date	Assessment – macroinvertebrates	Assessment -fish
VT08-10	Fargo Brook	0.3	9/30/2010	excellent	---
VT08-10	Fargo Brook	0.3	9/28/2015	excellent	good
VT08-10	Huntington River	0.7	9/30/2010	excellent-very good	---
VT08-10	Huntington River	4.2	9/30/2010	excellent	---
VT08-10	Huntington River	7.9	9/28/2015	excellent-very good	good
VT08-10	Huntington River	8.6	9/30/2010	excellent	---
VT08-10	Huntington River	12.0	9/30/2010	excellent	---

Table 20. Biological sampling sites locations in the Huntington River watershed

WBID	Stream or River	Town	Rm ¹	Description
VT08-10	Fargo Brook	Huntington	0.3	Off East Street (above/upstream of Huntington Woods Rd junction)
VT08-10	Huntington River	Richmond	0.7	At end of the road at Jonesville Estates.
VT08-10	Huntington River	Richmond	4.2	0.4 miles north from Huntington main road – upstream of rip-rap.
VT08-10	Huntington River	Huntington	7.9	At large wasting bank (from July 3, 2001 storm).
VT08-10	Huntington River	Huntington	8.6	One hundred feet downstream of Bridge Street bridge.
VT08-10	Huntington River	Huntington	12.0	Behind Huntington town offices

1 Rm = rivermile (or station)

Table 21. Biological monitoring needed in the Huntington River watershed

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-10	Unnamed trib in Richmond (flows west to east into the Huntington River – south of Owls Head)	At least one site, two would be ideal	A fairly large trib to the Huntington River with a number of tribs of its own – no bio data to date at all.
VT08-10	Johns Brook	Re-sample 1 of the 2 sites	Two sites sampled only once back in 1996. Re-sample one.
VT08-10	Unnamed trib in Huntington & Hinesburg that Texas Hill Road follows some	One or two sites	This large tributary has not been sampled.
VT08-10	Bakers Brook or one of the streams near the headwaters	One or two sites on one or two streams.	There are no sites on the many tribs to the upper part of the Huntington River.
VT08-10	Huntington River	Rm 15.7	This was last sampled in 2008. Another sample would be informative.

Specific Rivers and Streams

Huntington River

The Huntington River was sampled for macroinvertebrate community health and integrity at rm 10.6 in September 2000 and was assessed as "very good." The fish community was also sampled in September 2000 but at rm 0.7 and rm 5.8. The community was assessed as "excellent" and "very good" respectively.

Water Quality Sampling

E. coli Results

The Huntington River Conservation Commission originally began sampling the Huntington River for *E. coli* in 2003. It extended the scope of Huntington River sampling in 2006 to include a group of sites in Richmond with Richmond volunteers and so the study is now a two town effort. The sampling and reporting is now done by the Huntington River Conservation Partnership.

Table 22 . Sites sampled for *E. coli* on the Huntington River (2008 to 2016)¹:

Site Name	2008	2009	2010	2012	2013	2014	2015	2016
Carse Bridge	74 ²	50	31	42	79	20	37	34
Shaker Mountain	64	48	54	41	102	47	60	81
Brace Bridge	81	78	68	72	84	53	----	----
Spence Bridge	76	62	68	64	85	46	77	101
East Street	132	69	61	64	109	55	----	----
Bridge Street	147	80	82	63	109	57	80	126
Cemetery Bank	103	66	75	72	174	----	----	----
Audubon Horseshoe	110	62	72	71	131	61	86	92
Audubon Hemlock	106	55	70	62	110	58	109	128
Moultrop Bridge	103	45	74	71	94	63	77	119
Dugway West	132	56	82	86	92	----	----	----
Yaggy	120	59	68	75	104	60	129	113
Gorge	99	38	71	59	75	65	107	----
Triple Buckets	87	42	52	43	75	57	113	86
Chalet Trail	74	43	54	45	116	55	93	103
Cochran Bridge	118	56	63	133	150	71	119	113

1 - 2011 was not sampled; 2 – geometric means for the season; 3 – values above the 126 standard

In 2005, the Commission also measured temperatures and determined conductivity at two sample sites on each of the 15 sampling dates. On August 3 and 10, the water temperatures at Bridge Street were 24.8° and 22.1°C respectively and at the Horseshoe Bend site, it was 27.5°(!) and 21.5°C respectively.

Lower Winooski River Watershed

General Description

The Lower Winooski River watershed for the purposes of this assessment is the area from the confluence of the Little River with the Winooski River downstream to the mouth of the Winooski at Lake Champlain. The subwatershed described below includes the Winooski mainstem plus any tributary and its watershed except for the Huntington River watershed.

Downstream from the mouth of the Little River, the Winooski flows over the hydroelectric dam at Bolton Falls near the Waterbury/Bolton town line and then below the dam, Ridley Brook and its tributaries join the river from the south. The Winooski continues its northwesterly flow with Pinneo Brook, Gleason Brook, Joiner Brook, Preston Brook, and Duck Brook, among others, converging on the Winooski in the town of Bolton.

The Winooski then flows into Richmond where soon the Huntington River and its mountain tributaries enter. See the Huntington River watershed description in previous pages. Snipe Island Brook from the north and Johnnie Brook from the south also flow into the Winooski in the town of Richmond.

Just past the village of Richmond, the river goes into a wide bend and begins a more northerly track, which it maintains as it flows between Williston and Jericho forming the border of those two towns. Then, where the Winooski forms the Essex and Williston border, the flow, albeit through large meanders, is generally westerly in its course. Within this stretch, from North Williston to the pool of Essex 19 dam, the river deepens and widens. Below the dam is Williston (Essex) Gorge that is 15 to 35 feet deep and 150 to 200 yards long.

The Winooski River between Essex and South Burlington jogs north then south in a relatively tight loop then settles back to a northwesterly flow. It forms the Colchester/South Burlington border and in this stretch flows through the 700 to 800 foot-long Lime Kiln Gorge. About a half-mile downstream, the river flows through the Winooski Gorge. Here the river forms the Winooski/Burlington border and next the Colchester/Burlington border then loops around Derway Island and into Lake Champlain.

More description of the Lower Winooski River watershed can be found in the report for the [Lower Winooski Basin: An Inventory of Uses, Values and Goals](#) done by Jerry McArdle of the ANR DEC Water Quality Division in April 1992.

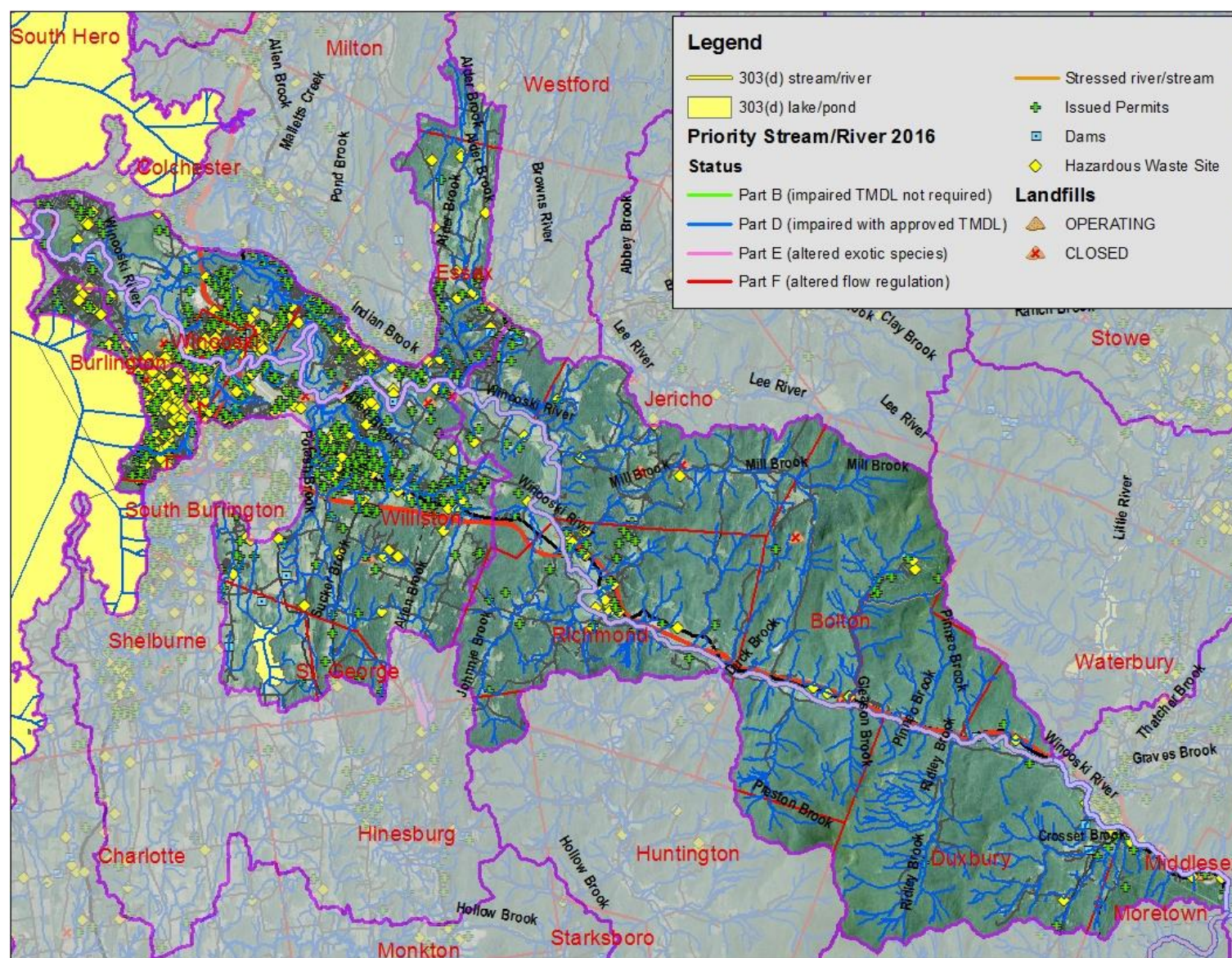


Figure 9. The Lower Winooski River watershed with assessment information

Uses and Values

Waterfalls, Cascades, and Gorges

The Waterfalls, Cascades and Gorges of Vermont report describes nine sites with either falls, cascades, a gorge, some or all of these features. Four of these sites are on tributaries and five of these sites are on the Winooski mainstem.

The tributary sites include: Duck Brook Falls in Bolton with about 150 feet of low gradient cascades and then a seven-foot waterfall; Devils Pothole on Joiner Brook in Bolton, which consists of a 15-foot waterfall, two sets of cascades, and a large pothole; Allen Brook Cascades in Williston, which are 200 feet long and drop a total of 20 feet with some small (one foot across or less) potholes; and Frazier Falls, which are really large cascades, located on an unnamed stream in a wooded ravine in Williston. Slightly longer descriptions are in the [2008 Winooski River watershed assessment report](#).

On the Winooski River mainstem, Bolton Falls were once at the end of a large gorge in Waterbury and Duxbury. However, a hydroelectric dam is now located where the falls once flowed. The current hydroelectric facility, owned by Green Mountain Power, was licensed in 1982 and constructed in 1985-86. It operates as a peak generation facility using the highly managed flows from Green Mountain Power's upstream facilities in Marshfield and Peacham and at Waterbury Dam. The powerhouse is located at the base of the dam; consequently none of the river is penstock bypassed. Conservation flows are provided as required in the federal license and water quality certification.

Middlesex Gorge is a 1000-foot long gorge with rock walls that are 20 to 60 feet high. There are no falls or cascades because the gorge was dammed shortly before the construction of Bolton Falls Dam, and the upper two-thirds of the gorge is now flooded by the dam. The dam was destroyed by the 1927 flood and then reconstructed. With flashboards in place, the dam backwaters much of the river reach between Montpelier and Middlesex. The hydroelectric station operates on a peak power schedule often using managed flows from Marshfield Station.

The Williston Gorge is a low limestone gorge below a dam and a bridge between Williston and Essex Junction and so its surroundings are urban/suburban. There is a picnic area on the south side of the bridge and trails from there down to the river below the gorge.

Lime Kiln Gorge is a dramatic gorge with near-vertical walls through which the Winooski River itself flows. The walls of the gorge are from 15 to 70 feet high. It used to be a site of a number of rare plants but most haven't been found here recently.

Winooski Falls in the city of Winooski include cascades over a broad series of ledges upstream of the Route 7 bridge then downstream the river is bordered by limestone cliffs and drops about 20 feet over an old dam. People visit the falls, picnic, or fish below the falls. Winooski re-development projects have built views of the cascades and falls into their plans although unfortunately not adequate riverside tree protection.

Boating

The AMC River Guide Third Edition describes a stretch of boating between Montpelier and Jonesville on the Winooski. In this stretch are two portages around the Middlesex Dam and Bolton Falls Dam.

Fishing

There is a lot of fishing use on the lower Winooski River. During the spring spawning run, people fish for walleye in the stretch from the Salmon Hole below Winooski Falls to the lake. They also fish for salmon and steelhead in this reach in season. As part of the Lake Champlain salmonid restoration program, a fish trap-and-truck operation was established at the Winooski One Hydroelectric Project (the American Woolen Mill Dam) when that facility was licensed and constructed in the 1980s.

Trout fishermen can be seen in the Winooski all the way from Montpelier to Essex using pull-offs along Route 2 to access the river. The Bolton Falls access area is popular for fishing to the point of often being overcrowded.

Smallmouth bass fishing occurs from Essex down to the lake on the Winooski.

Significant Natural Communities

In the Lower Winooski River watershed, there are a number of significant natural communities identified in inventory reports of the Vermont Natural Heritage Program. The 2008 Winooski River Watershed Assessment Report contains a brief summary of the floodplain forests, northern white cedar swamps, and hardwood swamps that can be found in the lower Winooski watershed.

Biological Monitoring and Assessments

Sampling Results, Site Locations, and Sampling Needed Tables

Table 23. Biological sampling results for the Lower Winooski river - 2008 to 2016

Wbid	River/Stream	River-mile	Date	Assessment – macroinvertebrates	Assessment-fish
VT08-01	Winooski River	16.3	10/13/2010	very good	---
VT08-01	Winooski River	16.3	9/9/2015	very good-good	---
VT08-02	Alder Brook	0.3	10/5/2010	good	---
VT08-02	Alder Brook	0.3	10/3/2012	good	---
VT08-02	Alder Brook	1.1	9/22/2010	good	good
VT08-02	Alder Brook	4.1	10/13/2015	very good	ua
VT08-02	Allen Brook	2.4	10/5/2010	very good	fair
VT08-02	Allen Brook	2.4	10/3/2012	good	poor
VT08-02	Allen Brook	2.4	10/5/2015	good	good
VT08-02	Allen Brook	2.4	9/1/2016	----	fair
VT08-02	Allen Brook	4.3	10/6/2010	good	good
VT08-02	Allen Brook	4.3	9/1/2016	----	good

VT08-02	Allen Brook	6.5	9/29/2010	very good	----
VT08-02	Allen Brook	8.2	10/2/2015	very good	----
VT08-02	Centennial Brook	0.2	9/28/2012	poor	----
VT08-02	Centennial Brook	0.2	9/5/2014	poor	fair
VT08-02	Centennial Brook	0.4	9/27/2012	----	fair
VT08-02	Morehouse Brook	0.3	10/5/2010	fair	----
VT08-02	Morehouse Brook	0.3	10/2/2015	poor	----
VT08-02	Muddy Brook	1.0	10/5/2011	good	----
VT08-02	Muddy Brook	1.2	10/6&13/2010	good	good
VT08-02	Muddy Brook Trib 4	0.2	10/6/2010	fair	good
VT08-02	Muddy Brook Trib 4	0.2	8/29/2012	fair	good
VT08-02	Muddy Brook Trib 4	0.5	10/5/2015	fair	----
VT08-02	Muddy Brook Trib 4	0.7	9/10/2012	poor	----
VT08-02	Muddy Brook Trib 4	0.7	10/5/2015	fair	----
VT08-02	Sucker Brook	1.5	10/2/2012	very good	----
VT08-02	Sunderland Brook	1.1	9/27/2011	----	fair
VT08-02	Sunderland Brook	3.2	9/21/2011	good	good
VT08-02	Sunderland Brook	3.3	10/11/2012	poor	good
VT08-02	Sunderland Brook	3.5	9/21/2011	good-fair	----
VT08-02	Sunderland Brook	3.6	10/6/2015	very good	----
VT08-02	Sunderland Brook	4.6	10/6/2015	fair	----
VT08-02	Sunnyside Brook	0.2	10/5/2010	good-fair	
VT08-02	Sunnyside Brook	0.2	10/19/2011	good-fair	good ¹
VT08-02	Sunnyside Brook	0.2	10/11/2012	fair	good ¹
VT08-02	Sunnyside Brook	0.2	10/9/2014	fair	good
VT08-02	Sunnyside Brook Trib 1	0.1	10/5/2010	very good	----
VT08-02	Sunnyside Brook Trib 1	0.1	10/11/2012	very good-good	----
VT08-02	Sunnyside Brook Trib 1	0.1	10/9/2014	very good	----
VT08-03	Winooski River	29.9	9/14/2010	good	----
VT08-03	Winooski River	29.9	9/9/2015	very good	----
VT08-04	Goose Pond Brook	0.1	9/26/2014	fair	----
VT08-04	Joiner Brook	3.8	9/22/2014	fair	----
VT08-04	Joiner Brook	3.8	9/22/2015	good-fair	poor (rm1.4)
VT08-04	Joiner Brook Trib	0.1	10/24/2008	good-fair	----
VT08-04	Mill Brook	0.3	9/22/2015	very good	----
VT08-04	Mill Brook	3.6	9/29/2010	excellent	----
VT08-04	Mill Brook	3.6	9/22/2015	exc-very good	good
VT08-04	Ridley Brook	1.7	8/30/2010	exc-very good	----
VT08-04	Sand Hill Brook	0.4	9/28/2015	very good	excellent
VT08-04	Snipe Island Brook	0.5	9/29/2010	excellent	----
VT08-04	Snipe Island Brook	1.4	9/22/2015	exc-very good	poor

1 Just above the pass/fail threshold

Table 24. Biological sampling sites locations on the Lower Winooski River

WBID	Stream or River	Station	Town	Description
VT08-02	Winooski River	16.3	Essex	Off Poor Farm Road below Route 2, south side of river
VT08-02	Alder Brook	0.3	Essex	Above Route 117 bridge about 350 meters as stream enters woods
VT08-02	Alder Brook	1.1	Essex	Above 200 meters above first 289 stream crossing.
VT08-02	Alder Brook	4.1	Essex	Behind small pull-off along Chapin Road
VT08-02	Allen Brook	2.4	Williston	Just upstream of Industrial Ave crossing
VT08-02	Allen Brook	4.3	Williston	Adjacent to Allen Brook Rd, about 170 meters below Talcott Road bridge
VT08-02	Allen Brook	6.5	Williston	About 50 meters below road to Turtle Crossing development near Brookside Lane
VT08-02	Allen Brook	8.2	Williston	Above South Road culvert, above I-89
VT08-02	Centennial Brook	0.2	Burlington	Below Grove Street bridge about 500 ft
VT08-02	Centennial Brook	0.4	Burlington	Below hospital effluent discharge, below small tributary near the ballpark
VT08-02	Morehouse Brook	0.3	Colchester	Immediately below Mallets Bay Avenue, below stormwater outfall.
VT08-02	Muddy Brook	1.0	Williston	Off Industrial Avenue, to end of Avenue A behind storage units
VT08-02	Muddy Brook	1.2	South Burlington	Located 100 meters downstream of Kimball Avenue
VT08-02	Muddy Brook Trib 4	0.2	Williston	Below South Brownell Road crossing
VT08-02	Muddy Brook Trib 4	0.5	Williston	Above Marshall Avenue next to Wellness Drive
VT08-02	Muddy Brook Trib 4	0.7	Williston	Located at the end of Commerce Street
VT08-02	Sucker Brook	1.5	Williston	Behind church just north of where stream crosses Route 2A
VT08-02	Sunderland Brook	1.1	Colchester	Upstream from Pine Island Road culvert
VT08-02	Sunderland Brook	3.2	Colchester	Immediately below Sunnyside Brook, below Route 2 crossing
VT08-02	Sunderland Brook	3.3	Colchester	Just below Route 7 culvert, above Sunnyside tributary
VT08-02	Sunderland Brook	3.5	Colchester	Above Route 7 crossing about ¼ miles within falls area between two wetlands
VT08-02	Sunderland Brook	3.6	Colchester	Near station 3.5 but above fall line in slow winder section
VT08-02	Sunderland Brook	4.6	Colchester	100 meters below Trib 13 (Ethan Allen trib), just above Tributary 12
VT08-02	Sunnyside Brook	0.2	Colchester	Above and adjacent to Route 2 crossing and above confluence with Trib 11 (Camp Johnson tributary)
VT08-02	Sunnyside Brook Trib 1	0.1	Colchester	Above confluence with Sunnyside Brook about 100 meters
VT08-03	Winooski River	29.9	Richmond	Downstream of Richmond WWTF
VT08-04	Goose Pond Brook	0.1	Bolton	About 100 meters above confluence with Joiner Brook

VT08-04	Joiner Brook	3.8	Bolton	Located below existing leachfields JB-2
VT08-04	Joiner Brook Trib	0.1	Bolton	Below log landing #2
VT08-04	Mill Brook	0.3	Jericho	Below bridge on route 117 approximately 50 meters
VT08-04	Mill Brook	3.6	Jericho	About 2000 feet upstream of Fields Land Bridge off of Nashville Road
VT08-04	Ridley Brook	1.7	Duxbury	Adjacent to Camels Hump Road just above bridge crossing. Power pole #34.
VT08-04	Sand Hill Brook	0.4	Essex	Above Roue 117 about ½ mile – at the top of and adjacent to a field.
VT08-04	Snipe Island Brook	0.5	Richmond	Along Snipe Island Drive between Route 2 and O'Neil Drive
VT08-04	Snipe Island Brook	1.4	Richmond	Immediately below bridge at 933 Snipe Ireland Road

Table 25. Biological monitoring needed in the Lower Winooski River

Water-body id	Stream or river name	Location/number of sites	Comments
VT08-04	Preston Brook	At least 1 site	No biological monitoring has been done on this named tributary
VT08-04	Johnnie Brook	At least one site	No biological monitoring has been done on this named tributary
VT08-04	Crossett Brook	At least sample again at rm 3.8	This site hasn't been sampled since 2006 – and before that 1995. No result given in 2006 but “excellent” in 1995.

Specific Rivers and Streams

In addition to the information below, there is specific older information on these rivers and streams contained in the 2008 Winooski River Water Quality and Aquatic Habitat Assessment Report.

Winooski River mainstem

Waterbury Reservoir hydroelectric releases that occur on the Little River have resulted in dramatic flow and temperature fluctuations on the Winooski mainstem as well below the Little River confluence. In December 2014, the Agency issued a new water quality certification and FERC issued the new license in February 2016 for the hydroelectric project. The certification and license require the facility to operate in true run-of-river mode after the replacement of a turbine runner, construction of a bypass flow valve, and the replacement of the Tainter gates. (Also see Little River watershed section above.)

Tributary to Winooski River

Surface water samples from a tributary to the Winooski River on the South Burlington landfill site showed iron and arsenic above standards in four surface water samples. The tributary once flowed through the area that is now the capped landfill. The tributary was put into a culvert under the landfill but the pipe got crushed. Now the stream goes into a

pond that is above the landfill and the pond water is piped around the landfill and back into the original stream channel. The upstream pond surface water sample and the stream samples downgradient of the landfill all had the arsenic and iron violations.

Muddy Brook

Muddy Brook originates in the wetlands northeast of Shelburne Pond. The brook winds in an east-of-north direction up along the South Burlington/Williston border. Allen Brook flows into Muddy Brook just before it enters the Winooski River. Muddy Brook is about 7 miles long and drains a 26 square mile watershed.

Muddy Brook was on the impaired waters list from 1996 until 2014. The aquatic biota/habitat use was impaired due to nutrients and turbidity but the biological communities improved and so this stream was removed from the list in the 2014 cycle.

Muddy Brook Tributary #4



Tributary 4 to Muddy Brook (and up a tributary to Tributary 4 behind Commerce Street) is impaired and on the Part A 303(d) Impaired Waters List. It is listed from its mouth at Muddy Brook upstream for 0.9 miles. The aquatic biota/habita is impaired due primarily to chlorides from stormwater runoff from commerical and industrial land. However, TCE, vinyl chloride and other contaminants from the Commerce Street plume hazardous waste site are there too.

The cause of the impairment on Tributary #4 to Muddy Brook and its tributary along Commerce Street was first listed as “undefined” but further detailed study by EPA and consultants working for EPA determined that chlorides were having more of an impact than the toxic compounds found in the stream. Details of that investigation are below.

Figure 10. Muddy Brook Trib 4 subwatershed

Commerce Street Plume (Mitec) Superfund Site

An unnamed tributary to Muddy Brook has been listed as impaired due to tetra and trichloroethylene as well as other VOCs discharging to the brook from the Commerce Street plume that originates at the former Mitec parcel in Alling Industrial Park in Williston. The site (DEC site #77-0120) is now a Superfund site (proposed 9/2004 and listed in 4/2005). The following information is taken from EPA's website.

The one acre site was home to manufacturing and electroplating operations from 1960 to 1986 - Mitec leased the site from 1979 to 1986. Between 1979 and 1984, Mitec discharged rinse water and sludge wastes associated with electroplating into an unlined lagoon. A concerned Mitec employee first told the Vermont Agency of Environmental Conservation, as it was then called, about the waste in 1982. Sampling in 1984 by AEC found chromium in groundwater below the lagoon and sampling by the Department of Health found six residential drinking wells contaminated with TCE and PCE. Indoor air samples also showed high VOCs. Numerous sampling events occurred between 1984 and 2002 - groundwater, surface water, sediment, soil, and residential air. DCE at 180 ppb, TCE at 170 ppb, chromium at 3.4 ppb, and vinyl chloride at 11 ppb were found in wetlands and the unnamed tributary to Muddy Brook in 1996. Groundwater samples downgradient of the site had TCE at levels as high as 90,00 ppb in 1999. In 2002, EPA found elevated levels of 11 VOCs and 13 metals in monitoring wells through the industrial park and surrounding residential area. EPA held a public meeting about the Superfund site in January 2006.

Expanded monitoring occurred in 2010 by Nobis Engineering for U.S. EPA Region 1 at the Commerce Street site. In May 2010, 29 groundwater samples were collected and submitted for analysis of VOCs, SVOCs, and target analyte metals. In June, Nobis did temperature profiling throughout the unnamed stream to identify potential groundwater infiltration points and in July, they collected porewater samples. In November and December 2010, 45 groundwater samples were collected from 42 monitoring wells. TCE, Cis-1,2-DCE, and vinyl chloride were all detected in some of the 20 porewater locations with TCE exceeding the GWPR/MCL in 3 of the 4 locations detected; Cis-1,2-DCE exceeding the GWPR/MCL in 1 of the 8 locations detected; and vinyl chloride exceeded the GWPR/MCL in 5 of the 5 locations detected. There were VOCs, naphthalene, and metals (arsenic, cadmium and manganese) detected in the shallow overburden groundwater with VOCs and the metals above standards in some of the wells.

In 2012, there was a screening level ecological risk assessment (SLERA) conducted for U.S. EPA by Environmental Services Assistance Team (ESAT). Due to uncertainty about the ecological risk from TCE at the site, macroinvertebrate surveys were done at five stations in the Trib to Trib #4 to Muddy Brook. Surface water was sampled for temperature, pH, D.O., conductivity, chlorides, VOCs, bromide, fluoride, nitrate, nitrite, sulfate. Sediments were sampled for VOCs, SVOCs, the target analyte list metals, and total organic carbon. Also at each site, infaunal invertebrates (down 3 inches into the sediment) and epifaunal invertebrates were sampled. Habitat condition was also assessed by scoring ten habitat parameters (1 being lowest condition, 20 being the best possible condition).

Below are two tables with some of the results of the monitoring that occurred. One table shows surface water results and the second shows sediment sampling results. The sites selected correspond with porewater sampling sites from earlier monitoring and assessment except that one “off-site” reference site was sampled above the stretch where porewater was sampled in 2010. The “off-site reference” and PW-2 are both above the Commerce Street plume contamination; PW-11 is at the contaminated site; PW-17 and PW-20 are below the contaminated site and are sampled to look for recovery.

Table 26. Surface water results from sampling Trib to Trib#4 Muddy Brook

	Off-site reference	PW-2	PW-11	PW-17	PW-20
Conductivity (uSiemens/cm)	965	916	1004	2475	1916
D.O. (%)	100.9	88.2	76	78.4	73.5
Chloride (mg/l)	190	190	210	620	450
TCE (ug/l)	nd	nd	15	6.0	2.6
VC (ug/l)	nd	nd	3.2	<1	<1
DCE (ug/l)	nd	nd	38	9.2	3.8

nd = non-detect

Table 27. Sediment results from sampling Trib to Trib#4 Muddy Brook

Units for parameters below are ug/kg or ppb	Off-site reference	PW-2	PW-11	PW-17	PW-20	TEC	PEC
Benzo(a)anthracene	nd	nd	nd	nd	270	108	1050
Benzo(a)pyrene	nd	nd	nd	nd	240	150	1450
Chrysene	nd	nd	nd	nd	680	166	1290
Fluoranthene	480	nd	nd	nd	nd	4223	2230
Pentachlorophenol	nd	nd	nd	nd	860	---	---
Pyrene	380	nd	nd	nd	nd	195	1520
Total PAHs	860	nd	nd	nd	3920	1610	22800
Units for parameters below are mg/kg or ppm							
Aluminum	7400	3900	3700	5800	4100		
Iron	14000	6600	8800	12000	7300		
Zinc	240	54	34	48	28	121	459
Mercury	0.034	nd	nd	nd	0.030		

The health of the infauna community decreases from a maximum at the off-site reference to PW-11 or PW-17 then recovers at PW-20 based on several metrics (Hilsenhoff biotic index and % tolerant taxa) although other metrics don't show this same trend leaving the situation unclear in terms of this community.

The trend for the epifaunal community is much more clear with seven metrics showing a maximum condition in the off-site reference dropping to the worst condition (for 6 of the 7 metrics) usually at PW-17 (the first site below the impact site) and then recovering to a better condition at PW-20.

The conclusions of this 2012 monitoring work is that the impacts on the macroinvertebrate community are more likely due to the high chlorides and conductivity than to the VOCs. The conductivity and chloride concentration is “nearly constant from the reference [site] to the impact area PW-11 and then rises sharply at PW-17 with conductivity doubling and chloride nearly tripling.” This matches the macroinvertebrate and water quality sampling that Vermont DEC did in 2005 and 2010 at Trib #4 Muddy Brook just downstream from this Superfund site-related sampling. The 303(d) impaired waters list pollutant was changed from “undefined” to chlorides during the 2016 listing cycle.

Allen Brook

Allen Brook originates in the southern part of the town of Williston. It flows north to the village in Williston then west and then northwest before joining Muddy Brook just before it reaches the Winooski River. The brook is about 10 miles long and drains an 11 mile watershed that includes part of the interstate.

An assessment of Allen Brook’s physical condition and the stressors on it was done in 2008 (the report is listed in Table 2). Potential projects that would protect or restore the brook are also described in that report.

E. coli sampling has been done on Allen Brook since 2007. As shown by the numbers included in the table below, the site located on conservation land has not had high *E. coli* numbers, however, the site located near Williston Central School athletic fields and downstream of a number of large subdivisions has constantly had high *E. coli* numbers. The other sites have had some years with elevated or high numbers and other years with lower counts.

Table 28. *E. coli* sampling results (geometric means for the season) at sites on Allen Brook

Site		E. coli 2007	E. coli 2008	E. coli 2010	E. coli 2014	E.coli 2015
AB2	Mud Pond Conservation Lands	28.1	79.0	38.9	64.9	103.4
AB3	Route 2 village center	205.1	65.6	344.0	121.4	173.8
AB4	Williston Central School	204.8	178.7	168.0	149.2	302.0
AB5	Southridge Road	258.6	124.2	1.5	---	----
AB6	Talcott Road East	304.7	101.7	116.4	53.4	363.1
AB7	Route 2A	69.0	78.1	----	----	----
AB8	River Cove Road	145.0	92.0	126.1	----	----

Centennial Brook

Centennial Brook is a small tributary to the Winooski River about 2.1 miles in length with a southern branch that is an additional 0.8 miles long. It originates where Burlington Airport has been built and flows northwesterly to the Winooski River. It joins the Winooski about ½ mile above the Winooski Dam. The watershed includes an interstate exchange, part of the airport, urban/suburban land uses, and the 100-acre Centennial Woods Natural Area.

The brook was last sampled biologically in 2014 and the assessment comments included: "Centennial Brook has been sampled at this reach 0.2, or at rm 0.1, since 1993 seven times. On all occasions the community has been rated as poor. It was last sampled at this location in 2012, with a very similar community and poor assessment. The community has an elevated high abundance of very tolerant taxa... Habitat and water quality samples indicate stressors are mostly stormwater related. Silt rating was high 4 out of 5, field conductivity was 1900 uohms, and chloride was 475 mg/l on this date, and measured over 700 mg/l in April 2014. Total phosphorus at 68 ug/l and turbidity at 16 NTU are also elevated." LaRosa chemistry monitoring occurred near the biomonitoring site from 2012 to 2015 and the phosphorus and turbidity numbers ranged from 38 to 456 ug/L and 3 to 58 NTUs respectively.

Sunderland Brook

Sunderland Brook flows west to east for about 6.4 miles spanning the towns of Essex Junction and Colchester. The watershed drainage area is approximately 5.5 square miles and discharges about 6.9 cfs at the mouth (Essex Waterways Association (EWA) report 2006). The watershed has three diverse areas. Agricultural land dominates the lower watershed. The middle watershed flows through forested areas associated with Camp Johnson and is minimally disturbed, while the upper watershed is surrounded by urban areas in the area of Suzie Wilson Road and has poor habitat condition and a lot of erosion. The lower watershed reaches below Mallets Bay Avenue, approximately 1.5 miles, have been historically channelized, re-located, dredged, and riparian vegetation altered.

Summary information from the Essex Waterways Association sampling and a chloride assessment on six streams in Chittenden County are summarized in the 2008 Winooski River Water Quality and Aquatic Habitat Assessment Report.

Sunnyside Brook (a tributary to Sunderland Brook)

Sunnyside Brook or Tributary #8 to Sunderland Brook was added to the impaired waters list (or 303(d) list) in 2016 because of impacts to the macroinvertebrate community from high chloride concentrations instream.

Tributary to Sunderland Brook

The tributary to Sunderland Brook near Hercules Drive in Colchester was once threatened by industrial wastes from wire and cable manufacturing that was dumped into the ground by Champlain Cable (DEC site #77-0046). This site and situation is described in the 2008 Winooski River WQ and AH Assessment Report.

Tributary to Sunderland Brook

The tributary to Sunderland Brook near Morse Drive in Essex Junction was at least threatened by organic compounds from the Hampden Color & Chemical hazardous waste site (DEC site #77-0103). The last time the site was sampled was in August 2000. At that time, PCE was the only VOC found exceeding the VGES and it was found in only one of the three wells sampled. Sampling was supposed to continue in 2001 but it didn't. A letter was sent from Vermont DEC in 2004 reminding the owner that sampling was supposed to occur but the letter was apparently ignored. Next time the site is sampled, a stream sediment sample should be taken and analyzed as well as the groundwater sampling.

Alder Brook

Alder Brook is an 11.6 mile-long stream that flows from north to south from its headwaters in Westford through the town of Essex and empties into the Winooski River upstream of Essex Junction. The watershed area is about 10.4 square miles. The upper section of the stream is in relatively steep, forested terrain in Westford. The middle section of the brook consists of a winding, low-gradient stream flowing through agricultural, residential and some forested land. The lower section, below the village of Essex Center, again drops more steeply where it is cut into deep, sandy ravines.

There is further information on Alder Brook in the 2008 Winooski River Water Quality and Aquatic Habitat Assessment Report starting on page 65.

Mill Brook

Mill Brook originates in the Green Mountains east of West Bolton. It is about 9.5 miles long and drains a watershed of 17 square miles. The brook flows in a westerly direction generally through West Bolton and through the town of Jericho meeting the Winooski River on the western edge of Jericho. The stream is well-shaded with largely forested buffers.

Macroinvertebrate sampling was done at Mill Brook in Jericho in 1993, 2000, 2004, 2010, and 2015. The community's health at rivermile 0.6 in 1993 was found to be "excellent". At rivermile 0.3, the macroinvertebrate community has been "very good" over a fifteen year period with sampling in 2000, 2004, and 2015. At rivermile 3.6, the community was "excellent" and "excellent-very good". This stream should be considered for reclassification of its aquatic community.

Fish community sampling on Mill Brook in 2004 at rivermile 0.4 found a community in "excellent" health and integrity. At rivermile 3.6, the fish community was assessed as "good" in 2015.

Morehouse Brook

Morehouse Brook is drained by a small, highly urbanized watershed straddling the town boundary between Colchester and Winooski, with a drainage area of approximately 0.5 square miles. This stream is impaired and has been since at least 1998. The biological community assessment results are in Table 23 above and a brief description of its physical condition is the 2008 Winooski River WQ and AH Assessment Report.

Snipe Island Brook

Snipe Island Brook originates in southeast Jericho and flows south/southwesterly through the northern part of Richmond into the Winooski River. The brook is approximately three and a half miles long and drains a four and a half square mile watershed. A tributary that arises from Preston Pond in Bolton joins Snipe Island Brook from the west. A stretch of the brook has small, pretty cascades and swim holes.

Biological sampling in 2010 and 2015 found a macroinvertebrate community of "excellent" at rm 0.5 and "excellent-very good" at rm 1.4 respectively. The fish community, however, was "poor" in 2015 with very low densities of fish found.

A gravel road follows this brook for a substantial portion of its length and the road and residential development and activities threaten the water quality and aquatic habitat.

Joiner Brook

Joiner Brook flows south from the mountains in Bolton down to the Winooski River. It is approximately 5 miles long and drains a watershed of 10 square miles. The brook has a series of pools, cascades, and waterfalls that are popular for swimming. Brook trout occur naturally in the brook and rainbow and brown trout from the Winooski spawn at the mouth of Joiner Brook.

Macroinvertebrate sampling and a habitat assessment were done on a tributary to Joiner Brook in 1997. The community was assessed as “poor” at rivermile 0.4 and “fair” at rivermile 0.1. In 2000, sampling at rivermile 0.4 again found the community in “fair” health.

The macroinvertebrate community was sampled more recently upstream of the original sites. At rivermile 3.8, the community in 2014 was still “fair” but in 2015 had improved a little to “good-fair”. The fish community in 2015 at rm 1.4 was “poor”. At rivermile 3.8, the stream channel was very embedded, about 75%, and the stream was overwidened.

The Bolton Valley ski resort access road follows the brook up and rivermile 3.8 is just below one of the places that the road crosses the brook – this looks like it could be having an impact on the stream channel. And then there is the ski area development and residential development upstream of this sampling location as well, changing the hydrology and runoff in the upper watershed.

References and Resources

- 1) All of the Phase 2 and River Corridor Plans done for the Winooski River watershed listed in Table 1 on page 3 of this report.
- 2) *AMC River Guide: New Hampshire/Vermont*, Third Edition, 2002. Appalachian Mountain Club, Boston, Massachusetts.
- 3) *2014 Annual Monitoring Report for the Unifirst Plant Site, Williamstown, Vermont*, March 30, 2015. Prepared for: Vermont Department of Environmental Conservation Waste Management Division, Montpelier. Prepared by: Waite-Heindel Environmental Management, Burlington, Vermont.
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Appendix A Housing Growth in the Winooski River watershed

Table A.1. Housing Units of Winooski River Watershed Towns

Town	Housing Units 1980	Housing Units 1990	Housing Units 2000	Housing Units 2010	percent change 1980 - 1990	percent change 1990 - 2000	Percent change 2000 - 2010
Barre Town	2335	2747	3046	3402	18	11	12
Barre City	4152	4321	4477	4504	4	4	1
Berlin	918	1022	1172	1236	11	15	5
Bolton	359	543	412	602	51	-24	46
Buels Gore	8	4	8	14	-50	100	75
Burlington	13763	15480	16398	16897	12	6	3
Cabot	449	496	634	771	10	28	22
Calais	573	679	773	842	18	14	9
Colchester	4566	5922	6727	7104	30	14	6
Duxbury	403	442	569	639	10	29	12
East Montpelier	730	896	1055	1129	23	18	7
Essex	4826	6310	7170	8146	31	14	14
Fayston	701	787	900	1201	12	14	33
Huntington	448	622	744	821	39	20	10
Jericho	1079	1489	1774	1948	38	19	10
Marshfield	494	540	686	729	9	27	6
Middlesex	484	604	719	764	25	19	6
Montpelier	3437	3769	3899	4034	10	3	3
Moretown	544	639	727	797	17	14	10
Northfield	1704	1877	1958	2101	10	4	7
Orange	276	359	422	489	30	18	16
Plainfield	457	512	520	565	12	2	9
Richmond	1071	1391	1528	1653	30	10	8
Roxbury	229	335	362	441	46	8	22
St. George	241	274	277	292	14	1	5
South Burlington	3972	5437	6498	8429	37	19	30
Stowe	1823	2830	2728	3526	55	-4	29
Waitsfield	684	831	908	1011	21	9	11
Warren	1337	1949	2078	2232	46	7	7
Waterbury	1658	1956	2106	2385	18	8	13
Williamstown	861	1133	1318	1479	32	16	12
Williston	1284	1874	3036	3652	46	62	20
Winooski	2403	2926	3015	3393	22	3	13
Woodbury	523	564	659	713	8	17	8

Appendix B Dams in the Winooski River Watershed

Table B.1. Dams in the Winooski River Watershed

Dam Name	Stream	Town	Status	Use *	Built	Re-con+	State ID
West Hill Pond	Trib to Jug Brook	Cabot	In Service	R	1820		39.01
Mamet Pond	Jug Brook-TR	Woodbury	In Service	R	1994		252.17
Marshfield No. 6	Mollys Brook	Cabot	In Service	HR	1927	1935	39.02
Milne	Trib to Mollys Falls Reservoir	Cabot					39.03
Clarks Saw Mill	Winooski River	Cabot					39.04
Cabot-6	Winooski River	Cabot	Breached				39.06
Peacham Pond	Sucker Brook	Peacham	In Service	HR	1930		151.03
Goslants Pond	Trib to Peacham hollow Brook	Peacham	Deleted				151.08
Mud Pond	Trib to South Peacham Brook	Peacham	Breached				151.11
Richards	Trib to Winooski River	Marshfield	In Service	R	1969		123.01
Bailey Pond	Marshfield Brook	Marshfield	In Service	R			123.02
Marshfield Pond	Marshfield Brook	Marshfield					123.03
Laird Pond	Nasmith Brook	Marshfield	Partially Breached	R	1900	1959	123.04
Farrington	Winooski River	Marshfield					123.05
Marshfield-6	Winooski River	Marshfield	Breached				123.06
Marshfield-7	Winooski River	Marshfield	Breached				123.07
Marshfield-8	Winooski River	Marshfield	Removed - 2012				123.08
Marshfield-9	Winooski River	Marshfield	Breached				123.09
Old Batchelder Mill	Winooski River	Plainfield					155.01
Valley Lake	Dog Pond Brook	Woodbury	Breached (Partial)	R	1900		252.04
Woodbury-5	Dog Pond Brook	Woodbury					252.05
Woodbury Upper	Dog Pond Brook	Woodbury	Breached (Partial)	R	1949	1973	252.06
Woodbury Lower	Dog Pond Brook	Woodbury	Breached (Partial)				252.07
Woodbury	Dog Pond Brook	Woodbury					252.08
South Woodbury Pond	Trib to Sabin Pond	Woodbury	In Service	R	1875		252.09
Daniels Mill	Trib to Woodbury Lake	Woodbury					252.10
Woodbury-11	Trib to Nelson Pond	Woodbury					252.11
Woodbury-12	Trib to Nelson	Woodbury					252.12

Dam Name	Stream	Town	Status	Use *	Built	Re- con+	State ID
	Pond						
Benjamin	Trib to Woodbury Lake	Woodbury					252.13
Woodbury-14	Trib to Woodbury Lake	Woodbury					252.14
Woodbury-15	Trib to Nelson Pond	Woodbury					252.15
King Pond (Lower)	Trib to Forest Lake	Woodbury					252.16
Sabin Pond	Kingsbury Branch	Calais	Breached				40.02
East Calais Mill	Kingsbury Branch	Calais	In Service	R	1900	1975	40.08
Nelson Pond	Trib to Mirror Lake	Calais	Breached				40.01
No. 10 Pond	Trib to Dugar Brook	Calais	In Service	R	1820		40.03
North Calais Mill	Mirror Lake Brook	Calais					40.06
Calais-7	Mirror Lake Brook	Calais					40.07
Scribner	Mirror Lake Brook	Calais					40.14
Curtis Pond	Curtis Pond Brook	Calais	In Service	R	1900		40.09
Robinsons Sawmill	Curtis Pond Brook	Calais	In Service				40.10
Elmslie	Pekin Brook	Calais	In Service	R	1989		40.17
Adamant Pond	Beaver Meadow Brook	Calais	In Service	R	1870	1975	40.11
Hatch's Mill	Beaver Meadow Brook	Calais					
Rogers	Trib to Sodom Pond Brook	Calais			1962		40.13
North Montpelier Pond	Kingsbury Branch	East Montpelier	In Service	R	1920	1984	65.02
Sodom Pond	Sodom Pond Brook	East Montpelier	Breached				65.04
Crystal Pool	Sodom Pond Brook	East Montpelier					65.06
Chapels Pond	Trib to Sodom Pond Brook	East Montpelier					65.07
East Montpelier	Winooski River	East Montpelier					65.05
Montpelier No. 5	Winooski River	East Montpelier					65.01
Brooklyn Street	Stevens Branch	Barre City	Breached				13.01

Dam Name	Stream	Town	Status	Use *	Built	Re-con+	State ID
Jones Brothers	Stevens Branch	Barre City	Breached				13.03
Jockey Hollow	Stevens Branch	Barre Town					14.04
Phelps Mill	Jail Branch	Barre City					13.04
East Barre	Jail Branch	Barre Town	In Service	C	1935	1956	14.02
Barre-3	Jail Branch	Barre Town					14.03
Sargents Mill	Jail Branch	Barre Town					14.05
Hands Mill	Jail Branch	Washington	Abandoned	O	1860	1928	225.01
Green	East Orange Branch-TR	Washington					225.02
Creamery	Jail Branch	Washington					225.04
Giacherio	Gunners Brook	Barre Town					14.09
Whitcomb	Stevens Branch-TR	Williamstown			1933		244.01
Rouleau	Stevens Branch-TR	Williamstown			1945		244.02
Limehurst Pond	Stevens Branch-TR	Williamstown					244.03
Sorimaini	Stevens Branch-TR	Williamstown					244.07
Williamstown-9	Stevens Branch-OS	Williamstown					244.09
Williamstown-10	Martin Brook	Williamstown					244.10
Martin Brook	Martin Brook	Williamstown	Not in Use	S			244.13
Thurman W. Dix Reservoir	Orange Brook	Orange	In Service	S	1950	1968	147.01
Upper Orange Reservoir	Orange Brook	Orange					147.02
Lower Orange Reservoir	Orange Brook	Orange	In Service	S	1910	1996	147.03
Orange-11	Orange Brook	Orange	Breached				147.11
Orange-12	Orange Brook	Orange					147.12
East Orange (Upper)	Trib to East Orange Branch	Orange					147.08
East Orange (Lower)	Trib to East Orange Branch	Orange					147.09
Bennetts Mill	Nelson Brook	Orange	Abandoned				147.06
Bolster Reservoir	Trib to Stevens Branch	Barre Town	Abandoned	S	1910		14.01
Barre-8	Trib to Stevens Branch	Barre Town					14.08
Berlin-2	Trib to Stevens Branch	Berlin					20.02
Dry Pond	Berlin Pond-TR	Northfield	Breached		1905		143.01
Berlin Pond	Trib to Stevens Branch	Berlin	In Service	S	1920		114.09
Berlin-1	Trib to Winooski River	Berlin					20.01

Dam Name	Stream	Town	Status	Use *	Built	Re-con+	State ID
Montpelier Reservoir (Lower)	Benjamin Falls Brook	Berlin					20.04
Montpelier Reservoir (Upper)	Benjamin Falls Brook	Berlin					20.09
Montpelier No. 4	Winooski River	Berlin	In Service	H	1909	1985	20.05
Montpelier No. 3	Winooski River	Montpelier					131.03
Worcester Pond	Worcester Brook	Worcester	Breached (Partial)	R	1933		255.01
Ladds Mill	North Branch Winooski River	Worcester	In Service	H	1928		255.02
Janawics	North Branch Winooski River	Worcester					255.03
Chandler Sawmill	Minister Brook	Worcester					255.04
Worcester Brook	Worcester Brook	Worcester					255.05
Worcester-6	North Branch Winooski River	Worcester	Breached				255.06
Middlesex-3	Trib to Great Brook	Middlesex					126.03
Wrightsville	North Branch	Middlesex	In Service	CH R	1935		126.01
North Branch	North Branch	Montpelier					131.07
Lane	North Branch	Montpelier	Not in Use	O	1920		131.01
Dodge-Roya	North Branch	Montpelier	Breached				131.04
Trestle	North Branch	Montpelier					131.05
Middlesex No. 2	Winooski River	Middlesex	In Service	H	1928		126.02
Roxbury-2	Trib to Dog River	Roxbury					170.02
Beaver Pond	Trib to Dog River	Roxbury	In Service		1933		170.04
Northfield-12	Felchner Brook	Northfield					143.12
Camp Wihakowi	Bull Run	Northfield	Breached				143.08
Baker Pond	Sunny Brook	Brookfield	In Service	R	1956	1995	32.01
Wardner Pond	Sunny Brook	Brookfield	Breached				32.06
Cooks Mill	Sunny Brook	Northfield					143.09
Vatters Pond	Robinson Brook	Northfield		R			143.02
Boutwell	Robinson Brook	Northfield					143.03
Towne	Trib to Robinson Brook	Northfield		R			143.07
Union Brook	Union Brook	Northfield	Removed - 2010				143.13
Cox Brook	Cox Brook	Moretown	Removed - 2008				132.07
Pierson	Cox Brook	Northfield					143.06
Northfield Mills	Dog River	Northfield					143.04
Cross Brothers	Dog River	Northfield	Breached			1924	143.05

Dam Name	Stream	Town	Status	Use *	Built	Re-con+	State ID
Randall Wood Products	Dog River	Northfield	Breached				143.11
Riverton	Dog River	Berlin	Breached				20.08
Newbrough Upper	Trib to Dog River	Berlin	In Service	R	1965	1967	20.06
Newbrough Lower	Trib to Dog River	Berlin					20.07
Sugarbush Snow-making Pond	Mad River-OS	Waitsfield	In Service	R	1996		217.03
Plenge		Warren					223.01
Warren Lake	Mills Brook	Warren	In Service	R	1983	2004	223.02
Warren Village	Mad River	Warren				1984	223.03
Sugarbush Tank	Rice Brook-TR-OS	Warren	In Service	O	1989		223.05
Moretown No. 8	Mad River	Moretown	In Service	H	1910		132.01
USGS Gage No. 2880	Mad River	Moretown					132.02
Eight Trout Club	Welder Brook	Moretown	Breached	R	1935		132.03
Ward Lower	Mad River	Moretown	Breached (Partial)				132.04
Ward (Upper)	Mad River	Moretown	Breached				132.05
Moretown-6	Mad River	Moretown	Breached				132.06
Bolton Falls No. 1	Winooski River	Duxbury	In Service	H	1899	1986	63.01
Duxbury Mill	Crossett Brook	Duxbury					63.02
Kimibakw	Trib to Sterling Brook	Morristown	In Service	R	1964		134.05
Schwartz	Trib to Sterling Brook	Morristown	In Service	R	1989		134.08
Lake Mansfield	Miller Brook	Stowe	In Service	R	1900	1980	199.01
Culver Mill	Miller Brook	Stowe					199.02
Feed Company (Upper)	Thatcher Brook	Waterbury	Breached				226.02
Ice Pond	Thatcher Brook	Waterbury	Breached (Partial)				226.03
Adams	Little River	Stowe	Breached	O			199.03
Moscow Mills	Little River	Stowe	In Service	H			199.04
Pike	Little River	Stowe					199.05
Sylvan Park	Trib to Little River	Stowe		R	1966		199.06
Bloch	Trib to Barrows Brook	Stowe	In Service	R	1967		199.07
Barrows Brook	Barrows Brook	Stowe					199.08
Heath		Stowe					199.09
Mount Mansfield Corp.	West Branch Waterbury River	Stowe	In Service	R	1979		199.10
Stowe-11	Little River-TR-OS	Stowe					199.11

Dam Name	Stream	Town	Status	Use *	Built	Re-con+	State ID
Beaver Pond	Miller Brook	Stowe					199.12
Stowe Upper Golf Course	Winooski River-OS	Stowe	In Service	R	2004		199.16
Waterbury	Little River	Waterbury	In Service	CRH	1938	1985	226.01
Ice Pond	Trib to Winooski River	Duxbury	Breached (Partial)				63.03
Colbyville Upper	Thatcher Brook	Waterbury		H			226.04
Colbyville Lower	Thatcher Brook	Waterbury					226.05
Brisco	Bryant Brook-OS	Waterbury		R	1971	1973	226.06
Waterbury-7	Trib to Alder Brook	Waterbury					226.07
Gillette Pond	Johns Brook	Richmond		R	1900	1960	166.01
Richmond Pond	Trib to Snipe Island Brook	Richmond					166.02
Pechie	Trib to Hollow Brook	Starksboro	In Service	R	1971		197.02
Saxon Hill Reservoir (North)	Trib to Winooski River	Essex		S			69.03
Saxon Hill Reservoir (South)	Trib to Winooski River	Essex					69.04
Essex No. 19	Winooski River	Essex	In Service	H	1917		69.05
IBM Lagoon	Winooski River-OS	Essex	In Service		1983		69.06
Essex Town Reservoir	Trib to Winooski River	Essex					69.08
Gorge No. 18	Winooski River	South Burlington	In Service	H	1914	1928	192.01
Winooski One	Winooski River	Burlington	In Service	H	1876	1992	38.01
Chace Mills No. 21	Winooski River	Burlington					38.02
Howe Farm WMA	Winooski River-OS	Burlington	In Service	F	1985		38.03
Burlington Electric WMA	Winooski River-OS	Burlington	In Service		1985		38.04
Winooski Water Supply Upper	Trib to Winooski River	Winooski	Breached	R	1900	1983	250.01
Winooski Water Supply Lower	Trib to Winooski River	Winooski					250.02
Kelly Pond	Trib to Winooski River	Winooski					250.03

*H = hydroelectric, R = recreation, C = flood control, S= water supply, O = other, blank = unknown

+ date re-constructed