West River Watershed Alliance

2007
Annual Report
&
Five -Year Summary
2002-2007

compiled and written by
Rebecca Salem

Acknowledgements

The West River Watershed Alliance would like to thank all of its dedicated volunteers for another great season of monitoring our rivers and making the Water Quality Monitoring Program possible.

Lisa Ash
Fred and Laura Bacon
Jeff Burkert
David Charis-Mink
Domenica Pero Coger
Gloria Cristelli
Beckie Scotten Finn
Denise Green
Luke Hamm
Lorna & Fred Hard
Michael Marantz
Simon Norton
Krystina Lankone
Darlene and Ernie Palola
Eric Skarsten
Cory, Theran, and Sylvia Stark
Helen Syzmanski
Tom & Sally Topitzer
Bill & Betsy Uptegrove
Eric & Heather Van Horn

In addition, we would like to acknowledge the following businesses and organizations for their support:

VT Agency of Natural Resources, Watershed Grant Program
La Rosa Labs, Waterbury
Brattleboro Reformer, Brattleboro
The Message, Chester
Shell Station, Rockingham
Windham Regional Commission
Windham County Natural Resource Conservation District
WRWA supporting members
WRWA Board of Directors

Finally, we are grateful to the following towns for their support as well:
Brattleboro, Dummerston, Wardsboro, Townshend, Newfane, Londonderry, Jamaica, & Brookline

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I. Introduction

A. The Organization

The West River Watershed Alliance (WRWA) is a grass roots organization that engages its members in citizen science by raising the awareness about the watershed and the conservation issues it is faced with today. WRWA was established in 1998 and achieved its incorporation as a non-profit organization in February of 2003 with the mission to protect and restore the West, Williams and Saxtons rivers, and educate the communities within the watersheds about water quality and watershed protection.

Since that time WRWA has grown to become a sixty-member organization. WRWA and its volunteers have accomplished a number of projects to help increase safe river access and use. Most recently WRWA was one of the leading organizations in the creation of the Basin 11 Management Plan and officially acts as the Watershed Council for the basin. (Basin 11 is the management term used by natural resource agencies in Vermont for the three river basin.) This document outlines all of the major conservation issues within the basin and specifies necessary activities for amelioration or complete reversal of each one. It is an essential resource for concerned citizens, non-profit conservation groups and natural resource professionals as it provides a map of how these different sectors can work together in tackling these issues over the next five years.

The WRWA maintains an active Board of Directors which successfully guides its programs with the help of a dedicated team of local volunteers. The organization has one part-time employee, Rebecca Salem, Director of the Water Quality Monitoring Program. For the past five years, WRWA has received a great deal of in-kind support from the Windham Regional Commission and Windham County Natural Resources Conservation District. The WRWA is now building its resource base so that it may expand its programs to include more outreach and restoration activities throughout the basin.

B. The Water Quality Monitoring Program (WQMP)

One principal focus of WRWA has been its Water Quality Monitoring Program. Each year, WRWA recruits and trains over twenty volunteers how to collect and transport water samples from the three major rivers in the West River basin. The West River basin includes the West, Williams, and Saxtons Rivers along with their tributaries.

Over the past five years, WRWA and its volunteers have collected samples from 38 sites along these three rivers and their tributaries. Many natural resource professionals, WRWA and other citizen groups use the data collected for a variety of purposes. These include: comparing regions of the state, measuring progress toward project goals, documenting water quality conditions, identifying sites for cleanup and restoration, developing public policy, determining where to direct limited resources and analyzing how and why a waterbody is changing over time. All of these activities are central to keeping our rivers healthy. Rivers are not only a beautiful part of the landscape but they are essential habitat for many plant and animal species and provide citizens with water for consumption and recreation, as well as being used for irrigation of food and other crops. These are just the very basic services rivers provide directly to us. They are also an integral part of the greater ecological systems that sustain life on this planet and, as our globe continues to suffer from an innumerable amount of activities that threaten this life support system, the WRWA and its volunteers are making a very real, important and local step in protecting, preserving and restoring these systems.

C. Questions and Concerns

The Water Quality Monitoring Program (WQMP) has two main objectives. First, is to inform the public as to the levels of *E.coli* bacteria that is present upstream of their local swimming holes. For this reason, most of the sampling sites are popular swimming spots. WRWA distributes these results to town health officers and publishes them in local newspapers. When a swimming hole is found to have elevated levels of bacteria for a sustained period of time WRWA will notify the town health officer of this fact and recommend that the swimming hole be posted with a sign warning swimmers as to the potential risks of swimming in waters that have high levels of E.coli. If the problem persists, WRWA will make further efforts to work with the town to determine the source of the bacterial pollution and remediate it.

Other concerns within the West River Watershed are nutrient loading and an increase in water temperature. The WQMP has been monitoring the levels of total phosphorus and nitrates/nitrites throughout the entire five-year sampling period as well as taking measurements of the water temperature. This consistent and sustained collection of information has allowed us to characterize the three rivers in the drainage basin and establish a baseline as to what is "normal." We have also been able to determine where there are problems with some nutrient loading in the system and make some educated guesses as to where there may be an increase in water temperature.

D. Monitoring Parameters

Escherichia coli is a bacteria that lives in the guts of all healthy mammals, including humans. Pathogens are micro-organisms that cause disease. Most species of E.coli bacteria are harmless, but there are some which are pathogenic, such as E.coli 0157:HC57. Infections from this bacteria are primarily contracted through the ingestion of undercooked ground beef, but some have been waterborne. The EPA cites two incidents when swimmers were infected in Washington County, NY and Clark County, WA.

So, even though the presence of *E.coli* is not necessarily a direct health threat it is commonly monitored because its presence is a clear indication of sewage or animal waste having entered the water body. Pathogens in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems. A list of symptoms and more information about the health risks can be found at the EPA's website as well as the Center for Disease Control.

Phophorus is most commonly found in nature as part of a phosphate ion. It is an essential form of energy for all plants and animals and is constantly being cycled through aquatic and terrestrial ecosystems. Most phosphates are found in deep ocean sediments or in rocks. Over time, rain leaches the phosphates from the rocks and carries them into soils, streams, lakes and rivers. From here it is available to be used by plants. The phosphorus is absorbed into plant roots to make usable organic compounds, and then passed to animals through the food chain. Phosphorus is necessary to animals for the formation of DNA, RNA, cell membranes, bones, teeth, phospholipids (fat cells), and energy carrying molecules (ATP and NADP). Urine, feces, death, and decay release organic phosphates, which are reduced by bacteria back to mineral (inorganic) phosphates into the soil (or the ocean floor), completing the cycle.

When there is too much phosphorus in a river or stream it can cause eutrophication to take place. This process is characterized by a sharp increase in plant growth that will continue until the plants use all of the available carbon dioxide for photosynthesis at which point they will begin to die. The decomposition process depletes the amount of oxygen available for fish, insect larva, and other aquatic life causing a die off of these animals as well.

The **nitrogen** in soil is derived from the earth's atmosphere. Although the atmosphere is 78% nitrogen, most living things cannot use atmospheric nitrogen to make proteins and other organic substances. Whenever an organism dies, decomposers break down the nitrogen compounds in the corpse into ammonium. The highly specialized capacity for converting atmospheric nitrogen to a form that can be used by cells is limited to a few prokaryotes. This unique process is called nitrogen fixation. On a worldwide basis, the usable nitrogen available in soils is the major limiting nutrient in crop plant growth.

We monitor nitrate/nitrite (NOx) because elevated levels are a good indication of pollution from fertilized lawns, fields, farms and septic systems. The naturally occurring amount of nitrate/nitrite in surface waters is very low, less than 1 mg/L. As the availability of usable nitrogen is another limiting factor for plant growth, a water body is again put at risk of eutrophication when over-loaded.

The measurement of **turbidity** puts a number value on the overall clarity of the water. Turbidity is often correlated with the amount of total suspended solids (TSS). TSS is an indicator of many kinds of pollution including increased amounts of erosion due to stream bank development. An increase in turbidity means that light cannot penetrate the water; less sunlight means less photosynthesis and stunted plant growth, especially phytoplankton. An increase in turbidity can also lead to an increase in water temperature as suspended particles absorb heat from the sunlight.

When the **water temperature** of a stream or river is above 20 degrees Celsius for a sustained period of time the plants and animals are put at risk. Cold water holds a greater quantity of dissolved oxygen, which is essential for a healthy stream habitat. Many fish species need cold waters during their larval development. Warmer waters also nurture the growth of pathogens that can infect plant and animal species.

The **pH** of a water body is in indication of how acid or basic it is. The pH scale ranges from 0 to 14 with a reading of 7 being neutral. When a stream or river has a low reading then it is an indication of acid rain, which has a pH of less than 5. Other types of chemical and industrial pollution could also alter the level of pH. It is important to monitor pH and keep a record of baseline data so that if these types of pollution were ever to occur there would be documentation of the healthy river for comparison.

Conductivity is measured for many of the same reasons as pH. It is necessary to establish a baseline of information in order to note any changes that may occur due to future pollution. Water is typically a poor conductor of electricity so that its level of conductivity is largely influenced by the geology of the surrounding area. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize (dissolve into ionic components) when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Conductivity is measured in micromhos (umhos/cm) per centimeter or microsiemens per centimeter (us/cm).

The following table outlines the general guidelines for expected amounts of each parameter in a healthy stream. These guidelines can vary for specific streams and rivers.

Table 2.b. Guidelines for Healthy Streams & Rivers

Parameter	Source	Units measured	Healthy Measurement
E. coli	Human and animal feces	Colony forming units/100 ml	EPA 235 cfu/100 ml VT standard 77 cfu/ 100 ml for class B waters
pH	• Acid rain and industrial pollution can change natural pH of an area •Substrate	Scale is from 0-14 No units	•Generally 6.5-8.5 •Bogs are naturally acidic and as low as 4.2
Phosphates and Nitrates	•Sewage, industry •detergents •Fertilizer, animal wastes •Phosphates occur naturally in volcanic soil	Milligrams (mg) / liter Or Micrograms (ug) / liter	•Phosphates 30 ppb for streams < 2500 feet •Nitrates < .8 mg/l
Temperature	•Solar heat •Waste heat	Amount of average heat in water	< 20 degrees C
Turbidity	• Erosion • Sewage • Storms	NTU's	< 10 NTU's
Conductivity	• Salts • Geology • Heavy metals	Umhos/cm	50 – 1500 umhos/cm

E. The Watershed (Description adapted from the Basin 11 Management Plan)

The West River Basin is composed of the West, Williams, and Saxtons Rivers. Natural resource professionals throughout the state commonly refer to this land area as Basin 11. Basin 11 is located in the southeastern corner of Vermont and drains the eastern slope of the Green Mountains. It covers approximately 618 square miles. The rivers and their tributaries flow down from the mountains through the foothills and across the Vermont Piedmont to the Connecticut River Valley where they join the Connecticut River. The Williams River joins the Connecticut River in Rockingham, the Saxtons River joins the Connecticut River in Bellows Falls, and the West River joins it in Brattleboro. Most of Basin 11 lies within Windham County although portions are also within Windsor and Bennington Counties and a very small portion is in Rutland County. The basin is part of the Southern Green Mountain biophysical region of Vermont.

The mainstem of the **West River** originates in the south part of Mount Holly, 2,400 feet above sea level. It flows generally south through the towns of Weston and Londonderry then southeasterly through Jamaica, Townshend, Newfane, Dummerston, and Brattleboro where it meets the Connecticut River. The length of the mainstem is 46 miles and the river drains a watershed that is 423 square miles.

The uppermost section of the West River flows through forested then partially forested and partially open country. It has a stony bottom with extensive gravel bars in some places and is considered good trout and salmon habitat. As it continues its course, the river flows down cascading waterfalls, through rough meadows, alder thickets, dense forests, along roadsides, into reservoirs, and across valleys where it floodplains range from a quarter to a half mile across.

Major tributaries include: Greendale Brook, Utley Brook, Flood Brook, Thompsonburg Brook, Winhall River, Ball Mountain Brook, Wardsboro Brook, and the Rock River. There are two dams that are currently active along the river, these are Townshend Dam and Ball Mountain Dam.

The **Williams River** originates on the eastern edge of the southern Green Mountains and flows easterly then southeasterly through the Southern Vermont Piedmont before joining the Connecticut River at Herricks Cove in Rockingham. The Williams River has a stream length of 25 miles and drains an area of 117 square miles. Much of the upper basin is rugged, hilly land with steep slopes and poor drainage. The Williams River headwater streams come off the slopes of Terrible Mountain and other nearby mountains to form the Williams River mainstem. The river flows easterly through Andover and into the southern portion of Ludlow where Wheaton Brook, Lovejoy Brook, and Bear Brook join in. It continues its easterly flow into Chester and is confined to a relatively narrow valley until it turns south-southeast. At that point it flows in a broad fertile valley down the length of the town of Chester. In the village of Chester, the Middle Branch of the Williams River joins the Williams River mainstem.

The Middle Branch originates in Windham and flows north for several miles before flowing east through Andover and Chester into the Williams River. Lymans Brook, Andover Branch, and South Branch are all tributaries to the Middle Branch. The Middle Branch is 13 miles in length and drains a watershed of 47 square miles.

From Chester village, the Williams River continues its southeasterly flow into the town of Rockingham where it flows through Bartonsville, over the Brockways Mills dam at the top of a dramatic gorge, and through a narrow valley before flowing out into Herricks Cove at the Connecticut River. (VDEC 2001)

The **Saxtons River** rises on the eastern slopes of the southern Green Mountains in the town of Windham and flows southeasterly across the Vermont Piedmont to the Connecticut River. Its length is 20 miles draining an area of 78 square miles with a total drop of approximately 1800 feet. The upper watershed is characterized by narrow steep gorges cut through rugged hilly uplands with outcropping bedrock and poor drainage.

The Saxtons River originates in an extensive wetland complex in the Lawrence Four Corners area in Windham from which it begins its easterly flow. Many headwater tributaries from the hills and mountains of the eastern part of Windham and the western part of Grafton flow northerly and southerly through narrow, forested valleys to join the Saxtons River. The Saxtons continues an easterly flow through Houghtonville where 1.5 miles downstream, the river turns south and flows in a somewhat wider valley to Grafton village.

In Grafton, the South Branch joins the Saxtons River from the south. The South Branch is six miles long and drains a watershed that is 20.3 square miles. From Grafton village and the South Branch confluence, the river flows northeasterly then southeasterly around the base of Kidder Hill then continues southeasterly to the Village of Saxtons River. From the Village of Saxtons River, the river continues its southeasterly journey until North Westminster where it bends back on itself, flows over Twin Falls then continues in a northeast direction for a little more than a mile before emptying into the Connecticut River. (2007, Windham County Natural Resources Conservation District)

II. Methods

A. Volunteer Training

The WRWA hosted a volunteer training session on June 9th at Jamaica State Park. Volunteers met at the park where they were instructed how to properly fill out their field data sheets, measure stream flow, water temperature and fill each of the sample bottles. All of the volunteers received coolers with ice packs, aquatic thermometers, sampling bottles with labels from the La Rosa Lab and a volunteer field manual. The volunteers were all given an opportunity to practice filling the different bottles so they would be ready for the actual events during the summer.

B. Sampling Protocols

Volunteers were trained to collect samples in accordance with the VT state protocols as described in the Quality Assurance Program Plan (QAPP) this is required by the EPA for all recipients of the La Rosa Lab grant. Specifically, these protocols included the following:

1. All volunteers collected samples between 8:00 and 10:00 in the morning. This is a logistical necessity, but it also provides a "snapshot" of the river at this time and allows for data results to be more consistent than if they were collected during different times of day.

2. Samples were taken upstream of the swimming hole sites whenever possible.

3. Volunteers are instructed to wait for one to two minutes before filling their bottles to allow sediment kicked up to flow past the sampling area.

4. Sample bottles were filled upstream of the sampler's body.

5. Once filled, the samples were deposited into coolers with ice packs as soon as possible.

6. All samples were kept cool for the duration of their transport to the lab.

Many of the volunteers expressed their uncertainty about measuring stream velocity at the beginning of the season. We reviewed the procedures during our volunteer training, but decided that only volunteers who were sampling on tributaries of the main rivers would be required to take this measurement. Stream flow and water level data from the USGS gauges was used to replace this information. The following gauges were used for the following sampling sites.

USGS Station	West River, Jamaica	West River, Townshend Dam	Saxtons River, Saxtons River	Williams River, Rockingham
Sampling Sites	S. Londonderry S. Londonderry II Jamaica State Park	Scott Covered Bridge Brookline Bridge Newfane Swim Hole Dummerston Bridge Deyo's Hole Milkhouse Meadows	Saxtons River Bellows Falls Sandy Beach	N. Street Bridge Bartonsville Bridge Rockingham Trestle

The sampling season began on June 12 and ended on September 18. Volunteers collected samples between 8:00 am and 10:00 am every other week. The volunteers dropped their samples off at the Dummerston Covered Bridge or the Shell gas station in Rockingham. The Program Director sorted all of the samples and transferred them into two coolers for transport to the lab in Waterbury, VT.

The pH and field conductivity were measured with YSI meters at the sample drop-off sites. Results were recorded onto the volunteers' field data sheet and then transcribed to the master Excel spread sheet. The pH meter was calibrated each morning.

C. Data Input & Analysis

The Program Director transcribed data from the volunteer field data sheets onto an Excel data sheet. All of the data from the lab analysis was transcribed from the website onto paper and then entered into the data sheet. All numbers were reviewed and checked by the Program Director and a volunteer.

Data analysis consisted of a few very basic processes. Initially, all data was sorted by site and then arranged by river system. The Excel Program was used to calculate the appropriate summary number (geometric mean, mean or median) for each parameter per site. This information is then displayed in tables and graphs. The goal is to provide the reader and WRWA with a "snapshot" of the river that we can use for comparison to past and future years.

When the average level of bacteria for a site exceeds the VT State Standard for class B waters this report takes a closer look at how these levels changed in relationship to stream flow.

D. Quality Assurance

WRWA made an effort to follow all quality assurance procedures as stated in the Quality Assurance Project Plan. This process began at the volunteer training session where emphasis was put on the importance of keeping the bottles, sampling area and all equipment as clean and free of contaminants as possible. Once the sampling season started, field duplicate samples were taken every tenth site sampled. This procedure ensures that protocols are being followed and that the samples are truly representative of the water body being sampled. The following chart shows that the mean relative percent difference calculated for each of the parameters sampled is within the target range noted in the QAPP.

	E.coli	NO2-NO3	TP	Turbidity
Mean Relative Percent Difference	**28.8**	**1.0**	**4.1**	**9.0**
QAPP Target	100.0	11	15	10

Field blanks were periodically taken throughout the season to ensure that bottles were not being contaminated in the coolers. A field blank is a bottle that is filled with distilled water and then placed in the cooler along with all of the other sample bottles. All of the blank samples yielded results of less than one of the units measured for each parameter.

Finally, all of the swimming hole sites were sampled approximately 8 times. The General Water Quality Sites were almost all sampled four times each. The following table lists all of the sampling sites and how many samples were taken per site.

Swimming Hole Sites

SH1 Milkhouse Meadows	8
SH2 Deyo's Hole	8
SH4 Dummerston Covered Bridge	7
SH6 Indian Love Call	7
SH7 Newfane Swimming Hole	7
SH8 Brookline Bridge	8
SH9 Scott Covered Bridge	7
SH10 Jamaica State Park	7
SH11 Pikes Falls	8
SH12 South Londonderry	7
SH 14 North Street, Chester	8
SH 15 Bartonsville Bridge	7
SH 19 Rockingham Trestle	7
SH 17 Saxtons River Center	6
SH 18 Bellows Falls Sandy Beach	7

General Water Quality Sites

Whetstone Brook	4
Whetstone II	4
Ball Mountain Brook II	4
South Londonderry II	3
Hapgood / Flood Brook	4

III. 2007 Results

A. The West River & Its Tributaries

Table 3a. West River Summary

The following table shows the result averages from all samples taken during the sampling season. Sampling sites are listed in order from the headwaters of the river to the mouth. The highlighted numbers are results that exceed a natural or safe range and indicate places where there could be pollution entering the river system.

Site Names	E.coli (mpn/ml) geomean	Nitrogen (mg/l) mean	TP (ug/l) mean	Turbidity NTU's mean	pH mean	Field Conductivity mean	H20 T C median
S. Londonderry 2	109.31	0.06	13.55	0.95			19.00
S. Londonderry	400.70	0.07	7.64	0.57	7.02	66.90	17.00
Jamaica State Park	14.77	0.07	11.49	1.06	6.91	65.12	18.00
Scott Covered Bridge	53.95	0.07	12.99	1.51	6.65	61.69	14.00
Brookline Bridge	71.77	0.19	8.54	0.78	6.74	74.83	16.50
Newfane Swim Hole	77.17	0.22	8.15	0.61	6.67	75.73	18.00
Dummerston Bridge	33.83	0.15	10.11	0.76	6.94	65.63	19.00
Deyos Hole	39.13	0.14	7.06	0.54	6.86	76.06	19.00
Milkhouse Meadows	75.38	0.12	7.77	0.68	6.80	80.24	20.50

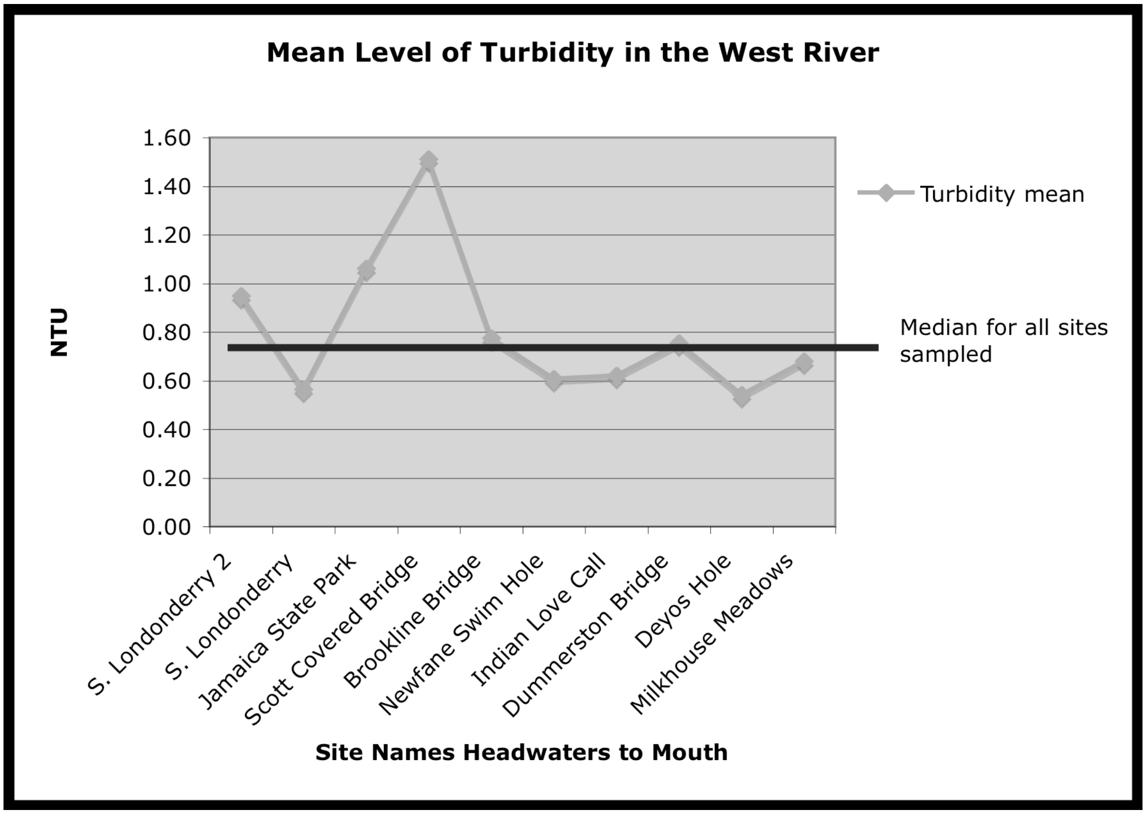
Gray areas mark results that are high in comparison to what is expected for a healthy river.

Table 3.b West River Tributaries

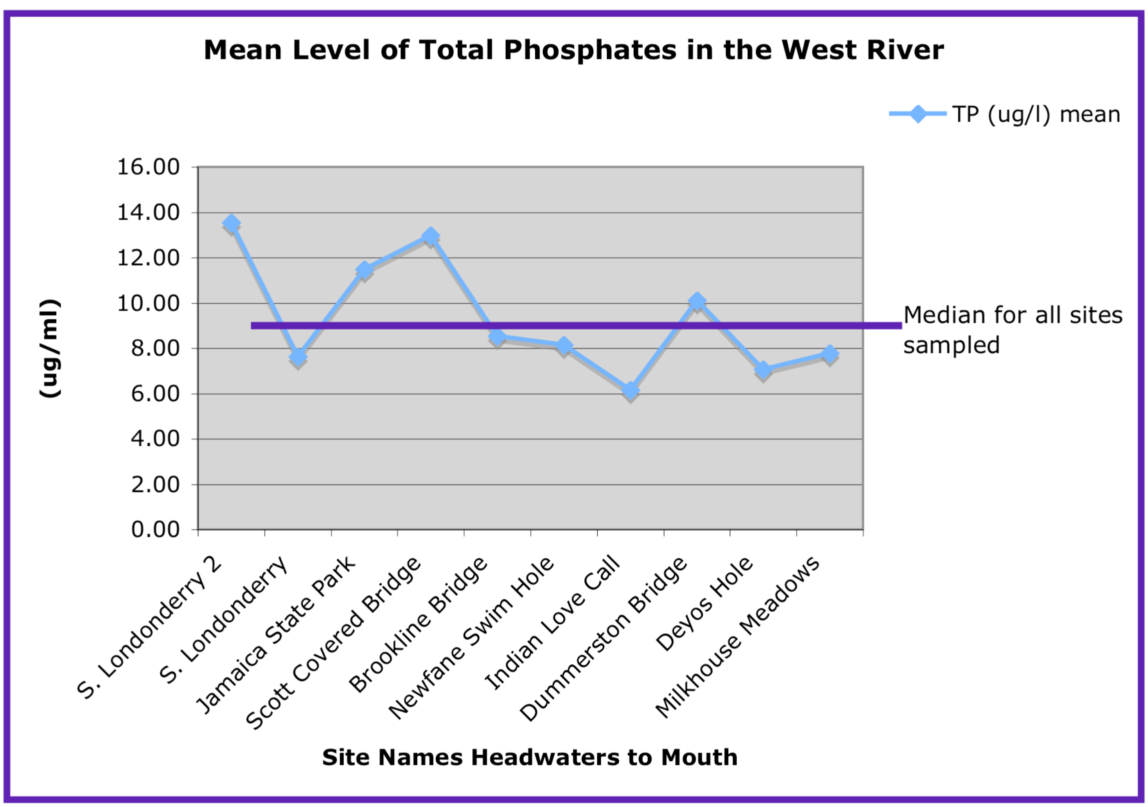
Site Names	E. coli	mg - N/l	ug-P/L	Turbidity	fieldcond	Water T
SH 11 - Pikes Falls	21.43	0.20	6.54	0.69	157.63	14.56
SH 6 – Indian Love Call	27.33	0.08	6.17	0.62	6.90	59.43
SH 16 - Wardsboro Brook	6.82	0.10	5.44	0.22	97.17	14.64

West River Snapshot - Graphs 3.1 – 3.5

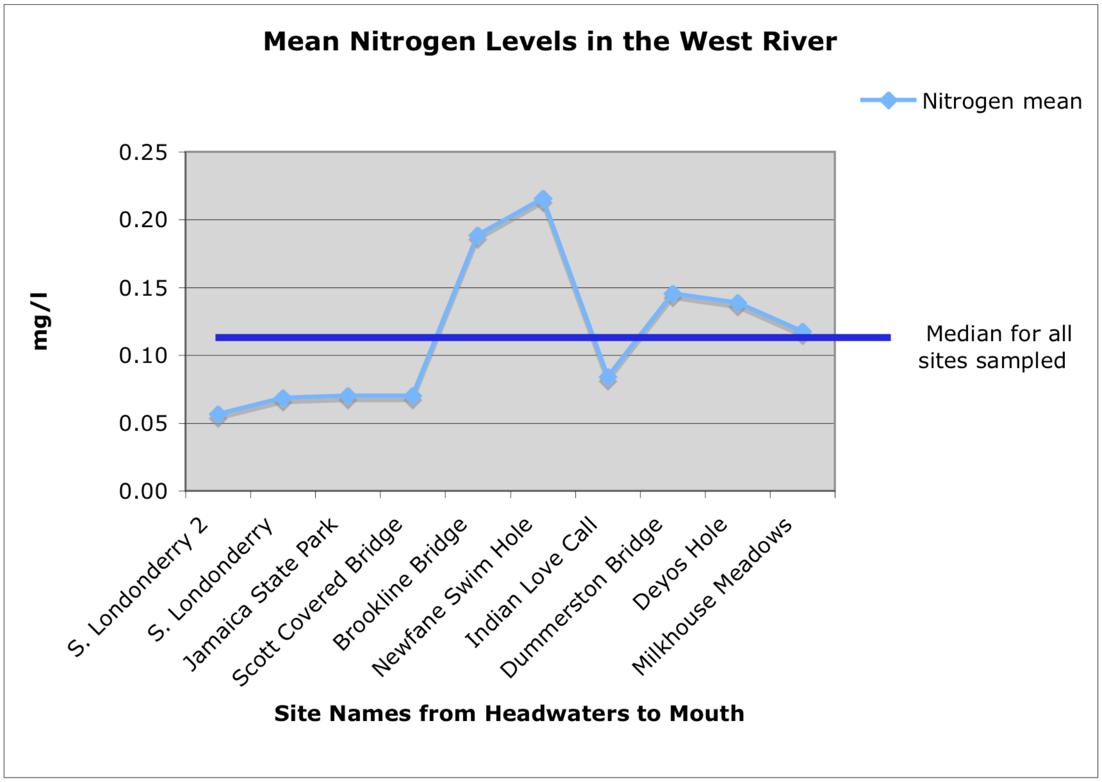
The following graphs present the results outlined in Table 3.a. for each parameter sampled. They provide a kind of "picture" of the river. The sampling sites are in the same order as in the table: upstream to downstream, left to right. The median for all of the sites sampled along the river is depicted as a blue line; this can be interpreted as a kind of baseline number for comparisons over time.


Mean Level of Turbidity in the West River
NTU
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Turbidity mean
Median for all sites sampled
S. Londonderry 2
S. Londonderry
Jamaica State Park
Scott Covered Bridge
Brookline Bridge
Newfane Swim Hole
Indian Love Call
Dummerston Bridge
Deyos Hole
Milkhouse Meadows
Site Names Headwaters to Mouth

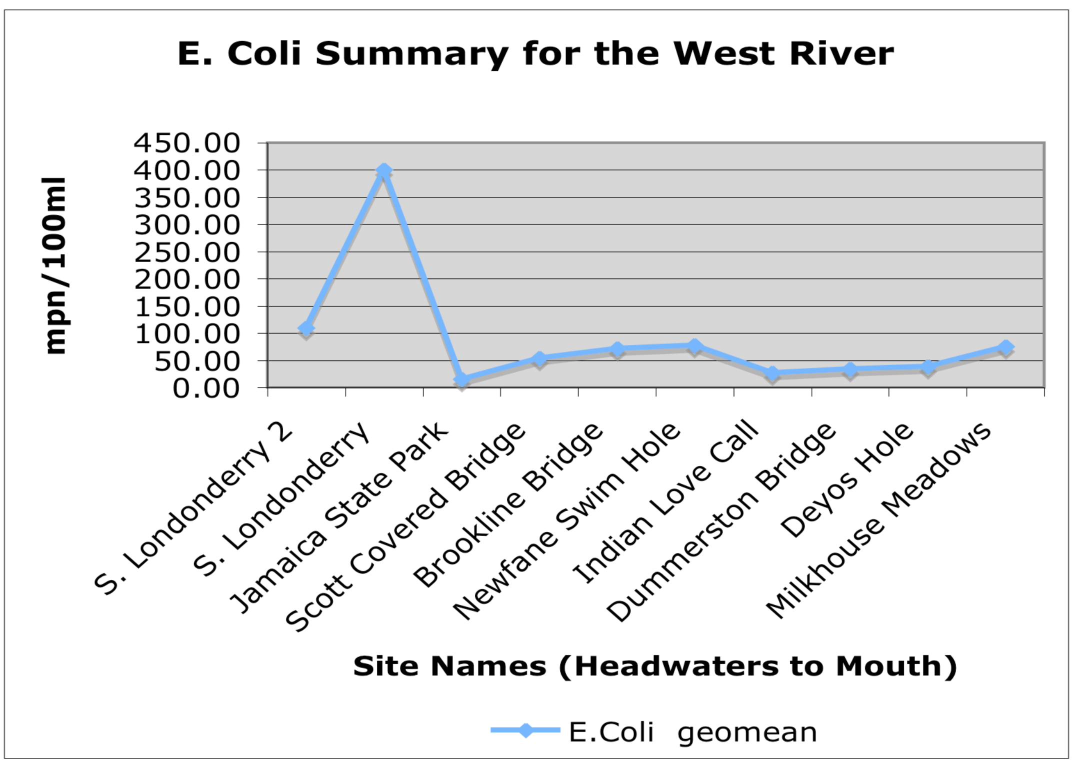
Graph 3.1


Mean Level of Total Phosphates in the West River
TP (ug/l) mean
(ug/ml)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Median for all sites sampled
S. Londonderry 2
S. Londonderry
Jamaica State Park
Scott Covered Bridge
Brookline Bridge
Newfane Swim Hole
Indian Love Call
Dummerston Bridge
Deyos Hole
Milkhouse Meadows
Site Names Headwaters to Mouth

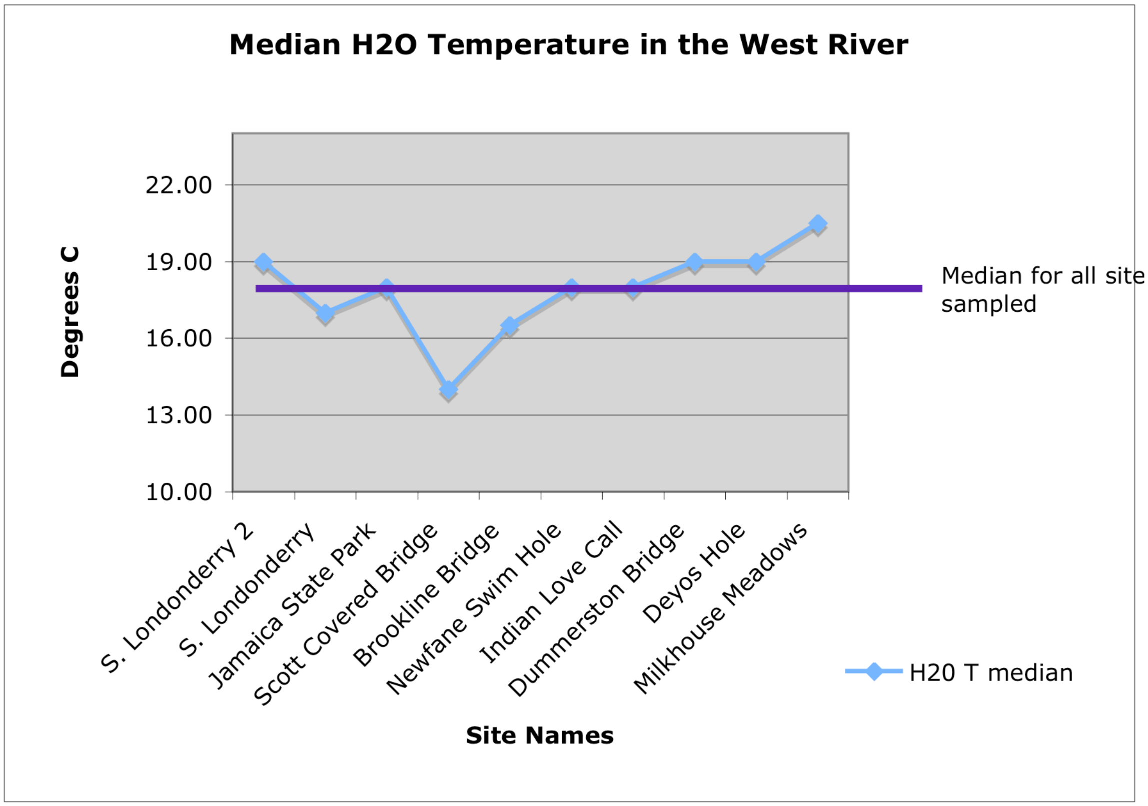
Graph 3.2



Graph 3.3



Graph 3.4

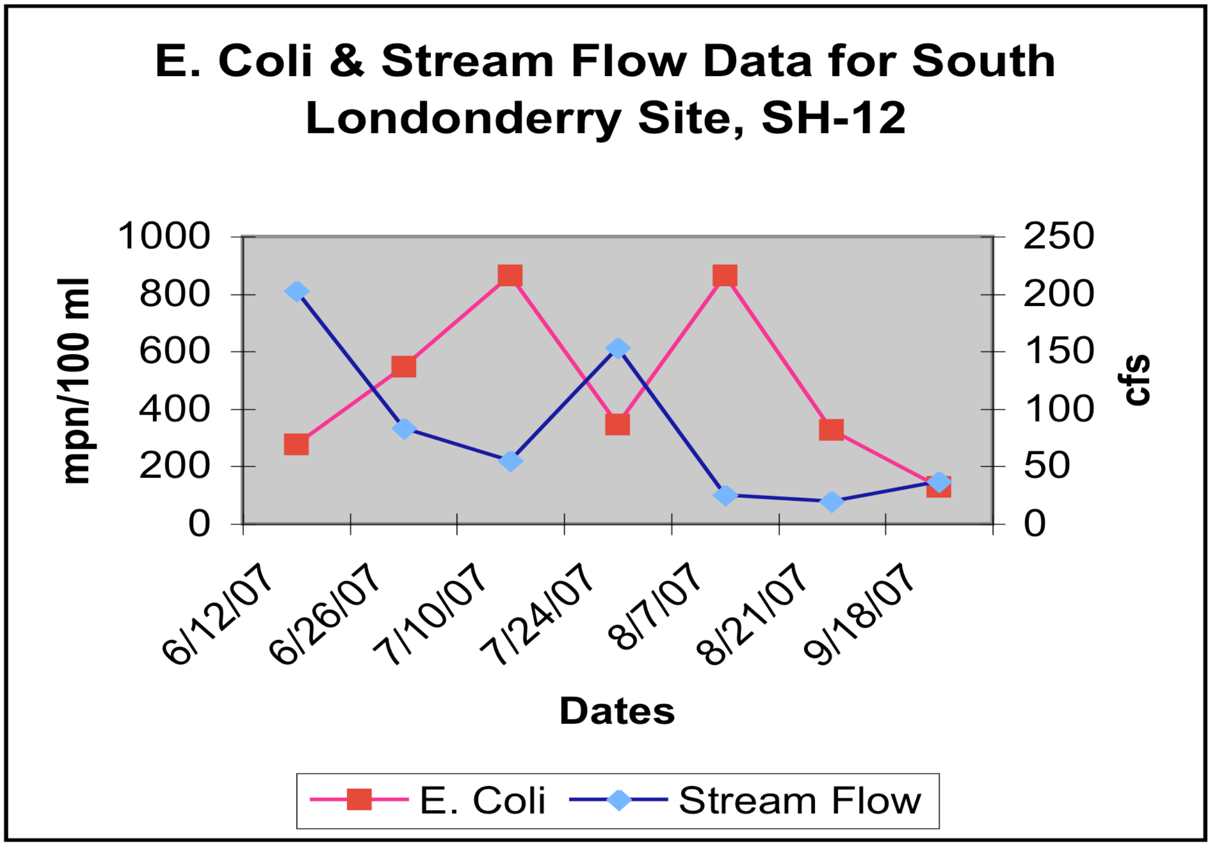


Graph 3.5

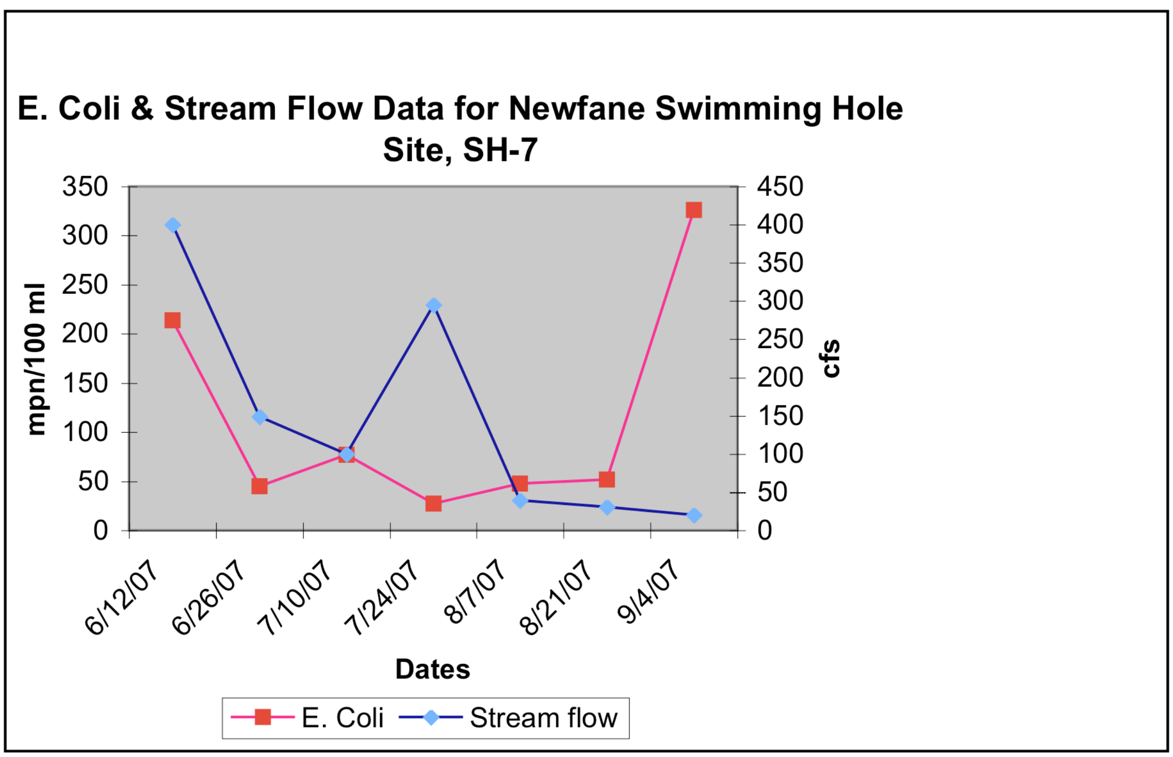
Graphs 3.6 – 3.9 Bacterial Pollution & Stream Flow

The sites in the next series of graphs have an average level of E.coli bacteria that exceeds or almost exceeds the limit for Vermont Class B waters. In an attempt to discern the nature of this imbalance, the following graphs contrast bacteria levels with flow data.

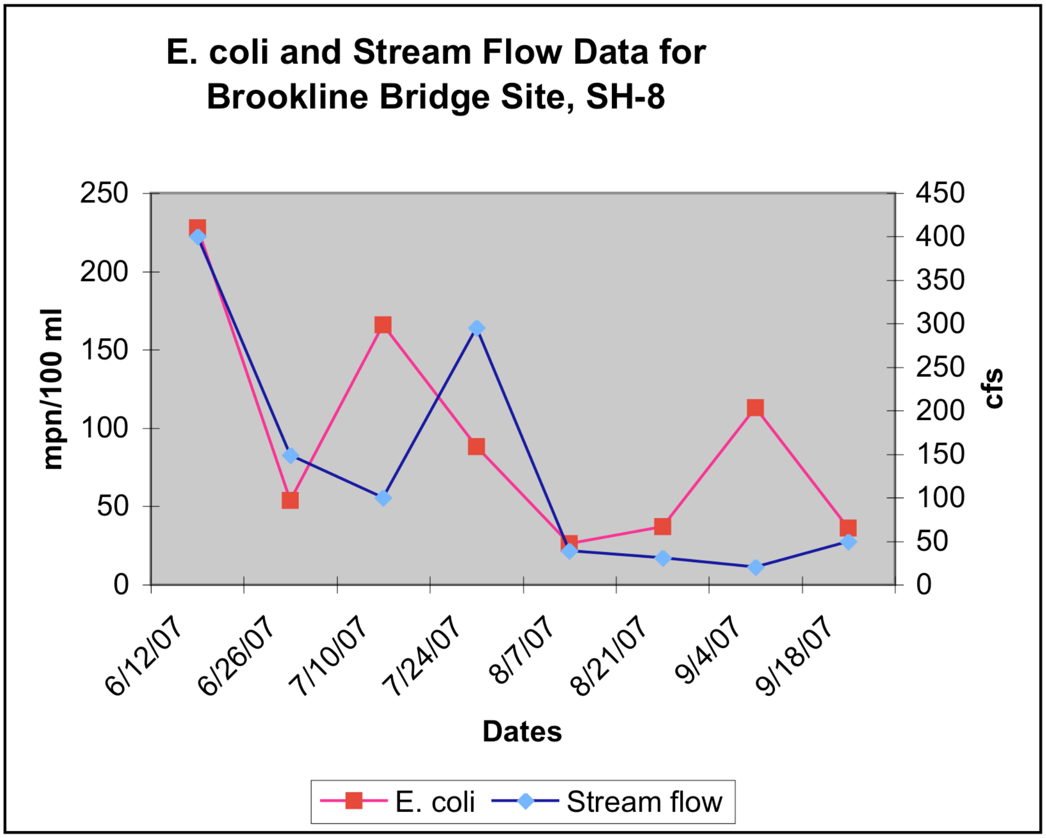
3.6 South Londonderry – It is important to remember that the USGS Station is downstream of this sampling site, so the stream flow data is not exactly accurate. Essentially, it just provides an overall picture of when the stream flow rose and fell in relationship to the levels of bacteria. From June through early August, there is a direct inverse relationship between the two numbers. Each time the flow increased, the level of bacteria found in the river diminished. When the flow decreased, the level of bacteria increased.



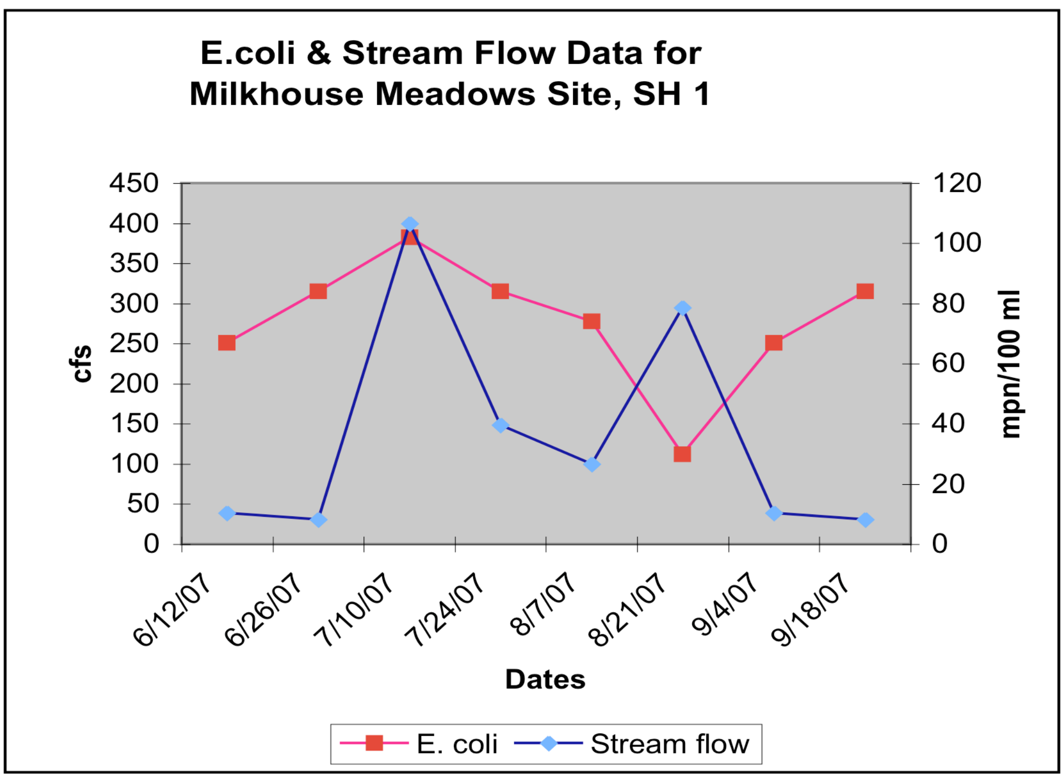
Graph 3.6



Graph 3.7



Graph 3.8



Graph 3.9

3.7 / 3.8 Newfane Swimming Hole & Brookline Bridge – These two sites exhibit a similar pattern in that the levels of E.coli bacteria increase and decrease in direct relationship to the increase and decrease of the flow of the river in the early summer when the flow was still at a normal level. Toward the end of the summer, when the river was running low for an extended period of time, there is a spike in E. coli levels.

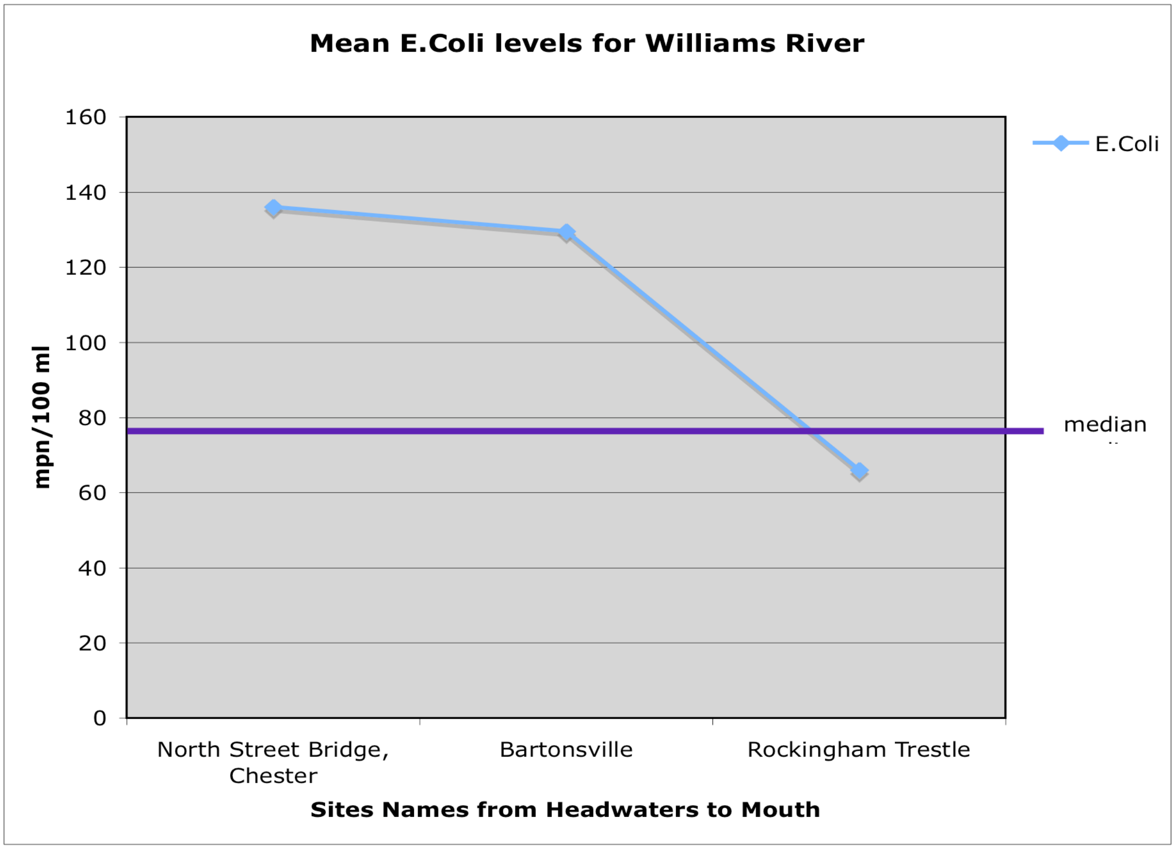
3.9 Milkhouse Meadows – The data indicates that there is an indirect relationship between the levels of E. Coli bacteria and the stream flow of the river, similar to the pattern at the SH-12.

<u>B. The Williams River</u>

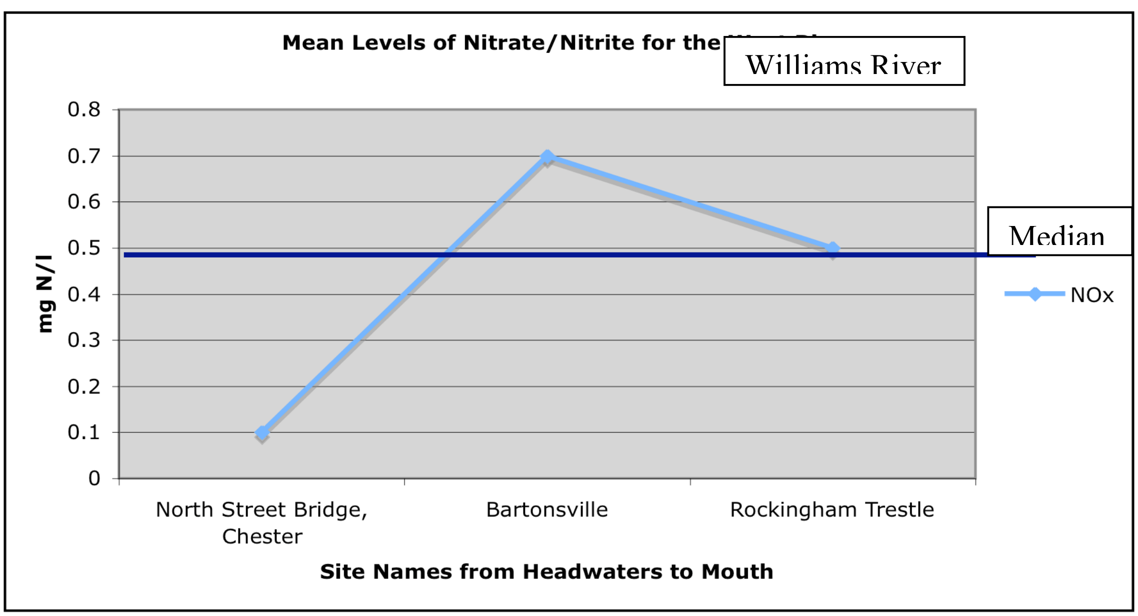
Table 3.c Williams River Summary

Site Names	E.coli	NOx	TP	Turbidity	pH	FieldCond	H20 T
North Street Bridge, Chester	136	0.1	8.7	1.5	7	72	14
Bartonsville	130	0.7	22.3	2.8	6.7	89.4	15.5
Rockingham Trestle	66	0.5	16	2.1	7.1	101.4	12
Median	130	0.5	16	2	7	89	14

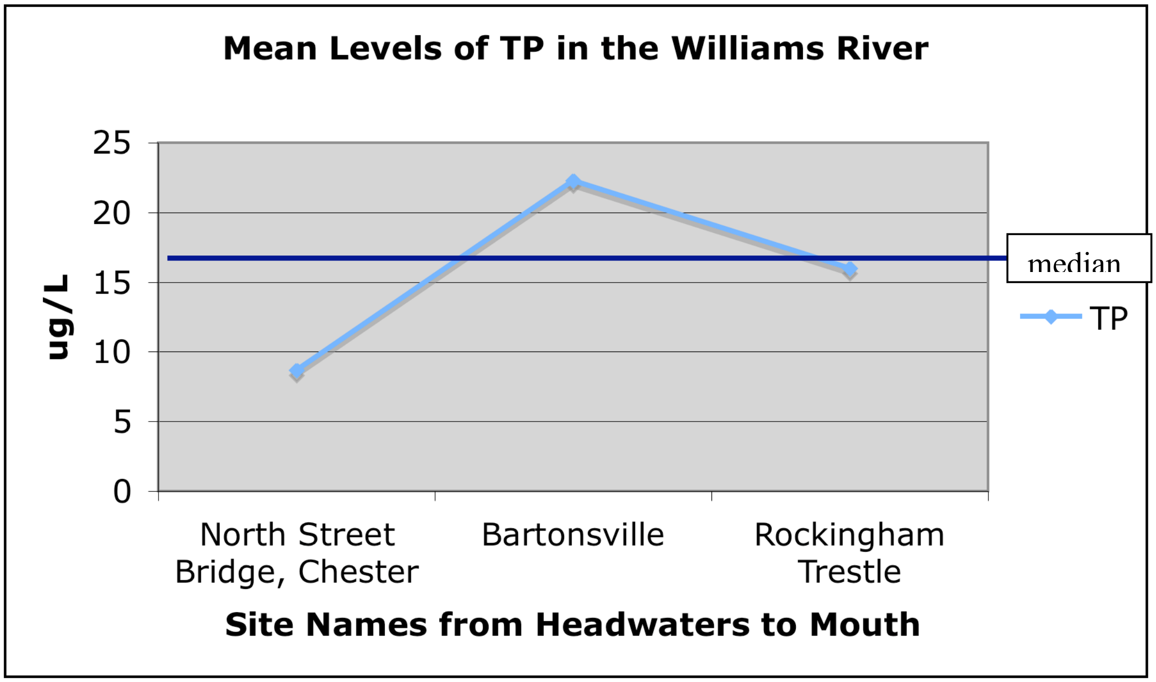
Graphs 3.10 – 3.14 Williams River Snapshot



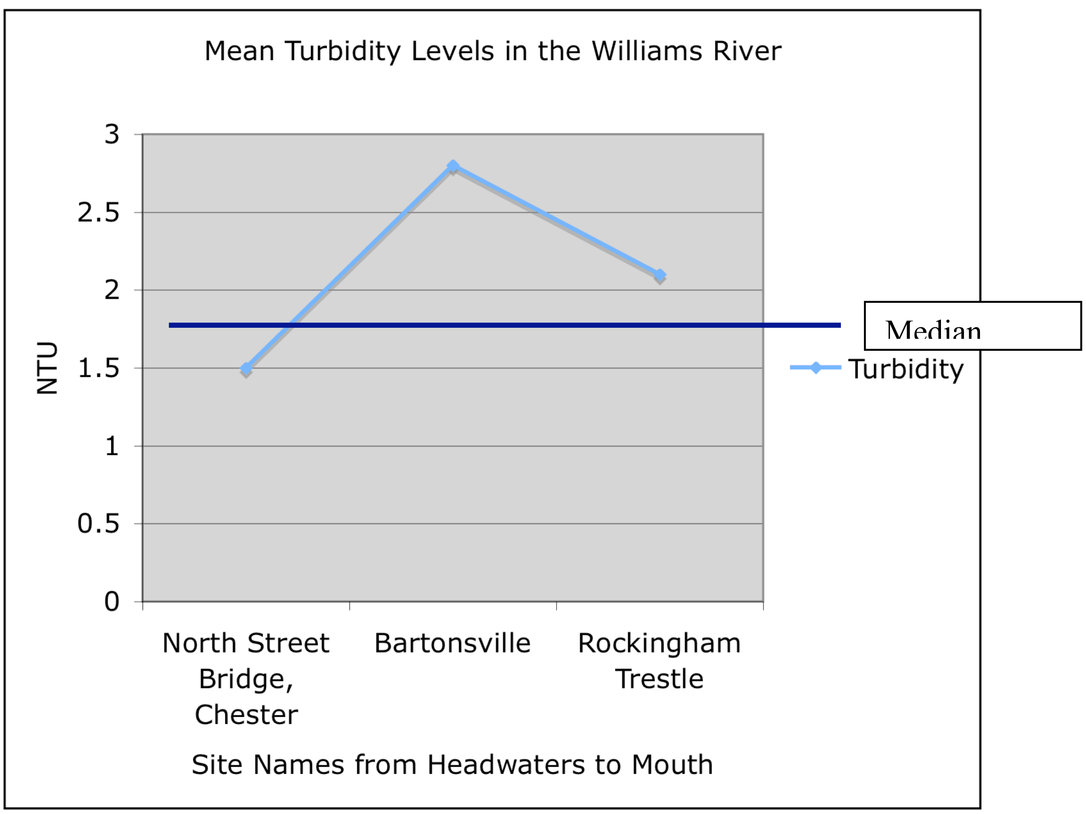
Graph 3.10

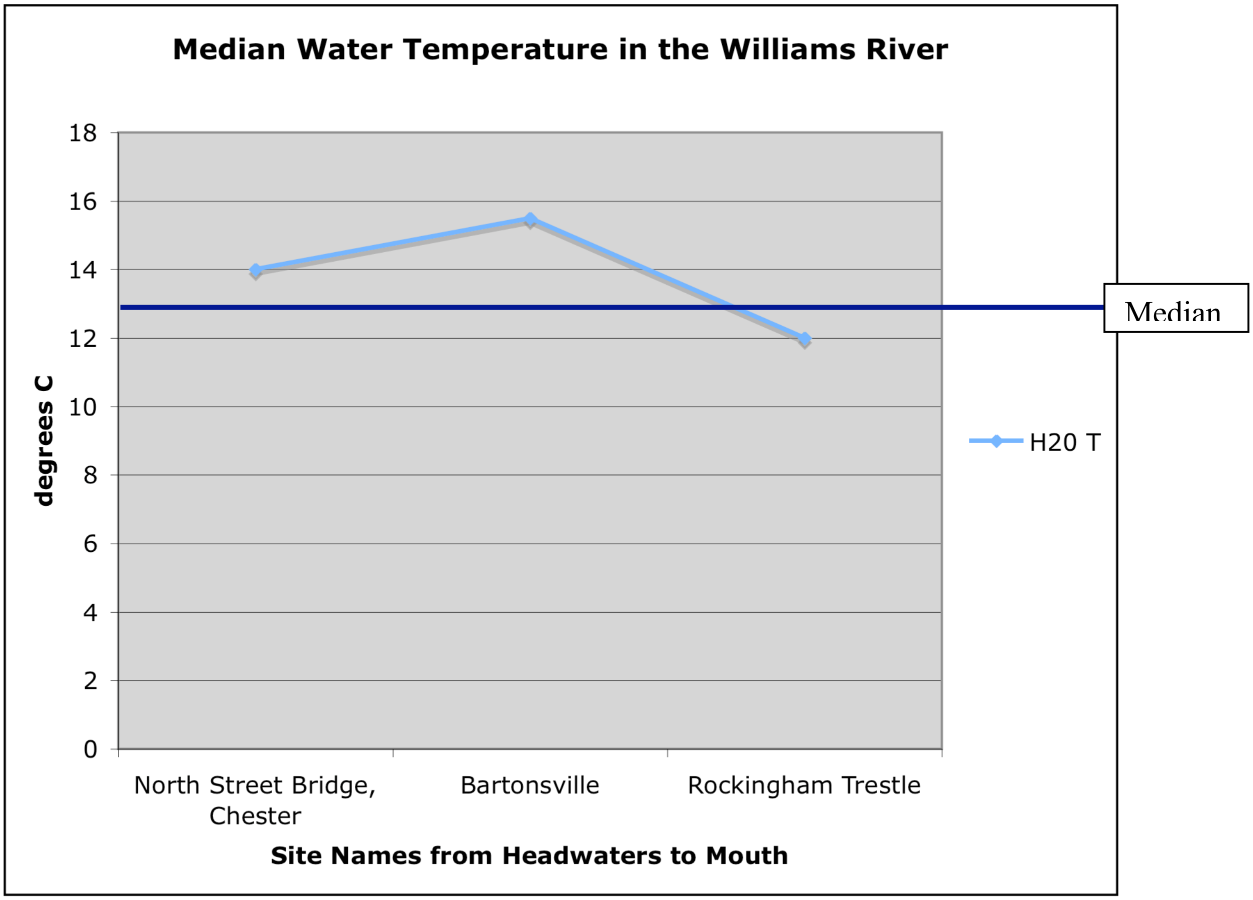


Graph 3.11


Mean Levels of TP in the Williams River
25
20
15
10
5
0
ug/L
median
TP
North Street Bridge, Chester
Bartonsville
Rockingham Trestle
Site Names from Headwaters to Mouth

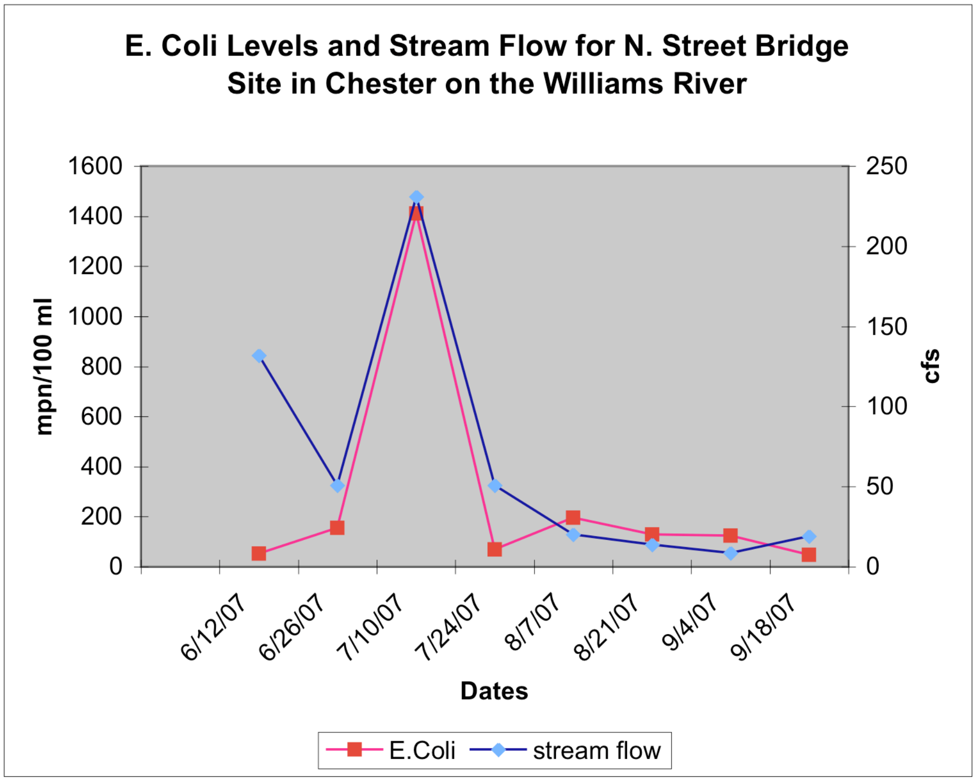
Graph 3.12


Mean Turbidity Levels in the Williams River
3
2.5
2
1.5
1
0.5
0
NTU
Median
Turbidity
North Street Bridge, Chester
Bartonsville
Rockingham Trestle
Site Names from Headwaters to Mouth

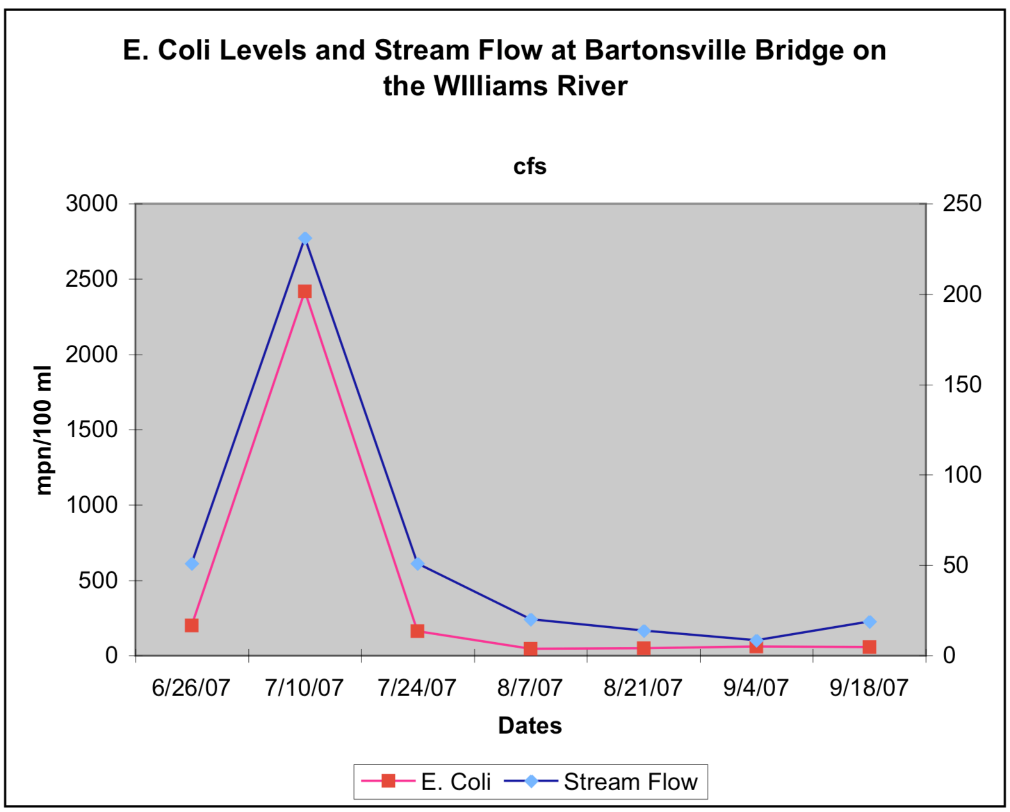

Median Water Temperature in the Williams River
18
16
14
12
10
8
6
4
2
0
degrees C
Median
H20 T
North Street Bridge, Chester
Bartonsville
Rockingham Trestle
Site Names from Headwaters to Mouth

Graph 3.14

Graphs 3.15 – 3.16 Bacterial Pollution



Graph 3.15



Graph 3.16

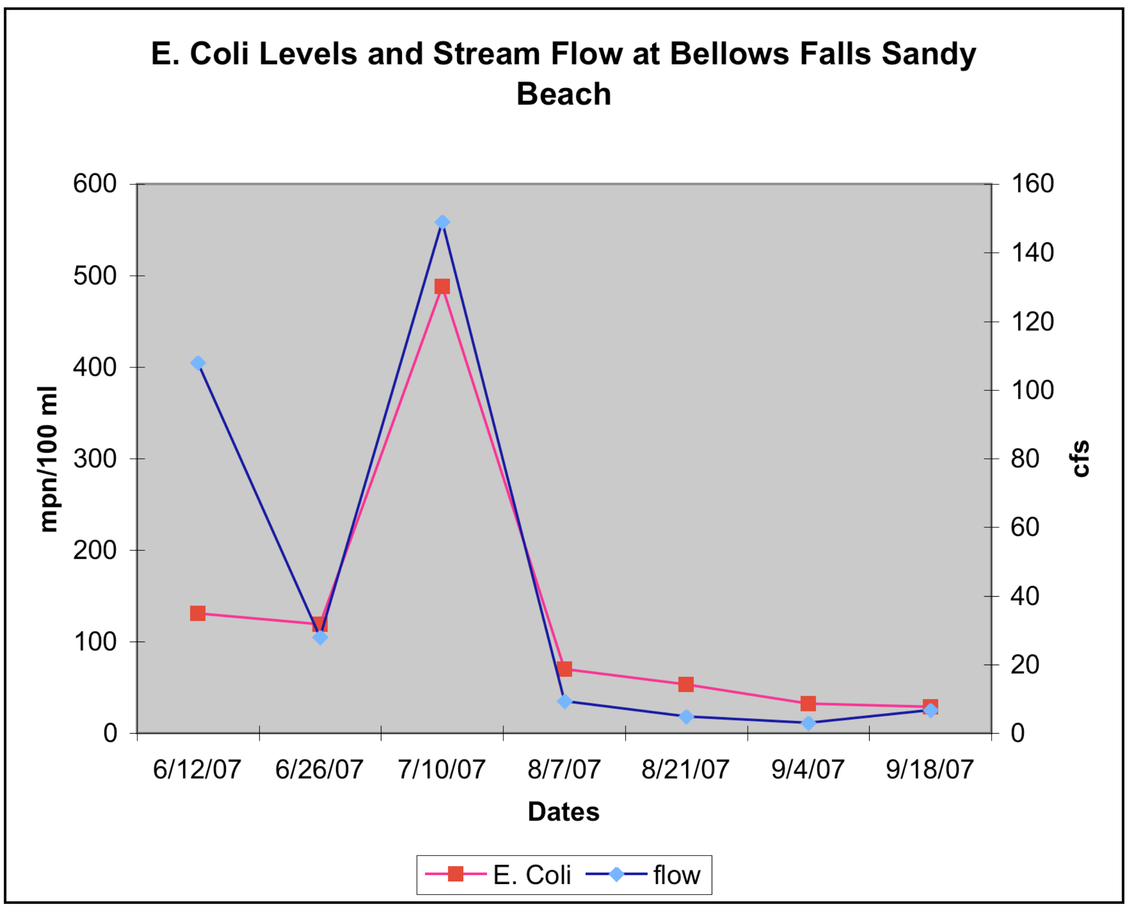
<u>C. The Saxtons River</u>

Table 3.d Saxtons River Summary

The following table shows the mean levels of each parameter for all sampling sites on the Saxtons River as well as the median for each both sites.

	E. Coli Mpn/100ml	NOx Mg N/l	TP ug/L	Turbidity NTU	Water T Celcius
Saxtons River Center	64	0.12	8.2	0.73	12
Bellows Falls Sandy Beach	83	0.15	14.2	4.2	15
Median	73.3	0.13	11.2	2.5	13.5

Graph 3.13 E. Coli and Stream Flow levels for Bellows Falls Sandy Beach



V. Conclusions for 2007

For the most part, the data collected through the Water Quality Monitoring Program provides a chemical picture of what the three major rivers in the West River Basin look like. The rivers' chemistry is only one aspect of the entire system and provides information as to where there are concerns about water quality and what kinds of pollution is entering the river. In order to find out how the river is being impacted, where the source of pollution is often requires more research.

Most sites sampled along the **West River** fell within the guidelines for clean and healthy rivers. The series of graphs titled "West River Snapshot" provide a demonstration of how the results for each sampling site compares to the median level for all sites sampled on the river. There are three sites that show signs of nutrient loading. Sites with an average level of total phosphorus that is above the guidelines for a healthy river are: S. Londonderry 2, Jamaica State Park and the Scott Covered Bridge (3.2). It should also be noted that all of these sites also have turbidity levels that are above the river median of .7 NTU (3.1). This could indicate the presence of excessive run-off at these sites.

The mean levels of bacteria found at the South Londonderry, Newfane SwimHole and Brookline Bridge are excessive with the levels at South Londonderry being of greatest concern. As stated in the results section, graph 3.6 shows a direct inverse relationship between the level of bacteria and the amount of water in the river. This would suggest that the source of pollution is not related to surface run-off entering the river, but from a more direct source. The other interesting piece of data is that the levels of bacteria found just one half of a mile upstream from SH-12 at sample site GW-19 were much lower and showed little relationship to the bacteria levels present at SH-12. The following table compares the two results from the two sites for the three days when both sites were sampled.

Table 5.a E. coli Levels at both sites in S. Londonderry

Date	GW – 19	SH – 12
7/24/07	161	345.00
8/7/07	104	866.00
9/18/07	78	130.00

The levels show a sharp peak in the quarter mile of river between these two sites. Conversations with Londonderry's Town Health Officer suggest that the source could be a beaver den. At a meeting with the Londonderry Conservation Commission it was noted that there is an old spring line that runs under the river at this site as well. More research is necessary to determine where the pollution is coming from and the best approach for resolving the problem.

Table 5.b Point and Non-point Source Pollution in the West River

	Point Source	Non-point Source	
Site Names	South Londonderry, SH 12 Milkhouse Meadows, SH1	Brookline Bridge, SH8 S. Londonderry 2, GW19 Jamaica State Park, SH10 Newfane SwimHole, SH7 Scott Covered Bridge, SH9	

The sites listed in the above table all have indications of some level of bacteria or nutrient pollution.

Results from the three sampling sites along the **Williams River** also exhibit signs of nutrient loading and bacterial pollution. Each of the graphs of the Williams River Snapshot (3.10 – 3.14) are almost identical; they all spike at Bartonsville Bridge, SH15. Bartonsville Bridge and North Street Bridge sampling sites both had an average level of E.coli bacteria above the designation for VT Class B waters and safe recreation. As shown in Graphs 3.15 & 3.16, these levels rose and fell directly with the river's stream flow, indicating that the pollutions source is related to the surrounding land – use directly upstream.

The average result of 22.3 ug/100 ml of total phosphorus at Bartonsville Bridge is also a point of concern – this number is two and half times the level found upstream in Chester and twice as high as the maximum level of 10 ug/100 ml for a healthy stream. Increased levels of phosphorus are usually due to residential and/or agricultural run-off entering the river.

The two monitoring sites along the **Saxtons River** rarely exceeded water quality standards for healthy rivers. The levels of E. coli, nitrate/nitrite and total phosphorus were all slightly elevated at the Bellows Falls Sandy Beach in Westminster (Table 3.d). This site was also noted by volunteers as having a lot of litter and smelling like urine. The site is located where the river passes under Route 5 and just downstream of Bellows Falls. The direct relationship between stream flow and pollution levels (3.13) found at this site indicates that surface run-off from surrounding urban areas could be impacting the river.

WRWA has taken steps to notify the town health officers about elevated bacteria levels that pose a health risk to swimmers. The organization hopes to use this information to continue a dialog with town officials and other members of the community define and remediate the exact sources of pollution. WRWA will also use this data and the five-year summary to inform the future of the WQMP.

V.I. Results for 2002-2007

The annual mean for each parameter is presented for all sampling sites. Not all sites were sampled for all years due to a lack of funding, volunteer capacity or need for further research.

SITE #	YEAR	WATER T	CONDUCT	E.COLI	TP	NOX	TSS	Turbidity
SH1	2003			50.80	16.00	0.13		
SH1	2004	20.5	86.44	131.60	13.00	0.11	3.88	
SH1	2005	22	88.27	86.62	10.82	0.11	1.31	1.25
SH1	2006	17.5	69.27	77.85	9.66	0.10	1.40	0.88
SH1	2007	20.5	80.24	75.38	7.77	0.12		0.68
SH2	2003			50.80	8.00	0.12	2.10	
SH2	2004	18.25	82.74	62.90	12.45	0.11	4.32	
SH2	2005	21	79.10	28.77	8.51	0.11	2.02	0.73
SH2	2006	17	64.83	38.00	9.30	0.09	1.24	0.82
SH2	2007	19	76.06	39.13	7.06	0.14		0.54
SH3	2003			35.50	15.00	0.12	4.80	
SH3	2004	18.5	74.58	68.81	13.58	0.11	4.64	
SH3	2005	21.5	77.56	31.95	8.38	0.12	1.59	1.01
SH4	2003			34.90	8.50	0.14	1.20	
SH4	2004	18.5	81.46	81.15	12.18	0.11	3.57	
SH4	2005	21	82.74	41.02	8.84	0.13	1.33	0.76
SH4	2006	17	63.93	44.08	9.40	0.10	1.36	0.93
SH4	2007	19	65.63	33.83	10.11	0.15		0.76
SH5	2003			30.00	7.80	0.14	1.20	
SH5	2004	16.75	74.66	47.16	8.80	0.09	2.12	
SH5	2005	20.25	78.30	82.54	9.33	0.13	1.36	0.93
SH6	2003			21.25	6.50	0.08	1.20	
SH6	2004	14	55.40	24.69	10.57	0.07	2.76	
SH6	2005	18	72.94	14.92	5.59	0.10	1.10	0.42
SH6	2006	15	55.02	19.24	8.74	0.07	1.05	0.36
SH6	2007	18	59.43	27.33	6.17	0.08		0.62
SH7	2003			36.70	9.25	0.16	1.90	
SH7	2004	19	84.06	98.65	11.77	0.16	3.27	
SH7	2005	20	85.36	71.30	9.48	0.19	1.64	0.80

SH7	2006	18	69.79	62.64	9.55	0.16	1.16		0.73
SH7	2007	18	75.73	77.17	8.15	0.22			0.61
SH8	2003			50.82	9.50	0.13	2.10		
SH8	2004	18	82.11	68.38	10.56	0.11	2.40		
SH8	2005	21	84.57	94.55	10.75	0.13	1.40		0.88
SH8	2006	17	66.46	65.19	10.06	0.10	1.22		0.84
SH8	2007	16.5	74.83	71.77	8.54	0.19			0.78
SH9	2003			17.90	12.50	0.06	2.10		
SH9	2004	20	77.45	47.81	16.21	0.05	3.19		
SH9	2005	22	83.54	29.22	16.80	0.08	2.31		2.31
SH9	2006	18	62.67	41.43	17.59	0.05	5.56		1.71
SH9	2007	14	61.69	53.95	12.99	0.07			1.51
SH10	2003			30.70	12.00	0.08	>1		
SH10	2004	17	68.54	20.07	12.37	0.05	1.80		
SH10	2005	18.5	65.13	8.00	18.64	0.08	1.92		1.72
SH10	2006	16	52.50	15.95	16.23	0.05	4.69		1.97
SH10	2007	18	65.12	14.77	11.49	0.07		1.06	
SH11	2003			35.00	5.80	0.15	>1		
SH11	2004	14	175.97	8.40	7.21	0.15	1.53		
SH11	2005	17	165.07	7.43	6.20	0.12	<1		0.40
SH11	2006	14	162.82	30.63	6.47	0.16	1.10		0.56
SH 11	2007	14.56	157.63	21.53	6.54	0.20			0.69
SH12	2004	17	78.44	277.36	10.88	0.07	1.70		
SH12	2005	19.15	77.10	133.32	14.73	0.08	7.42		1.76
SH12	2006	12.5	59.99	204.69	9.44	0.05	1.14		0.73
SH12	2007	17	66.90	400.70	7.64	0.07		0.57	
SH13	2003			10.08	5.30	0.09	>1		
SH13	2004	14	84.13	25.79	12.99	0.20	2.21		
SH13	2005	16	77.43	42.56	13.48	<.05	14.70		1.59
SH14	2003			97.07	8.50	0.09	>1		
SH14	2004	15.5	82.45	105.12	9.19	0.08	1.53		
SH14	2005	17.9	69.40	75.03	15.33	0.08	12.34		1.96
SH14	2006	15.25	60.16	51.26	7.31	0.08	1.03		0.46
Sh14	2007	14	72.00	136.03	8.70	0.10	1.50		7.00
SH 15	2003			115.90	14.30	0.65	1.60		
SH15	2004	15	103.34	86.30	11.59	0.42	0.93		
SH15	2005	17.5	139.34	91.47	20.64	0.70	6.92		3.58

SH15	2006	17	86.74	104.77	14.72	0.44	7.10	0.76
SH15	2007	15.5	89.40	129.51	22.30	0.70	2.80	6.70
SH16	2004	14	84.19	10.93	6.69	0.08	1.23	
SH16	2006	13	66.01	12.59	7.69	0.08	1.52	0.46
Sh 16	2007	14.5	97.17	6.82	5.44	.10		
SH17	2004	16	137.78	108.51	9.76	0.18	1.13	
SH17	2005	19.25	131.76	281.23	15.47	0.16	7.66	3.52
SH17	2006	16.25	98.30	117.46	10.16	0.15	1.47	0.78
SH 17	2007	15.00	133.00	82.58	14.20	0.15	4.25	7.06
SH18	2004	16	118.83	50.07	7.34	0.10	1.00	
SH18	2005	18	107.84	112.57	25.34	0.10	75.25	19.94
SH18	2006	14.75	77.22	70.29	8.31	0.09	1.22	0.63
SH18	2007	12.00	87.30	63.98	8.17	0.12	0.73	7.04
SH19	2005	19.25	141.60	57.04	11.68	0.50	2.91	1.08
SH19	2006	17	96.60	83.69	9.50	0.36	1.25	0.79
SH19	2007	12	101.40	66.06	16.00	0.50	2.10	7.10

VII. Summary of Results for 2002 – 2007

The following summary defines the range of results for each parameter at each sampling site over the five-year sampling period. Because the site locations, sampling protocols and parameters have remained consistent throughout this time period, it is possible make an accurate comparison from one year to the next, and that changes in the data reflect real changes in the river system. The notes accompanying the data just highlight any patterns, anomalies, and other points of interest that may call for further investigation.

This is true for everything except for the water temperature. There is a large range for water temperature at many of the sites and it is most likely due to the fact that different samplers would collect samples at different times of the morning. Essentially, the water temperature information is just a descriptor and accurately reflects the range of temperatures at that site. A more focused study is needed to determine if any thermal pollution is present at the site. It should also be noted that none of the sites have data for water temperature or conductivity in 2003.

SH 1 – Milkhouse Meadows 2003-2007

Most notably, these results show a steady decrease in the amount of total phosphorus from 16 ug/ml in 2003 to 7.8 ug/ml in 2007.

Field Conductivity	69.3 – 88.3
E. coli	50.8 – 131.6
TP	7.8 – 16
NOx	.13 - .1
Water Temperature	17.5 – 22

SH – 2, Deyo's Hole 2003-2007

The results for all parameters have been fairly consistent throughout the entire sampling history.

Water T	17 - 21
Conductivity	64.8 – 82.7
E. coli	28.7 – 62.9
TP	8 – 12.45
NOx	.09 - .14

SH – 3, Quarry Road 2003 - 2005

There was a consistent decrease in the level of total phosphorous and total suspended solids during the sampling period.

Water T	18.5 – 21.5
Conductivity	74.5 – 77.5
E. coli	31.9 – 68.8
TP	8.3 - 15
NOx	.11 - .12

SH-4, Dummerston Bridge 2003-2007

There is a noticeable decrease in the E.coli, total phosphorus, nitrate/nitrite, and total suspended solids between 2004 & 2005.=

Water T	17 - 21
Conductivity	63.9 – 82.7
E. coli	33.8 - 44
TP	8.5 – 12.5
NOx	.1 - .15

SH-5, West/Rock 2003-2005

Levels consistent and healthy.

Water T	17– 20
Conductivity	74.7 – 78.3
E. coli	30 – 82.5
TP	7.8 – 9.3
NOx	.09 - .14

SH-6, Indian Love Call 2003-2007

Consistent and low, excellent water quality.

Water T	14 - 18
Conductivity	55 - 73
E. coli	15 – 27.3
TP	.07 - .1
NOx	.07 - .1

SH – 7, Newfane Swimming Hole 2003-2007

There was a peak in E. coli levels in 2004 from the bottom of the range to the top, successive years have yielded an average close to 77 mpn/100 ml. There is a similar pattern for the levels of total phosphates and a steady increase in nitrate/nitrite.

Water T	18 - 20
Conductivity	69 - 85
E. coli	36.7 – 98.6
TP	8.2 – 11.8
NOx	.16 - .22

SH – 8, Brookline Bridge 2003- 2007

There is a steady, small increase in the E.coli levels with nutrient levels remaining at the higher end of levels indicating good water quality.

Water T	16.5 - 21
Conductivity	66.5 – 84.6
E. coli	50.8 – 94.6
TP	8.5 – 10.7
NOx	.1 - .19

SH – 9, Scott Covered Bridge 2003-2007

All levels are fairly consistent throughout the sampling period with levels of total phosphorus exceeding the limits for excellent water quality in streams.

Water T	14 - 22
Conductivity	61.7 – 83.6
E. coli	29.2 - 54
TP	12.5 – 17.6
NOx	.05 - .08

SH 10 – Jamaica State Park 2003-2007

All results are within the expected range for a healthy stream.

E. coli	8 – 30.7
Conductivity	52.5 – 68.54
TP	11.5 – 18.6
NOx	.08 - .05
Water T	16 – 18.5

SH 11 - Pikes Falls 2003-2007

All results are indicative of clean & healthy waters throughout the five-year sampling period.

Water T	14 -17
Conductivity	163 – 176
E. coli	7.4 – 35
TP	5.8 – 7.2
NOx	.12 - .20

SH-12, South Londonderry 2004-2007

The site has maintained an average level of E.coli bacteria that is two to five times as high as the VT state standard for Class B waters and safe recreation of 77 cfu/100ml. There has been a steady decrease in the level of total phosphates from 10.88 ug/100ml to 7.64 ug/100ml. The mean annual levels for all other parameters have been within the limits for healthy waters.

Water T	12.5 – 19.15
Conductivity	59.99 – 78.44
E.coli	133.32 – 400.70
TP	7.64 -14.73
NOx	.05 - .08

SH 13, Gassetts Talc Mine 2003-2005

The levels of total phosphates almost tripled over the three -year sampling period.

Water T	14 - 16
Conductivity	77 - 84
E. coli	10 - 42
TP	5 - 13.5
NOx	.05 - .2

SH – 14, North Street Bridge, Chester 2003-2007

Fairly consistent results throughout the sampling period except for a spike in total phosphates in 2005 to the top of the range and increased levels of bacteria in 2004 and 2007.

Water T	14 - 17.9
Conductivity	60 - 82
E. coli	51 - 136
TP	7.3 - 15.3
NOx	.08 - .10

SH – 15, Bartonsville Bridge 2003-2007

Levels of E.coli bacteria and total phosphates are consistently high throughout the entire sampling period.

Water T	15 - 17.5
Conductivity	86 - 139
E. coli	86 - 129.5
TP	11.6 - 22
NOx	.42 - .7

SH – 16, Wardsboro Brook 2003-2007

Water T	13 - 14
Conductivity	66 - 84
E. coli	10.9 – 12.5
TP	6.6 – 7.6
NOx	.08 - .08

SH – 17, Bellows Falls Sandy Beach 2004-2007

Nutrient and bacteria levels are consistently high throughout the sampling period.

Water T	15 – 19.25
Conductivity	98.3 – 137.7
E. coli	82.5 – 281.25
TP	9.7 – 14.2
NOx	.15 - .18

SH – 18, Saxtons River Center 2004-2007

Consistent levels for all parameters except for a spike in E.coli, bacteria and sediment in 2005.

Water T	12 - 18
Conductivity	77 – 118.8
E. coli	50 – 112.6
TP	7.3 – 25.3
NOx	.09 - .12

SH – 19, Rockingham Trestle 2005-2007

E. coli levels at this site can have high spikes in heavy rains, but stay within the levels for healthy waters most of the time. There levels of total phosphates and nitrate/nitrite are consistently high.

Water T	12 – 19.3
Conductivity	96.6 – 141.6
E. coli	57 – 83.7
TP	9.5 - 16
NOx	.36 - .5
