Jordan River Water Quality Monitoring:

An assessment of Jordan River and Deer Creek

2025

Prepared for:

Friends of the Jordan River Watershed, Inc.

By:

Tip of the Mitt Watershed Council

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Abstract

The Jordan River is known to have high water quality with elevated nutrients. While the river drains mostly forested land, there is also a significant amount of agriculture and a fish hatchery. Tip of the Mitt Watershed Council partnered with Friends of the Jordan River Watershed in 2017 to assess basic water quality parameters in Jordan River and Deer Creek, a major tributary. In 2025, the partnership continued to update the water quality monitoring work. Results indicate nitrogen and phosphorus levels exceeding reference thresholds, two nutrients that can cause excess algae and vegetation growth, while having otherwise high water quality. Concentrations in these two nutrients are much different than in the 2017 monitoring work. Future work should include targeted monitoring of nutrients, habitat assessments, and source identification and mitigation.

Introduction

As water flows over the earth and eventually outlets to a stream or larger water body, water will encounter different materials and processes. While natural land cover like forests and wetlands in a watershed yields high-quality water downstream from natural ecosystem services (e.g. filtering of excess nutrients), an altered landscape generally degrades water quality. Contaminants coming from multiple diffuse sources are called nonpoint source pollution, as opposed to a single source, such as a factory. Nonpoint source pollutants including nutrients, and soil particles (sediment) from erosion can result in negative impacts to water quality downstream. Contaminants can commonly occur in an urbanized setting, some related to automobiles, others related to cleaning or personal care products. Stormwater, often channeled out of city streets and into water bodies, can contain excess nutrients such as phosphorus and nitrogen. Ions such as chloride from road salt application during the winter is captured during the snowmelt and can be carried into nearby streams. The sum of all interactions in each watershed between land and runoff determines the water quality downstream. Due to this, the waters of any lake are inexorably linked to the watershed by which it is supplied.

Nonpoint source pollution is a continual threat to Michigan's pristine rivers, lakes, and streams. Nitrogen and phosphorus are two nutrients connected to water quality. They are key nutrients that are required for biological growth but can become ecologically harmful at excessive levels. Excessive nitrogen and phosphorus can cause shifts in the aquatic food web, encourage colonization by invasive species (e.g. *Phragmites* and narrow-leaved cattail), and cause a river system to become eutrophic. Eutrophic simply means excessive nutrients for biological productivity to the point of nuisance algal and vegetative growth. Too much productivity can lead to reduced dissolved oxygen levels which are harmful to fish and other organisms.

This report documents nitrogen, phosphorus, chloride, and other physiochemical measurements (temperature, dissolved oxygen, specific conductivity, and pH) in five stream sites on Deer Creek and the Jordan River in Antrim and Charlevoix Counties in Michigan.

Study Area

The Jordan River was the first river to receive the State of Michigan's "wild and scenic" designation under the Natural River Act of 1970. Sections of the River are considered high-quality Blue Ribbon Trout Stream by the Michigan Department of Natural Resources (MDNR). With a dense network of tributaries, the Jordan River flows from headwaters in Antrim County to the South Arm of Lake Charlevoix in East Jordan (Figure 1). Encompassing 39% of the Lake Charlevoix Watershed, the Jordan River supplies roughly 60% of Lake Charlevoix's total water inflow (TOMWC 2015). Moreover, some of the most productive and diverse natural areas in Northern Michigan are found within the Jordan River Watershed. The Jordan River Spreads is a highly productive and diverse natural area covering several hundred acres adjacent to the city of East Jordan. Moving upstream, the Jordan River transitions from the open waters of Lake Charlevoix through shallow submerged aquatic plant beds, emergent vegetation, wetlands dominated by shrubs, and then into upland area. Land cover data from NOAA's Costal Change Analysis Program depict the exceptional natural areas found in the Jordan River Watershed (Table 1; Figure 2).

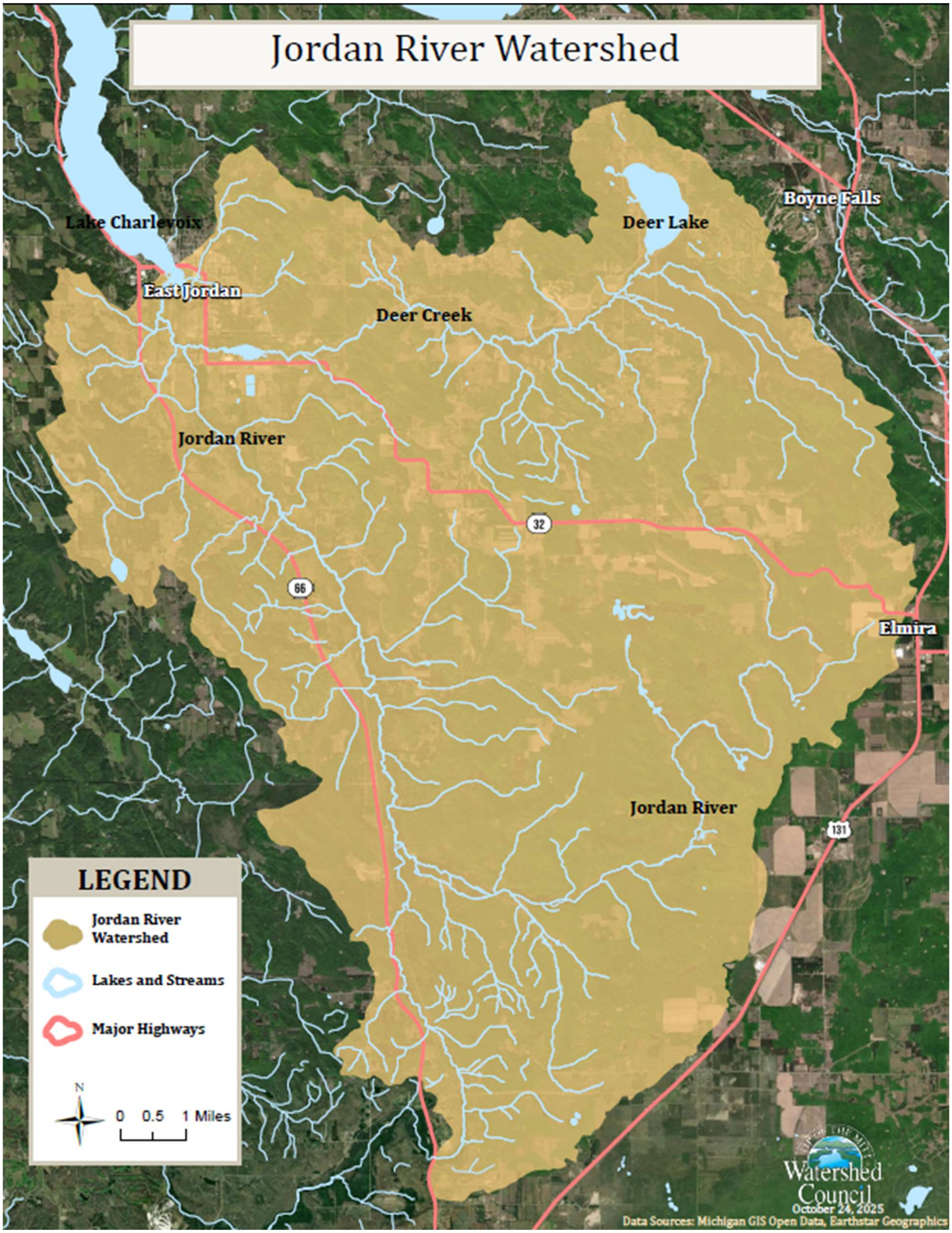

Figure 1. Jordan River Watershed

Table 1. Land cover statistics for the Jordan River Watershed

Land Cover Type	2006 (%)	2010 (%)	2016 (%)
Agriculture	12.8	12.7	12.8
Barren	0.1	0.1	0.8
Forested	60.5	58.0	58.2
Grassland	6.4	6.7	6.7
Scrub/Shrub	2.7	2.8	2.6
Developed (Urban)	2.6	2.6	1.8
Water	0.7	0.8	0.8
Wetland	14.2	16.3	16.3
Total	100	100	100

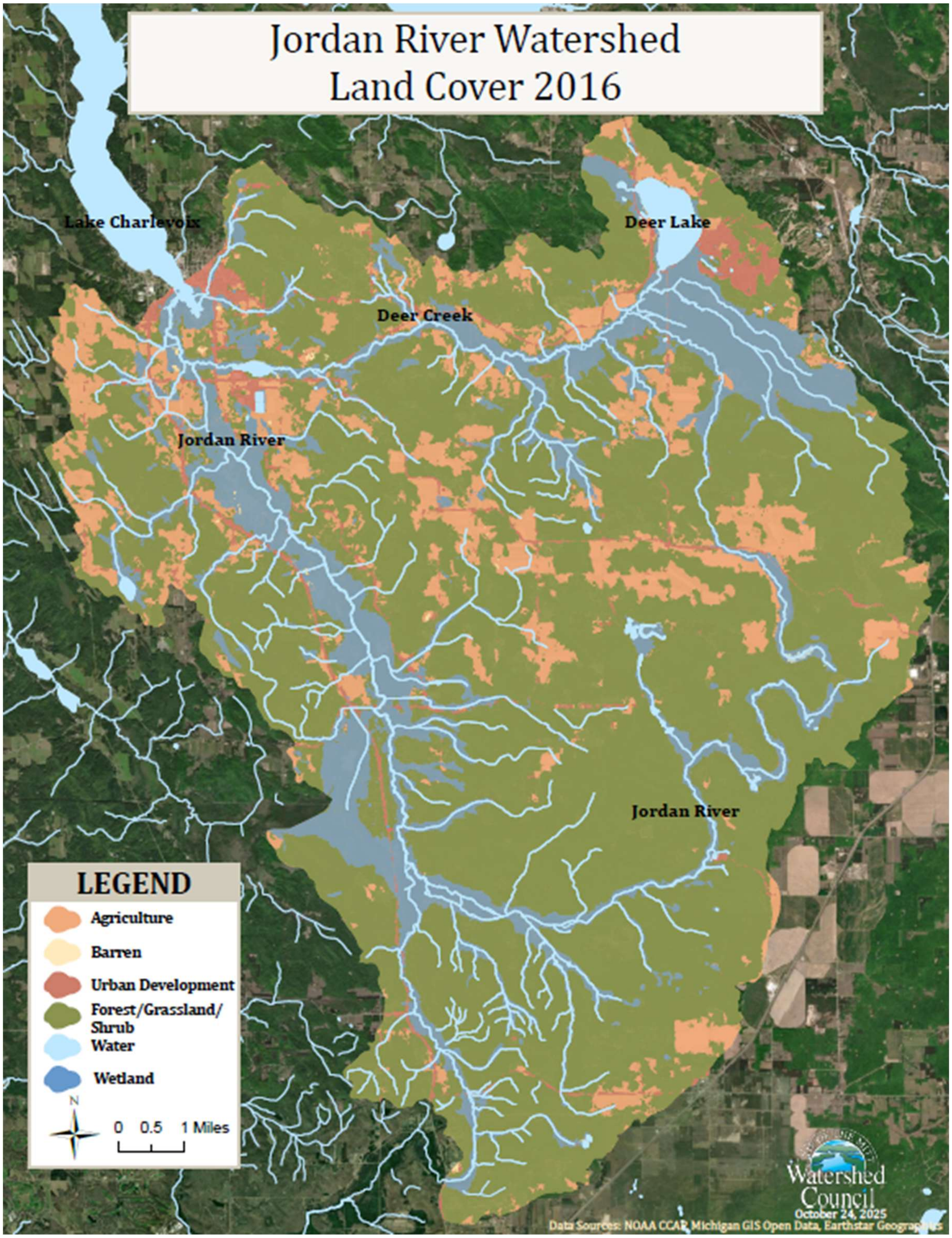

Figure 2. Jordan River Watershed Land Cover

As seen in Table 1, land cover has remained consistent over the last decade with a large portion of the watershed still forested (58.2%) and wetland (16.3%) area (Figure 2). These areas help filter excess nutrient runoff from surface and groundwater infiltration. This is true of the Jordan River watershed with no recent evidence for water quality problems. However, the Jordan River is a unique system in that not all groundwater sources lie entirely within the surface watershed.

Areas outside the Jordan River Watershed boundary have been identified to likely contribute groundwater to the Jordan River and associated nearby tributaries. The Mancelona Plains region southeast of the watershed is used for agriculture, mostly potato farming, and this area contributes groundwater to the Jordan River. Any increased nutrient detection (i.e. – nitrogen) in the upper reaches of the watershed might be related to land use practices of this area. Another source of elevated nutrients could be the Jordan River National Fish Hatchery.

The Jordan River National Fish Hatchery, operated by the US Fish and Wildlife Service, was established in 1963. The Hatchery produces roughly 3 million cisco, lake trout, brook trout, and rainbow trout for federal and state recreation and restoration programs annually (USFWS 2025). The hatchery uses water from Five Tile and Six Tile Creeks to supply its operations and discharges water from the facility to the Jordan River. In 2018, the Hatchery finished its state-of-the-art recirculating aquaculture building for coregonine restoration. The Hatchery's effluent is regulated through a National Pollutant Discharge Elimination System (NPDES) permit administered by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). In addition to fish production, the hatchery offers educational opportunities.

Methods

The five sites chosen as a focus were Deer Creek at Maple Street and Jordan River at M32, Rogers Road, and upstream and downstream of the Jordan River National Fish Hatchery (Table 2; Figure 3). Each of these tributaries are unique in their position and role in the Watershed. The farthest upstream sites in the Jordan River watershed are positioned closely upstream and downstream of the Jordan River National Fish Hatchery. Upstream of these two sites is mostly forested in the surface water watershed with a significant amount of agriculture near the community of Alba occurring within the groundwater source area. Farther downstream, Jordan River – Rogers Road is about two miles from the mouth of the Jordan River. Most of the surrounding land upstream of the Rogers Road site is forest, agriculture and wetlands. The most downstream site is the mouth of the Jordan River - M32 site, which is where the Jordan River meets the South Arm of Lake Charlevoix in East Jordan. While there is a riparian buffer for the majority of the last 2 miles to the mouth, between the Rogers Road and M32 (mouth) sites, there are also more urban and industrial areas. The M32 (mouth) site is also downstream of the confluence of the Jordan River and Deer Creek. Deer Creek captures water from forested, residential, and industrial areas. The Jordan River – upstream and downstream of the fish hatchery sites and Deer Creek – Maple Street were part of the 2017 Jordan River Water Quality Monitoring effort, so there's comparable historical data for these three locations (TOMWC 2017).

Table 2. Jordan River 2025 Water Quality Monitoring Site Locations

Waterbody	Sample Location	Sampling date	Latitude	Longitude
Deer Creek	Maple Street	6/27/25	45.13597	-85.11897
Jordan River	M32 (mouth)	6/27/25	45.15208	-85.129452
Jordan River	Rogers Road	6/27/25	45.132492	-85.123993
Jordan River	Downstream of Fish Hatchery	6/27/25	45.020101	-84.98405
Jordan River	Upstream of Fish Hatchery	6/27/25	45.03271	-84.96581

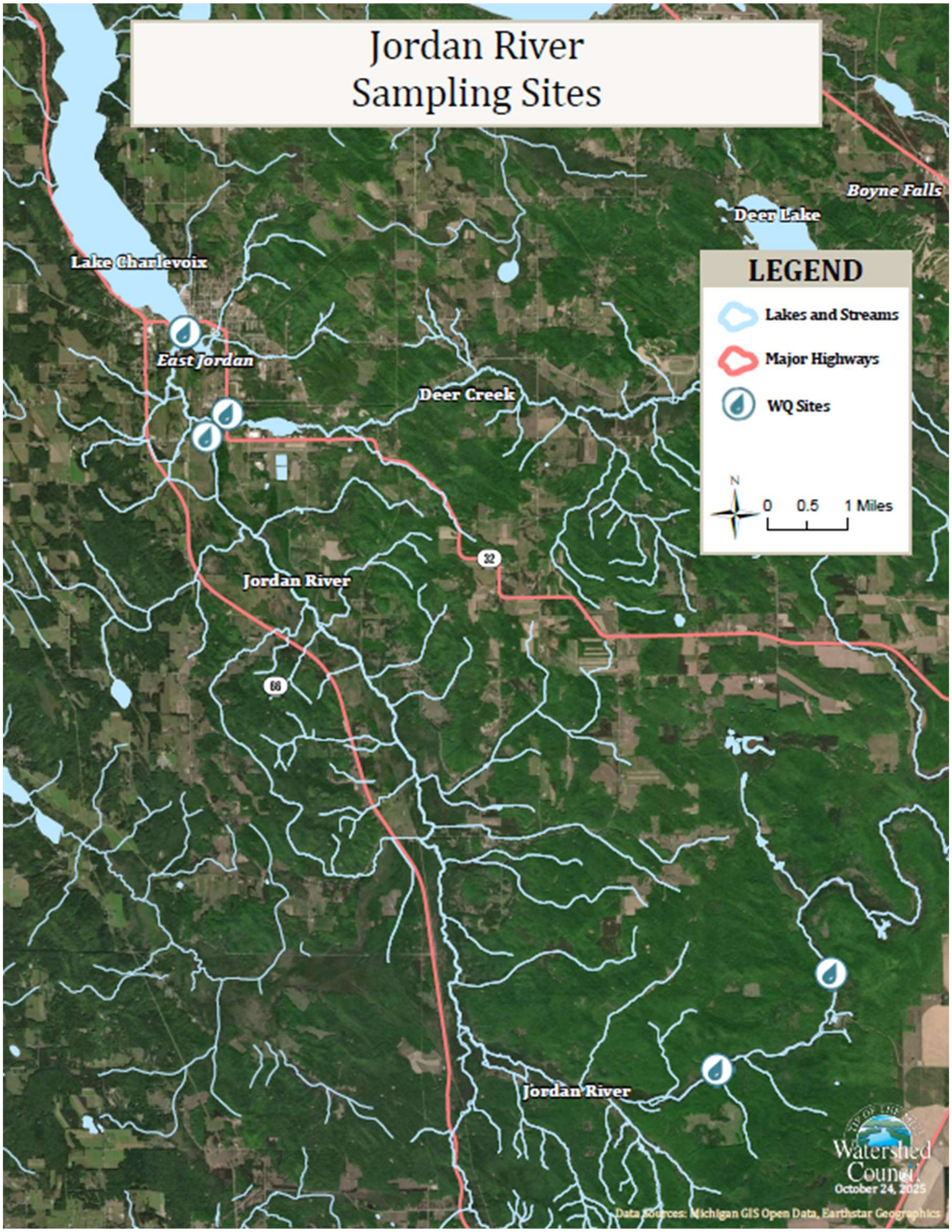

Figure 3. 2025 Jordan River Water Quality Monitoring Site Map

Monitoring was conducted on June 27th, 2025, during a wet weather event. A wet weather event defined by the contract is a rain event with at least 0.5 inches of rain over a 24-hour period or 0.25 inches of rain over a 12-hour period prior to monitoring. Water samples were collected for total phosphorus, total nitrogen, and chloride at mid-depth in acid-washed sample bottles (250 mL). Sample bottles were rinsed three times with stream water before being filled for collection. At sites that were unwadeable, a kemmerer was used to collect the water samples at mid-depth and was also rinsed three times with stream water. A multiparameter probe (YSI Exo 1) was used to collect in-stream physical parameters such as temperature, dissolved oxygen, conductivity, and pH. Readings were collected at mid-depth in the stream, and three readings were taken consecutively and averaged. At wadeable stream sites, waders were worn to enter the stream and decontaminated with 409 solution and scrub brushes before entering a new site.

Water samples were transported in a cooler with ice to the Watershed Council office where they were stored in a lab freezer until they were delivered to Lake Superior State University's Center for Freshwater Research and Education (CFRE) for analysis. All water samples taken to CFRE were analyzed within the 28-day hold times required for the analyses and passed quality assurance and control procedures. Physical parameters and lab results were then analyzed for water quality standards exceedances (Table 3), comparison between sites, and comparison to the 2017 Jordan River Water Quality Monitoring results.

Table 3. Water quality criteria for each subecoregion. The Jordan River Upstream and Downstream of the Fish Hatchery sites were in subecoregion 50 and all other sites were in subecoregion 51.

Parameter	Subecoregion 50 - Criteria	Subecoregion 51 - Criteria	Source of Criteria
Temperature (ºC)	68 for June	68 for June	State of Michigan (Part 4)
Dissolved Oxygen (mg/L)	7	7	State of Michigan (Part 4)
Total Dissolved Solids (mg/L)	750	750	State of Michigan (Rule 51)
pH	6.5 - 9	6.5 - 9	State of Michigan (Rule 53)
Total Phosphorus (µg P/L)	12	28.75	US EPA
Total Nitrogen (µg N/L)	440	710	US EPA
Chloride (mg/L)	150	150	State of Michigan (Rule 57 - Final Chronic Value)

Results

Physical Measurements

Conductivity is a measure of the ability of water to conduct an electric current resulting from the concentration of charged particles (ions) dissolved in the water and serves as an early indicator of water quality problems. Water samples within a drainage basin or watershed will have a relatively consistent range of conductivity. A noticeable change in conductivity under similar environmental conditions (i.e. - temperature, seasonality) can indicate discharge within the drainage basin or watershed has changed. In particular, a significant change in conductivity can result from a change in road salt, sewage, fertilizer, pesticide, or other pollutant accumulation within the drainage area. Conductivity is not addressed in EGLE Part 4 Water Quality Standards, though Rule 51 (323.1051) provides a framework for regulating total dissolved solid (TDS) concentrations from point source discharge. TDS in mg/L can be estimated from specific conductivity readings by using the widely applied multiplication factor of 0.67. Estimated TDS concentrations for conductivity measurements from all sites were well below the Rule 51 TDS maximum of 750 mg/L. Conductivity readings were highest at the Deer Creek site, but still within expected, normal levels (Figure 4; Appendix A).

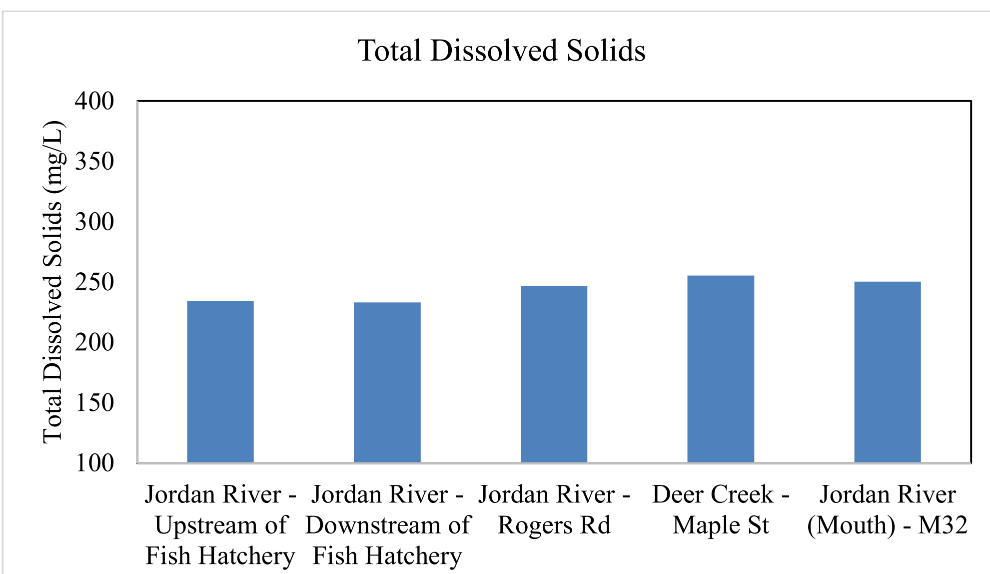

Figure 4. 2025 Jordan River & Deer Creek total dissolved solids estimates

pH is a value of H^+ ions in the water producing an acidic, neutral, or basic environment. When acidic material comes in contact with surface waters, such as acid rain, $CaCO_3$ in the water dissociates to neutralize the H^+ ions and maintain a constant pH. Aquatic organisms, such as fish, can only survive within certain pH levels – too low or too high pH levels and the organisms will be severely impacted and won't be able to survive. Hydrogen ions, expressed as pH, ranged from 8.03 to 8.14 throughout all sites (Figure 5). All pH readings fell within the range of 6.5 to 9.0 required for all Michigan surface waters according to EGLE Part 4 Water Quality Standards, Rule 53 (323.1053).

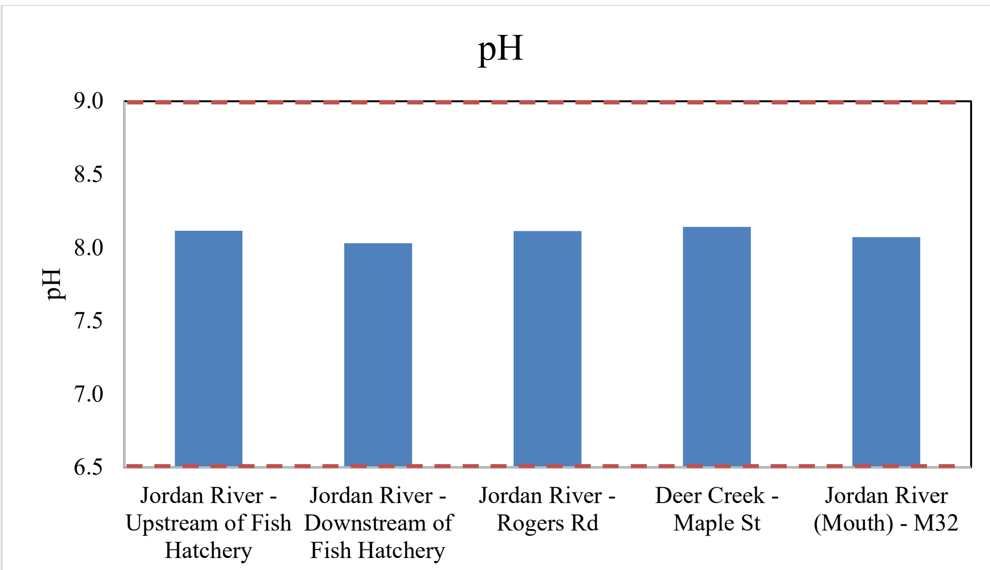

Figure 5. 2025 Jordan River & Deer Creek pH measurements. The red lines indicate the thresholds for pH in the State of Michigan water quality standards.

Dissolved oxygen is of crucial importance for respiration and ultimate survival of nearly all stream organisms. If a decrease in dissolved oxygen were present, it may be caused by the decomposition of abundant vegetation, very low flow, or pollution entering the stream. Dissolved oxygen concentrations ranged from 8.93 mg/L to 9.76 mg/L (Figure 6). EGLE Part 4 Water Quality Standards minimum dissolved oxygen concentration for sustaining a cold-water fishery is 7 mg/L. All sites were well above the 7 mg/L standard.

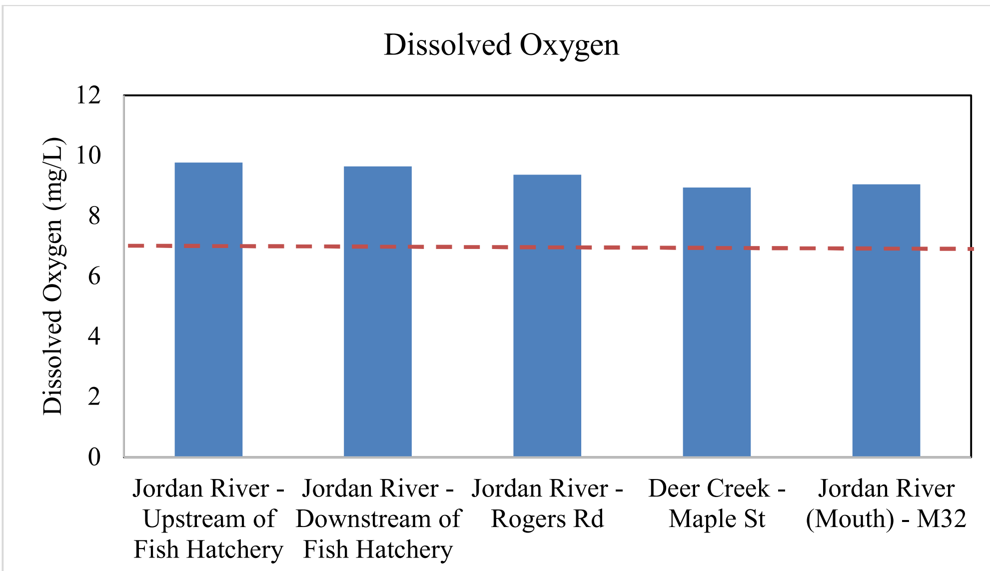

Figure 6. 2025 Jordan River & Deer Creek dissolved oxygen measurements. The red line indicates the thresholds for dissolved oxygen in cold-water streams in the State of Michigan water quality standards.

Stream organisms, like trout, have specific temperature ranges which they can survive in. Elevated temperature may be caused by very low flow, stream impediments like dams, and a lack of vegetative cover over the stream. All 2025 monitoring sites are regulated as cold-water streams. According to EGLE Part 4 Water Quality Standards, monthly maximum temperatures for streams supporting cold-water fish are set at 68° Fahrenheit (20.0 ºC) for June. All sites were below this temperature threshold, with Deer Creek being closest at 19.3 ºC (Figure 7).

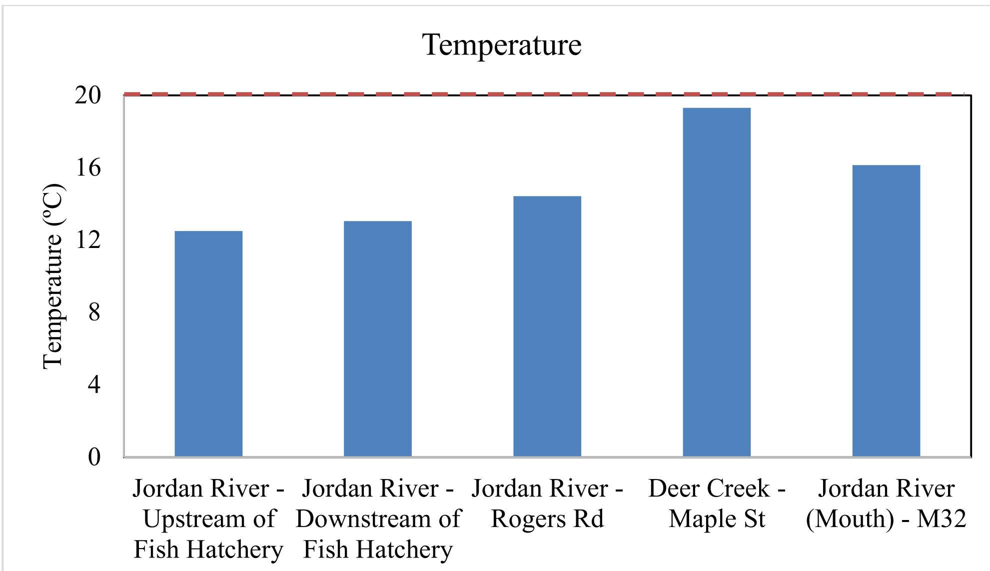

Figure 7. 2025 Jordan River & Deer Creek temperature measurements. The red line indicates the temperature threshold for cold-water streams in June from the State of Michigan water quality standards.

Nutrients

Chloride, a component of salt, is naturally present at low levels in Northern Michigan surface waters due to the marine origin of the underlying bedrock (typically < 5 mg/L). As part of the State of Michigan's Rule 57 Water Quality Values, chloride has a final chronic value of 150 mg/L. The final chronic value is the level at which aquatic life can live indefinitely in the presence of the contaminant without long-term harm to its growth, reproduction, or survival. Although current chloride levels in Northern Michigan are generally far below the State of Michigan's toxicity thresholds, increases are indicative of other pollutants reaching our waterways (e.g., automotive fluids from roads; nutrients/bacteria from septic systems). Chloride concentrations were below State of Michigan thresholds for all streams and all, but one site were near the typical concentration of < 5 mg/L. Deer Creek had the highest concentration of 9.89 mg/L (Figure 8). Chloride is likely higher than natural conditions due to road salt use in the Watershed.

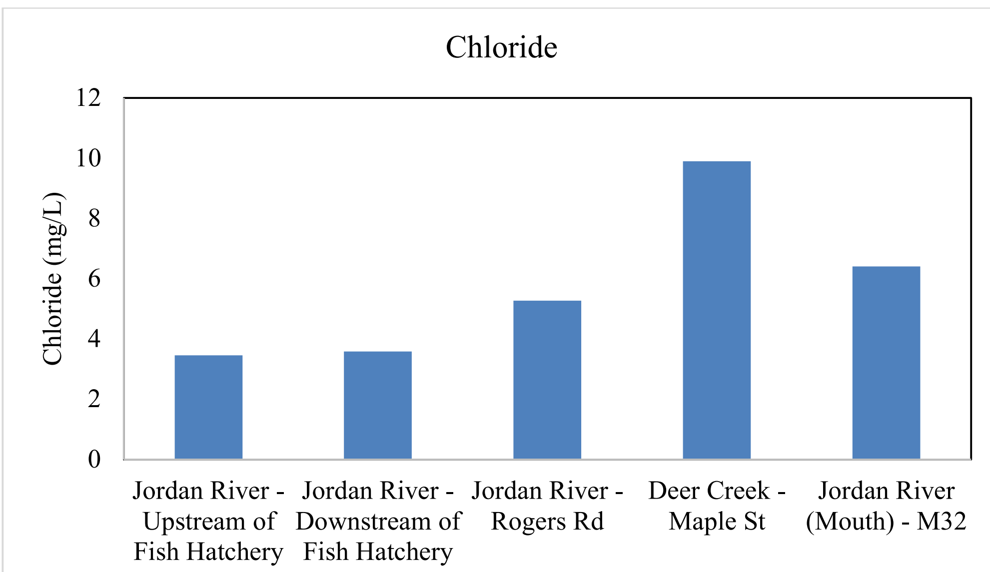

Figure 8. 2025 Jordan River & Deer Creek chloride levels

EGLE Part 4 Water Quality Standards does not include a numerical standard for nutrient concentration limits for surface waters. Regulation for surface waters is limited to the following narrative standard from Rule 60 Plant Nutrients (R 323.1060): "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state." TP concentrations of 12 µg/L or 28.75 µg/L for streams in Northern Michigan ecoregions are considered the reference condition by the United States Environmental Protection Agency (USEPA) "because it is likely associated with minimally impacted conditions, will be protective of designated uses, and provides management flexibility" (USEPA 2001). Total phosphorus (TP), which is a measure of all phosphorus types in the water sample, reached a peak of 61.4 µg/L at the upstream of the fish hatchery site on Jordan River (Figure 9). Both sites in subecoregion 50 (Jordan River upstream and downstream of the hatchery) exceeded the threshold of 12 µg/L. None of the sites in subecoregion 51 (Deer Creek, Jordan River at Rogers Rd, Jordan River at M32) exceeded the threshold of 28.75 µg/L.

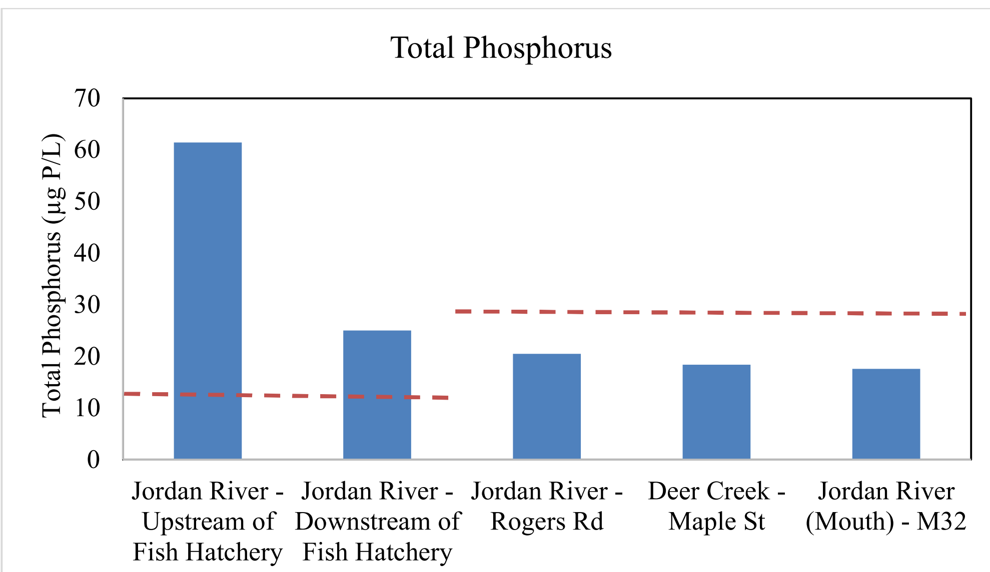

Figure 9. 2025 Jordan River & Deer Creek total phosphorus levels. The red lines indicate the total phosphorus thresholds based on subecoregion for the USEPA water quality reference conditions.

Total nitrogen (TN) is a measure of all nitrogen types in a water sample. The USEPA TN reference conditions of 440 µg/L (subecoregion 50) and 710 µg/L (subecoregion 51) for minimally impacted conditions for Northern Michigan streams was exceeded for all sites except Jordan River-downstream of the fish hatchery (Figure 10). The highest concentration was on the Jordan River upstream of the fish hatchery (about 5.5 times the threshold), while downstream of the hatchery was the lowest concentration found in this study. However, the TN levels were exceeding the threshold again at Jordan River-Rogers Rd and slightly decreased to Jordan River-M32. Deer Creek TN levels were between Jordan River-Rogers Rd and Jordan River-M32 levels.

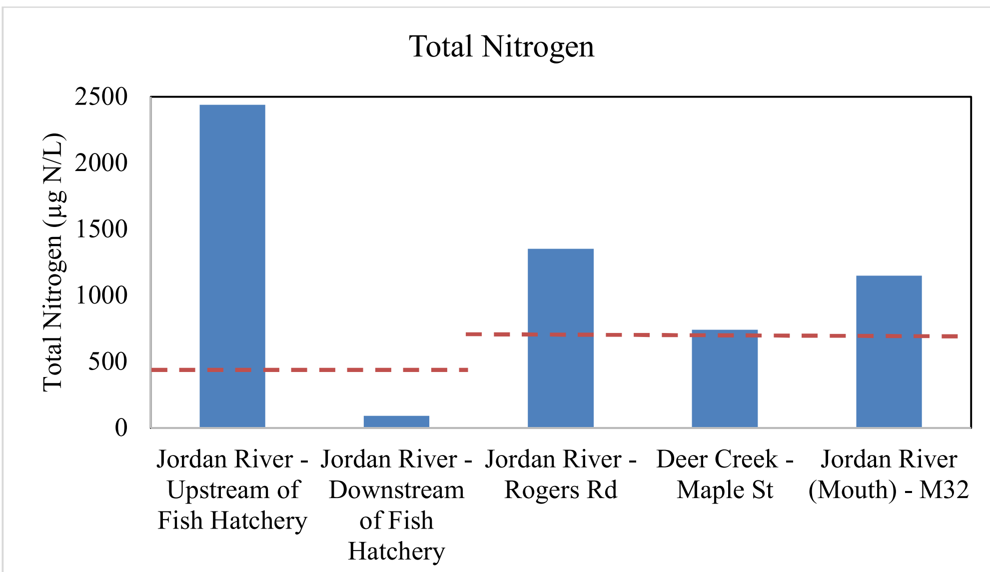

Figure 10. 2025 Jordan River & Deer Creek total nitrogen levels. The red lines indicate the total nitrogen thresholds based on subecoregion for the USEPA water quality reference conditions.

Discussion

Water quality on Jordan River and Deer Creek was monitored in June of 2025. Physical parameters, including temperature, dissolved oxygen, specific conductivity (reported as Total Dissolved Solids -TDS), and pH were not a concern for any site. Total Phosphorus and Total

Nitrogen exceeded the thresholds, with nitrogen levels being a more widespread concern. Chloride at one site was slightly elevated, but all results were well within acceptable levels.

Total Phosphorus levels were highest upstream of the hatchery, made a significant drop downstream of the hatchery, then gradually decreased further downstream. These levels point to the phosphorus source being upstream of the hatchery site, rather than throughout the watershed. Most rivers and streams are phosphorus-limited. Phosphorus drives biological productivity, leading to algae and vegetation growth. When algae and vegetation die, their decomposition lowers dissolved oxygen in the water. The five sites did not have concerning levels of dissolved oxygen during sampling, but during the vegetation die-out at the end of the season, lower levels may be present if algae and vegetation are abundant.

Total Nitrogen levels were also highest upstream of the hatchery and made a significant drop downstream of the hatchery but increased again at Rogers Road. These levels indicate multiple source areas in the watershed. Excess nitrogen from agricultural operations (fertilizers or manures) or lawns (especially large lawns like golf courses) can run off the land during wet events. Excess nitrogen can cause harmful algal blooms and filamentous algae. Filamentous algae, which differs from blue-green in that it grows in long hair-like strands, can be a good indicator for excess nutrients. Monitoring habitat upstream and downstream, including the presence of algae, would help identify the effects of the elevated nutrient levels in this system.

The results from this 2025 monitoring were largely similar to the TOMWC-FOJR Water Quality Monitoring done in 2017, aside from nitrogen and phosphorus levels (Appendix B). Three sites were identical between them: Deer Creek at Maple Street, and Jordan River upstream and downstream of the fish hatchery. Temperature and dissolved oxygen levels were similar but due to the difference in sampling months, it's difficult to compare them closely. Total dissolved solids (TDS) was slightly higher in 2025, especially at Deer Creek. pH and chloride were similar between studies. In 2017, none of the three sites were over the total phosphorus threshold, but all sites were over the threshold in 2025. All three sites at least doubled in total phosphorus in 2025, with the upstream hatchery site increasing the most. Total nitrogen was similar at Deer Creek between the two sampling efforts. At the Jordan River sites, there was a large decrease in total nitrogen in 2025, with upstream and downstream of the hatchery having about 75% and 2% of the 2017 total nitrogen levels.

The decrease in nitrogen and phosphorus levels between upstream and downstream of the fish hatchery seen in 2025, which was not evident in 2017, may be due to the dilution of stream water with hatchery discharge and the new recirculating aquaculture system for cisco. Recirculating aquaculture systems typically allow for a reduction in intake water and discharge, thus likely reducing the nutrient load into the river. More frequent sampling at additional sites would be helpful in determining potential source areas of nonpoint pollution and identifying potential mitigation strategies. Despite these changes and its otherwise high water quality, Jordan River's nutrient loads still remain a concern and further investigation and mitigation is still needed to improve the nutrient loads and evaluate their impacts.

There will be an annual report for the Lake Charlevoix Watershed coming out this winter which will include a discussion of all of our data in the watershed and any long-term trends. Our Volunteer Stream Monitoring (4 sites on Jordan River and 1 site on Deer Creek), Volunteer Lake Monitoring (Deer Creek), and Comprehensive Water Quality Monitoring data (Deer Creek and Jordan River) will be included in the report including the aforementioned sites in the Jordan River Watershed.

Recommendations

1. Share the results of this study with FOJR membership, Jordan River riparian property owners, Lake Charlevoix Association, EGLE, Jordan River National Fish Hatchery, and other partners.
2. Investigate nutrient uptake throughout the Jordan River's channel to identify areas with high and low nutrient uptake. Sampling more sites with greater frequency will help this effort. Evaluate river habitat upstream and downstream of the Hatchery to assess algae/plant growth and other possible effects of elevated nutrient concentrations.
3. Investigate sources of groundwater-fed nutrients, in particular nitrogen. A thorough understanding of this issue will inform possible mitigation actions and partnerships with agricultural operations.
4. Develop and implement a plan to reduce nutrient inputs to Jordan River and Deer Creek

by working with agricultural producers to implement best management practices (BMPs). Extend outreach and education efforts to all agricultural producers and hobby farms, with a focus on the largest agricultural operations. Specifically, these producers could volunteer to be verified through the Michigan Agricultural Environmental Assurance Program, which is a comprehensive, voluntary, proactive program designed to reduce farmers' legal and environmental risks. See their website for more information: https://www.michigan.gov/mdard/environment/maeap.

5. Work with aquaculture operations to understand their procedures for reducing pollutant loads to receiving water bodies.

6. Engage in watershed management through involvement in the Lake Charlevoix Watershed Advisory Committee.

7. Work with Michigan Department of Transportation (MDOT) and county road commissions to minimize nonpoint source pollution (i.e. – chloride) entry at road/stream crossings. Direct road runoff away from surface waters where feasible. Municipal and private stormwater sources may exist as well.

8. Maintain river protection efforts by commenting on EGLE permit applications, remaining active in local government, and ensure upholding of the Wild and Scenic Rivers Act.

9. Assess algal communities in Lake Charlevoix to determine if changes are occurring as a result of excessive nitrogen and phosphorus inputs from the tributaries.

10. Repeat this monitoring project every five to ten years to evaluate changes in the Jordan River over time. After mitigation efforts have begun, select monitoring sites in sub-watersheds up and downstream of BMP installations to accurately assess longitudinal changes in the streams.

References

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Appendix A. 2025 Jordan River Water Quality Monitoring Results.

	Temp (°C)	Dissolved oxygen (mg/L)	Specific Conductivity (µS/cm)	TDS (mg/L)	pH (units)	TP (µg/L)	TN (µg/L)	Cl (mg/L)
Jordan River - Upstream of Fish Hatchery	12.49	9.76	349.9	234.4	8.12	61.4	2440	3.45
Jordan River - Downstream of Fish Hatchery	13.04	9.64	348.0	233.1	8.03	25.0	91	3.58
Jordan River - Rogers Rd	14.42	9.36	368.3	246.8	8.11	20.5	1351	5.27
Deer Creek - Maple St	19.30	8.93	381.3	255.5	8.14	18.4	742	9.89
Jordan River (Mouth) - M32	16.13	9.04	373.7	250.4	8.07	17.6	1149	6.40

Samples and measurements taken on June 27, 2025, during a wet-weather event. Results in red indicate exceedances to water quality standards. Results in black indicate results not exceeding water quality standards.

Appendix B. Comparable 2017 Jordan River Water Quality Monitoring Results

	Temp (°C)	Dissolved oxygen (mg/L)	Specific Conductivity (µS/cm)	TDS (mg/L)	pH (units)	TP (µg/L)	TN (µg/L)	Cl (mg/L)
Deer Creek - Maple St	14.57	9.91	326.4	218.7	8.27	9.0	703	8.57
Jordan River - Upstream of Fish Hatchery	11.76	10.52	314.0	210.4	8.21	10.1	3362	4.73
Jordan River - Downstream of Fish Hatchery	10.92	10.54	335.2	224.6	8.17	8.6	3658	4.23

Averaged sample results and measurements taken in June, September, and October 2017 during wet- and dry-weather events. Results in red indicate exceedances to water quality standards. Results in black indicate results not exceeding water quality standards.