Fall 2019

Rouge Education Project: Data Summary Report

Friends of the Rouge

Plymouth, Michigan

www.therouge.org

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Introduction

History of the Rouge Education Project

The Rouge Education Project (REP) is a school-based watershed education and water quality monitoring program coordinated by Friends of the Rouge. Its mission is to promote awareness and stewardship of the Rouge River watershed through school-based water quality monitoring, investigation, and problem solving. The program's major objectives are to:

- Provide opportunities for schools to engage students in hands-on, real world science through water quality monitoring of the Rouge River;
- increase participants' awareness of the Rouge River watershed, how they impact it, and how it impacts them; and
- empower participants to apply knowledge and awareness gained through the REP to identify and address environmental issues in the Rouge River watershed and beyond

The Rouge Education Project began in 1987 with 16 high schools. During fall 2019, 17 schools, representing 14 communities throughout southeast Michigan, participated (Appendix I). This involved 1,501 students, 45 teachers, and over 47 parent, corporate, and other trained volunteers – making it our largest fall monitoring event to-date! Official monitoring day was Wednesday, October 9, 2019, but schools sampled September 20 – October 18.

Results throughout this report are organized by the seven subwatersheds that comprise the Rouge River basin: Lower 1 and Lower 2 (encompassing the Lower Branch of the river), Main 1-2 and Main 3-4 (encompassing the Main Branch of the river and the Main Stem downstream of the confluence of all branches), Middle 1 and Middle 3 (encompassing the Middle Branch of the river), and Upper (encompassing the Upper Branch of the river).

The majority of participating schools use a combination of *LaMotte* brand water test kits and a Hach® Total Phosphate testing kit for chemical analyses. In addition, a small minority of schools conduct chemical testing with a series of Hach® brand testing kits and/or digital testing probes and meters. This report, additional data, and program information also are available on the Friends of the Rouge website at www.therouge.org.

How Data are Used

As noted above, the REP mission is to promote and increase each student's environmental awareness and sense of stewardship within his or her local watershed. As such, data are not intended to meet the same standards of collection and use as other, more scientifically rigorous programs. While REP staff continues to develop effective quality assurance/quality control methods to ensure that the data are as consistent and reliable as possible, REP results are used primarily for educational awareness and demonstrate an exercise in field water quality monitoring and analysis for school groups.

Michigan Watersheds & the Rouge River Basin

Michigan is home to numerous wetlands, streams, and rivers. Figure 1 displays the general division of watersheds throughout the state. Areas that are left un-shaded are areas with many small streams and no major river body.

Figure 1: Major watersheds of Michigan. The red outline depicts the Rouge River basin. (Image courtesy of Michigan State University.)

Scaling down to the Rouge from the state level, the river is divided into seven smaller drainage basins called "sub-watersheds." These subwatersheds (Figure 2) comprise the four branches of the Rouge River: the Main, Upper, Middle, and Lower branches. All four branches flow into the Main Stem, which empties into the Detroit River. The Rouge River watershed is approximately 467 square miles in area and is home to 1.35 million people in 48 communities.

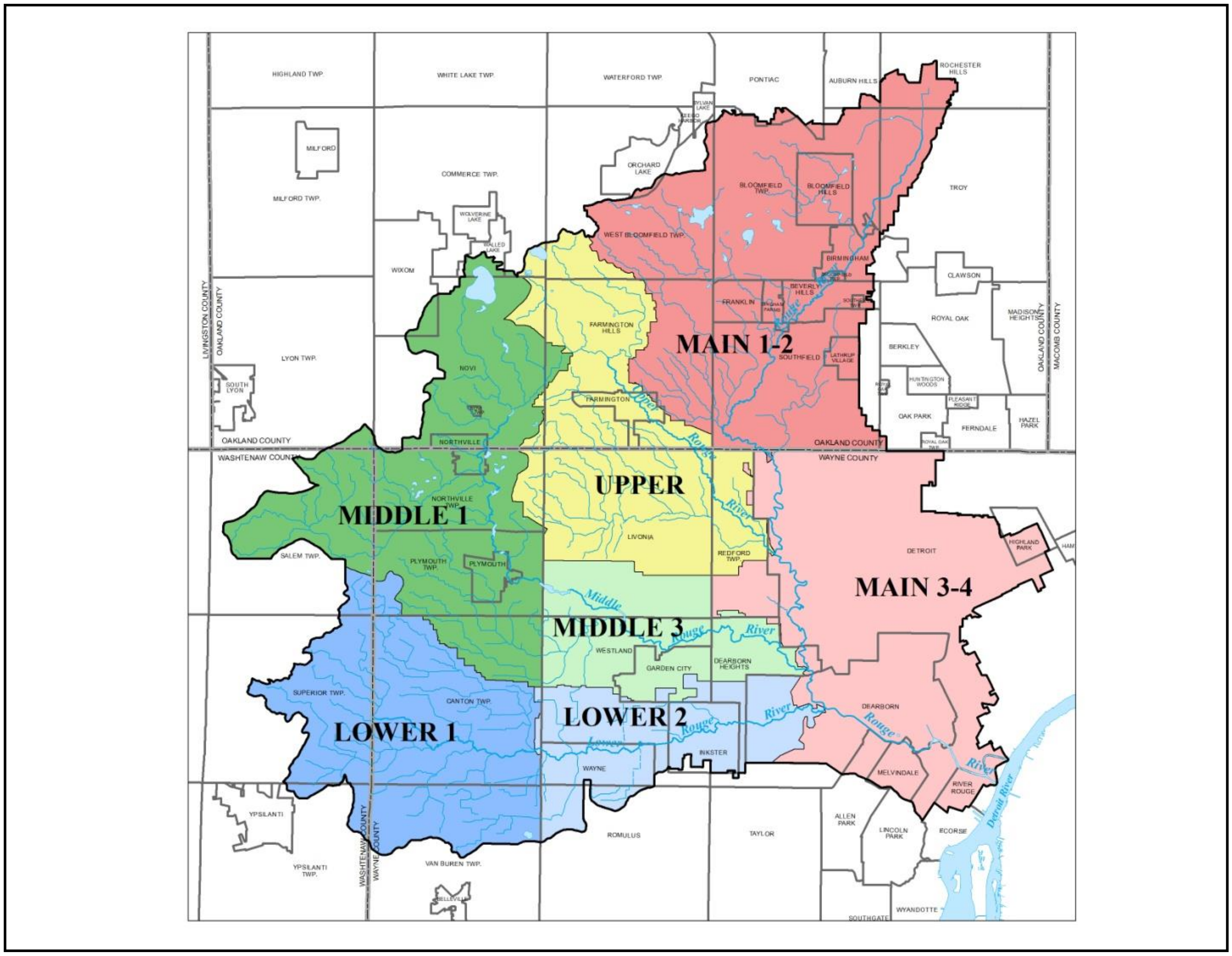

Figure 2: Seven subwatersheds that make up the Rouge River basin in Michigan

Water Quality Monitoring Parameters

Schools participating in the Rouge Education Project are encouraged to follow the procedures recommended in the Mark K. Mitchell & Wiliam B. Stapp *Field Manual for Water Quality Monitoring*. The Rouge Education Project was the first large-scale sampling event of its kind using this protocol.

Chemical Monitoring

Schools participating in the REP monitor up to nine chemical water quality parameters (described below). These include dissolved oxygen, fecal coliform bacteria, pH, biochemical oxygen demand (BOD), change in temperature, total phosphates, nitrates, turbidity, and total solids (though elementary schools do not conduct the latter).

Middle and high schools that monitor at least six chemical parameters calculate an overall water quality value (index) for their sampling site, which is based on all of their chemical test results. This value, dubbed the "Q" value, is on a scale of zero to 100, with higher numbers indicating relatively better water quality (Appendix II). Chemical testing techniques reveal a snapshot of water conditions at the time of sampling opposed to conditions over time.

Dissolved oxygen

Oxygen from the atmosphere is mixed into water by waves and turbulent motion. Algae and rooted aquatic plants also put oxygen into water through photosynthesis. Most aquatic plants and animals must have some amount of oxygen to survive. Waters with consistently high levels of dissolved oxygen (DO) are considered to be stable ecosystems and able to support diverse populations of organisms. DO results are commonly reported as milligrams of oxygen per liter of water (mg/L), and are considered in terms of the tolerance of certain organisms, particularly fishes, to low (*i.e.,* stressful) levels. DO levels below 3.0 mg/L are considered too low to sustain fish populations.

Fecal coliform bacteria

Feces of humans and other warm-blooded animals contain *E. coli* and other types of fecal coliform bacteria. These bacteria themselves do not normally cause disease or illness, but if levels are high, it is more likely that other pathogens are present in the water. Sources of fecal coliform in the river include discharged sewage, wildlife wastes, and runoff from pet waste and livestock. It is important to note that in the Rouge, fecal coliform levels tend to be much higher after rain or snowmelt than during dry periods. During heavy rains and snowmelt, animal wastes are washed into the river and combined sewer systems may overflow, releasing raw or partially treated sewage. Results are commonly reported as the number of colonies of fecal coliform bacteria per 100 milliliters of water.

pH

Water (H_2O) is composed of hydroxide (OH^-) and hydrogen (H^+) ions. The pH test, which stands for "potential of hydrogen," measures the concentration of H^+ ions in a given water sample (*i.e.,* the potential to "give away" excess hydrogen ions). pH values range from zero to 14. A pH of 7 is considered neutral, less than 7 is acidic, and greater than 7 is basic. The pH of water in the U.S. is usually between 6.5 and 8.5. Most organisms cannot live in water that has high or low pH values (more than 9.6 or less than 4.5). The pH is commonly reported as pH units. It is important to note that pH values are logarithmic (pH= $-\log[H^+]$) and, therefore, cannot be averaged to express central tendency (*i.e.,* mean). Instead, median values are used to express central tendency.

Biochemical oxygen demand

Biochemical oxygen demand (BOD) is the measure of the amount of oxygen used by aerobic (air-breathing) microorganisms, such as bacteria and fungi, as they feed upon decomposing organic matter, such as dead aquatic plants. Inputs of phosphates and nitrates to water bodies stimulate the growth of aquatic plants. As these plants die and decompose over time, more and more oxygen is removed from the water by the microorganisms that break them down. High BOD levels can lead to fish kills as the aerobic bacteria use up the dissolved oxygen that fish need to live. BOD results are commonly reported as milligrams of oxygen per liter of water.

Change in temperature

For this test, water temperature is measured both at the sampling site and one mile upstream. The upstream temperature is then subtracted from the downstream temperature to determine the change in temperature. Most physical, biological, and chemical processes in a river are directly affected by temperature. For example, temperature affects the amount of dissolved oxygen in water (cold water holds more oxygen than warm water), the rate of photosynthesis in plants, the metabolic rate of aquatic animals, and the sensitivity of organisms to pollution, disease, and parasites. Changes in water temperature may be the result of thermal pollution (adding warm water to a body of water), changes in the amount of shade over the river, and soil erosion (soil particles suspended in water absorb heat from sunlight). Results for this metric are commonly reported as degrees Celsius.

Total phosphates

Phosphorus is a nutrient that plants need to grow. In most waters, phosphorus is present in very low concentrations, which limits plant growth. However, phosphorus is added to water through human and industrial wastes, fertilizers, and processes that disturb land vegetation. When human activities increase the rate of the supply of phosphorus (and/or other "organic matter") to a water body, it is called cultural eutrophication. The addition of excess nutrients, such as phosphorus, stimulates plant growth and can cause dramatic growth ("blooms") of resident algae and other vegetation. When this vegetation decomposes, dissolved oxygen levels drop dramatically, especially near the bottom of the body of water. Results are commonly reported as milligrams of total phosphate per liter of water.

Nitrates

All plants and animals require nitrogen to build protein. In freshwater systems, nitrogen is naturally more abundant than phosphorus and is most commonly found in its dissolved, atmospheric form (N_2 gas). However, this is not readily available for use by most aquatic plants and must be converted to ammonia (NH_3) and nitrates (NO_3^-). In these forms, nitrogen acts as a plant nutrient, loadings of which can contribute to eutrophication (see *Total phosphates* section above). Plants are less sensitive to changes in ammonia and nitrate levels than they are to phosphorus, however, because nitrogen so rarely limits plant growth (since it is naturally more abundant than phosphorus in freshwater environments). Excess nitrogen is added to rivers by humans through sewage, fertilizers, and runoff from dairies and barnyards. Results are commonly reported as milligrams of nitrates per liter of water.

Note that, as of spring 2013, results for this parameter are not comparable with nitrate findings from historical REP data. This is due to the fact that a conversion factor was introduced and used to account for the entire nitrate compound, as opposed to the isolated nitrogen molecule, which is solely what the LaMotte-brand testing kit measures.

Turbidity

Turbidity is a measure of water clarity; murky or cloudy water has a high turbidity, while clear water has a low turbidity. Suspended solids – such as soil particles, sewage, plankton, and industrial wastes – increase turbidity and decrease the transmission of light. Turbid waters are warmer (see *Change in temperature* section above) and allow less sunlight through for photosynthesis to occur in aquatic plants. In turn, warmer water contains less oxygen for organisms to utilize, which can lead to lower abundances of fishes and invertebrates. Also, suspended solids can harm aquatic organisms by clogging gills, increasing susceptibility to disease, slowing growth rates, and preventing the development of larvae and eggs.

REP schools choose one of three different methods to measure turbidity, which yield results in three different units: feet and inches (using a secchi disk), Jackson Turbidity Units (using a field test kit), and Nephlometer Turbidity Units (using a turbidimeter). To facilitate comparison, these results are converted to a Q-value, which is a scale of approximately zero to 100. As with the overall water quality index (see above), the higher the Q-value, the lower the turbidity, and the better the water quality.

Total solids

As opposed to turbidity, measuring total solids gives a more quantitative indication of the amount of dissolved and suspended material in water. Suspended solids are matter that can be trapped by a filter, such as soil particles, sewage, plankton, and industrial wastes. These are the materials typically considered to cause changes in turbidity and, as such, are associated with the effects listed above (*e.g.,* clogging gills, increasing disease susceptibility). Dissolved solids are matter that can pass through a filter, such as bicarbonate, calcium, phosphorus, iron, nitrogen, sulfur, and other ions. Dissolved solids can harm aquatic organisms in other ways. Among other effects, these materials control the flow of water to and from organisms' cells, and can affect their balance in the water column. Sources of total solids include urban runoff, lawn fertilizers, effluent from wastewater treatment plants, soil erosion, and decayed plant and animal matter. Results are commonly reported as milligrams of total solids per liter of water.

Biological Monitoring

Most elementary, middle, and high schools in the Rouge Education Project conduct biological monitoring by sampling for and identifying benthic macroinvertebrates. Teachers and select volunteers are trained in sampling and identification using protocol from the Michigan Clean Water Corps for volunteer water monitoring (Appendix II). Schools calculate a total stream quality score based on the type and quantity of benthic macroinvertebrates that they find; higher scores indicate better water quality. These data are not included in this report due to the often incorrect identification of the organisms. To find acceptable biological monitoring data, please refer to the Friends of the Rouge

Benthic Macroinvertebrate Sampling Program results which can be found on the Friends of the Rouge website.

Benthic macroinvertebrates

Benthic macroinvertebrates are bottom-dwelling organisms without a backbone that are visible to the naked eye, such as aquatic insect larvae, crayfish, clams, snails, leeches, and aquatic worms. Some benthic invertebrates are very sensitive to pollution and are only found in pristine areas, while others have a high tolerance for pollution and can live in both pristine and lower quality areas. Thus, the types and abundance of benthic organisms collected in the river can be a key indicator of the water quality of an area over time.

Physical Monitoring

Elementary, middle, and high schools in the Rouge Education Project conduct physical monitoring by completing a physical stream survey (Appendix II). Most of the survey is qualitative, based on observations of the immediate site and surrounding land uses. Schools use this information to assess stream site conditions, compare results to the previous year(s), if applicable, and then are encouraged to discuss and form conclusions in reference to benthic and chemical sampling results. Results are not included in this report, but are available on the Friends of the Rouge website.

Sampling Sites & School Locations

REP 2019 Schools & Sampling Sites

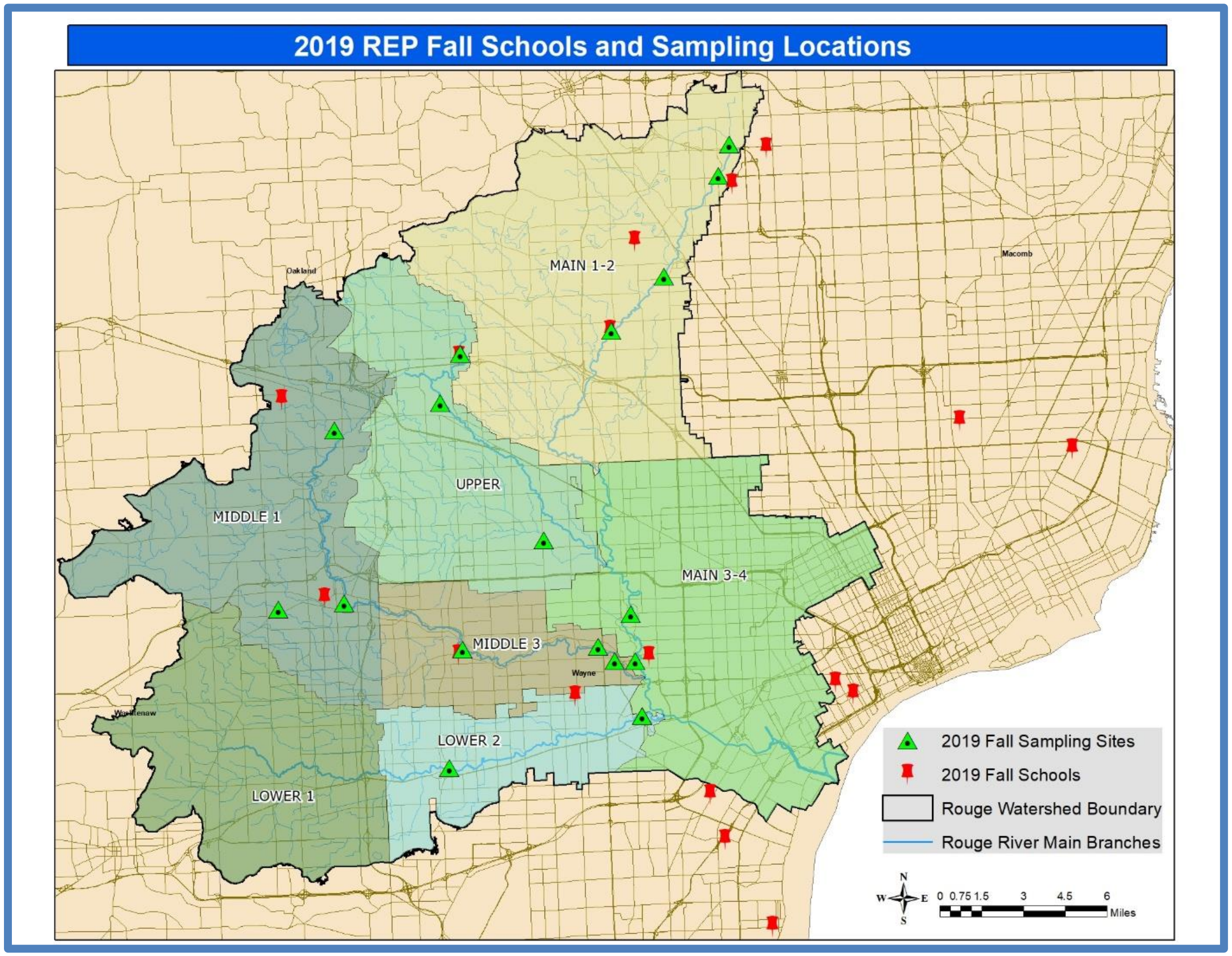

Figure 3: Distribution of fall 2019 schools and monitoring sites (N = 17). The shaded area delineates the Rouge River watershed (as in Figure 2, above). Green and black triangles indicate sampling sites of participating schools. Red push-pins indicate school locations. Different schools using the same monitoring site were assigned different monitoring dates to avoid overlap, sample contamination, data obfuscation, etc.

Chemical Testing Results: Advanced Kits

Schools sampling within each subwatershed are listed. Not each school, however, was able to collect a full range of samples. Thus, scores reported for each parameter may not reflect all schools that monitored in an area. Raw data are available at www.therouge.org and at the end of this report. Please note that the schools reporting are only listed for fall 2019.

Lower 1 Subwatershed

School reporting: None

Lower 2 Subwatershed

School reporting: Inter-City Baptist School, Lincoln Park High School

Parameter	Fall 2018 Mean	Fall 2019 Mean	State of Michigan Standard (MDEQ)
Dissolved oxygen (mg/L)	8.35	6.82	5 mg/L for warm water fish (bass, bluegill, pike)--most of Rouge River.
Fecal coliform (colonies/100 mL water)		175	<300 colonies *E. coli*/100 ml for total body contact (swimming), <1,000 colonies *E. coli*/100 ml for partial body contact (boating, fishing).
pH (pH units)*	7.38	7.25	6.5 to 9.0, any discharge into the river must not change the natural pH more than 0.5 units.
Biochemical oxygen demand (mg/L)			No state standard; effluent limitations must be restrictive enough to ensure the receiving water will meet standards for dissolved oxygen.
Change in temperature (°C)	0.05	0.65	Any discharge into the river should not warm the water more than 2.8°C (5°F).
Total phosphates (mg/L)		2.23	No state standard; level of phosphates must not stimulate excessive growth of aquatic plants, fungi, or bacteria. Point-source discharges must not exceed 3.0 mg/L as a maximum monthly average unless other limits, either higher or lower, are deemed necessary and appropriate by the MDEQ. The EPA recommends that total phosphates should not exceed 0.15 mg/L in a stream at the point where it enters a lake or reservoir, and should not exceed 0.3 mg/L in streams that do not enter a lake or reservoir.
Nitrates (mg/L)	3	34.4	No state standard; level of nitrates must not stimulate the growth of aquatic rooted, attached, suspending, and floating plants, fungi, or bacteria which are or may become injurious to designated uses**.
Turbidity (Q-value)***	51	73	Cannot have unnatural quantities injurious to designated uses**.
Total solids (mg/L)		634	Cannot have unnatural quantities injurious to designated uses**.
Overall water quality index		53	No state standard; generally 91-100 excellent, 71-90 good, 51-70 medium, 26-50 fair, 0-25 poor

*pH values reported are the median, not the mean.
**At minimum, all surface waters of the state are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption.
***See Turbidity paragraph in the Water Quality Parameters section for an explanation of Q-value.

Main 1-2 Subwatershed

School reporting: Detroit Country Day Middle School, Troy College & Career High School, Troy High School

Parameter	Fall 2018 Mean	Fall 2019 Mean	State of Michigan Standard (MDEQ)
Dissolved oxygen (mg/L)	5.3	7.63	5 mg/L for warm water fish (bass, bluegill, pike)--most of Rouge River.
Fecal coliform (colonies/100 mL water)	100	80	<300 colonies *E. coli*/100 ml for total body contact (swimming), <1,000 colonies *E. coli*/100 ml for partial body contact (boating, fishing).
pH (pH units)*	7.9	7.8	6.5 to 9.0, any discharge into the river must not change the natural pH more than 0.5 units.
Biochemical oxygen demand (mg/L)	0.9	2.07	No state standard; effluent limitations must be restrictive enough to ensure the receiving water will meet standards for dissolved oxygen.
Change in temperature (°C)	0.1	0.67	Any discharge into the river should not warm the water more than 2.8°C (5°F).
Total phosphates (mg/L)	0.1	0.44	No state standard; level of phosphates must not stimulate excessive growth of aquatic plants, fungi, or bacteria. Point-source discharges must not exceed 3.0 mg/L as a maximum monthly average unless other limits, either higher or lower, are deemed necessary and appropriate by the MDEQ. The EPA recommends that total phosphates should not exceed 0.15 mg/L in a stream at the point where it enters a lake or reservoir, and should not exceed 0.3 mg/L in streams that do not enter a lake or reservoir.
Nitrates (mg/L)	4.4	5.2	No state standard; level of nitrates must not stimulate the growth of aquatic rooted, attached, suspending, and floating plants, fungi, or bacteria which are or may become injurious to designated uses**.
Turbidity (Q-value)***	67	74	Cannot have unnatural quantities injurious to designated uses**.
Total solids (mg/L)	568	287	Cannot have unnatural quantities injurious to designated uses**.
Overall water quality index	68	75	No state standard; generally 91-100 excellent, 71-90 good, 51-70 medium, 26-50 fair, 0-25 poor

*pH values reported are the median, not the mean.
**At minimum, all surface waters of the state are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption.
***See Turbidity paragraph in the Water Quality Parameters section for an explanation of Q-value.

Main 3-4 Subwatershed

Schools reporting: None

Middle 1 Subwatershed

<u>Schools reporting</u>: Roosevelt High School, Steppingstone School

Parameter	Fall 2018 Mean	Fall 2019 Mean	State of Michigan Standard (MDEQ)
Dissolved oxygen (mg/L)		7.6	5 mg/L for warm water fish (bass, bluegill, pike)--most of Rouge River.
Fecal coliform (colonies/100 mL water)		100	<300 colonies *E. coli*/100 ml for total body contact (swimming), <1,000 colonies *E. coli*/100 ml for partial body contact (boating, fishing).
pH (pH units)*		7.50	6.5 to 9.0, any discharge into the river must not change the natural pH more than 0.5 units.
Biochemical oxygen demand (mg/L)		1.55	No state standard; effluent limitations must be restrictive enough to ensure the receiving water will meet standards for dissolved oxygen.
Change in temperature (°C)		2.4	Any discharge into the river should not warm the water more than 2.8°C (5°F).
Total phosphates (mg/L)		3.50	No state standard; level of phosphates must not stimulate excessive growth of aquatic plants, fungi, or bacteria. Point-source discharges must not exceed 3.0 mg/L as a maximum monthly average unless other limits, either higher or lower, are deemed necessary and appropriate by the MDEQ. The EPA recommends that total phosphates should not exceed 0.15 mg/L in a stream at the point where it enters a lake or reservoir, and should not exceed 0.3 mg/L in streams that do not enter a lake or reservoir.
Nitrates (mg/L)		1.30	No state standard; level of nitrates must not stimulate the growth of aquatic rooted, attached, suspending, and floating plants, fungi, or bacteria which are or may become injurious to designated uses**.
Turbidity (Q-value)***		72	Cannot have unnatural quantities injurious to designated uses**.
Total solids (mg/L)		544	Cannot have unnatural quantities injurious to designated uses**.
Overall water quality index		67	No state standard; generally 91-100 excellent, 71-90 good, 51-70 medium, 26-50 fair, 0-25 poor

*pH values reported are the median, not the mean.
**At minimum, all surface waters of the state are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption.
***See Turbidity paragraph in the Water Quality Parameters section for an explanation of Q-value.

Middle 3 Subwatershed

School reporting: Crestwood High School, Huron Valley Lutheran High School, Lincoln Senior High School

Parameter	Fall 2018 Mean	Fall 2019 Mean	State of Michigan Standard (MDEQ)
Dissolved oxygen (mg/L)	9.91	8.15	5 mg/L for warm water fish (bass, bluegill, pike)--most of Rouge River.
Fecal coliform (colonies/100 mL water)	2600	1022	<300 colonies *E. coli*/100 ml for total body contact (swimming), <1,000 colonies *E. coli*/100 ml for partial body contact (boating, fishing).
pH (pH units)*	7.96	8.00	6.5 to 9.0, any discharge into the river must not change the natural pH more than 0.5 units.
Biochemical oxygen demand (mg/L)	3.02	3.66	No state standard; effluent limitations must be restrictive enough to ensure the receiving water will meet standards for dissolved oxygen.
Change in temperature (°C)	0	0.33	Any discharge into the river should not warm the water more than 2.8°C (5°F).
Total phosphates (mg/L)	0.33	0.22	No state standard; level of phosphates must not stimulate excessive growth of aquatic plants, fungi, or bacteria. Point-source discharges must not exceed 3.0 mg/L as a maximum monthly average unless other limits, either higher or lower, are deemed necessary and appropriate by the MDEQ. The EPA recommends that total phosphates should not exceed 0.15 mg/L in a stream at the point where it enters a lake or reservoir, and should not exceed 0.3 mg/L in streams that do not enter a lake or reservoir.
Nitrates (mg/L)	0.3	5.4	No state standard; level of nitrates must not stimulate the growth of aquatic rooted, attached, suspending, and floating plants, fungi, or bacteria which are or may become injurious to designated uses**.
Turbidity (Q-value)***	52	67	Cannot have unnatural quantities injurious to designated uses**.
Total solids (mg/L)	645	529	Cannot have unnatural quantities injurious to designated uses**.
Overall water quality index	69	67	No state standard; generally 91-100 excellent, 71-90 good, 51-70 medium, 26-50 fair, 0-25 poor

*pH values reported are the median, not the mean.
**At minimum, all surface waters of the state are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption.
***See Turbidity paragraph in the Water Quality Parameters section for an explanation of Q-value.

Upper Subwatershed

Schools reporting: Chandler Park Academy High School, Clippert Multicultural Honors Academy, Farmington STEAM Academy

Parameter	Fall 2018 Mean	Fall 2019 Mean	State of Michigan Standard (MDEQ)
Dissolved oxygen (mg/L)	6.65	8.74	5 mg/L for warm water fish (bass, bluegill, pike)--most of Rouge River.
Fecal coliform (colonies/100 mL water)	345	145	<300 colonies *E. coli*/100 ml for total body contact (swimming), <1,000 colonies *E. coli*/100 ml for partial body contact (boating, fishing).
pH (pH units)*	8.25	8.00	6.5 to 9.0, any discharge into the river must not change the natural pH more than 0.5 units.
Biochemical oxygen demand (mg/L)	1.65	2.47	No state standard; effluent limitations must be restrictive enough to ensure the receiving water will meet standards for dissolved oxygen.
Change in temperature (°C)	0.5	0	Any discharge into the river should not warm the water more than 2.8°C (5°F).
Total phosphates (mg/L)	0.77	0.07	No state standard; level of phosphates must not stimulate excessive growth of aquatic plants, fungi, or bacteria. Point-source discharges must not exceed 3.0 mg/L as a maximum monthly average unless other limits, either higher or lower, are deemed necessary and appropriate by the MDEQ. The EPA recommends that total phosphates should not exceed 0.15 mg/L in a stream at the point where it enters a lake or reservoir, and should not exceed 0.3 mg/L in streams that do not enter a lake or reservoir.
Nitrates (mg/L)	13.2	10.3	No state standard; level of nitrates must not stimulate the growth of aquatic rooted, attached, suspending, and floating plants, fungi, or bacteria which are or may become injurious to designated uses**.
Turbidity (Q-value)***	79.5	67	Cannot have unnatural quantities injurious to designated uses**.
Total solids (mg/L)	691.4	566	Cannot have unnatural quantities injurious to designated uses**.
Overall water quality index	60	75	No state standard; generally 91-100 excellent, 71-90 good, 51-70 medium, 26-50 fair, 0-25 poor

*pH values reported are the median, not the mean.
**At minimum, all surface waters of the state are designated and protected for all of the following uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, fish consumption.
***See Turbidity paragraph in the Water Quality Parameters section for an explanation of Q-value.

Figures

Mean results for each parameter are shown below. Results with zero or one colored bar(s) present indicate that data were not available in one or both sampling seasons. Data depicted are from the advanced set of chemical data. Not every school reporting could associate the same degree of confidence in their data collection and calculation of final values, therefore standard error bars have been excluded from figures.

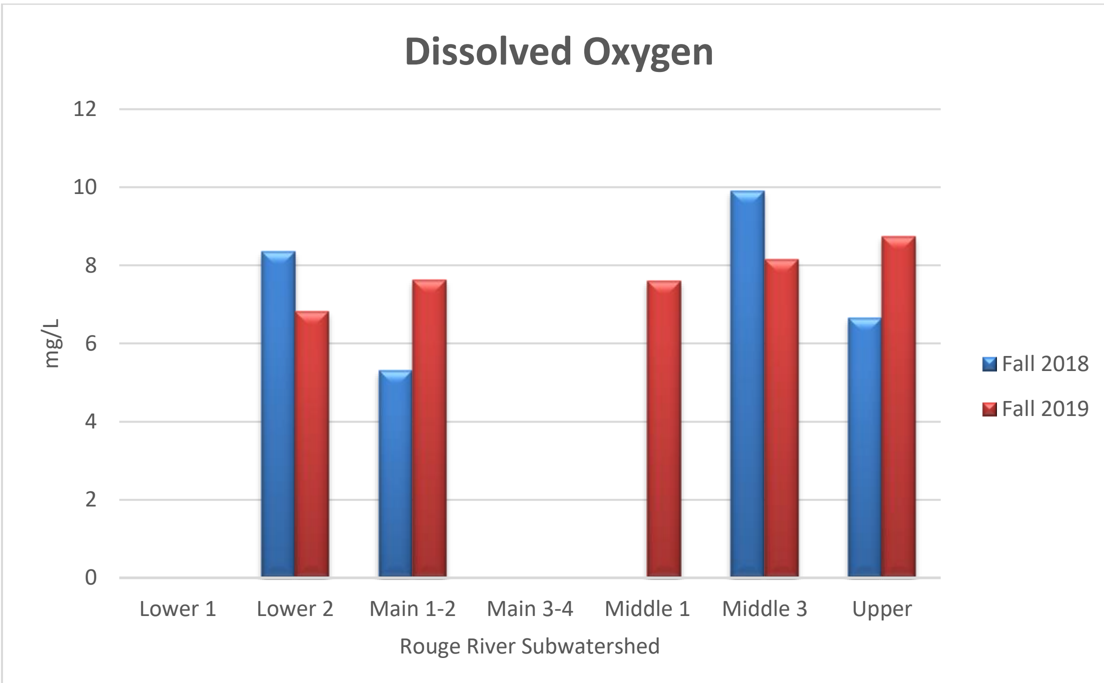

Figure 4: DISSOLVED OXYGEN results from fall 2018 and 2019 monitoring. Results were not available for the Lower 1 or Main 3-4, or Middle 1 in 2018.

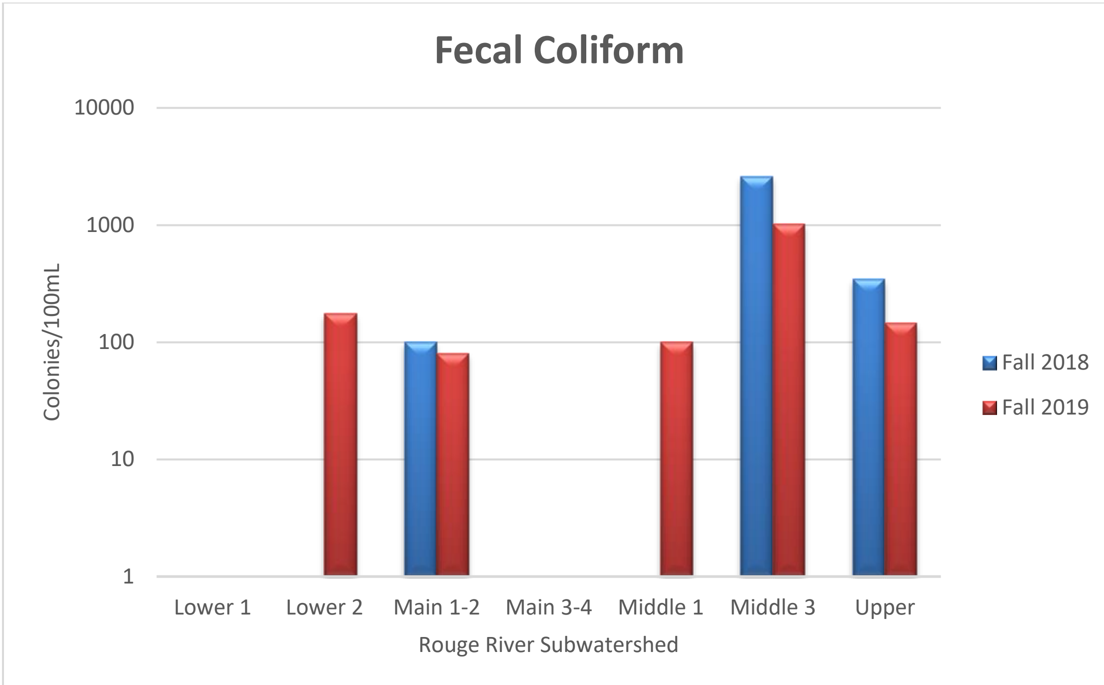

Figure 5: FECAL COLIFORM results from fall 2018 and 2019 monitoring. Results are presented on a logarithmic scale. Results were not available from the Lower 1 or Main 3-4, or the Lower 2 or Middle 1 in 2018.

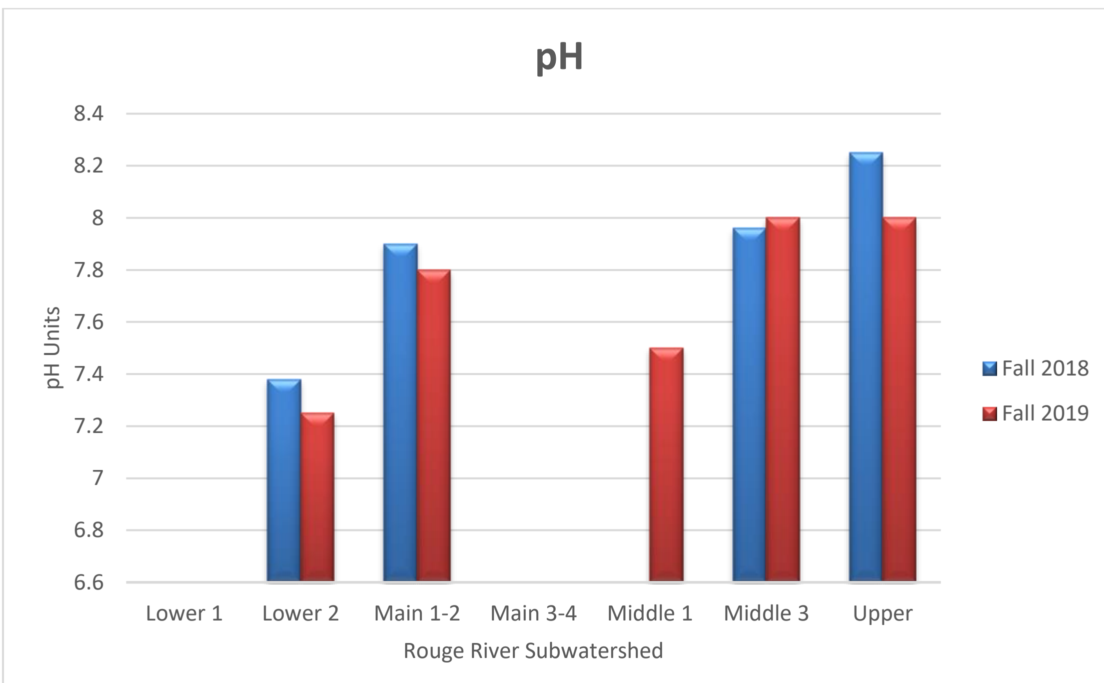

Figure 6: pH results for fall 2018 and 2019 monitoring. Results depict the median value of those collected in each subwatershed. Results were not available for the Lower 1 or Main 3-4, or Middle 1 in 2018.

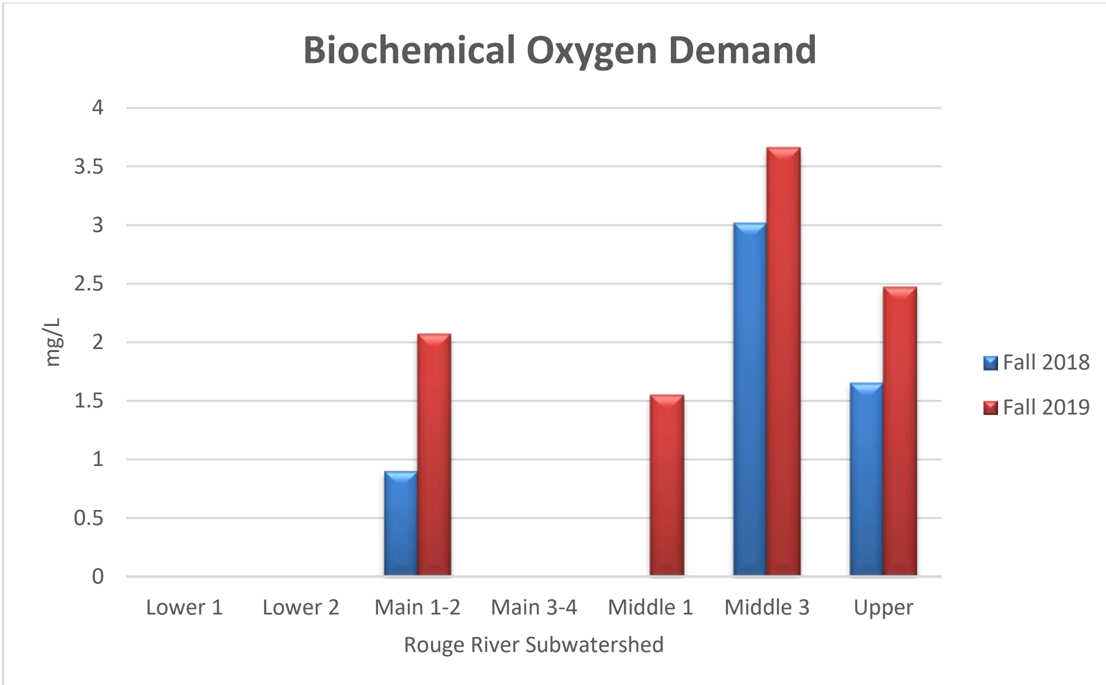

Figure 7: BIOCHEMICAL OXYGEN DEMAND results for fall 2018 and 2019 monitoring. Results were not available for the Lower 1, Lower 2, or Main 3-4, or Middle 1 in 2018.

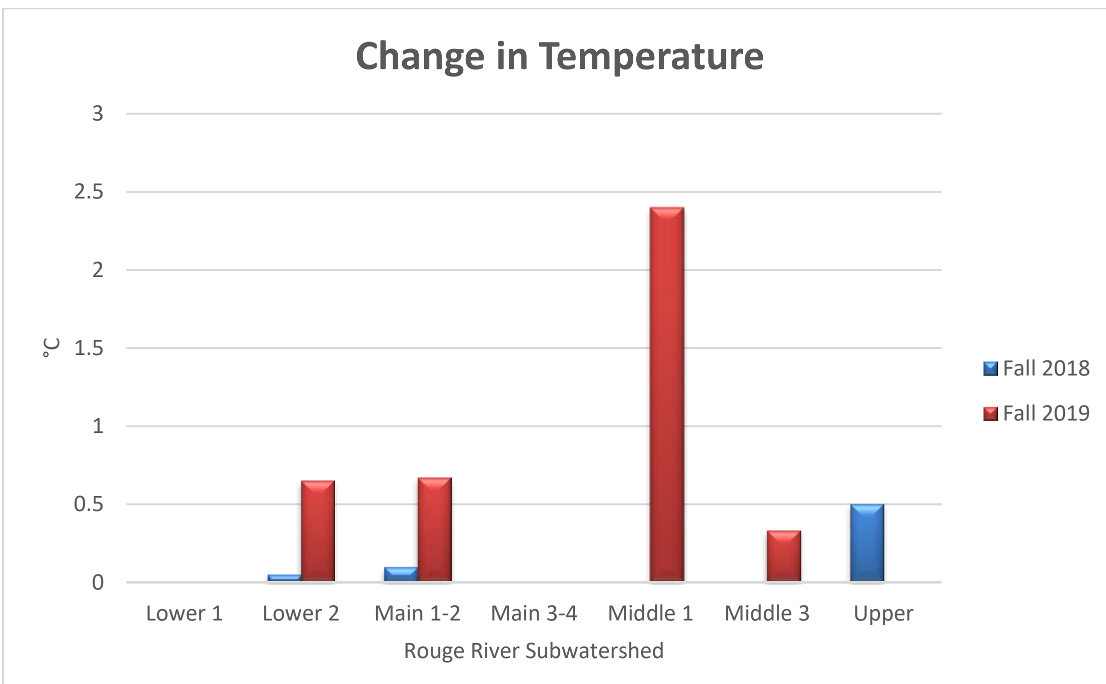

Figure 8: CHANGE IN TEMPERATURE results for fall 2018 and 2019 monitoring. Results were not available for the Lower 1 or Main 3-4, or the Middle 1 or Middle 3 in 2018.

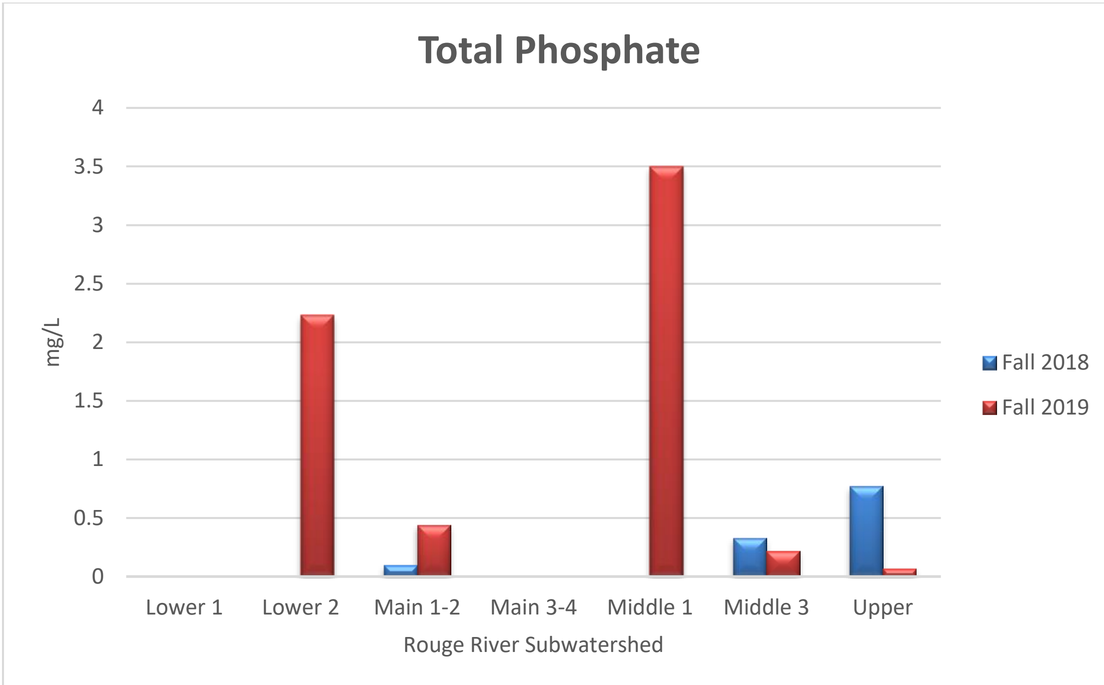

Figure 9: TOTAL PHOSPHATE results for fall 2018 and 2019 monitoring. Results were not available from the Lower 1 or Main 3-4, or the Lower 2 or Middle 1 in 2018.

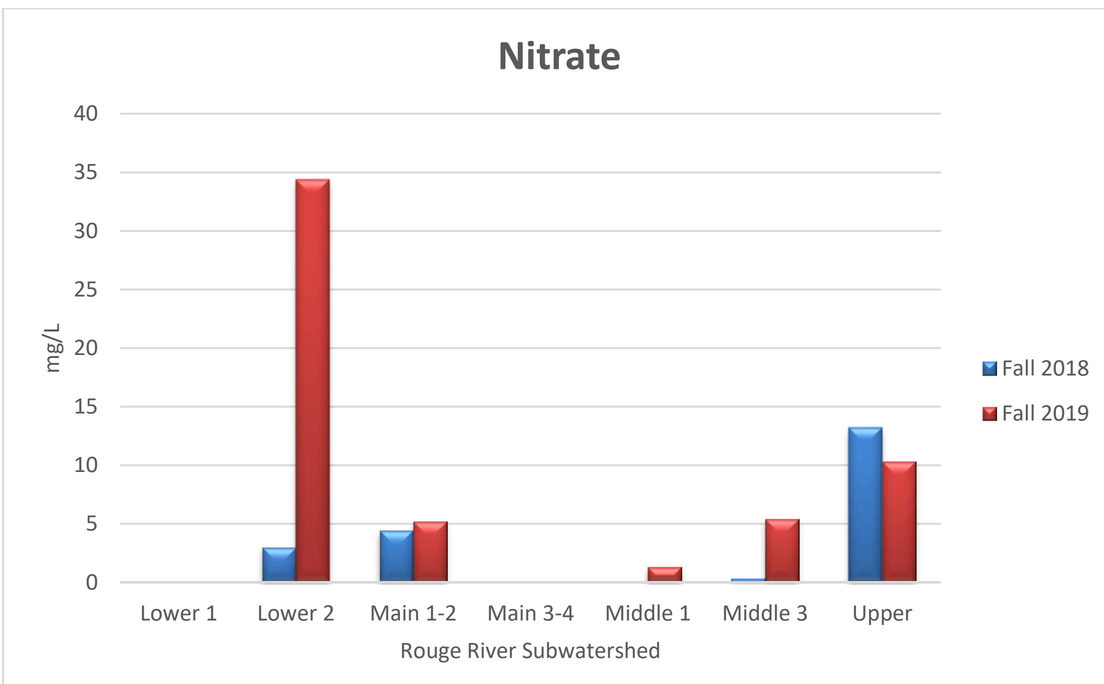

Figure 10: NITRATE results for fall 2018 and 2019 monitoring. Results were not available for the Lower 1 or Main 3-4, or the Middle 1 in 2018.

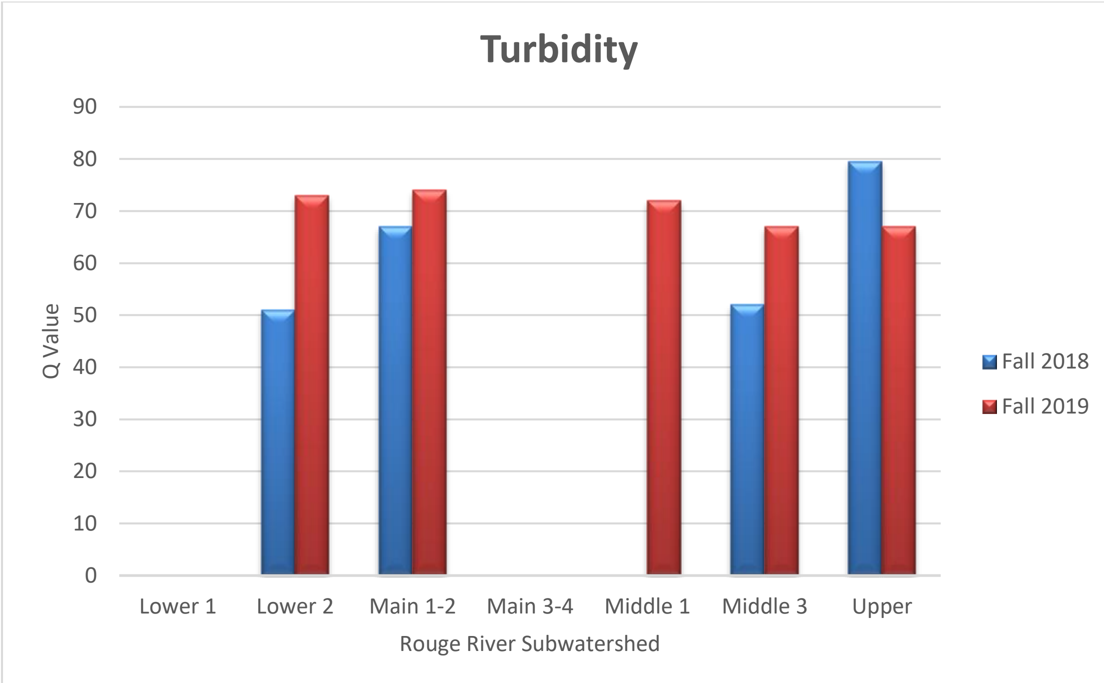

Figure 11: TURBIDITY results for fall 2018 and 2019 monitoring. As in tables above, results are displayed as standardized Q-values to account for the multiple units in which schools measure/record this parameter. Results were not available for the Lower 1 or Main 3-4, or Middle 1 in 2018.

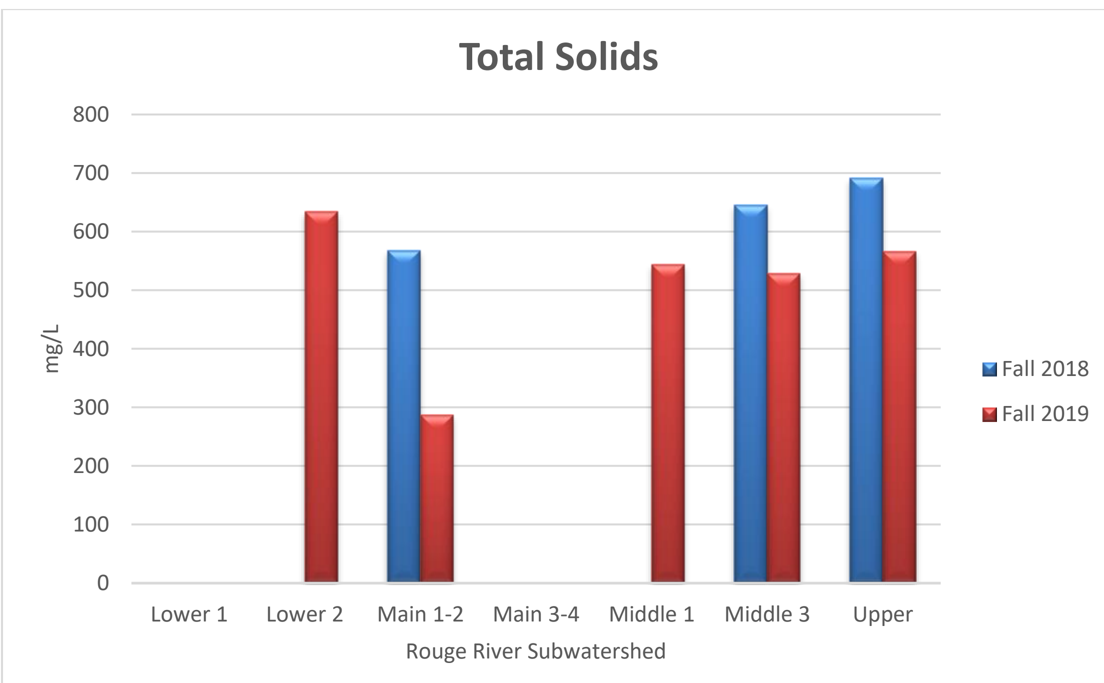

Figure 12: TOTAL SOLIDS results for fall 2018 and 2019. Results were not available for the Lower 1 or Main 3-4, or the Lower 2 or Middle 1 in 2018.

Overall Water Quality

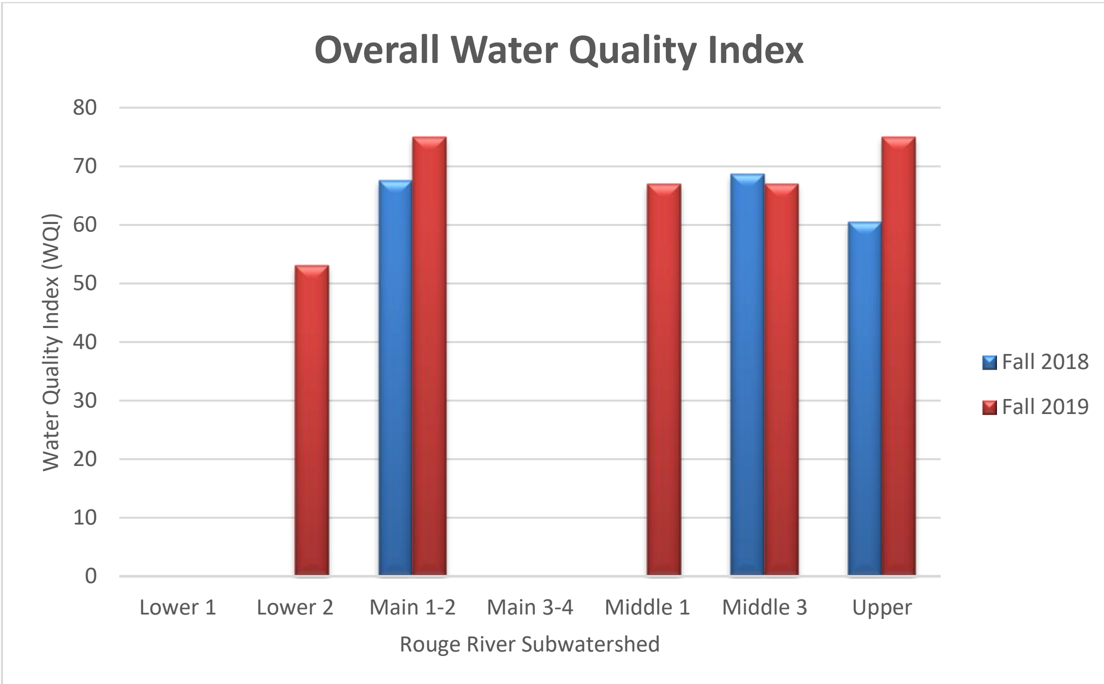

Figure 13: OVERALL WATER QUALITY INDEX for the seven subwatersheds of the Rouge River basin for fall 2018 and 2019. Water quality is measured on a 0-100 scale, with higher numbers reflecting relatively better water quality conditions. Water quality categories based on Q-values are as follows: 91-100 = Excellent; 71-90 = Good; 51-70 = Medium/average; 26-50 = Fair; 0-25 = Poor. Data were not available for the Lower 1 or Main 3-4, or the Lower 2 or Middle 1 in 2018.

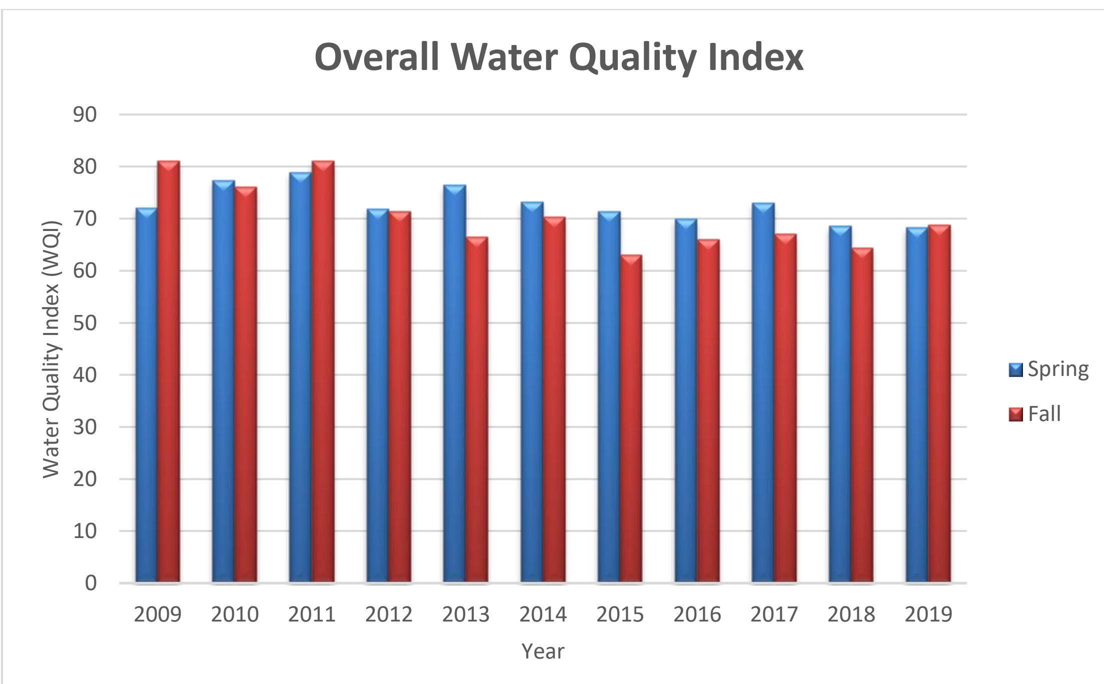

Figure 14: OVERALL WATER QUALITY INDEX for the entire Rouge River watershed (as sampled by REP participants) from spring 2009 through fall 2019. Water quality categories based on Q-values are as follows: 91-100 = Excellent; 71-90 = Good; 51-70 = Medium/average; 26-50 = Fair; 0-25 = Poor.

Chemical Testing Results: EZ-Tab Kits

EZ-Tab results are categorized for each parameter measured according to a range of possible results. Schools used the LaMotte brand GREEN Low-Cost Water Quality Monitoring Kit. The "Overall Water Quality" score is ranked on a 1-4 scale (4.0 = Excellent; 3.0 = Good; 2.0 = Fair; 1.0 = Poor). Results in the tables below represent the mean (or raw in the case of only one school representing a subwatershed). As of fall 2016, a new data sheet reflecting measured results (instead of the resulting "Excellent / Good / Fair / Poor" values) was introduced. Please note that the schools reporting are only listed for spring 2018.

Lower 1 Subwatershed

Schools reporting: None

Lower 2 Subwatershed

Schools reporting: None

Main 1-2 Subwatershed

School reporting: Birmingham Covington School

Parameter	Fall 2018 Mean	Fall 2019 Mean
Dissolved oxygen (% saturation)	42.25	50
Fecal coliform (Presence: Y=Poor; N=Good)	Y	
pH*	7	7
Biochemical oxygen demand (mg/L)	4	
Change in temperature (°C)	0.5	0
Total phosphates (mg/L)	1.5	2.00
Nitrates (mg/L)	2.63	5.0
Turbidity (JTU)	0	>0-40
Overall water quality index	3.06	2.83
*pH values reported are the median, not the mean.		

Main 3-4 Subwatershed

Schools reporting: None

Middle 1 Subwatershed

Schools reporting: Novi Meadows Elementary School

Parameter	Fall 2018 Mean	Fall 2019 Mean
Dissolved oxygen (% saturation)		74
Fecal coliform (Presence: Y=Poor; N=Good)		Positive
pH*		7
Biochemical oxygen demand (mg/L)		4
Change in temperature (°C)		0
Total phosphates (mg/L)		0.66
Nitrates (mg/L)		20.0
Turbidity (JTU)		>0-40
Overall water quality index		2.88
*pH values reported are the median, not the mean.		

Middle 3 Subwatershed

Schools reporting: None

Upper Subwatershed

Schools reporting: None

Notable Results & Discussion

Fall Monitoring 2019

It is important to note that some subwatersheds had very few or no sites monitored, and not every school that participated reported data for each water quality parameter. Hence, these results may not fully represent the overall health of each subwatershed.

Overall, most parameters fell within the defined standards for the state of Michigan (and within ranges expected for the Rouge River). Values of note include a Change in Temperature along the Middle branch of 2.4 degrees Celsius, and extremely high total phosphate values of 3.4 and 3.5 mg/L from the Lower and Middle branches, respectively. There was also a high nitrate value at a site along the Upper at 26.4 mg/L. These were the only relatively unusual findings. These values are possible, and may indicate the need for further investigation.

All other parameters in these subwatersheds were within relatively "normal" ranges. Chemical analysis reflects a snapshot of conditions at the time of sampling.

Water levels varied slightly across the two-week long monitoring period due to wet-weather (Figure 15).

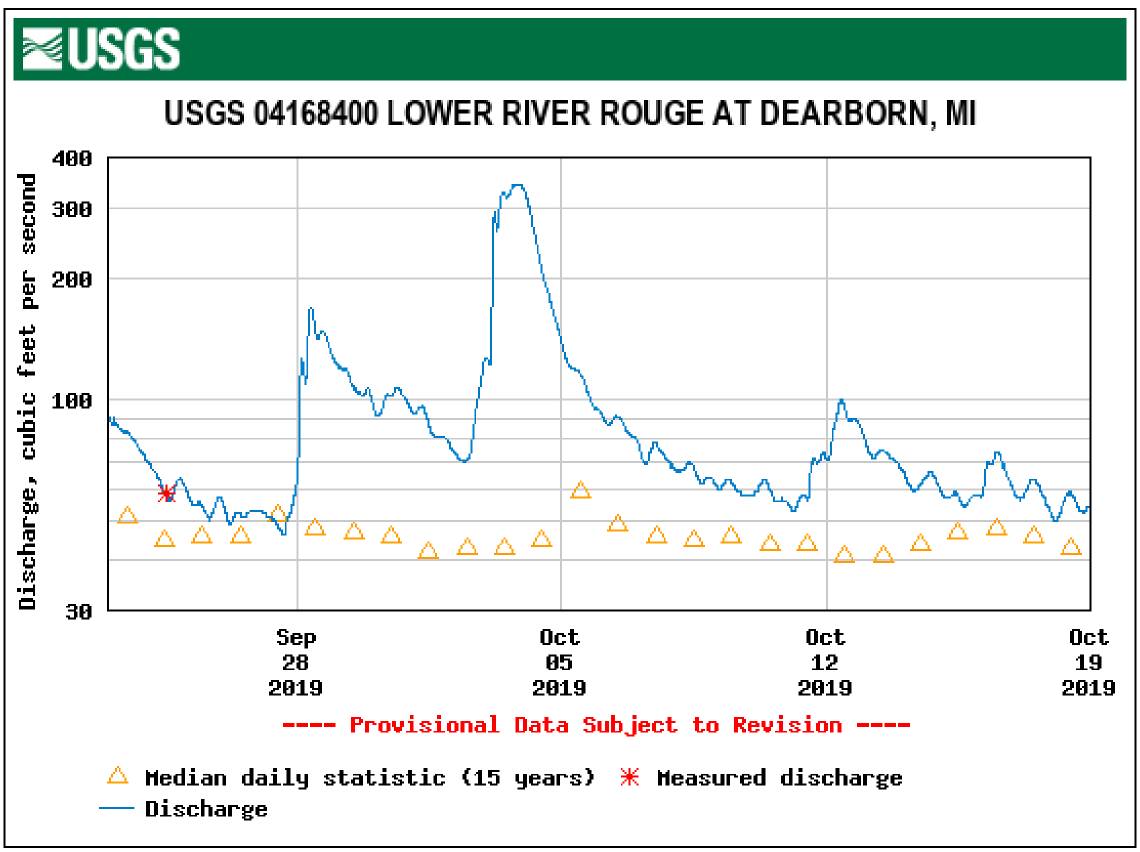

Figure 15: Streamflow data from the United States Geological Survey gage on the Lower Rouge River. Data are shown for the week prior to sampling (September 23, 2019) to the conclusion of all sampling events (October 18, 2019). Fifteen year (15) year median data are depicted by the orange triangles, and the daily mean of stream discharge for the time period under consideration is depicted by the solid blue line.

Overall Summary & Conclusions

Overall water quality results from fall 2019 appear to fall in line with results observed over the past 10 years (Figure 14). The Rouge River system remained in the "Medium" water quality category (water quality index between 51-70). Results are becoming more robust as additional schools conduct monitoring in the fall and test a complete set of parameters. The data set from this fall was missing results from the Academy of the Americas High School who sampled on the Main 3-4. Steppingstone School recently moved and changed sampling sites, therefore was unable to collect the usual full set of data. Tonda Elementary School planned to monitor in the fall, but cancelled due to rainy weather and were unable to reschedule. They plan to sample in the spring instead.

More schools continue to shift from a spring to fall monitoring event each season. This allows for discussion of results throughout the remainder of the school year, and leaves time for student-led action projects based on issues identified as part of their monitoring efforts.

Overall, there were a few values that may have cause for concern and further monitoring. This was the first time Roosevelt High School sampled their site at Plymouth Township Park in the fall. They had a noticeable change in temperature that almost violated the state standard of 2.8 degrees Celsius (although this state standard only applies to point-source discharges entering the water, of which this is not). Their sampling site is located downstream from a large detention pond that collects runoff from a parking lot. According to their results, the water temperature is 2.5 degrees Celsius cooler before it enters this detention pond from a heavily shaded area and small stream. This detention pond could be collecting runoff that has been warmed by the hot parking lot, and sits in a large pond that is generally not shaded at all.

Plymouth Township Park also had extremely high phosphate readings – at a level the Project has never seen at that site before. Their sampling site is also downstream from a golf course. Usually high phosphate values mean it is likely that nitrate values will also be high depending on the source. Their nitrate values were low, which may mean that the phosphorus runoff could potentially be coming from fertilizer at the golf course. The State of Michigan enacted a ban on phosphorus in fertilizer for home use, but golf courses are still allowed to apply phosphorus-containing fertilizer by a certified applicant. It would be interesting to know the golf course fertilizer schedule to see if this is the source of high phosphate levels and further testing is recommended to see if this is a regular occurrence.

Adding to this mystery is that much further downstream along the same branch, Huron Valley Lutheran High School had relatively *low* phosphate values, and further downstream from there where Lincoln Senior High School samples, values were back up a bit. The site where Huron Valley Lutheran High School samples is just downstream of the confluence of two branches of the river. This could potentially be diluting any high inputs of phosphorus. Lincoln Senior High School samples a little ways down from another golf course. Further testing is recommending to see if there is a correlation.

Other high phosphate values occurred along the Lower branch of the river. Phosphate and nitrate levels are typically elevated along this branch, would could be due, in part, to the discharge from the Ypsilanti

Wastewater Treatment Plant. Regardless, phosphate values were four times higher at that site than they were in the spring. This site is also a little ways downstream from two golf courses.

These suggestions are no means the absolute reasoning for these values, but will hopefully spark discussion in the classroom and jump start potential student research projects.

There were unusually high nitrate values from Heritage Park, results were not typical for that site. Turbidity was pretty even across the board – the weather was mostly cooperative with levels slightly higher than usual, but still wadable in most instances. High fecal coliform readings at Parr Recreation Area and Ford Field were typical for those sites.

Proper identification of benthic macroinvertebrates continues to improve. This could be due to the additional training events offered to teachers, as well as support of Friends of the Rouge staff that are able to verify identification on-site. Extensive identification resources will continue to be provided to teachers, including a book and illustrated flashcards, and the recommendation of an "Aqua Bugs" smartphone application, produced by the Izaak Walton League organization. Following fall monitoring, a new macroinvertebrates.org website was released with incredibly detailed photos and resources – produced with funding from the National Science Foundation. Even so, benthic data will not be included in this report. Please refer to our Benthic Macroinvertebrate Monitoring Program at Friends of the Rouge for acceptable data.

As mentioned previously in this report, not every school used the same set of water quality monitoring equipment, performed the same number of trials for each parameter, or conducted sampling at the same day and time. Highlighted throughout this report, it is important to note that REP data are strictly intended to be used as part of the program's mission to promote environmental awareness and stewardship of the Rouge River watershed through long-term monitoring efforts. While REP staff makes every effort to verify with participating teachers and correct data as necessary, results are not yet collected or recorded with a level of accuracy or confidence so as to allow them to be used for scientific or analytical purposes. This data summary report represents one of many possible methods of water quality monitoring investigation and analysis, and schools are encouraged to conduct their own study and report. That being said, the REP continues to strive to find methods that make data collection, reporting, and interpretation as straightforward as possible. Certification is required for new teachers (via a series of training workshops with REP staff and community partners), and highly recommended for returning teachers every three years as part of quality assurance efforts.

2019 marked the 32nd season of the Rouge Education Project, a testament to the strength of this long-term data collection project. The staff of the Rouge Education Project wishes to thank the teachers, students, and volunteers who participated in the program this year for all of their hard work and dedication, in addition to the sponsors and grantors who made the program possible.

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							Dissolved Oxygen			pH		Change in Temperature		Total Phosphate		Nitrate		Turbidity			Total Solids		Biochemical Oxygen Demand		Fecal Coliform		Overall Water Quality	
School Name	**Date Sampled**	**Site ID**	**Subwatershed**	**River Branch**	**Location**	**Water Temperature (°C)**	**mg/L**	**% Saturation**	**Q-value**	**pH**	**Q-Value**	**(°C)**	**Q-Value**	**mg/L**	**Q-Value**	**mg/L**	**Q-Value**	**Turbidity**	**Units**	**Q-Value**	**mg/L**	**Q-Value**	**mg/L**	**Q-Value**	**(col/100 mL)**	**Q-Value**	**Index**	**Value**
Birmingham Covington School	10/7/2019	Main4	Main 1-2	Main	Linden Park	18.0	4.00	50	1	7.00	4	0	4	2.00	3	5.0	2	>0-40	JTU	3	N/A	N/A					3	Good
Novi Meadows Elementary School	10/16/2019	Upstream of Wall1	Middle 1	Middle	Orchard Hills West Park	10.0	8.00	74	3	7.00	4	0	4	0.66	4	20.0	1	>0-40	JTU	3	N/A	N/A	4.00	3	Positive	1	3	Good
Academy of the Americas High School	10/8/2019	Downstream of MN-2	Main 3-4	Main	Scout Hollow, Rouge Park																							
Chandler Park Academy High School	10/1/2019	Up1	Upper	Upper	Heritage Park	15.0	8.00	79	86	7.00	88	0	93	0.03	99	26.4	31	20	JTU	61	319	57	1.00	95	300	34	71	Good
Clippert Academy	10/9/2019	UR-2	Upper	Upper	Bell Creek Park	13.0	8.22	78	85	8.00	84			0.19	92	0.0	97	17	NTU	65	814	20	1.40	91	1	99	83	Good
Crestwood High School	10/2/2019	MR-10	Middle 3	Middle	Parr Recreation Area	19.0	7.94	86	92	8.00	84	0	93	0.30	81	1.4	96	15	NTU	67	615	20	5.99	51	1200	21	67	Medium/Average
Detroit Country Day School	10/2/2019	Nott	Main 1-2	Main	Detroit Country Day Middle School Grou	18.0	8.66	91	96	6.50	72	0	93	0.20	92	6.8	58	10	JTU	76	120	82	1.57	89	100	44	77	Good
Farmington STEAM Academy	10/1/2019	Min3	Upper	Upper	Farmington STEAM Academy School Gr	8.0	10.00	84	90	8.00	84	0	93	0.00	100	4.4	68	10	JTU	76	564	20	5.00	56	133	41	71	Good
Huron Valley Lutheran High School	10/9/2019	Upstream of MR-11	Middle 3	Middle	Nankin Mills Footbridge	14.6	9.50	93	97	8.00	84	1	89	0.04	98	8.8	54	10	NTU	76	400	47	3.00	67	200	37	72	Good
Inter-City Baptist	10/9/2019	LR-11	Lower 2	Lower	Ford Field Dearborn	15.1	6.54	65	66	7.25	92	0.1	93			28.3	29	15	JTU	67								
Inter-City Baptist	10/9/2019	LR-3	Lower 2	Lower	Goudy Park (Michigan Ave & Wayne)	16.5	7.62	78	85	7.20	92	1.2	88	1.05	39	39.6	18	10	JTU	76	614	20			250	35	59	Medium/Average
Lincoln Park High School	10/18/2019	LR-11	Lower 2	Lower	Ford Field Dearborn	10.0	6.30	56	52	7.90	87			3.40	19	35.2	22	10	JTU	76	653	20			100	44	47	Fair
Lincoln Senior High School	10/3/2019	Upstream of MR-15	Middle 3	Middle	Helm's Haven	14.0	7.00	68	72	8.00	84	0	93	0.33	78	5.9	61	23	JTU	59	572	20	2.00	80	1667	19	63	Medium/Average
Roosevelt High School	10/9/2019	Ton1	Middle 1	Middle	Plymouth Township Park (Ann Arbor Tra	14.4	7.60	74	80	7.50	93	2.4	83	3.50	19	1.3	96	15	JTU	67	544	20	1.55	89	100	44	67	Medium/Average
Steppingstone School	10/2/2019	Mid2	Middle 1	Middle	Plymouth Riverside Recreation Area	20.0				7.50								10	JTU	76								
Troy College & Career High School	9/30/2019	Main1	Main 1-2	Main	Firefighter's Park	16.0	7.58	77	84	7.80	90	2	85	0.13	95	4.4	68	5	JTU	86			3.20	66			82	Good
Troy High School	10/4/2019	Upstream of Main13	Main 1-2	Main	Coolidge/Long Lake	14.0	6.65	65	66	7.80	90	0	93	1.00	40	4.4	68	20	JTU	61	454	39	1.45	91	60	50	67	Medium/Average

Appendix I: Fall 2019 Participating Schools

Rouge Education Project: Fall 2019				
		Teachers		
School	**School City**	**First Name**	**Last Name**	**# students**
Academy of the Americas High School	Detroit	William	Albrecht	79
Birmingham Covington School	Bloomfield Hills	Ryan	Arbaugh	215
		Tammy	Brown	
		Ross	Burdick	
		Amy	Burns	
		Elizabeth	Cook	
		Rick	Joseph	
		Vicki	Lowery	
		Anne	Warner	
Chandler Park Academy High School	Harper Woods	Emily	Davis	5
		Chris	Trepanowski	
Clippert Multicultural Honors Academy	Detroit	Tracy	Ortiz	35
Crestwood High School	Dearborn Heights	Diana	Johns	150
Detroit Country Day Middle School	Beverly Hills	Heather	Barbash	420
		Joe	Case	
		Daniel	Case	
		Linda	Engler	
		Jennifer	Gabrys	
		Nicole	Jakubowski	
		Cari	Zabolotny	

Rouge Education Project: Fall 2019				
		Teachers		
School	**School City**	**First Name**	**Last Name**	**# students**
Farmington STEAM Academy	Farmington Hills	Kim	Burke	240
		Michael	Cahill	
		Audrey	Edwards	
		Joan	Henkel	
		Shawn	Kassab	
		Greg	Kirk	
		Bryan	Lamble	
		Nicole	Laramee	
		Kevin	Ozar	
Huron Valley Lutheran High School	Westland	Steven	Grosinske	20
Inter-City Baptist School	Allen Park	Joshua	Hubbard	25
Lincoln Park High School	Lincoln Park	Emily	Cizmas	45
Lincoln Senior High School	Warren	Mary	Balamucki	30
Novi Meadows Elementary School	Novi	Audrey	Akcasu	50
		Carri	McDonald	
Roosevelt High School	Wyandotte	Kelly	MacGregor	30
		Tina	Weller	
		Jeff	Weller	
Steppingstone School	Plymouth	Teresa	Lindenmuth-Louk	6
		Reef	Morse	

Rouge Education Project: Fall 2019				
		Teachers		
School	**School City**	**First Name**	**Last Name**	**# students**
Tawheed Center School	Dearborn Heights	Inara	Azeer	25
		Wajida	Taj	
Troy College & Career High School	Troy	Renee	Boogren	15
Troy High School	Troy	Mandy	Chin	111
		Robert	Zynda	
	TOTALS		**45**	**1,051**

Appendix II: Rouge Education Project Data Forms

Below are examples of REP data forms.

-Understanding “Q-Value” and “Overall Water Quality”

-Advanced Chemical Data Worksheet

-Calculating Overall Water Quality

-Calculating Overall Water Quality Tests Adjustment Formula

-Chemical Form for the LaMotte GREEN Low Cost Water Monitoring Kits

-Michigan Clean Water Corps Stream Macroinvertebrate Datasheet

-Physical Survey Sheet

UNDERSTANDING Q-VALUE & OVERALL WATER QUALITY

After each chemical test is completed a "Q-Value" must be determined for that specific test. What is a Q-Value?

According to the Friends of the Chicago River,

> *A Q-value is a way of standardizing all the different water quality test results so that they can be combined and used to find an overall water quality value for the river. You can think of the Q-value like a score on a test. Less than 50 is like a failing grade, whereas 90 or more is like an "A."*

For example, please refer to the "pH Test Results" Q-value chart. It can be noted that a pH of 7 results in a Q-value of approximately 90. By thinking of the Q-value as a grade on a test, it would appear rivers with a pH of 7 score a 90%, or an A. This makes sense since a pH of 7 would be neither too basic nor too acidic for most wildlife to live in. A pH of 10, on the other hand, receives a Q-value of 20 while a pH of 4 receives a Q-value of 10. Both of these Q-values are very low (a failing grade!), indicating that the water is either too basic or too acidic.

Once the Q-value is identified for a particular test that Q-value must be multiplied by that particular test's 'weighting factor'. The weighing factor is a number that indicates the importance of each parameter (D.O., pH, etc.) in determining overall water quality. Parameters with higher weighing factors are considered more important in determining the water quality than parameters with smaller weighing factors.

For example, please refer to the "Calculating Overall Water Quality" worksheet. Dissolved oxygen and fecal coliform have the highest weighting factors, with .17 and .16 respectively. These numbers indicate that water quality, or the health of the river, is greatly dependant on how much oxygen is present in the water and how many colonies of fecal coliform are present. Using a 'weighting factor' is necessary to demonstrate that some parameters have a greater effect on water quality than other parameters. Dissolved oxygen has a greater influence on water quality than turbidity.

Finally, add up all of the numbers in the last column (on the "Calculating Overall Water Quality" page). This sum will result in the Overall Water Quality. The chart below matches Overall Water Quality scores with actual overall water quality.

91-100	Excellent
71-90	Good
51-70	Medium or average
26-50	Fair
0-25	Poor

NOTE: *Please remember this is simply a tool for environmental education. It is a way to help participants understand the chemical test results.*

Friends of the ROUGE

Rouge Education Project: Chemical Data Worksheet

Name of group ____

Location/Site ID ____

City/Township ____

Date ________/______/______

Time ________:________ am or pm

Chemical Test Results

Dissolved Oxygen

1. Titrator Reading_______mg/L
2. Titrator Reading_______mg/L
3. Titrator Reading_______mg/L
4. Titrator Reading_______mg/L
5. Titrator Reading_______mg/L

Throw out the high and low value, average the remaining three.

Water temperature _______°C Correction Factor ________

Calculate the average of the remaining three:

(1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______

Average titrator reading _______mg/L (uncorrected DO) x correction factor__________

= _______ mg/L (corrected DO)

_____% saturation

_____Q-Value

Fecal Coliform

______ # of colonies / sample size (mL)	=	X / 100mL	X =
______ # of colonies / sample size (mL)	=	X / 100mL	X =
______ # of colonies / sample size (mL)	=	X / 100mL	X =
______ # of colonies / sample size (mL)	=	X / 100mL	X =
______ # of colonies / sample size (mL)	=	X / 100mL	X =

Use highest value

_____# of colonies/100mL

_____Q-Value

pH

1. Comparator reading_______
2. Comparator reading_______
3. Comparator reading_______
4. Comparator reading_______
5. Comparator reading_______

Find median value

Line up results from lowest to highest and circle the median:

(1)_____ (2)_____ (3)_____ (4) _____ (5) _____

_____pH

_____Q-Value

Rouge Education Project: Chemical Data Worksheet

Chemical Test Results (continued)

Test	Instructions	Results		Calculation
Biochemical Oxygen Demand	Run the dissolved oxygen test on a water sample that has not been exposed to light for five days. No correction factor necessary.	DO result from sample that has been incubated five days 1. mg/L 2. mg/L 3. mg/L 4. mg/L 5. mg/L	Throw out the high and low values, average the remaining three	Calculate the average: _____mg/L _____Q-Value (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______ Uncorrected DO in mg/L _______ - Average DO result in mg/L_______ = ______ (original sample) (incubated sample)
Change in Temperature	_______°C (Downstream) - _______°C (Upstream one mile) = _______°C (Downstream) - _______°C (Upstream one mile) = _______°C (Downstream) - _______°C (Upstream one mile) = _______°C (Downstream) - _______°C (Upstream one mile) = _______°C (Downstream) - _______°C (Upstream one mile) =		Throw out the high and low values, average the remaining three	Calculate the average: (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______ _____°C _____Q-Value
Total Phosphate	1. _______mg/L PO_4 2. _______mg/L PO_4 3. _______mg/L PO_4 4. _______mg/L PO_4 5. _______mg/L PO_4		Throw out the high and low value, average the remaining three.	Calculate the average of the remaining three: _____mg/L _____Q-Value (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = ______

Friends of the ROUGE

Rouge Education Project: Chemical Data Worksheet

Nitrates	1. Comparator reading_______mg/L x 4.4 = 2. Comparator reading_______mg/L x 4.4 = 3. Comparator reading_______mg/L x 4.4 = 4. Comparator reading_______mg/L x 4.4 = 5. Comparator reading_______mg/L x 4.4 =	Throw out the high and low value, average the remaining three.	Calculate the average of the remaining three: (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______ _____mg/L _____Q-Value
Turbidity	1. # of additions_____ = _____JTU 2. # of additions_____ = _____JTU 3. # of additions_____ = _____JTU 4. # of additions_____ = _____JTU 5. # of additions_____ = _____JTU	Throw out the high and low value, average the remaining three.	Calculate the average of the remaining three: (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______ _____JTU _____Q-Value
Total Solids	___________weight of residue / 100mL x 1000mg / 1 gram x 1000mL / 1 liter = ___________mg/L ___________weight of residue / 100mL x 1000mg / 1 gram x 1000mL / 1 liter = ___________mg/L ___________weight of residue / 100mL x 1000mg / 1 gram x 1000mL / 1 liter = ___________mg/L ___________weight of residue / 100mL x 1000mg / 1 gram x 1000mL / 1 liter = ___________mg/L ___________weight of residue / 100mL x 1000mg / 1 gram x 1000mL / 1 liter = ___________mg/L	Throw out the high and low value, average the remaining three.	Calculate the average of the remaining three: (1)_______ + (2)_______ + (3)_______ = _______ ÷ 3 = _______ _____mg/L _____Q-Value

Congratulations! You've completed all of the tests.
Please complete the Calculating Overall Water Quality Data Sheet to determine your site's overall water quality score.

If you were not able to complete one to three of the tests, please use the adjustment formula on the back of the Calculating Overall Water Quality Data Sheet.

Friends of the ROUGE

Rouge Education Project: Calculating Overall Water Quality Data Sheet

Name of group ________________________ Date _____ / _____ / _____
Location/Site ID ________________________ Time _____ : _____ am or pm
City/Township ________________________

Chemical Test Results

Water Test		Test Result		Q-value		Weighting Factor		Water Quality Index
1. Dissolved Oxygen – DO	mg/L		% saturation		X	0.17	=	
2. Fecal Coliform—FC			colonies/100mL		X	0.16	=	
3. pH			units		X	0.11	=	
4. Biochemical Oxygen Demand—BOD			mg/L		X	0.11	=	
5. Change in Temperature—Temp			°C		X	0.10	=	
6. Total Phosphate—TP			mg/L		X	0.10	=	
7. Nitrates—NO_3			mg/L or ppm		X	0.10	=	
8. Turbidity—Turb			NTU/JTU or feet		X	0.08	=	
9. Total Solids—TS			mg/L		X	0.07	=	

-To determine Q-value, use the weighting curve charts from the *Field Manual for Water Quality Monitoring.*
-Multiply the Q-value by the weighting factor to get your water quality index.
-Add up the nine water quality index values to determine your overall water quality score.
Note: If you're missing up to three test results, please use the adjustment formula (on back) to calculate an adjusted overall water quality index.

91-100	Excellent
71-90	Good
51-70	Medium
26-50	Fair
0-25	Poor

Overall Water Quality ________

Adjusted Value (if applicable) ________

Rouge Education Project: Calculating Overall Water Quality Adjustment Formula

If you're missing one to three test results, use the adjustment formula. The adjustment formula provides you with an Overall Water Quality value that is relative to the value you would have gotten if you performed all nine water quality tests. If you're missing more than three test results, leave the Water Quality Index blank and do not use the adjustment formula.

1. Add together the Water Quality Index Values from the tests you performed.					
2. Add together the weighting factors from the tests you performed.					
3. Divide 1 by the weighting factor total you found in Step 2.	1	÷		=	
4. Multiply your total from Step 1 by the number you found in Step 3. This is your adjusted water quality index.		x		=	

EXAMPLE

Water Test	Q-value		Weighting Factor		Water Quality Index
1. DO	90	X	0.17	=	15.30
2. FC	44	X	0.16	=	7.04
3. pH	84	X	0.11	=	9.24
4. BOD	67	X	0.11	=	7.37
5. Temp		X	0.10	=	
6. TP	40	X	0.10	=	4.00
7. NO_3	26	X	0.10	=	2.60
8. Turb	57	X	0.08	=	4.56
9. TS		X	0.07	=	

1. Add together the Water Quality Index Values from the tests you performed.	15.30 + 7.04 + 9.24 + 7.37 + 4.00 + 2.60 + 4.56 = 50.11				
2. Add together the weighting factors from the tests you performed.	0.17 + 0.16 + 0.11 + 0.11 + 0.10 + 0.10 + 0.08 = 0.83				
3. Divide 1 by the weighting factor total you found in Step 2.	1	÷	0.83	=	1.20
4. Multiply your total from Step 1 by the number you found in Step 3. This is your adjusted water quality index.	50.11	x	1.20	=	60.13 ≈ 60

LaMotte Earth Force® GREEN Low Cost Water Monitoring Data Sheet

Name of group ______________________ Date ____/____/____
Location /Site ID ______________________ Time ____:____ am or pm
City/Township ______________________

Chemical Test Results

	4 (excellent)	3 (good)	2 (fair)	1 (poor)
Coliform bacteria		☐ Negative (<20 colonies/100mL)		☐ Positive (>20 colonies/100mL)
Dissolved oxygen (DO) Water temperature_____°C Result: _____ppm **Percent saturation** *(from chart in booklet)*: ___%	☐ 91-110%	☐ 71-90%	☐ 51-70%	☐ <50%
Biochemical oxygen demand (BOD) DO original sample: _____ppm DO incubated sample: _____ppm **Difference = _____ppm**	☐ 0 ppm	☐ 4 ppm	☐ 8 ppm	
Nitrate **Result: _____ppm**	☐ 0 ppm or ~1 ppm	☐ ~2 ppm - <5ppm	☐ 5 ppm	☐ >5 ppm
pH **Result *(circle one)*: 4 5 6 7 8 9 10**	☐ 7	☐ 6 or 8		☐ 4, 5, 9 or 10
Phosphate **Result: _____ppm**	☐ 0 ppm or 1 ppm	☐ 2 ppm	☐ 4 ppm	
Temperature change Downstream result: _____°C Upstream result: _____°C **Difference: _____°C**	☐ 0-2°C	☐ 3-5°C	☐ 6-10°C	☐ >10°C
Turbidity **Result: _______JTU**	☐ 0 JTU	☐ >0-40 JTU	☐ >40-100 JTU	☐ >100 JTU
Totals:	# Excellent ___	# Good ___	# Fair ___	# Poor ___

Calculating Overall Water Quality

Excellent ________ x 4 = ________

Good ________ x 3 = ________

Fair ________ x 2 = ________

Poor ________ x 1 = ________

Add above totals: ________

Divide total by number of tests performed: ________ ÷ ________

= Overall water quality: ________

Number of tests performed: ________

Overall Water Quality
4 = Excellent
3 = Good
2 = Fair
1 = Poor

MiCorps Site ID#:_______________

Michigan Clean Water Corps

Stream Macroinvertebrate Datasheet

Stream Name: ____

Location:____ (Circle one: *Upstream* or *Downstream* of road?)

Date:______________________________ Collection Start Time:_______________ (AM/PM)

Major Watershed:_____________________ HUC Code (if known):______________________

Latitude:____________________________ Longitude:______________________________

Monitoring Team:

Name of Person Completing Datasheet:____

Collector:____

Other Team Members:____

Stream Conditions: Water Temperature**:**_______°C Average Water Depth:__________ feet

Is the substrate covered with excessive silt? ____ No ____ Yes (describe:__________________)

Substrate Embeddedness in Riffles: ____ 0-25% ____ 25-50% _____ > 50% ____ Unsure

Did you observe any fish or wildlife? ( ) Yes ( ) No If so, please describe:_____________________

Macroinvertebrate Collection: Check the habitats that were sampled. Include as many as possible.

____ Riffles
____ Cobbles
____ Aquatic Plants
____ Runs
____ Stream Margins
____ Leaf Packs
____ Pools
____ Undercut banks/Overhanging Vegetation
____ Submerged Wood
____ Other (describe:________ ___________________)

Did you see, but not collect, any **live crayfish**? (___ Yes ___ No), or **large clams**? (___ Yes ___ No)
remember to include them in the assessment on the other side!

Collection Finish Time: ____________(AM/PM)

Datasheet checked for completeness by:____ Datasheet version 1/12/09
Data entered into MiCorps database by:____ Date:____________

MiCorps Site ID#:________________

IDENTIFICATION AND ASSESSMENT

Use letter codes [**R** (rare) = 1-10, **C** (common) = 11 or more] to record the approximate numbers of organisms in each taxa found in the stream reach.

*** Do NOT count empty shells, pupae, or terrestrial macroinvertebrates***

Group 1: Sensitive

____ Caddisfly larvae (Trichoptera)
EXCEPT Net-spinning caddis
____ Hellgrammites (Megaloptera)
____ Mayfly nymphs (Ephemeroptera)
____ Gilled (right-handed) snails (Gastropoda)
____ Stonefly nymphs (Plecoptera)
____ Water penny (Coleoptera)
____ Water snipe fly (Diptera)

Group 2: Somewhat-Sensitive

____ Alderfly larvae (Megaloptera)
____ Beetle adults (Coleoptera)
____ Beetle larvae (Coleoptera)
____ Black fly larvae (Diptera)
____ Clams (Pelecypoda)
____ Crane fly larvae (Diptera)
____ Crayfish (Decapoda)
____ Damselfly nymphs (Odonata)
____ Dragonfly nymphs (Odonata)
____ Net-spinning caddisfly larvae
(Hydropsychidae; Trichoptera)
____ Scuds (Amphipoda)
____ Sowbugs (Isopoda)

Group 3: Tolerant

____ Aquatic worms (Oligochaeta)
____ Leeches (Hirudinea)
____ Midge larvae (Diptera)
____ Pouch snails (Gastropoda)
____ True bugs (Hemiptera)
____ Other true flies (Diptera)

STREAM QUALITY SCORE

Group 1:
____ # of R's * 5.0 = ____
____ # of C's * 5.3 = ____
Group 1 Total = ______

Group 2:
____ # of R's * 3.0 = ____
____ # of C's * 3.2 = ____
Group 2 Total = ______

Group 3:
____ # of R's * 1.1 = ____
____ # of C's * 1.0 = ____
Group 3 Total = ______

Total Stream Quality Score = _______
(Sum of totals for groups 1-3; round to nearest whole number)

Check one:
____ Excellent (>48)
____ Good (34-48)
____ Fair (19-33)
____ Poor (<19)

Identifications made by:____

Rate your confidence in these identifications: Quite confident 5 4 3 2 1 Not very confident

Datasheet checked for completeness by:______________________________________ Datasheet version 1/12/09
Data entered into MiCorps database by:______________________________________ Date:______________

Physical Survey Data Sheet

Friends of the Rouge

Name of group ________________	Length of section to be surveyed ________ (*at least 100ft or 30m*)
Location /Site ID ________________	Date ____/____/____
City/Township ________________	Time ____:____ am or pm

Weather

Describe today's weather ________________	Air temperature ____ °C or °F Water temperature ____ °C or °F
________________	Has there been a significant rain event in the last 7 days? Y or N

Land Use Observations

Check all that are present and circle the most predominant.

____ Agricultural	____ Parkland	____ Forested	____ Other (describe)
____ Residential	____ Nature preserve	____ Golf course	________
____ Urban	____ Open field	____ School/university	________
____ Commercial/industrial			

Land use score

____

4 (excellent)	Mostly forest or grassland, very little development
3 (good)	Some forest or grassland, parks and fields, some development
2 (fair)	Native vegetation clearly disturbed, suburban areas (residential)
1 (poor)	Urban, industrial, no or very few natural areas

Riparian Vegetation

Riparian vegetation is vegetation along the river corridor. Look downstream: right hand=right bank, left hand=left bank.

Riparian vegetation is made of ________________

[choices include brush, mowed grass, grasses, shrubs, trees, barren, other (please note)]

Average width of riparian vegetation [not including mowed grass] ________ m or ft *for right bank* ________ m or ft *for left bank*

Riparian vegetation score

________*for right bank*

________*for left bank*

4 (excellent)	Vegetation present, extends at least 30m/100ft
3 (good)	Vegetative buffer present, but less than 20m/65ft; some disturbance
2 (fair)	Small buffer less than 5m/16ft, vegetation disturbed for local land use
1 (poor)	Cleared land, urban development, no buffer or consists of mowed grass

Bank Erosion & Stability Evaluation

Estimate the percentage of bare soil on the stream banks ________ %

The bank slope is (circle one)	Steep	Moderate	Slight	
Bank stability is (circle one)	Stable	Slightly eroded	Moderately eroded	Unstable

Bank erosion score

________*for right bank*

________*for left bank*

4 (excellent)	Stable, no sign of bank erosion, no bare soil
3 (good)	Very occasional and very local erosion, small patches of bare soil
2 (fair)	Some erosion evident, obvious areas of bare soil
1 (poor)	Extensive erosion, unstable banks, almost no deep-rooted vegetation present

Habitat & Substrate Assessment

Check all that are present.

____ Wood in stream	____ Undercut banks	____ Aquatic plants
____ Logjams (# of ? large or small?)	____ River bends	____ Algae (what color?)
____ Overhanging vegetation	____ Leaf packs	________

Proportion of reach represented by stream morphology types (if present) riffle____% pool____% run____%

Friends of the ROUGE

Physical Survey Data Sheet

Habitat & Substrate Assessment (cont'd)

Habitat score ________

4 (excellent) Bends present, lots of riffles, many logs or undercut banks

3 (good) Bends present, some riffles, some logs or large rocks

2 (fair) Occasional bend, riffles or pools present but spaced far apart, few logs and rocks

1 (poor) Very channelized/straight, riffles and pools absent, no large logs or rocks

Check if present, circle the predominant two.

____Boulder *(>10" diameter)* ____Cobble *(2.5-10" diameter)* ____Gravel *(0.1-2.5" diameter)* ____Sand ____Silt ____Clay

Percent embeddedness in riffles (circle one or leave blank if no riffles) 0-25% 26-50% 51-75% 76-100%

Substrate score ________

4 (excellent) Large cobbles, boulders present in stream, large rocks are not smothered by sand and silt; kicking the bottom of the stream does not result in clouding

3 (good) Some large cobbles, gravel, less than 50% embedded in silt or clay

2 (fair) Gravel & sandy bottom, or larger rocks well embedded and hard to move in mucky bottom

1 (poor) Sandy or silty bottom, no large rocks present, kicking up the bottom results in cloudiness lasting one or two minutes

Water Odor & Appearance

Place a sample of river water in a large clear or white container.

Describe the odors that you smell in the water ____

[choices include chlorine, earthy, musty/moldy, sewage, fishy, grassy, sulfur (rotten eggs), flowery, chemical, other (describe)]

What appearance does the water have? Check all that apply.

________ No unusual appearance	________ Blue	________ Milky white
________ Orange-red (rust)	________ Multi-colored oily sheen	________ Foamy/soapy
________ Green	________ Muddy/cloudy	________ Other (describe)

How turbid is the water?

____Clear *(can see clearly to the bottom)* ____Slightly turbid *(can partially see to bottom)* ____Turbid *(cannot see to bottom)*

Stream Characteristics

Has the stream been altered? ____

____

[Is there a detention basin, bridge/dock, evidence of channelization, a dam, erosion wall (seawall or other control)? Has a wetland been drained, are there pipes/outfalls draining into the river that you can see?)]

If you can see pipes, how many are there? ________

Are the pipes flowing? Y or N

Can you tell what the discharge is? (circle)

Stormwater Sewage Industrial

If you notice suspicious activity or evidence of illegal dumping, call the State of Michigan at 800-292-4706.
If you witness illegal dumping in action, call 911.

Physical Condition Rating

Overall Score ________

4 (excellent) Healthy stable banks, riparian zones well vegetated, diverse habitats, rocky bottom, no odors or off-colors

3 (good) Somewhat stable banks, riparian zones partially vegetated, some diversity in habitats, gravel bottom, slight odor or off-colors present

2 (fair) Unstable banks, riparian zone minimally vegetated or highly disturbed, little habitat diversity, bottom has silt build-up, detectable odor, and water is off color

1 (poor) Seriously channelized or eroded banks, little to no natural or riparian area, silty or sandy bottom, no habitat rocks or woody material

What do you think is the greatest **current** and **potential** threat to the river's health at this site?

Friends of the Rouge

Physical Survey Data Sheet

Calculating Stream Discharge

Step #1:

Measure width across your stream in three different places and then average the results

Measurement #1________m

Measurement #2________m

Measurement #3________m

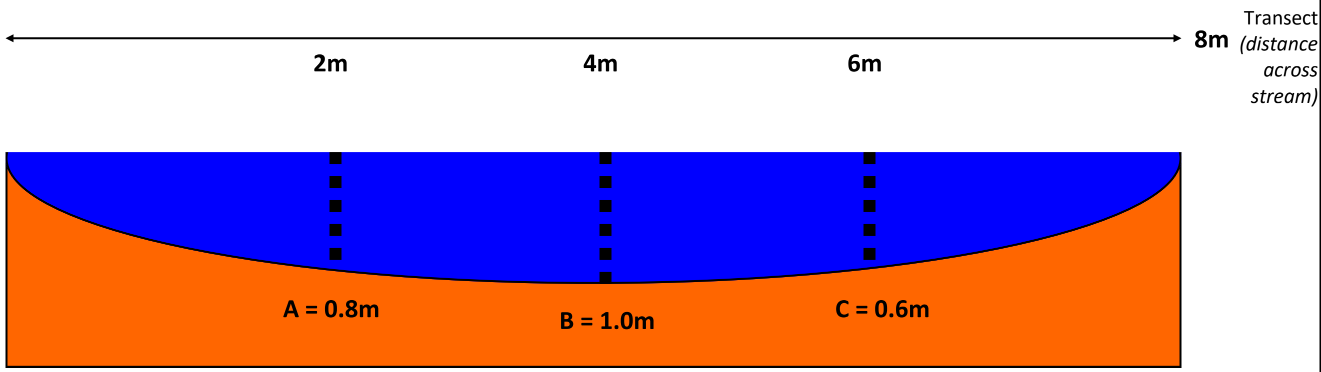
Average width ________m

Enter result in step #4

Step #2:

To determine average depth, establish a transect across your stream. Measure the depth at three points evenly across the transect (example, if your stream is 8 meters across, measure at 2 meters, 4 meters, and 6 meters). Add the measurements together, then divide by 4 (this takes into account that the stream depth is zero at the shores) and record your answer below. Repeat two more times.

EXAMPLE



Average depth of one transect = (A + B + C) ÷ 4 = ___m

0.8m + 1.0m + 0.6m = 2.4m ÷ 4 = **0.6m**

Transect #1 (Depth #1________m + Depth #2________m + Depth #3________m) ÷ 4 = ________m

Transect #2 (Depth #1________m + Depth #2________m + Depth #3________m) ÷ 4 = ________m Average depth ________m

Transect #3 (Depth #1________m + Depth #2________m + Depth #3________m) ÷ 4 = ________m

Enter result in step #4

Step #3:

Measure velocity by releasing an object (such as an orange) into the main current of your stream in an area free from obstructions. Time how long the object takes to float a measured distance in meters downstream. The measured distance should be at least 15m, if possible. Average the times and divide your measured distance by the average time (written in meters/second).

Measured distance ________m

Trial #1________seconds

Trial #2________seconds

Trial #3________seconds

Measured distance ________m ÷ Average________seconds =

Average velocity ________m/s

Enter result in step #4

Step #4:

Calculate discharge:

Discharge = average width (m) x average depth (m) x average velocity (m/s) x roughness constant*

*Constant = 0.8 for rock/gravel bottoms and 0.9 for sandy/muddy bottoms

Discharge = average width _______m x average depth _______m x average velocity _______m/s x roughness constant _______

(step #1) *(step #2)* *(step #3)*

Discharge = ________m^3/s

Friends of the ROUGE

Physical Survey Data Sheet

General Observations

Did you observe any fish or wildlife? Please describe. ____

How would you describe the cleanliness of the site? Was there human-made and/or natural debris in or around the river?

If possible, review the results for this site from last year. How has the landscape changed?

OPTIONAL: Write a paragraph about how the physical conditions at your site could be improved or discuss.

Illustration

Use the space below to draw your sampling site (including vegetation, logs and boulders, bank slopes, and riffles and pools), OR submit photos to Friends of the Rouge. Use this to compare your site in subsequent visits.