

**Chittenden County Stream Team
2012 Volunteer Water Quality Monitoring Report**

The Chittenden County Stream Team (CCST) is a program to engage citizens across an eight-town area to implement projects to reduce non-point source pollution and stormwater volume at the local level. The participating towns are Burlington, Essex, Essex Junction, Milton, Shelburne, South Burlington, Williston, and Winooski. The project is managed by the Chittenden County Regional Planning Commission, and run by the Winooski Natural Resource Conservation District with assistance from the Friends of the Winooski River. This report describes results from the first year of a volunteer water quality monitoring effort by the CCST. The Friends and the District will work with the Steering Committee of the CCST to share the results and publicize the findings.

The Chittenden County Stream Team collected biweekly water quality samples at eleven sites on Centennial, Englesby, Indian, Morehouse, Muddy and Potash Brooks during the summer of 2012. These streams suffer from sedimentation, excessive nutrient loads, high temperatures, bacteria, and other urban pollutants. A total of five samples were collected at each site during the season and were analyzed for turbidity, total phosphorous, total nitrogen, and chloride. The CCST also sampled for total suspended solids (TSS), total phosphorous, total nitrogen, and chloride at five of these sites during a rain event on 8/12/12. A list of the specific sampling sites and their locations is shown in Table 1. A summary of the 2012 results for these sites are shown in Table 2 and quality assurance data is presented in Appendix A. Project completeness percentages are given in Appendix B.

Table 1. Chittenden County Stream Team 2012 Water Quality Sampling Sites

<u>Location</u>	<u>Waterbody</u>	<u>Site ID</u>	<u>Lat / Long</u>
Grove Street in Burlington	Centennial Brook	Cent 10	44.48453 / 73.18423
Champlain School Comm. Gardens Burlington off Pine Street	Engelsby Brook	Engelsby 10	44.45627 / 73.21394
Essex High School	Indian Brook	Indian 10	44.49668 / 73.11093
Lang Farm in Essex	Indian Brook	Indian 20	44.50442 / 73.09190
Landry Park Winooski	Morehouse Brook	Morehouse 10	44.50037 / 73.19370
River Cove Road in Williston	Muddy Brook	Muddy 10	44.47293 / 73.13505
Marshall Avenue in South Burlington	Muddy Brook	Muddy 20	44.45340 / 73.13833
Van Sicklen Road in Williston	Muddy Brook	Muddy 30	44.42823 / 73.14622
Kindness Court in South Burlington	Potash Brook	Potash 10	44.44572 / 73.21348
Farrell Street in South Burlington	Potash Brook	Potash 20	44.44660 / 73.20415
Dorset Street in South Burlington	Potash Brook	Potash 30	44.45150 / 73.17849

Table 2. 2012 Chittenden County Stream Team Results: Mean chloride, total nitrogen, total phosphorous, and turbidity values in six Burlington area streams under all weather conditions and dry conditions. Mean chloride levels above 230mg/L and mean phosphorous levels above 10ug/L are highlighted.

Site ID	Mean Chloride (mg/L)		Mean Nitrogen, Total - Persulfate (mg N/L)		Mean Phosphorus, Total (ug P/L)		Mean Turbidity (NTU)	
	All	Dry	All	Dry	All	Dry	All	Dry
Cent 10	306	364	0.48	0.46	59	44	10.1	4.7
Engelsby 10	143	119	0.74	0.74	82	90	6.7	6.7
Indian 10	156	195	1.09	1.2	64	48	14.5	9.2
Indian 20	100	120	0.53	0.49	56	47	10.1	8.9
Morehouse 10	65	65	0.73	0.72	44	36	10.4	10.6
Muddy 10	113	115	0.91	0.96	78	50	15.3	5.7
Muddy 20	109	110	0.9	0.91	108	91	17.3	10.9
Muddy 30	24	25	1.44	1.63	144	145	12.4	7.9
Potash 10	274	313	0.67	0.65	47	31	6.5	2.8
Potash 20	282	343	0.6	0.57	60	41	5.1	1.8
Potash 30	245	278	0.71	0.72	60	48	5.9	5.4

At sites where two extra samples were collected at part of rain event sampling, all seven sample data points were used to calculate the mean values for “all conditions”. “Dry conditions” were 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 Burlington airport rainfall data obtained from the National Climate Data Center Climate Data Online website. The results for each water quality criterion are discussed separately below.

Chloride

The relative levels of chloride at each of the sampling sites under all and dry weather conditions are shown in Figure 1. Chloride levels were elevated at all sites, particularly in Centennial and Potash Brooks. The chloride concentrations in these streams exceeded the EPA chronic criterion of 230 mg/L in both dry and all weather conditions. According to the Vermont Surface Water Management Strategy, chloride levels above 230 mg/L can lead to poor health and reduced reproduction in aquatic species and may increase stratification in ponds and lakes, thereby inhibiting natural mixing and limiting oxygen availability. Chloride sources include road deicing salts, wastewater, and leachate from landfills. Chlorides of potassium, magnesium and calcium have more of an adverse effect on the health of aquatic organisms than sodium chloride, upon which the standard is based.

Centennial Brook originates south of the Centennial Woods Natural Area between the Sheraton Conference Center and the University of Vermont Library Storage buildings and is known as the stream with the highest chloride concentrations in the state of Vermont. The stream originates on the UVM campus, drains the natural area and a large section of South Burlington near the airport, and empties into the Winooski River. The Potash Brook parallels both I-89 and I-189 and drains a large area of South Burlington. At all sites sampled, mean chloride levels during dry weather conditions were equal to or (in most cases) higher than the mean chloride levels calculated using samples taken under all conditions.

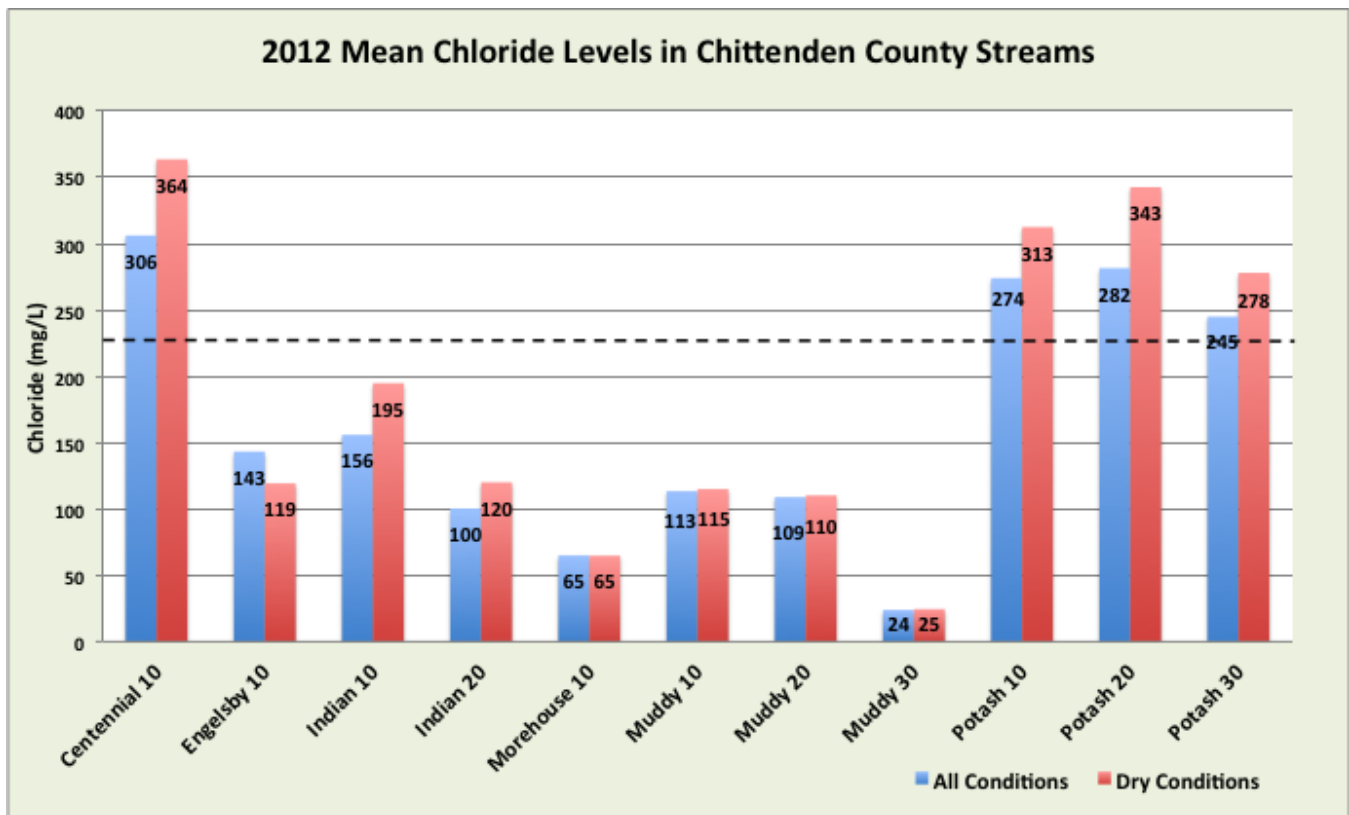


Figure 1. Mean chloride values in the streams sampled by the Chittenden County Stream Team in 2012. The mean under dry conditions is shown in red; the mean under all weather conditions is shown in blue. The concentration of chloride above which chronic health effects have been observed in of aquatic species (230 mg/L) is indicated by the dotted line.

Nitrogen

Mean nitrogen levels in the sampled streams varied from 0.46 to 1.63 mg/L and did not vary much between all conditions and dry conditions. The Vermont Water Quality Standards standard for nitrogen levels in Class B waters is 5 mg NO₃-N/L at flows above base flow. None of the samples had nitrogen levels that exceeded this standard. The highest nitrogen level in a single sample was 2.75 mg/L, taken at the Muddy 30 site under dry conditions.

Phosphorous

Phosphorous sources include fertilizers, animal manure, septic systems, pet waste, erosion, and crop plant residues. The mean phosphorous levels in all the streams was high, ranging from 31 to 145 ug/L and are shown in Figure 2. 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. This concentration is indicated by a dotted line in Figure 2.

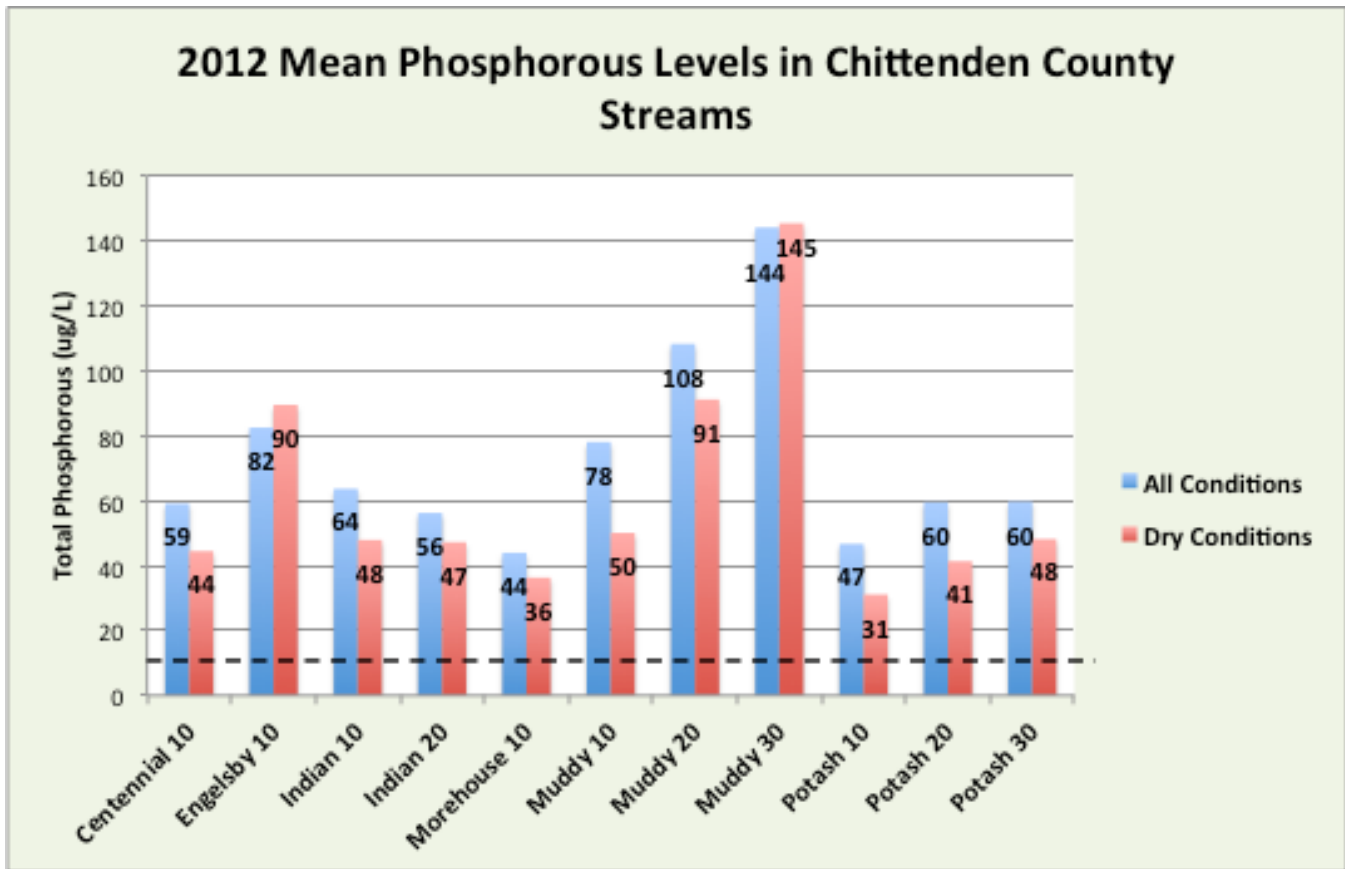


Figure 2. Mean phosphorous levels at the sites sampled by the CCST in the summer of 2012. The phosphorous standard for the Main Lake of Lake Champlain (10ug/L) is indicated by the dotted black line.

The phosphorous levels at all the sites in all the streams sampled was above the target 10ug/L concentration for Lake Champlain. Muddy Brook and Engelsby Brook had the highest levels. Muddy Brook, forming the border between South Burlington and Williston, had particularly high levels of phosphorous, especially at the most upstream site. This site is in a fairly rural area of both farms fields and estate-type homes with large expanses of lawn. Engelsby Brook originates on the UVM campus, drains the South End of Burlington and the Burlington Country Club Golf Course, and empties directly into Lake Champlain near the Burlington/South Burlington line. Since all the mean phosphorous levels from all streams sampled were above 10 ug/L, all the streams can be considered to contribute to the phosphorous problems in Lake Champlain.

Turbidity

The turbidity of a water sample is a measure of its light-scattering properties, is related to the amount of sediment, algae, microbes, etc suspended in the water, and is an indicator of erosion and/or high nutrient levels. These suspended substances absorb heat from the sun, thereby influencing water temperatures and dissolved oxygen levels. High turbidity can also limit photosynthesis in aquatic plants and algae and affect the health and reproduction of fish and aquatic invertebrates. 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. While Indian Brook, Centennial Brook, and all the Muddy Brook sites experienced turbidity levels in single samples above 25 NTU after the 7/23/12 rainstorm, none of the mean turbidity measurements from any of the sampled streams exceeded the VT WQS level.

Rain event sampling

In order to get information regarding the effect of stormwater runoff on stream water quality, Chittenden County Stream Team volunteers sampled five sites twice during the summer of 2012, once during dry conditions on 8/28/2012, to determine baseline conditions, and once on 8/12/2012 during the 8/09/2012 to 8/12/12 rainstorm during which over 2 inches of rain fell. The results of this sampling are shown in Table 3.

Table 3. Chittenden County Stream Team Rain Event Sampling. Chloride levels above 230 mg/L and phosphorous levels above 10ug/L are highlighted. Means for dry conditions were determined from the biweekly sampling described above.

Site ID	Chloride (mg/L)	Nitrogen (mg/L)	Phosphorous (ug/L)	Total Suspended Solids (mg/L)
Indian 10 2012 mean, dry conditions	120	0.49	47	na
Indian 10 baseline (8/28/12)	211	1.3	48.3	3.2
Indian 10 rain event (8/12/12)	66.8	0.82	91	32.4
Cent 10 2012 mean, dry conditions	364	0.46	44	na
Cent 10 baseline	339	0.27	44.4	2.4
Cent 10 rain event	148	0.46	83.3	14.6
Morehouse 10 2012 mean, dry conds.	65	0.72	36	na
Morehouse 10 baseline	76.7	0.63	30.8	1.9
Morehouse 10 rain event	92.9	0.55	53.2	11.4
Muddy 20 2012 mean, dry conditions	110	0.91	91	na
Muddy 20 baseline	143	0.84	73.2	5.47
Muddy 20 rain event	135	0.95	120	24
Potash 20, 2012 mean, dry conditions	343	0.57	41	na
Potash 20	353	0.64	43.4	1.4
Potash 20 rain event	106	0.63	97.9	19.2

While chloride levels during the rain event declined relative to baseline and mean chloride values and nitrogen levels remained relatively constant, phosphorous and total suspended solid (TSS) concentrations increased significantly during the rainstorm at all sites. Phosphorous concentrations increased by 35% at the Muddy Brook site to 144% at the Potash Brook site. Total suspended solid concentrations increased approximately 3- to 13- fold during the rain event with Muddy Brook again showing the lowest percentage increase for TSS, and Potash Brook showing the highest.

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

Site ID	Date	Sample Type	Relative Percent Difference Between Duplicate Pairs (RPD)
GB0.1	9/11/12	Chloride	0.4%
		Phosphorous	3.7%
		Nitrogen	1.6%
NB0.2	8/15/12	Chloride	0%
		Phosphorous	7.7%
		Nitrogen	0%
WIN72.8	6/19/12	Chloride	0.8%
		<i>E. coli</i>	44%
		Phosphorous	6%
		Nitrogen	2.6%
WIN72.8	7/10/12	Chloride	8.7%
		<i>E. coli</i>	45%
		Phosphorous	4.6%
		Nitrogen	7.7%
WIN81.6	9/11/12	<i>E. coli</i>	20%
WIN83.4	8/15/12	<i>E. coli</i>	54%
WIN85.5	8/15/12	<i>E. coli</i>	73%
Mean Relative Percent Difference (Mean RPD)		Chloride	3.3%
		<i>E. coli</i>	47.2%
		Phosphorous	3%
		Nitrogen	5.5%

Appendix B– Project Completeness

Parameter	Number of Samples Anticipated	Number of Valid Samples Collected & Analyzed	Percent Complete
TSS (rain event only)	14	14	100%
Turbidity (bi-weekly testing only)	65	65	100%
Total phosphorus	79	78	99%
Total Nitrogen	79	79	100%
Chloride	79	79	100%