

**Volunteer Biological Assessment Program  
Stream Data Collection Report for the Saco Watershed  
2024**



**Macroinvertebrate sorting stations at Cold River in North Sandwich, NH**

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## **Acknowledgements**

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### **Volunteers & Staff**

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Volunteers: Elena Piekut, Elaine Swett  
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### **Participating School Groups:**

Effingham Elementary School  
Ossipee Central School  
Lakeside Elementary School  
Sandwich Central School  
Kenneth A. Brett School

### **Community Partners:**

The Other Bakery  
Scissors of Oz  
US Forest Service

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## **Introduction**

Since 1997, the New Hampshire Department of Environmental Services (DES) has conducted stream surveys to determine the health of aquatic ecosystems. As part of these efforts, DES developed a preliminary screening protocol for 1<sup>st</sup> through 4<sup>th</sup> order streams that is appropriate for volunteers to evaluate the biological condition of aquatic macroinvertebrate communities. The goals of the protocol are as follows:

- To educate the public about water quality issues as interpreted through biological assessments;
- To build a constituency of individuals who will practice sound water quality management at the local level; and
- To build public support for water quality protection.

Since 2006, Green Mountain Conservation Group (GMCG) has collaborated with DES, NH Fish & Game Department, and local volunteers and schools for the Volunteer Biological Assessment Program (VBAP). While NH DES no longer oversees the program “due to lack of staff support” according to David Neils, Chief Aquatic Pollution Biologist, GMCG continues to offer the VBAP program to schools in the Ossipee Watershed for educational purposes following the recommendation of NH DES and NH Fish & Game Department. In recent years, the program has expanded to additional schools and sites outside of the Ossipee Watershed, including parts of the Saco River Watershed in Conway, NH and Porter, ME.

In 2024, GMCG worked with students and teachers from five local schools across the Saco Watershed in New Hampshire to collect, sort, and analyze macroinvertebrates at four sites. This report contains the results of that sampling, along with additional data analysis which compares sites across the watershed over time as some of these sites are sampled year-round for GMCG’s RIVERS (Regional Interstate Volunteers for the Ecosystems and Rivers of Saco) program. As monitoring continues, data will continue to be evaluated and analyzed for any trends or water quality issues.

Due to elementary school restructuring in the Conway school district in 2024, Pine Tree Elementary School participated in the program as Lakeside Primary School with 60 kindergarteners this year instead of their typical 30-40 sixth graders. The program was adapted to engage these much younger students in understanding about the importance of protecting water quality and using macroinvertebrates as bioindicators of water quality, however, students did not sample the Swift River in Conway as they had in the past due to the younger age of students and safety concerns for being on the river. Overall, the program engaged over 250 people in 2024, including students, teachers, chaperones and volunteers.

## **Methods**

Prior to sampling, a training was held in May at GMCG’s Conservation Center for AmeriCorps members, GMCG staff, teachers, and interested members of the public. A training session was also held at each school for students and consisted of the following topics: macroinvertebrate identification; biomonitoring and macroinvertebrate tolerance levels; macroinvertebrate sampling protocols; watersheds; riparian ecosystems; and aquatic food chains. Additionally, student volunteers were trained to collect and record supplementary data for

physical and chemical parameters of the rivers/streams, including: habitat assessments; stream measurements; pH; conductivity; temperature; and dissolved oxygen.

In 2024, GMCG staff and AmeriCorps members also incorporated microplastics sampling as part of the program for the fourth year. Students were introduced in the classroom to the concept of microplastics in the environment and were able to collect water samples during the field day which were later analyzed in GMCG's water quality lab. Students collected a sample by placing a plankton net in an area with moving current. The net was left in the current for at least five minutes, and was retrieved. A water sample was then collected and transferred to a glass storage container. In the GMCG lab, 100 mL of each sample was filtered through a Buchner funnel with a 0.45  $\mu\text{m}$  filter. After filtering, the filter paper was transferred to a glass plate for observation. This was done twice. The first sample was examined by students in their classroom using a white light microscope. 10 mL of 10 $\mu\text{g}$  Nile Red solution was added to the second sample. This sample was then examined in the GMCG water quality lab using a microscope equipped with blue light and an orange filter. Under these lighting conditions, nonpolar particles (i.e. plastic) treated with Nile Red will appear fluorescent.

### **Sampling Sites**

All four sampling sites were accessible, wadeable, approximately 200 feet in length, 1<sup>st</sup> through 4<sup>th</sup> order streams and contained appropriate sampling habitat (at least one riffle, one pool, and one run with mixed cobble substrate).

Additional sites are sampled from spring through fall for GMCG's Regional Interstate Volunteers for the Ecosystems and Rivers of Saco (RIVERS) program, and have been periodically sampled by school groups in the past for VBAP. While some schools sample their adopted VBAP site annually, some are on a biennial schedule due to combined classes. Sampling was scheduled throughout September and October and required three to four hours per site.

### **Data Collection**

The data collection at each site and along the stream followed the same protocol. The protocol was as follows:

- A 500-micron mesh kicknet was placed perpendicular to stream flow and held firmly against the streambed with the opening of the net facing upstream to promote macro invertebrate collection.
- A collector would disturb the sample area (1/5 m<sup>2</sup>) upstream of the net for a total of 60 seconds (30 second hand-scrub followed by a 30 second kick).
- The kicknet was carefully lifted out of the water and the contents of the net were emptied into a shallow container with a small amount of water. All organisms remaining on the net were carefully removed and added to the sample.
- The same process was repeated four additional times with each sample collected further upstream (spanning 200 feet). Collectively, active sampling time approximated five minutes within one square meter area at each sampling station.

## Macroinvertebrate Sorting and Identification

For 60 minutes, student volunteers, teachers and/or staff removed macroinvertebrates from the selected portion of the sample with spoons or pipettes and placed them into separate containers according to common attributes. After sorting, specimens were identified to its respective taxonomic group. The number of macroinvertebrates within each taxonomic group was identified, calculated, and recorded, as seen in Table 1. Students were assisted by GMCG staff and/or trained volunteers with the process of identifying the macroinvertebrates in the sample.

**Table 1.** Total Macroinvertebrates Found Across the Ossipee Watershed in 2024. For individual site macroinvertebrate counts, see Appendix A.

Order	Common Name	Number of Macroinvertebrates
Ephemeroptera	Mayfly nymph	369
Plecoptera	Stonefly nymph	138
Trichoptera	Caddisfly larvae	244
Odonata	Dragonfly larvae	6
	Damselfly nymph	0
Diptera	Black fly larvae	8
	Midge larvae	7
	True flies	16
Megaloptera	Alderfly	0
	Hellgrammite	6
Coleoptera	Riffle Beetle	46
	Water Penny	1
	Beetle/Beetle like	0
Other	Crayfish	1
	Snails	0
	Aquatic Worms	5
	Scuds	1
	Sowbug	0
	Leech	0
	Water Mites	4
	Planaria	0

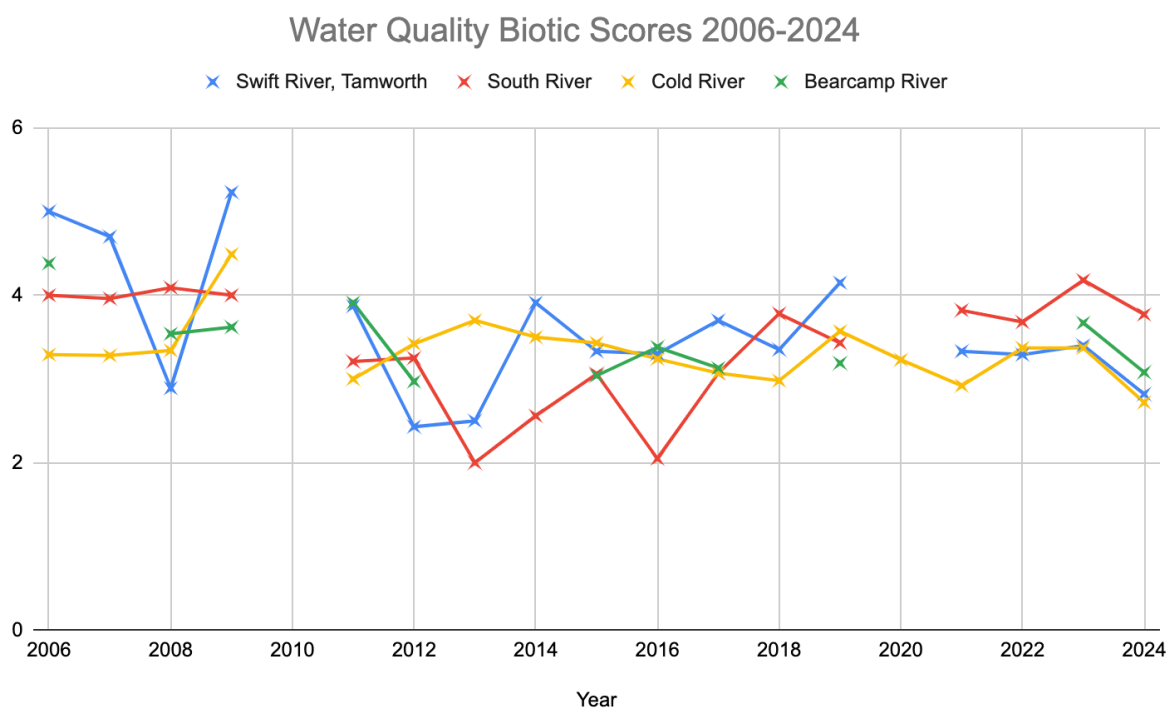
## Biotic Index Computation

Biotic scores are based on pollution tolerance values ranging from 0 to 9 and are assigned to individual taxonomic groups. More tolerant groups have higher tolerance values and less tolerant groups have lower values. A standardized computational worksheet was used to compute the biotic scores for each sample site (stream/river). Taxonomic-specific biotic scores for individual samples were computed by multiplying the number of individual organisms by their respective tolerance value; summing the taxonomic-specific biotic scores; and then dividing the sum by the total number of individuals identified in the respective sample. Final biotic scores (see Table 2) correspond to three narrative categories:

- Excellent (0 to 3.5)
- Good (3.5 to 4.8)
- Fairly Poor (greater than 4.8).

**Table 2.** Biotic Scores of Sampling Sites. Table 2 highlights the biotic score and the narrative category for each sampling site tested in the Ossipee Watershed. Three of the four scores fell in the “Excellent” category while one fell in the “Good” category.

School Group	Date	Location	Town	Total Number of Macros	Biotic Score	Water Quality Score
Effingham Elementary	9/27/24	South River	Parsonsfield, ME	250	3.77	Good
KA Brett School	9/30/24	Bearcamp River	Tamworth, NH	146	3.08	Excellent
Sandwich Central School	10/04/24	Cold River	Sandwich, NH	221	2.72	Excellent
Ossipee Central School	10/02/24	Swift River	Tamworth, NH	232	2.82	Excellent



**Figure 1.** Water Quality Scores. The graph shows changes in water quality scores over time at the sites sampled in 2024 and in years past.

### Supplementary Data

The water chemistry and physical parameters of the stream were recorded. Physical parameters recorded included width/depth of the stream, canopy cover, observations of nearby erosion or human influence, pH, conductivity and temperature. A multi-parameter submersible Hach water quality probe was used to collect pH, dissolved oxygen, conductivity and temperature data (see Table 3). Microplastics samples were collected using a standard plankton net.

### Water Quality Results

Basic water quality data were collected at each of the sampling locations. The data included chemical parameters, physical parameters, and calculating a biotic score for each of the sampling sites. Macroinvertebrate samples from each site were evaluated using the VBAP biotic score index utilizing taxa-specific tolerance values. A cumulative biotic score for all sites and individual site-specific biotic scores were computed. The average biotic score for all sites was 3.10 and corresponds to the “Excellent” narrative category. Overall, mayfly nymphs were the most dominant taxon with 369 identified(43.4%), followed by caddisfly larvae at 244 (28.7%) and stonefly nymphs at 138 (16.2%). Together, these three taxa comprised nearly 89% of all the individuals collected and are some of the least tolerant taxonomic groups. In completing the sampling effort, volunteers collected and staff identified 852 macroinvertebrates (See Table 1).



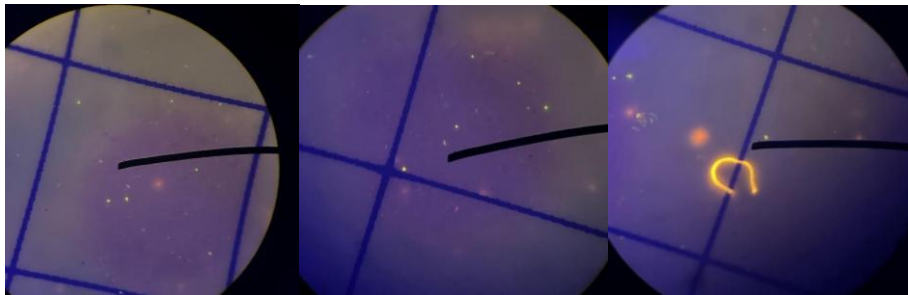
**Table 3.** Physical & Chemical Parameters of Sampling Sites

Physical & Chemical Parameters	pH	Dissolved Oxygen (mg/L)	Conductivity ( $\mu\text{S}/\text{cm}$ )	Temperature ( $^{\circ}\text{C}$ )	Turbidity
Normal Range/Optimal Value	6.0-8.0	5 and above	Below 100	Below $21^{\circ}\text{C}$ for trout/mayfly nymphs	Below 10 NTUs
South River	6.74	6.88	73.9	14.1	2.28
Cold River	7.14	10.17	28.1	11.9	.29
Swift River (Tamworth)	7.35	10.07	35.9	12.0	.29
Bearcamp River	7.11	9.69	38.4	14.5	.72

Dissolved oxygen, pH, conductivity, temperature and turbidity were conducive to supporting aquatic life at all sites.

Evidence of microplastics was found at all of the four sampling sites from samples collected by the students using plankton nets (see Figure 2).

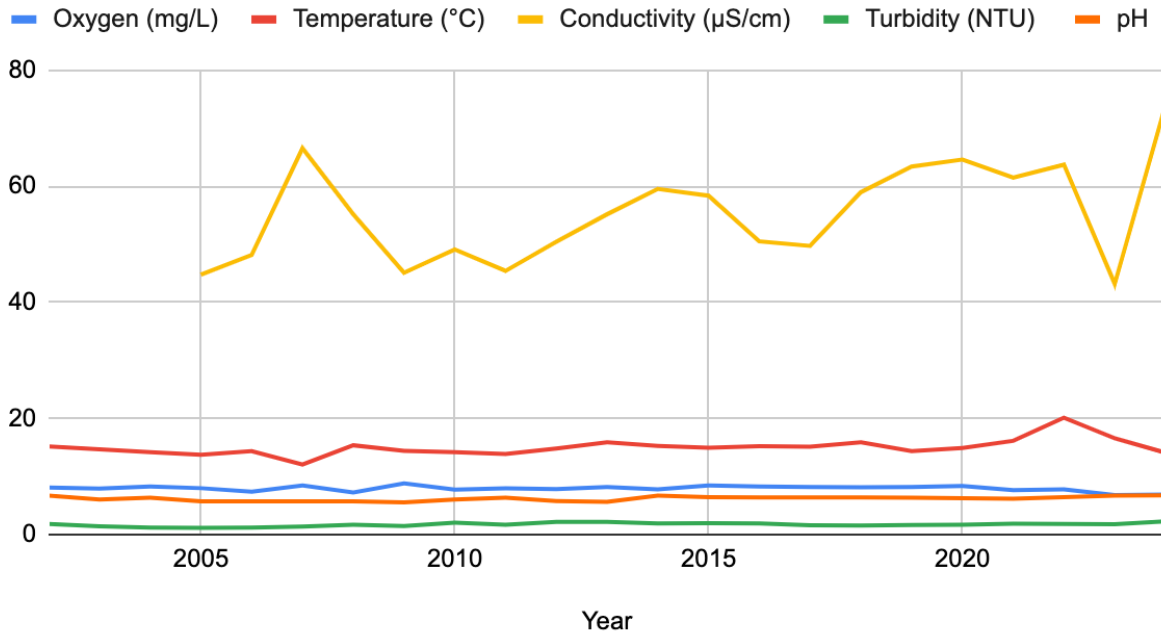
**Figure 2.** Evidence of microplastics was found at each of the four sites. From left to right these images show microbeads, micro fragments, and a microfilament of plastic collected from Bearcamp River in Tamworth.



Conductivity is a measure of the concentration of dissolved salts in water. Conductivity levels are not a concern to the EPA (Environmental Protection Agency) unless they rise above  $500 \mu\text{S}/\text{cm}^2$  for rural areas or  $1500 \mu\text{S}/\text{cm}^2$  for urban areas, according to Jill Emerson, GMCG's Water Quality Coordinator. For reference, seawater has a specific conductance of  $55,000 \mu\text{S}$ . NH DES states that conductivity levels in freshwater bodies across the state are rising, in general, mostly due to road salting, faulty septic systems and urban/agricultural runoff (NHDES, 2004). While conductivity levels across all VBAP sampling sites remain low, conductivity levels at South River are slightly elevated and data shows a steady increase in the median annual conductivity in the South River over the past twenty years. Trend line analysis of historical data taken from GMCG's RIVERS program demonstrates that conductivity levels at this site are slightly increasing over time, likely due to road salting activities (see Figure 3).

**Figure 3.** South River chemical and physical data trends from 2002 - 2024. The analysis shows a steady increase in the median annual conductivity in the South River over the past twenty years. A dip in conductivity levels can be seen for 2023, this trend is seen across all RIVERS sites. The decline is most likely due to the high amounts of rain in 2023, resulting in dilution of the salts.

### South River Chemical and Physical Data 2002-2024



New Hampshire’s freshwater lakes, streams and groundwater are becoming saltier each year. The leading cause is the 400,000 tons of road salt applied every winter to our Interstates, state highways, town roads and other surfaces. Salt is toxic to aquatic life and plants, it corrodes bridges and vehicles, and when it accumulates in drinking water it jeopardizes human health. To bring this issue of rising conductivity levels to the attention of Ossipee Watershed towns, GMCG has co-hosted workshops such as Green SnowPro with UNH T2 Center, NH DES and NH Department of Transportation to train area road agents and plow drivers on efficient use/spreading of salt, helping educate those on the front lines about the importance of not over-salting our freshwater ecosystems. In 2024, the Green SnowPro program is expanding to include a Municipal Green SnowPro program so that municipal employees can also get certified through the program. Information and the guidance documents that go into detail about certification requirements are on [Municipal Green SnowPro Certification | NH Department of Environmental Services](#).

Green Mountain Conservation Group also launched the Salt Responsibly campaign in January 2022 to inform New Hampshire residents about the harm caused by road salts and to provide guidance on ways to reduce the amount of salt that is contaminating New Hampshire’s waterways and water supply. Visit [saltresponsibly.com](http://saltresponsibly.com) for more information.

The Salt Responsibly campaign is not about casting blame. We recognize that safety is the first priority of those responsible for winter road maintenance, and until the day that practical alternatives are widely available, road salt use will continue. What we seek is a broader public understanding of the problem and to inspire everyone to make changes that will reduce the amount of salt that is damaging our environment, threatening our health, and hurting our economy.

For more detailed water quality analyses on the water bodies in the Ossipee Watershed, please see the 10 Year Water Quality Report (GMCG, 2015) or town reports as recent as 2022: <http://www.gmcg.org/research/water-quality-program-data/>. The SRCC's water quality report of data from 2001 through 2020, published in 2021, is also available: [https://srcc-maine.org/wp-content/uploads/2022/01/SRCC\\_2020WQManalysis\\_FBE\\_FinalDraft.pdf](https://srcc-maine.org/wp-content/uploads/2022/01/SRCC_2020WQManalysis_FBE_FinalDraft.pdf).

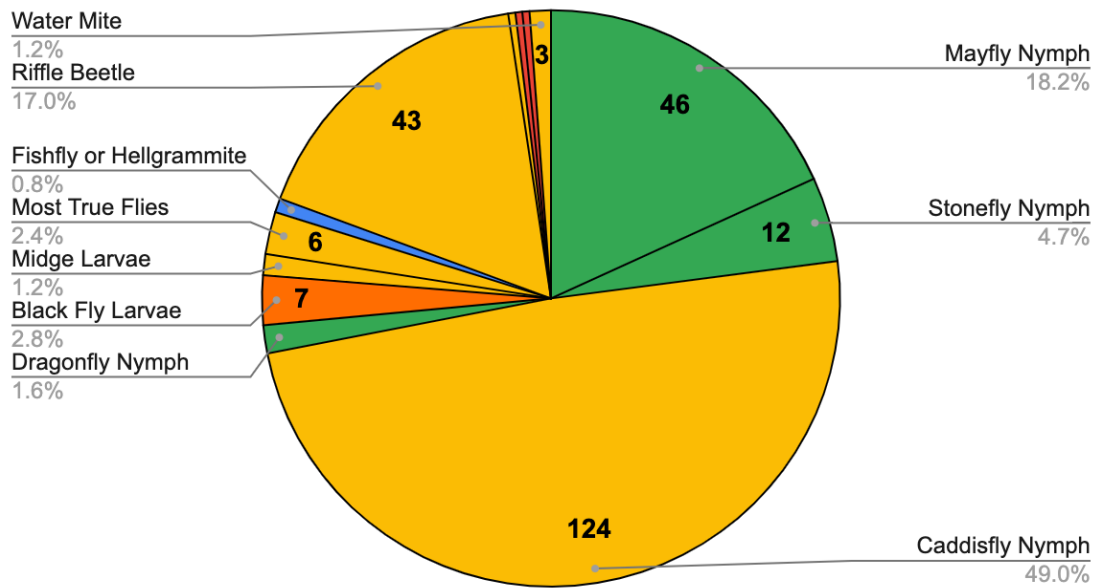
### **Future Recommendations**

The documentation of the aquatic invertebrate communities by volunteers using the VBAP protocol during the fall of 2024 in the Saco Watershed marked the nineteenth year of 'screening' efforts to evaluate the status of aquatic communities. Sampling efforts included four sites in the Saco Watershed. Macroinvertebrates are widely used as indicators of water quality that can show the effects of multiple pollutants over time. It is important to recognize that the results obtained from the VBAP protocol are not intended to represent formal water quality assessments, but rather a basic indicator of aquatic community condition. Ultimately, the results from the VBAP for 2024 build upon the efforts conducted by GMCG, NH DES and NH Fish & Game to establish reference sites in the state, compare sites across the state, and provide watershed education to youth. The results of the program serve as a basis for further monitoring and management practices to be put into use throughout the watershed. Schools also use their VBAP data for the Trout in the Classroom program to make sure the water quality conditions and macroinvertebrates at their release sites are adequate to support Eastern brook trout. These data are in fact required by NH Fish and Game in order to issue schools permits for the program.

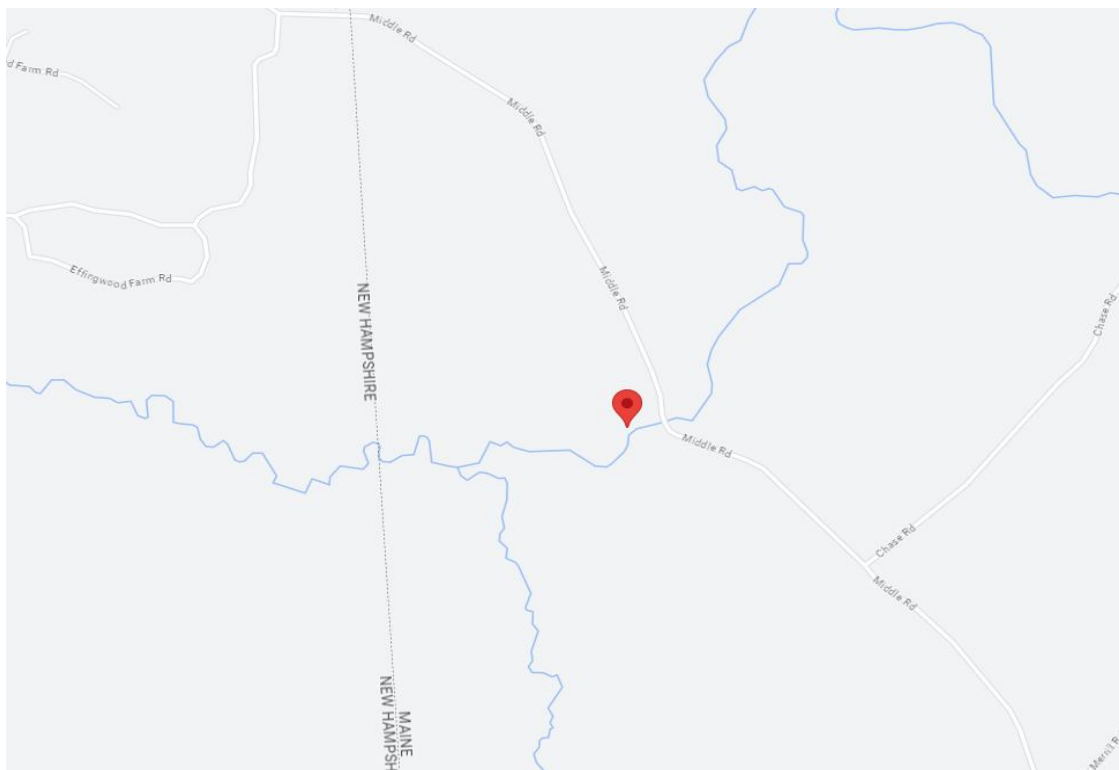
The Saco Watershed has a reputation for having great water quality overall and the VBAP results validate this statement. It is recommended that GMCG continue to work with schools in the Saco Watershed and continue to monitor the water quality of the local streams and rivers. Biotic scores for sites sampled in 2024 ranged from good to excellent, and continued monitoring will be essential to track any water quality changes over time. The long-term health of surface waters will depend on preventing potential sources of contamination from entering water bodies and using best management practices that reduce or prevent adverse impacts from human activities, such as road salting. Sites where human activities appear to be impacting water quality should be monitored closely for potential sources of contamination, and road salting alternatives should be sought. In addition, continued monitoring for microplastics pollution is recommended as a means of educating students about the importance of reducing plastic use and the local impacts of this global problem.

## Appendix A: Macroinvertebrate Total Charts and Site Maps

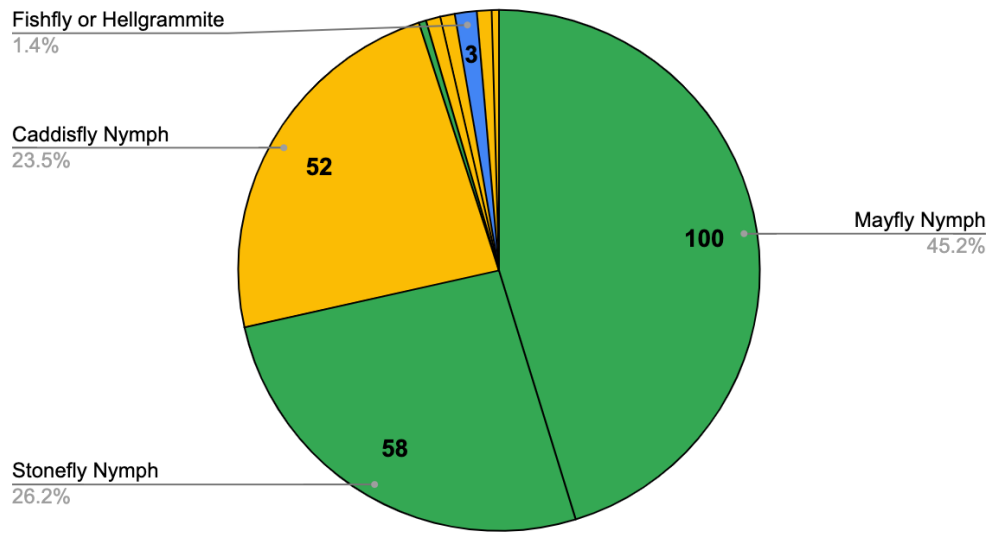
### Effingham Elementary School's Total Macros



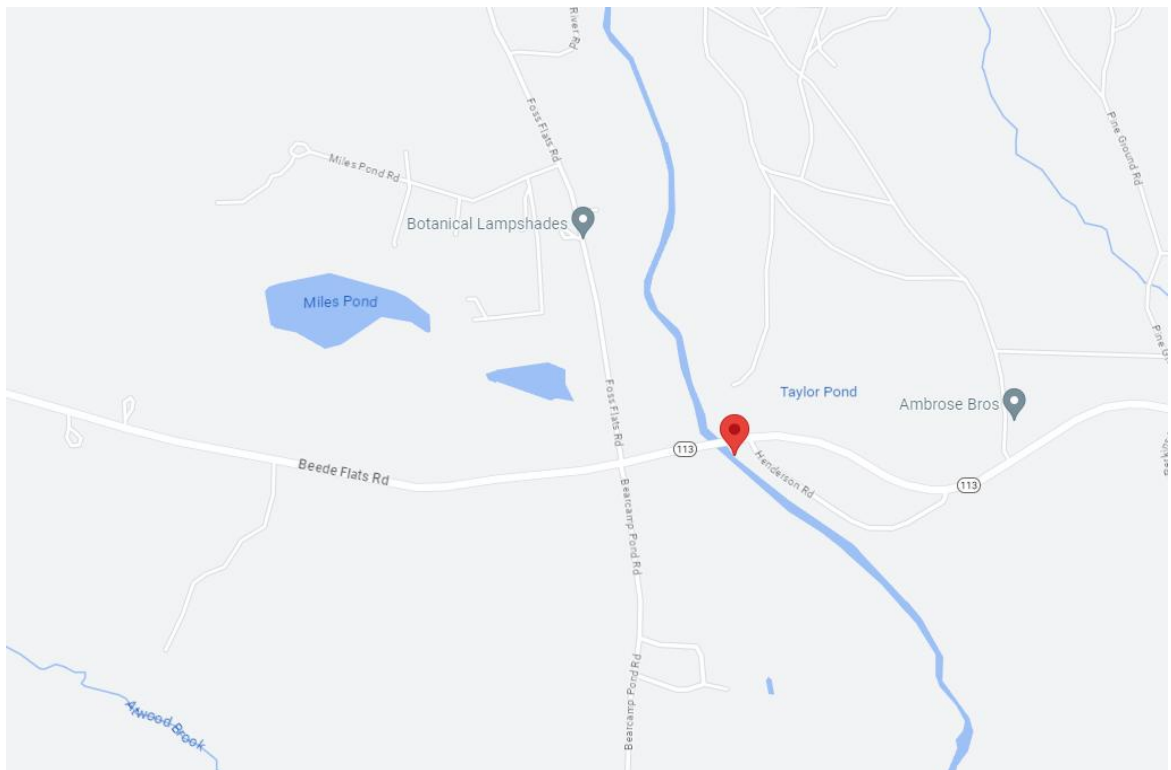
(Above) Total macroinvertebrates found at South River in Parsonsfield, ME (Below)



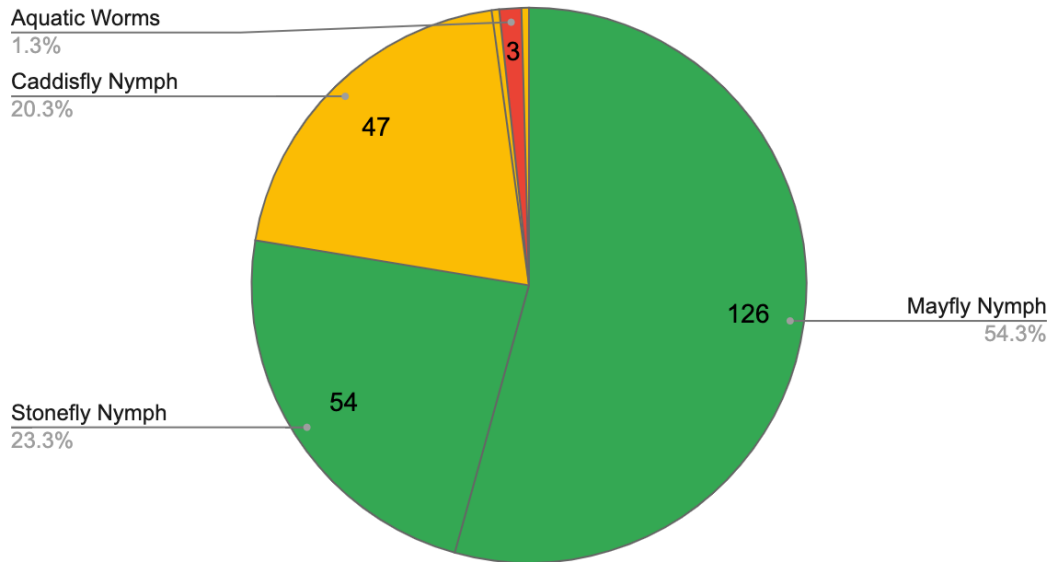
## Sandwich Elementary School's Total Macros



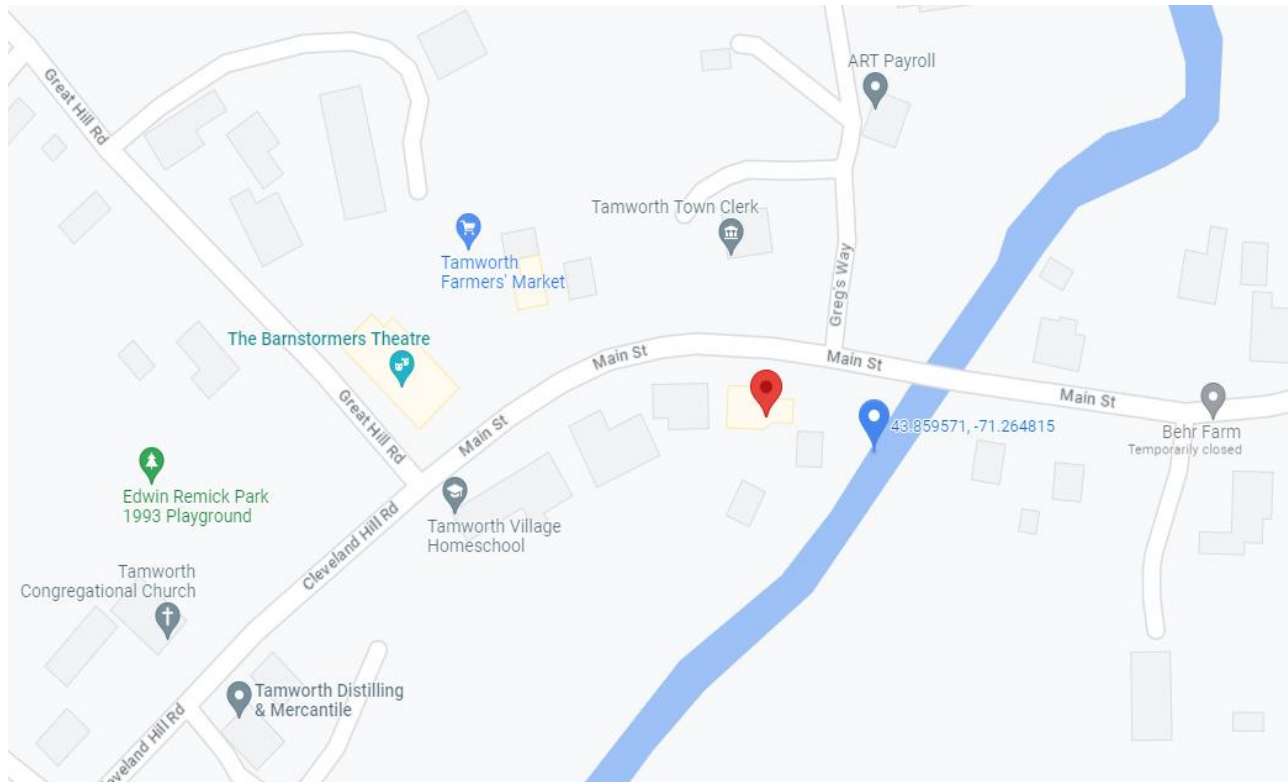
(Above) Total Macroinvertebrates found at Cold River in Sandwich, NH (Below)



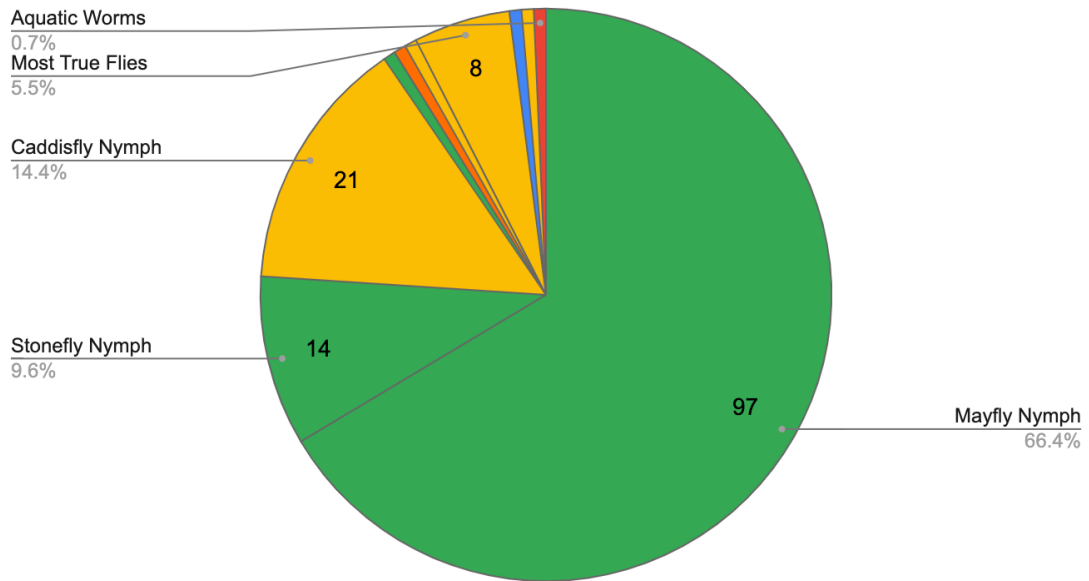
## Ossipee Central School's Total Macros



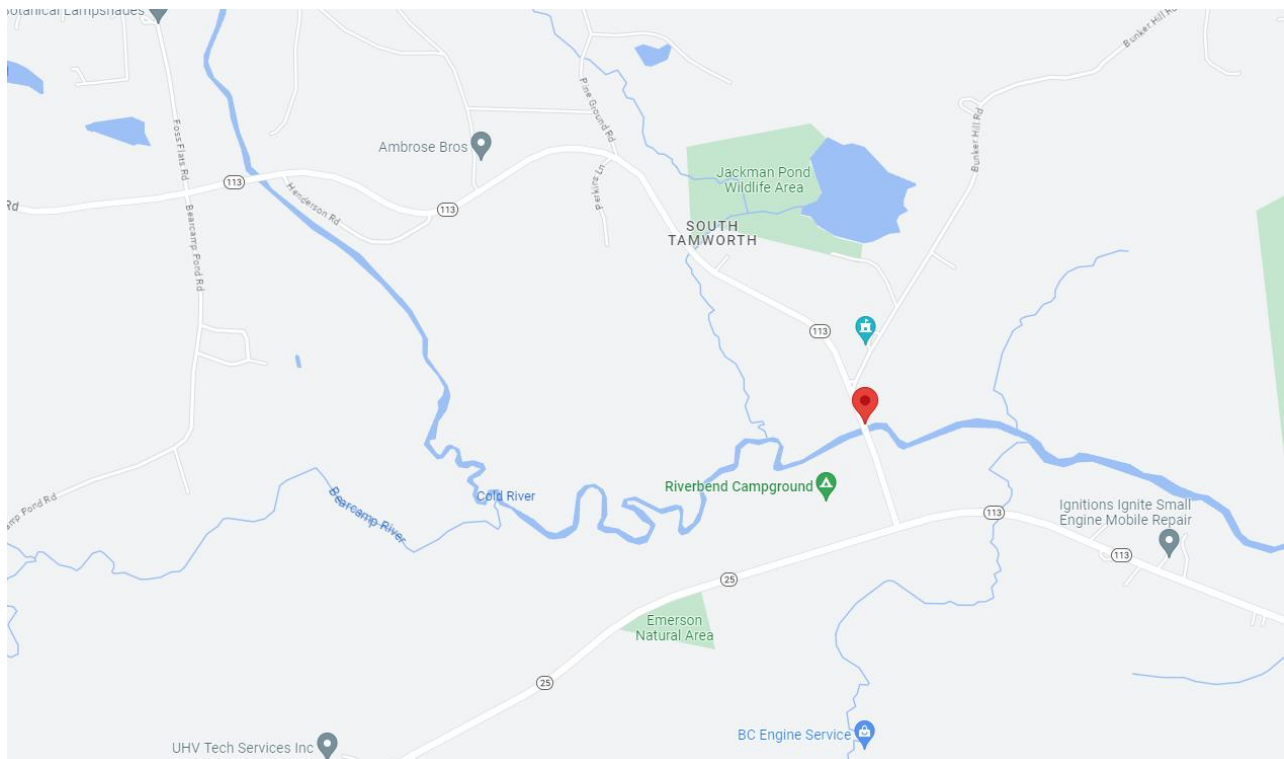
(Above) Total macroinvertebrates found at Swift River in Tamworth, NH (Below)



### KA Brett School's Total Macros



(Above) Total macroinvertebrates found at Bearcamp River in Tamworth, NH (Below)



## Appendix B: Site Data Sheets

### South River, Parsonsfield, ME

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	46	=	138		
Plecoptera	Stonefly Nymph	1	*	12	=	12		
Trichoptera	Caddisfly Larvae	4	*	124	=	496		
Odonata	Dragonfly Nymph	3	*	4	=	12		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	7	=	49		
	Midge larvae	6	*	3	=	18		
	Most True flies	4	*	6	=	24		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	2	=	0		
Coleoptera	Riffle beetle	4	*	43	=	172		
	Water Penny	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	1	=	6		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	1	=	8		
	Scuds	8	*	1	=	8		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	7		
	Water Mites	4	*	3	=	12		
<b>Totals</b>				<b>253</b>		<b>955</b>	<b>3.77</b>	<b>Good</b>



## Cold River, Sandwich, NH

Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	100	=	300		
Plecoptera	Stonefly Nymph	1	*	58	=	58		
Trichoptera	Caddisfly Larvae	4	*	52	=	208		
Odonata	Dragonfly Nymph	3	*	1	=	3		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	0	=	0		
	Midge larvae	6	*	2	=	12		
	Most True flies	4	*	2	=	8		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	3	=	0		
Coleoptera	Riffle beetle	4	*	2	=	8		
	Water Penny	4	*	1	=	4		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	0	=	0		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
<b>Totals</b>				<b>221</b>		<b>601</b>	<b>2.72</b>	<b>Excellent</b>

## Swift River, Tamworth, NH

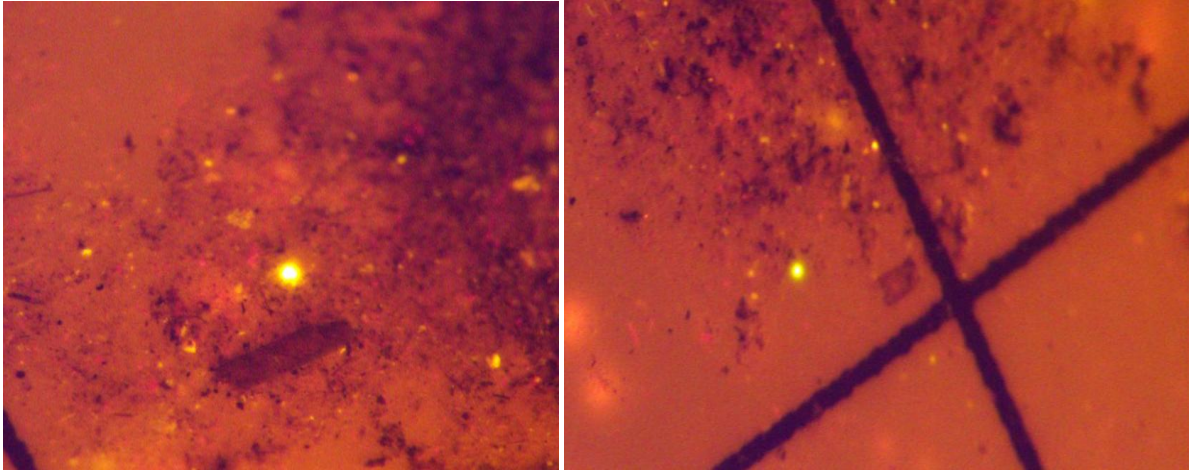
Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	126	=	378		
Plecoptera	Stonefly Nymph	1	*	54	=	54		
Trichoptera	Caddisfly Larvae	4	*	47	=	188		
Odonata	Dragonfly Nymph	3	*	0	=	0		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	0	=	0		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	0	=	0		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	0	=	0		
Coleoptera	Riffle beetle	4	*	0	=	0		
	Water Penny	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	3	=	24		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
	Water Mites	4	*	1	=	4		
<b>Totals</b>				<b>232</b>		<b>654</b>	<b>2.82</b>	<b>Excellent</b>

## Bearcamp River, Tamworth, NH

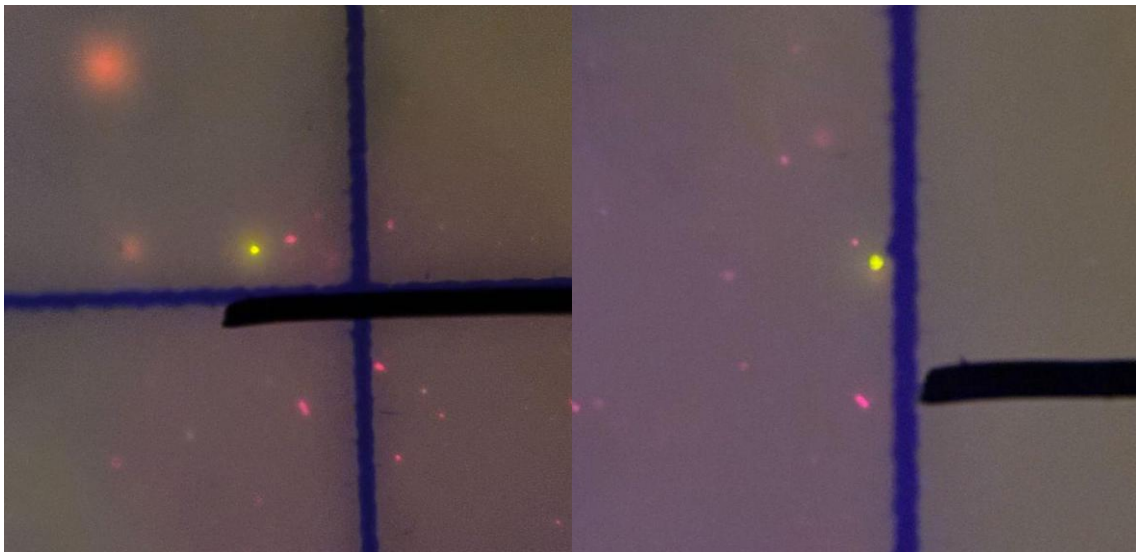
Order	Common Name	Value	*	Found	=	Score	Score	Category
Ephemeroptera	Mayfly Nymph	3	*	97	=	291		
Plecoptera	Stonefly Nymph	1	*	14	=	14		
Trichoptera	Caddisfly Larvae	4	*	21	=	84		
Odonata	Dragonfly Nymph	3	*	1	=	3		
	Damselfly Nymph	7	*	0	=	0		
Diptera	Black fly larvae	7	*	1	=	7		
	Midge larvae	6	*	1	=	6		
	Most True flies	4	*	8	=	32		
Megaloptera	Alderfly	4	*	0	=	0		
	Hellgrammite	0	*	1	=	0		
Coleoptera	Riffle beetle	4	*	1	=	4		
	Water Mite	4	*	0	=	0		
	Beetle & Beetle-like	7	*	0	=	0		
Others	Crayfish	6	*	0	=	0		
	Snails	7	*	0	=	0		
	Aquatic Worms	8	*	1	=	8		
	Scuds	8	*	0	=	0		
	Sowbugs	7	*	0	=	0		
	Clams and Mussels	7	*	0	=	0		
<b>Totals</b>				<b>146</b>		<b>449</b>	<b>3.08</b>	<b>Excellent</b>

**Appendix C: Microplastics Photos**

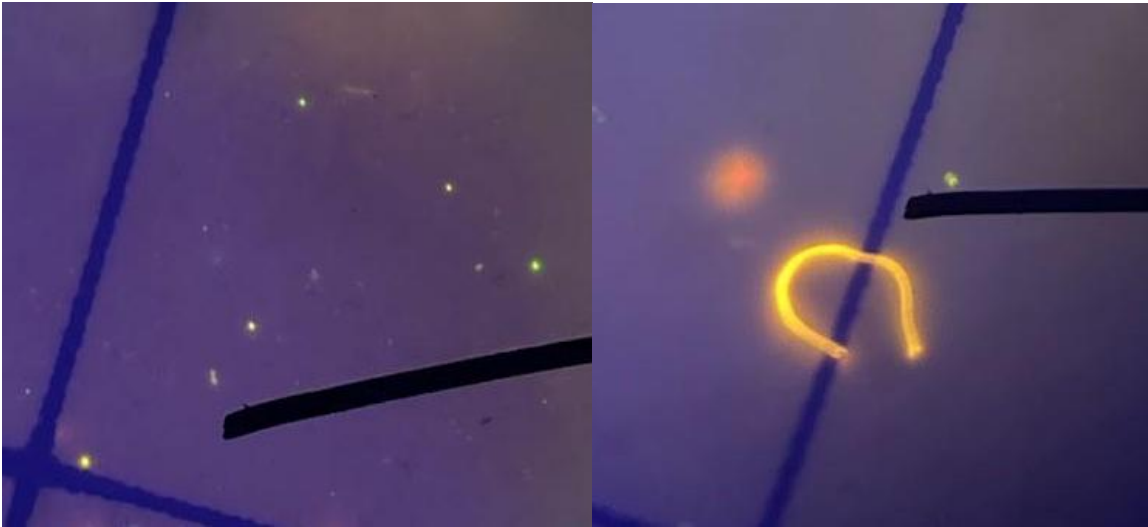
**South River, Parsonsfield, ME**



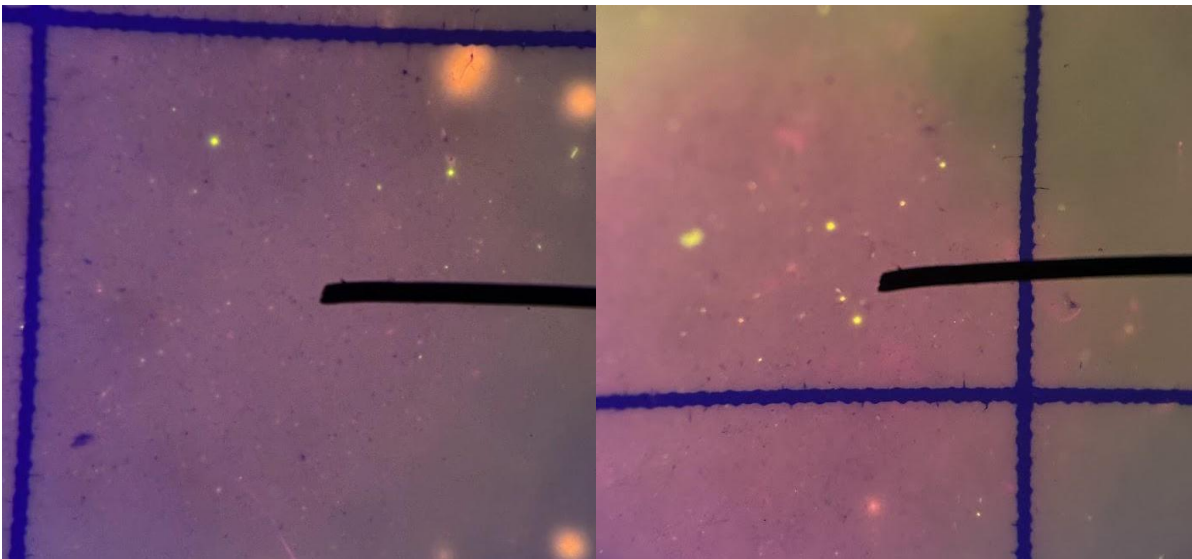
**Cold River, Sandwich, NH**



**Bearcamp River, Tamworth, NH**



**Swift River, Tamworth, NH**



## Appendix D: Works Cited

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