Summary Report: 2014 Sampling Results
Addison County Riverwatch Collaborative

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1 Lemon Fair River – 2014 Water Quality Summary
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3 Little Otter Creek – 2014 Water Quality Summary
4 Middlebury River – 2014 Water Quality Summary
5 New Haven River – 2014 Water Quality Summary
6 Otter Creek (Lower) – 2014 Water Quality Summary

1.0 Introduction

This report provides a brief summary of the 2014 sampling results for the Addison County Riverwatch Collaborative (ACRWC). Sampling was carried out by a network of volunteers, with logistical and technical support provided by Ethan Swift of the VTDEC Monitoring, Assessment and Planning Program, Kevin Behm of the Addison County Regional Planning Commission and Kristen Underwood of South Mountain Research & Consulting. Analytical services were provided by the LaRosa Analytical Laboratory in Burlington, VT, through an analytical services partnership grant.

The reader is referred to a series of water quality reports prepared by Dr. Bill Hoadley in 2009 for an analysis of historical water quality results in each of these watersheds. This summary report is intended to be a brief synopsis of the 2014 season, with reference to these more technical reports for historical context and trend analysis.

Section 6.0 provides a one-page summary of sampling results for each of the ACRWC watersheds. These summaries are formatted to serve as a one-page handout for each watershed that can be distributed to the public in relevant towns.

2.0 Background

The ACRWC has been monitoring water quality (including sediment, phosphorus, nitrates, and *E.coli*) in six watersheds in Addison County (Figure 1) for two decades, with the earliest monitoring efforts beginning in 1992:

- Lemon Fair River (2003 – present)
- Lewis Creek (1992 – present)
- Little Otter Creek (1997 – present)
- Middlebury River (1993 – present)
- New Haven River (1993 – present)
- Otter Creek (1992 – present)

During a hiatus from sampling in the 2009 season, the ACRWC conducted a programmatic review of their water quality monitoring goals and objectives, and met with various state and regional groups to identify opportunities for collaboration and data sharing. With input from Dr. Bill Hoadley (2009 Draft Water Quality Reports), historical sample results and trends were analyzed to refine the overall sampling design for each of these six watersheds, in light of updated goals and objectives.

Since several years of baseline data now exist for the six ACRWC watersheds, the sampling schedule was revised, beginning with the 2010 season, to include longer-term trend monitoring at a reduced number of key sites in each watershed (sentinel sites) with a reduced number of water quality parameters. These sentinel sites are to be combined with a more focused monitoring effort in two of the six watersheds that will rotate for a period of two years on and four years off (Table 1). The focused evaluation will involve a greater number of sites (and testing parameters) than the sentinel sites, and will be conducted to meet specific data needs of relevance to the chosen watershed.

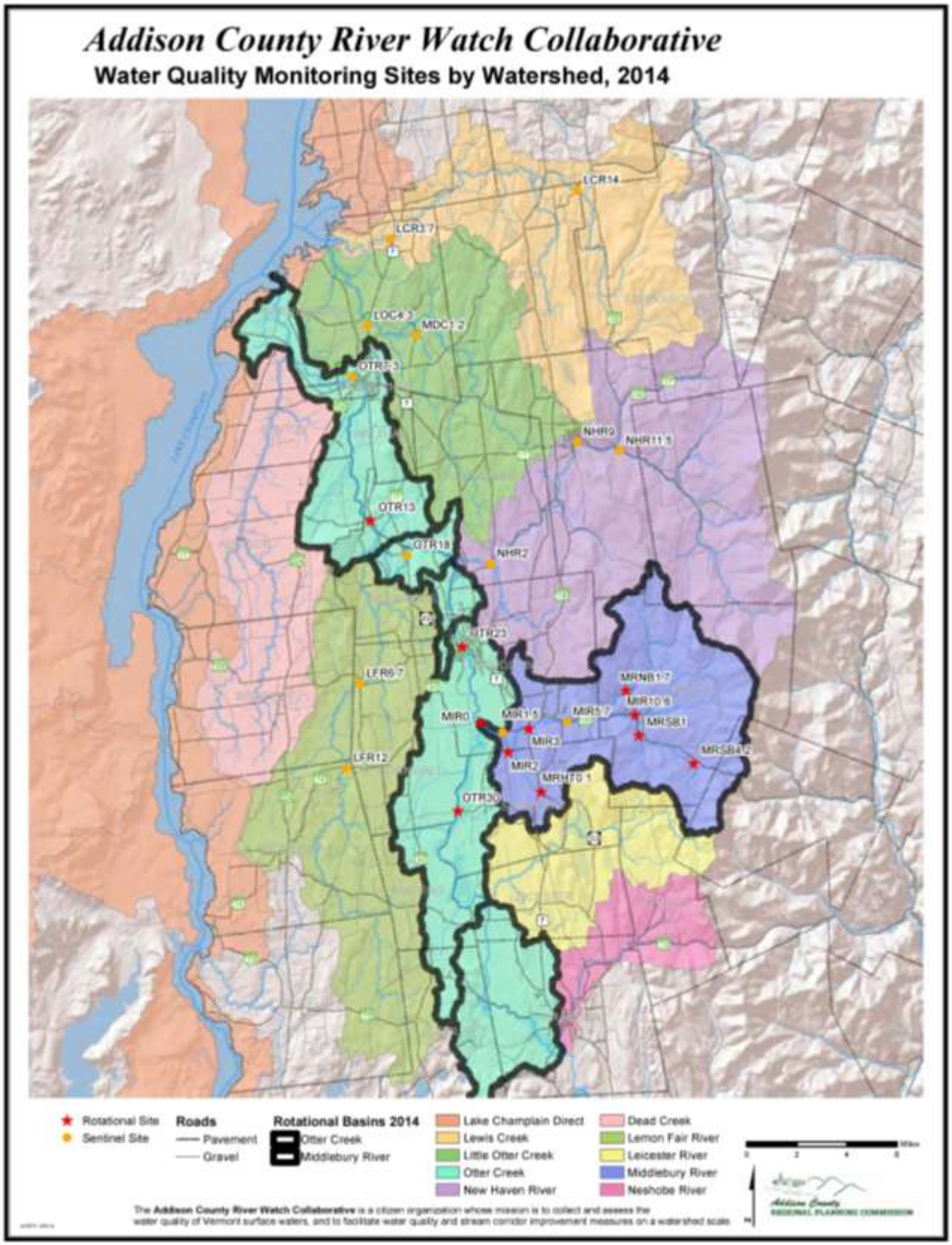

Addison County River Watch Collaborative
Water Quality Monitoring Sites by Watershed, 2014
LCR14
LCR3.7
LOC4.2
MDC1.2
OTR7.3
NHR9
NHR11.5
OTR13
OTR18
NHR2
OTR23
LFR6.7
MRNB1.7
MRT0.8
MIR0
MIR1.5
MIR5.7
MRSB1
MIR3
MRSB4.2
LFR12
MIR2
MRHF0.1
OTR30
Rotational Site
Sentinel Site
Roads
Pavement
Gravel
Rotational Basins 2014
Otter Creek
Middlebury River
Lake Champlain Direct
Lewis Creek
Little Otter Creek
Otter Creek
New Haven River
Dead Creek
Lemon Fair River
Leicester River
Middlebury River
Neshobe River
The Addison County River Watch Collaborative is a citizen organization whose mission is to collect and assess the water quality of Vermont surface waters, and to facilitate water quality and stream corridor improvement measures on a watershed scale.

Figure 1.

Table 1. Rotational Schedule for Focused Monitoring

2012 – 2013	2014 - 2015	2016 - 2017
Lewis Creek	Middlebury River	Little Otter Creek
Lemon Fair	Otter Creek	New Haven River

Beginning with the 2014 sampling season, Otter Creek and the Middlebury River were selected to be focus watersheds (Figure 1, watersheds in bold outline). Therefore, rotational sites were scheduled for sampling in addition to the sentinel sites in these two watersheds. Table 2 displays the schedule of sampling sites and parameters for the 2014 season; "R" denotes a rotational site, "S" for a sentinel site. A slightly different schedule of sampling parameters is indicated for Spring versus Summer months – i.e., *E. coli* and Alkalinity were added to the list for Summer events.

3.0 Methods

Water quality samples were collected by ACRWC volunteers in accordance with quality assurance procedures outlined in the EPA-approved Generic Quality Assurance Project Plan prepared by VTDEC. A Quality Assurance Summary report for the 2014 sampling data was submitted under separate cover. Samples were delivered to the LaRosa Analytical Laboratory housed in the Hills Building in the University of Vermont campus in Burlington, Vermont.

During 2014, ACRWC volunteers collected grab samples at 24 sites in these six watersheds during two Spring events (April and May) and four Summer events (June, July, August and September). Sampling dates were pre-determined as the first Wednesday of each month, and were not designed to capture any specific flow condition:

- April 9 (postponed from April 2 due to persistent ice cover)
- May 7
- June 4
- July 2
- August 6
- September 3

Table 2. 2014 Schedule of Sites / Parameters – Spring and Summer

Project Name: Addison County River Watch Collaborative																
Project Number: **137-01**				Spring Schedule (Apr, May)					Summer Schedule (Jun, Jul, Aug, Sep)							
Sample Year: **2014**									**PARAMETERS**							
Type	**River Name**	**Site ID**	**Site Location**	**TP**	**DP**	**TN**	**Turbidity**	**TSS**	***E.coli***	***ALK***	**TP**	**DP**	**TN**	**Turbidity**	**TSS**
S	Lewis Creek	LCR3.7	Old Route 7 Bridge	X			X		X		X			X	
S	Lewis Creek	LCR14	Tyler Bridge	X			X		X		X			X	
S	Lemon Fair River	LFR6.7	Route 125 bridge.	X	X		X	X	X		X	X		X	X
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge	X	X		X	X	X		X	X		X	X
S	Little Otter Creek	LOC4.3	Route 7 Bridge	X	X		X	X	X		X	X		X	X
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)	X	X		X	X	X		X	X		X	X
R	Middlebury River	MIR0	Mouth of Middlebury River	X		X	X		X		X		X	X	
S	Middlebury River	MIR1.5	Shard Villa Road Bridge	X		X	X		X		X		X	X	
R	Middlebury River	MIR2	Blake Roy Road Bridge	X		X	X		X		X		X	X	
R	Middlebury River	MIR3	Route 7 Access	X		X	X		X		X		X	X	
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge	X		X	X		X		X		X	X	
R	North Branch MR	MRNB1.7	Dugway Road Bridge	X			X		X	X	X			X	
R	Middlebury River (Midd Br)	MIR10.6	Natural Turnpike Road	X			X		X	X	X			X	
R	South Branch MR	MRSB1	Goshen Road Bridge	X			X		X	X	X			X	
R	South Branch MR	MRSB4.2	Brook Road Bridge	X			X		X	X	X			X	
R	Halnon Brook MR	MRHT0.1	Upstream of Route 7 crossing	X			X		X	X	X			X	
S	New Haven River	NHR2	Muddy Branch confluence (just below)	X			X		X		X			X	
S	New Haven River	NHR9	South St. Bridge	X			X		X		X			X	
S	New Haven River	NHR11.5	Bartlett's Falls Pool						X						
S	Otter Creek	OTR7.3	Vergennes Falls / below outfall	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR13	Route 17 Bridge	X	X	X	X		X		X	X	X	X	
S	Otter Creek	OTR18	Twin Bridges Picnic Area	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR23	Frog Hollow	X	X	X	X		X		X	X	X	X	
R	Otter Creek	OTR30	Swamp Road Bridge	X	X	X	X		X		X	X	X	X	
			Total # sites per event	23	9	10	23	4	24	5	23	9	10	23	4
			Total # Field QC samples per event	6	2	2	6	2	6	2	6	2	2	6	2

Site Types: R = Rotational; S = Sentinel; O = Other (special project).

4.0 Precipitation Data

Precipitation data were compiled from existing weather stations in vicinity of the ACRWC watersheds (Table B-1). Calendar year 2014 was a near-normal precipitation year, as recorded at regional weather stations in South Burlington (Airport) and Rutland. In general, April through July months saw greater than normal precipitation (as measured at the Burlington airport), while August, September and November were below normal. Snowfall in the winter of 2013–2014 was near normal at the Burlington airport and somewhat above normal at the Rutland station (Table B-2). Weather records at the South Lincoln station were incomplete.

5.0 Hydrologic Data

Flow data were compiled from available USGS gaging stations in vicinity of the ACRWC watersheds. Four of the six watersheds sampled by the ACRWC have USGS gaging stations which record instantaneous flow at fifteen minute intervals. Gages on Lewis Creek, Little Otter Creek, and New Haven River are near the downstream end of the main stem. A nearby gage on Otter Creek (at Middlebury) is located mid-basin, at 66.5 % of this 944 square mile basin.

Flow records are available for the past 24 years at Little Otter Creek, New Haven River, and Lewis Creek gaging stations. Mean annual flows recorded at these stations over that time period are summarized in Table 5, along with data from the Otter Creek at Middlebury station. Data are summarized by water year – which begins October 1st of the previous calendar year and extends through September 30th of the indicated year. Based on 24 years of record, mean annual flows in these ACRWC watersheds for water year 2014 were near normal.

Table 5. Mean Annual Flows, 1991 – 2014, ACRWC watersheds.

Watershed	Little Otter Creek		New Haven River		Lewis Creek		Otter Creek at Middlebury	
Drainage Area (sq mi)		73		116		81		944
Gaged Area (sq mi)		57.1		115		77.2		628
Min (1991-2014)	*2002*	27	*1995*	129	*1995*	54	*1995*	672
Max (1991-2014)	*2011*	145	*2011*	378	*2011*	214	*2011*	1912
Mean (1991-2014)		**N/A**		219		**N/A**		1167
Water Year 2014		**N/A**		211		**N/A**		1086

Source: USGS, 2015, on-line surface water data, <http://waterdata.usgs.gov/vt/nwis>.
Note: As of 2/9/2015, 2014 USGS data for ACRWC stations were still provisional or unavailable.

Figure 2 presents mean daily flows in the Little Otter Creek, New Haven River and Lewis Creek. Flows have been normalized to gaged drainage area. Generally, New Haven River tends to exhibit more flashy flows, and often has a somewhat higher flow per unit area than the Lewis Creek and Little Otter Creek.

Based on USGS provisional real-time gaging records, ice-out on the Little Otter Creek and Otter Creek Middlebury stations occurred on April 3, while ice-out on the Lewis Creek and New Haven River occurred on April 4. All four stations recorded a January thaw event prior to this from approximately Jan 12 through at least January 19. A localized ice-jam flooding event occurred on the lower Middlebury River on January 11-12 resulting from warming temperatures and a rain-on-snow event. Portions of Route 7 and Three Mile Bridge Rd were closed temporarily due to inundation flooding (NCDC, 2014).

While the average yearly flows in the ACRWC watersheds were near normal in 2014, monthly flows were somewhat above normal for much of April, May, and August and below normal in September and October. Peak flows for water year 2014 were associated with the spring thaw and occurred on April 15 (New Haven River), April 16 (Lewis Creek) and April 18 (Otter Creek at Middlebury). Recorded flows were at or above the estimated 2-year storm (Olson, 2002) at each gaging station. While flows in the Little Otter Creek were also elevated in mid-April, the peak flow in this river was recorded on January 13 during the January thaw. Still, this peak flow for the year represented a less than 2-year event in Little Otter Creek.

Flows in these four rivers reached their lowest point for the year in late September. Flows in Little Otter Creek and the Otter Creek at Middlebury approached the 7-day 10-year low flow stage.

Figure 3 presents a flow duration curve for the Lewis Creek watershed, annotated with the 2014 season sample dates. It is used to characterize the flow condition for each sample event as ranging from high-flow to low-flow (after EPA, 2007). The April 9 sampling date coincided with high stages in area rivers resulting from snow melt and spring runoff. Another high-flow event was captured on August 6 as a result of a thunderstorm that occurred in the overnight hours just prior to sampling. The May and June sample events represented moderate to low flows sustained by spring rains. And the summer sampling dates of July 2 and September 3 coincided with low- to base-flow conditions.

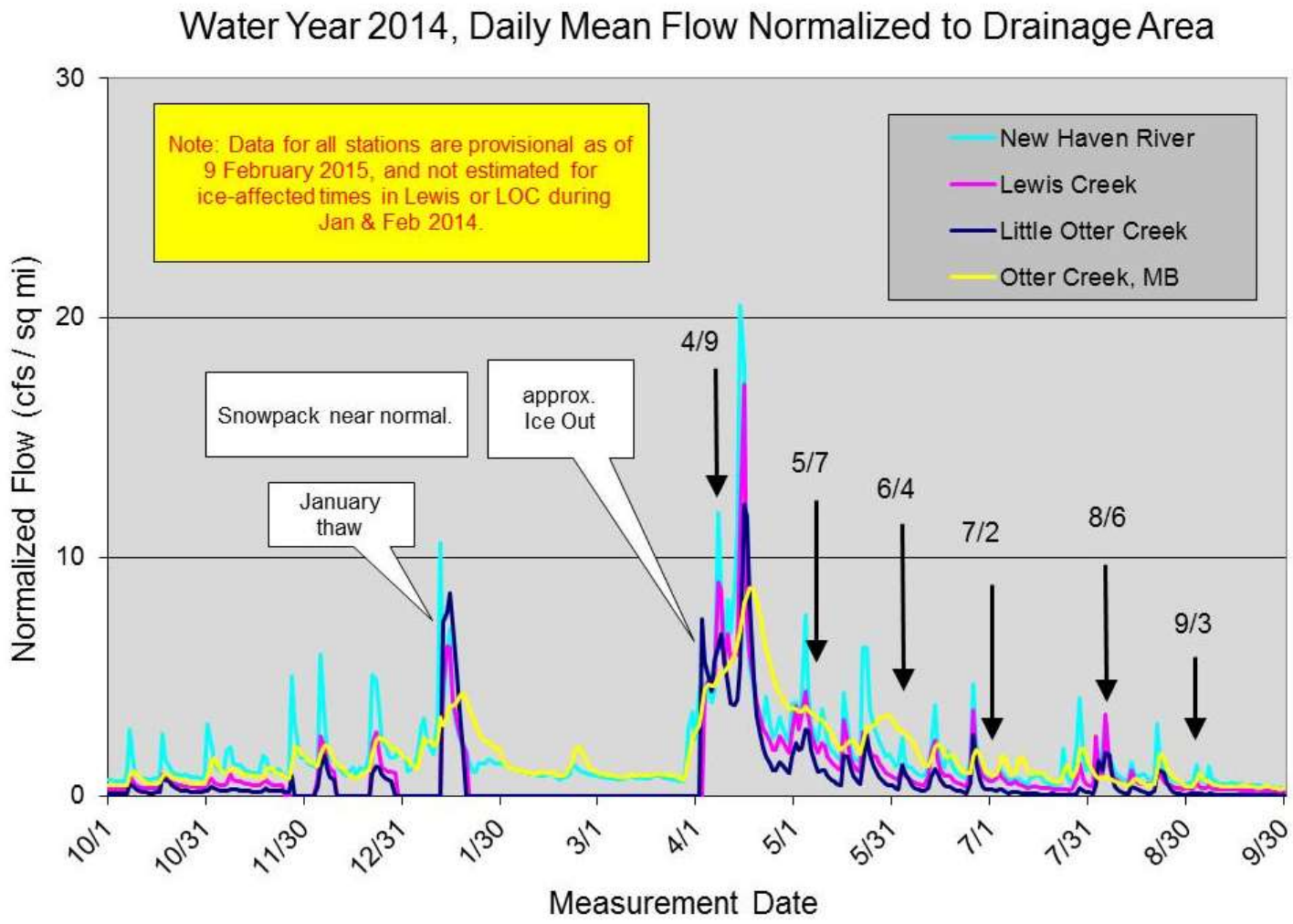


Figure 2. ACRWC Scheduled Spring and Summer Sampling Dates in 2014 relative to Mean Daily Flows normalized to Gaged Drainage Area.

Note: As of 9 February 2015, daily mean flow data posted on the USGS web page for all stations are provisional, and estimates have not been made for ice-affected portions of the flow record in January and February 2014 for Lewis and LOC.

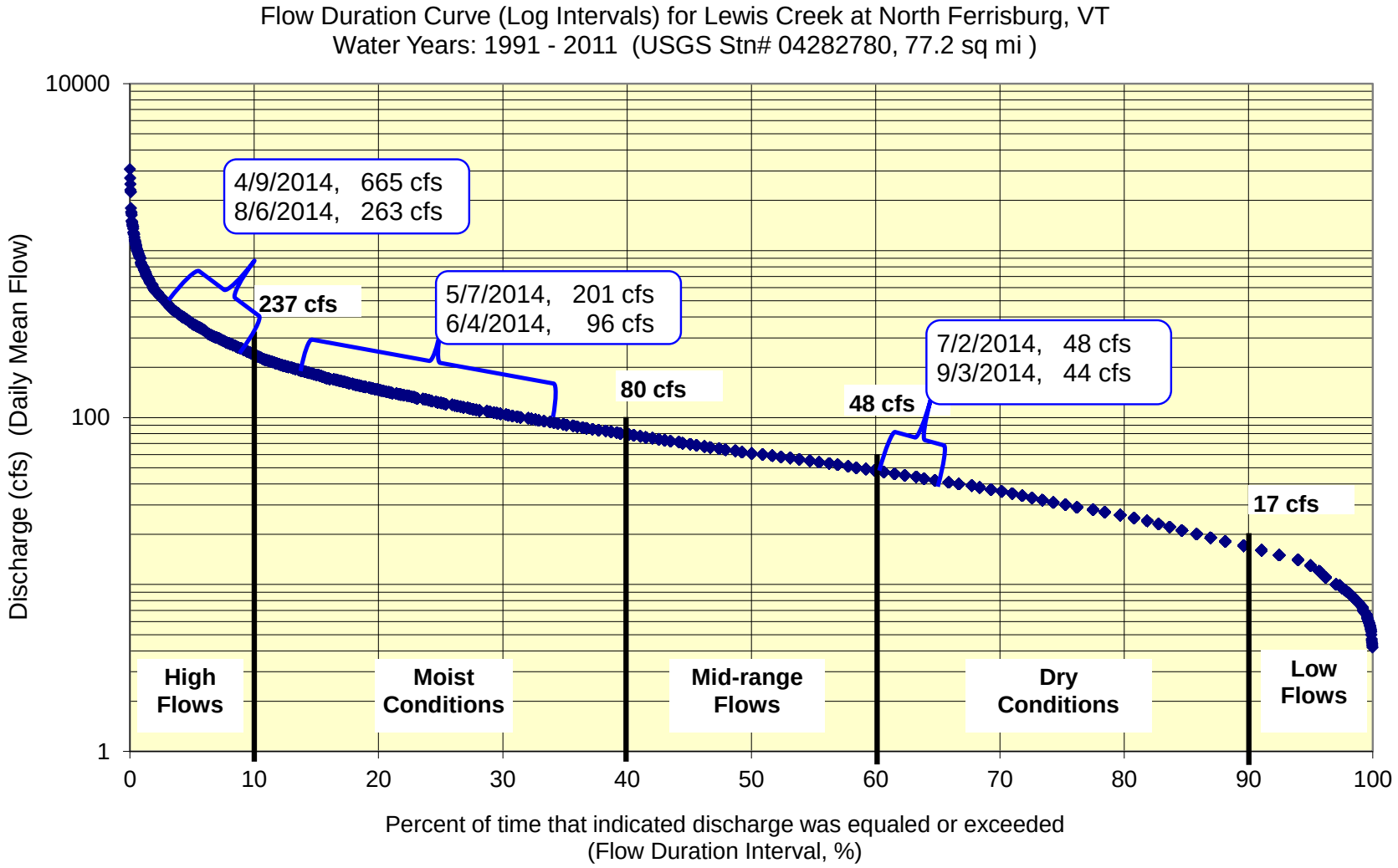


Figure 3. ACRWC Scheduled Spring and Summer Sampling Dates in 2014 relative to Flow Duration Curve for the Lewis Creek watershed (after EPA, 2007)

6.0 Sample Results

Appendix C contains quality-assured sample results for the 2014 season for the ACRWC watersheds. Attachments 1 through 6 summarize these results on a single page for each watershed. These attachments have been designed to serve as a handout for use in future outreach events to watershed stakeholders and relevant town boards. As discussed in Section 2.0, the Middlebury River and the lower Otter Creek were chosen as focus watersheds for 2014. Therefore, sample results are presented for sentinel as well as rotational sites in these watersheds.

The Vermont Agency of Natural Resources (VTANR) updated the Vermont Water Quality Criteria, effective October 2014. There is now a revised standard for *E.coli* "for the protection of waters for swimming for consistency with the U.S. Environmental Protection Agency's (EPA) guidance under Section 304(a) of the federal Clean Water Act (CWA)" (VWMD, 2014). A new standard has been approved for phosphorus in wadeable streams "to comply with EPA's National Strategy for the Development of Regional Nutrient Criteria promulgated under Section 304(a) of the CWA" (VWMD, 2014). The turbidity standard was clarified to apply to "an annual average under dry weather base-flow conditions" (VWMD, 2014). In the past the Collaborative has made reference to proposed nutrient criteria and proposed standards for nitrogen (VTWQD, 2009) – but these have been eliminated from recent updates to the VT water quality standards (see Technical Support documentation). Updated water quality standards relevant to each watershed are detailed in the footnotes in Appendix C.

In general, water quality results for 2014 were consistent with historic results and trends summarized in the 2009 Draft Water Quality Reports for each watershed (Hoadley, 2009). *E.coli* counts in each river exceeded the VT Water Quality Standard (VWQS) of 235 organisms/ 100 mL at one or more stations during one or more summer sampling dates. Generally, elevated *E.coli* detections were associated with developed land uses including nearby agriculture and livestock with direct access to the river. Wildlife sources of *E.coli* also exist in these rivers, including beaver, deer, and waterfowl. Some of the regions popular swimming sites had one or more detections of *E. coli* above the standard this past summer, including Bartlett's Falls on the New Haven River (NHR11.5), Middlebury River Gorge (MIR5.7), Blake Roy Rd bridge on the Middlebury River (MIR2), and Tyler Bridge Rd on Lewis Creek (LCR14). *E.coli* counts tended to be especially high during the low-flow event of September 3. A similar occurrence of elevated *E. coli* counts was noted during low flows in 2012 and 2013 and in historic drought years – e.g., 1993 and 1995. However, *E.coli* can also be elevated during high flows –as was apparent at select stations on the Lemon Fair, Lewis Creek, lower New Haven, and lower Middlebury. The Vermont Agency of Natural Resources has published EPA-approved Total Maximum Daily Load (TMDL) plans for the Lewis Creek (and Pond Brook), Little Otter Creek, Middlebury River, and Otter Creek (VTDEC, 2011). These TMDL plans include recommendations for further assessment and mitigation of *E.coli* sources in these waters.

Turbidity concentrations in the ACRWC watersheds vary, in part depending on geologic setting and flow stage. In the mountainous watersheds of Lewis Creek, Middlebury River, and New Haven River (shaded yellow in Table A-1), turbidity tends to become elevated during high flows – such as occurred during the

August 6 thunderstorm event and the April 9 snow melt event in these watersheds. The water quality standard in these cold-water Class B streams is 10 NTUs, but is applicable only under dry weather base-flow conditions (WMD, 2014). On the two sampling dates that could be classified as low-flow base-flow conditions (July 2 and September 3), average turbidity concentrations exceeded the standard of 10 NTUs only in the Middlebury River watershed – in the lowest reaches (MIR2, MIR1.5, and MIR0) and at the new station on Halnon Brook (MRHT0.3). In the valley watersheds (Little Otter Creek and Lemon Fair, shaded light blue in Table A-1), the turbidity standard (10 NTUs for the designated cold-water fishery of Little Otter and 25 NTUs for the warm-water fishery of Lemon Fair) tends to be exceeded on a more frequent basis. During base-flow sampling events in 2014, turbidity at both sentinel stations in Lemon Fair and the Little Otter Creek long-term monitoring site exceeded the standard. As noted in Table A-1 the valley watersheds have a much higher percentage of silt / clay soils derived from glacial lake sediments, which contributes to the higher turbidity in these rivers. The Otter Creek represents a mixed water with contributions from both the mountainous and valley watersheds. During 2014 base-flow events, the turbidity standard (25 NTUs) at the sentinel and rotational stations on Otter Creek was not exceeded. While the turbidity standard is intended to be applied at base-flow conditions only, elevated turbidity at other times of the year during high-flow conditions is a concern due to aesthetics, water clarity, and nutrient loading associated with fine sediments carried in suspension.

Phosphorus is monitored in the Addison County watersheds with respect to two main objectives. First, total phosphorus concentrations are compared to newly-adopted instream nutrient standards (VWMD, 2014) to identify potential impacts to Aquatic Life Support and Aesthetics uses of these waters. Elevated phosphorus can lead to enhanced algae production and other changes in water quality that reduce the river's capacity to support macroinvertebrates, fish and other aquatic organisms. These changes also have the potential to impact aesthetics and recreational uses of these waters. VTANR recommends that the mean phosphorus concentration of at least three samples collected at low median monthly (LMM) flow on non-consecutive days from June through October be compared to the relevant proposed phosphorus standard[1]. Only two of the Summer sampling events from 2014 could be classified as low flow near the LMM value: July 2 and September 3 (see Figure 3 and Table B-3). Mean total phosphorus concentrations for these low-flow dates exceeded the standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype for a Class B water at the following stations:

- both sentinel stations of Lewis Creek, Little Otter Creek, and New Haven River;
- select stations of the Middlebury River watershed: the lowest reaches (MIR2, MIR1.5, and MIR0) and at the new station on Halnon Brook (MRHT0.3);
- and all five sentinel and rotational stations of the Otter Creek.

[1] Within this context, VTANR defines low flow as the median monthly flow for that month having the lowest median monthly (LMM) flow. This definition differs somewhat from the "Low Flows" presented in the context of a Flow Duration Curve (after EPA, 2007). LMM flows for ACRWC watersheds have been calculated by Blaine Hastings of VTANR and are presented in Table B-3.

A second reason to monitor for phosphorus at the subwatershed level in Addison County watersheds is to evaluate relative contributions of phosphorus to Lake Champlain. Each of the watersheds monitored by the Collaborative contributes significant phosphorus to the lake, either directly (Lewis Creek, Little Otter Creek) or via Otter Creek (Middlebury River, New Haven River, Lemon Fair). The most substantial loading occurs during high flow events – generally occurring in the spring or fall months. In 2010 and 2011, the Collaborative carried out a flow / loading study in the Little Otter Creek through its member organization and fiscal agent, Lewis Creek Association. A similar study was completed by Lewis Creek Association in 2012 on the Pond Brook tributary of Lewis Creek. Results are reported separately and are available at www.lewiscreek.org. Stream flow and water quality monitoring data have been used to inform and develop priority implementation projects on a sub-watershed scale. Coarse estimates of phosphorus yields from each sub-watershed were used to communicate land use impacts on water quality and encourage landowner and municipal participation. In cooperation with local, state and federal partners, projects were prioritized and (with landowner willingness) will be developed to achieve reductions in phosphorus and sediment loading from these catchments. Identified projects have included wetland restoration & conservation, livestock exclusion, riparian buffer plantings, alternate tillage and crop rotation practices, gully stabilization, improved forest management techniques, and improved road maintenance practices.

Nitrogen was monitored in two of the Addison County watersheds in 2014: Middlebury River and Otter Creek. Values were relatively low – ranging from 0.26 to 0.88 mg/L . A past standard for nitrogen as nitrate (5 mg/L) was eliminated during the 2014 update of the Vermont Water Quality Standards.

7.0 References

Olson, Scott A., 2002, *Flow-Frequency Characteristics of Vermont Streams*. USGS Water-Resources Investigations Report 02-4238.

National Climatic Data Center, 2015, Event Narratives for Flood Events in Addison County, Vermont, accessed on 5 January 2015 at: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms

NOAA Online Weather Data: Daily Almanac accessed in January 2015 at: http://www.weather.gov/climate/xmacis.php?wfo=btv

USGS, 2015, on-line surface water data, <http://waterdata.usgs.gov/vt/nwis>.

VTDEC, 2011, *Vermont Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters*, prepared by FB Environmental Associates, Inc., Portland, ME. Including Appendices 2, 3, 4, 5 and 6.

VTDEC Water Quality Division, 2009 (August 18), *Proposed Nutrient Criteria for Vermont's Lakes and Wadeable Streams*. http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_2009nutrientcriteria.pdf

Vermont Watershed Management Division, 2014. *Vermont Water Quality Standards*. Effective 30 October 2014. Montpelier, VT. http://www.watershedmanagement.vt.gov/rulemaking/docs/wrprules/wsmd_wqs2014.pdf

Appendix A

Physical Features of Watersheds
Monitored by Addison County Riverwatch Collaborative

Table A-1 summarizes the physical characteristics of the ACRWC watersheds and nearby LaPlatte River. A majority of the drainage area for the New Haven River and Middlebury River is positioned in the mountainous terrain of the Northern Green Mountain physiographic province. Lewis Creek also has a significant percentage of its drainage area in this province. LaPlatte River, Little Otter Creek and Lemon Fair River are located further to the west in the broad, low-relief, Champlain Valley physiographic province. Thus, topographic relief and overall gradients of the New Haven River, Middlebury River and Lewis Creek are substantially higher than that of the Champlain Valley watersheds.

The Green Mountain watersheds (New Haven River, Middlebury River, and Lewis Creek; shaded yellow in Table A-1) tend to exhibit flashier flows, than the Champlain Valley watersheds due, in part, to the steeper overall gradients. The lower-gradient watersheds of the Champlain Valley (shaded blue in Table A-1) tend to be characterized by higher percentages of hydric soils derived from lacustrine and marine lake sediments, and have higher percentages of wetlands. These conditions offer temporary surface water storage and lagged flows, resulting in broader, lower-magnitude storm peaks, longer times to peak, and gradual hydrograph recessions.

In general, the Green Mountain watersheds tend to have higher percentages of forest cover, while the Champlain Valley watersheds have higher percentages of agricultural land use.

Table A-1. Physical Features of Watersheds.

Watershed	Physical Characteristics										
	Geologic Province (1)		Soils (2) (% Lake Sediments)	% Hydric Soils	% Wetlands (VSWI)	Topography		Major Land Cover/ Land Use			Stream Classification (Class B) (3)
	NGM	CV				Relief (ft)	Gradient (ft / mile)	Forest	Agric	Urban	
Middlebury River 63 sq mi	71%	29%	10%	15.2%	3.2%	1,758	111	81%	11%	3%	Cold Water Fish
New Haven River 116 sq mi	63%	37%	14%	9.8%	2.5%	2,720	106	76%	15%	4%	Cold Water Fish
Lewis Creek 81 sq mi	31%	69%	24%	18.6%	6.5%	1,676	52	60%	26%	5%	Cold Water Fish
LaPlatte River 53 sq mi	5%	95%	45%	25.3%	6.1%	960	49	38%	39%	16%	Warm Water Fish
Little Otter Creek 73 sq mi	--	100%	62%	30.3%	9.7%	416	18	35%	45%	4%	Cold Water Fish
Lemon Fair River 91 sq mi	--	91%	63%	19.3%	7.3%	256	8	25%	63%	6%	Warm Water Fish
Lower Otter Creek 498 sq mi (of 944 sq mi basin)	29%	69%	38%	20.8%	8.9%	NM	NM	67%	21%	6%	Warm Water Fish

Notes:

(1) NGM = Northern Green Mountains; CV = Champlain Valley; geologic province after Stewart & MacClintock (1969) or biophysical province after the VT Biodiversity Project.

(2) Soils of glaciolacustrine parent material, Natural Resource Conservation Service County Soil Survey Data.

(3) As per VT Water Quality Standards, effective Jan 1, 2008.

Appendix B

Precipitation and Flow Data

Table B-1. Monthly / Annual Precipitation at climate stations located in vicinity of Addison County.

	Data Source	Time Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Burlington, VT (Airport)	*1*	1971-2000	2.22	1.67	2.32	2.88	3.32	3.43	3.97	4.01	3.83	3.12	3.06	2.22	36.05
	2	1981-2010	2.05	1.76	2.21	2.82	3.45	3.69	4.15	3.91	3.64	3.60	3.12	2.37	36.77
330 ft amsl	*2*	2009	1.76	1.81	1.90	1.86	5.25	5.25	4.62	2.32	3.67	2.98	2.98	3.02	37.42
20 miles N	*2*	2010	2.41	2.13	2.85	3.08	1.52	5.87	2.25	3.51	4.17	6.24	3.10	3.60	40.73
	2	2011	1.44	3.02	3.39	7.88	8.67	3.52	3.68	6.11	6.06	3.49	1.43	2.23	50.92
	2	2012	1.96	0.89	0.98	2.84	4.41	3.22	3.78	2.92	5.36	5.04	1.24	3.30	35.94
	2	2013	1.11	1.32	2.05	2.05	8.74	9.86	4.49	3.07	4.74	2.59	2.43	2.54	44.99
	2	2014	2.45	1.83	1.88	3.66	3.94	4.35	5.54	2.05	1.63	4.17	1.98	2.85	36.33
South Lincoln, VT	*1*	1971-2000	2.92	2.10	3.14	4.20	4.31	4.58	4.24	5.22	4.44	4.39	3.98	3.13	46.65
	2	1981-2010	2.81	2.27	3.12	3.71	4.24	4.75	4.83	5.11	4.13	5.02	3.99	3.41	47.39
1,370 ft amsl	*2*	2009	3.05	2.91	2.14	2.55	8.71	5.52	9.07	3.03	2.25	4.52	4.76	3.80	52.31
13.6 miles SE	*2*	2010	2.88	3.69	4.65	4.17	2.21	7.50	7.18	5.61	3.36	11.56	2.13	3.08	58.02
	2	2011	1.26	2.04	4.04	1.23	3.95	1.22	2.06	10.71	1.66	1.09	2.19	2.83	34.28
	2	2012	2.19	0.83	1.90	3.64	6.29	3.12	2.88	4.77	4.94	7.02	1.38	3.92	42.88
	2	2013	1.79	1.44	2.78	2.40	6.33	9.90	8.02	5.54	4.47	2.86	4.15	3.75	53.43
	2	2014	3.63	3.31	3.29	3.54	4.84	4.15	6.08	3.31	2.13	M	M	M	M
Rutland, VT	*1*	1971-2000	2.70	1.97	2.59	2.80	3.52	3.85	4.58	4.18	3.91	3.21	3.08	2.73	39.12
	2	1981-2010	2.44	2.15	2.77	2.88	3.71	4.00	4.77	4.10	3.78	3.83	3.25	2.96	40.64
620 ft amsl	*2*	2009	2.29	1.98	2.04	1.96	4.43	3.86	9.30	7.71	2.27	4.76	3.64	3.00	47.24
40 miles SSE	*2*	2010	2.22	2.83	4.69	3.04	2.87	3.00	5.35	4.14	1.95	9.76	2.28	3.66	45.79
	2	2011	2.93	3.76	3.61	5.69	4.40	4.38	4.88	11.24	4.88	3.48	1.29	2.80	53.34
	2	2012	1.69	0.69	1.12	3.32	5.26	3.66	3.62	3.42	4.58	4.57	0.71	4.08	36.72
	2	2013	1.85	0.78	1.51	2.58	5.60	5.93	5.59	3.30	3.25	1.36	2.58	2.50	76.66
	2	2014	3.61	3.42	2.56	2.05	4.14	4.44	5.19	2.69	1.54	4.30	2.12	3.77	39.83

Total precipitation in inches, including liquid equivalent of snow, sleet. M = Missing

Values for 1971-2000 and 1981-2010 periods reflect averages for the time period. Values for individual years are totals.

Data Sources: [1] National Climatic Data Center, 2002, Climatography of the United States No. 81 - 43 (Vermont), Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days: 1971-2000

[2] NOAA Online Weather Data, http://www.weather.gov/climate/index.php?wfo=btv

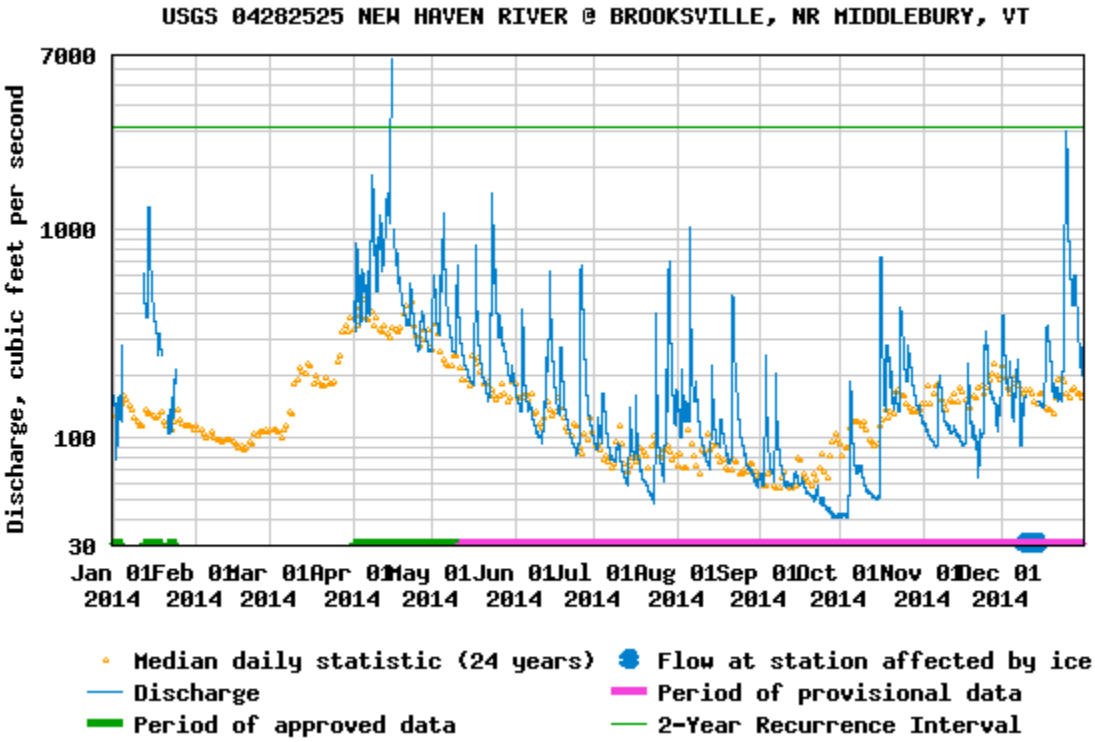
Table B-2. Monthly / Seasonal Snowfall Totals at climate stations located in vicinity of Addison County.

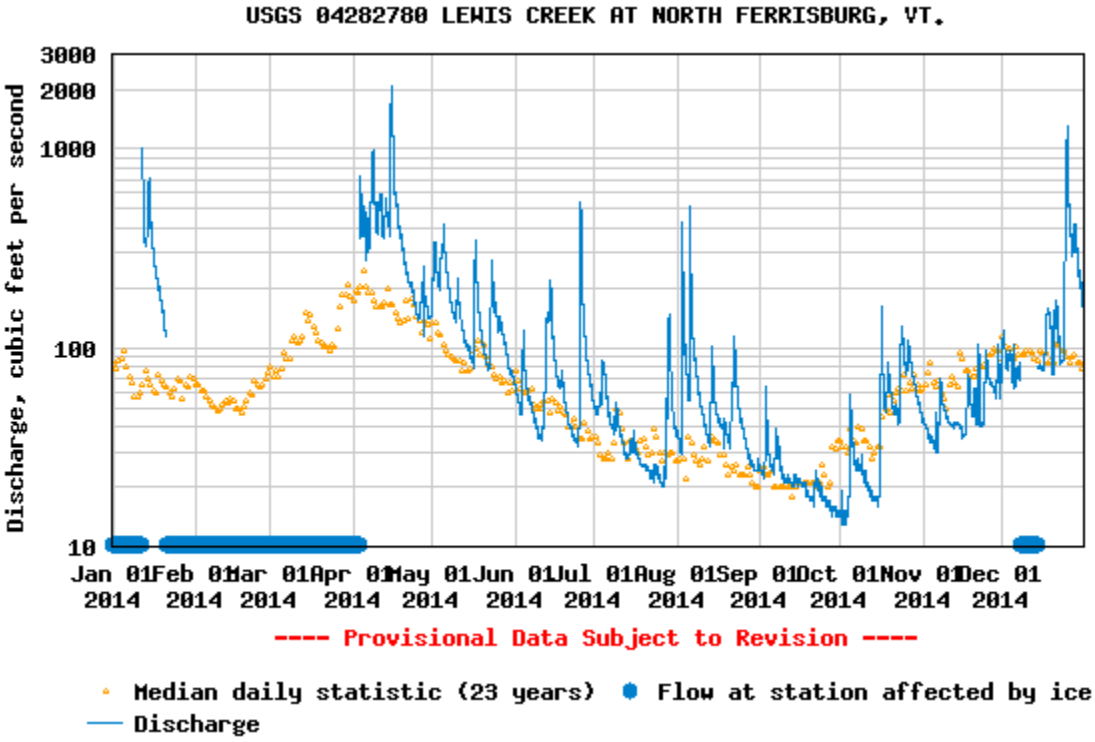
	Time Period	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Season
So. Burlington, VT	1971-2000	0.0	0.0	0.0	0.3	7.2	17.1	20.9	15.3	15.4	5.8	0.0	0.0	81.9
	1981-2011	0.0	0.0	0.0	0.3	5.1	19.1	21.9	16.9	15.6	4.6	0.0	0.0	83.6
(Airport)	2009-2010	0.0	0.0	0.0	0.0	0.0	17.7	48.4	24.0	0.9	5.5	0.0	0.0	96.5
	2010-2011	0.0	0.0	0.0	0.1	0.3	27.9	26.9	43.1	29.3	0.8	0.0	0.0	128.4
	2011-2012	0.0	0.0	0.0	0.1	5.0	6.9	13.4	6.4	5.9	0.0	0.0	0.0	37.7
	2012-2013	0.0	0.0	0.0	0.0	3.8	30.7	14.6	16.6	16.2	1.0	0.0	0.0	82.9
	2013-2014	0.0	0.0	0.0	Tr	6.4	15.3	12.5	24.1	25.4	2.8	0.0	0.0	86.5
South Lincoln, VT	1981-2000	0.0	0.0	0.0	2.2	13.9	26.9	29.6	22.8	24.5	10.5	0.7	0.0	131.1
	1981-2011	0.0	0.0	0.0	2.3	11.4	28.6	27.3	24.0	21.5	9.4	0.6	0.0	125.0
	2009-2010	0.0	0.0	0.0	0.1	1.1	26.0	22.5	33.0	3.2	10.0	1.0	0.0	96.9
	2010-2011	0.0	0.0	0.0	2.2	4.0	39.5	42.3	40.2	26.2	1.8	0.0	0.0	156.2
	2011-2012	0.0	0.0	0.0	2.4	4.9	24.3	18.4	12.0	11.6	0.0	0.0	0.0	73.6
	2012-2013	0.0	0.0	0.0	0.0	4.8	25.8	14.4	11.9	21.3	1.3	0.0	0.0	79.5
	2013-2014	0.0	0.0	0.0	0.7	M	15.8	17.2	M	30.1	Tr	0.0	0.0	M
Rutland, VT	1971-2000	0.0	0.0	0.0	0.3	5.6	13.5	16.7	13.9	12.4	3.6	0.0	0.0	66.0
	1981-2011	0.0	0.0	0.0	0.5	4.4	16.7	17.3	14.7	12.6	3.3	0.0	0.0	69.3
	2009-2010	0.0	0.0	0.0	0.0	0.0	18.2	15.9	19.9	0.1	2.1	0.0	0.0	56.2
	2010-2011	0.0	0.0	0.0	0.0	0.9	21.3	26.8	37.2	14.6	0.9	0.0	0.0	101.7
	2011-2012	0.0	0.0	0.0	6.5	2.9	5.0	8.9	2.7	4.2	0.0	0.0	0.0	30.2
	2012-2013	0.0	0.0	0.0	0.0	0.4	23.9	8.1	8.5	10.9	0.2	0.0	0.0	52.0
	2013-2014	0.0	0.0	0.0	0.3	4.5	18.9	14.5	30.4	20.5	1.7	0.0	0.0	90.8

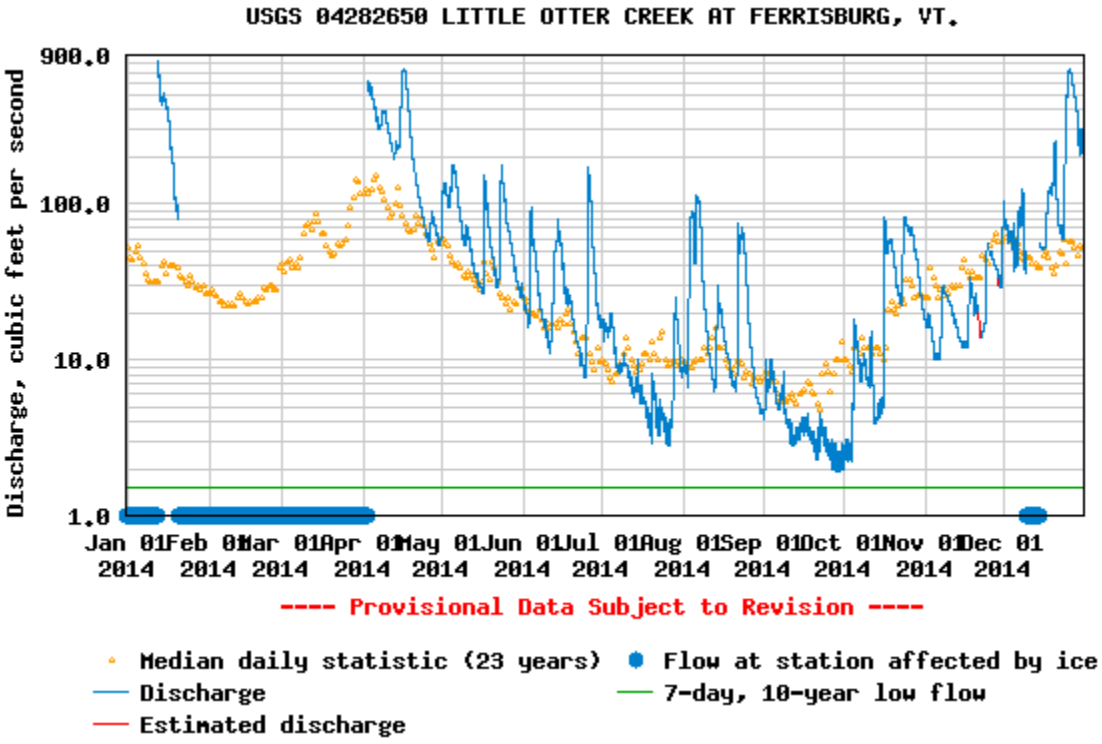
Total snowfall in inches. Values for 1971-2000 and 1981-2011 periods reflect averages for the time period. Values for seasons are totals.
Source: http://www.weather.gov/climate/xmacis.php?wfo=btv data available as of Jan 2015
Tr = Trace; M - Missing data

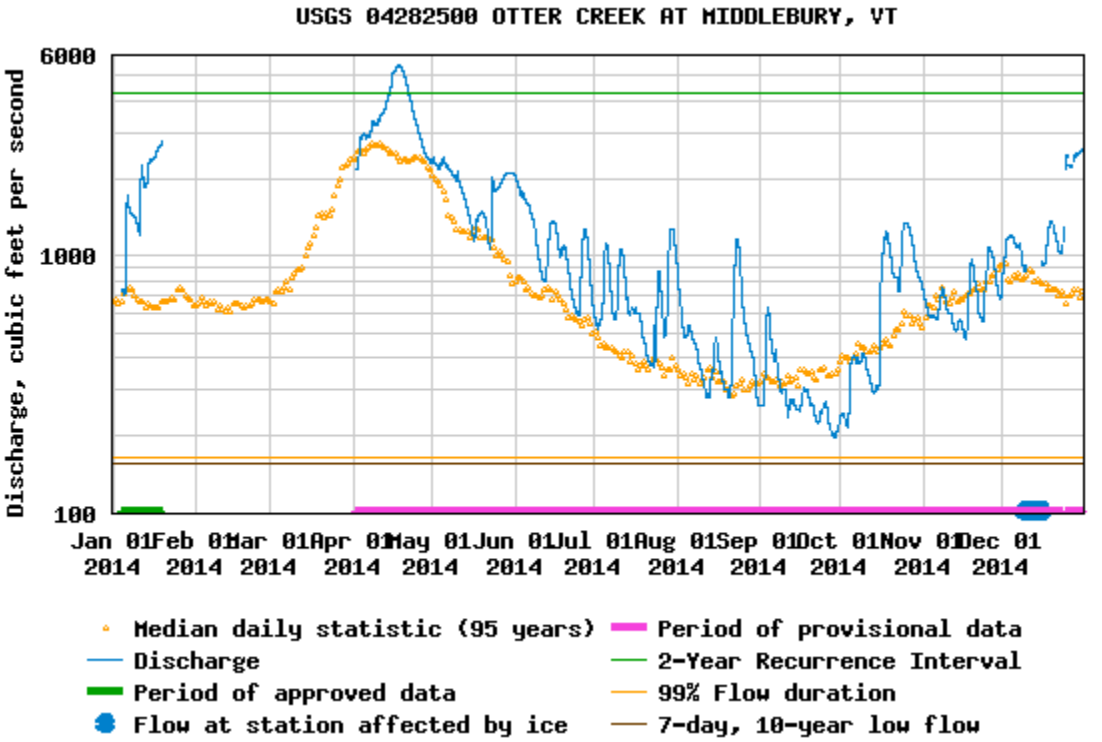
Table B-3. 2014 Flows recorded in Addison County rivers, with reference to estimated peak flows and low median monthly flows.

	River	Little Otter Ck	Lewis Creek	New Haven River	Otter Ck MB
	USGS Gage #	#04282650	#04282780	#04282525	#04282500
	Drainage Area (sq mi)	57.1	77.4	115	630
Sample Dates	4/9/2014	389	665	989	3,270
(Daily Mean Flows)	5/7/2014	112	201	350	2,180
(cfs)	6/4/2014	74	96	283	1,720
	7/2/2014	16	48	101	532
	8/6/2014	105	263	365	506
	9/3/2014	8.2	44	150	443
Peak Flows	Q2	1,120	2,280	4,410	4,270
(Olson, 2002; Table 2)	Q5	1,640	2,990	6,980	5,840
	Q10	1,990	3,420	8,870	6,970
	Q25	2,440	3,920	11,500	8,480
	Q50	2,790	4,270	13,500	9,680
	Q100	3,130	4,590	15,700	10,900
	Q500	3,950	5,290	21,200	14,200
Low Median Monthly Flows (Blaine Hastings, VWMD)		6.6	21.2	65.0	325


USGS 04282525 NEW HAVEN RIVER @ BROOKSVILLE, NR MIDDLEBURY, VT
Discharge, cubic feet per second
7000
1000
100
30
Jan 01 2014
Feb 01 2014
Mar 01 2014
Apr 01 2014
May 01 2014
Jun 01 2014
Jul 01 2014
Aug 01 2014
Sep 01 2014
Oct 01 2014
Nov 01 2014
Dec 01 2014
Median daily statistic (24 years)
Flow at station affected by ice
Discharge
Period of provisional data
Period of approved data
2-Year Recurrence Interval


USGS 04282780 LEWIS CREEK AT NORTH FERRISBURG, VT.
Discharge, cubic feet per second
3000
2000
1000
100
10
Jan 01 2014
Feb 01 2014
Mar 01 2014
Apr 01 2014
May 01 2014
Jun 01 2014
Jul 01 2014
Aug 01 2014
Sep 01 2014
Oct 01 2014
Nov 01 2014
Dec 01 2014
---- Provisional Data Subject to Revision ----
Median daily statistic (23 years)
Flow at station affected by ice
Discharge


USGS 04282650 LITTLE OTTER CREEK AT FERRISBURG, VT.
Discharge, cubic feet per second
900.0
100.0
10.0
1.0
Jan 01 2014
Feb 01 2014
Mar 01 2014
Apr 01 2014
May 01 2014
Jun 01 2014
Jul 01 2014
Aug 01 2014
Sep 01 2014
Oct 01 2014
Nov 01 2014
Dec 01 2014
---- Provisional Data Subject to Revision ----
Median daily statistic (23 years)
Flow at station affected by ice
Discharge
7-day, 10-year low flow
Estimated discharge


USGS 04282500 OTTER CREEK AT MIDDLEBURY, VT
Discharge, cubic feet per second
6000
1000
100
Jan 01 2014
Feb 01 2014
Mar 01 2014
Apr 01 2014
May 01 2014
Jun 01 2014
Jul 01 2014
Aug 01 2014
Sep 01 2014
Oct 01 2014
Nov 01 2014
Dec 01 2014
Median daily statistic (95 years)
Period of provisional data
Discharge
2-Year Recurrence Interval
Period of approved data
99% Flow duration
Flow at station affected by ice
7-day, 10-year low flow

Appendix C

Water Quality Data Tables by Watershed

Abbreviations:

TN = Total Nitrogen
TP = Total Phosphorus
DP = Dissolved Phosphorus
TSS = Total Suspended Sediments

MPN/100 mL = organisms per 100 milliliters
mg/L = milligrams per liter
ug/ L = micrograms per liter
NTU = Nephelometric Turbidity Units

-- = No Data
NS = Not Sampled
NA = Not Analyzed (e.g., insufficient sample volume; vial broken in transit)
NM = Not Measured

JB = estimated value; constituent was present in an associated field blank

JD = estimated value; Relative Percent Difference (RPD) of primary and field duplicate sample values exceeded the QAPP RPD goal for that constituent

Note: QA/QC issues further detailed in separate QA Summary Report

Lemon Fair River

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)		TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
LFR6.7	4/9/2014			107		53	10.5	33
LFR12	4/9/2014			158		58.3	54.3	101
LFR6.7	5/7/2014			68.5		29.4	22.3	34
LFR12	5/7/2014			59.3		29.6	12	23.6
LFR6.7	6/4/2014	1,733		232	JB	67.4	87	145
LFR12	6/4/2014	770		183	JB	47.4	111	124
LFR6.7	7/2/2014	162		232		61.4	130	167
LFR12	7/2/2014	127		244		54.7	161	193
LFR6.7	8/6/2014	411		169		38.6	81.2	67.4
LFR12	8/6/2014	1,046		197		52.4	182	211
LFR6.7	9/3/2014	2,420		278		64.3	174	257
LFR12	9/3/2014	1,414		254		54.9	163	219

VT Water Quality Standards (effective October 2014):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Lewis Creek

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
LCR3.7	4/9/2014			448			178
LCR14	4/9/2014			284			67.5
LCR3.7	5/7/2014			39.7			17
LCR14	5/7/2014			28.5			7.14
LCR3.7	6/4/2014	461		86.8			14.4
LCR14	6/4/2014	> 2419.6		43.2			5.09
LCR3.7	7/2/2014	272		26.1			5.8
LCR14	7/2/2014	687		21.9			3.02
LCR3.7	8/6/2014	> 2419.6		362			223
LCR14	8/6/2014	1,300		114			34.2
LCR3.7	9/3/2014	150		52.3			15.4
LCR14	9/3/2014	> 2419.6		43			6.53

VT Water Quality Standards (effective October 2014):

- **Turbidity** (cold water Class B) = **10 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Little Otter Creek

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
LOC4.3	4/9/2014			108	46.3	32	49.9
MDC1.2	4/9/2014			111	59.8	8.43	18
LOC4.3	5/7/2014			43.2	23.6	9.33	13.4
MDC1.2	5/7/2014			43.4	33.4	1.6	2.51
LOC4.3	6/4/2014	1,986		230	53.3	125	166
MDC1.2	6/4/2014	517		295	204	12.4	15.3
LOC4.3	7/2/2014	1,120		240	96.3	63	69.7
MDC1.2	7/2/2014	135		367	293	7.75	9.67
LOC4.3	8/6/2014	830		333	88.4	205	280
MDC1.2	8/6/2014	1,300		230	77.5	160	264
LOC4.3	9/3/2014	148		110	59.2	36	41.7
MDC1.2	9/3/2014	261		169	125	11.7	16.5

VT Water Quality Standards (effective October 2014):

- **Turbidity** (cold water Class B) = **10 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Middlebury River

Location	Date	Alklinity (mg CaCO3/L)	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
MIR0	4/9/2014			0.7	67.6			29
MIR1.5	4/9/2014			0.71	84.3			29.7
MIR2	4/9/2014			0.79	70.4			23.4
MIR3	4/9/2014			0.64	33.5			10.6
MIR5.7	4/9/2014			0.63	25.7			6.67
MRNB1.7	4/9/2014				25.5			4.24
MIR10.6	4/9/2014				31.5			3.9
MRSB1	4/9/2014				47			6.75
MRSB4.2	4/9/2014				22.4			6.67
MRHT0.1	4/9/2014				100			36.1
MIR0	5/7/2014			0.42	14.5 JB			3.66
MIR1.5	5/7/2014			0.42	14.8 JB			3.34
MIR2	5/7/2014			0.42	10.6 JB			2.57
MIR3	5/7/2014			0.41	7.55 JB			1.22
MIR5.7	5/7/2014			NS	NS			NS
MRNB1.7	5/7/2014				7.95 JB			1.16
MIR10.6	5/7/2014				6.92 JB			0.58
MRSB1	5/7/2014			0.48	7.78 JB			1.67
MRSB4.2	5/7/2014				6.15 JB			0.83
MRHT0.1	5/7/2014				82.1 JB			15.4
MIR0	6/4/2014		> 2419.6	0.62	77.7			9.64
MIR1.5	6/4/2014		> 2419.6	0.68	77			9.04
MIR2	6/4/2014		> 2419.6	0.55	56.6			6.74
MIR3	6/4/2014		101	0.32	11.7			1.57
MIR5.7	6/4/2014		NS	NS	NS			NS
MRNB1.7	6/4/2014	17 JD	70		12.4			0.35
MIR10.6	6/4/2014	18 JD	72		12.6			0.87
MRSB1	6/4/2014	14 JD	44		14.3			1.12
MRSB4.2	6/4/2014	10 JD	38		10.9			1.18
MRHT0.1	6/4/2014	176 JD	178		93.3			20.4

VT Water Quality Standards (effective October 2014):

- **Turbidity** (cold water Class B) = **10 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**.
  In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Middlebury River (continued)

Location	Date	Alklinity (mg CaCO3/L)	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
MIR0	7/2/2014		365	0.43	25.5			3.01
MIR1.5	7/2/2014		NA	0.42	25.8			3.12
MIR2	7/2/2014		135	0.35	16.2			1.45
MIR3	7/2/2014		36	0.36	10.5			0.37
MIR5.7	7/2/2014		11	0.36	10.3			0.22
MRNB1.7	7/2/2014	22 JD	46		15.6			0.45
MIR10.6	7/2/2014	28 JD	14		17.1			< 0.2
MRSB1	7/2/2014	26 JD	19		8.96			< 0.2
MRSB4.2	7/2/2014	12 JD	75		10.3			0.36
MRHT0.1	7/2/2014	180 JD	687		114			18
MIR0	8/6/2014		276	0.31	28.7			4.48
MIR1.5	8/6/2014		179	0.33	28.6			2.82
MIR2	8/6/2014		172	0.31	21.5			2.55
MIR3	8/6/2014		24	0.36	10.6			0.62
MIR5.7	8/6/2014		30	0.26	11.6			0.67
MRNB1.7	8/6/2014	28	47		17.4			1.05
MIR10.6	8/6/2014	26	20		13.9			0.34
MRSB1	8/6/2014	24	38		10.8			0.49
MRSB4.2	8/6/2014	20	26		10.7			0.61
MRHT0.1	8/6/2014	185	124		124			17.1
MIR0	9/3/2014		> 2419.6	0.88	145			28.3
MIR1.5	9/3/2014		> 2419.6	0.85	164			23.6
MIR2	9/3/2014		> 2419.6	0.8	137			16.1
MIR3	9/3/2014		980	0.42	27.5			4.68
MIR5.7	9/3/2014		727	0.43	26.2			4.12
MRNB1.7	9/3/2014	28	921		27.3			3.63
MIR10.6	9/3/2014	26	148		23.2			1.5
MRSB1	9/3/2014	23	488		17.7			1.97
MRSB4.2	9/3/2014	15	365		16.3			1.72
MRHT0.1	9/3/2014	164	1,414		127			27.5

VT Water Quality Standards (effective October 2014):

- **Turbidity** (cold water Class B) = **10 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**.
  In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

New Haven River

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
NHR2	4/9/2014			145			35.3
NHR9	4/9/2014			54.7			7.23
NHR2	5/7/2014			20.8			3.88
NHR9	5/7/2014			9.11			1.81
NHR2	6/4/2014	1,414		38.2			10.3
NHR9	6/4/2014	114		25.6			1.35
NHR11.5	6/4/2014	96					
NHR2	7/2/2014	201		20.6			2.91
NHR9	7/2/2014	133		214			1.58
NHR11.5	7/2/2014	206					
NHR2	8/6/2014	980		55.4			15.2
NHR9	8/6/2014	199		32.1			3.34
NHR11.5	8/6/2014	178					
NHR2	9/3/2014	1,986		56.2			13.8
NHR9	9/3/2014	1,414		29.7			6.61
NHR11.5	9/3/2014	1,120					

VT Water Quality Standards (effective October 2014):

- **Turbidity** (cold water Class B) = **10 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Otter Creek (Lower)

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
OTR7.3	4/9/2014		0.8	210	21.9		69.7
OTR13	4/9/2014		0.71	119	21.9		36.8
OTR18	4/9/2014		0.6	98.1	16.6		24.8
OTR23	4/9/2014		0.6	54.5	15.6		14.7
OTR30	4/9/2014		0.58	49.6	13.4		9.08
OTR7.3	5/7/2014		0.44	32.2	11.2		7.49
OTR13	5/7/2014		0.42	26.2	9.76		8.03
OTR18	5/7/2014		0.42	21.9	8.02		4.97
OTR23	5/7/2014		0.4	22	7.57		6.03
OTR30	5/7/2014		0.39	23.9	7.57		4.82
OTR7.3	6/4/2014	1,733	0.79	127	37.5		48.9
OTR13	6/4/2014	770	0.61	61.9	27.4		21.7
OTR18	6/4/2014	579	0.53	82.5	22.5		5.6
OTR23	6/4/2014	687	0.58	86.2	24.8		4.34
OTR30	6/4/2014	47	0.5	78.5	24.1		3.86
OTR7.3	7/2/2014	104	0.49	38.5	20		5.62
OTR13	7/2/2014	73	0.49	31.4	17.6		4.5
OTR18	7/2/2014	44	0.49	28.1	17.8		2.43
OTR23	7/2/2014	178	0.53	31.2	21.3		2.93
OTR30	7/2/2014	20	0.58	31	16.8		2.2

VT Water Quality Standards (effective October 2014):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Otter Creek (Lower) – (continued)

Location	Date	Final E. Coli. (MPN/100mL)	TN (mg/L)	TP (ug/L)	TDP (ug/L)	TSS (mg/L)	Turbidity (NTU)
OTR7.3	8/6/2014	69	0.43	37.8	19.5		8.44
OTR13	8/6/2014	1,203	0.5	61.1	20.5		39.3
OTR18	8/6/2014	1,986	0.51	73.7	24.1		32.3
OTR23	8/6/2014	111	0.48	26.8	15.2		3.05
OTR30	8/6/2014	47	0.52	21.1	13.3		3.72
OTR7.3	9/3/2014	93	0.48	31.3	15.1		6.12
OTR13	9/3/2014	66	0.52	33.7	19.3		6.29
OTR18	9/3/2014	33	0.55	43.3	34.9		3.21
OTR23	9/3/2014	411	0.57	27.2	15.2		4.57
OTR30	9/3/2014	111	0.55	28.3	15.3		2.54

VT Water Quality Standards (effective October 2014):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Attachments

1 Lemon Fair River – 2014 Water Quality Summary
2 Lewis Creek – 2014 Water Quality Summary
3 Little Otter Creek – 2014 Water Quality Summary
4 Middlebury River – 2014 Water Quality Summary
5 New Haven River – 2014 Water Quality Summary
6 Otter Creek (Lower) – 2014 Water Quality Summary

Lemon Fair River - 2014 Water Quality Summary
Addison County Riverwatch Collaborative

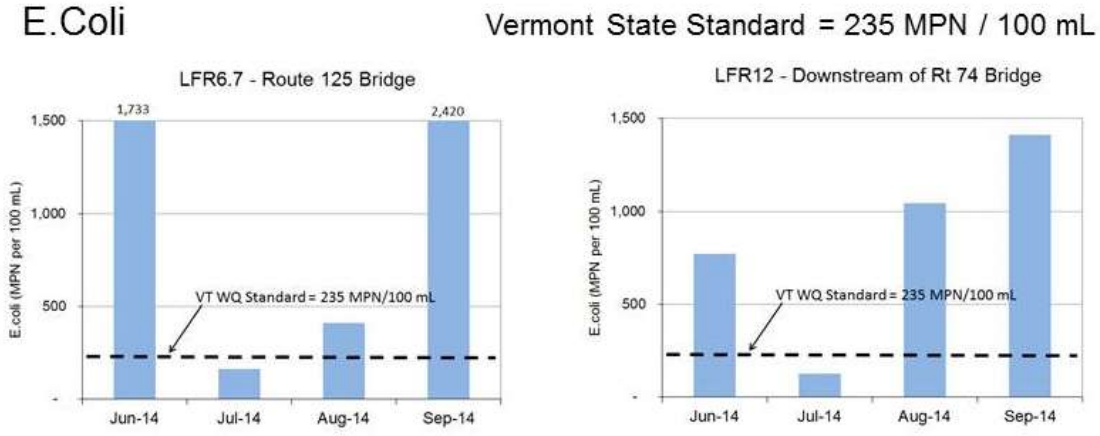
Site	Location	Town
LFR6.7	Route 125 bridge.	Cornwall
LFR12	Downstream of Route 74 bridge	Shoreham

The Addison County Riverwatch Collaborative has been monitoring water quality in the Lemon Fair River since 2003. For years 2014 through 2017, the number of sampling locations in this watershed has been reduced to two sentinel stations, LFR6.7 and LFR12.

During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred during a time of snow melt and represented high flow conditions on the river, based on streamflow gaging records for a similar river (Little Otter Creek). May, June and August events occurred during moderate flow conditions on the river, while the July and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative.

Samples from the Lemon Fair watershed were tested for E.coli, phosphorus (total and dissolved), total suspended solids, and turbidity; E.coli was tested only on the summer dates.

E.coli counts in the Lemon Fair watershed at the two sentinel sites exceeded the state standard of 235 organisms/ 100 mL on a majority of the sampling dates. The geometric mean of summer sampling results was 727 org/100mL at LFR6.7 and 617 org/100mL at LFR12; these values exceed the state's geomean standard of 126 organisms/ 100 mL. Detected E.coli counts were largely consistent with historic monitoring results which indicate chronic exceedences of the water quality standard at these two sites.



Turbidity levels at the sampled stations in Lemon Fair watershed ranged from 23.6 to 257 NTUs, with a mean of 131 NTUs. Highest concentrations were detected during low-flow conditions on July 2 and September 3. The Vermont state standard of 25 NTUs (for Class B warm-water fisheries) is applicable

during low-flow conditions. Detected concentrations were well above the standard on both low-flow sampling dates at each sentinel station.

Phosphorus was detected at moderate levels during the six spring and summer sampling dates of 2014. Concentrations ranged from 59.3 to 278 ug/L. As with turbidity, phosphorus concentrations were particularly elevated during low-flow months. The mean of the results available for the two low-flow, summer sampling dates (July and September) at each station exceeded the recently approved instream phosphorus criterion of 27 ug/L for warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters. It is possible that Lemon Fair River would instead be classified as a slow-winder stream ecotype (not yet determined for the reaches sampled); there is no instream phosphorus criterion for the slow-winder ecotype.

2015: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus (total and dissolved), total suspended sediments, and turbidity at these two sentinel sites in 2015. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Lemon Fair for a two-year period beginning in the year 2018.

For more information, contact the Lemon Fair interim sampling coordinator:
Barb Otsuka, 388-6829, botsuka@sover.net
Addison County Riverwatch Collaborative coordinator: Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

Lewis Creek - 2014 Water Quality Summary
Addison County Riverwatch Collaborative

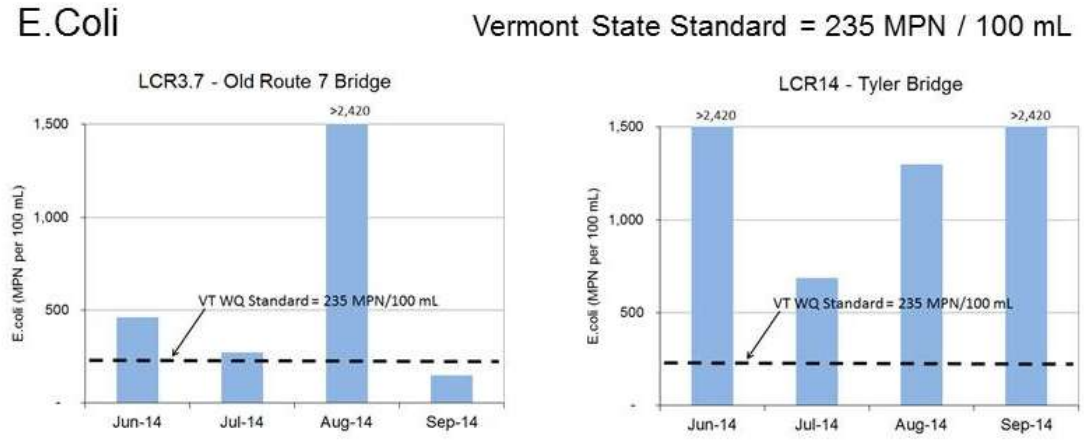
Site	Location	Town
LCR3.7	Old Route 7 Bridge	Ferrisburgh
LCR14	Tyler Bridge	Monkton

The Addison County Riverwatch Collaborative has been monitoring water quality in the Lewis Creek since 1992. For years 2014 through 2017, the number of sampling locations in this watershed has been reduced to two sentinel stations, LCR3.7 and LCR14.

During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred just after ice out during a time of snow melt and represented high flow conditions on the river, based on streamflow gaging records from the USGS streamflow gage located at the Route 7 crossing. The August event also captured high flows resulting from an overnight thunderstorm. The May and June events occurred during moderate flow conditions related to higher-than-normal rainfall in the spring months. The July and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative.

Samples from the Lewis Creek watershed were tested for E.coli, total phosphorus, and turbidity; E.coli was tested only on the summer dates.

E.coli counts in the Lewis Creek at the two sentinel stations exceeded the recently modified state standard of 235 organisms/100 mL on a majority of the sample dates. Detected E.coli counts at these sites in the 2014 season were largely consistent with historic results. Station LCR14 is located downstream of a dairy pasture where livestock have direct access to the stream. This station is also located downstream of the confluence with Hollow Brook which flows through wetlands populated by beavers.



Turbidity levels in the Lewis Creek at the sampled stations ranged from 3.0 to 223 NTUs, with a mean level of 48 NTUs for the six sample dates. Highest turbidity concentrations were observed during high-flow events on April 9 (178 NTUs) and August 6 (223 NTUs) at station LCR3.7 near the Route 7 bridge. Based on past years' sampling results, turbidity can be elevated at times of increased flow – during a summer thunderstorm, or during spring runoff conditions – especially in the lower reaches of the river. An increasing trend in turbidity with distance downstream is generally observed during all flow conditions. The Vermont state standard of 10 NTUs (for Class B cold-water fisheries) is applicable during low-flow conditions. The turbidity standard was exceeded on one low-flow sampling date (September 3) at station LCR3.7 (15.4 NTUs).

Phosphorus was detected at low to moderate concentrations during the six Spring and Summer sampling dates, ranging from 21.9 to 448 ug/L, with an average of 129 ug/L. Highest phosphorus concentrations were associated with the April 9 and August 6 high-flow events at both stations, LCR3.7 and LCR14. The mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July and September) at LCR3.7 (39.2 ug/L) and LCR14 (32.4 ug/L) each exceeded the approved instream nutrient standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters. Historic results for both sentinel and rotational sites have shown an increasing trend in phosphorus concentration with distance downstream.

2015: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, total phosphorus, and turbidity at these two sentinel sites in 2015. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Lewis Creek for a two-year period beginning in the year 2018.

For more information, contact the Lewis Creek sampling coordinator:
Louis DuPont, 453-5538, ldupont@gmavt.net
Addison County Riverwatch Collaborative coordinator: Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

Little Otter Creek - 2014 Water Quality Summary
Addison County Riverwatch Collaborative

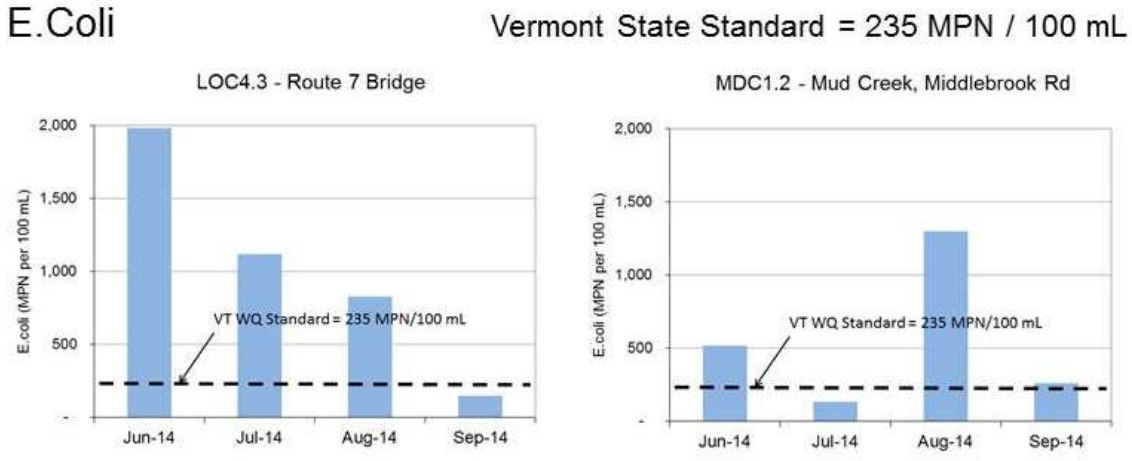
Site	Location	Town
LOC4.3	Route 7 Bridge	Ferrisburgh
MDC1.2	Wing Rd./Middlebrook Rd. (South)	Ferrisburgh

The Addison County Riverwatch Collaborative has been monitoring water quality in the Little Otter Creek since 1997. For years 2012 through 2015, the number of sampling locations in this watershed has been reduced to two sentinel stations, LOC4.3 and MDC1.2.

During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred just after ice out during a time of snow melt and represented high flow conditions on the river, based on records from the USGS streamflow gage located at the Route 7 crossing. May, June and August events occurred during moderate flow conditions on the river, while the July and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative.

Samples were tested for E.coli, phosphorus (total and dissolved), total suspended solids, and turbidity; E.coli was tested only on the summer dates.

E.coli counts at the two sentinel stations exceeded the recently modified state standard of 235 organisms/100 mL on a majority of the sample dates. Detected E.coli counts at these sites in the 2014 season were largely consistent with historic results.



Turbidity levels in the Little Otter Creek at the two sentinel stations ranged from 2.5 to 280 NTUs, with a mean level of 79 NTUs for the six sample dates. Highest turbidity concentrations were observed during moderate flow events on June 4 (166 NTUs) at LOC4.3 and on August 6 (280 and 264 NTUs) at both sentinel stations. Turbidity results for 2014 at these two stations were largely consistent with historic trends. Based on past years' sampling results, turbidity can become elevated at times of increased flow

– during a Summer thunderstorm, or during Spring runoff conditions. The Vermont state standard of 10 NTUs (for Class B cold-water fisheries) is applicable during low-flow conditions. The turbidity standard was exceeded on both low-flow sampling dates (July 2 and September 3) at station LOC4.3 (69.7 and 41.7 NTUs).

Phosphorus levels were detected at low to moderate concentrations during the six spring and summer sampling dates, ranging from 43.2 to 367 ug/L, with an average of 190 ug/L. Total Phosphorus concentrations detected in 2014 were generally consistent with historic data. The mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July and September) at LOC4.3 (175 ug/L) and MDC1.2 (268 ug/L) each exceeded the approved instream nutrient standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters.

2015: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus (total and dissolved), total suspended sediments, and turbidity at these two sentinel sites in 2015. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Little Otter Creek for a two-year period beginning in the year 2016.

For more information, contact the Little Otter Creek sampling coordinator:
Deb Healey, 475-2944, lumiere@gmavt.net
Addison County Riverwatch Collaborative coordinator: Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

Focus watershed:
2014 and 2015

Middlebury River - 2014 Water Quality Summary
Addison County Riverwatch Collaborative

River Name	Site	Location	Town
Middlebury River	MIR0	Mouth of Middlebury River	Middlebury
Middlebury River	MIR1.5	Shard Villa Rd. Bridge	Middlebury
Middlebury River	MIR2	Blake Roy Rd. Bridge	Salisbury
Middlebury River	MIR3	Route 7 Access	Middlebury
Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge	Middlebury
North Branch MR	MRNB1.7	Dugway Road Bridge	Ripton
MR (Middle Branch)	MIR10.6	Natural Turnpike Road	Ripton
South Branch MR	MRSB1	Goshen Road Bridge	Ripton
South Branch MR	MRSB4.2	Brook Road Bridge	Ripton
Halnon Brook MR	MRHT0.1	Upstream of Route 7 crossing	Salisbury

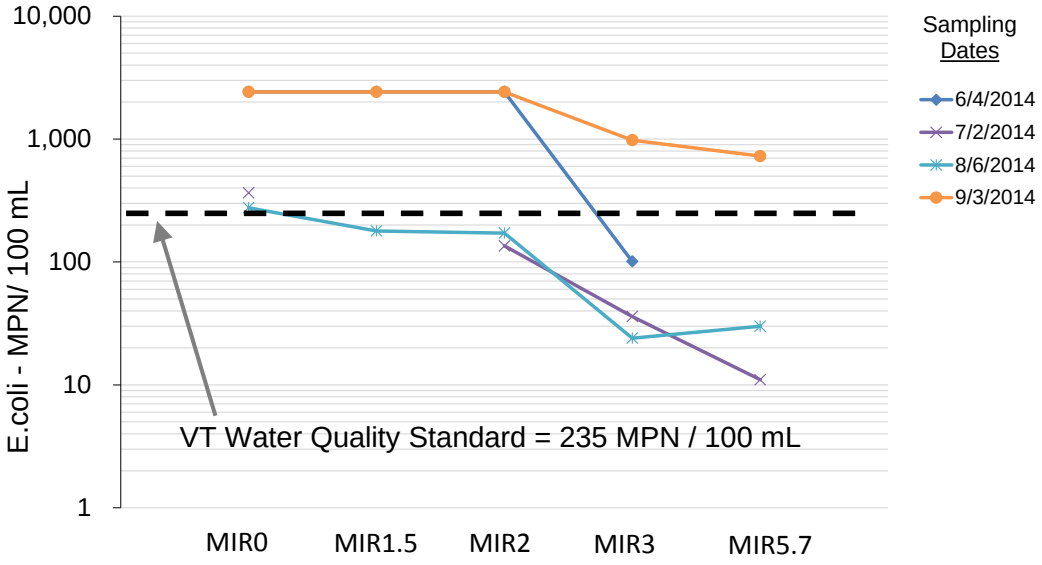
The Addison County Riverwatch Collaborative has been monitoring water quality in the Middlebury River since 1993. For the 2014 and 2015 seasons, the Middlebury River is the subject of a more intensive monitoring focus, where rotational as well as sentinel stations are monitored and additional parameters are tested. Sampled stations include two sentinel sites (MIR1.5 and MIR5.7) and six rotational sites located on the main stem, South Branch, North Branch and Halnon Brook tributaries (see above table). The tributary stations were sampled this season to obtain baseline water quality information; these stations have not been tested previously by the Collaborative. The Middlebury Gorge station was inaccessible during May and June due to ongoing bridge construction activities.

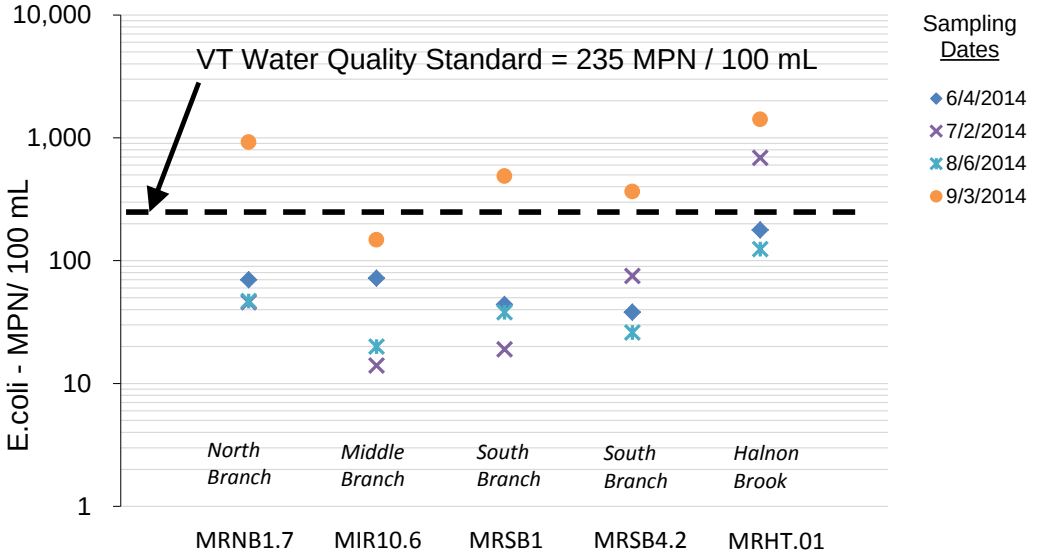
During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred just after ice out during a time of snow melt and represented high flow conditions on the river, based on streamflow gaging records from nearby gages (on the New Haven River and Lewis Creek). The August event also captured high flows resulting from an overnight thunderstorm. The May and June events occurred during moderate flow conditions related to higher-than-normal rainfall in the spring months. The July and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative.

Samples were tested for E.coli, total phosphorus, total nitrogen and turbidity; E.coli was tested only on the summer dates. As part of the baseline water quality study, alkalinity was tested at the newly-established tributary sites during the summer months only.

E.coli counts at sites on the Middlebury River main stem and tributaries ranged from 11 to >2,420 organisms/ 100 mL (see graphs on following page). Along the main stem (top graph), E.coli counts showed an increasing trend with distance downstream from the Middlebury Gorge, consistent with historic results. Values exceeded the recently-modified state standard of 235 organisms/100 mL on all four summer sampling dates at the downstream-most station, MIR0, near the confluence with Otter Creek. E.coli counts exceeded this standard at all stations on September 3; low-flow conditions and warm temperatures likely contributed to elevated E. coli counts on this date. During moderate flow conditions on June 4, E. coli counts exceeded the standard at downstream stations MIR2, MIR1.5, and MIR0. Agricultural land uses dominate the river corridor in this lower end of the Middlebury River.

At the newly-established tributary stations (bottom graph), E.coli counts were generally below the standard, except for four stations (on the North Branch, South Branch and Halnon Brook) on September 3 and Halnon Brook station (MRHT.01) on July 2.

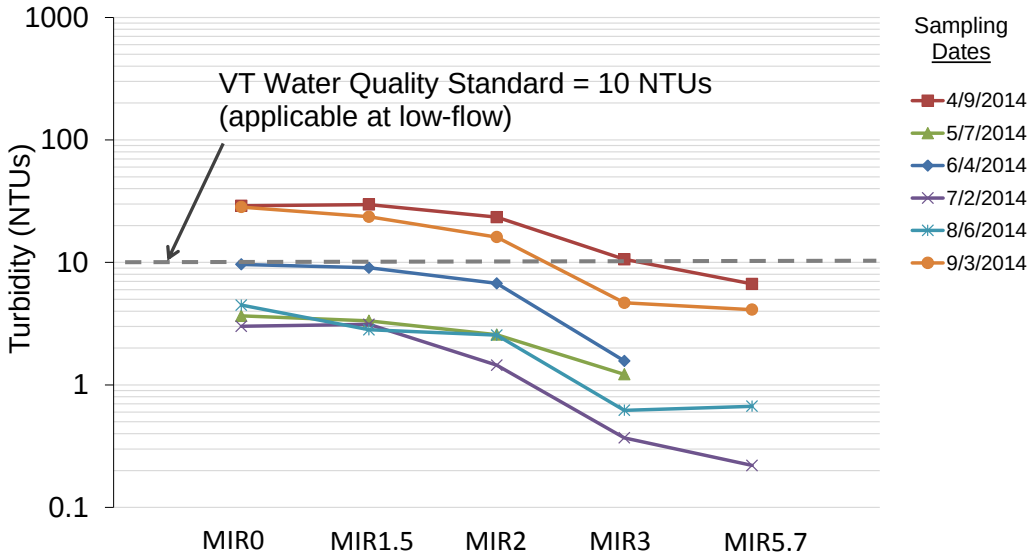


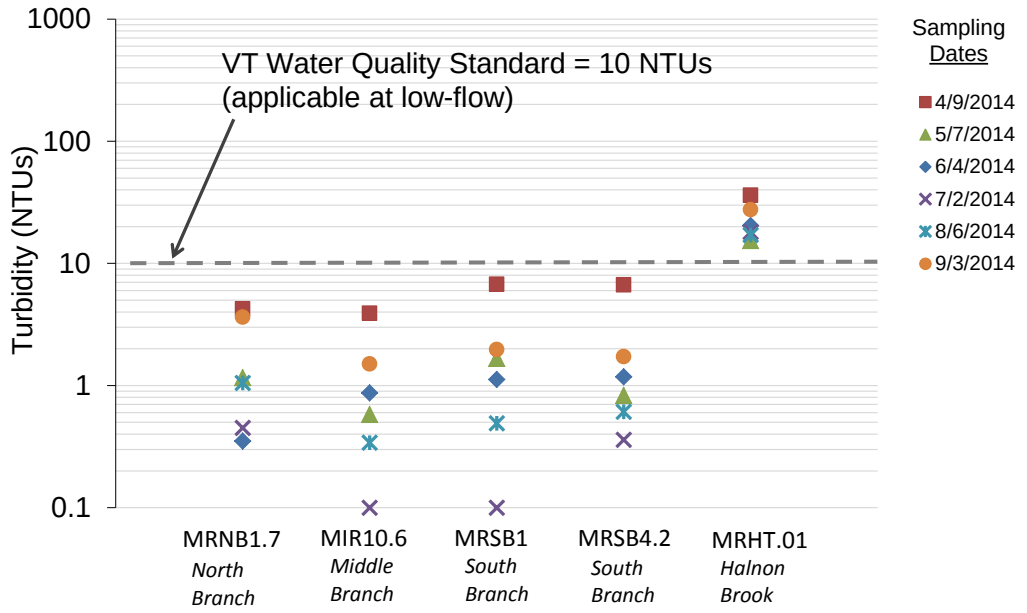


Nitrogen levels were detected at very low concentrations during the six spring and summer sampling dates. Concentrations ranged from 0.3 to 0.9 mg/L, with an average of 0.5 mg/L. A past standard for nitrogen as nitrate (5 mg/L) was eliminated during the 2014 update of the Vermont Water Quality Standards.

Turbidity levels in the Middlebury River were relatively low, ranging from <0.2 to 36 NTUs, with an average level of 7.1 NTUs for all six sample dates. Main stem results (upper graph) are largely consistent with historic trends. Based on past years' sampling results, turbidity can become elevated at times of increased flow – during a summer thunderstorm, or during spring runoff conditions – especially in the lower reaches

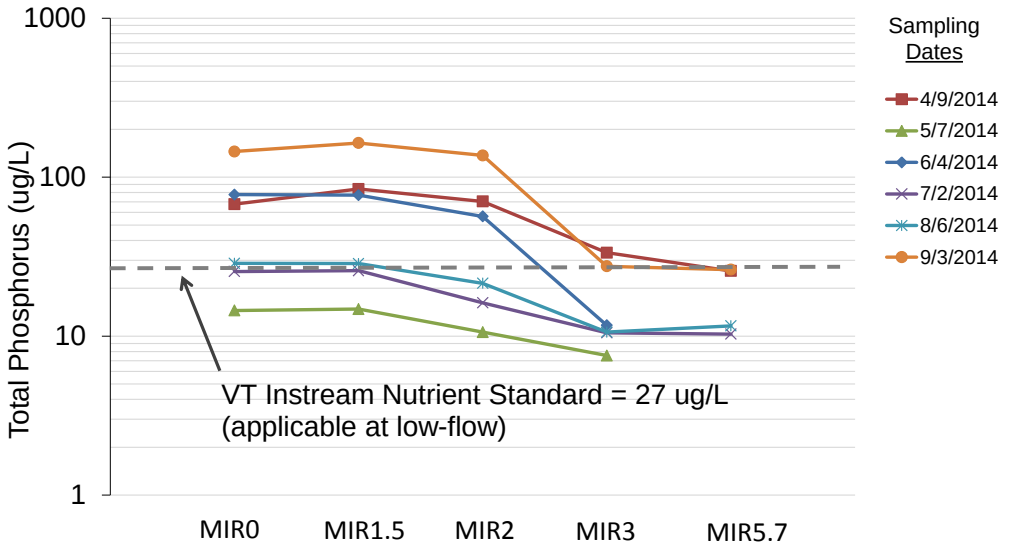
of the river below the Route 7 bridge. A slight increasing trend in turbidity with distance downstream is generally observed during all flow conditions. The Vermont state standard of 10 NTUs (for Class B cold-water fisheries) is applicable during low-flow conditions. The turbidity standard was exceeded on one of the two low-flow events (September 3) at downstream stations MIR2, MIR1.5 and MIR0. It is possible that low-flow turbidity on September 3 was at least partly associated with algae. Turbidity was also elevated at these stations during high flows following the spring runoff (April 9). Turbidity values at the newly-established tributary stations (lower graph) were all below 10 NTUs on all sample dates, except for the Halnon Brook tributary station. Turbidity values exceeded 10 NTUs during low to high flow conditions on all sample dates at MRHT.01. This station is located downstream from a fish hatchery.

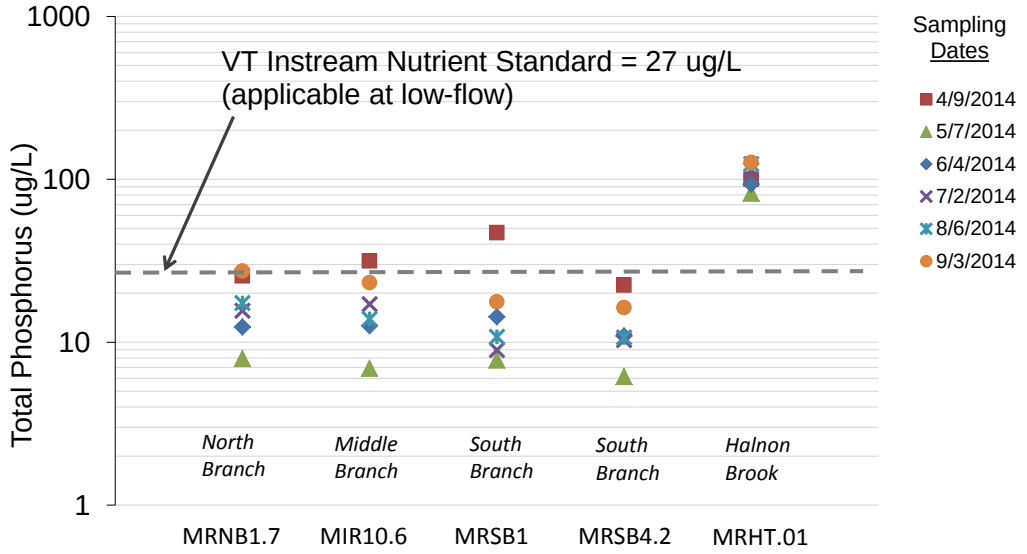




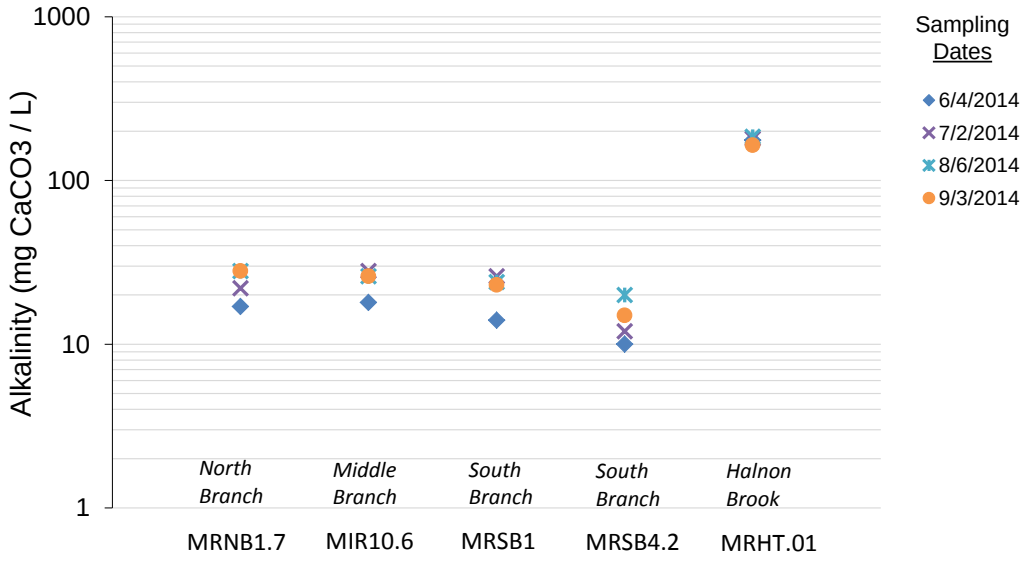
Phosphorus levels were detected at low to moderate concentrations during the six spring and summer sampling dates, ranging from 6.2 to 164 ug/L, with a mean of 39 ug/L. Along the main stem (top graph), phosphorus concentrations showed an increasing trend with distance downstream from the Middlebury Gorge, consistent with historic results. The mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July and September) at MIR2 (77 ug/L), MIR1.5 (95 ug/L), and MIR0 (85 ug/L) each exceeded the approved instream nutrient standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters.

Phosphorus concentrations at the tributary stations were generally lower than concentrations along the main stem on all sample dates, with the exception of the Halnon Brook station. Phosphorus concentrations at this location were elevated during all flow conditions relative to the other Middlebury River stations. The mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July and September) at MRHT.01 (121 ug/L) exceeded the instream nutrient standard (27 ug/L) for the WWMG stream ecotype.





Alkalinity detected at tributary monitoring sites during the summer sampling dates ranged from 10 to 185 mg CaCO3 per liter. Highest values were consistently detected at the Halnon Brook station, MRHT.01.



2015: Focused monitoring at both sentinel and rotational sites in the Middlebury River watershed will continue in 2015. Based on feedback received during outreach meetings in Ripton, additional stations will be added on the North Branch and Middle Branch to expand baseline water quality monitoring on these two tributaries.

For more information, contact the Middlebury River sampling coordinator:
Heidi Willis, 352-4327, redsprings@nbnworks.net
Addison County Riverwatch Collaborative coordinator: Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

New Haven River - 2014 Water Quality Summary

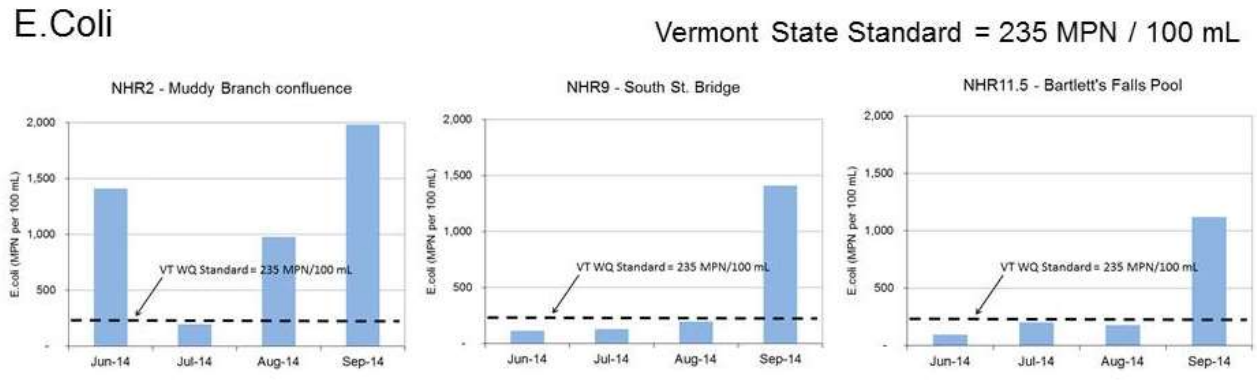
Addison County Riverwatch Collaborative

Site	Location	Town
NHR2	Muddy Branch confluence	New Haven
NHR9	South St. Bridge	Bristol
NHR11.5	Bartlett's Falls Pool	Bristol

The Addison County Riverwatch Collaborative has been monitoring water quality in the New Haven River since 1993. In 2014, the number of sampling locations in this watershed has been limited to two sentinel stations, NHR2 and NHR9, and a third recreational site monitored only for pathogens (NHR11.5).

During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred just after ice out during a time of snow melt and represented high flow conditions on the river, based on records from the USGS gage on the New Haven River at Brooksville. The August event also captured high flows resulting from an overnight thunderstorm. The May and June events occurred during moderate flow conditions related to higher-than-normal rainfall in the spring months. The July and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative. Samples were tested for phosphorus and turbidity; E.coli was tested only on the summer dates.

E.coli counts at popular recreational sites (South St. Bridge, NHR9; Bartlett's Falls, NHR11.5) were below the recently-modified state standard of 235 organisms/100 mL on all summer dates except September 3. In the lower watershed, the station near Nash Bridge in New Haven (NHR2) indicated E.coli counts elevated above the state standard in June, August and September. Low-flow conditions and warm temperatures likely contributed to elevated E. coli counts on September 3. Consistent with historic results, an increasing trend in E.coli levels is evident with distance downstream from station NHR11.5 to NHR2. Developed and agricultural land uses are more prevalent in the lower New Haven River watershed.



Turbidity levels on the New Haven River at the two sentinel stations ranged from 1.4 to 35 NTUs, with a mean level of 8.6 NTUs for the six sample dates. Results from 2014 are largely consistent with historic trends. Based on past years' sampling results, turbidity can become elevated at times of increased flow – during a summer thunderstorm, or during spring runoff conditions – especially in the lower reaches of the river below the Bristol Flats. A slight increasing trend in turbidity with distance downstream is generally observed during all flow conditions. The Vermont state standard of 10 NTUs (for Class B cold-water

fisheries) is applicable during low-flow conditions. The turbidity standard was slightly exceeded on one of the low-flow sampling dates (September 3) at station NHR2 (13.8 NTUs).

Phosphorus was detected at low to moderate concentrations on the New Haven River during the spring and summer sampling dates. Concentrations ranged from 9.1 to 214 ug/L, with an average of 58.5 ug/L. Results were consistent with historic trends, which indicate an increase in concentrations with distance downstream. At all stations, moderately high concentrations of Total Phosphorus have been detected in past years at times of high flow and runoff. In 2014, the mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July 2, September 3) at each of the New Haven River sentinel sites exceeded the approved instream nutrient standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters.

2015: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus and turbidity at these sentinel sites in 2015. In response to feedback from the Town of Bristol, an additional recreational site at Sycamore Park (NHR6) will be monitored for E.coli during the summer months. This site is a popular swimming site and the town requested that it be monitored for public health. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the New Haven River for a two-year period beginning in the year 2016.

For more information, contact the New Haven River sampling coordinator:
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Addison County Riverwatch Collaborative coordinator: Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

Focus watershed:
2014 and 2015

Otter Creek - 2014 Water Quality Summary
Addison County Riverwatch Collaborative

Site	Location	Town
OTR7.3	Vergennes Falls/below outfall	Vergennes
OTR13	Route 17 Bridge	Weybridge
OTR18	Twin Bridges Picnic Area	Weybridge
OTR23	Frog Hollow	Middlebury
OTR30	Swamp Road Bridge	Salisbury

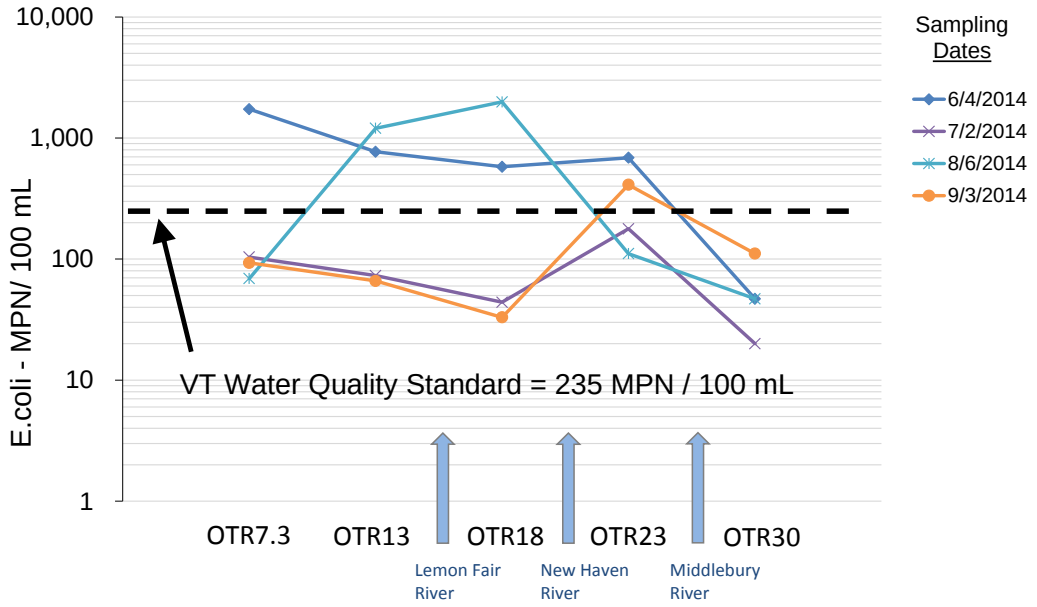
The Addison County Riverwatch Collaborative has been monitoring water quality in the lower Otter Creek since 1992. For the 2014 and 2015 seasons, Otter Creek is the subject of a more intensive monitoring focus, where rotational as well as sentinel stations are monitored and additional parameters are tested. Sampled sites include two sentinel sites (OTR18 and OTR7.3) and three rotational sites located on the main stem (see above table).

During 2014, sampling occurred on two spring dates (April 9 and May 7) and four summer dates (June 4, July 2, August 6, and September 3). The April event occurred during a time of snow melt in the mountains and represented high flow conditions on the river, based on records from the USGS gage on the Otter Creek at Middlebury and other area gages. May and June events occurred during moderate flow conditions on the river, while the July, August, and September events captured low to baseflow conditions. On an average annual basis, flows in 2014 were near normal in the Addison County watersheds monitored by the Collaborative.

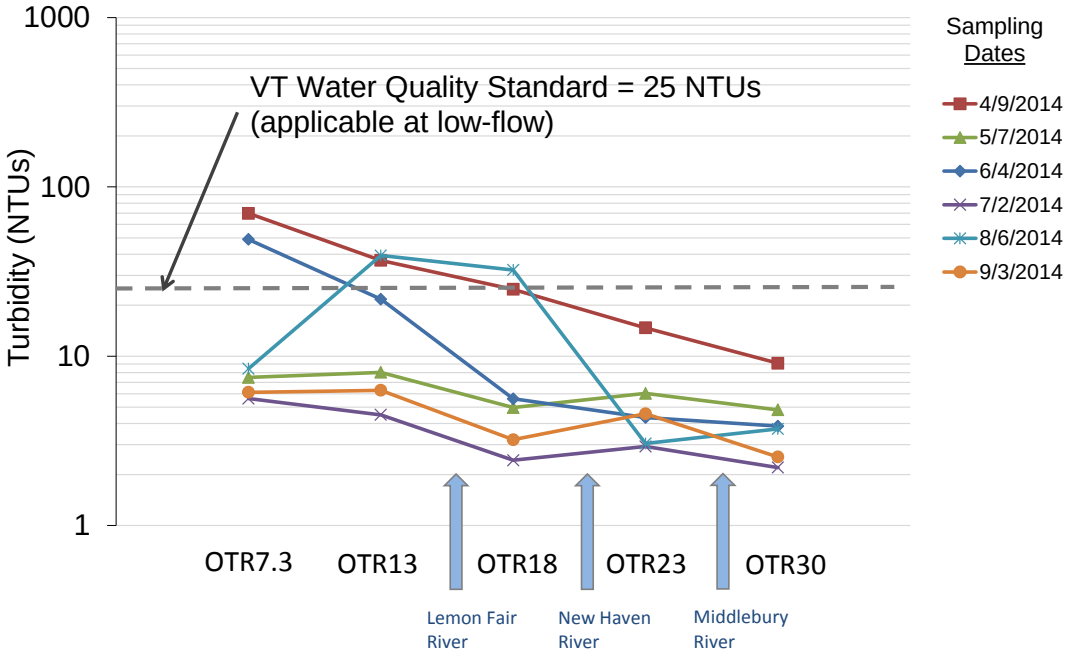
Samples were tested for E.coli, phosphorus (total and dissolved), nitrogen and turbidity; E.coli was tested only on the summer dates.

E.coli counts at sites on the lower Otter Creek ranged from 20 to 1,986 organisms/ 100 mL (see graph on following page). During low-flow conditions (July and September), E.coli values were below the recently-modified state standard of 235 organisms/100 mL at all stations except OTR23 on September 3. This station is downstream of inputs from Middlebury River, which yielded very high E. coli counts (>2,420 MPN/100 mL) during low-flow conditions on this date. During moderate to high flow conditions resulting from a summer thunderstorm (August 6) and persistent spring rains (June 4), E.coli counts were elevated at each Otter Creek station, exceeding the water quality standard at a majority of the stations. Between stations OTR30 and OTR13, Otter Creek receives runoff from the Middlebury River, New Haven River and Lemon Fair River. E.coli concentrations in one or more of these contributing watersheds were elevated on those dates, August 6 and June 4.

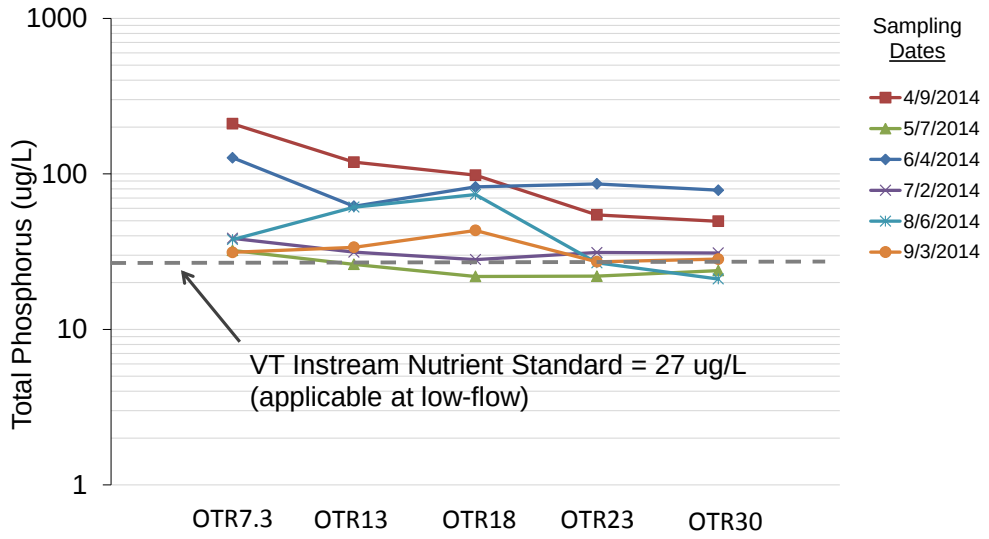
Nitrogen levels were detected at very low concentrations during the six spring and summer sampling dates, Concentrations ranged from 0.4 to 0.8 mg/L, with an average of 0.5 mg/L. These results are largely consistent with historic sampling results for nitrogen. A past standard for nitrogen as nitrate (5 mg/L) was eliminated during the 2014 update of the Vermont Water Quality Standards.



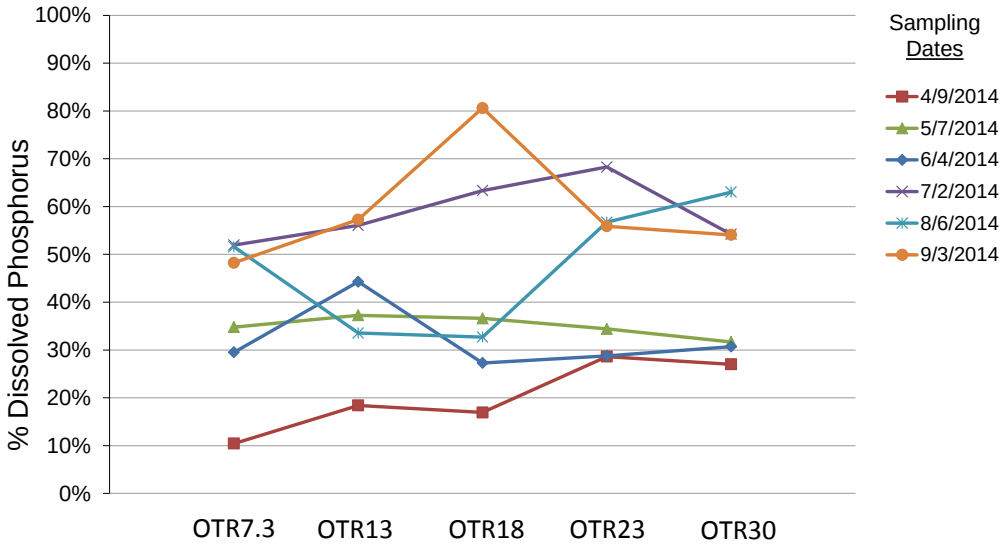
Turbidity levels at the Otter Creek stations ranged from 2.2 to 70 NTUs, with a mean value of 13 NTUs for the six sample dates. Results from 2014 are largely consistent with historic trends. Based on past years' sampling results, turbidity can become elevated at times of increased flow – during a summer thunderstorm, or during spring runoff conditions. A modest increasing trend in turbidity with distance downstream is typically observed during all flow conditions. The Vermont state standard of 25 NTUs (for Class B warm-water fisheries) is applicable during low-flow conditions. Turbidity results were below the standard at each station during low-flow conditions on July 2 and September 3. Turbidity was elevated at select downstream stations during moderate- to high-flow conditions on April 9 and August 6, and at downstream station OTR7.3 on June 4. As with E.coli, Turbidity values from contributing watersheds of the New Haven River and Lemon Fair River were somewhat elevated on those high-flow dates.



Phosphorus levels at Otter Creek stations were detected at low to moderate concentrations during the six spring and summer sampling dates in 2014. Concentrations ranged from 21 to 210 ug/L, with a mean of 55 ug/L. Results were consistent with historic trends, which generally indicate a modest increase in concentrations with distance downstream. At all stations, moderately high concentrations of Total Phosphorus have been detected in past years at times of high flow and runoff. In 2014, the mean concentration of Total Phosphorus for the two available low-flow summer sample dates (July 2, September 3) at each of the sites exceeded the approved instream nutrient standard of 27 ug/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters. These reaches of the Otter Creek might instead be classified as a Slow Winder stream ecotype, but criteria have not yet been developed for this stream classification.



The percent of total phosphorus present in the dissolved form varied with flow condition during the 2014 sample dates. Dissolved phosphorus represented a higher percentage of the Total Phosphorus concentration during low-flow conditions on July 2 and September 3. This pattern likely reflects the greater relative contribution of sediment-sorbed forms of phosphorus during moderate to high flows.



2015: The lower Otter Creek will continue to be a focus watershed in 2015, with the same five sentinel and rotational sites monitored for E.coli, total and dissolved phosphorus, total nitrogen, and turbidity. Beginning in year 2016 and continuing through 2019, the number of sampling locations in this watershed will be reduced to two sentinel stations, OTR18 and OTR7.3, as the focus of more intensive sampling rotates to another Collaborative watershed.

For more information, the Otter Creek sampling coordinator:
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