Water Quality Assessment
Of Furnace Brook
and the Walloomsac River

By Alex Romac
and Nick Harris
What is the relationship between flow and water quality at a rural forested site and at an urban site?
Hypothesis

The Stronger the flow is in a river the worse the water quality will be. A stronger flow will stir up more dirt and pull in dirt from the banks. A strong flow can mean that the river has been channeled by the town. It also could mean that there are several tributaries that run into the river providing more water. The more tributaries present, the more likely it is that polluted water from upstream will flow into the main river. Since channeling usually occurs in urban areas, then the river is likely surrounded by impervious surfaces that are covered in chemicals that are washed into the river.
Furnace Brook is a typical small Vermont Stream.
Brook isn’t very deep and flow is typically slower.
Rocky bottom with many riffles.
Great Canopy Cover.
Sturdy banks with vegetation.

Habitat Score: 90.5
Potential Threats:

Direct Runoff

- Pipes
- Storm Drains
- Construction of Highway

Storm Drain pipe running from MAUMS to Furnace Brook

Construction of the new Bennington Bypass
The Walloomsac River is a river that runs right through the heart of Bennington.
- Fast Flowing River
- Deep in areas
- Average Canopy Cover
- Not too many riffles

Habitat Score: 79
Potential Threats:
- Erosion of Banks
- Littering
- Impervious Surroundings
- Narrow channels
- DANGEROUS IN STORMS!

Eroded banks of the Walloomsac

Litter in the river
Correlation of TSS vs Flow in Furnace Brook

Correlation: \( .892345 \)

\( R^2 = 0.7963 \)

P Value: \( 6.44E-07 \)
Relationship Between Flow and TSS in the Walloomsac River

<table>
<thead>
<tr>
<th>Date</th>
<th>Flow (m/s)</th>
<th>TSS (mg/L)</th>
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<tbody>
<tr>
<td>7/6</td>
<td>5/26</td>
<td>7/15</td>
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<tr>
<td>11/23</td>
<td>0/0</td>
<td>0/0</td>
</tr>
</tbody>
</table>

Legend:
- Flow
- TSS
- 2 per. Mov. Avg. (Flow)
- 2 per. Mov. Avg. (TSS)
Correlation of TSS vs Flow in the Walloomsac River

- Correlation: 0.345296
- \( R^2 = 0.1192 \)
- P Value: 0.160496

Graph showing the correlation between TSS (Mg/L) and Flow (m/s) in the Walloomsac River.
Relationship Between Flow and Phosphorus at Furnace Brook Over Time

Flow (m/s)

Phosphorus (µg/L)

Date

Furnace Brook

Flow

Phosphorus

2 per. Mov. Avg. (Flow)

2 per. Mov. Avg. (Phosphorus)
Phosphorus vs. Flow @ Furnace Brook

Correlation: 0.887865

$R^2 = 0.7883$

P Value: .000603
Furnace Brook
Flow & Phosphorus @ Walloomsac River

Flow (m/s)

Phosphorus (mg/L)

Date

7/6 7/26 8/15 9/4 9/24 10/14 11/3

Flow
Phosphorus
2 per. Mov. Avg. (Flow)
2 per. Mov. Avg. (Phosphorus)
Phosphorus vs. Flow @ Walloomsac River

Correlation: 0.548789
$R^2 = 0.3012$
P Value: 0.100424
Relationship Between Flow and E. Coli Over Time at Furnace Brook
Correlation of E Coli Vs Flow at Furnace Brook

Correlation: 0.452976

P Value: 0.103835

$R^2 = 0.2052$
Relationship Between Flow and E. Coli Over Time in the Walloomsac River

Flow (m/s) vs. E. Coli (MPN)

- 2 per. Mov. Avg. (E. Coli)
- 2 per. Mov. Avg. (Flow)

Date:
- 7/6
- 7/26
- 8/15
- 9/4
- 9/24
- 10/14
- 11/3
- 11/23
Correlation of E. Coli vs Flow in the Walloomsac River

- Correlation: 0.8789538
- \( R^2 = 0.7726 \)
- P Value: 0.000166
Could the temperature of the water effect the water quality?
Relationship Between Water Temp. and E. Coli Over Time in the Walloomsac River

Graph showing the relationship between water temperature and E. Coli over time in the Walloomsac River. The graph indicates a trend where E. Coli levels decrease as water temperature increases over time.
Correlation of Ecoli vs. Water Temp in the Walloomsac River

Correlation: .610384
Correlation w/o Outlier: .850525
R² = 0.3726
P Value: 0.03504
Relationship Between Water Temp and E. Coli Over Time at Furnace Brook

Water Temp (°C) vs E. Coli (MPN)

- Blue line: 2 per. Mov. Avg. (Water Temp)
- Red line: 2 per. Mov. Avg. (E. Coli)
- Water temp and E. Coli values over time.
Correlation of E Coli vs Water Temp at Furnace Brook

Correlation: 0.565649

Correlation w/o Outlier: 0.937679

R² = 0.32

P Value: 0.035009

E Coli

Water Temp (°C)
• Water Flow and Water Temperature clearly play a role in the water quality of a river or stream.
• Underneath the rocks, macro invertebrates are living with the effects of human impacts on the environment.

How do macro invertebrates react to water quality? What observations can be made by studying the diversity of the rivers?
Macro Invertebrate Percent Composition in the Walloomsac River

- Ephemeroptera: 14%
- Plecoptera: 2%
- Tricoptera: 14%
- Amphipoda: 4%
- Diptera: 15%
- Coleoptera: 10%
- Bivalva: 10%
- Oligochaeta: 0%
- Odonata: 1%
- Nematomorpha: 1%
- Chironomidae (Midges): 29%
- Caddisfly (Midges): 14%
- Truefly (Worms): 15%
- Beetle (Worms): 10%
- Worms (Worms): 10%
- Midges (Worms): 1%
Macro Invertebrate Percent Composition in Furnace Brook

- **Diptera**: 23%
- **Tricoptera**: 16%
- **Coleoptera**: 7%
- **Ephemeroptera**: 2%
- **Plecoptera**: 0%
- **Oligochaeta**: 0%
- **Hirundinea**: 1%
- **Amphipoda**: 1%
- **Nematoda**: 1%
- **Other**: 1%
- **Bivalva**: 7%
- **Chironomidae**: 0%

**Groups**:
- **Worms**: 16%
- **Stonefly**: 16%
- **Mayfly**: 24%
- **Beetle**: 7%
- **Caddisfly**: 18%
- **Truefly**: 7%

**Legend**:
- Blue: Diptera
- Brown: Tricoptera
- Green: Coleoptera
- Purple: Ephemeroptera
- Teal: Plecoptera
- Orange: Oligochaeta
- Dark Green: Hirundinea
- Red: Amphipoda
- Gray: Nematoda
- Brown: Other
- Green: Bivalva
- Orange: Chironomidae
Furnace Brook
Biological Assessment Profile

Water Quality Scale

Walloomsac River

Replicate#

Water Quality Impact
Non-slight
moderate
severe

Family EPT FBI PMA Mean

0 1 2 3 4 5 6 7 8 9 10

2.5 5 7.5 10

0 2.5 5 7.5 10
• There is a strong relationship between the flow of a stream and its water quality.
• The Walloomsac River had a stronger flow due to its in-town channelization and its amount of tributaries upstream.
• The Walloomsac River had a stronger flow, but its water quality was worse than Furnace Brooks. Its lack of a buffer zone, direct pollution, and runoff from impervious surfaces made its water quality worse.
• Furnace Brook was much slower and more natural because it wasn’t strongly altered by the town.
• Since Furnace Brook wasn’t channeled or altered, its banks are still sturdy and runoff from impervious surfaces isn’t a problem.
Flow was a good indicator of water quality, and the faster the flow was the worse the water quality was in general. However, there were situations when the flow didn’t relate to the water quality, such as the TSS vs Flow in the Walloomsac River and the E. Coli vs Flow in Furnace Brook. Temperature had a very strong relationship with the amount of E. Coli in both rivers. The warmer the water was, the more E. Coli thrived. It is tough to determine if temperature or flow has a stronger relationship with the water quality from just these two streams, and only E. Coli was compared to the temperature of the water.

The macro invertebrates in both streams were good, but the Walloomsac River was slightly more impacted. Perhaps the reason for this was because the Walloomsac had worse spikes in pollution levels especially during storms. When it rained, chemicals in town and fertilizers upstream may have washed into the river damaging the water quality and affecting macro invertebrates. The difference in macro invertebrate quality is better in the Furnace Brook because spikes in pollution are minor.
Future Ideas

• The Walloomsac River is healthy but threats are present.
• Channeling of the Walloomsac River should be prevented as much as possible.
• Banks should be upheld and buffer zones need to be maintained to prevent further runoff and erosion.
• Farmers upstream should also be notified to keep their animals out of the river and to try and keep pesticides out of water as much as possible.
Thank You!

• Mr. Rosenthal
• All Members of Vermont EPSCoR - Organizers, teachers, and students.
• Saint Michaels College
• University of Vermont
• Parents
• Any others who have helped make our study possible/better