

Barnet Storm Event Water Quality Study Summer 2007

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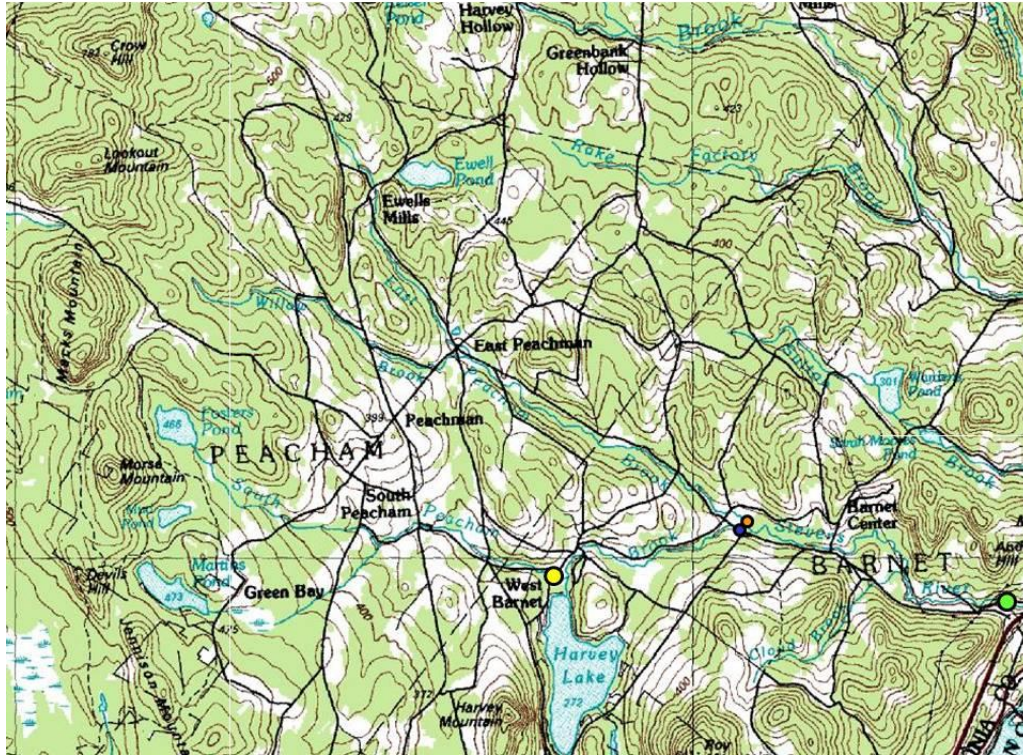
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EXECUTIVE SUMMARY

1. Rain event water chemistry parameters of phosphorous and turbidity were collected at a total of 4 sites within The Stevens River Watershed on South Peacham Brook, Peacham Hollow Brook and the Stevens River main stem from June 2007 through October 2007.
2. The measurements of phosphorous and turbidity, may help in the understanding of specific river reaches erosions properties as well as indicate how sediment is transported through these river systems.
3. Total phosphorous and turbidity parallel each other and can be linked to the amount of soil fraction within the water (USGS, 2005). These parameters are a good indication of runoff input or river bank erosion/river dynamics. Over the three events total phosphorous and turbidity ranged from 5.8 to 171ug/l and 0.20 to 10.4 NTU respectively. Except for one occasion on 9/15/2005 at PH02, turbidity was well under Vermont water quality standards of 10 NTU for Class B2 waters (State of VT, Water Resources Board, 2000).
4. Dissolved oxygen, and water temperature were measured in the field and are useful indicators of healthy aquatic habitat. During storm events river stage is high mixing is thorough with low water clarity. Dissolved oxygen and water temperature ranged from 7.3 to 14.0 mg/l and 8.0 to 19.0 C° respectively, where dissolved oxygen was above tolerance of 6.0 mg/l as determined by the Vermont water quality standards (State of VT, Water Resources Board, 2000).
5. Four stream discharges at the site were established over the course of the field campaign. Flow was determined by velocity rating curves that were developed by stage height. The rating curves help to model sediment and phosphorous load transport during rain event conditions and base flow conditions. The average discharge (from three discharge measurement) on the main stem of the Stevens River measured at Bens Mill was 3.18 m³/s (112.3 cfs). The PH02 site (Peacham Hollow Brook) and SR01 (South Peacham Brook) had average discharges of 0.23 m³/s (8.15 cfs) and 0.790 m³/s (27.9 cfs) respectively.

1.0 INTRODUCTION

This project investigated specific water quality parameters on the Stevens River main stem and its major tributaries, South Peacham Brook, and Peacham Hollow Brook (See Figure 1, and Table 1) during three rainfall events. The sampling sites were spread out over the watershed (see map), the closest to the Connecticut River was at Anderson Street in Barnet (ASR01, green). Sampling then moved upstream in elevation, to a site on South Peacham Brook (SR01, blue). The other two sites were on Peacham Hollow Brook (PH02, red) and on South Peacham Brook at the bridge crossing near the lake access parking lot (WBB01, yellow). The Stevens River drainage is a sub watershed contained within Basin 14, as designated by The Vermont Department of Environmental Conservation (VT ANR, 1999). Appendix 1 on page 9 indicates the tabular data collected at these site.



Site Name	Elevation (m)	Location Latitude/Longitude		Map Color	Water body
SR01	235	N 44°18.773'	W072°06.413'	BLUE	South Peacham Brook
WBB01	297	N 44° 18.465"	W072°08481'	YELLOW	South Peacham Brook
ASR01	N/A	N 44 °18.103'	W072 °03.492'	GREEN	Stevens River
PH02	374	N 44 °20.768'	W072 °09.952'	RED	Peacham Hollow Brook

Figure 1 – Generalized map of water quality sampling sites.

The watershed is about 80% forested, with a concentration of farms in Peacham and West Barnet. Harvey's Lake, located in the heart of the watershed, is a heavily used recreational resource with many summer camps, year round homes, boating, swimming and fishing (VT ANR 1999). Town roads are mostly gravel, with steep hills subject to the erosion of road ditches. A paved town highway parallels much of the main stem.

This project fills void in overall completeness of surface water monitoring regarding tributaries and watershed of this nature within the state of Vermont. The project is facilitating an assessment and understanding of water quality as it pertains to the current working landscape of the Stevens River Watershed. The data will benefit the community as a whole, especially the Stevens River Watershed Council, and The Peacham Conservation Commission. This monitoring program was designed as a follow up to water sampling done in 2005 where only one storm event was captured and turbidity and phosphorus levels were up to 50 times higher than background levels.

Water quality sampling, and river gauging was coordinated by Andy Mosedale with some help from Ben Copans and the great volunteer efforts from local Barnet Resident John Fairchild. The State lay monitoring program delivered the samples to Waterbury Vermont.

2.0 METHODS

Each site was sampled total phosphorous and turbidity during three rainfall events from June 2007 through October 28, 2007. These samples were sent to the State of Vermont La Rosa Analytical Laboratory in Waterbury Vermont where each sample was analyzed under EPA qualified analytical methods. Hand held meters were used to obtain temperature, dissolved oxygen were also use to gather field data as well. These were standardized and calibrated before each sampling session.

3.0 PHYSICAL HYDROLOGY

Staff gauges and discharge measurements were performed during the project length at all sites within the watershed (Bens Mill, SR01, and PH02, ASR01, and WBB01). The rating curve (stage height and discharge) relationships are found in Appendix 2 on page 10. The collection of this and rainfall information aid in the initial understanding of how these tributaries respond to changed climate conditions and how these systems transport sediment.

4.0 RESULTS

Over the course of the project approximately 55 chemistry samples were taken in total at each site in this watershed. Flow measurements and rating curves were also completed at the 3 sites lending a basic understanding of the hydrology at each site and how the river reacts to rain input. Appendix 1 & 2 contains summarized chemistry data and flow rating curves. Figures 2 below indicate the average differences between the sites measured during the three storm events. Average phosphorous and turbidity levels at the four sites showed only minor variability across the Stevens River Watershed. Average concentrations of phosphorus ranged from 32ug/l at ASR01 to 48ug/l at SR01. Average turbidity levels ranged from 1.9 NTU at WBB01 to 3.3 NTU at PH02. Maximum phosphorus levels ranged from 112 ug/l at WBB01 to 171 ug/l at PH02 and Maximum turbidity levels ranged from 5.4 NTU at Stevens River to 10.4 NTU at PH02. Quality assurance objectives were met for phosphorus, but the variability between duplicate samples for turbidity exceeded the quality assurance goal by a factor of nearly 100%. One possible factor in the high variability of duplicate turbidity samples is the relatively low levels of turbidity measured in most samples making small differences in turbidity levels of duplicates samples result in large in percentage differences.

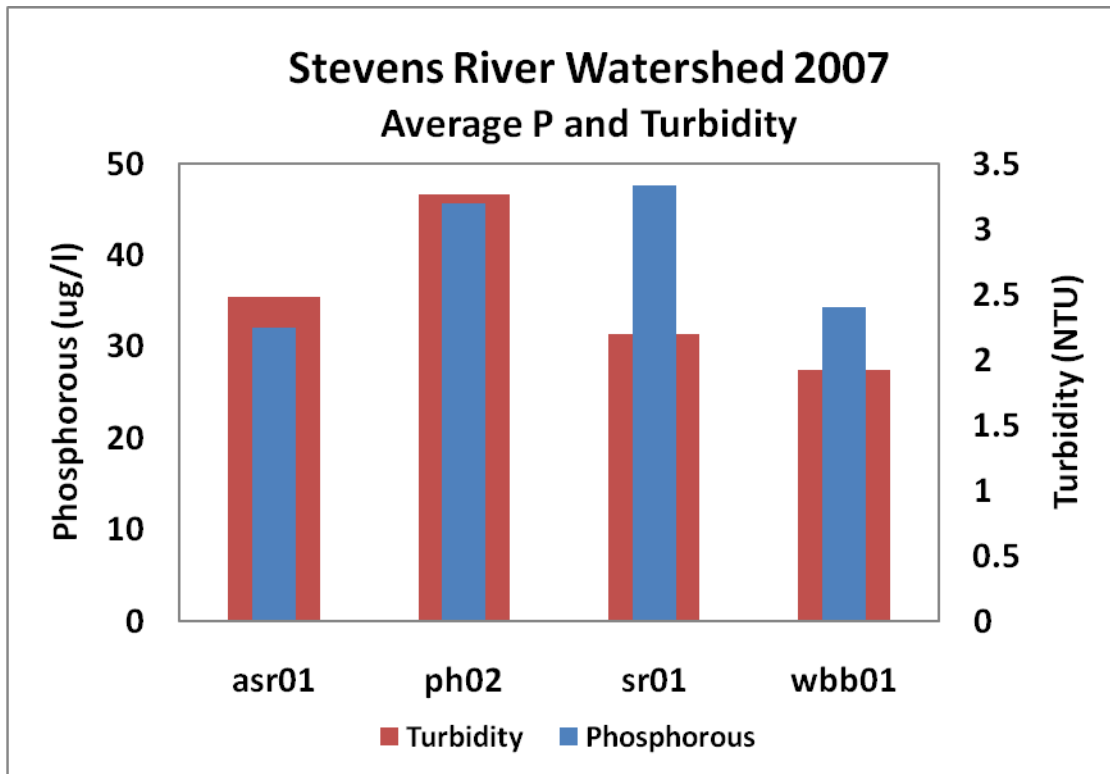


Figure 2- Average phosphorous and turbidity concentrations.

SUMMER EVENT CHEMISTRY

On July 4, 2007 the first storm event was conducted where 0.2 inches of rainfall occurred. Concentrations of phosphorous and turbidity were samples for over 3 hour period from 6:30 pm to 9:00 pm. There was only a slight increase in phosphorous and turbidity over the event.

On September 15, 2007 0.4 inches of rain fell within the watershed. Event sampling occurred over a 4 hour period from 8:00 am to 12:00 pm. Concentrations of phosphorous and turbidity were elevated to above 100 (ug/l) at each site where average baseline concentrations during the summer of 2005 were 20 (ug/l). There are indications at each site during this event that (figure 3) that responses to rain input are apparent and are reflected in increases in phosphorous and turbidity concentrations.

On October 27 and 28, 2007 approximately 1.45 inches of rain was recorded to have fallen at a weather station in Walden VT near the Stevens Rvier Watershed. Samples for phosphorous and turbidity were taken from 7:00 am to 5:00 pm on October 28 where most of the rainfall occurred on October 27, 2007. Concentrations of phosphorous and turbidity over the course of the sampling period declined suggesting that peak flows, turbidity and phosphorous levels may have occurred before the sampling commenced so these maximum levels could have been missed.

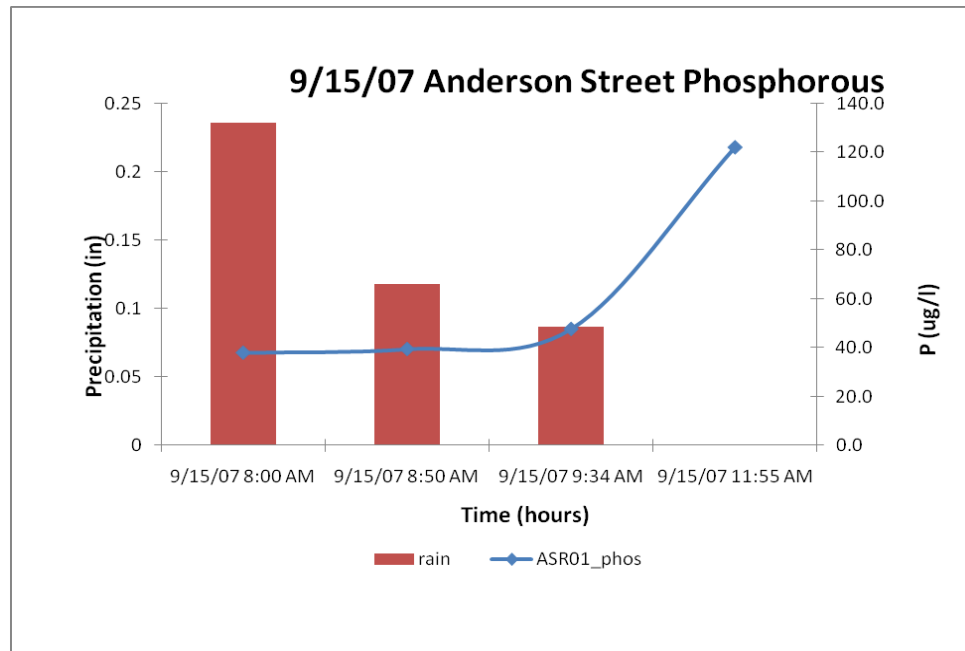


Figure 3 – Phosphorous response to rainfall during the 9/15/2007 rain event.

Precipitation input tends to increase concentrations of phosphorous and turbidity, indicating how responsive these streams are to precipitation. Temperatures were never above what is acceptable for brook trout, but measurements were made in the morning so may not have reflected the hottest temperatures.

5.0 DISSCUSSION AND CONCLUSIONS

The water quality chemistry results from this study on the Stevens River Watershed show no alarming indication of impacted biology. Specific cause and effect results can only be speculated, due to the changing climate conditions, site locations, and frequency of sampling. These are initial storm event data from this project help explain some of the chemical and physical properties of this watershed as a follow up to the 2005 storm event, where phosphorous and turbidity concentrations were 50 times baseline concentrations. Event chemistry measured in 2007 did not show the same magnitude of increased phosphorus and turbidity levels as seen in 2005, however this can be attributed to sample timing in conjunction with the onset of rainfall event (in the case of 10/28/2008) and lower rain event intensity (on 7/4/07 and 9/15/07). The variability in storm events make comparisons between events or over time complex, but the 2005 results indicate that the storm event in 2007 was of particularly high intensity and that the levels of turbidity and phosphorus measured during this storm event are not routinely reached during smaller or less intense storms of the magnitude captured in 2005. While it is also possible that there were changes in the watershed which have reduced turbidity and phosphorus levels between 2005 and 2007, this seems unlikely because trends appeared to be similar in both the Peacham hollow Brook and

South Peacham Brook, whereas watershed changes would likely impact tributaries differently. In addition, the variability in phosphorus and turbidity between events in 2007 closely correlated to storm intensity indicating that storm intensity is a major driving factor as to phosphorus levels reached during events.

While the 2007 event sampling captured maximum phosphorus and turbidity levels that were an order of magnitude lower than those captured in 2005 this does not mean that other more intense storm events that were not captured in 2007 did not reach such levels as a number of roughly similar storms occurred but were not sampled. Therefore recommended actions remain the same as those suggested in 2005 including supporting many other investigations and actions within this watershed such as geomorphic assessment (river dynamic and equilibrium), better back roads/road drainage improvement, agriculture best management practices and design and feasibility studies.

Site WBB01 was added in 2007 to provide information to help understand local concerns about nutrient transport into Harveys Lake from South Peacham Brook during storm events when the Harveys Lake Dam causes a backflow of water from South Peacham Brook into Harveys Lake. Backflow was not observed during the course of sampling in 2005 suggesting higher flows than were seen are needed to reverse the flow direction at the Harveys Lake outlet stream. WBB01 had relatively low phosphorus and turbidity levels compared to the other three sites sampled in the Stevens River Watershed in 2005 including the lowest maximum phosphorus levels and lowest average turbidity levels. The backflow from South Peacham Brook may still have an important influence on nutrient levels in Harveys Lake.

References

Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division April 1999, *Stevens, Wells, Waits, Ompompanoosuc Rivers Water Quality & Aquatic Habitat Assessment Report.*

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State of Vermont, Water Resource Board, July 2000, *Vermont Water Quality Standards*, Montpelier VT.

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<http://md.water.usgs.gov/watershed/MD151/waterchem.html>, Baltimore MD.

APPENDIX 1 – DATA

STORM EVENT DATA 7/04/2008 – 9/15/2008 10/27/2008

SITE	DATE/Time	Phos ug/l	Turb NTU	DO (mg/l)	Water T (C)	Rainfall (in)	Staff Ht (cm)
Asr0la	7/4/07 6:15 PM	7.4	0.3	9.3	19	0.007874	7.5
Asr01b	7/4/07 7:00 PM	7.9	0.41			0.047244	7.5
Asr01c	7/4/07 7:45 PM	7.9	0.45			0.047244	7.5
Asro1c	7/4/07 7:45 PM	7.4	0.36			0.031496	7.5
Asr01d	7/4/07 8:31 PM	9.5	0.51	9	18.4	0.055118	7
Asr01e	7/5/07 6:30 AM	14	0.37				13
Asr0la	9/15/07 8:00 AM	38	3.85	10	15.1	0.23622	9.5
Asr01b	9/15/07 8:50 AM	39.5	2.77	9.2	15.8	0.11811	12.5
Asr01c	9/15/07 9:34 AM	61.2	1.46	8.7	15.5	0.055118	14.5
Asro1c	9/15/07 9:34 AM	34.2	1.24	8.7	15.5	0.031496	14.5
Asr01d	9/15/07 11:55 AM	122	4.91	8.8	15.1	0	17
ASR01a	10/28/07 7:42 AM	41.2	3.65				35
ASR01b	10/28/07 8:15 AM	36.6	6.72	12.7	9.2		34.5
ASR01c	10/28/07 9:35 AM	32.5	5.77	13.3	9.4		34
ASR01c	10/28/07 9:35 AM	31.9	4.97	13.3	9.4		34
ASR01d	10/28/07 5:17 PM	21.1	1.92				32.5
PH02A	7/4/07 6:35 PM	5.8	0.42	9.1	16.2	0.007874	37
PH02B	7/4/07 7:21 PM	6.2	0.2			0.047244	37.5
PH02C	7/4/07 8:03 PM	10	0.23	8.7	16.2	0.047244	38
PH02C	7/4/07 8:03 PM	11	0.2			0.031496	38
PH02D	7/4/07 8:52 PM	6.9	0.2	9.2	15.7	0.055118	38
PH01E	7/5/07 6:47 AM	19.8	0.85				45
PH02A	9/15/07 8:22 AM	171	7.9	9.4	14	0.23622	39.5
PH02B	9/15/07 9:13 AM	97.6	10.4	8.7	13.5	0.11811	44.5
PH02C	9/15/07 9:53 AM	100	5.52	8.7	13.5	0.055118	49
PH02C	9/15/07 9:53 AM	96.4	5.17	8.7	13.5	0.031496	49
PH02D	9/15/07 12:21 PM	118	7.75	8.3	13.7	0	58.5
PH02A	10/28/07 7:53 AM	18.7	3.94	12.6	9.2		54
PH02B	10/28/07 8:25 AM	21.9	3.26	14	9.1		54
PH02C	10/28/07 9:53 AM	16	2.55	12.5	8.9		53
PH02C	10/28/07 9:53 AM	20	1.71	12.5	8.9		53
PH02D	10/28/07 5:46 PM	10.5	2				50.5
Sr0la	7/4/07 6:31 PM	16.5	0.36	9.4	17.3	0.007874	12
SR01b	7/4/07 7:19 PM	17.4	0.39			0.047244	12.5
Sr01c	7/4/07 7:59 PM	21.2	0.44			0.047244	12.5
Sr01c	7/4/07 7:58 PM	20	0.76	8.9	17.9	0.031496	12.5
Sr01d	7/4/07 8:46 PM	29.1	0.52	8.7	17.7	0.055118	12.5
Sr01e	7/5/07 6:45 AM	21.8	0.47				12.75
Sr0la	9/15/07 8:19 AM	67	1.33	9.9	16.6	0.23622	16
SR01b	9/15/07 9:01 AM	75	1.12	8.8	14.9	0.11811	19
Sr01c	9/15/07 9:49 AM	85.4	1.15	9	14.7	0.055118	19.5

SITE	DATE/Time	Phos ug/l	Turb NTU	DO (mg/l)	Water T (C)	Rainfall (in)	Staff Ht (cm)
Sr01c	9/15/07 9:49 AM	87.7	1.12	9	14.7	0.031496	19.5
Sr01d	9/15/07 12:17 PM	146	5.36	8.7	15.2	0	19.5
SR01a	10/28/07 7:50 AM	41	3.97	12.6	9.3		31.5
SR01b	10/28/07 8:22 AM	41	5.22	13.7	9.3		31.5
SR01c	10/28/07 9:50 AM	35	4.64				32
SR01c	10/28/07 9:50 AM	35.6	5.35	13.3	8.8		32
SR01d	10/28/07 5:42 PM	21.4	2.93				26
Wbb01a	7/4/07 6:50 PM	10.9	0.21	8.6	18.7	0.007874	198
Wbb01b	7/4/07 7:27 PM	14	0.21			0.047244	
Wbb01c	7/4/07 8:15 PM	9.2	0.23	7.3	16.4	0.047244	198
Wbb01c	7/4/07 8:15 PM	10.5	0.3			0.031496	198
Wbb01d	7/4/07 9:00 PM	10.7	0.23	8.6	15.8	0.055118	
Wbb01e	7/5/07 6:50 AM						197
Wbb01a	9/15/07 8:31 AM	32.1	1.85	7.8	14.6	0.23622	188
Wbb01b	9/15/07 9:22 AM	65.9	1.34	8.3	12.9	0.11811	186
Wbb01c	9/15/07 10:01 AM	76.9	2.38	7.7	15.1	0.055118	183
Wbb01c	9/15/07 10:01 AM	70.2	2.43	7.7	15.1	0.031496	183
Wbb01d	9/15/07 12:28 PM	112	2.11	8.3	13.7	0	178
WBB01a	10/28/07 8:00 AM	24	7.06	12.4	8.7		175
WBB01b	10/28/07 8:39 AM	21.7	3.31	13.7	8.5		174
WBB01c	10/28/07 10:03 AM	21.2	2.5	12	8		175
WBB01c	10/28/07 10:03 AM	20.8	3.07				175
WBB01d	10/28/07 5:06 PM	13.6	1.63				181
	n	63.0	63.0	44.0	44.0		61.0
	STD Dev:	38.0	2.4	2.0	3.3		67.9
	t	1.7	1.7	1.7	1.7		1.7
	Mean:	40.0	2.5	10.0	13.6		64.4
	Min	5.8	0.2	7.3	8.0		7.0
	Max	171.0	10.4	14.0	19.0		198.0
	95% upper:	47.9	3.0	10.5	14.5		78.9
	95% lower:	32.0	2.0	9.5	12.8		49.9

APPENDIX 2 – RATING CURVES

