Peacham Barnet Water Quality Study
Summer 2005

http://webpages.charter.net/andrewm/Stevens_River

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A final report Submitted to the Connecticut River Joint Commission, November 30, 2005 from the Peacham Conservation Commission

EXECUTIVE SUMMARY

1. The first ever water chemistry parameters were collected at a total of 5 sites within The Stevens River Watershed on South Peacham Brook, Peacham Hollow Brook and the Stevens River main stem from June 2005 through September 2005.

2. Baseline measurements of total nitrogen, nitrate (NO_3- N), total phosphorous, turbidity, and chloride were collected 2x per month and analyzed at the State of Vermont analytical lab. In situ measurements of stream velocity, dissolved oxygen, pH, conductivity, and temperature supplemented the data set.

3. Total N and the by product nitrate (NO_3- N) can implicate excessive fertilizer use. Other sources are also attributed to high amounts of organic material breaking down in well oxygenated environments (Allen, 1996). Total N and NO_3 ranged from 0.130 to 0.870 mg/l and 0.068 to 0.696 mg/l respectively. NO_3 – N was well below the Vermont Water quality standards of 5 mg/l for Class B2 waters.

4. 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. Total phosphorous and turbidity ranged from 5.55 to 122 ug/l and 0.370 to 14.7 NTU respectively. Except for one occasion on 9/1/2005 at ASR01, turbidity was well under Vermont water quality standards of 10 NTU for Class B2 waters (State of VT, Water Resources Board, 2000) except for the samples taken the 8/21/2005 storm event

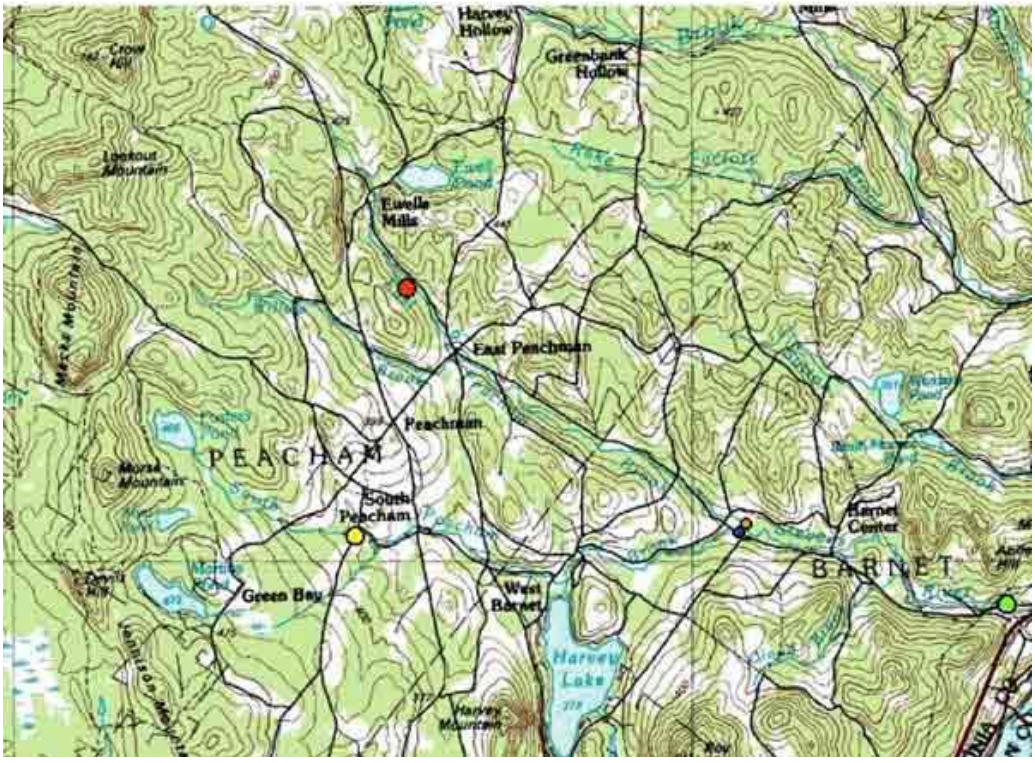
5. Dissolved oxygen, pH, water temperature and conductivity were measured in the field and are useful indicators of healthy aquatic habitats. Dissolved oxygen and pH ranged from 6.1 to 12.2 mg/l and 6.8 to 8.7 respectively, where dissolved oxygen was above tolerance of 6.0 mg/l as determined by the Vermont water quality standards (State of VT, Water Resources Board, 2000). pH was also with the range of 6.5 – 8.8 for this Class B2 waters. The higher more alkaline pH values are based on the underlying calcified geology of this watershed. Water temperature ranged form 12.9 to 20.0 C^o. Conductivity was also affected by bedrock weathering and ranged from 150 to 310 μS.

6. Three stream discharges site were established over the course of the field campaign. Flow was determined by velocity rating curves that were developed by stage height. The average discharge (from three discharge measurement) on the main stem of the Stevens River measured at Bens Mill was 3.18 m^3/s (112.3 cfs). The PH02 site (Peacham Hollow Brook) and SR01 (South Peacham Brook) had average discharges of 0.23 m^3/s (8.15 cfs) and 0.790 m^3/s (27.9 cfs) respectively.

7. One storm event sampling round was conducted on August 21, 2005 at PH01 and SR01. Where 0.90 inches of rain fell within 6 hours of sampling. Average concentrations at PH01 for Total N, nitrate (NO_3- N), total phosphorous, turbidity and chlorine were 1.52 mg/l, 0.123 mg/l, 530.075 ug/l, 90.1 NTU, and 9.105 mg/l respectively. At SR01 average concentrations of Total N, Nitrate (NO_3- N), total phosphorous, turbidity and chlorine were found to be 1.65 mg/l, 0.553 mg/l, 369.2 ug/l, 52.9 NTU, and 13.2 mg/l 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). The five 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 them moved upstream in elevation, to a site on South Peacham Brook (SR01, blue) and a site on Peacham Hollow Brook just above their confluence (PH01, orange). These were preceeded by a site on Peacham Hollow Brook (PH02, red) and the final site on South Peacham Brook at the intersection of Governor Maddox road and County Road (SPB01, 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).



Site Name	Elevation (m)	Location Latitude/Longitude		Map Color	Water body
SR01	235	N 44°18.773'	W072°06.413'	BLUE	South Peacham Brook
PH01	231	N 44°18.781'	W072 °06.387'	ORANGE	Peacham Hollow Brook
ASR01	N/A	N44 °18.103'	W072 °03.492'	GREEN	Stevens River
SPB01	353	N44 °18.879'	W072 °10.647'	YELLOW	South Peacham Brook
PH02	374	N44 °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. Harveys 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.

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, members of the Peacham Conservation Commission, Dave Magnus, Ron Miller, and Cindy McKnight. The State lay monitoring program delivered the samples to Waterbury Vermont.

2.0 METHODS

CHEMISTRY

Each site was sampled for total nitrogen, nitrate – N, total phosphorous, chloride, and turbidity twice a month from June 2005 through September 15, 2005. 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, pH and conductivity measurements (Appendix 1). These were standardized and calibrated before each sampling session.

PHYSICAL HYDROLOGY

Staff gauges and discharge measurements were performed during the project length at 3 sites within the watershed (Bens Mill, SR01, and PH02). The rating curve (stage height and discharge) relationships are found in Appendix 2. The collection of this and rainfall information aid in the initial understanding of how these tributaries respond to changed climate conditions and what may be happening chemically within the water body. Table 1 summarizes the summer 2005 field season on these streams.

Table 1. Overview of the sampling schedule, reasoning, and sampling frequency of the Peacham Barnet Water quality study 2005.

Site(s)	Parameters	Frequency	Process	Why?
All Sites	Total N, NOx , Total P, Cl-, and Turbidity	6/9/05 6/23/05 7/7/05 7/21/05 8/4/05 8/18/05 9/1/05 9/15/05	Field Grab samples. State of Vermont La Rosa Lab, Waterbury VT via lay lake monitor from Harveys Lake.	Evaluate current conditions of surface waters, help understand land uses and make informed decisions based on data collected N, P, NOx: Nutrients, fertilizers, terrestrial inputs Cl- : Road salt, also helps in GW terrestrial links Turbidity: Storm events, river erosion/dynamics
All Sites	pH, Temperature, Conductivity, Dissolved Oxygen	6/9/05 6/23/05 7/7/05 7/21/05 8/4/05 8/18/05 9/1/05 9/15/05	In situ with hand held meters data recorded in field book	Water Quality indicators easily and frequently done for comparison/contrasting other study sites, other studies or past data from the specific site.
2 Sites PH02 SR01	N, NOx, P, Cl-, Turbidity, pH, Temperature, Conductivity, Dissolved Oxygen	Rainstorm Event 8/21/2005 6:00am – 9:00 am	Field Grab samples. Collection of parameters at the same sites over the course of the storm approximately 4 samplings sessions at one site.	To understand the watershed/basin response to rainfall look at potential loads from areas upstream To see how two different tributaries drain different land use area respond chemically to rainfall events
3 Sites PH02 Bens Mill SR01	Flow	3-5 times over the Summer	In situ with hand held meter	Helps link together chemistry as well as define site (steep, slow)
SR01, Bens Mill, PH02	Staff Gauge Climate/Rain	Daily/weekly	In situ with tape measure or direct read of relative water height Climate data from local meteorological weather station	Height is related to volumetric flow graphically that indicates discharge with associated height.

3.0 RESULTS

Over the course of the project approximately 50 chemistry samples were taken at each site in this watershed. This includes blanks, and storm event samples. Flow measurements and rating curves were also completed at 3 sites lending a basic understanding of the hydrology. Appendix 1 & 2 contains summarized chemistry data and flow rating curves. Figures 2 – 4, below indicate the

differences between the sites measured for water chemistry.

SUMMER BASELINE CHEMISTRY

The Stevens River at Anderson Street (ASR01) is the lowest site in elevation within the watershed and had chemistry levels that appeared to be an average of the constituents measured at PH01 and SR01.

South Peacham Brook at the confluence with Peacham Hollow Brook (SR01) had higher Nitrogen levels than Peacham Hollow Brook. There were some variations in the nitrogen levels which could be related to some terrestrial inputs, combined with rainfall or other land use factors.

Peacham Hollow Brook above the confluence with South Peacham Brook (PH01) had slightly lower levels of all the nutrients without a lot of variability over the summer. There is a trend of increasing chloride over the summer that could be related to chloride application on the East Peacham Road during the winter or the summer application of chloride to reduce dust on the road.

Peacham Hollow Brook above the town garage (PH02) had slightly lower nutrient levels than other sites except for a very high phosphorus measurement on 7/21/05 of 56 ug/l. This high phosphorus level was not correlated to high turbidity, like the storm samples, so it is an anomaly. Reaches in this brook have several debris dams that may randomly breach at times.

South Peacham Brook at Governor Maddox Road and County Road (SPB01) had very low chloride levels but otherwise did not have a lot of variation and had slightly higher than average nutrient levels compared to other sites except for SR01.

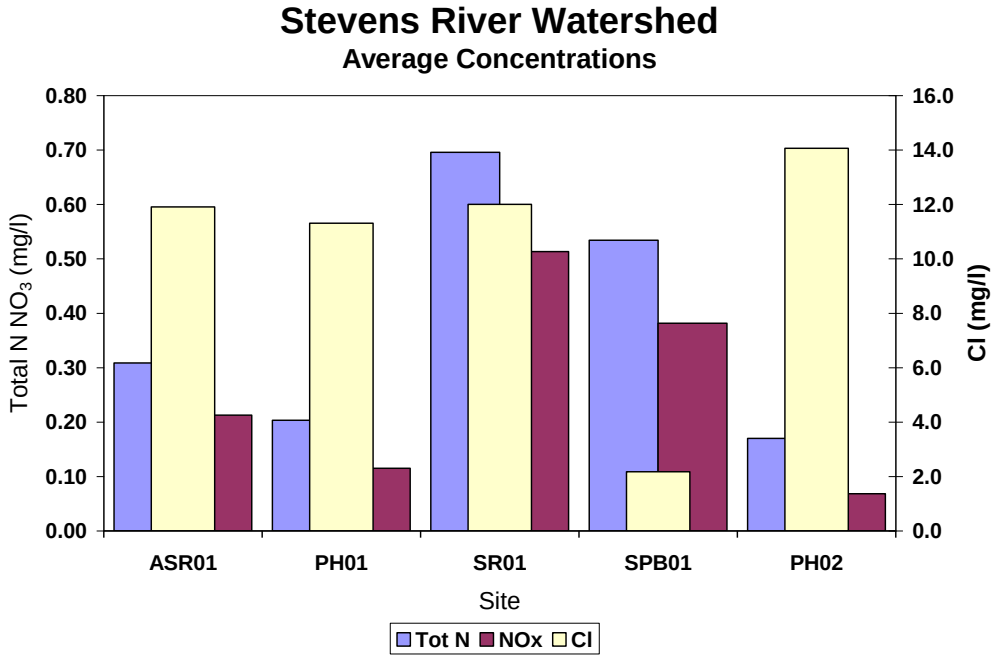


Figure 2 – Average nitrogen, NO_3, and chloride by site.

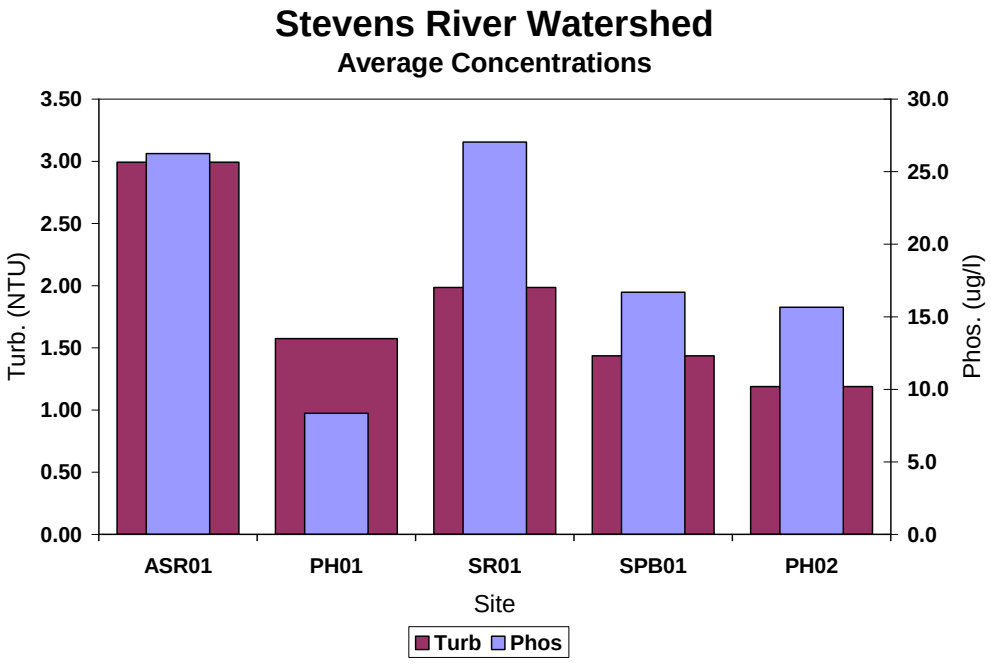


Figure 3 – Average total phosphorous and turbidity by site.

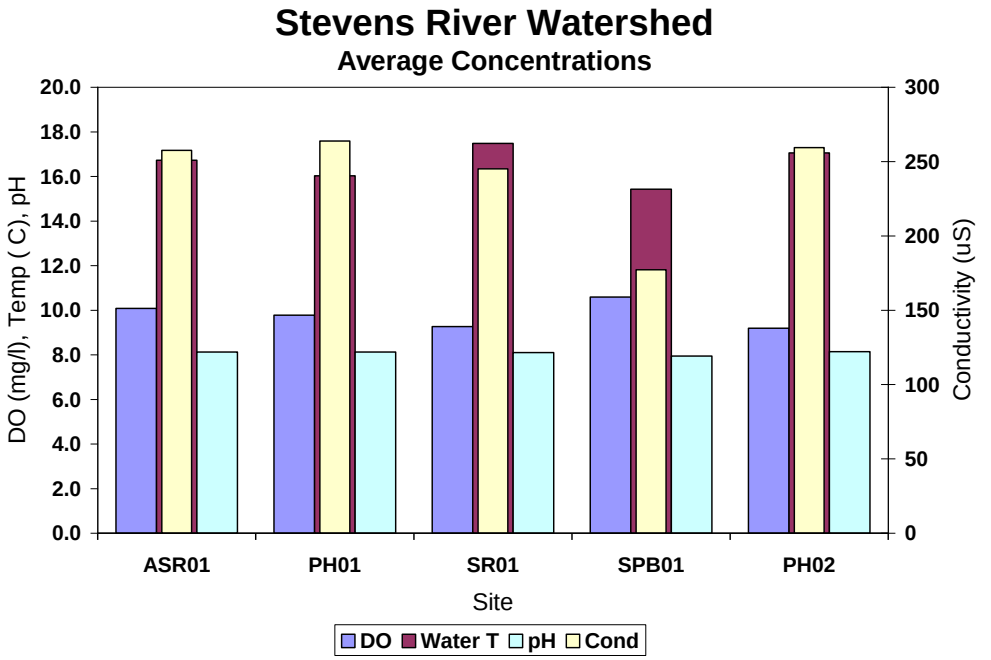


Figure 4 – Average dissolved oxygen, water temperature, pH, and conductivity by site.

Changes in chemistry from site to site are controlled by a combination of geology, climate and land use for the specific area. No real obvious trends emerge when comparing average concentrations over

the summer (See Appendix 3, for the temporal changes in chemistry at specific sites). Precipitation input tends to increase concentrations of phosphorous and turbidity, indicating how responsive these streams are. Conductivities and pH were relatively high, probably related to the carbonate bedrock that underlies much of the watershed. 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. Nutrient levels measured as total nitrogen, nitrate nitrogen and total phosphorus varied over the summer but were not above water quality standards during base flow conditions. There were some higher measurements during storm event sampling (Figure 5 and Appendix 2).

STORM EVENT

On August 21, 2005 0.91 inches of rain fell within the watershed from approximately 3:00 am to 9:00 am. Water chemistry measurements were taken at PH01 and SR01 over the course of the rain event (Figure 5). The chemistry results indicated elevated concentrations from baseline conditions. However since only one event was sampled at two sites, resolving sources and contributing factors degrading water quality cannot be determined, but issues of storm event runoff can be linked to degrading water quality habitat.

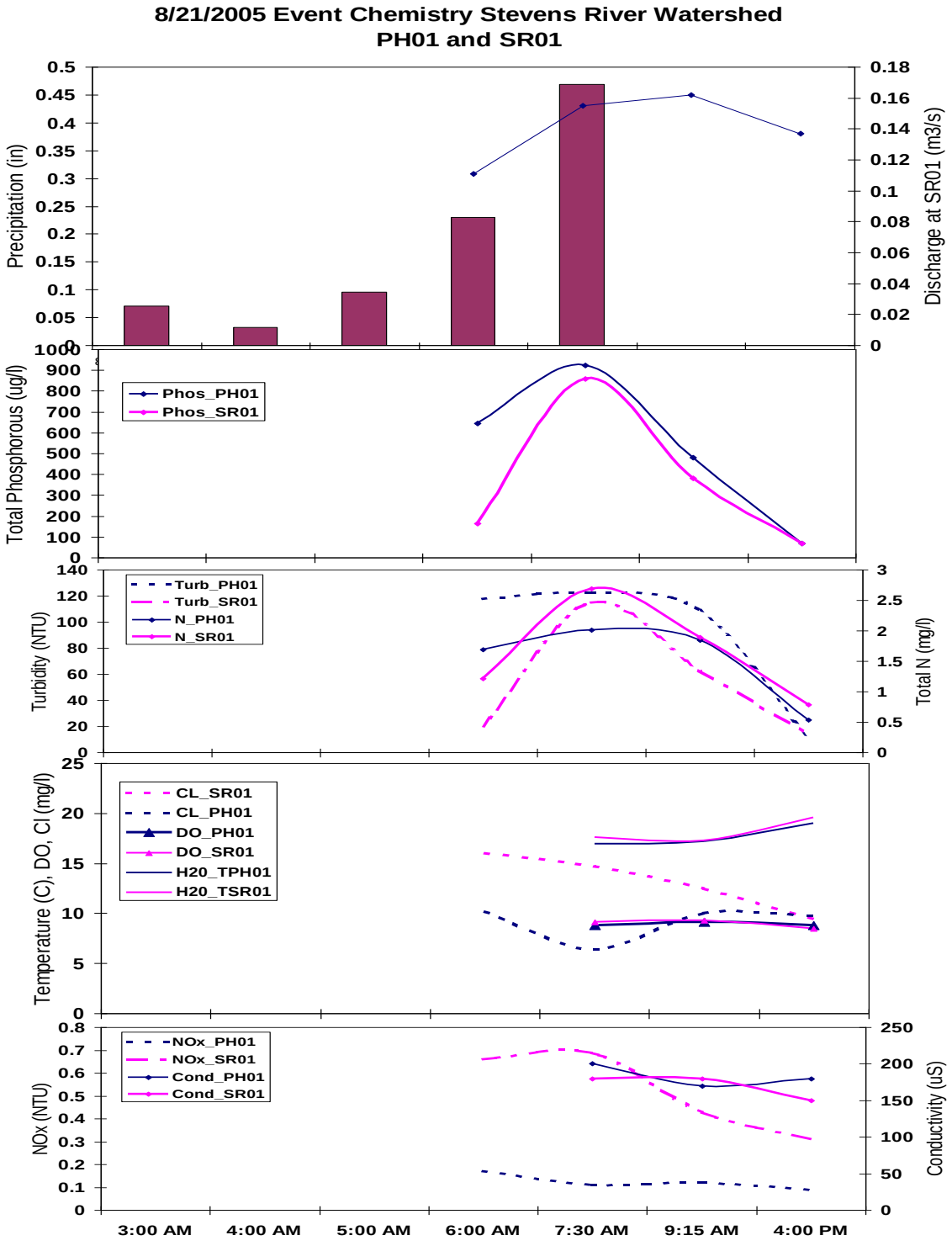


Figure 5 – 8/21/2005 Storm event chemistry- Stevens River Watershed PH01 and SR01

4.0 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 initial data from this project help explain some of the chemical and physical properties of this watershed. These baseline chemistry results begin to explain the dynamics of this watershed within the context of a working landscape. Current results such as those suggesting high levels of sedimentation during storm events will support many other investigations 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. The potential for expansion of more sampling points and higher frequency of sampling may help pin point the non-point source impacts to this river and its tributaries. Excluding the one storm event sampling these initial baseline measurements indicate an attainment of water quality standards and generally excellent water quality in the watershed.

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.*

Allen, David J, 1996, *Stream Ecology- Structure and function of running waters*, Chapman Hall, New York.

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

USGS, Water Resources Division, 2005, *Potomac Water Quality Monitoring Project*, http://md.water.usgs.gov/watershed/MD151/waterchem.html, Baltimore MD.

APPENDIX 1 – DATA

SITE	DATE	Total N mg/L	Nitrate mg/L	Phos ug/l	Turb NTU	Chloride mg/L	DO (mg/l)	pH	Cond (uS)	Water T (C)	Air T (C)
ASR01	6/9/2005	0.27	0.16	8.16	1.02	11.6	10.3	7.9	260	15.9	
ASR01	6/24/2005						11.1	8.7	200	14.1	10.2
ASRO1	7/7/2005	0.36	0.19	15.5	1.57	10.5	9.6	8.7	250	17.3	20.1
ASRO1 DUP	7/7/2005	0.35	0.2	15.2	1.38	10.3					
ASRO1	7/21/2005	0.34	0.21	11.6	1.56	14.1	9.4	8.6	310	18.6	16.3
ASR01	8/4/2005	0.31	0.16	20.1	1.66	10.4	10.6	8.2	240	17.3	14.2
ASR01	8/18/2005	0.32	0.25	9.96	1.01	15	11.1	7.7	300	15	
ASR01	9/1/2005			122	14.7	8.28	8.7	7.6	210	17.5	18.5
ASR01	9/15/2005	0.21	0.32	7.35	1.04	15.1	9.8	7.6	290	18.1	20
PH01	6/9/2005	0.17	0.11	7.85	0.52	10.2	10.3	8	240	15.9	16.1
PH01	6/24/2005			8.66		9.84	10.9	8.6	240	12.9	11.5
PH01	7/7/2005	0.26	0.12	9.85	0.8	10	9.4	8.5	250	16.7	18.4
PH01	7/21/2005	0.22	0.12	8.93	0.37	11.5	9.7	8.4	290	18.1	17.2
PH01	8/4/2005	0.2	0.12	9.08	0.95	12.9	9.9	8	290	16.1	14.7
PH01	8/18/2005	0.16	0.11	6.14	0.38	13.8	10.7	7.9	300	14	11.9
PH01	8/21/2005										
PH01a	8/21/2005	1.69	0.17	645	118	10.2					
PH01b	8/21/2005	2.01	0.11	925	123	6.42	8.8	7.9	200	16.9	20.4
PH01c	8/21/2005	1.85	0.12	480	109	10	9.1	7.9	170	17.2	21.2
PH01d	8/21/2005	0.53	0.09	70.3	10.5	9.8	8.8	8	180	19	
PH01	9/1/2005			48.3	9.38	9.44	7.7	7.8	230	17.1	20.8
PH01 DUP	9/1/2005			46.1	5.19						
PH01 DUP	9/15/2005	0.21									
PH01	9/15/2005	0.21	0.11	7.93	0.71	12.8	9.6	7.8	270	17.4	18.1
PH02	6/9/2005	0.16	0.08	7.26	1.62	14.3	9.7	8.1	260	15.1	
PH02	6/24/2005			7.06		13.2	10.6	8.6	240	14.3	12.9
PH02	7/7/2005	0.21	0.06	9.04	0.59	13.5	8.8	8	255	17.9	16.7
PH02	7/13/2005										
PH02	7/21/2005	0.17	0.07	56.8	0.58	14.1	8.6	8.6	260	18.9	20
PH02	8/4/2005	0.15	0.07	7.77	0.8	14.5	9.4	8	270	17.6	15.4
PH02	8/12/2005										
PH02	8/18/2005	0.13	0.06	5.55	0.51	15.5	10.8	7.8	280	15	12.8
PH02	8/21/2005										
PH02	8/25/2005										
PH02	9/1/2005			23.3	2.98	11.6	6.1	8	240	19.1	17.9
PH02	9/15/2005	0.2	0.07	8.37	1.24	15.8	9.5	8	270	18.5	17.7
SPB01*	6/9/2005	0.46	0.34	10.5	0.76	2	9.9	8.1	180	15.2	16.5
SPB01*	6/24/2005			9.61		2	10.7	8.4	150	13.2	11.9
SPB01*	7/7/2005	0.54	0.28	11	0.52	2	9.8	7.9	170	16.4	18.1
SPB01*	7/21/2005	0.5	0.36	15.1	0.82	2	9.4	8.5	180	17.5	19.5
SPB01	8/4/2005		0.38	20.9	1.68	2.01	10.7	7.9	180	15.9	16
SPB01	8/18/2005	0.58	0.58	10.1	0.37	2.36	11.4	8	200	13.1	13.5
SPB01 DUP	9/1/2005			42.3	3.79	2					
SPB01	9/1/2005			34.6	4.17	2					

SITE	DATE	Total N mg/L	Nitrate mg/L	Phos ug/l	Turb NTU	Chloride mg/L	DO (mg/l)	pH	Cond (uS)	Water T (C)	Air T (C)
SPB01	9/15/2005	0.59	0.35	18.4	1.78	2.98					
SPB01 DUP	9/15/2005			17.4	2.06	3.02	12.2	6.8	180	16.7	17.7
SR01	6/9/2005	0.61	0.5	10.8	0.69	13.3	10.4	7.9	260	15.5	16.1
SR01	6/24/2005			23.3		6.98	10.3	8.4	190	16.4	12.7
SR01	7/7/2005	0.56	0.29	26.8	1.09	9.9	9.1	8.6	230	18	18.1
SR01	7/13/2005										
SR01	7/14/2005										
SR01	7/21/2005	0.87	0.7	16.9	0.63	16.8	8.6	8.5	310	18.6	16.3
SR01	8/4/2005	0.46	0.24	28.7	3.91	17.4	9.6	8	210	18.7	15.2
SR01 DUP	8/4/2005	0.45	0.26	28.2	4.04	8.5					
SR01	8/12/2005										
SR01	8/18/2005	0.82	0.68	16.7	1.32	17.4	10.6	7.9	310	14.6	14.1
SR01a	8/21/2005	1.22	0.66	165	19.8	16					
SR01b	8/21/2005	2.69	0.69	860	115	14.7	9.1	7.85	180	17.6	19.9
SR01	8/21/2005										
SR01c	8/21/2005	1.89	0.43	382	62.8	12.5	9.3	7.9	180	17.3	21.4
SR01d	8/21/2005	0.79	0.31	69.6	14.1	9.47	8.5	8	150	19.6	
SR01	8/25/2005										
SR01	9/1/2005			75.3	5.18	6.84	8.2	7.6	180	18	20.4
SR01	9/15/2005	0.86	0.66	18	1.01	16.3	7.3	7.9	270	20	19.6
n		40.0	40.0	52.0	48.0	51.0	45.0	45.0	45.0	45.0	40.0
STD Dev		0.6	0.2	201.5	32.7	4.8	1.1	0.4	47.4	1.8	3.0
Mean		0.6	0.3	86.9	13.7	10.3	9.6	8.1	233.4	16.8	16.8
Min		0.1	0.1	5.6	0.4	2.0	6.1	6.8	150.0	12.9	10.2
Max		2.7	0.7	925.0	123.0	17.4	12.2	8.7	310.0	20.0	21.4

* Note that Cl- concentrations are below detectable limit.
Blank and duplicate samples were collected for QA/QC proposes relative percent difference was determined with field duplicates. Turbidity was elevated above its precision range by 2%.
a,b, c and d site notations are for storm event sampling.

Dup = Duplicate

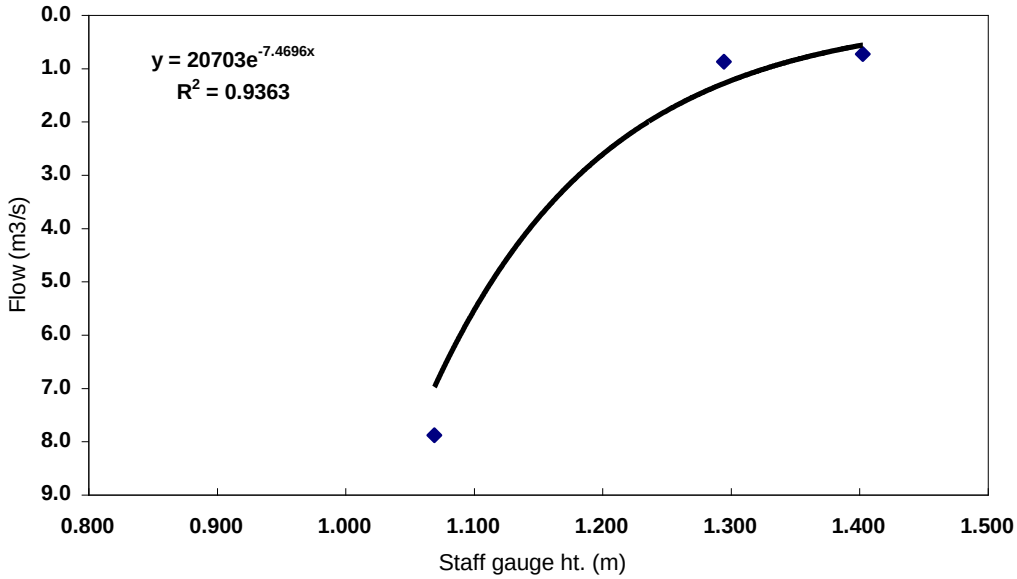
STORM EVENT DATA 8/21/2005

SITE	time	Total N mg/L	Nitrate mg/L	Phos ug/l	Turb NTU	Chloride mg/L	DO (mg/l)	pH	Cond (uS)	Water T (C)	Air T (C)
PH01	3:00 AM										
PH01	4:00 AM										
PH01	5:00 AM										
PH01a	6:00 AM	1.69	0.17	645	118	10.2					
PH01b	7:30 AM	2.01	0.11	925	123	6.42	8.8	7.9	200	16.9	20.4
PH01c	9:15 AM	1.85	0.12	480	109	10	9.1	7.9	170	17.2	21.2
PH01d	4:00 PM	0.53	0.09	70.3	10.5	9.8	8.8	8	180	19	
PH01AVG		1.52	0.1225	530.075	90.125	9.105	8.9	7.933	183.33	17.7	20.8

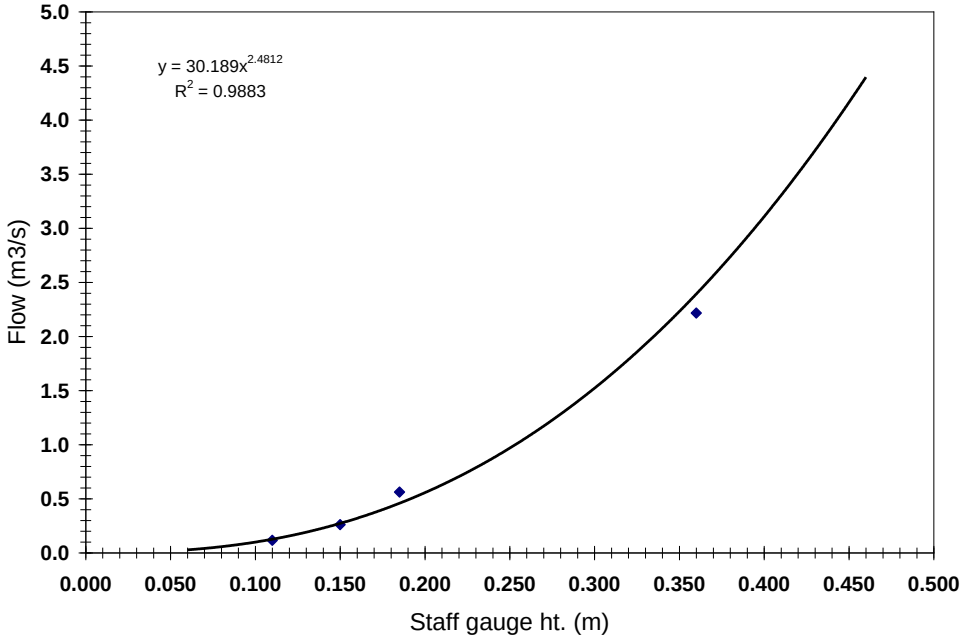
SITE	time	Total N mg/L	Nitrate mg/L	Phos ug/l	Turb NTU	Chloride mg/L	DO (mg/l)	pH	Cond (uS)	Water T (C)	Air T (C)
SR01	3:00 AM										
SR01	4:00 AM										
SR01	5:00 AM										
SR01a	6:00 AM	1.22	0.66	165	19.8	16					
SR01b	7:30 AM	2.69	0.69	860	115	14.7	9.1	7.85	180	17.6	19.9
SR01c	9:15 AM	1.89	0.43	382	62.8	12.5	9.3	7.9	180	17.3	21.4
SR01d	4:00 PM	0.79	0.31	69.6	14.1	9.47	8.5	8	150	19.6	
SR01AVG		1.6475	0.5225	369.15	52.925	13.1675	8.97	7.917	170	18.1667	20.65

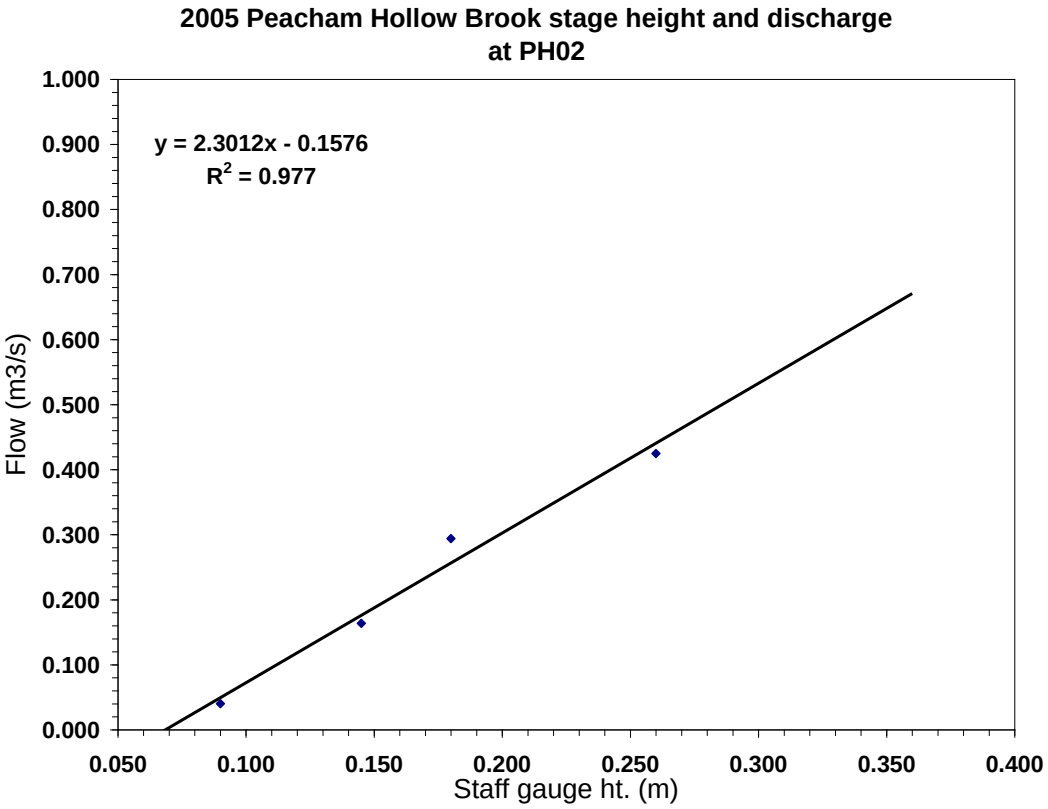
APPENDIX 2

2005 Stevens River stage height and discharge at Bens Mill, Barnet VT

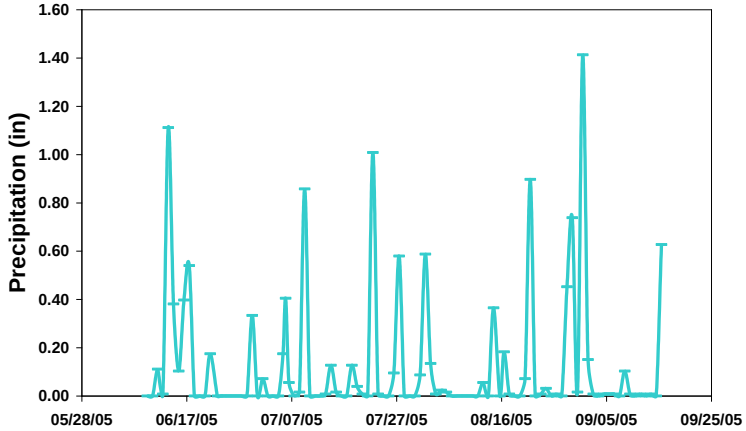


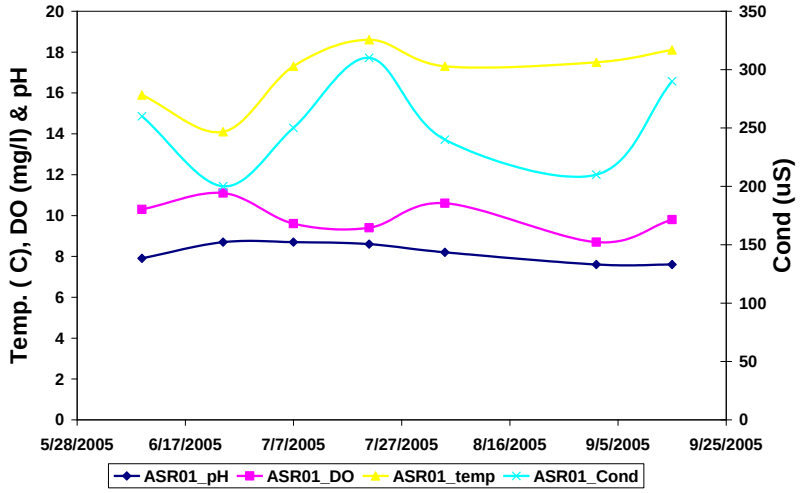
2005 Stevens River stage height and discharge at SR01 Barnet, VT

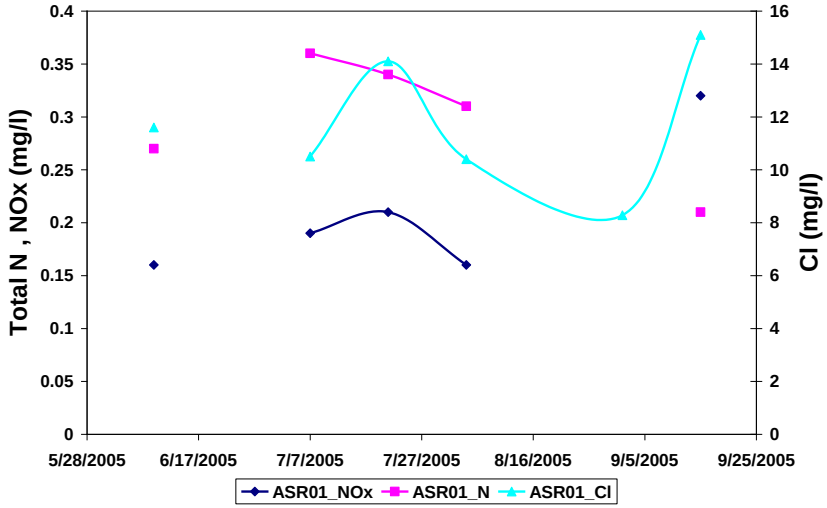


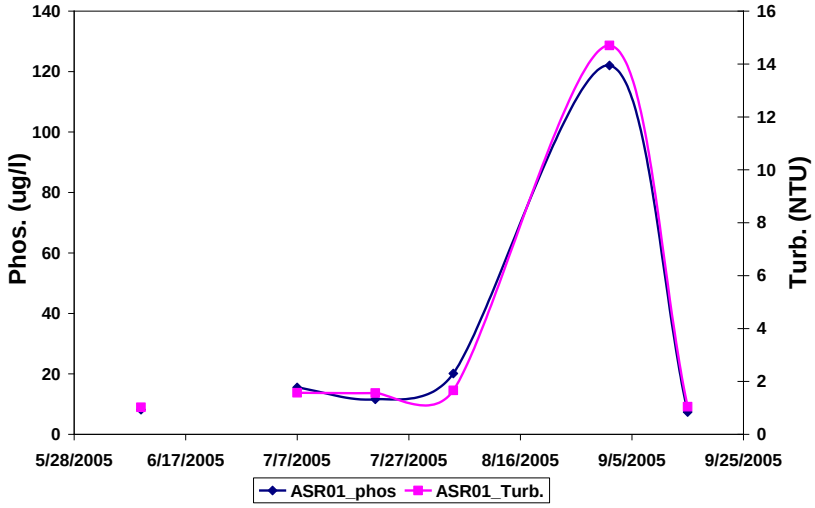

2005 Peacham Hollow Brook stage height and discharge at PH02
y = 2.3012x - 0.1576
R2 = 0.977
Flow (m3/s)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
Staff gauge ht. (m)

APPENDIX 3
ASR01 Summer 2005









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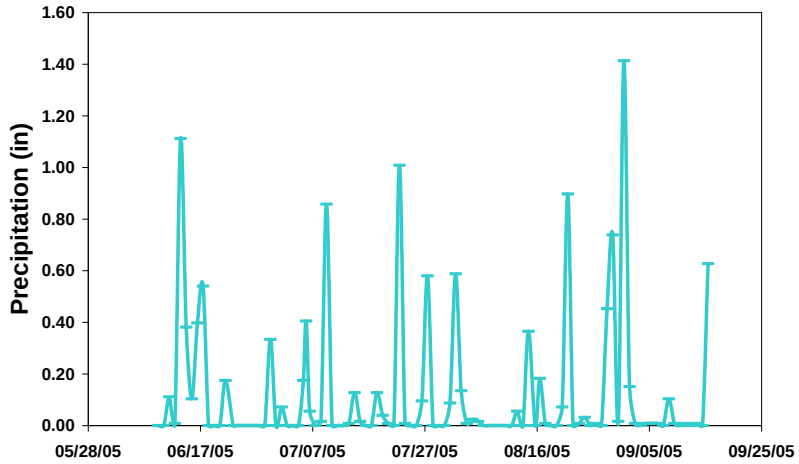

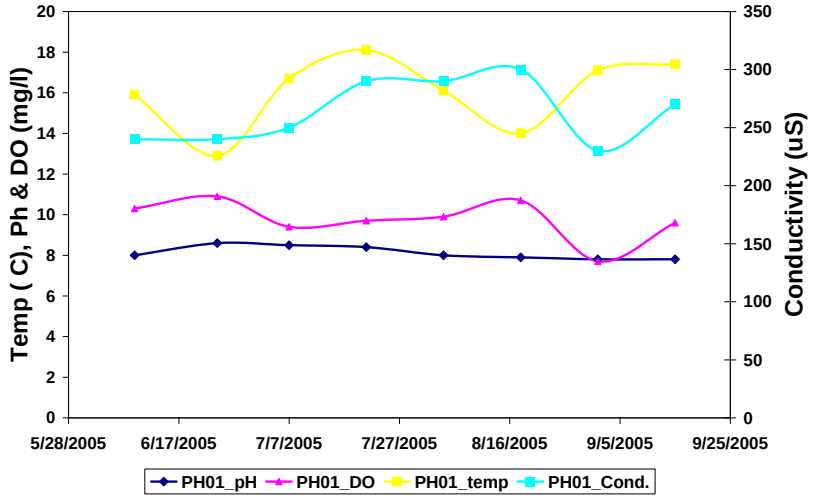

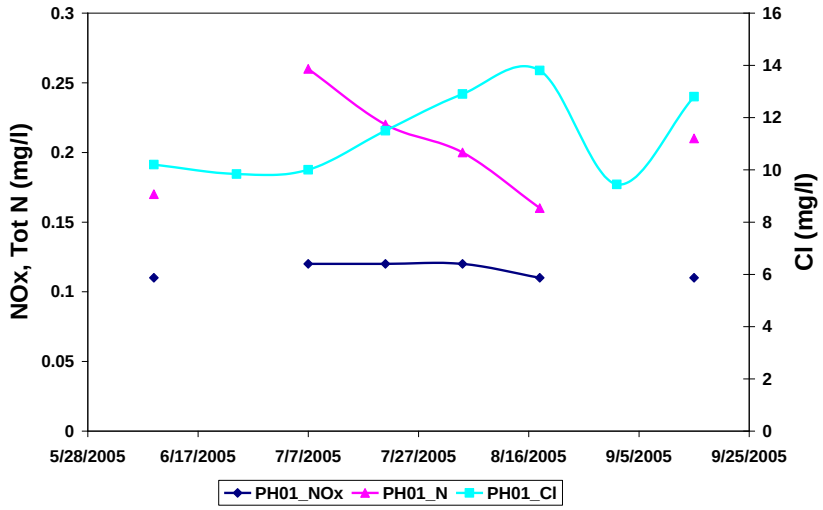

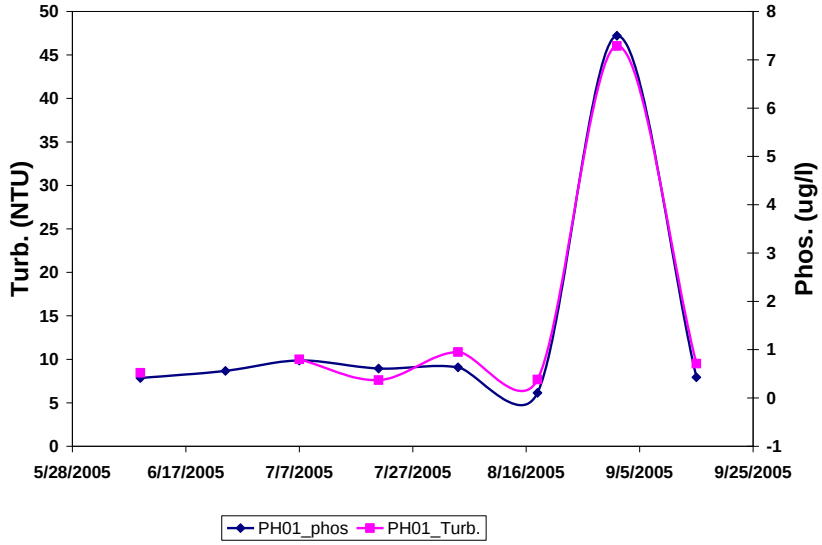

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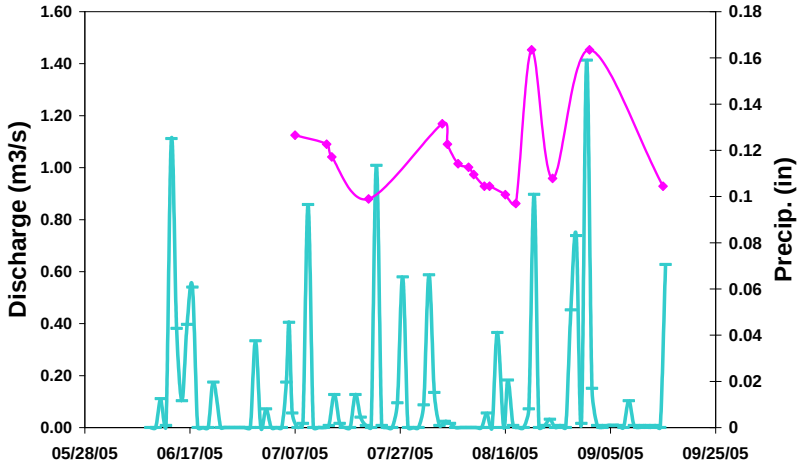

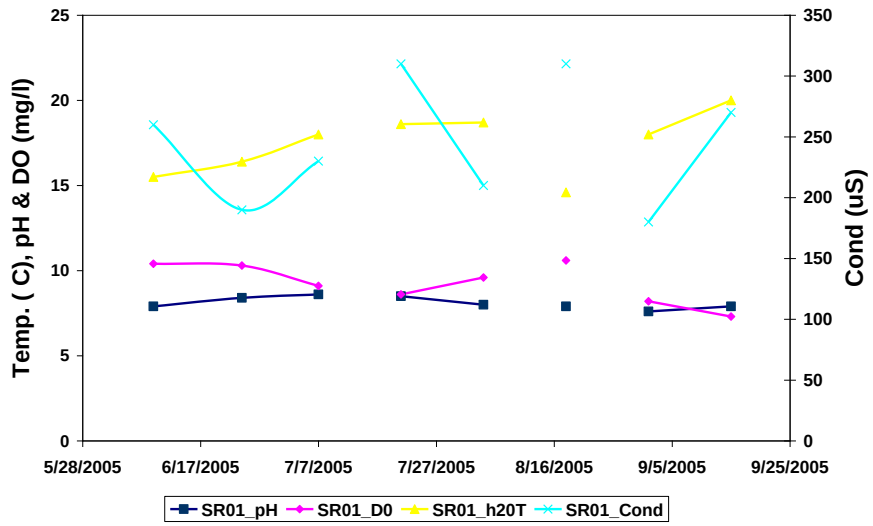

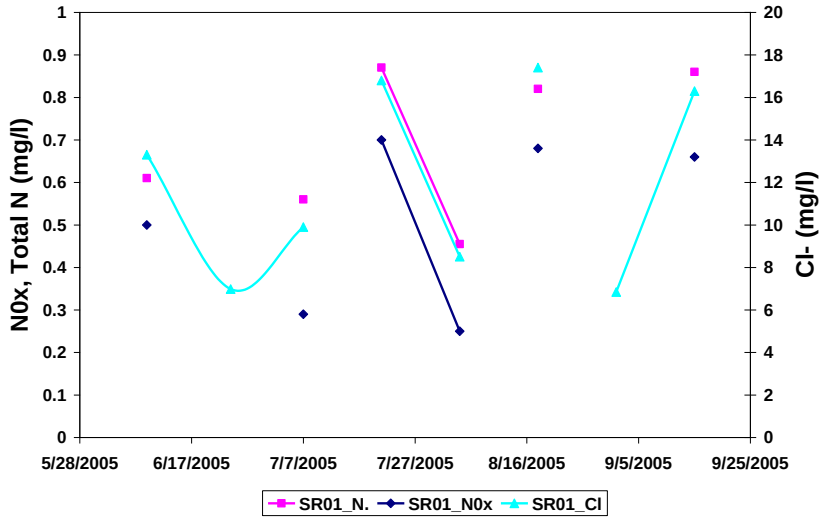

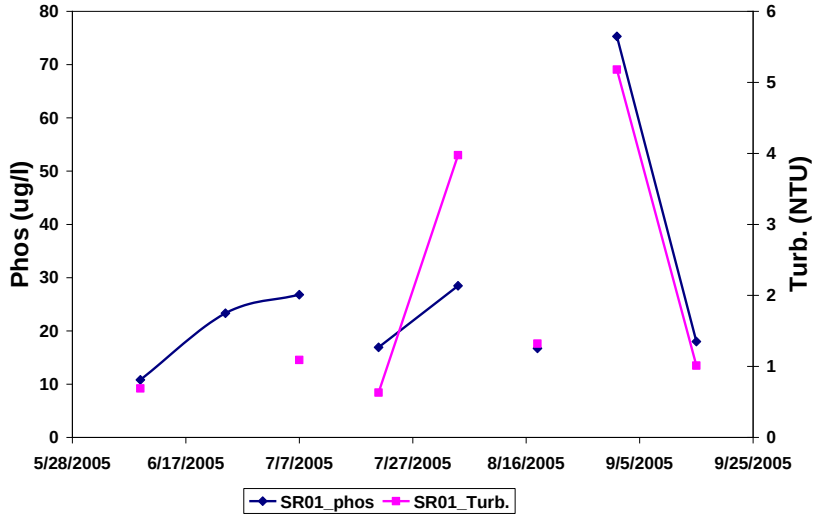

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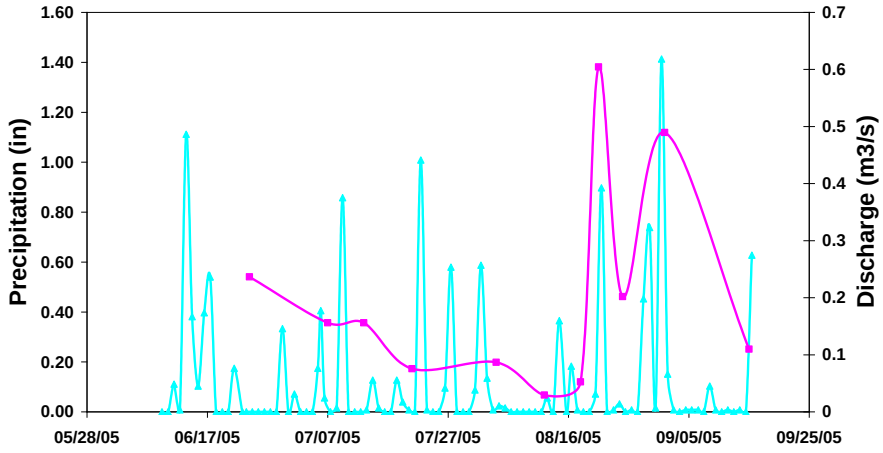

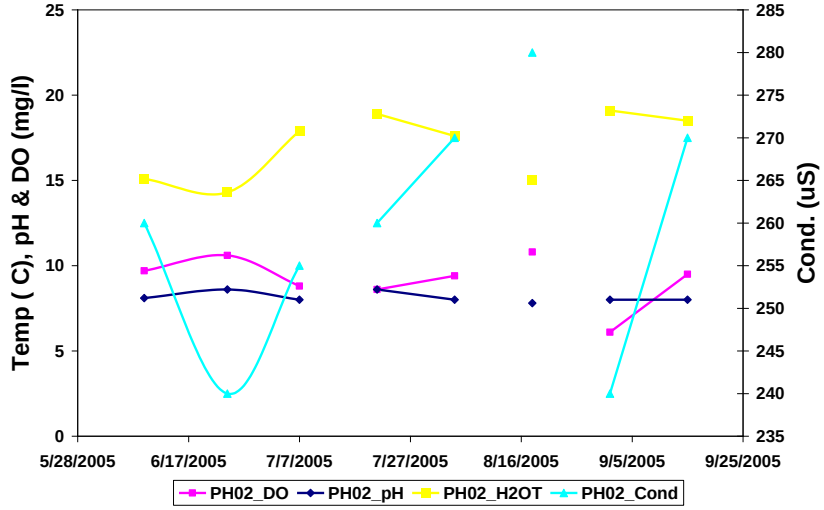

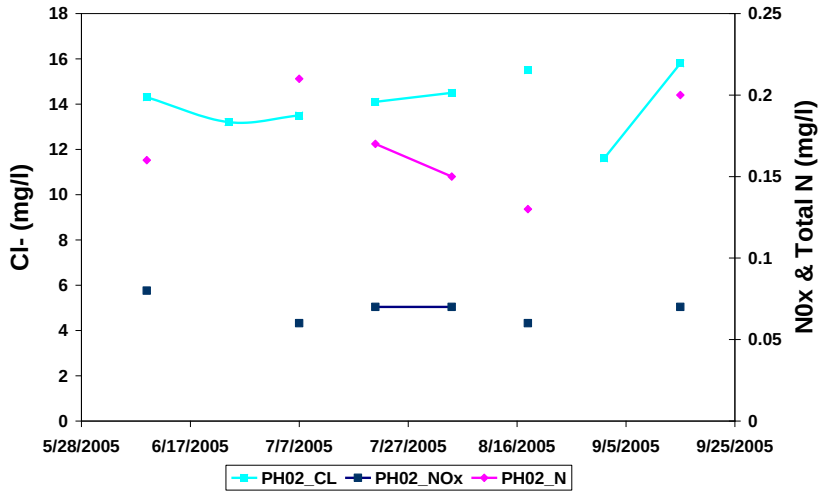

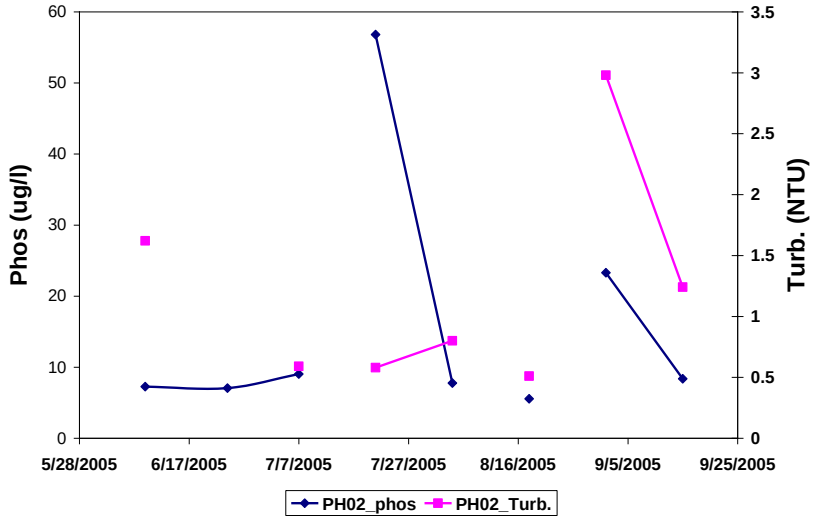

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