

Report for 2012 Four Rivers Partnership Volunteer Water Quality Monitoring

Background:

The Four Rivers Partnership is an affiliation of nonprofit organizations, state and local government entities, and schools focused on Winooski River watershed projects including water quality monitoring. It includes the area of the Winooski River that is bounded on the upstream edge by the confluence of the Kingsbury River and on the downstream end by the confluence with the Dog River. The Stevens Branch and North Branch join the Winooski River in between the Kingsbury and Dog River.

Goals:

As stated in the 2012 Four Rivers Partnership (4RP) water quality monitoring project application, there were four goals:

1. Test common recreational sites (8) for bacteria that could present a health risk;
2. Collect water quality data from potentially contaminated storm water outfalls to determine whether poor water quality documented in prior illicit discharge assessments was rectified or still exists;
3. Gather data on turbidity and phosphorus concentration with the goal of identifying and reducing pollutant sources;
4. Engage and educate the public through the monitoring process and provide water quality information based on monitoring data.

Results

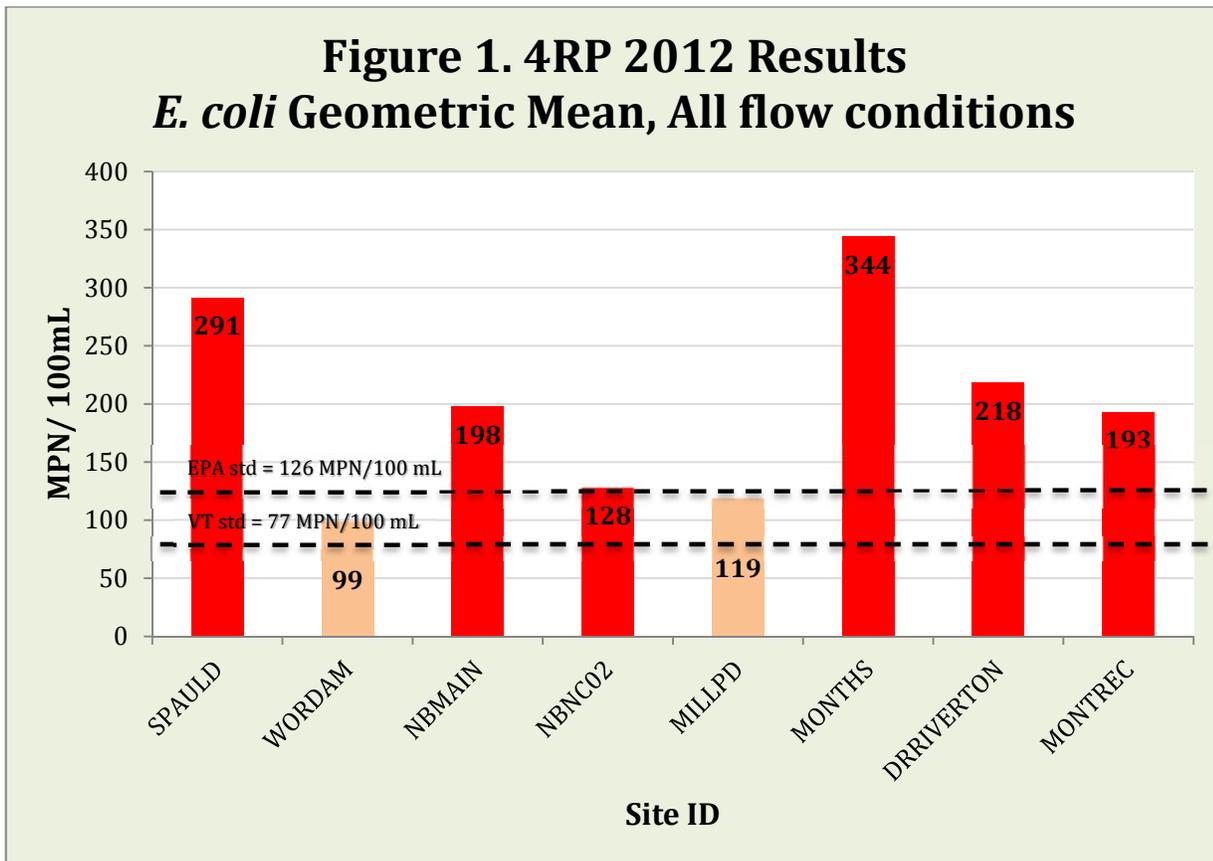
Bacteria testing and recreational contact: Members of the Partnership have been collecting bacterial data since 2008 on eighteen recreational sites. In 2012 the Partners collected data at eight sites that exceeded State and Federal standards in the past and/or sites that have a high level of recreational contact. This data has been posted on the Friends of the Winooski Website and will be used to educate the public about possible microbiological contamination of certain sites and, if possible, to identify bacteria sources. The Partners recruited and trained volunteers to collect samples from the following eight recreational sites. These samples were then submitted data to the State laboratory for analysis:

Table 1. Four Rivers Partnership Water Quality Testing Sites, 2012

<u>Location</u>	<u>Waterbody</u>	<u>Site ID</u>	<u>Lat / Long</u>
Worcester Dam Swimming Hole	North Branch	WORDAM	44.373441 / 72.5453
Mill Road Swimming Hole	North Branch	NBMAIN	44.385342 / 72.550879
North Branch Nature Center Bridge	North Branch	NBNC02	44.26766 / 72.56882
Mill Pond Park Canoe Access	North Branch	MILLPOND	44.155976 / 72.340654
Montpelier High School Access	Winooski River	MONTHS	44.261859 / 72.586412
Spaulding Falls	Jail Branch	SPAUD	44.111917 / 72.489982
Montpelier Recreation Fields	Dog River	DRMONTREC	44.25188 / 72.60126
Riverton canoe access	Dog River	DRRIVERTON	44.1994 / 72.6338

A summary of the 2012 results for these sites are shown in Figures 1 and 2 and quality assurance data is presented in Appendix A. Figure 1 displays the geometric mean *E. coli* counts for all sites under all flow conditions. The geometric mean *E. coli* count exceeded the Vermont standard of 77 MPN/100 mL at all sites sampled, and six out of the eight sites had *E. coli* levels exceeding the EPA standard of

a geometric mean of 126 MPN/100 mL. Only two sites, WORDAM and NBNC02 had geometric means that did not exceed the EPA standard.



In addition to the geometric mean standard, the EPA also recommends a single sample maximum (SSM) *E. coli* level of 235 MPN/100 mL. All eight sites sampled in the Four Rivers Program in 2012 had at least one sample with an *E. coli* count that exceeded this SSM EPA standard, and three sites exceeded this standard on multiple dates. The number of times each site's *E. coli* levels were above the EPA SSM standard of 235 MPN /100mL for each site is shown in Table 2.

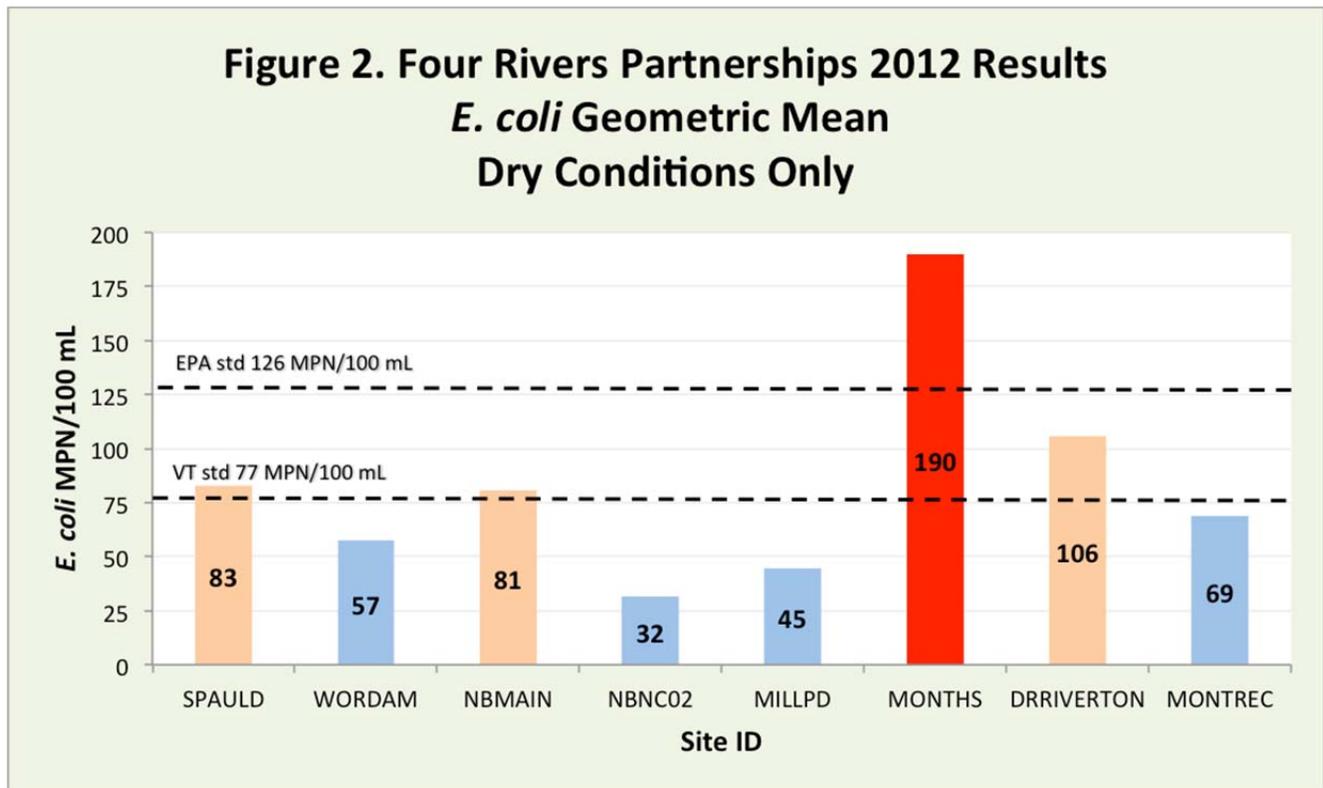
Table 2. Number of 2012 samples (out of five total) with *E. coli* counts greater than the EPA recommended single sample maximum of 235 MPN/ 100 mL.

Site ID	# of samples
SPAULD	2
WORDAM	1
NBMAIN	3
NBNC02	1
MILLPD	1
MONTHS	3
DRRIVERTON	1
MONTREC	1

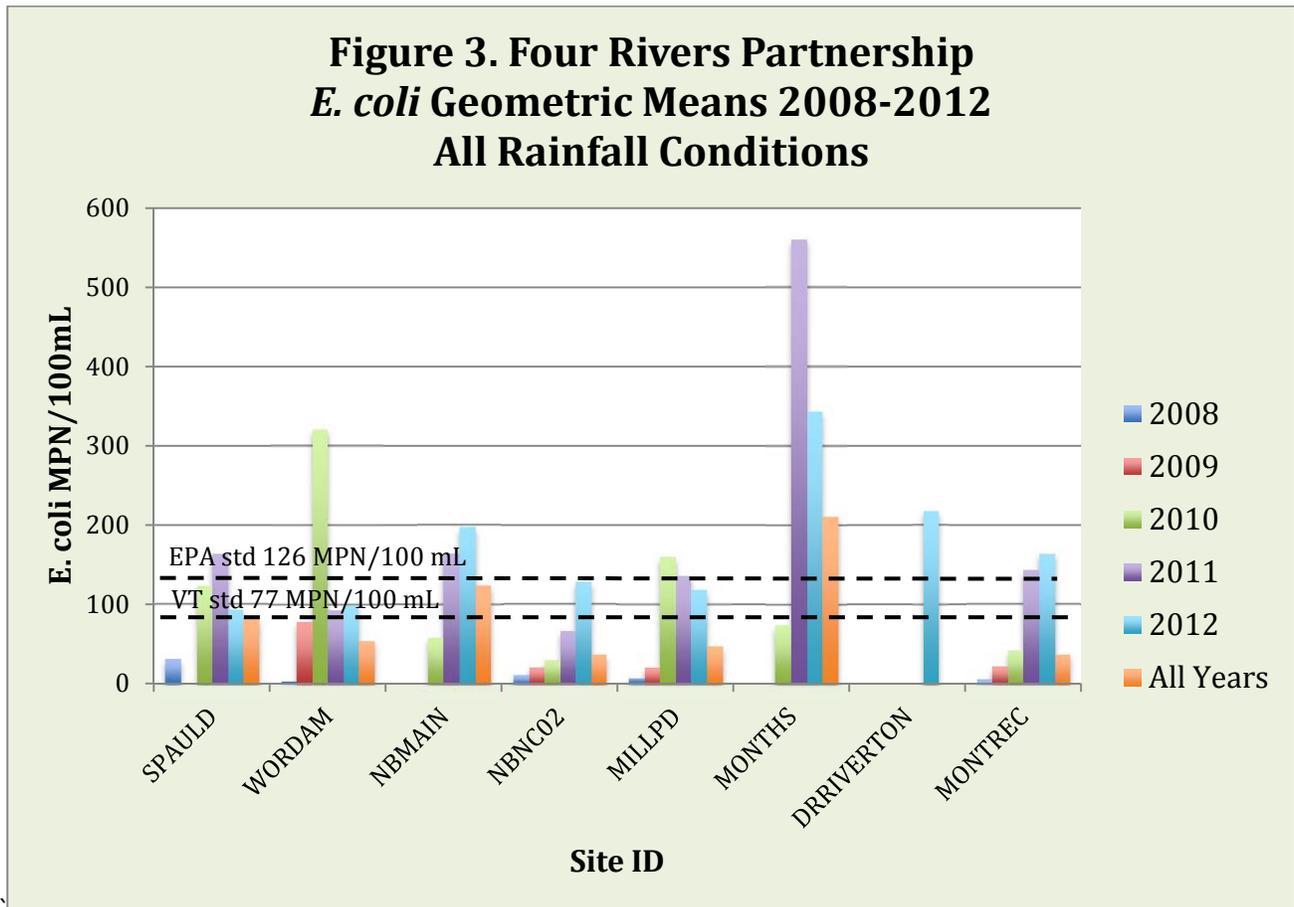
Two sites, NBMAIN and MONTHS each exceeded the EPA single sample maximum three times. The NBMAIN site is a swimming hole; the MONTHS site is the boat access for the Montpelier High school.

Since *E. coli* counts vary considerably with rainfall amounts, the EPA standard for *E. coli* geometric mean values in recreational waters is based on dry weather conditions (Quality Criteria for Water, EPA, 1986). The data was therefore reanalyzed where only those samples taken under dry conditions were included. “Dry conditions” are defined here as sample dates when there had been less than a total of 0.25 inches of rain during the preceding 2 days based on Barre/Montpelier rainfall data, obtained from the National Climate Data Center Climate Data Online website (<http://www.ncdc.noaa.gov/cdo-web/>). Three out of the five sampling dates qualified as dry weather conditions under this criterion.

The results of this reanalysis are shown in Figure 2. Under dry conditions, three sites (SPAULD, NBMAIN and DRRIVERTON) had a geometric mean above the VT standard (81 and 106 MPN/100mL, respectively), and one (MONTHS) had a geometric mean (190 MPN/100mL) that exceeded the EPA standard. All other sites had geometric means that fell below both VT and EPA standards.



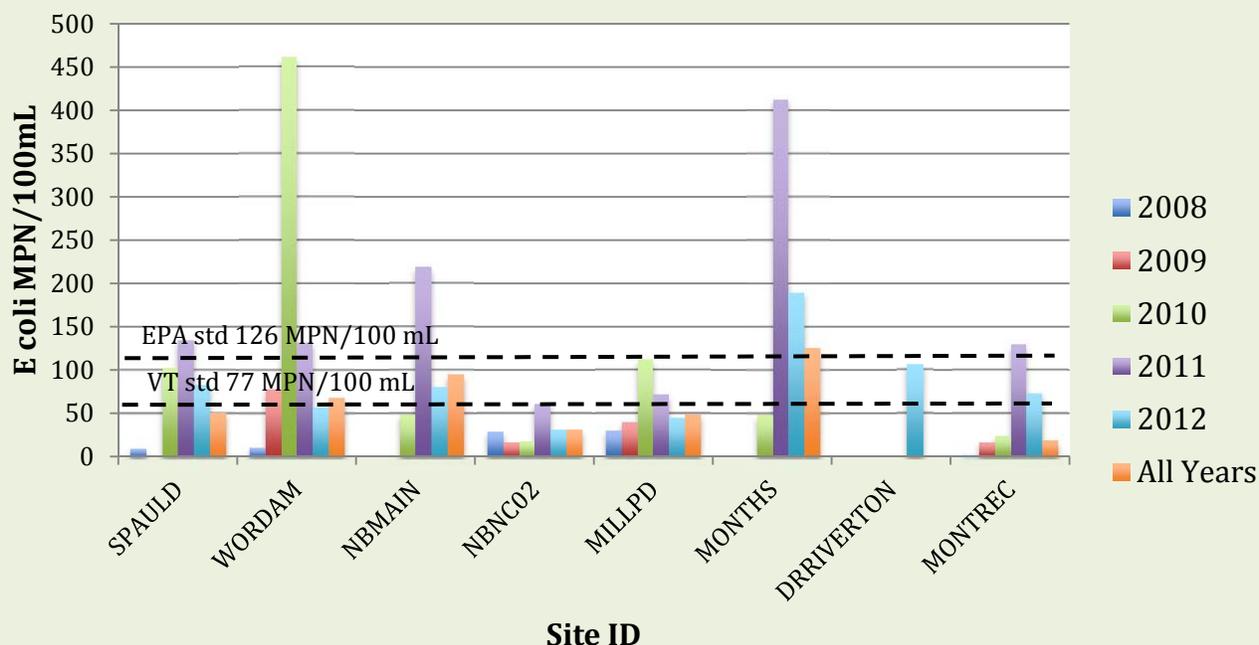
The Four Rivers Partnership has been collecting *E. coli* data on a number of sites in the central Winooski watershed since 2008, including seven of the sites sampled in 2012. (DRRIVERTON being the only site for which *E. coli* data had not been collected in prior years.) In order to identify any chronically high *E. coli* levels, the geometric mean *E. coli* values were compared across years. Figure 3 below shows the geometric mean values for all years under all conditions.



The only site with a geometric mean value that did not exceed the EPA recommended standard during any of the five years sampled was NBNC02. All other sites had at least one year where the geometric mean was greater than the EPA standard. Three sites, NBMAIN, MONTHS, and MONTREC have all had geometric mean values above the EPA standard for both 2011 and 2012. The MONTHS values, again, were particularly high.

Figure 4 shows the comparison of the geometric mean values when only samples taken in dry weather conditions are included (as defined above).

**Figure 4. Four Rivers Partnership
E. coli Geometric Means 2008-2012
Dry Conditions Only**



When only dry conditions are considered, five of the sites have a geometric mean above the EPA standard in at least one of the sampling years (SPAULD, WORDAM, NBMAIN, MONTHS, and MONTREC). The WORDAM 2008 value, however, was based on only one sample, and so may not have been representative. Both WORDAM and MONTHS sites have geometric mean values above the standard for two separate years. As in the previous datasets, the MONTHS values are particularly high. When all of the dry weather samples in all years are used to calculate an overall geometric mean for each site, all the values fall below the EPA standard except the MONTHS site value, which falls right at the EPA standard value of 126 MPN/mL.

The number of times the single sample maximum exceeded the EPA standard of 235 MPN/mL was also determined and is shown in Table 3.

Table 3. Number of samples with E coli counts exceeding the EPA single sample maximum for years 2008-2012.

Site ID	# of samples > EPA std	Total number of samples taken	Percentage of samples > EPA std
SPAULD	7	14	50
WORDAM	4	19	21
NBMAIN	6	15	40
NBNC02	2	27	7
MILLPD	4	23	17
MONTHS	9	17	53
DRRIVERTON	1	5	20
MONTREC	2	26	8

The percentages of samples with *E. coli* counts exceeding the *E. coli* standard varied considerably. The NBNC02 and MONTREC sites had few samples that exceeded the SSM standard despite the fact that those sites had been sampled many times. At sites SPAULD, NBMAIN, and MONTHS, however, 40% or more of the samples taken had *E. coli* counts exceeding the EPA SSM standard.

Storm water outfall monitoring: The Friends of the Winooski River and Stone Environmental have conducted comprehensive storm water outfall monitoring in Barre City (2006), Montpelier (2008), Berlin (2008), Northfield (2008), Richmond (2010), and Waterbury (2010). A total of 460 outfalls were monitored during dry weather and if flowing a number of tests were conducted. In a number of cases (~30), dry weather flow indicated the presence of one or more pollutants. The Friends and Stone worked with municipal public works departments or businesses to trace, locate, and, if possible, correct the source of the contaminant. In the summer of 2011, the Friends, with support from Stone, conducted some follow-up monitoring on 10 of the most egregious outfalls. Some showed considerable improvement and others warranted additional follow up. For 2012, the Friends proposed to sample of the most problematic outfall sites for *E. coli* during dry weather periods. Three of these outfalls were sampled; the remaining outfalls were either dry, under water, or blocked with debris, and could not be tested. Table 4 compares the original results with the 2011 and 2012 results. See Appendix A for quality assurance data.

Table 4. 2012 Outfall *E. coli* Monitoring Results

Outfall ID	Waterbody	Lat/Long	<i>E. coli</i> count (MPN/100mL)		
			2006	2011	2012
EB-O-3	Edgewood Brook	44.194758 / 72.491101	TNTC	na	> 2419.6
EB-O-4	Edgewood Brook	44.195046 / 72.490151	1050 cfu/mL	50	210
GB-O-4	Gunner Brook	44.207925 / 72.503888	4900 cfu/mL	345	*
GB-O-5	Gunner Brook	44.208073 / 72.503961	1900 cfu/mL	2419	*
SB-O-7	Steven's Branch	44.198063 / 72.507563	0 cfu/mL	727	15
SB-O-13	Steven's Branch	44.200493 / 72.508381	TNTC	921	*

- these sites were not sampled because the outfall was either not running or was blocked

The EB-O-3 outfall into Edgewood Brook, located off Camp Street in Barre, had very high *E. coli* counts in 2006. It was not tested in 2011. Retesting in 2012, however, indicates that the *E. coli* levels in this outfall remain high. The storm sewer lines feeding into this outfall run in close proximity to sanitary lines along Hill Street between Woodland and Nelson Streets. Cleaning out and televising the storm lines revealed no obvious problems in 2006. The 2012 EB-O-4 outfall *E. coli* levels remain moderately elevated. The only other outfall sampled for *E. coli*, SB-O-7 on the Stevens Branch, had a low level of *E. coli*.

In order to determine potential sources of *E. coli* in the EB-O-3, EB-O-4, and GB-O-4 outfalls, and to recheck or confirm potential problem outfalls, selected outfalls and the storm sewer lines feeding selected outfalls were tested for the presence of optical brighteners (OB). Optical brighteners

are fluorescent dyes present in laundry detergents and can be used as an indicator for the presence of domestic wastewater. Cotton pads without optical brighteners added were lowered into catchbasins (CB) or secured in outfall pipes and retrieved one week later. The pads were then checked for fluorescence under UV light. The results of these tests are shown in Table 5.

Table 5. Optical Brightener Tests Barre City 2012

Outfall	Structure Type/Location	Result
EB-O-3	Outfall	High
EB-O-4	Outfall	High
EB-O-4	CB @ 344 Tremont	High
EB-O-4	CB @ 350 Tremont—intersection of Tremont/Delmont on Delmont side	High
EB-O-4	CB @ 350 Tremont—intersection of Tremont/Delmont on Tremont side	Very low
GB-O-4	Outfall—Lost pad or unable to set pad	NA
GB-O-4	CB @ entrance to Hope Cemetery, across from 133 Maple	High
GB-O-4	CB @ ‘Point G’ between 133 & 144 Maple	Low
GB-O-5	Outfall	Low
SB-O-1	Outfall	Unclear
SB-O-7	Outfall	None
SB-O-13	Outfall	None
SB-O-14	Outfall	None
SB-O-20	Outfall	None

The tests for optical brighteners in the catchbasins above the EB-O-4 and GB-O-4 outfalls help to differentiate between branches of sewer lines feeding these problem outfalls. On the EB-O-4 line, a clear difference is seen between two branches of sewer lines, one on the Delmont side of the Delmont/Tremont Street intersection, and one on the Tremont side of the intersection. Similarly, the high OB reading in catchbasin on the Hope Cemetery side of Maple Avenue and the low reading at Point G on the other side of the street helps determine which of two branches in the sewer line is a potential source of wastewater in the GB-O-4 outfall. These results should allow the Partnership to continue to narrow down the source of the *E. coli* in these two outfalls in 2013. Outfalls GB-O-5 to SB-O-20 appear to be relatively free of wastewater and revealed no site of major concern. The OB reading for SB-O-1 was unclear.

Urban Water Quality Parameters: Four Rivers Partnership volunteers sampled five small Winooski River and Steven’s Brook tributaries draining watersheds of varying land use composition to monitor for total phosphorus, turbidity, and chloride ions during a storm event in the summer of 2012. The locations of these sites are given in Table 5, and the results of a baseline sampling on 8/21 and a storm event sampling on 9/5 are shown in Table 6.

Table 5. Four Rivers Partnership Urban Water Quality 2012 Test Sites

Site ID	Tributary, if named	Description	Lat /Long
Macs 10		Trib behind MacDs on 302	44.134000/72.330374
Gunner 10	Gunner Brook	@ Blackwell St & 302	44.121391/72.303450
Bailey 10		Bailey & State, Montpelier	44.154318/72.351288
VTRANS 10	Pond Brook	Below footbridge at VTRANS bldg.	44.135739/72.331140
Sabin 10	Blanchard Brook	@ mouth	44.150259 /72.334766

Table 6. Chloride, Phosphorous, and Turbidity of Five Winooski River Tributaries During a Storm Event. 9/5/2012 represents the rain event date and 8/21/2012 the date on which baseline samples were taken.

Site ID	Date	Chloride (mg/L)	TP (ug P/L)	Turbidity (NTU)
Macs 10	8/21/12	555	6.3	0.94
Macs 10	9/5/12	231	62.3	43.5
Gunner 10	8/21/12	56.6	6.34	1.42
Gunner 10	9/5/12	25.7	75.2	41.3
Bailey 10	8/21/12	85.2	10.6	0.78
Bailey 10	9/5/12	64.4	60.6	7.63
VTRANS 10	8/21/12	64.8	9.75	0.58
VTRANS 10	9/5/12	198	28	3.2
Sabin 10	8/21/12	120	6.05	1.7
Sabin 10	9/5/12	70.7	108	37.4

Chloride: The chloride values measured in these tributaries varied from 25.7 to 555 mg/mL. The 8/21 baseline samples had higher chloride levels at most sites than did the 9/5 event despite the fact that 9/5 event had over an inch of total rainfall. According to the DEC's Vermont Surface Water Strategy (http://www.anr.state.vt.us/dec/waterq/wqd_mgtplan/swms_appB.htm), chloride levels above 250 mg/L can affect the health and reproduction of aquatic species. The baseline chloride levels at the Macs 10 site were particularly high, and far exceeded the 250 mg/mL standard. Chloride sources include road deicing salts, wastewater, and leachate from landfills.

Phosphorous: The VT water quality standards (VT WQS) state "total phosphorous loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses." However, the VT WQS sets no specific standard for phosphorous levels in Class B waters below 2500 feet in elevation. One way of analyzing the phosphorous levels detected during the storm events could be to ask whether the phosphorous levels in a stream are contributing to or diluting the phosphorous that eventually gets transported to Lake Champlain. The target phosphorous standard for the Main Lake of Lake Champlain is of 10ug/mL. Therefore, since the total phosphorous levels in the samples taken during the 9/5 rain event were all well above 10 ug P/L, these tributaries can be considered to have

contributed to the phosphorous load during this storm. In contrast, the samples taken as a baseline on 8/21, are mostly below 10 ug P/L.

Turbidity: The VT Water Quality standard for turbidity is 25 nephelometric units (NTU) for warm-water fish habitat and 10 NTU for cold-water fish habitat measured as an average annual turbidity under base flow conditions. Although our sampling was done during a storm event, the turbidity at most sites was well below these values on 8/21. Samples taken during the storm on 9/5 were relatively high at Macs 10, Gunner 10, and Sabin 10, but remained fairly low at the VTRANS 10 and Bailey 10 sites.

Appendix A. Quality assurance measures for *E. coli* sampling in 2012

Site ID	Date	Relative Percent Difference Between Duplicate Pairs (RPD)	Comments
WORDAM	7/10/12	9%	
NBNC02	7/24/12	0%	
MILLPD	8/7/12	16%	Calculated using MILLPD-B and MILLPD-DUP since MILLPD count was <1, and so was probably the blank.
SPAULD	8/21/12	62%	Calculated using SPAULD-B and SPAULD since SPAULD DUP count was <1, and so was probably the blank.
DRMONTREC	9/11/12	82%	According to our field data sheets, duplicate and blank samples were taken at the SPAULD site on this date, not DRMONTREC. It looks like four samples got mixed up here: DRMONTREC, SPAULD, SPAULD-D, & SPAULD-B, since the SPAULD sample E coli count was <1. All four measurements were removed from the data analysis.
EB-03	9/12/12	0%	
Mean Relative Percent Difference (Mean RPD)		28%	

Appendix B. Quality Assurance Measures for Phosphorous, Chloride, and Turbidity Sampling in 2012

Site ID	Date	Sample Type	Relative Percent Difference Between Duplicate Pairs (RPD)	Comments
Gunner 10	8/21/12	Phosphorous	0.9%	
	8/21/12	Chloride	1.2%	
	8/21/12	Turbidity	2.9%	
Gunner 10	9/5/12	Phosphorous	2.4%	
	9/5/12	Chloride	0.4%	
	9/5/12	Turbidity	0.5%	
Mean Relative Percent Difference (Mean RPD)		Phosphorous	1.65%	
		Chloride	0.8%	
		Turbidity	1.7%	

Appendix C. Project Completeness

Parameter	Number of Samples Anticipated	Number of Valid Samples Collected & Analyzed	Percent Complete *
Chloride	12	14	117%
Total and Dissolved Phosphorus	12	14	117%
<i>E. coli</i>	75	51	68%
Turbidity	12	14	117%

* Percent Complete = # of Valid Samples Collected and Analyzed / # of Samples Anticipated