Water Quality of the Grasse River & Little River in Canton: Historic Background, Pollution Concerns, and Current Water Monitoring Efforts

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Abstract

Beginning in November 2023, St. Lawrence University became a host site for the Campus Compact Campus Climate Action Corps AmeriCorps project. As part of this project, AmeriCorps member Evelyn Laferriere worked closely with Nature Up North to begin the process of re-establishing a community science water quality monitoring project on the Grasse and Little Rivers. Historic information about land use and previous water quality data was compiled. Community concerns regarding road salt, agricultural, and other pollutants were taken into account. Preliminary data was collected using a Hydrolab instrument in January, with follow up testing in March and April. This data does not include testing for common agricultural runoff pollutants like Nitrogen and Phosphorus. Data collected was compared with New York State Department of Environmental Conservation data, along with information from previous research. The data collected by our team does not appear to indicate any high levels of contamination; however, community data collected with Nature Up North test kits in the future will be able to provide further insight into agricultural and other potential pollutants. Research by other teams also indicates concern regarding microplastic contamination. While pollutant concerns from community members are valid, as indicated by previous research and studies ongoing by other teams, more monitoring needs to be completed to determine the extent of road salt and agriculture pollution in the Grasse and Little Rivers in Canton.

Land Acknowledgment

St. Lawrence University and the Village of Canton lie on the traditional territory of the Kanien'keha:ka community of the Haudenosaunee people and their ancestors, who have been stewards of this land since time immemorial. The authors of this paper acknowledge that they are settlers on this unceded land, and they recognize and respect the connections Indigenous peoples have to the Grasse River and its surrounding lands and waterways.

Introduction

In November 2023, St. Lawrence University became a host site for the Campus Compact Campus Climate Action Corps (CCAC) AmeriCorps project. CCAC strives to build the capacity of campuses and community partners to create change leading to increased energy efficiency and improvements for at-risk ecosystems via local solutions for underserved households and communities (Campus Compact, 2021). To meet CCAC's goal of improving at-risk ecosystems, Michael Iversen (St. Lawrence Assistant Director of Sustainability & Energy Management) proposed a water quality monitoring project on the Grasse and Little Rivers, located in Canton, New York. Public concern regarding nutrient runoff and agricultural contamination, as well as road salt impacts, has been raised to the Village of Canton Sustainability Committee. While the New York State Department of Environmental Conservation (NYSDEC) has taken water quality samples from both rivers (as detailed in the Background section below), data is outdated, and the rivers were not monitored over the long term. The CCAC monitoring project aims to fill this data gap, better understand the health of these two rivers, identify any threats posed to the health of local community members, and to educate and involve community members in local water quality.

To implement this project, Evelyn Laferriere, the AmeriCorps Climate Action Leader hosted on campus through the CCAC project, established a partnership with Nature Up North. Nature Up North is a community-based organization housed at St. Lawrence University. Their mission is "to foster a deeper sense of appreciation for, and connection to, the North Country environment and in doing so to create a bioregionally literate community that is committed to protecting the wild things and wild places that define this place we call home" (Nature Up North, 2024). Nature Up North had previously established the MOW the Grasse (Monitor Our Water) project, in which various community organizations were trained and assigned to monitoring locations. St. Lawrence's CCAC team and Nature Up North, along with two Community-Based Learning (CBL) students, worked during the spring semester to begin the process of reestablishing this project.

The water monitoring methods deployed by Nature Up North align with the NYSDEC Water Assessments by Volunteer Evaluators (WAVE) citizen science project. Once community partners are established and trained, data can be shared with NYSDEC for reporting purposes and to identify potential sites that require professional investigation (NYSDEC, 2024). This data would ideally be collected July through September. For the purposes of the CCAC project, an ArcGIS web map (see the Results section) of initial sampling data has been created as a method of sharing water quality information with the public in an interactive way. Nature Up North will continue the process of connecting with community volunteers and reestablishing community water quality monitoring. This report contains historical background, previous research, and initial sampling data. More work will need to be completed to answer concerns regarding road salt, agricultural, and other potential contaminants in the Grasse and Little Rivers.

Background

The Grasse River (often spelt "Grass") is located in St. Lawrence County. It, along with its tributaries, makes up one out of the six watersheds in the county (Washburn, 2024). The Little River is its largest tributary. The Grasse's headwaters are in the Adirondack foothills, and it empties into the St. Lawrence River in the town of Massena (2024). These headwaters are protected in the State Forest Preserve, however, the river itself is one of the United States' most polluted sites in Massena due to the Alcoa aluminum plant (Van de Water, 2020). The river begins in a forested area with a sparse human population and travels through dairy farmland and more heavily populated communities (Chiarenzelli et al., 2010). About 74-84% of St. Lawrence County is composed of forested land, with agricultural use making up 19-37% of land use (Murphy, 2011). The Canton Little River watershed consists of less than 3% wetlands, allowing for more agricultural use (2011). There is a dam on the Grasse in the town of Madrid, and a hydroelectric facility at Pyrites. Above Pyrites, NYSDEC classifies the Grasse as a cold-water fishery, and a warm-water fishery below Pyrites (Washburn, 2024).

Historic Land Use

Within the Village of Canton, Grasse River Heritage's Heritage Park and the Heritage Trail (Figure 1) are currently located on a site that experienced industry, floods, fire, and pollution (Grasse River Heritage, 2008). The first sawmill and gristmill was constructed on the western bank of the Grasse River in 1801 (2008). Looking first to the West Channel of the Grasse River, the Eagle Mill grist mill was constructed in 1842 (2008). This structure was four-stories, made of sandstone, and served as a mill until 1917. It was used as a warehouse until 1959, when it was demolished and replaced by a restaurant and motel (Grasse River Heritage, 2008). The three-story brick D.W. Sherwin Grist Mill was located on Falls Island across the river from Eagle Mill. It was destroyed by a flood in November 1927. A dam ran across the river between these two mills, creating a mill pond to support the use of water power. There was a dam in the East Channel as well. Spring flooding from snowmelt pushed logs downstream (2008).

Also located on Falls Island was the H.H. Stickles Sash and Blind Factory (Grasse River Heritage, 2008). This factory produced wood products, including doors, stairs, and window sashes. It was powered by either a waterwheel or turbine. The factory itself had a toilet that stuck out from the building over the river (2008). Wood was likely supplied from the nearby lumber mill.

The cutting of trees increased the risk and danger of flooding on the Grasse. Ice jams rushing downstream, as well as logs, could damage or destroy bridges, dams, sawmills, and other structures (Grasse River Heritage, 2008). Beyond damage to property, the dumping of sawdust, wood shavings, and edgings into the river polluted the water in the 1880s and 1900s (2008). Pollution due to fires also occurred as sawmills and other mills on the island converted (or attempted to convert) to steam power (2008).

Overall, Falls Island was mostly occupied by a grist mill, sash and blind factory, and a sawmill, but there were also times where furniture and caskets were produced, as well as axes. There was also a tannery on the island for a short time (Grasse River Heritage, 2008). South of the island, the land where Bend in the River Park and the Canton Pavilion is currently located (at the end of Lincoln Street), was used as a dump site by the Village of Canton in the 1950s and 60s (2008).

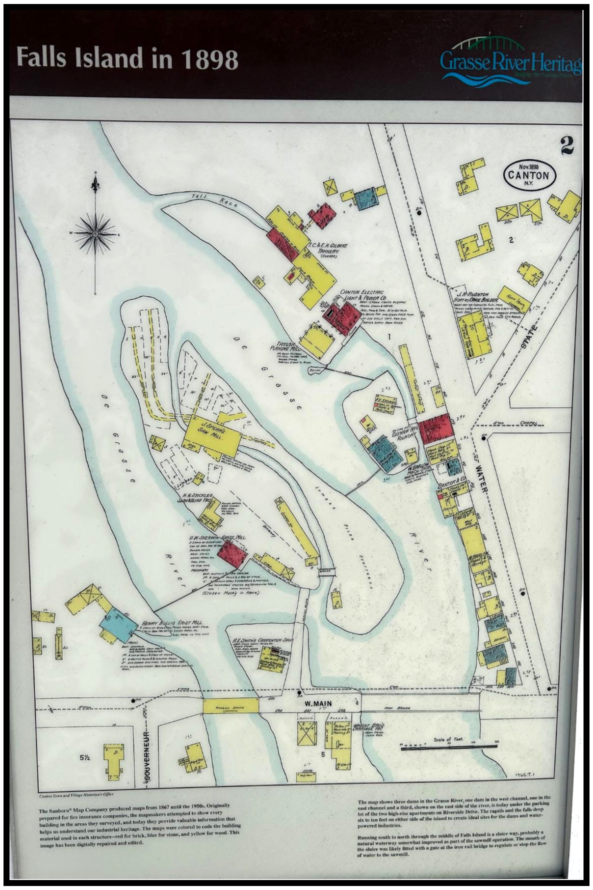

Figure 1: A photograph of an interpretive sign at Heritage Park featuring a map of Falls Island in 1898 (Grasse River Heritage, 2008).

Outside of Canton (Figure 2), the Grasse was impacted by mills and other factories. During the Civil War, a mill and blast furnace for magnetite iron ore was located at Twin Falls (Van de Water, 2020). The magnetite mine was also active during World War II. Further downstream, there is the hydroelectric facility in Pyrites, farmland, and old sulfur and zinc mines (in Stellaville and Edwards, respectively) (Van de Water, 2020). In communities along the river, iron, zinc-lead, and talc were historically mined, and sandstone, dolostone, and marble are still quarried (Chiarenzelli et al., 2010). A large open pit iron mine was located near Star Lake until the 1970s (2010). Below the dam in Madrid, the river is a critical habitat for salmon and sturgeon spawning (Van de Water, 2020).

Figure 2: Map of St. Lawrence County with major towns, highways, drainage systems, and the Adirondack Park Boundary (Murphy, 2011).

In Massena, the Grasse has been dredged and polluted by the aluminum plant, contaminated with polychlorinated biphenyls and other toxics (2020). A clean up was ordered by the EPA — the affected area is a Superfund site.

Current Pollution Sources & Concerns

According to Brian Washburn, Professor Emeritus of Chemistry & Environmental Science at SUNY Canton, the Grasse River has high NYSDEC water quality ratings above Pyrites, with quality decreasing downstream (2024). The Little River watershed currently has a high rating and is potentially being evaluated for decreasing quality (Washburn, 2024).

Wastewater Treatment Plant Outfall. The Village of Canton's wastewater treatment plant (Figure 3) has a permitted outfall (Figure 4) which discharges into the Grasse River. According to the NYSDEC, treated effluent is discharged at this outfall, with some being sent to the Canton Golf Course for irrigation purposes. The effluent goes through preliminary and secondary treatment, as well as disinfection (Division, 2021). The plant is required to perform regular monitoring and testing of effluent discharge to maintain its permit. This testing includes Fecal Coliform levels, total suspended solids, mercury, nitrate, and more. Information on all parameters tested can be found on the State Pollutant Discharge Elimination System Discharge Permit, available through the DECinfo Locator.

Figure 3: Google Maps screen capture of the Village of Canton Wastewater Treatment Plant and approximate location of the outfall into the Grasse River.

Figure 4: Permit signage posted at the Village of Canton Wastewater treatment plant outfall on the Grasse River.

Road Salt & Stormwater Outfall. Pollution enters the Grasse and Little Rivers via runoff from roads and stormwater outfalls. Road salt is a concern, as it is applied to roads and parking lots for traffic safety in the winter months as an anti-icing and deicing material. When salt becomes dissolved in melt water, it flows off the roads or is splashed by vehicle tires into nearby soil and water (Langen et al., 2006). Water contaminated with salt can also enter groundwater via soil infiltration (2006). Streams draining highways are sensitive to road salt impacts. Surface runoff entering streams and rivers is mostly made up of diluted anti-icer/deicer, with concentrations of sodium and chloride depending on the area of road drained, topography, drainage patterns, the amount of anti-icer/deicer applied, temperatures, and precipitation (Langen et al., 2006). When contaminated water reaches surface waters like rivers and streams through groundwater, it may have elevated levels of metals and other cations like magnesium and calcium due to interactions with soil (2006). Increased mobility of hydrogen ions due to soil interactions may also decrease the pH of the surface water (2006).

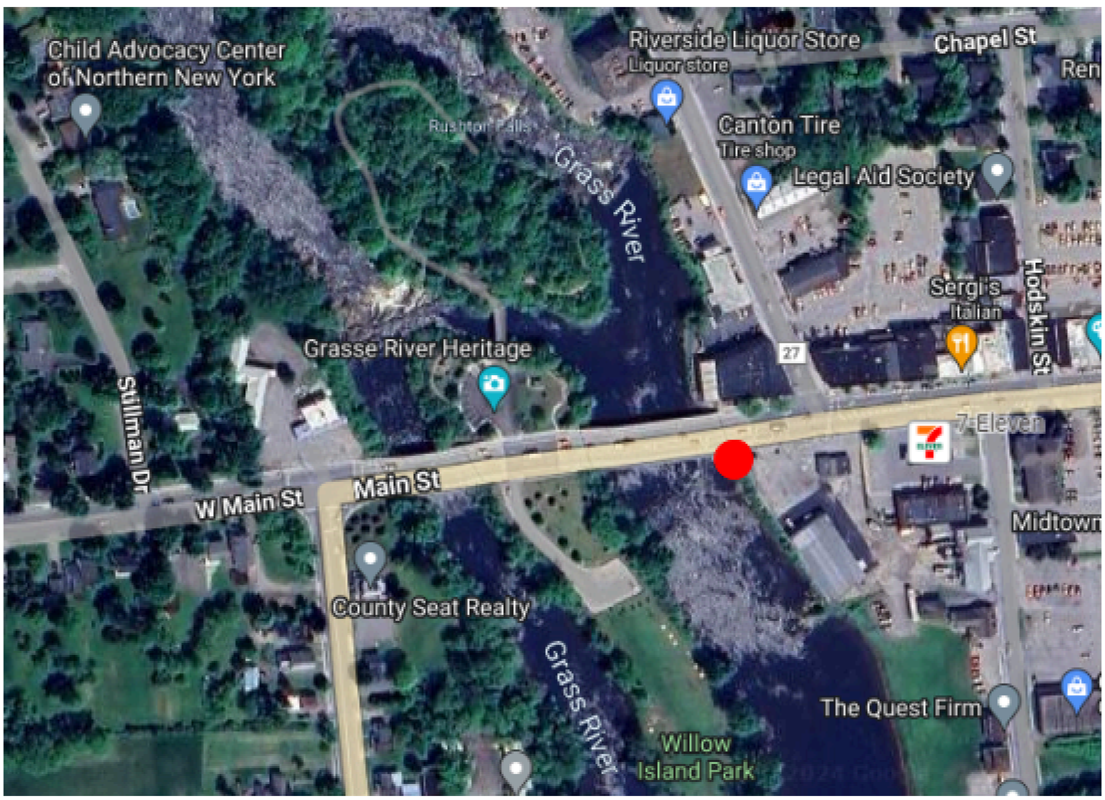

Figure 5: A Google Maps screen capture of Main Street, Canton. The red dot indicates the approximate location of the stormwater outfall under the Main Street bridge.

Figure 6: A photograph of the stormwater outfall under the Main Street bridge in Canton, NY.

The stormwater outfall, located under the Main Street bridge (Figure 5 and 6), discharges water polluted by roadways into the Grasse River. The amount and concentration of pollutants entering the water from stormwater runoff depends on precipitation levels, snowmelt, the amount of deicing materials used, and the amount of garbage that ends up on the roads.

Agricultural Runoff. According to the US Environmental Protection Agency (2023), agricultural runoff is the number one source of water quality impacts to rivers and streams. Pollution from agricultural runoff includes pesticides, nitrogen and phosphorus; soil erosion and nutrient loss, bacteria from animal manure, and pesticides are the primary stressors (US EPA, 2023). Rainfall and snowmelt are the primary mode of transport for these pollutants. Fertilizer runoff can cause algal blooms and hypoxic conditions, sedimentation can overwhelm ecosystems, and bacteria can impact beaches (i.e. swimming safety), fishing, and drinking water (2023).

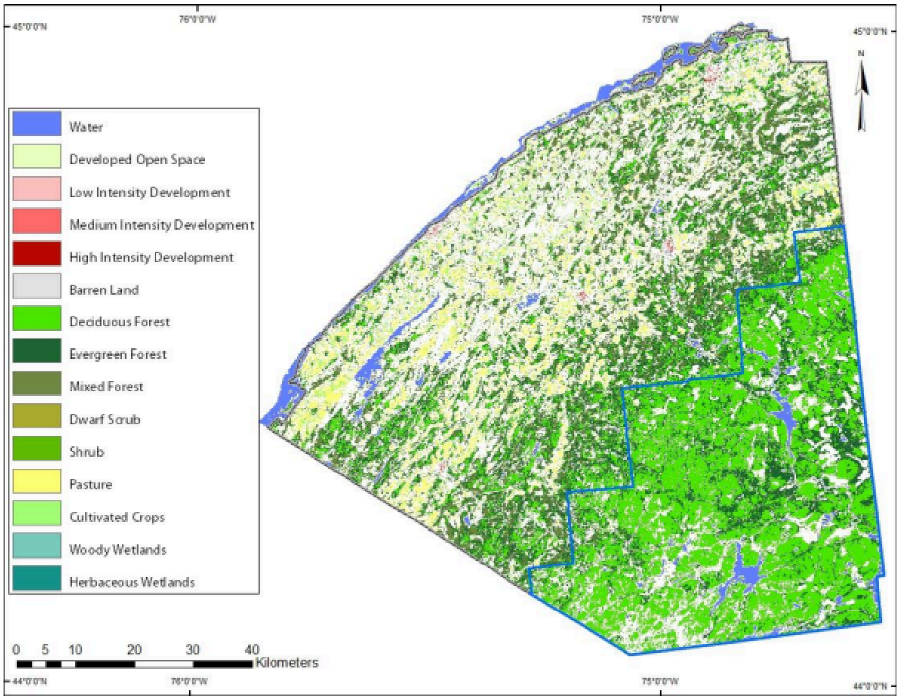

Figure 7: Land use map of St. Lawrence County (Murphy, 2011).

As shown in Figure 7, In the St. Lawrence River Valley, a major use of land is still dairy farming and cropland (Chiarenzelli et al., 2010).

Microplastics. As discussed below in the Clarkson University Research section, plastic pollution is also of concern in the Grasse River. Microplastics can be classified as primary or secondary (Baki & Haque, 2024). Primary Microplastics examples are fibers from textiles and microbeads in beauty products or toothpaste; primary microplastics are designed to be microplastics (2024). Secondary Microplastics are larger plastics, like water bottles, that have been broken down (2024). Microplastics enter water when clothing is washed, via runoff from roadways, wastewater outflows, litter, and when personal care products are washed down the drain (among many other sources). They are a concern to aquatic ecosystems and human health because they can bioaccumulate and biomagnify in a food web (2024). Ingestion of microplastics can cause blockages and malnutrition in animals, disrupt ecosystem dynamics, reduce water clarity and overall quality, and pose health risks to humans (2024). These risks can include respiratory effects due to inhalation, and can lead to inflammation when accumulated in the body via ingestion and dermal contact. Additive chemicals in microplastics, as well as the plastics themselves, can have potential toxic, hormonal, and carcinogenic effects (2024).

Previous Water Quality Research & Monitoring

Various research projects, including those conducted by faculty and students at St. Lawrence University, SUNY Canton, and Clarkson University, have compiled data regarding water quality on the Grasse and Little Rivers. The NYSDEC has also taken water quality measurements on the two rivers, with their data made public on the Division of Water Monitoring Data Portal (NYSDEC, 2022).

SUNY Canton Student Data. From 1990-2016, SUNY Canton students performed laboratory exercises on the Grasse River. This included evaluations of the flow of the river, pH, conductivity, and chloride ion concentration, as well as macroinvertebrate studies (Washburn, 2024). Unfortunately, due to a laboratory fire and changes in online platforms, much of the student data have been destroyed.

Each fall, students collected Surber net samples in riffle areas of macroinvertebrates in the branches of the river flowing around the island on campus. Macroinvertebrate data can be used to indicate long-term water quality (Washburn, 2024). Students consistently found water pennies, caddis and damselfly nymphs, which indicate high water quality due to their water quality tolerance levels (Washburn, 2024).

In spring semester courses, students evaluated road salt contamination of snow adjacent to roadways (Washburn, 2024). Students found that total conductivity and chloride ion concentration decreased with distance from the roadway (2024). The New York State Department of Transportation was determined to be the largest user of road salt in the area. Student data from 2014 found a conductivity of 11400 ppm and a chloride ion concentration of 2891 ppm along Route 68 in the 40 mph zone, with 1722 ppm and 678 ppm in the 55 mph zone (Washburn, 2024).

Students also evaluated the conductivity and pH of the Little River. The pH ranged from 7.4-7.6, which is typical for St. Lawrence river water (Washburn, 2024). Total conductivity above 1000 ppm was found around an outfall with upstream values exceeding 250 ppm (with 100-120 being the typical range) (2024). Road salt contamination is speculated as the cause of higher conductivity levels, however conductivity and chloride ion concentrations were similar when sampled in the fall, prior to road salt applications (2024).

St. Lawrence Research Data. Professor Jeffrey Chiarenzelli of St. Lawrence University's Department of Geology has shared research that he and students have conducted on water quality of local streams and rivers. Lakes in the Adirondacks serve as the headwaters for rivers like the Grasse; the Adirondack region has been heavily impacted by acid rain and mercury deposition (Chiarenzelli et al., 2010). Streams are more vulnerable to acidification than lakes due to source water from overland/shallow flow paths that are ineffective at neutralizing acidity (Murphy, 2011). Increased acidity can increase the solubility of elements like aluminum and can leach calcium and other nutrients from forest soils (Murphy, 2011). The Grasse River crosses three areas of bedrock with distinct characteristics and differences in topography, bedrock composition, and metamorphic grade (Chiarenzelli et al., 2010). These characteristics have various influences on metrics like neutralizing ability, elemental ratios, and other water quality measurements.

In one of Chiarenzelli's studies, the Oswegatchie, Grasse, Raquette, and St. Regis Rivers, as well as thirteen tributaries of the Oswegatchie River, were sampled from June to July. Data was collected using a Hydrolab multi-probe, including temperature, pH, Chlorophyll-a, and specific conductance (Chiarenzelli et al., 2010). The overall study found no uniform trend of cooling or warming, but in the St. Lawrence River Valley water temperatures rose from mid-June to mid-July (2010). The pH values indicate that acidification is greater in the westernmost Adirondacks; pH also increased downriver (2010). Chlorophyll-a values were found to be similar at each sampling site. Specific conductance ranged from 12-309 mS/cm, and was found to generally increase downstream. On the Grasse, specific conductance decreased from 308 mS/cm at first sampling to 70 mS/cm in June and July (Chiarenzelli et al., 2010). This could potentially be related to the dilution of road salt inputs over the course of the summer. Decreasing levels of Na/Cl rations from June to July may also indicate a decreasing influence of road salt (Chiarenzelli et al., 2010). However, road salt contaminates groundwater, which can eventually make its way into surface waters, causing a spike in salt levels (Langen, 2024). Other decreases in elemental ratios found seem to align with the application of fertilizer on farmland early in the growing season (2010). However, bedrock type and pH variation also play a role in elemental ratios; therefore, anthropogenic sources like road salt and fertilizer use are not the sole factors influencing these ratios (2010).

This study also included multi-element and statistical analysis of samples. It was found that one group of elements (Al, Ce, Dy, Er, Fe, Gd, La, Mn, Nd, Pr, Si, Y, and Zr) decreased downriver from the Adirondack Highlands to the Lowlands and the St. Lawrence River Valley (Chiarenzelli et al., 2010). Another group of elements (Ba, Ca, Cu, K, Li, Mg, Na, Rb, S, and Sr) were found to increase (2010). Chiarenzelli and his co-authors note that these differences are related to solubility: insoluble elements decreased in abundance downriver likely because of sedimentation, a rise in pH, and dilution by waters with more soluble elements (2010).

In a related paper, undergraduate student John T. Murphy, Jr., studied the geochemistry of five watersheds in St. Lawrence County (Murphy, 2011). These watersheds were found to be impacted by acidification, mining, agriculture, and geologic materials. The Canton Little River watershed was included in this study (there is also a Little River in Star Lake). Samples for this study were taken in June and July 2010; results are shown in Table 1.

Table 1: Summary table for physical properties in the Little River Canton Watershed taken from Murphy, 2011. (SpC = Specific Conductivity, TDS = Total Dissolved Solids, ANC = Acid Neutralizing Capacity.)

	Temperature (°C)	DO %	DO (ppm)	pH	SpC (µS·cm^{-1})	TDS (g/L)	ANC (meq/L)
Maximum Values Round 1	22.160	120.000	11.970	8.400	441.100	0.282	4.444
Minimum Values Round 1	15.970	64.000	5.800	7.210	73.500	0.047	1.104
Range Round 1	6.190	56.000	6.170	1.190	367.600	0.235	3.340
Average Round 1	19.563	94.150	8.358	7.746	230.829	0.148	2.399
Standard Deviation Round 1	1.761	13.445	1.396	0.342	95.696	0.061	0.973
Maximum Values Round 2	21.760	81.000	7.470	8.130	380.900	0.244	3.797
Minimum Values Round 2	19.370	36.500	3.210	7.090	117.400	0.075	1.120
Range Round 2	2.390	44.500	4.260	1.040	263.500	0.169	2.677
Average Round 2	20.684	65.621	5.895	7.537	227.918	0.146	2.243
Standard Deviation Round 2	0.892	12.112	1.126	0.306	89.764	0.057	0.868
Average Round 1 &2	20.124	79.886	7.126	7.641	229.373	0.147	2.321
Consistency (R^2)	0.934	0.932	0.939	0.936	0.931	0.919	0.704

The temperature of the Little River in Canton changed the least over the two sampling dates out of the streams sampled, with an increase of 1.12 degrees C (Murphy, 2011). The pH values found ranged from 6.37 (±1.96) to 7.75 (±0.34). The Canton Little River was the most basic on average out of streams sampled, with a decrease in pH value throughout the summer (2011). Dissolved oxygen ranged on average from 5.49 (±2.71) to 9.25 (±0.60) ppm, with the highest value being 11.97 ppm on the Canton Little River during the first round of sampling (2011). The Little River watershed also had the highest level of total dissolved solids (2011).

Clarkson University Research Data. Dr. Abul Baki and graduate student Addrita Haque presented research conducted regarding microplastic pollution in the Raquette and Grasse Rivers in February, 2024. Water samples were collected as bulk water column samples, and as plankton net, wash loads, and bed load samples. Samples were prepared and filtered, and then microscopy and spectroscopy were used to identify microplastic types and chemistry (Baki & Haque, 2024). Results for the Raquette River found the average amount of microplastics in the sediment samples to be 195 ± 67.21 items/kg (mean± standard deviation), and the average amount of microplastics in the water sample to be 20.2 ± 7.86 items/L (mean± standard deviation) (2024). Baki and Haque note that the aquatic life threshold established by the California Environmental Protection Agency is 5 items of microplastics per liter (2024).

On the Grasse River, mussels, water, sediment, and suspended sediment load was collected (Baki & Haque, 2024). Samples were taken upstream and downstream from the Massena wastewater treatment plant. Table 2 shows the results from their study.

Table 2: Results from research by Clarkson University (Baki & Haque, 2024). Microplastic was observed in mussels, the water column, in suspended sediment, and sediment samples.

Sampling Site	Microplastic Abundance Mussels (Item/individual)	Microplastic Abundance Water column (Item/L)	Microplastic Abundance SSL (Item/L)	Microplastic Abundance BL (Item/kg)
Grass River Upstream	1.2± 0.84	12	133.34	350
Grass River Downstream	2.2± 1.30	16	200.01	400

Their findings indicate that microplastics are making their way into the bodies of aquatic organisms in the Grasse River, and that water downstream from wastewater treatment plants likely has higher levels of microplastics present.

Looking to other work at Clarkson, Tom Langen, Professor of Biology, researches the impacts of roads on ecosystems, and has done extensive research on road salt impacts of nearby soils, vegetation, and water bodies. In one study along the Cascade Pass roadway in the Adirondacks, Langen and co-authors found that soils adjacent to the road were significantly altered by salt and sand use (Willmert et al., 2018). They observed dieback of woody vegetation, indicating changes in soil fertility and salt damage to plant tissue (2018). The soil was found to have an elevated concentration of sodium, while being depleted of magnesium, calcium, and potassium. These soil-essential nutrients were found at elevated levels in the lakes adjacent to the roadway, likely due to sodium-mediated leaching (2018).

In another report, Langen and co-authors note that because of the application of sodium chloride and sand, soil organic matter was found to be low, soil particle size was largely comprised of sands, sodium levels were high, and nutrient cation concentrations were low (Langen et al., 2006). Thus, the soil was nutrient-poor and easily erodible (2006). Chloride levels in Upper and Lower Cascade Lakes were 100 to 150 times higher than expected for an Adirondack Lake. Chloride concentrations peak in the summer because salt has percolated through the ground and then is discharged via groundwater into the lakes (Langen et al., 2006). High levels of chloride in lakes can cause permanent thermal stratification (though this had not occurred at the time of the study in the Cascade Lakes), preventing turnover and thermal mixing, which can impact dissolved oxygen concentrations and distributions (2006).

While these studies were not directly related to riverine systems such as the Grasse, they indicate the impacts of road salt applications to nearby ecosystems and raise potential concerns about groundwater and well contamination. In a presentation to the Village of Canton Sustainability Committee, Langen noted that parking lots are of particular concern (2024). Parking lots “de-ice” instead of “anti-icing,” meaning that they apply salt to snow after it has fallen to melt it, instead of applying salt before snow falls. Therefore, parking lots tend to use a lot more salt than roads (Langen, 2024). Sand, which is used as an abrasive (i.e. it provides something for tires to grip), is also a concern. When it is washed off into nearby water bodies, it can cause sedimentation, disrupting aquatic habitats. It is also a contributor to poor air quality as the snow melts and dry sand is blown into the air (2024).

NYSDEC Monitoring Data. Within the town of Canton, NYSDEC has sampled the Grasse River at two locations, and the Little River at one location (NYSDEC, 2022). The Grasse River was sampled off of Route 27 (Figure 8) in 1992, 2004, and 2009, and from the Miner Street Bridge in 2019. The Little River was sampled near Pike Road in 2004, 2005, and 2014. Some of this data can be found in Table 3 and Table 4. Detailed data for all years can be found on the Division of Water Monitoring Data Portal. Data collected includes chemical sampling (dissolved oxygen levels, Nitrogen and Phosphorus levels, salinity, etc.) as well as biological macroinvertebrate data (NYSDEC, 2022).

NYSDEC uses categories ranging from AAT to D to classify a river's health, with AAT being the highest quality (capable of supporting trout) and D being the poorest (Washburn, 2024). The Grasse is rated at an A level above Pyrites, and B and C downstream. The Little River watershed has been rated as A to AA, but is potentially being evaluated for decreasing quality (Washburn, 2024).

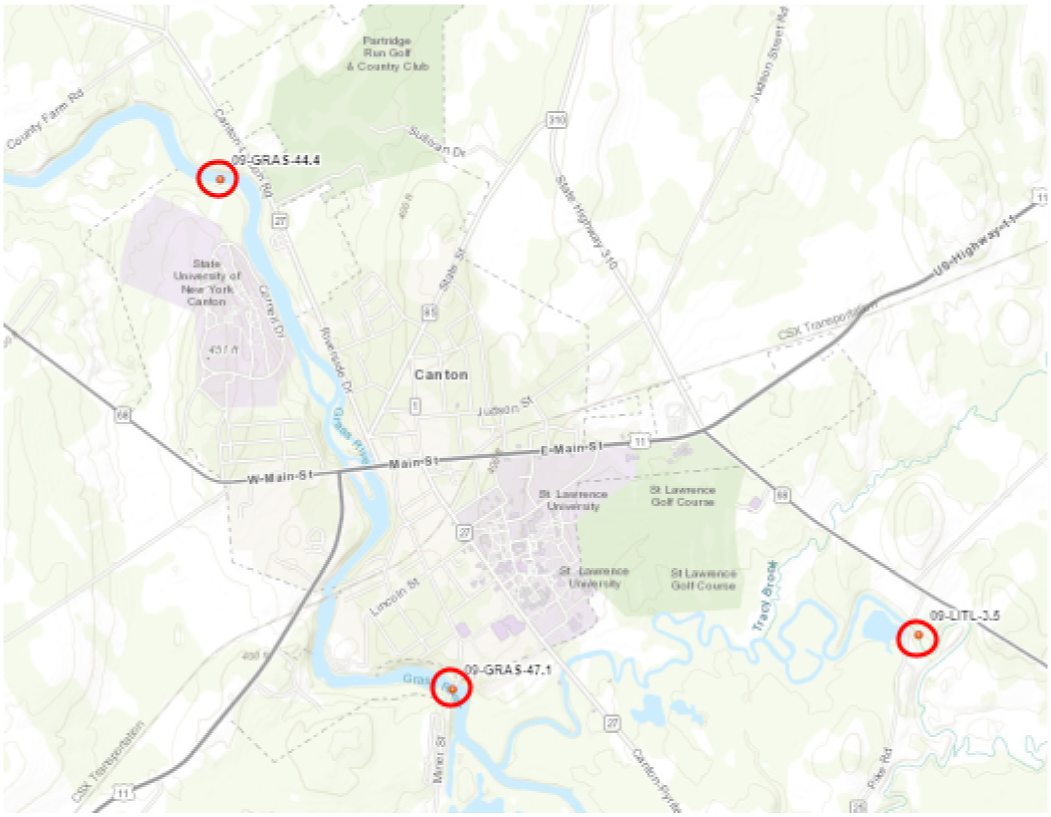

Figure 8: Screen capture from the NYSDEC Division of Water Monitoring Data Portal (NYSDEC, 2022). The three points circled in red indicate locations where the DEC has tested water quality in the town of Canton.

Biological macroinvertebrate data is evaluated on a common 10-scale and averaged to determine a Biological Assessment Profile (BAP) score (NYSDEC, 2021). A BAP above 5 indicates that the waterbody tested is not or only slightly impaired, whereas a score below 5 indicates moderate or severe impact on water quality conditions (2021). BAP is calculated using species richness, Ephemeroptera, Plecoptera, and Trichoptera (EPT) richness, Hilsenhoff's Biotic Index, percent model affinity, nutrient biotic index, species diversity, and non-Chironomidae and Oligochaeta richness (NYSDEC, 2021). The 2019 Grasse River BAP score indicates that the river is slightly impacted (Figure 9), as does the 2014 Little River Score, though the Little River scored higher (6.25 and 7.31, respectively) (NYSDEC, 2022).

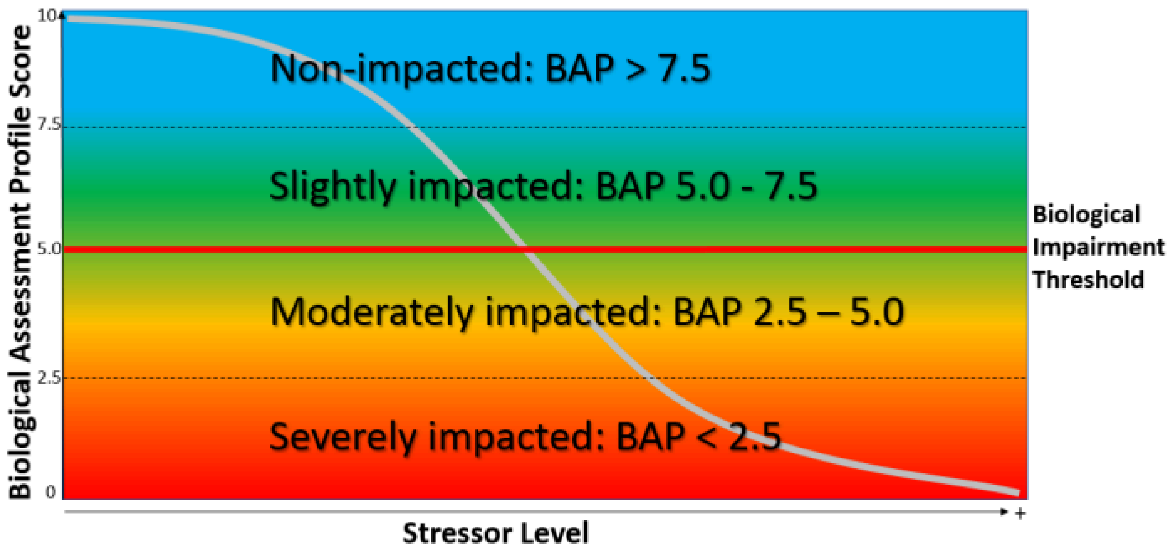

Figure 9: An illustration of the BAP score compared to stressor levels from the NYSDEC "Fact Sheet on Assessment of Water Quality Impact in Streams and Rivers" (NYSDEC 2021).

Table 3: NYSDEC Water Quality Data Grasse River (Miner Street)

Parameter	Value	Units
Sampling Date	9/11/2019	-
latitude	44.58	-
longitude	-75.17	-
Temperature	18	Celcius
pH	7.15	pH scale
Hardness	44.3	mg/L as CaCO3
Total Alkalinity	41	mg/L as CaCO3
Total Aluminum	77.5	µg/L
Total Cadmium	not detected	µg/L
Total Calcium	11,100.00	µg/L
Total Chloride	5.8	mg/L
Total Chlorophyll A	0.41	µg/L
Total Copper	not detected	µg/L
Total Iron	614	µg/L
Total Lead	not detected	µg/L
Total Magnesium	4060	µg/L

Total Nickel	0.42	µg/L
Nitrogen, Ammonia	not detected	mg/L
Nitrogen, Kjeldahl	0.39	mg/L
Nitrogen, Nitrate-Nitrite	0.05	mg/L
Nitrogen, Nitrate	0.05	mg/L
Nitrogen, Nitrite	not detected	mg/L
Total Nitrogen	0.44	mg/L
Total Phosphorus	0.01	mg/L
Total Silver	not detected	µg/L
Turbidity	2.35	NTU
Chlorophyll A (Probe)	0.5	RFU
Chlorophyll A (Probe)	1.75	µg/L
Dissolved Oxygen	9.25	mg/L
Dissolved Oxygen Saturation	97	Percent
Phycocyanin (Probe)	0.02	RFU
Phycocyanin (Probe)	0.05	µg/L
Salinity	0.05	ppt
Specific Conductance	107	µS/cm
BAP Final Score	6.25	-
Richness	19	-
Richness Score	9	-
HBI Index	4.74	-
HBI Score	7.2	-
PCT Model Affinity	51	-
PCT Model Affinity Score	5.32	-
Nutrient Biotic Index Phos	6.23	-
NBI Phos Score	4.42	-

Table 4: NYSDEC Water Quality Data Little River (Pike Road)

Parameter	Value	Units	Value Year
Sampling Date(s)	7/21/2004, 11/10/2005, 7/21/2014	-	-
latitude	44.59	-	-
longitude	-75.13	-	-
Temperature	28	Celcius	2014
pH	8.67	pH scale	2014

Average Hardness	93.33	mg/L as CaCO3	2014
Total Alkalinity	70.3	mg/L as CaC03	2005
Total Aluminum	437	µg/L	2005
Total Cadmium	Not detected	µg/L	2005
Total Calcium	19.60	mg/L	2005
Total Chloride	11.2	mg/L	2005
Total Coliform	8900	cfu/100mL	2005
Coliform, Fecal	300	cfu/100mL	2005
Total Copper	0.88	µg/L	2005
Total Fluoride	not detected	mg/L	2005
Total Iron	487	µg/L	2005
Total Lead	0.3	µg/L	2005
Total Magnesium	27.5	µg/L	2005
Total Manganese	27.5	µg/L	2005
Total Mercury	not detected	µg/L	2005
Total Nickel	0.9	µg/L	2005
Nitrogen, Ammonia	not detected	mg/L	2005
Nitrogen, Kjeldahl	0.41	mg/L	2005
Nitrogen, Nitrate-Nitrite	0.12	mg/L	2005
Nitrogen, Nitrate	0.12	mg/L	2005
Nitrogen, Nitrite	not detected	mg/L	2005
Total Nitrogen	0.53	mg/L	2005
Total Phosphorus	0.03	mg/L	2005
Total Potassium	1.41	mg/L	2005
Total Sodium	6.75	mg/L	2005
Total Sulfate (SO4)	8.51	mg/L	2005
Total Dissolved Solids	124	mg/L	2005
Total Solids	102	mg/L	2005
Total Suspended Solids	8.6	mg/L	2005
Total Volatile Solids	26	mg/L	2005
Turbidity	7.08	NTU	2005
Dissolved Oxygen	10.66	mg/L	2014
Dissolved Oxygen Saturation	136.5	Percent	2014
Specific Conductance	212	µS/cm	2014
Salinity	0.08	ppt	2004

Total Zinc ug/L	not detected	µg/L	2005
BAP Final Score	7.31	-	2014
Richness	23	-	2014
Richness Score	6.47	-	2014
Ept rich	10	-	2014
ept score	7.27	-	2014
HBI Index	3.9	-	2014
HBI Score	8.1	-	2014
PCT Model Affinity	84	-	2014
PCT Model Affinity Score	9.42	-	2014
Nutrient Biotic Index Phos	5.88	-	2014
NBI Phos Score	5.3	-	2014

Methodology

Beginning in November 2023, Evelyn and Michael Iversen (St. Lawrence Assistant Director of Sustainability and Energy Management) were trained by Professor Brad Baldwin in the use of a Hydrolab water quality monitoring instrument. This instrument provides various data values: these values include temperature, total dissolved oxygen (DO), percent DO, pH, specific conductivity, and a measurement of chlorophyll. The Hydrolab was submerged in the water for about one-two minutes, and data reading was transmitted to the handheld reader (Figures 10 and 11). Evelyn, Michael, and Dan French (Nature Up North Project Manager), were able to collect data for one location on the Grasse River, and one location on the Little River in December before the water froze (Table 5 and 6 in the results section). Each of these sites was tested with one submergence of the Hydrolab (i.e. the Hydrolab was submerged for ~one-two minutes and data readings were recorded).

Figure 10: Evelyn and Dan using the Hydrolab in the Little River by the SLU Canoe Shed.

Figure 11: Evelyn and Dan reading the Hydrolab data from the handheld monitor.

Beginning in February 2024, two St. Lawrence Community Based Learning (CBL) students became volunteers with Nature Up North. These two students provided support in identifying potential community partners. Using Google Maps, the students identified Massena, Louisville, Chase Mills, Madrid, Morley, Canton, Pyrites, Russel, Clare, and Degrasse as communities along the Grasse that may be interested in becoming MOW the Grasse participants. Massena, Canton, and Pyrites were deemed the most feasible to connect with based on previous NUN partnerships. Groups like rod & gun clubs, Grasse River Heritage, and the St. Lawrence Land Trust were identified as organizations to connect with. Grasse River Heritage and the St. Lawrence Land Trust had previously participated in the MOW the Grasse project prior to the Covid-19 pandemic. These two organizations are hoping to do testing three times a year with assistance from Nature Up North. Dan French continues to work to recruit organizations, with plans to provide training in the summer of 2024.

In March 2024, the two CBL students assisted in the revision of the MOW the Grasse Field Handbook that will be provided by volunteers. Then, the students participated in water quality testing. On March 6, the Little River at the Canoe Shack was tested with the Hydrolab, using the same procedure as detailed above. This data can be found in Table 7. Throughout the remainder of the spring semester, the two CBL students performed water quality testing with the Hydrolab and helped test out the Nature Up North monitoring procedures with test kits. Test kit data is not included in this report, as the students used expired kits to practice the procedures. These kits will hopefully be used by community members in the near future. The Nature Up North monitoring procedures are still being updated but can be found on Nature Up North's website.

Figure 12: Dan providing water safety instruction to the two CBL students before testing with the Hydrolab.

Results & Discussion

Using an ArcGIS Field Maps survey, water sampling data was collected and compiled into a web map (Figure 13). This map can be found on the St. Lawrence Office of Sustainability CCAC webpage. Data was collected in December, March, and April. Only Hydrolab data was reported. While the CBL students did practice using the Nature Up North test kits, the kits they used were expired and used solely for educational purposes.

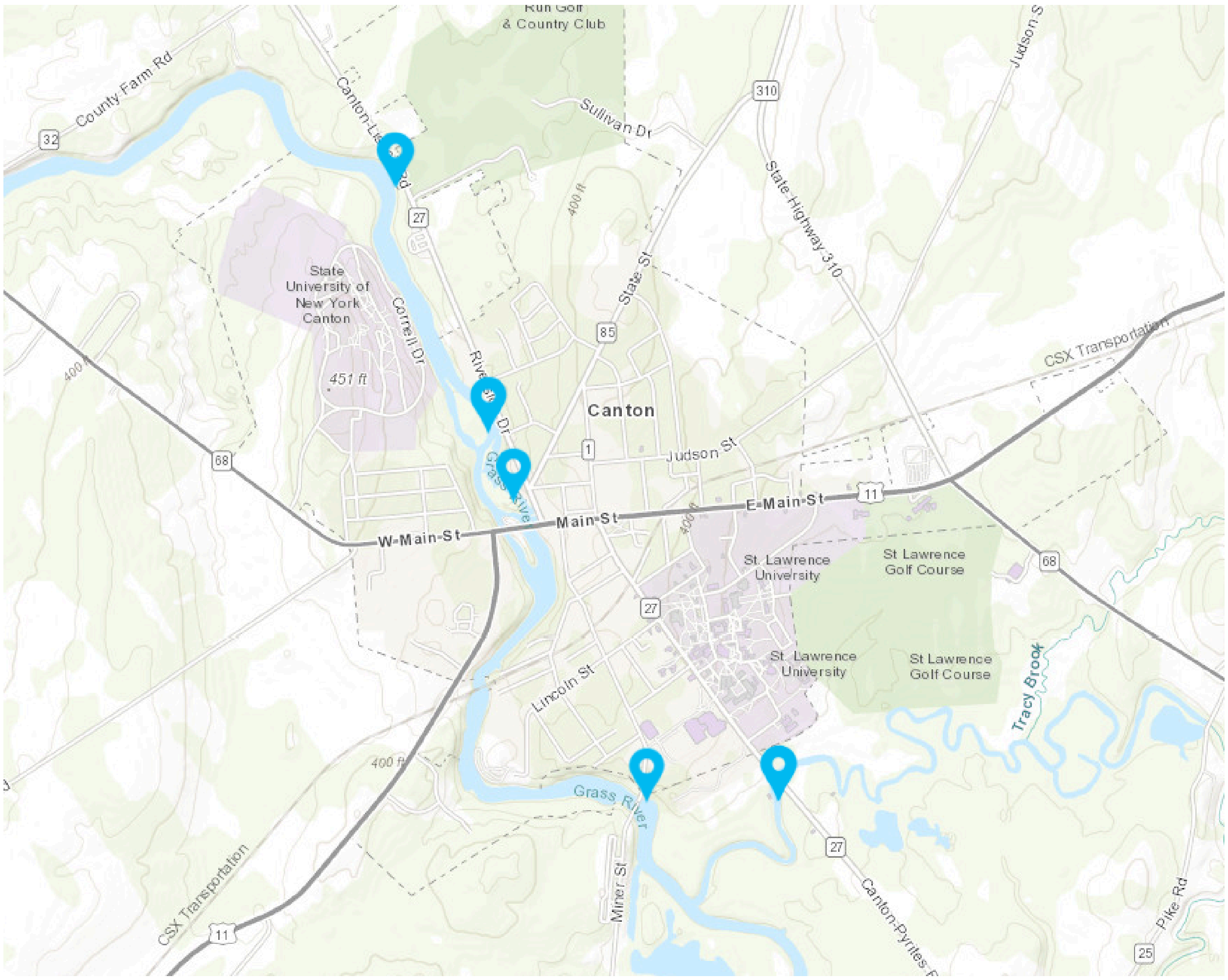

Figure 13: A screen capture of the ArcGIS Web Map created to document water testing locations and data.

The Little River was tested at the same location two times, whereas the Grasse River was tested at four separate locations. In-depth statistical analysis has not been performed to determine if changes in values between the locations, between the two rivers, or between our data and previously collected data, are significant.

Initial One-Time Testing

In December 2023, the Grasse River and the Little River were each tested once using the Hydrolab (Table 5 and 6). The Hydrolab was not submerged deep enough (visual approximation would be less than a foot) for a depth of sample reading. The pH readings fell within typical values; according to Washburn, river water in the St. Lawrence Basin has a pH above 7.0, ranging from 7.4-7.6 (2024). The DEC found similar values for the Grasse River, though a considerably more basic value of 8.67 for the Little River in 2014 (NYSDEC, 2022). A 2011 study found the average pH of the Little River to be 7.641 in June and July (Murphy, 2011). Percent dissolved oxygen levels for the Grasse River appear to be similar to previous studies. Percent dissolved oxygen for the Little River is similar to those found in Murphy, 2011, but lower than what the DEC reported in 2014 by ~35%. However, dissolved oxygen as mg/L was very similar to what the DEC reported for the Little River. This may have been due to an error with the Hydrolab or reading out the data, and it was only a one time sample.

Specific conductivity on the Grasse River was found to be 97 µS/cm, and 127.1 µS/cm on the Little River. For comparison, NYSDEC values were 107 µS/cm (Grasse) in 2019 and 212 µS/cm (Little) in 2014 (NYSDEC, 2022). According to the US Environmental Protection Agency, each water body will have a relatively constant conductivity range (US EPA, 2023). Significant increases in conductivity often indicate that a discharge or disturbance has decreased water quality and health; human disturbance tends to increase the amount of dissolved solids entering waters, and this increases conductivity (US EPA, 2023). One time data, as collected here, can not provide insight into increases or decreases overtime.

These initial one time Chlorophyll levels do not appear to indicate any cause for concern; they are not in a range indicative of increased algal activity or potential algal blooms. In lakes, a chlorophyll-a level of 100 µg/L has been used to define “exceptional” blooms, whereas levels of 5-10 µg/L have been used to identify a bloom (Adams et al., 2021). However, these values do not consider baseline chlorophyll-a concentrations; chlorophyll-a growth rates over time can be used to study algal blooms (2021). Our initial sampling data and DEC data do not indicate elevated levels.

Table 5: Initial Water Quality Data from the Grasse River using a Hydrolab Instrument.

Date	Time	Coordinates	Site Name	Weather	Air Temp C	Depth of Sample (m)	Water Temp C	DO (mg/L)	%DO	pH	Conductivity (µS/cm)	Chlorophyll (µg/L)
12/20/23	15:24	44.58344N, 75.166163W	Miner Street Bridge	Cloudy, no precipitation, two days of intense rainfall preceding	1.11	--	1.78	10.82	92.7	7.38	97	3.09

Table 6: Initial Water Quality Data from Little River using a HydroLab Instrument.

Date	Time	Coordinates	Site Name	Weather	Air Temp C	Depth of Sample (m)	Water Temp C	DO (mg/L)	%DO	pH	Conductivity (µS/cm)	Chlorophyll (µg/L)
12/20/23	15:44	44.583576N, 75.157953W	St. Lawrence Canoe Shack	Cloudy, no precipitation, two days of intense rainfall preceding	1.11	--	1.56	10.42	88.6	7.42	127.1	2.91

Followup Testing, March & April 2024

On March 6, the two CBL students used the Hydrolab to collect data on the Little River with the supervision of Dan and Evelyn. Two days of air temperatures in the 60s likely contributed to the warmer water temperature (Table 7). Percent dissolved oxygen decreased slightly (~2.4%) when compared to the December values, and pH increased from 7.42 to 7.6. Specific conductivity increased by ~70.8% when compared to December. Chlorophyll levels did not change. Statistical analysis has not been completed to determine if changes between values are significant. There is potential human error in the reading of the dissolved oxygen mg/L reading by the CBL student, so 8.66 mg/L may not be an accurate value. The Hydrolab readings were also potentially impacted by contact with sediment when the instrument was allowed to rest on the river floor. The Hydrolab was lifted and suspended in the water column to achieve more accurate readings. Repeat testing will be necessary to verify the data. However, if the conductivity reading is accurate, the elevated levels could potentially indicate the impact of road salt entering the river. However, salinity levels have been found to increase in the summer due to the impact of contaminated groundwater reaching surface waters (Langen, 2024). Other contaminants beyond salt could also contribute to the increase.

Table 7: One Time Sampling Data from the Little River using a HydroLab Instrument in March 2024.

Date	Time	Coordinates	Site Name	Weather	Air Temp C	Depth of Sample (m)	Water Temp C	DO (mg/L)	%DO	pH	Conductivity (µS/cm)	Chlorophyll (µg/L)
03/06/24	16:47	44.583522N, 75.158091W	St. Lawrence Canoe Shack	Raining, two days of 60 degree weather	41	--	8.06	8.66*	86.5	7.6	217.1	2.9

**Potential human reading error of the DO mg/L.*

On April 10, the two CBL students used the Hydrolab to collect data on the Grasse River at two locations, with the supervision of Dan and Evelyn. Warm, wet weather with rain and snowmelt occurred in the days prior to testing. At the wastewater discharge point sampling location, a manhole with bubbling foam was located nearby, and frogs and downed branches were in the water. As seen in Table 8, the dissolved oxygen levels were higher at the wastewater discharge point when compared to the levels at the SUNY Canton Bridge location, which is about half a mile upstream off of Route 27. Statistical analysis has not been completed to determine if changes between values are significant. The dissolved oxygen levels at the discharge point are more similar to the levels found in December at the Miner Street Bridge location (Table 5). The water was also moving at about 1.03 m/s near the SUNY Canton Bridge, whereas the water sampled at the discharge point was fairly stagnant. These findings are interesting, as normally areas with faster flowing water have higher oxygen levels, and it would be expected that dissolved oxygen levels would decrease near effluent discharge points. Various factors, like plant growth, human sampling error, or error with the Hydrolab, may have impacted the data collected. Measurements were also not taken further downstream from the discharge point; measurements starting upstream and moving downstream from the discharge point would potentially show the expected dip in dissolved oxygen closest to the discharge point, and then an increase further downstream as inputs are diluted.

On April 16, the two CBL students and Dan tested the Grasse River at Heritage Park in the Village of Canton. Heritage Park is upstream from the two April 10 sites. Here, water was flowing more rapidly than in other sampling locations, and the location lay between the park and a roadway/paved parking lots. Based on calculated standard deviations, conductivity and percent dissolved oxygen differed the most between sites. This could be due to various factors, including proximity to road ways, plant matter (in the water itself and the riparian zone), and water velocity.

Table 8: One Time Sampling Data from the Grasse River Using a HydroLab Instrument in April 2024.

Date	Time	Coordinates	Site Name	Weather	Air Temp C	Depth of Sample (m)	Water Temp C	DO (mg/L)	%DO	pH	Conductivity (µS/cm)	Chlorophyll (µg/L)
4/10/24	16:41	44.599700N, 75.175877W	SUNY Canton Bridge	Windy, sunny with clouds	18	0.4	11.2	7.05	75.6	7.51	70.7	1.78
4/10/24	17:54	44.610406N, 75.181671W	Wastewater Discharge Point	Windy, sunny with clouds	18	—	11.6	9.15	99.2	7.62	94.5	1.94
4/16/24	16:30	44*35'48" N 75*10'28' W	Heritage Park	Partly Cloudy	13	—	9	8.69	93.3	7.72	79.4	2.24
Mean Values	—	—	—	—	—	—	*47.1*	*8.9275*	*90.2*	*7.5575*	*85.4*	*2.2625*
Standard Deviation	—	—	—	—	—	—	*8.194713743*	*1.550534854*	*10.16562836*	*0.1461449053*	*12.50946308*	*0.5836879874*

While repeat testing at each site would be necessary for statistical analysis and a more accurate understanding of what is "normal" for the Grasse and Little River, the data collected thus far does not appear to indicate high levels of contamination or poor water quality.

Conclusions & Future Work

The Campus Climate Action Corps Water Quality project, in collaboration with Nature Up North, was able to collect preliminary data regarding the health of the Grasse and Little Rivers, compile historic background information and previous research, and educate two St. Lawrence students about water quality monitoring and community outreach. Preliminary data does not appear to indicate high levels of contamination, however, the rivers were not tested for nutrients associated with agricultural runoff. As community members become involved in the MOW the Grasse project, and Nature Up North testing kits and procedures are used, this data gap will be filled. Work will continue to connect with community organizations, with the goal of establishing regular monitoring of the Grasse and Little Rivers.

Link to the ArcGIS Web Map:
https://stlaw.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=d89040a56d8d47ee97247fd1fc10032b

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