

**Missisquoi Bay Basin Project:  
Identifying Critical Source Areas of Pollution**

***Short-term Tributary Monitoring Program  
Interim Report  
November 15, 2010***

**Project Status**

The first full season of short-term tributary water quality monitoring conducted by the Lake Champlain Basin Program (LCBP) began on March 22, 2010. LCBP staff has sampled five tributaries in the Missisquoi Bay Basin – Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek – in accordance with the approved Quality Assurance Project Plan (QAPP) for this project (see appended map for locations). LCBP staff will continue sampling until early winter of 2010, when the tributaries freeze. To date in 2010, 12 high-flow (storm event) and 4 low-flow (base flow) samples were collected at each site and analyzed for: water temperature, pH, conductivity, alkalinity, total and dissolved phosphorus, total nitrogen, total suspended solids, chloride, and earth metals (sodium, magnesium, potassium, calcium, and total calculated hardness). Additionally, 38 samples were collected from an automated sampler (ISCO) installed at Hungerford Brook and analyzed for total phosphorus and suspended solids. LCBP staff also collected one base-flow sample at each site on December 18, 2009. See Appendix A for a list of sampling dates and collection types.

As part of the sampling protocol, 8 field quality control (QC) samples were collected and analyzed for all parameters. According to the QAPP, “Field QC samples [should] represent approximately 10% of the water and biological collections made.” A total of 85 high- and low- flow samples have been collected, so QC samples are well within that range.

LCBP staff also collaborated with staff of the Québec Ministère du Développement durable, de l'Environnement et des Parcs (QCMDDEP) in order to compare laboratory testing results. Partners met in Highwater, Québec on September 8, 2010 to split samples that each group had collected from sampling sites in the Missisquoi Bay Basin; these samples were submitted to the Vermont and Québec laboratories for analyses of total suspended solids and total phosphorus. Samples were representative of low-flow conditions and results from these analyses will be evaluated in terms of relative percent difference to identify discrepancies between the two laboratories. Sample splits from a high-flow event will be collected in spring 2011 to identify laboratory discrepancies at higher flows.

**Monitoring Data**

All collected samples were submitted to the State of Vermont Department of Environmental Conservation LaRosa Environmental Laboratory (Lab) within their specified hold times, as required by the Lab and the approved QAPP for this project. Samples are analyzed by the Lab for alkalinity, total and dissolved phosphorus, total nitrogen, total suspended solids, chloride, and earth metals. LCBP staff measures the temperature, pH, and conductivity of each sample before submittal to the Lab.

To date, the Lab has finalized results for all samples collected prior to September 1, 2010 (Appendix B); all other results will be submitted to the LCBP upon completion and approval by the Laboratory Director. Four of the ISCO samples were analyzed for total suspended solids out of their accepted hold times, so these data will be flagged in any future analyses as suspect. Few data are currently available for a rigorous statistical



## Appendix A

Summary of the Short-term Tributary Monitoring Program collection events as of November 15, 2010. "Date collected" refers to the date the sample was collected from the tributary (for ISCO samples this refers to the date LCBP staff removed the sample(s) from the ISCO). Low-flow events represent seasonal base flow and high-flow events represent seasonal storms. The ISCO is the automated sampler installed at Hungerford Brook; it often collects multiple samples during a single storm event.

<b>Date Collected</b>	<b>Low-flow</b>	<b>High-flow</b>	<b>ISCO (# samples)</b>
12/18/2009	1		
3/22/2010	1		
3/23/2010		1	
4/17/2010		1	
4/29/2010			2
5/6/2010		1	1
6/3/2010		1	
6/28/2010		1	
7/10/2010		1	1
7/28/2010			1
8/4/2010		1	4
8/19/2010	1		
9/8/2010	1		
9/17/2010		1	
9/28/2010		1	
10/1/2010		1	4
10/6/2010			8
10/8/2010		1	
10/20/2010			6
11/2/2010			5
11/4/2010	1		
11/5/2010		1	
11/10/2010			6
<b>TOTAL</b>	<b>5</b>	<b>12</b>	<b>38</b>

## Appendix B.

Summary of water chemistry results for high-flow (Table 1), low-flow (Table 2), and automated ISCO samples (Table 3) collected through September 1, 2010.

Table 1. Mean and standard deviation of high-flow water chemistry results (n=7, through September 1, 2010).

<b>Tributary, Analyte</b>	<b>Mean</b>	<b>SD</b>
<b>Black Creek</b>		
Alkalinity (mg CaCO <sub>3</sub> /L)	44.39	14.29
Calcium (mg/L)	14.94	5.01
Chloride (mg/L)	5.05	1.81
Magnesium (mg/L)	2.34	0.59
Nitrogen, Total	0.94	0.48
Phosphorus, Filtered (ug P/L)	53.79	48.49
Phosphorus, Total (ug P/L)	217.01	214.69
Potassium (mg/L)	2.18	1.15
Sodium (mg/L)	3.76	1.12
Solids, Total Suspended (mg/L)	59.84	94.29
Total Calculated Hardness (mg/L)	46.96	14.94
<b>Hungerford Brook</b>		
Alkalinity (mg CaCO <sub>3</sub> /L)	116.51	40.04
Calcium (mg/L)	40.59	13.90
Chloride (mg/L)	22.97	8.72
Magnesium (mg/L)	7.10	2.35
Nitrogen, Total	2.90	2.17
Phosphorus, Filtered (ug P/L)	101.59	85.88
Phosphorus, Total (ug P/L)	306.11	295.01
Potassium (mg/L)	5.13	2.77
Sodium (mg/L)	14.98	5.34
Solids, Total Suspended (mg/L)	49.62	59.92
Total Calculated Hardness (mg/L)	130.70	44.37
<b>Mud Creek</b>		
Alkalinity (mg CaCO <sub>3</sub> /L)	34.33	15.41
Calcium (mg/L)	9.88	3.67
Chloride (mg/L)	7.27	3.34
Magnesium (mg/L)	3.88	1.55
Nitrogen, Total	1.62	1.13
Phosphorus, Filtered (ug P/L)	80.84	43.57
Phosphorus, Total (ug P/L)	198.40	107.46
Potassium (mg/L)	2.52	1.15
Sodium (mg/L)	4.87	1.94
Solids, Total Suspended (mg/L)	48.35	32.66
Total Calculated Hardness (mg/L)	40.63	15.55

**Trout Brook**

Alkalinity (mg CaCO <sub>3</sub> /L)	8.83	3.45
Calcium (mg/L)	4.48	0.76
Chloride (mg/L)	2.24	0.33
Magnesium (mg/L)	0.69	0.12
Nitrogen, Total	0.41	0.12
Phosphorus, Filtered (ug P/L)	10.25	4.20
Phosphorus, Total (ug P/L)	118.67	108.34
Potassium (mg/L)	0.36	0.05
Sodium (mg/L)	1.40	0.53
Solids, Total Suspended (mg/L)	81.57	103.41
Total Calculated Hardness (mg/L)		

**Tyler Branch**

Alkalinity (mg CaCO <sub>3</sub> /L)	22.60	9.17
Calcium (mg/L)	8.40	2.68
Chloride (mg/L)	2.67	0.95
Magnesium (mg/L)	1.29	0.39
Nitrogen, Total	0.79	0.22
Phosphorus, Filtered (ug P/L)	21.94	8.02
Phosphorus, Total (ug P/L)	139.69	112.96
Potassium (mg/L)	1.06	0.26
Sodium (mg/L)	1.98	0.83
Solids, Total Suspended (mg/L)	61.96	72.21
Total Calculated Hardness (mg/L)	26.30	8.27

Table 2. Mean and standard deviation of low-flow water chemistry results (n=4, through September 1, 2010).

<b>Tributary, Analyte</b>	<b>Mean</b>	<b>SD</b>
<b>Black Creek</b>		
Alkalinity (mg CaCO <sub>3</sub> /L)	50.13	20.61
Calcium (mg/L)	16.86	6.64
Chloride (mg/L)	5.56	1.40
Magnesium (mg/L)	2.60	0.91
Nitrogen, Total - Persulfate	0.47	0.13
Phosphorus, Filtered (ug P/L)	23.15	5.59
Phosphorus, Total (ug P/L)	40.65	7.79
Potassium (mg/L)	1.33	0.32
Sodium (mg/L)	4.21	1.26
Solids, Total Suspended (mg/L)	5.91	2.63
Total Calculated Hardness (mg/L)	52.78	20.33
<b>Hungerford Brook</b>		
Alkalinity (mg CaCO <sub>3</sub> /L)	137.00	30.58
Calcium (mg/L)	46.65	10.90

Chloride (mg/L)	28.85	7.99
Magnesium (mg/L)	9.08	2.07
Nitrogen, Total - Persulfate	1.83	0.79
Phosphorus, Filtered (ug P/L)	35.58	7.39
Phosphorus, Total (ug P/L)	64.08	7.84
Potassium (mg/L)	4.04	1.42
Sodium (mg/L)	18.93	5.72
Solids, Total Suspended (mg/L)	9.85	6.90
Total Calculated Hardness (mg/L)	154.00	33.60

#### **Mud Creek**

Alkalinity (mg CaCO3/L)	53.68	26.06
Calcium (mg/L)	13.61	5.93
Chloride (mg/L)	10.79	5.48
Magnesium (mg/L)	5.77	2.72
Nitrogen, Total - Persulfate	0.47	0.15
Phosphorus, Filtered (ug P/L)	29.50	5.04
Phosphorus, Total (ug P/L)	36.33	1.35
Potassium (mg/L)	1.67	0.60
Sodium (mg/L)	7.30	3.62
Solids, Total Suspended (mg/L)	2.88	1.65
Total Calculated Hardness (mg/L)	57.78	26.02

#### **Trout Brook**

Alkalinity (mg CaCO3/L)	18.88	9.06
Calcium (mg/L)	7.56	2.33
Chloride (mg/L)	4.52	1.75
Magnesium (mg/L)	1.18	0.34
Nitrogen, Total - Persulfate	0.46	0.08
Phosphorus, Filtered (ug P/L)	6.27	0.80
Phosphorus, Total (ug P/L)	8.97	2.75
Potassium (mg/L)	0.58	0.24
Sodium (mg/L)	3.29	1.24
Solids, Total Suspended (mg/L)	1.78	1.13
Total Calculated Hardness (mg/L)	23.75	7.23

#### **Tyler Branch**

Alkalinity (mg CaCO3/L)	40.05	17.35
Calcium (mg/L)	14.68	5.55
Chloride (mg/L)	6.04	2.68
Magnesium (mg/L)	2.22	0.77
Nitrogen, Total - Persulfate	0.82	0.23
Phosphorus, Filtered (ug P/L)	8.91	1.41
Phosphorus, Total (ug P/L)	14.80	4.39
Potassium (mg/L)	1.20	0.41
Sodium (mg/L)	4.23	1.84
Solids, Total Suspended (mg/L)	2.60	2.54
Total Calculated Hardness (mg/L)	45.85	17.05

Table 3. Mean and standard deviation of total phosphorus and total suspended solids samples collected from the automated sampler (n=9, through September 1, 2010).

<b>Analyte</b>	<b>Mean</b>	<b>SD</b>
Phosphorus, Total (ug P/L)	461.33	223.00
Solids, Total Suspended (mg/L)	157.50	126.25

# Missisquoi Bay Basin

## Short-term Monitoring Program Sites



- Short-term Monitoring Program water quality sampling with USGS flow gage
- ✕ Short-term Monitoring Program USGS flow gage
- Short-term Monitoring Program USGS weather station
- Existing NOAA weather station
- Major waters
- - - Sub-basin bounds (HUC12)

Sources: Geobase, NOAA, USGS, VCGI

