2006 WATER QUALITY MONITORING REPORT
POULTNEY METTOWEE WATERSHED PARTNERSHIP

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Introduction

The Poultney Mettowee Watershed Partnership (PMWP) in conjunction with the Poultney Mettowee Natural Resource Conservation District (PMNRCD) collected water quality samples at 17 sites between June and August, 2006. The samples were collected by both staff and volunteers and analyzed by the Vermont Department of Environmental Conservation's (DEC) LaRosa Environmental Lab (LaRosa) in Waterbury, VT, as part of their Volunteer Water Quality Monitoring Laboratory Services Partnership grant program.

Funding for this year's water quality monitoring program was provided through a Lake Champlain Basin Program Organization Support Grant and a Vermont DEC Watershed Grant. This funding was essential to our program's success.

This summer, with the help of our Green Mountain College intern Michelle Smith, the Poultney Mettowee Watershed Partnership monitored six streams in the watershed. We sampled the Poultney River for the fourth year in a row; the Mettowee River, Flower Brook and Beaver Brook were sampled for the second year and the Castleton River and Hubbardton River were added this year.

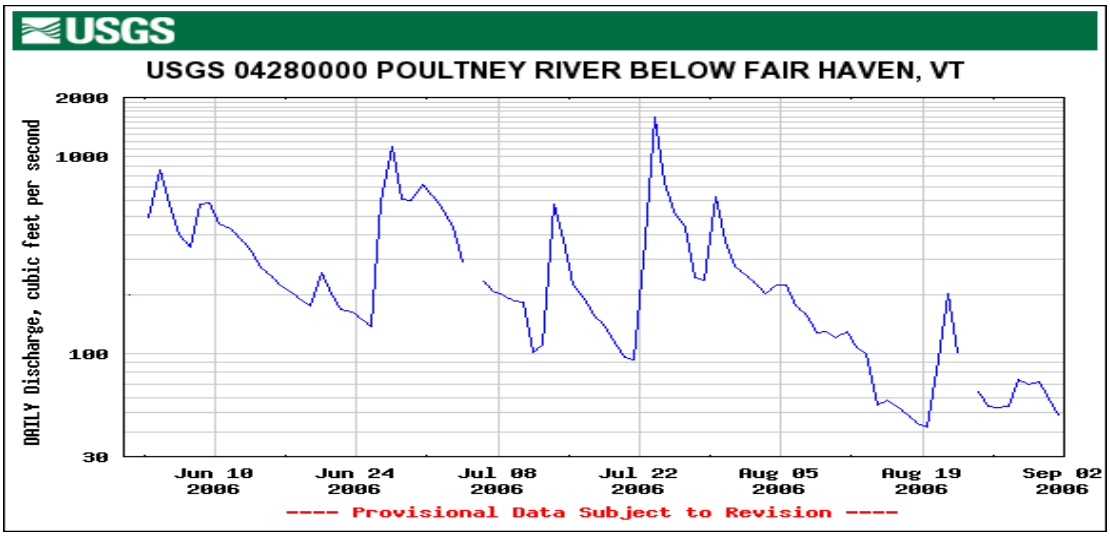
Scientists at LaRosa analyzed water samples for *E. coli*, turbidity and total phosphorus. *E. coli* tests measure the number of bacterial colonies in the water sample, while turbidity is a measure of water clarity (or conversely sediment levels) in the water and total phosphorus indicates the nutrient levels in the water.

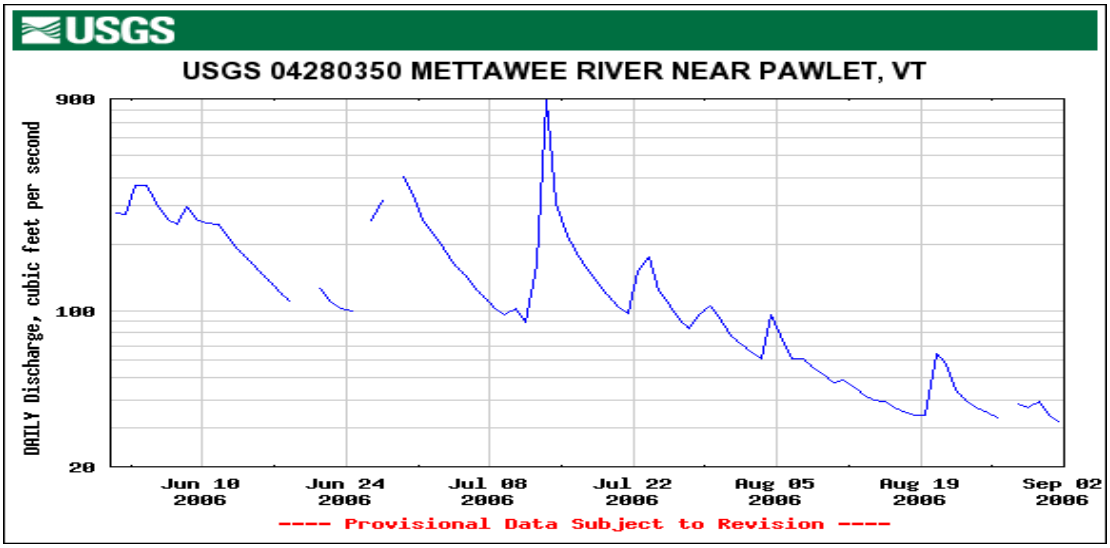
The PMWP collected samples every other Wednesday beginning June 7 and ending on August 30th. Samples were collected on scheduled days, based on the lab availability, and as a result were not always collected at times that provided the most information. The 2006 data results were heavily influenced by the high water levels resulting from heavy rains that occurred throughout the summer. Ironically, each sample date occurred as the flood waters receded. The analytical data results led us to believe that did not measure the pollution carried in the initial flush of runoff to the streams. Next year the PMWP plans to sample during storm events to measure storm-related inputs of phosphorus and turbidity to Lake Champlain.

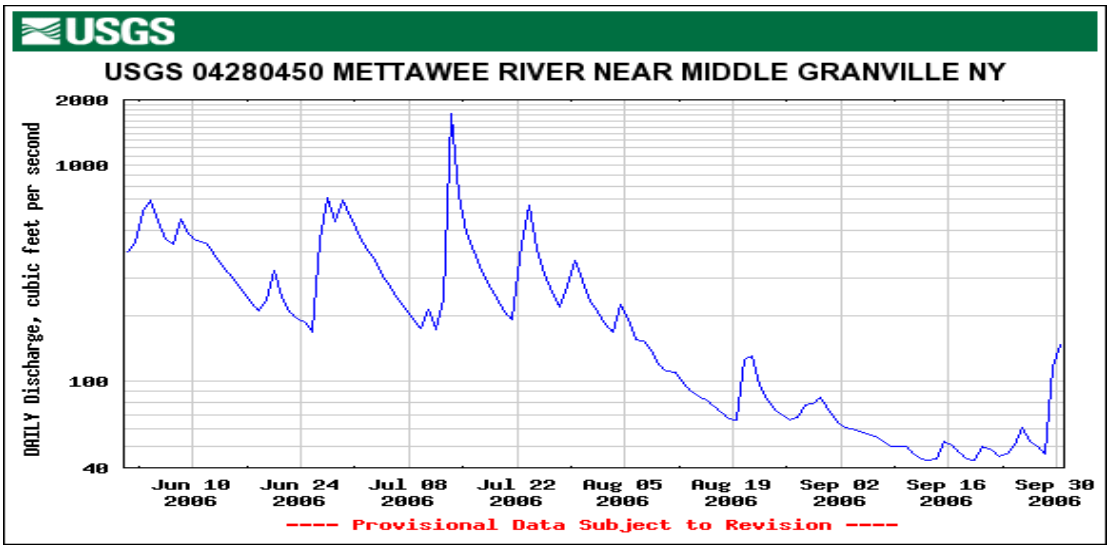
Flow Data and Weather Statistics

The following three graphs contain US Geologic Survey (USGS) Flow Data for the gage stations in our watersheds. The first graph shows flow data for the Poultney River recorded at the USGS station downstream of Fair Haven, VT. The second and third graphs are flow data recorded at USGS stations on the Mettowee River at Bette's Bridge in Pawlet, VT, and near Middle Granville in New York.

Graphs 1-3: USGS flow data for the Poultney and Mettowee Rivers.

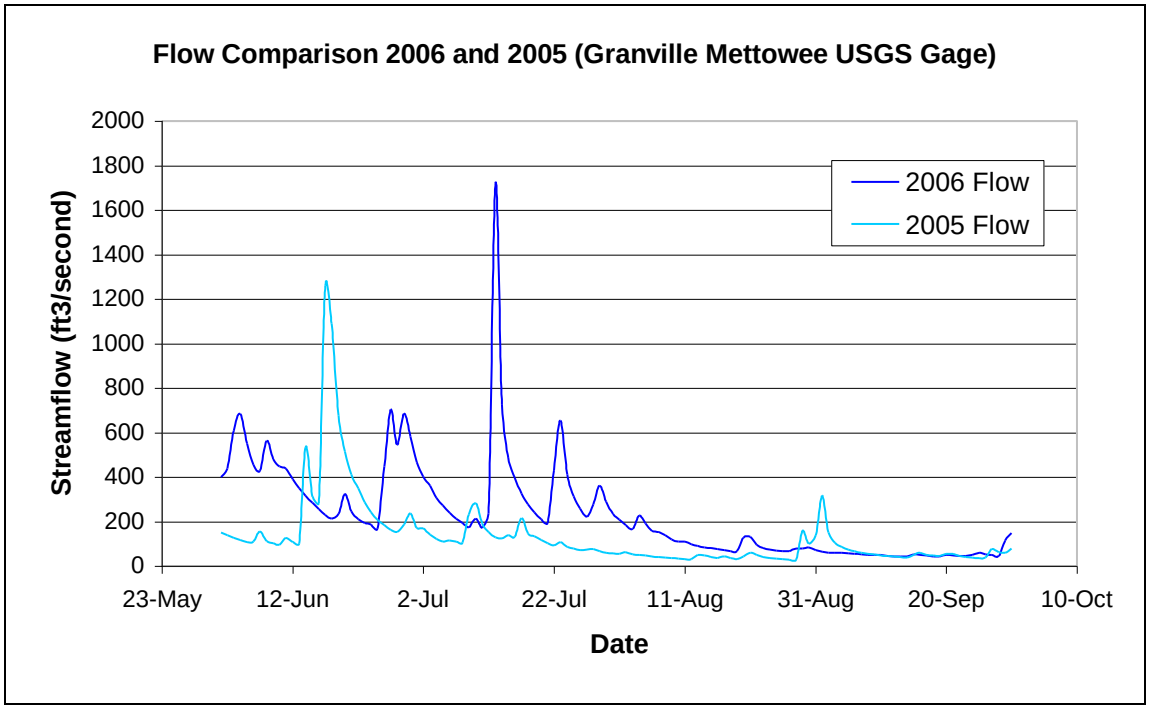






The flow spikes on the USGS discharge, or streamflow, graphs represent increased flow from storm runoff. It is evident from the numerous spikes on the graphs that there were many storms during the summer monitoring season. The Mettowee River stream discharge recorded on July 13, 2006, caused significant flooding and several instances of erosion and sediment deposition in the Pawlet area. As evidenced in Graph 4 there were more incidences of high flow in 2006 as compared to 2005.

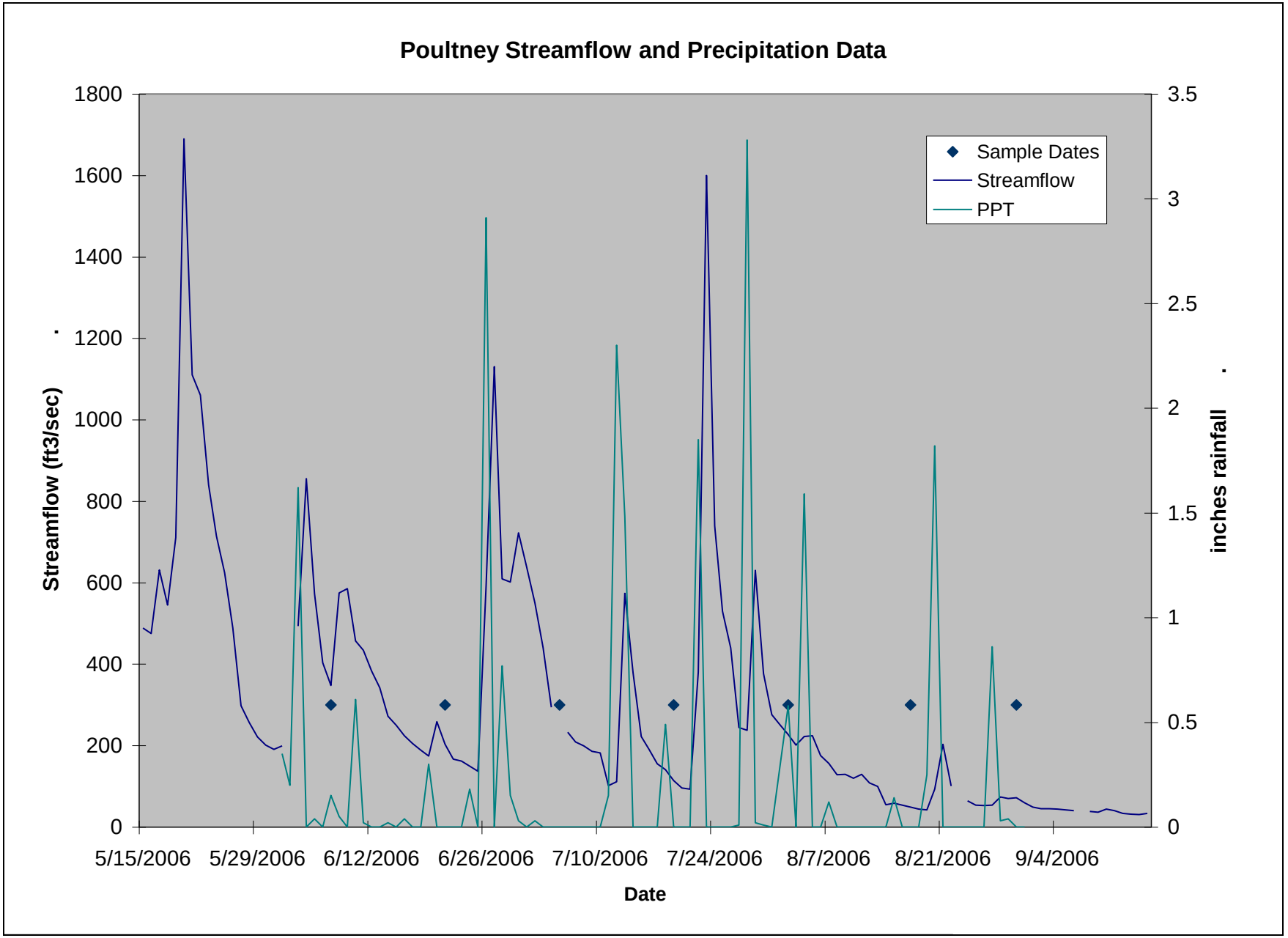
Graph 4: Streamflow for the 2005 and 2006 sampling period



In addition to the flow data, rainfall data from the Rutland and Glenns Falls areas were used to help interpret our data results. The following graphs show flow data for the Poultney River and the Mettowee River combined with rainfall data and overlaid with points that represent our sample collection dates. Many of our sample dates occurred on days with no precipitation and none of the sample dates coincided with *increasing* streamflow resulting from storm inputs. As a result, we believe that our data, which was collected during the *receding* waters after storms and after the initial flush of pollutants, showed lower *E. coli*, total phosphorus and turbidity levels than it might have under a different set of flow conditions. Pollution concentrations tend to be higher on the rising rather than the falling limb of a flood wave as a result of the mobilization of material that has accumulated during the pre-storm period. Additionally, many of the early storms may have transported the overwinter accumulation load downstream and each subsequent summer storm may therefore have carried less load (Knighton, 1998; Kamman, 2007). Baseflow conditions, as seen in August, allow us to consider groundwater inputs of E. coli.

Graph 4: Poultney River flow data, Rutland area precipitation and the PMWP sampling dates.

Graph 5: Mettowee River (near Granville) flow data, Rutland area precipitation and the PMWP sampling dates.


Poultney Streamflow and Precipitation Data
Streamflow (ft3/sec)
inches rainfall
Date
Sample Dates
Streamflow
PPT
1800
1600
1400
1200
1000
800
600
400
200
0
3.5
3
2.5
2
1.5
1
0.5
0
5/15/2006
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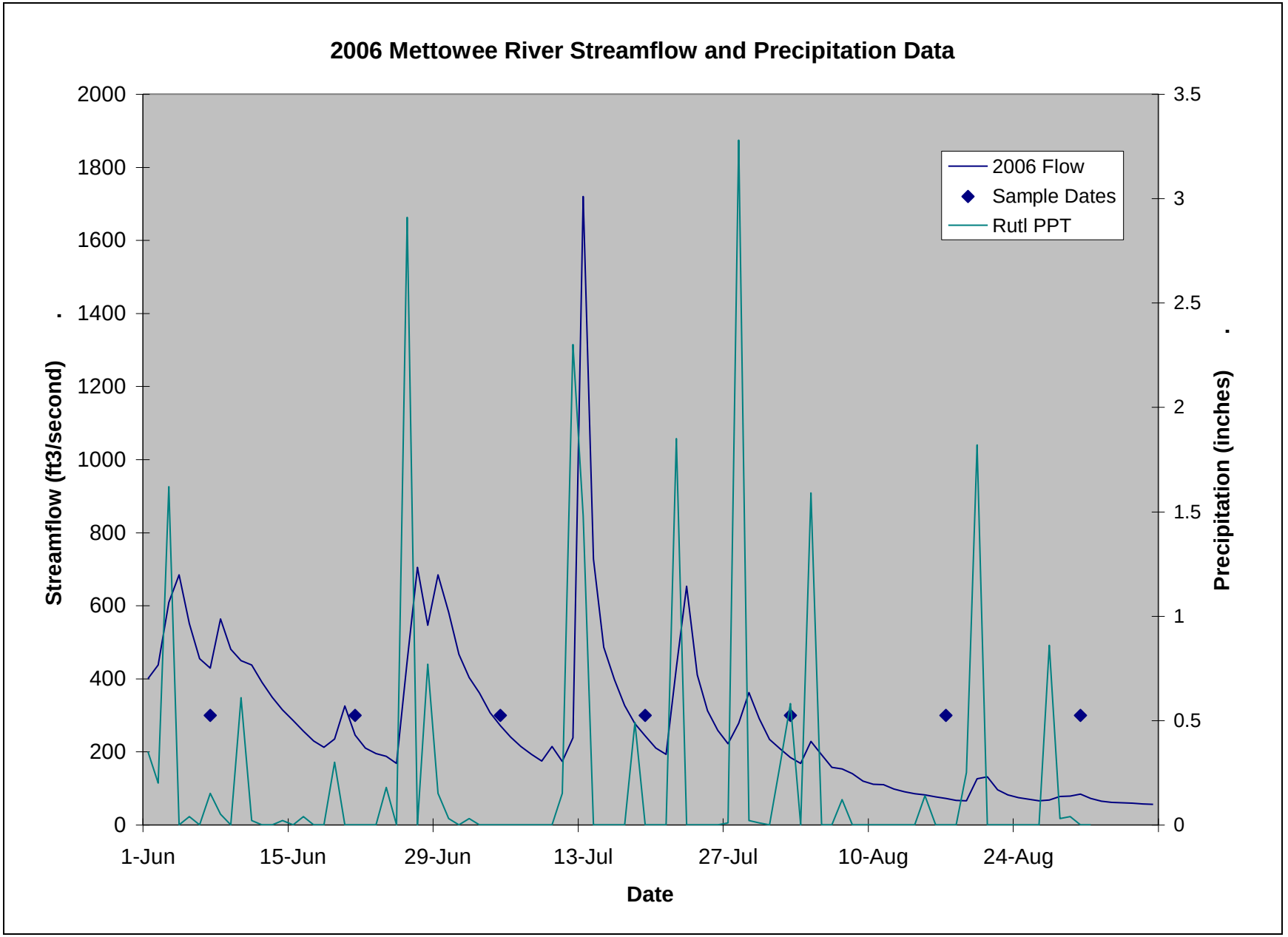
7/24/2006
8/7/2006
8/21/2006
9/4/2006


2006 Mettowee River Streamflow and Precipitation Data
Streamflow (ft3/second)
Precipitation (inches)
Date
2006 Flow
Sample Dates
Rutl PPT
2000
1800
1600
1400
1200
1000
800
600
400
200
0
3.5
3
2.5
2
1.5
1
0.5
0
1-Jun
15-Jun
29-Jun
13-Jul
27-Jul
10-Aug
24-Aug

2006 Data Results

E. coli

Table 1: *E. coli* results for the PMWP 2006 monitoring period (number of colonies per 100 ml of water):

Site	7-Jun	21-Jun	5-Jul	19-Jul	2-Aug	17-Aug	30-Aug	Geometric Mean
PR02	79	101	78	122	45	96	49	77
PR03	120	172	96	152	193	108	78	125
PR06	62	127	68	96	86	41	43	69
PR07	71	199	88	248	101	166	96	126
PR08	192	411	166	365	193	60	205	197
Mett1.5	24	35	61	199		25	82	52
Mett02	96	210	261	816		91	219	210
Mett2.5	147	249	214	64		131	488	178
Mett03	86	260	128	201		148	435	183
Flower01	185	122	206	147		261	613	219
Beaver01	345	179	365	204		167	387	258
Ca01	121	222	866	328	172	345	291	279
Ca02	73	114	99	119	64	99	88	92
Ca03	76	210	111	114	238	35	65	101
Ca05	91	125	158	192	285	128	435	177
Hubb01				145	285	73		144
VT Std	77	77	77	77	77	77	77	
EPA Std	235	235	235	235	235	235	235	

= Exceeds the US EPA Standard of 235 Colonies per 100 ml of water

= Exceeds the Vermont DEC Standard of 77 Colonies per 100 ml of water

Guidelines or standards for *E. coli* levels in streams fall under jurisdiction of State and Federal regulations. Vermont's Water Quality Standard for single samples collected from the rivers and streams similar to those found in our watershed is 77 colonies of *E. coli* per 100 ml of water. This number is one of the most protective of human health in the country (more information about the Vermont state standard can be found on our website (www.poutneymettowee.org) or the Vermont DEC website (http://www.anr.state.vt.us/dec/waterq/htm/wq_monitoring.htm). Please refer to the *Citizen's Guide to Bacteria Monitoring in Vermont Waters).* The US EPA standard for like waterbodies is set at 235 *E. coli* colonies per 100 ml of water. Vermont is governed by the more stringent 77 colonies per 100 ml of water; however, the US EPA standard can be used as a secondary benchmark against which to compare our results.

Even with relatively low (compared to past year's) *E. coli* results this year, the majority of samples were above Vermont Water Quality Standard for coliform concentrations. Of the 107 samples collected this season, only 19 samples (18%) were below Vermont's *E. coli* Water Quality Standard. Eighty-eight samples (82%) were above the Vermont standard and 22 samples (21%) were above both the Vermont standard and the US EPA standard.

Of the five sites monitored this year on the Poultney River, only the most downstream site (PR08) exceeded the US EPA standard (though ALL sites regularly exceeded the Vermont standard). The most upstream (headwater) site on the Mettowee only exceeded the Vermont standard twice, while other sites in the Mettowee watershed commonly exceeded both standards. The Castleton River regularly exceeded the Vermont standard; however, measurements at sites along the Castleton only exceeded the US EPA standard on August 2, 2006.

Geometric mean E. coli concentrations are used as longer-term indicators of systemic contamination. Vermont considers waters impaired for swimming use where geometric mean E. coli concentrations exceed 77 E. coli /100ml for two or more years, based on five or more samples per year. Vermont considers the flow regime under which the samples were collected in determining impairment (Kamman, 2006). In 2006, the geometric mean guideline was exceeded at all but three sites (PR02, PR06, Mett1.5).

Total Phosphorus

Table 2: Total Phosphorus results for the PMWP 2006 monitoring period (ug/l or ppb)

Site	7-Jun	21-Jun	5-Jul	19-Jul	2-Aug	17-Aug	30-Aug
PR02	8.1	8.5	9.6	13.7	11.6	7.4	6.7
PR03	12.6	9.9	9	14.6	11.8	5	6.6
PR06	8.8	8.6	6.7	12.1	9.1	6	5.9
PR07	7.5	7.8	6.8	11.1	8.3	11.6	7.5
PR08	18.2	18.3	14.5	19.6	18.1	9.8	13.9
Mett1.5	12.4	8.5	10.1	17.8		10.2	5.7
Mett02	19.8	13.8	11.4	11.8		5.3	6.7
Mett2.5	20.5	13.4	11.8	10.7		5.9	7.9
Mett03	17.5	13.8	11.8	15		5.5	7.5
Flower01	10.3	8.9	8.5	34.1		5.5	6.2
Beaver01	20.2	19.5	20.9	23.1		14.7	13.1
Ca01	18.2	22.2	20.5	35.6	24.4	18	15.2
Ca02	19.9	29.9	27.7	36.5	24.8	17.5	19.3
Ca03	17.3	18.6	23.8	25.5	21.9	7.7	7.1
Ca05	17.6	16.4	22	25.6	23.4	16.9	25.1
Hubb01				51.2	45.9	32.8	

According to Vermont DEC's Neil Kamman, "There is no specific criterion for TP in streams, except for streams ≥2,500 ft (nominally Class A{1}), where the criterion is 10ppb at low monthly median flow. Otherwise, the standard is that: "...loadings shall be limited so that they will not contribute to the acceleration of eutrophication or stimulation of the growth of aquatic biota in a manner that prevents the full support of uses."" (Personal communication, December 2006; Vermont WQS, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf)

The Vermont Water Quality Standards set 54 ppb as a goal for the South Lake B section of Lake Champlain (LCBP, http://www.lcbp.org/Atlas/HTML/is_pintro.htm). The PMWP has in the past used both 25 ppb and 10 ppb as goals for the rivers in our watershed. For the Poultney River and

the Mettowee River which have cobble and gravel as bottom substrates, we generally see Total Phosphorus measurements near the 10 ppb goal. For the Castleton and Hubbardton Rivers, which have clay and silt as bottom substrates (phosphorus bonds with clay and sediment), we expect higher Total Phosphorus levels.

The PMWP is currently trying to determine if the levels of phosphorus that we measured in the Castleton and the Hubbardton Rivers this season are representative of streams found in similar valley settings across the state.

According to stream geologist/geomorphologist Kristen Underwood of South Mountain Research and Consulting, the Castleton River is located in a relatively unique valley setting, having carved its path through an old delta to the post-glaciation Lake Vermont (13,000-12,800 years ago). Kristen postulated that the setting in a former lake bottom may have increased amounts of fine sediments in the bed and banks that are easily entrained or picked-up and carried in the water. These fine particles will have adsorbed phosphorus, which might be at higher than background levels in the soil due to agricultural landuse in the area. Compared to forested soil, mineralization of organic phosphorus in one study was four times as great in agricultural soil and runoff to a nearby stream was eight times as great (data from Vaithiyanathan and Correll (1992) as found in Brady and Weil, 1999). Kristen additionally stated that soils in floodplains may have greater variability of phosphorus concentrations than upland soil due to their dynamic nature. There are currently several studies that are attempting to better assess this variability (Underwood, personal communication, December 2006).

The Hubbardton, meanwhile, travels through the clay soils of the southern Champlain Valley. Clay soils may adsorb phosphorus more readily than other soil types, due to their chemical and mineral content (Brady and Weil, 1999).

Turbidity

Table 3: Turbidity results for the PMWP 2006 monitoring season (NTU)

Site	7-Jun	21-Jun	5-Jul	19-Jul	2-Aug	17-Aug	30-Aug
PR02	1.09	0.62	0.94	1.15	0.53	0.33	0.47
PR03	1.23	0.9	0.48	1.08	0.73	0.39	0.31
PR06	2.04	0.75	0.62	0.67	0.56	0.5	0.37
PR07	2.39	0.66	0.38	0.82	0.33	1.09	1.22
PR08	2.06	1.96	1.94	2.09	1.9	0.47	1.44
Mett1.5	3.43	1.42	1.21	2.56		0.21	0.59
Mett02	2.91	0.7	1.81	0.55		0.48	0.26
Mett2.5	3.75	1.63	0.87	0.55		0.5	0.73
Mett03	2.95	1.53	1.44	2.41		0.35	0.52
Flower01	1.84	1.01	0.44	2.22		0.28	1
Beaver01	2.23	1.08	1.25	1.64		1.24	1.09
Ca01	1.42	1.21	1.28	2.42	0.87	1.36	1.26
Ca02	1.32	2.26	2.3	2.01	1	1.69	1.65
Ca03	1.52	1.57	2.31	1.49	1.31	1.04	0.65
Ca05	1.75	1.24	3.94	1.61	2.75	1.55	1.52
Hubb01				25.7	22.8	19.7	

Again, according to Vermont DEC's Water Quality Standards, turbidity results "for class A(1) and A(2) waters, are not to exceed 10 NTU. For Class B waters designated warmwater reaches, they are not to exceed 25 NTU. For Class B waters in designated coldwater reaches, turbidity is not to exceed 10 NTU.(Kamman, personal communication, December 2006; Vermont WQS, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf)"

Based on the warmwater/coldwater fish habitat designations found in Vermont's Water Quality Standards (WQS), the only warmwater segments in the Poultney Mettowee watershed include the Poultney River below Carvers Falls and "all waters west of 22A". The Castleton crosses 22A in Fair Haven, but no samples were collected in the section designated warmwater. The Hubbardton crosses 22A in southern Benson. The Hubbardton samples were collected in the section designated warmwater fish habitat.

Similar to phosphorus results, the Poultney River showed the lowest turbidity levels, with the Mettowee River and its tributaries not much higher. The highest turbidity measurement on the Poultney River was 2.39 on June 7th at PR07 (the D and H Rail Trail bridge), while the highest turbidity measures in the Mettowee watershed was 3.75 NTU at Mett02.5 (downstream from the Flower Brook confluence). The Castleton River turbidity concentrations ranged between 0.65 and 3.94 NTU. The highest turbidity concentrations occurred on the Hubbardton River (19.7-25.7 NTU). All of the turbidity results were within the Vermont DEC standards except for one sample on the Hubbardton collected on July 19th that measured 25.7 NTU.

COMPILED MEAN DATA

The following graphs include all of the data collected to date by the PMWP. The data has been averaged by site and ranges from one to four years worth of results. It is generally recognized that stream data becomes statistically significant when five or more years of data are available (Kamman, personal communication, 2004). These graphs, while not containing five years worth of data, begin to show water quality differences between the sites. Each of the following graphs represents a stream continuum from upstream to downstream. Hopefully, this will help the reader to visualize the changes in water quality that are occurring spatially.

E. coli

The *E. coli* graphs show that many of the sites in the watershed are consistently over the State and Federal water quality standards. The lowest *E. coli* concentrations are found in the headwaters of the Poultney and Mettowee Rivers. The upstream site on the Castleton River (CA01) and the site on Beaver Brook are downstream of several wetlands and livestock pastures. *E. coli* bacteria at this site may result from either livestock in the stream or naturally-occurring animals, such as beaver, in the stream. Sites Flower01 and Mett02.5 may receive groundwater inputs from septic systems in Pawlet.

Table 6: Geometric mean *E. coli* data for the Poultney River sites

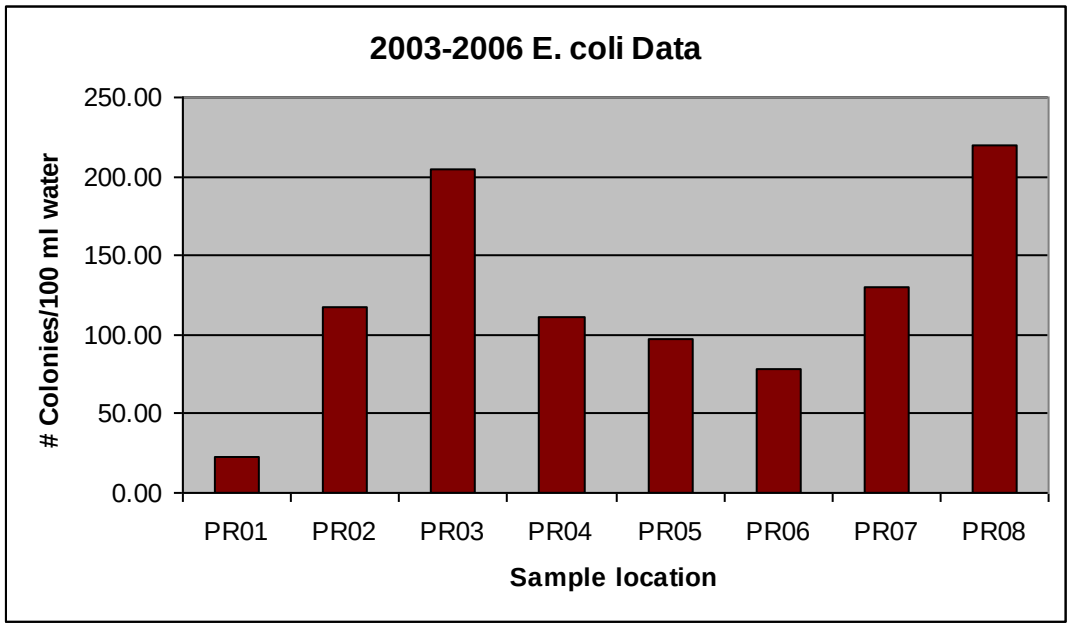


Table 7: Geometric mean *E. coli* data for the Mettowee River sites

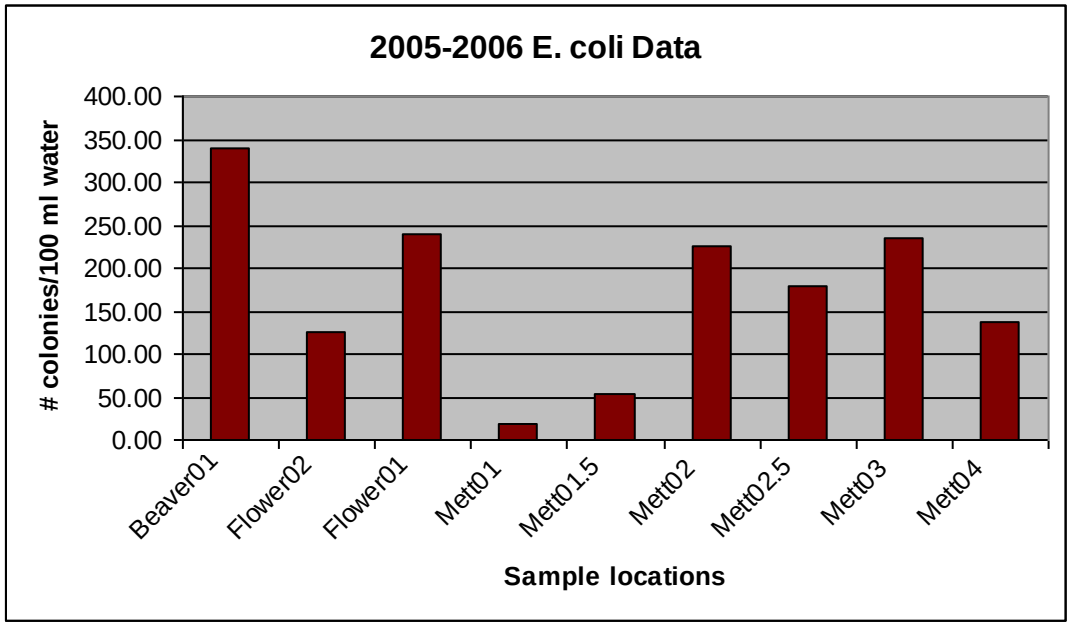
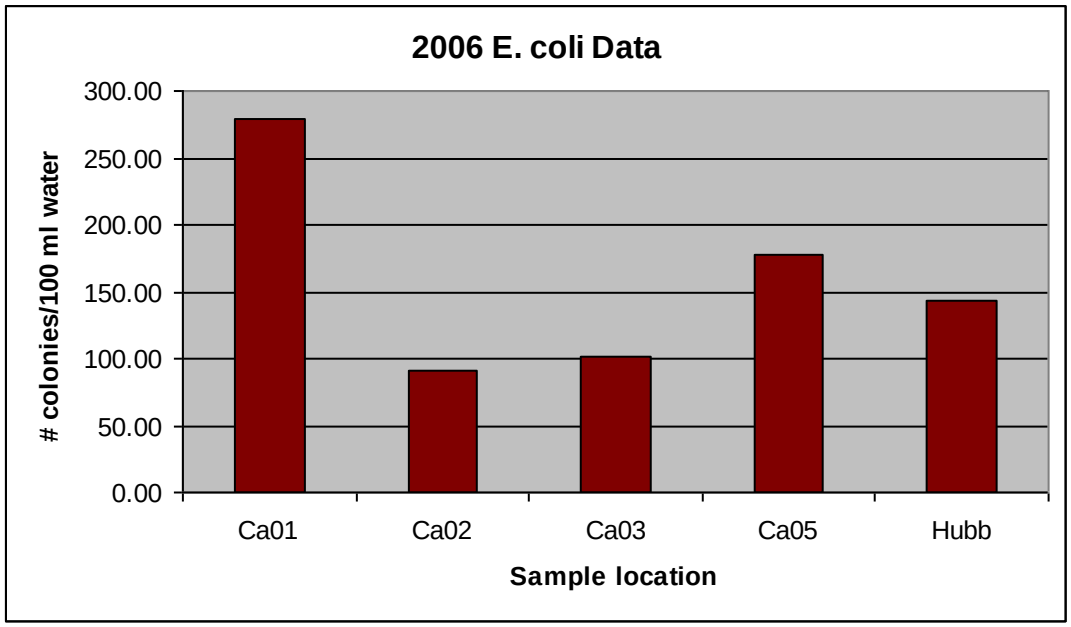


Table 8: Geometric mean *E. coli* data for the Castleton and Hubbardton sites



Phosphorus

The phosphorus measurements were variable along the length of the streams monitored. Again, the headwater Poultney and Mettowee sites (PR01 and Mett01) showed the lowest levels of phosphorus over the duration of the study period for each (four seasons for the Poultney and one for the Mettowee). This is to be expected, since as mentioned above, phosphorus binds to soil, and there is likely to be less sediment at the headwaters of a stream than downstream as erosion and river movement occurs. Of the Poultney and Mettowee sites, Beaver Brook and the downstream Poultney site, PR08 (Green Rd), had the highest phosphorus measurements over the duration of the study (around 19 and 16 ppb respectively).

This year the PMWP sampled the Castleton River and the Hubbardton Rivers for the first time. Both of these streams showed relatively high phosphorus results (as compared to the Poultney and Mettowee Rivers). The Castleton River sites averaged between 17 and 25 ug/liter of total phosphorus and the Hubbardton averaged 43 ug/liter phosphorus.

Table 9: Averaged Total Phosphorus data for the Poultney River sites

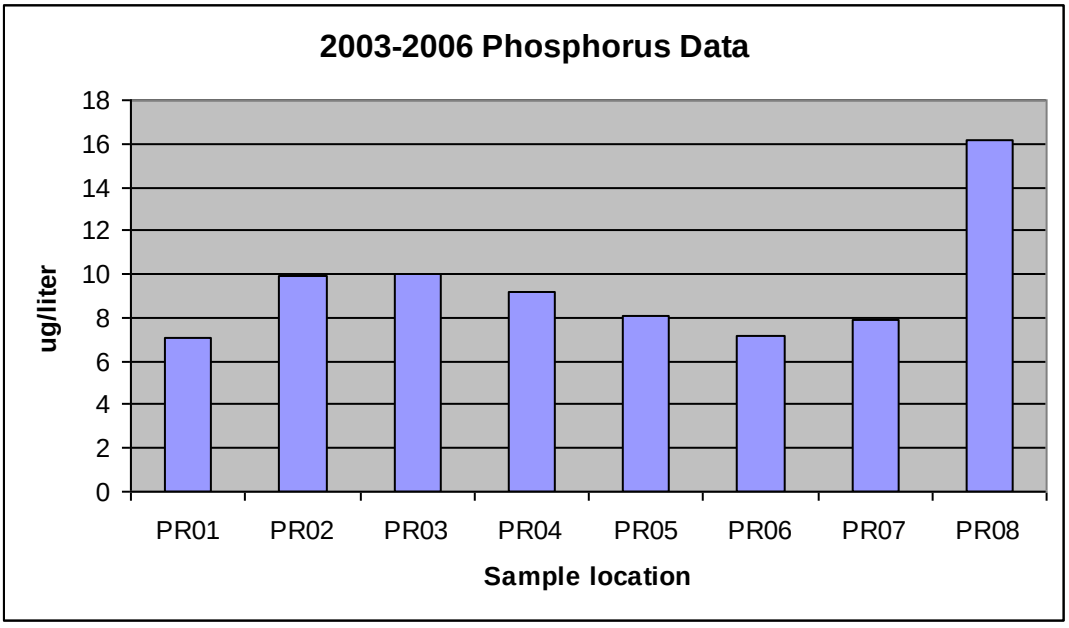


Table 10: Averaged Total Phosphorus data for the Mettowee River sites

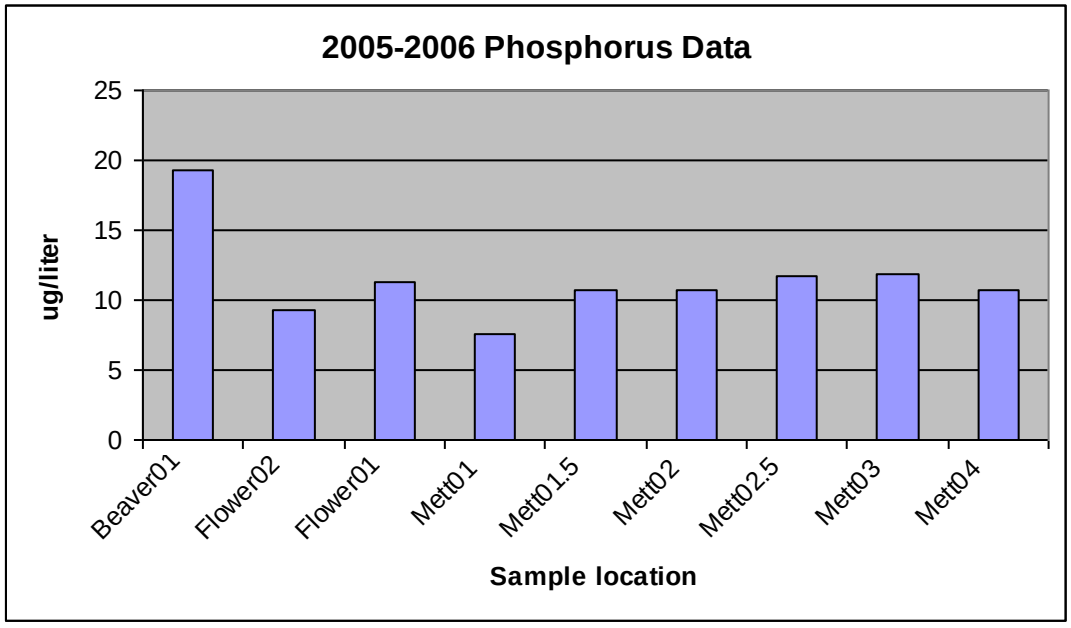
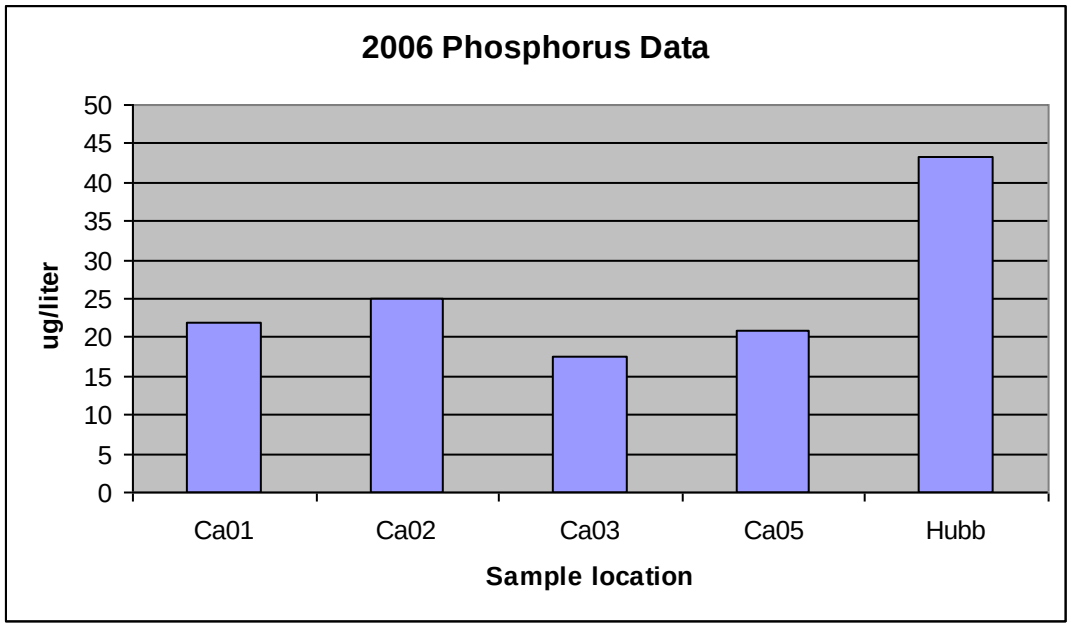


Table 11: Averaged Total Phosphorus data for the Castleton and Hubbardton River sites



Turbidity Data

All of the averaged turbidity results are within coldwater standards for the Poultney, Mettowee and Castleton Rivers and warmwater standards for the Hubbardton River. The Hubbardton River has the highest levels of turbidity monitored by the Partnership, however, these data are only from one season of sampling. They are also within the 25 NTU limit set for warmwater habitat by the WQS.

Table 12: Averaged Turbidity data for the Poultney River sites

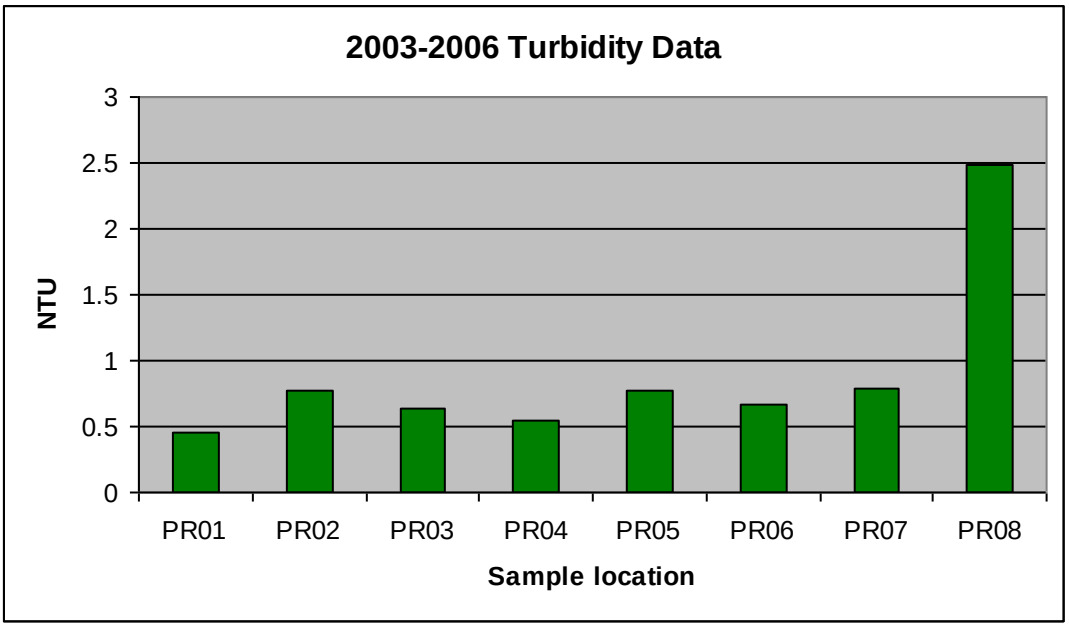


Table 13: Averaged Turbidity data for the Mettowee River sites

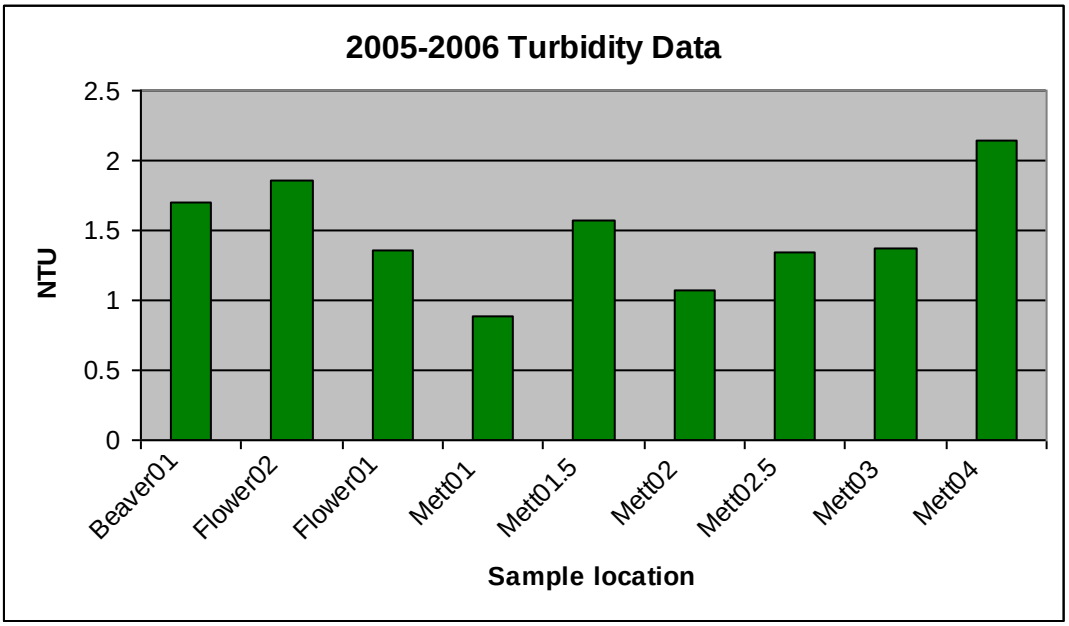
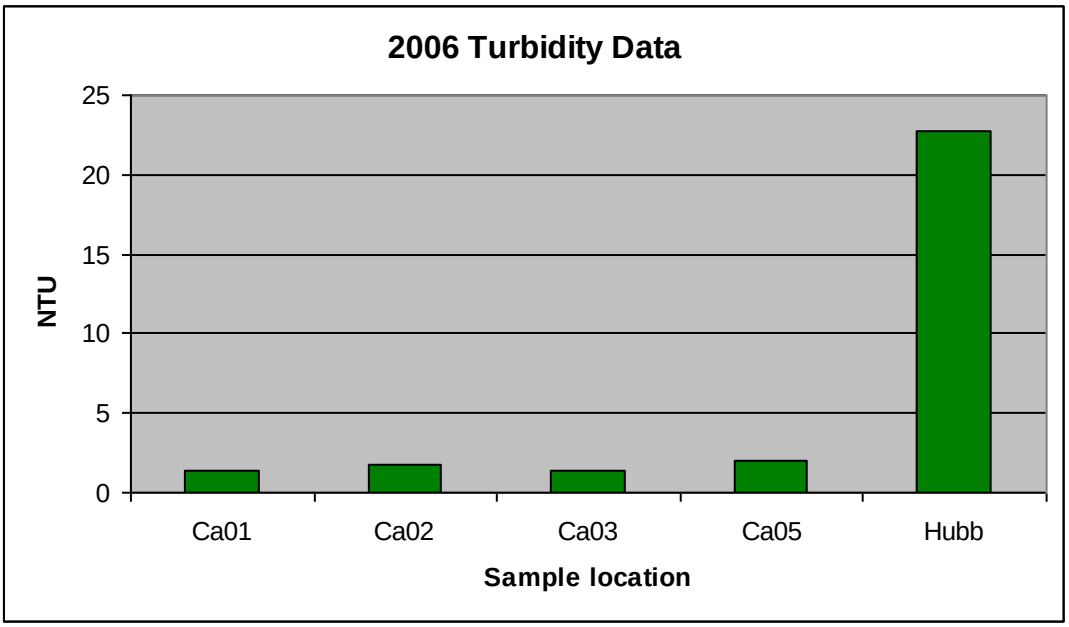


Table 14: Averaged Turbidty data for the Castleton and Hubbardton sites



CONCLUSIONS

Overall the PMWP water quality monitoring program has measured streams for levels of *E. coli*, Total Phosphorus and Turbidity for the past four years. The Partnership began monitoring the Poultney River in 2003 and has since included the Mettowee and several of its tributaries, the Castleton and the Hubbardton Rivers.

Throughout the study, *E. coli* measurements have been high according to State and Federal Water Quality Standards in all of the streams that we monitor. Sampling has shown that *E. coli* measurements in the watershed are particularly high after rain events. The PMWP is working to implement projects such as tree plantings (to act as buffers) and agricultural practice changes that we hope will decrease *E. coli* runoff to the water, and is continuing to assess streams for potential *E. coli* sources. Many of our partners are working directly with towns and agricultural producers to decrease *E. coli* in streams through projects that upgrade septic systems and exclude livestock from streams.

Data results have shown that total phosphorous is variable and dependent on water levels, or the type of runoff being received to the streams. The PMWP plans to monitor total phosphorus during storm runoff events to better quantify the levels of this nutrient reaching Lake Champlain.

Turbidity is relatively low throughout the watershed. This indicates that sediment levels in the water are relatively low. The PMWP also plans to monitor turbidity during storm events. Measuring the turbidity levels in streams carrying storm-related runoff may give a better indication of the sediment load being transported to Lake Champlain.

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