

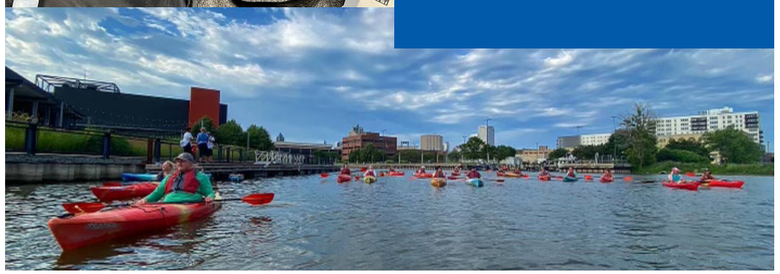
Milwaukee River Basin Report Card 2022



MILWAUKEE RIVERKEEPER®
PROTECT | RESTORE | CONNECT | ADVOCATE


TABLE OF CONTENTS

MILWAUKEE RIVERKEEPER®
PROTECT I RESTORE I CONNECT I ADVOCATE



CREATED IN PARTNERSHIP WITH:

Fund for Lake Michigan
Clearly making a deep impact.

DATA CONTRIBUTION PARTNERS

WISCONSIN DEPT. OF NATURAL RESOURCES

MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

OZAUKEE COUNTY
OZAUKEE FISH PASSAGE PROGRAM

SPECIAL THANK YOU TO GUEST AUTHOR: *Aaron Schiller, Wisconsin Department of Natural Resources*

DEAR FRIEND OF THE RIVER,

Milwaukee's rivers have borne witness to many changes over the years, both positive and negative. Access to freshwater has always been critical to those who settled in the Milwaukee River Basin. For thousands of years, many Native American tribes called the Milwaukee River Basin region home. Access to the rivers' vast network of transportation and communication pathways provided sustenance and supported life. It wasn't until Europeans took control of the region, forming cities and growing industry, that the waterways were altered to meet growing demand for resources. With no respect for their lifeforce, rivers were altered and lined with concrete, dams were built to control flow for industry, and pollution ran rampant. Human impacts disconnected the rivers, making many of them impassible for the wildlife that rely on them. These alterations left an indelible mark on the Milwaukee River Basin and it's aquatic ecosystem.

The need for restoration in the Basin is undeniable. Today, collaborative efforts to cleanup and reconnect the waterways throughout the Milwaukee River Basin are underway. Legacy pollution is being dredged from the river bottom and habitat is being restored. As dams and concrete channels are removed, up and downstream habitats are reunited, allowing fish, turtles and amphibians, freshwater mussels, and other creatures to move freely as their ancestors once did. Improving river access and water quality has brought people back to our waters with a renewed respect for their vitality and lifeforce.

Improvements in water quality take time to see. This report summarizes water quality data collected in the Milwaukee River Basin during 2022 and is intended to serve as a comprehensive reference, offering insights into the Basin's history and water quality, the pressing issues it faces today, and the promising steps toward restoration. It is our hope that the information presented in this report will inspire informed decision-making, foster greater community engagement, and catalyze a renewed dedication to the revitalization of our rivers.

Our Report Card represents an incredible amount of work from local government agencies, local leaders, and community partners to prioritize clean water. Special thanks to Milwaukee Riverkeeper's dedicated volunteer base for collecting the majority of this data and to the Fund for Lake Michigan for providing financial support for this work, without which, our work would not be possible.

GET INVOLVED: **www.milwaukeeriverkeeper.org**

STAY CONNECTED:

MILWAUKEE RIVERKEEPER WATER QUALITY TEAM

MAKING THE GRADE

Volunteers and water quality professionals **COLLECT** physical, chemical and biological water quality data throughout the Milwaukee River Basin year round. Collected data is submitted to the WDNR Surface Water Integrated Monitoring System (SWIMS). We **COMBINE** data from all of our project partners throughout the Milwaukee River Basin to produce the Annual Report Card.

We **COMPARE** water quality data for each parameter to established targets, set reasonable goals and assign a grade based on the percentage of data points that meet our goals. Targets are based on federal and state standards for water quality, as well as other available guidance. For more information about the water quality parameters, see pages 31 and 32. Overall watershed and subwatershed grades are computed by averaging their respective individual parameter grades.

- **A** — All water quality indicators meet desired targets **90 - 100%** of the time. Streams or river segments are capable of supporting fish and other aquatic life.
- **B** — Most water quality indicators meet desired targets roughly **80 - 89%** of the time. Most areas are capable of supporting fish and other aquatic life.
- **C** — Water quality indicators meet targets **70 - 79%** of the time. These waters have fair conditions for fish and most aquatic life.
- **D** — Water quality indicators meet targets **60 - 69%** of the time. Water quality and wildlife habitat of these waters tend to be poor.
- **F** — Water quality indicators meet targets **below 60%** of the time. Poor water quality in these streams and river segments result in poor conditions for fish and aquatic life.

We **CALCULATE** the overall Milwaukee River Basin grade by averaging all grades for the three major watersheds. A snapshot of river health is determined by analyzing water quality throughout the Basin for 2022. This Report Card provides us with general information on stream health, challenges in meeting water quality goals, and opportunities for implementing projects and changing practices and policies. Long term trends are also important, and touched on throughout the report.

THANK YOU VOLUNTEERS

Milwaukee Riverkeeper's Volunteer Water Quality Monitors are the eyes and ears of our waterways, and often, are the first to detect and report water quality issues. Our work simply would not happen without the tireless efforts of these individuals.

To learn more about Milwaukee Riverkeeper's Monitoring Programs, or to become a Water Quality Monitor and help contribute to this report, visit: **milwaukeeriverkeeper.org/protect**

2022 WATER QUALITY PROGRAM BY THE NUMBERS

90 volunteers

99 sites monitored

791 site visits

1187 volunteer hours

TEAMWORK MAKES THE DREAM WORK

MEET DAVE

VOLUNTEER SINCE 2016

If you were a macroinvertebrate, which one would you be & why? I would be a dragonfly larva. They are semi-sensitive to pollutants, so if the water quality of my stream diminished at times, I could survive to grow up and be a dragonfly. They are amazing flyers.

What is your fondest memory from monitoring? While monitoring the Kinnickinnic, I walked right up on a family of mink! There was one adult, and several kits. They seemed as surprised as I was and took some time getting back in the water before I got a grainy photo of the adult.

Why is volunteering with Milwaukee Riverkeeper important to you? I believe in the organization's mission to make swimmable, fishable rivers in the Milwaukee River Basin. A thriving and diverse environment is very important to me. Rivers play a critical role connecting people with nature, and without healthy rivers, that connection would tragically be lost.

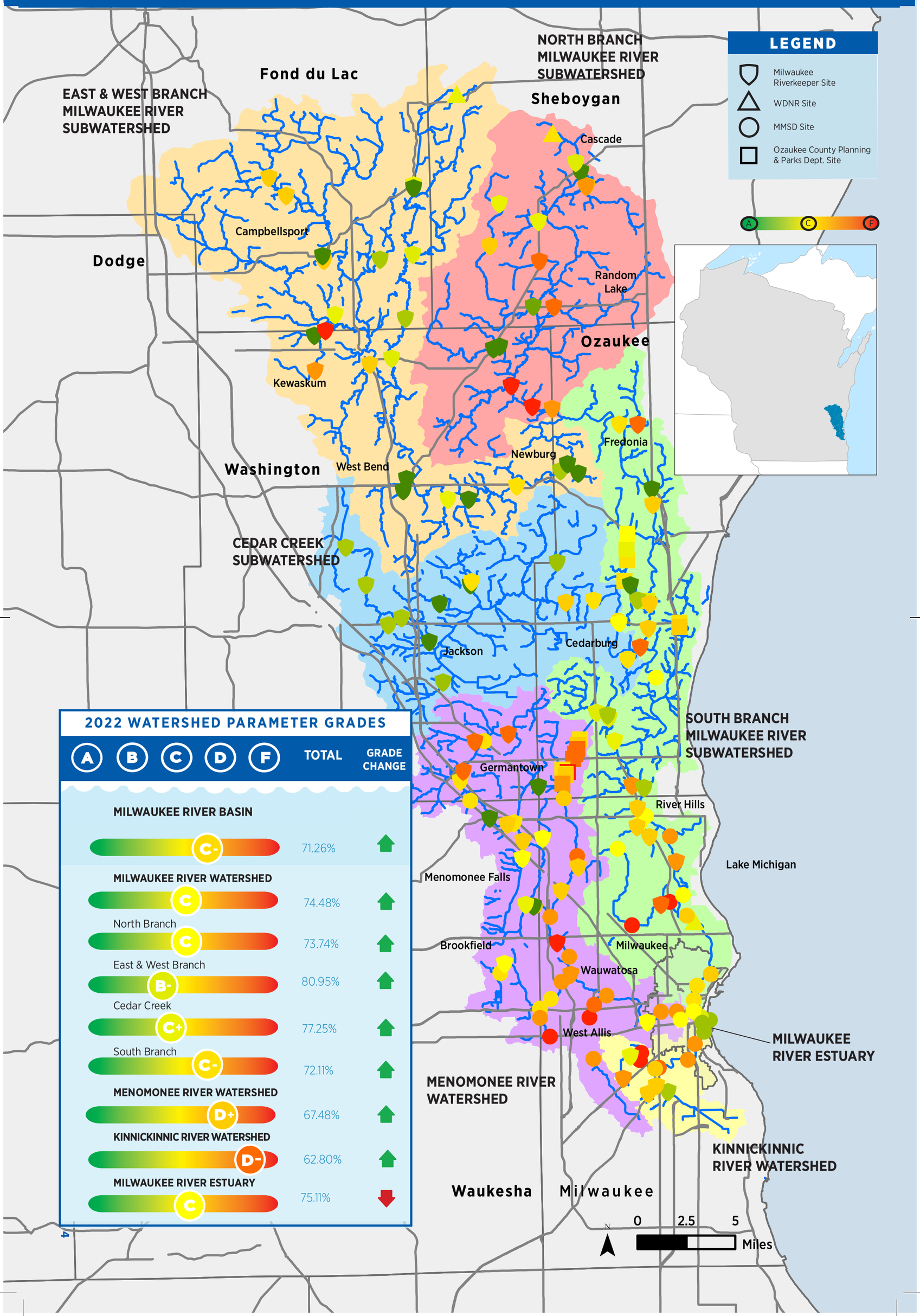
CELEBRATING LIVES & SERVICE

We pay tribute to the volunteers who have left us. These individuals selflessly invested their time and passion into safe- guarding our precious water resources. Their unwavering commitment to the protection of the Milwaukee River Basin has not only left a mark on the natural world, but also on the hearts of those who had the privilege of knowing and working alongside them. As we remember these champions of clean water, we are inspired to continue our work to achieve a swimmable, drinkable, fishable future for our waters.

TONI BUCK
Years Volunteered (2015 - 2023)

TOM SCHUKNECHT
Years Volunteered (2017 - 2022)

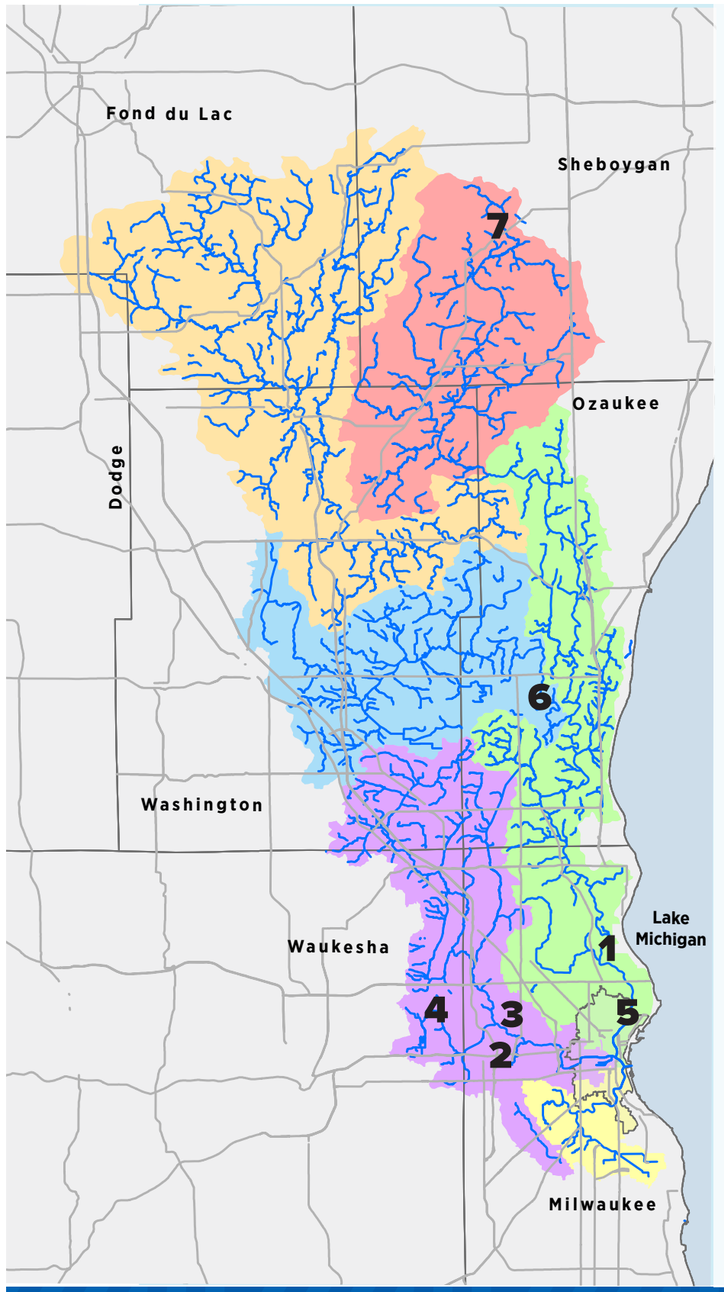
MILWAUKEE RIVER BASIN MAP



2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
MILWAUKEE RIVER BASIN			C-			71.26%	↑
MILWAUKEE RIVER WATERSHED			C			74.48%	↑
North Branch			C			73.74%	↑
East & West Branch			B-			80.95%	↑
Cedar Creek			C+			77.25%	↑
South Branch			C-			72.11%	↑
MENOMONEE RIVER WATERSHED				D+		67.48%	↑
KINNICKINNIC RIVER WATERSHED				D-		62.80%	↑
MILWAUKEE RIVER ESTUARY			C			75.11%	↓

ON PATROL WITH MILWAUKEE RIVERKEEPER



LOOKING AHEAD | 2024

1. **Estabrook Falls Fish Passage** construction will begin in late 2024 or early 2025. The passage will be built instream on both banks of the river. It will accommodate low and high water levels and streamflows. This will ensure that most fish can move upstream to spawning areas.
2. **Honey Creek Flood Management and Habitat Restoration Project** is in the design phase, with construction estimated to begin in 2025. Nearly 1 mile of concrete-lined channel will be removed, and an additional 0.6 miles of natural creek will be rehabilitated. These improvements will slow flows during rain events, improve streambank habitat, and reconnect the creek to its floodplain.
3. **Western Milwaukee Phase 2B Flood Management Project** construction began in 2023. Improvements will be made to reduce flood impacts along the Menomonee River, parallel to West State Street between 60th Street and US HWY 175. This project includes construction of storm sewers and earthen levees, and floodwall replacement to reduce the floodrisk for 300+ homes and businesses in the area.
4. **Underwood Creek Downtown Daylighting Project** should go to bid in 2024 for construction. The design will remove concrete from the streambed in the heart of the Village of Elm Grove, and "daylight" a portion of buried stream. Restoration will allow for fish to swim upstream to spawning habitat, and will reduce the risk of flooding downtown.
5. **The Milwaukee River Greenway Restoration**, as part of the AOC work, includes cleaning up contamination from 4 river miles from Estabrook Park to the former North Avenue Dam. This project will remove soil from floodplains and instream river sediments that are contaminated with industrial pollutants and pose a risk to human health.
6. **Cedar Creek Superfund Site Cleanup** efforts continue. Mercury Marine submitted a feasibility study of possible cleanup options for Cedar Creek from the Wire and Nail Dam to the confluence with the Milwaukee River. EPA will propose a cleanup plan for review soon.
7. **The Cascade Dam and Mill Pond Park Feasibility Study** is looking at options for removing the Cascade Dam on Nichols Creek (a segment of the North Branch of the Milwaukee River), or providing a fish passage around it, to improve water quality and restore a cold-water fishery.

WHAT IS A RIVERKEEPER?

WATERKEEPER® ALLIANCE

A Riverkeeper is a full-time, privately-funded, non-governmental advocate for an identified river. By responding to community concerns, patrolling the waterways and tracking down reported sources of pollution, Waterkeepers become the voice of their waterbody, advocating for the public's right to clean water. Waterkeeper Alliance unites more than 300 groups on the front lines of the planetary environmental crisis, patrolling and protecting rivers, lakes, and coastal waterways across six continents.

PROTECTING OUR WATER SUPPLY | PFAS

Milwaukee Riverkeeper's water quality monitoring program provides a strong foundation for our advocacy efforts to protect everyone's access to clean, fishable, swimmable, and drinkable water. Each year, we focus our advocacy efforts around the greatest threats to our water and best opportunities to create change. In the world of politics, our advocacy work doesn't usually go as planned. We're often forced to be nimble and react to proposed legislation, regulations, projects, permits, budget allocations, and implementation plans being pushed by decision makers that are often at odds with protecting our waters.

While we pushed our advocacy priorities forward this year, our focus continued to shift to PFAS. PFAS (poly- and perfluoroalkyl substances) are a group of thousands of chemicals that have been used widely in manufacturing of non-stick coatings, waterproof fabrics, firefighting foams, food packaging and many other products since the 1940s. Often referred to as "forever chemicals," they are difficult to break down and build up over time. Exposure to and consumption of PFAS is extremely harmful to both human health and the environment.

Most residents of the Milwaukee River Basin drink treated water from Lake Michigan, but around ⅓ are on private wells, which draw either shallow or deep groundwater for drinking. In Wisconsin, around ⅔ of residents drink groundwater. Over the last few years, we've spent considerable time advocating for State of Wisconsin and federal regulations to provide more protective health regulations for public drinking water supplies (both surface and groundwater), private groundwater supplies, and surface waters.

CHERYL NENN, Riverkeeper

Cheryl Nenn has served as Riverkeeper with Milwaukee Riverkeeper for 20 years. As a Riverkeeper, Cheryl patrols local waterways, identifies problems in the Milwaukee River Basin, responds to community concerns, reviews and comments on permits, advocates for river protection, and helps find collaborative solutions to problems affecting local rivers.

The EPA is likely to issue formal drinking water standards for two of the most widespread PFAS chemicals (PFOA and PFOS) early next year, and will address four other chemicals using a combined risk approach. These regulations apply to public drinking water supplies, and the standard is likely to be 4 parts per trillion (ppt). A ppt is equivalent to a single drop of water in 20 Olympic-sized swimming pools!

In summer 2022, the Wisconsin Legislature approved standards for PFOA and PFOS in public drinking water supplies at a much less protective standard (70 ppt individually or cumulatively) than what was recommended by state health professionals (20 ppt). If the federal standards are approved, they will provide a much greater level of protection to residents. Wisconsin also approved PFAS standards for surface waters (for PFOA and PFOS) like rivers and lakes, with different levels of PFAS allowed based on whether the waters are used for drinking or not. These levels were also meant to be protective of fish and aquatic life, and of the people who eat wild fish and game. Currently, we do not have any additional PFAS fish consumption advisories in the Milwaukee River Basin.

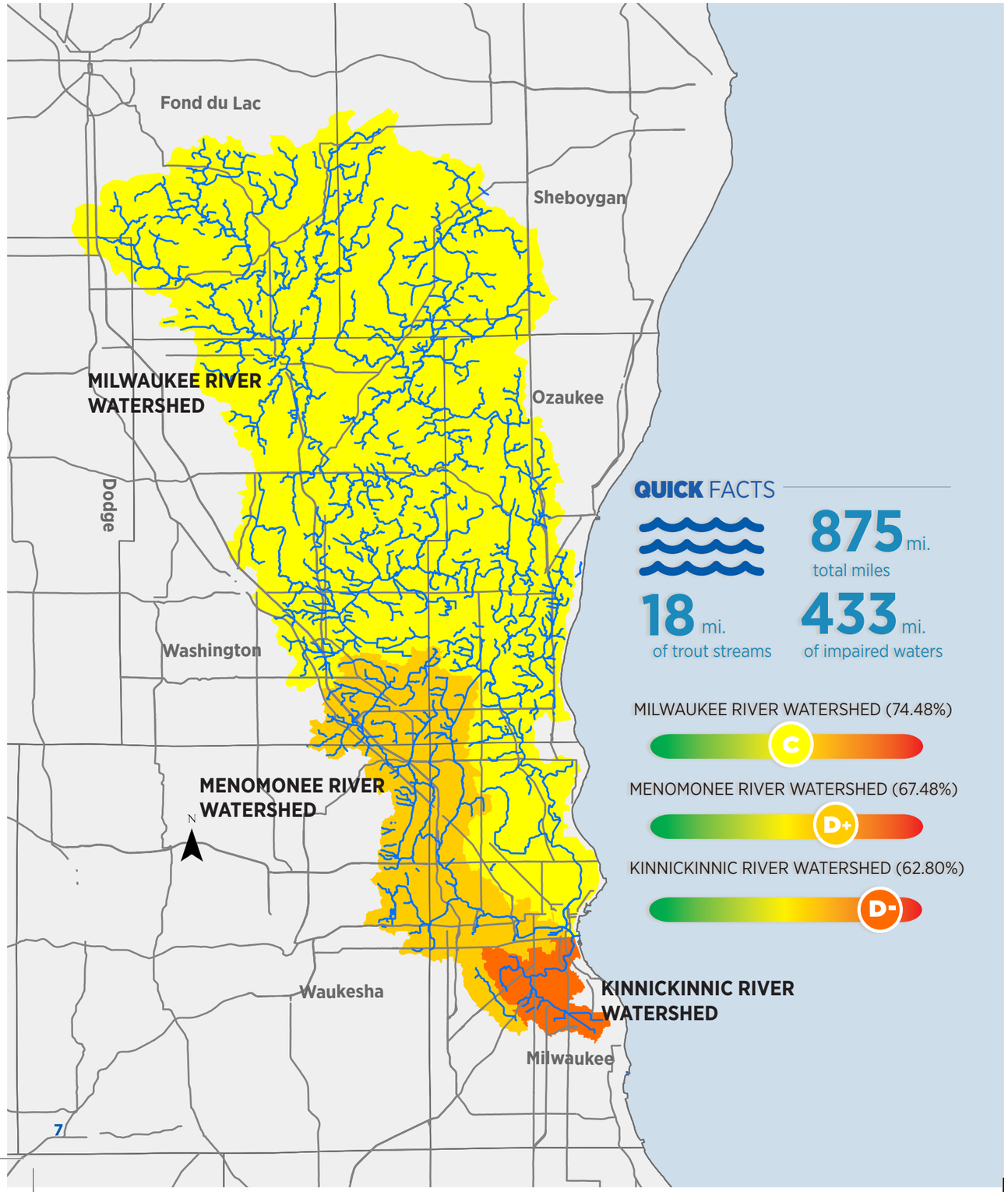
In early 2022, the Wisconsin Natural Resources Board refused to pass groundwater standards, largely due to pressure from many in the state's manufacturing community, leaving millions of Wisconsinites that get their drinking water from groundwater unprotected. Wisconsin reinitiated a new groundwater rulemaking process in December 2022, which will likely take 3 years, even though there has already been extensive science put into the last 3-year rulemaking effort.

We will continue to advocate for these groundwater protections as well as push for more stringent protections for all drinking and surface waters. It's never a bad time to contact your elected officials and representatives about these and other issues affecting clean water!

For more information about PFAS scan the code or visit: milwaukeeriverkeeper.org/pfas

LEARN MORE

PROTECTING THE MILWAUKEE RIVER BASIN



QUICK FACTS

875 mi.
total miles

18 mi.
of trout streams

433 mi.
of impaired waters

MILWAUKEE RIVER WATERSHED (74.48%)

C

MENOMONEE RIVER WATERSHED (67.48%)

D+

KINNICKINNIC RIVER WATERSHED (62.80%)

D-

OPPORTUNITIES FOR CHANGE | WATER POLICY

As the lifeblood of our planet, all water is intricately interconnected. As we navigate an era marked by environmental challenges, the significance of organizations like our own becomes increasingly apparent. Taking an innovative approach to solving water-related issues is no longer a want, but a need. At the heart of Milwaukee Riverkeeper's mission is a dedication to monitoring and improving water quality, and a commitment to use the gathered data as a catalyst for policy reform and transformative change. Every year, the DNR relies on the data we collect to add sections of rivers to the impaired waters list, which in turn gives those waters a higher level of protection so they can be restored. It's a wraparound approach that goes beyond the traditional boundaries of environmental advocacy.

Our efforts extend beyond the confines of merely informing the public about water-related issues. We are deeply engaged in a broader initiative — one that involves educating diverse audiences and fostering a sense of unity among individuals and groups who share common values and objectives. We want to make a connection between people and the water. Every year, we host a trash cleanup where thousands of people gather at the river's edge with a common goal to beautify and restore the rivers. This connection to water and place deepens the commitment of the community to advocate and care for our waterways.

Milwaukee Riverkeeper, in collaboration with our many partners, has led the effort to prioritize the clean up of the Milwaukee Estuary Area of Concern. The community is galvanizing around this work to finish in record time, so that we can leave our waterways and drinking water source cleaner and healthier for the next generation. Our concerted efforts have not only garnered historic levels of federal funding, but have also propelled us closer to the overarching objective of ensuring that our waters are swimmable, fishable, and drinkable.

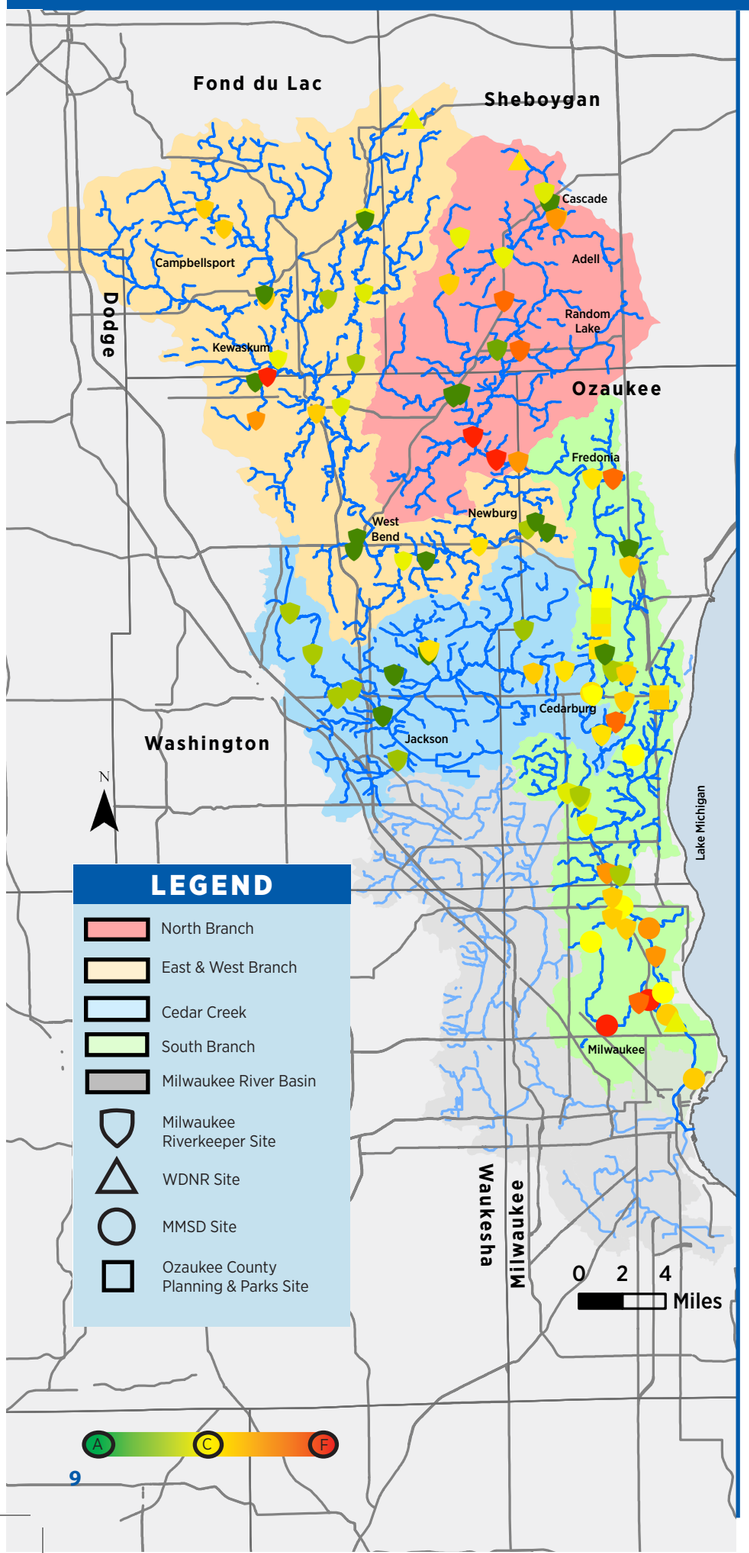
The interconnectedness of water-related challenges and the need for collaborative, innovative solutions cannot be over emphasized. Milwaukee Riverkeeper is committed to building a community that recognizes the inherent value of water and is dedicated to safeguarding this precious resource.

JENNIFER BOLGER BRECEDA, Executive Director

Jennifer has been an advocate for the environment personally and professionally. As Executive Director of Milwaukee Riverkeeper, Jennifer is responsible for "keeping the lights on" as well as making strategic decisions about the programs and advocacy initiatives the organization engages in. Her background as an environmental lawyer and litigator, makes Jennifer an important thought partner to community leaders and decision-makers.

STAY CONNECTED:
www.milwaukeeriverkeeper.org

MILWAUKEE RIVER WATERSHED | C



QUICK FACTS

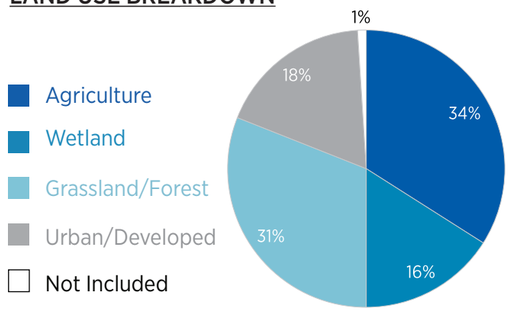
RIVER MILE FACTS

704 mi. total miles

18 mi. of trout streams

322 mi. of impaired waters

LAND USE BREAKDOWN



2022 MONITORING

97 total sites

874 total site visits

Milwaukee Riverkeeper Data Contribution:

76% of total sites

809 volunteer hours

62 volunteers

2022 DATA SUMMARY

The largest watershed in the Milwaukee River Basin is the Milwaukee River Watershed, which is made up of four smaller subwatersheds: North Branch, East and West Branch, South Branch, and Cedar Creek. The Milwaukee River Watershed's overall water quality grade for 2022 was a C, an over 4% improvement from the previous year. Of the water quality parameters measured, the Milwaukee River Watershed and its subwatersheds all struggle to meet standards for phosphorus, bacteria, and specific conductivity.

The phosphorus grade improved over 6% from 2021 overall, but continues to fail to meet the standard over 50% of the time. All of the subwatersheds of the Milwaukee River Watershed had the best phosphorus levels recorded since 2016, with the exception of the East and West Branch. These differences are hard to understand. However, there are many factors that influence phosphorus levels in our waterways, from changes in land use (in both urban and rural areas), to changes in weather patterns. The management of sewage, stormwater, and industrial effluent also play a large role in the total phosphorus score. Efforts to improve these grades are being made in each subwatershed, and will continue as the Milwaukee River Basin TMDL, a Basin-wide pollutant reduction plan, is implemented.

Out of all water quality parameters measured, bacteria grades improved the most, even though the Milwaukee River Watershed met bacteria standards only 53% of the time during 2022. Although each subwatershed grade improved 10% or more compared to the bacteria grade in 2021, the Watershed received an F for bacteria overall. Measuring instream bacteria is directly related to human health. Increased levels of *E. coli* indicate there is fecal contamination (from animals or humans) in the water, which may also contain viruses and pathogens that can make people sick. Studying bacteria across the watershed provides us with a better understanding of whether the Milwaukee River Watershed is clean enough for recreational use, and helps us identify areas in need of targeted remediation efforts to reduce sources of bacteria contamination.

The Milwaukee River Watershed continues to struggle with high specific conductivity levels. Conductivity is water's ability to pass an electrical current, due to charged particles within the stream, and generally increases with the addition of dissolved salts and minerals. Conductivity levels are naturally impacted by a stream's geology; however, pollutants from humans such as industrial waste, sewage, road salt, fertilizers, and sediment can affect conductivity. Healthy conductivity levels for streams were met less than 10% of the time in all subwatersheds, a trend consistent since Milwaukee Riverkeeper began monitoring conductivity in 2011. Better management practices and choices that reduce the amount of phosphorus, sediment, and chloride from entering waterways will help improve the conductivity levels within local waterways over time.

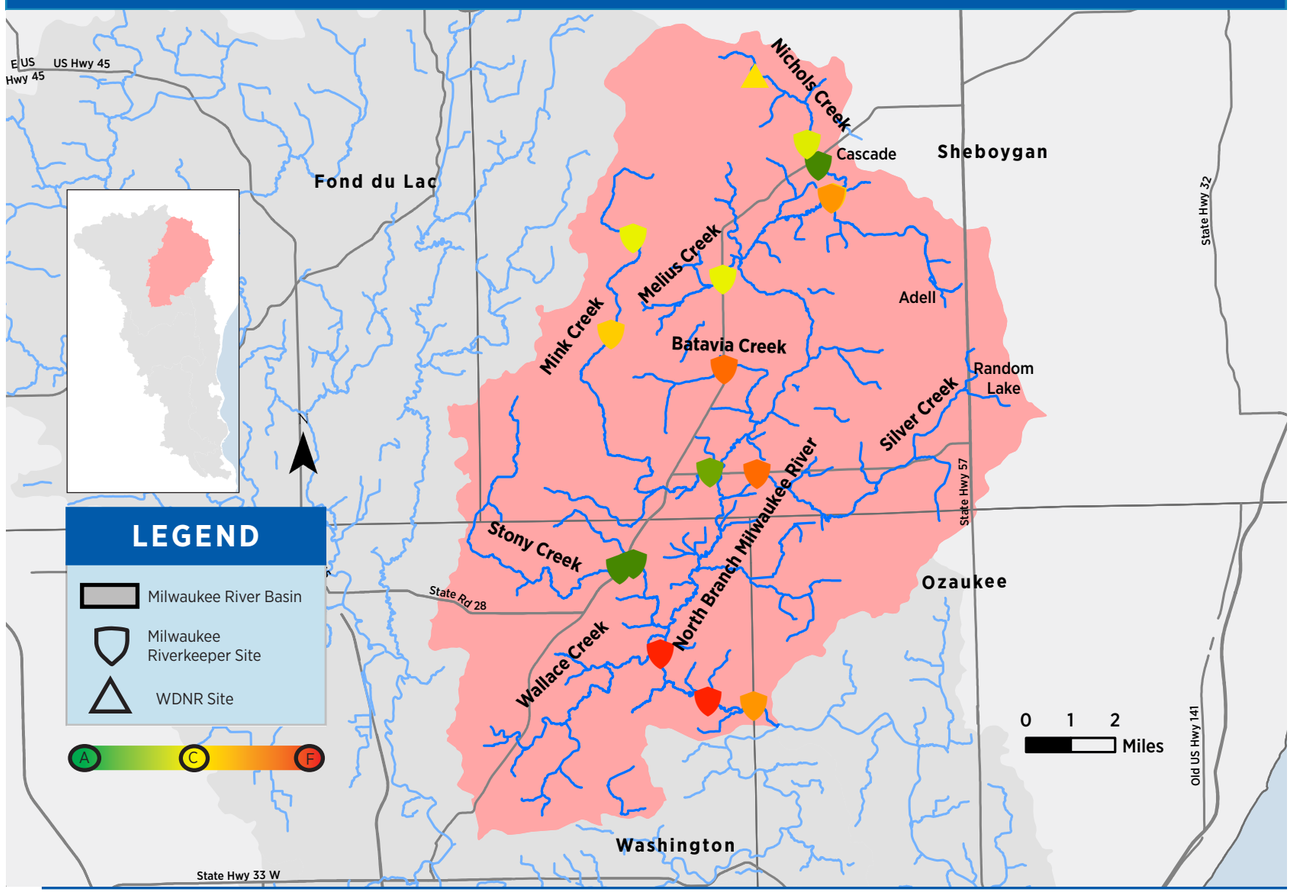
2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
WATERSHED			C			74.48%	↑
Temperature	A					99.24%	↓
Dissolved Oxygen	A					96.37%	↑
pH	A					99.80%	↑
Turbidity		B+				88.21%	↑
Phosphorus					F	49.44%	↑
Chloride	A					97.93%	↑
Specific Conductivity					F	4.72%	↑
Bacteria					F	52.97%	↑
MACROINVERTEBRATE BIOTIC INDEX			FAIR			2.41	↑

DID YOU KNOW?

High chloride levels can impair a fish's ability to maintain a balance of salt and water in their cells, which can lead to dehydration, stress, and even death.

NORTH BRANCH MILWAUKEE RIVER SUBWATERSHED | C



QUICK FACTS

RIVER MILE FACTS

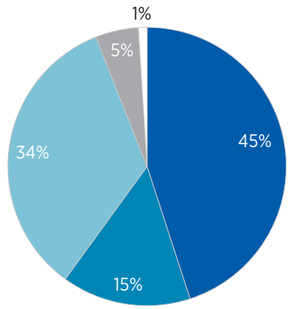
147 mi. total miles

7 mi. of trout streams

73 mi. of impaired waters

LAND USE BREAKDOWN

- Agriculture
- Wetland
- Grassland/Forest
- Urban/Developed
- Not Included



2022 MONITORING

16 total sites **102** total site visits

Milwaukee Riverkeeper Data Contribution:

94% of total sites **13** volunteers **153** volunteer hours

2022 DATA SUMMARY

The North Branch Subwatershed met water quality standards 74% of the time in 2022, and has remained solidly in the C range since 2017. Similar to previous years, the North Branch struggles with high phosphorus, conductivity, and bacteria. While still not meeting standards, phosphorus and bacteria grades did improve over 5% from 2021.

One way phosphorus enters waterways is bound to sediment particles. When it rains, sediment from exposed and eroding soil, construction sites, and farmland is washed into ditches and streams as runoff. During this time, turbidity levels spike in rivers and streams, impacting water clarity. Once the rain stops, sediment particles settle into the streambed, returning water clarity back to normal. However, phosphorus (and other pollutants) bound to sediment also settles to the bottom. Phosphorus can also enter streams in a dissolved state from manure, treated or raw sewage, or fertilizers. This partially explains why the turbidity grade in the North Branch met standards 95% of the time, and the phosphorus grade only met the standard 45% of the time.

Much like humans, life in the stream requires oxygen. Dissolved oxygen levels in the North Branch met water quality standards 92% of the time in 2022, with a few exceptions. Dissolved oxygen levels of Batavia Creek were half of the concentration necessary for a warm water creek during the fall of 2022, which is concerning. Melius Creek, one of a few cold-water streams in the Milwaukee River Basin, dipped below a healthy dissolved oxygen level in September. It is especially important that cold-water streams maintain a high level of dissolved oxygen, at or above 6 mg/L, to support aquatic life. When oxygen levels drop, sensitive fish and macroinvertebrates, like trout and stoneflies, can struggle to reproduce and survive. As extreme and volatile weather conditions continue with climate change, continual monitoring of temperature and dissolved oxygen levels in cold-water streams will help guide management practices to better protect these waters.

2022 WATERSHED PARAMETER GRADES

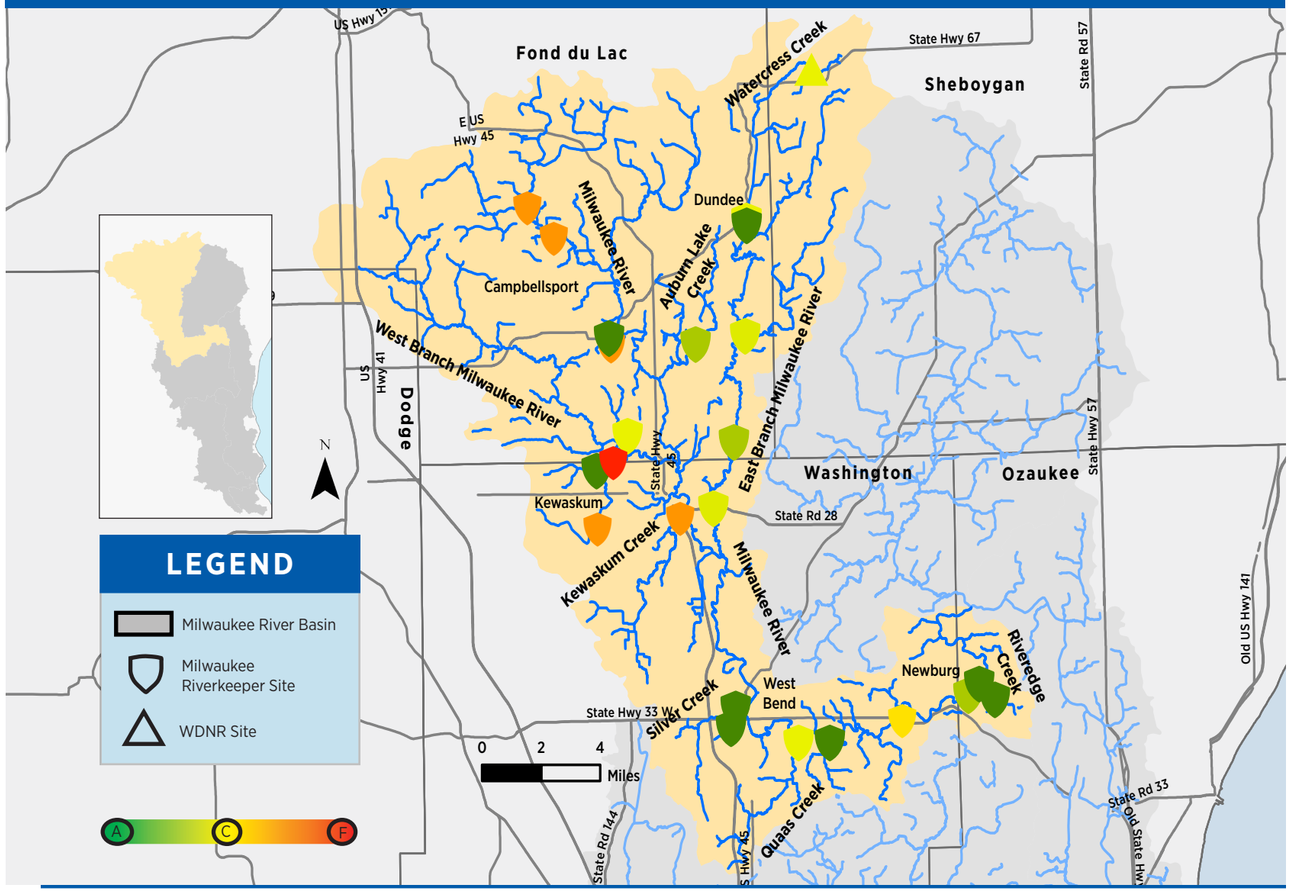
					TOTAL	GRADE CHANGE
A	B	C	D	F		
SUBWATERSHED		C+			73.74%	↑
Temperature		A			98.63%	↓
Dissolved Oxygen		A-			91.78%	↓
pH		A			100.0%	↑
Turbidity		A			94.52%	↑
Phosphorus				F	45.45%	↑
Chloride					N/A	
Specific Conductivity				F	0.00%	=
Bacteria				F	48.28%	↑

MACROINVERTEBRATE BIOTIC INDEX: FAIR 2.48 ↑

Historically, dams were built to harness water power to run machines that milled wool, grains, and lumber. Today, many of these dams are no longer functional, in a state of disrepair, and their millponds are filling up with trapped sediment and other pollutants. Blocking the movement of sediments in a stream negatively impacts in-stream habitat. Dams also block the passage of fish and aquatic life and create stagnant water, leading to warmer temperatures, decreased oxygen levels downstream, siltation, decreased water levels, and nuisance algae. Degrading dams pose a risk to public safety. Dam removal is often the cheaper option compared to the cost of repair, and improves water quality and fish passage, while reconnecting habitat for a large variety of aquatic life such as freshwater mussels.

In the North Branch, dams on Gooseville Creek, Nichols Creek, and Stony Creek disconnect these waterways. Nichols Creek, a 4+ mile cold-water trout stream, is disconnected from 23 miles of downstream habitat below the Cascade Millpond Dam. Currently, the feasibility of dam removal is being considered by the community.

EAST & WEST BRANCH MILWAUKEE RIVER SUBWATERSHED | B-



QUICK FACTS

RIVER MILE FACTS

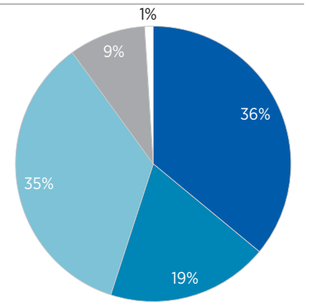
233 mi.
total miles

11 mi.
of trout streams

48 mi.
of impaired waters

LAND USE BREAKDOWN

- Agriculture
- Wetland
- Grassland/Forest
- Urban/Developed
- Not Included



2022 MONITORING

24 total sites **173** total site visits

Milwaukee Riverkeeper Data Contribution:

96% of total sites **20** volunteers **251** volunteer hours

2022 DATA SUMMARY

The East and West Branch Milwaukee River Subwatershed continues to score a B- for overall water health, receiving the highest overall grade out of the four subwatersheds in the Milwaukee River Watershed. This Subwatershed has areas of intense agriculture in the West Branch, as well as vast areas of protected forest in the East Branch, making up the Kettle Moraine North State Forest. The Watershed has remained in the B range, and above, since Milwaukee Riverkeeper began assigning river grades in 2010. Nonetheless, like the rest of the Milwaukee River Basin, the East and West Branch still struggles with phosphorus, bacteria, and conductivity.

Of all the parameters measured in 2022, besides conductivity, the phosphorus grade dropped the most, nearly 19% from the previous year. Water samples only met the state standard 56% of the time. In total, 48 miles of the East and West Branch streams are currently listed as impaired for phosphorus pollution. Despite this failing phosphorus grade, the East and West Branch Subwatershed has the best 6-year phosphorus average out of all waterways within the Milwaukee River Basin.

The large decrease in grade is likely the result of 10 more inches of rain in 2022 compared to the previous year. With more rain comes more surface runoff, which can easily transport higher amounts of pollutants, like phosphorus, to local waterways. Increased phosphorus levels have cascading water quality impacts. Protecting and improving the waterways of the East and West Branch will be important going forward, especially as weather becomes more extreme from climate change, likely in the form of more intense rain events, peppered with seasons of drought.

Water temperature in the East and West Branch met state standards 97% of the time in 2022. However, zooming into the 11 miles of cold-water streams in the Subwatershed, Auburn Lake Creek, a nearly 8-mile creek in the Kettle Moraine Forest, struggles to remain within the optimal temperature range for a cold-water stream. This is a significant data point that will be important to watch so it does not slip any further.

Native freshwater mussels are often overlooked, but play a critical role in our freshwater ecosystems. Filtering 10 gallons of river water per day per mussel, they have to withstand day-to-day changes, and seasonal fluctuations of water quality to survive. Mussels spend their entire lives in the stream making them great indicators of river health. During the summer of 2022, with the help of Mussel Biologists from the WDNR, Milwaukee Riverkeeper volunteers surveyed a stretch of river in the East Branch. Ellipse mussels, a state threatened species, were found along with other native mussel species. Healthy populations of mussels in the East and West Branch indicate overall water quality is fairly good, which is also backed up by the overall watershed grade for the East and West Branch.

2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
SUBWATERSHED		B-				80.95%	↑
Temperature	A					96.95%	↓
Dissolved Oxygen	A					96.90%	↓
pH	A					100.0%	=
Turbidity	A					98.47%	↑
Phosphorus					F	56.32%	↓
Chloride						N/A	
Specific Conductivity					F	7.69%	↑
Bacteria					F	40.74%	↑

MACROINVERTEBRATE BIOTIC INDEX

GOOD — 2.58 ↑

DID YOU KNOW?

Lack of shade, industrial discharge, and water runoff affect water temperature. If you live near a creek, keeping a buffer of native plants along the waterway can help improve temperature and water quality. Planting trees along the riverbanks provide shade and also keep temperatures cool, too.

CONNECT | ADVOCATE | PROTECT | RESTORE | MILWAUKEE RIVERKEEPER

Milwaukee Riverkeeper is a science-based advocacy organization working to protect, restore, connect and advocate on behalf of the Milwaukee, Menomonee, and Kinnickinnic River Watersheds.

It is the deep commitment to both community and clean water that drives our mission. We're proud of our work to build a movement around Milwaukee's waterways. Our rivers flow through and unite a myriad of communities. We are committed to celebrating this diversity of our people, ensuring inclusion for all, and working towards equity in all we do for our waterways.

> We're working to achieve swimmable, fishable, drinkable waters for future generations.

At Milwaukee Riverkeeper, we celebrate little victories as well as decisive wins. Systemic change and water quality improvements take time, collaboration, and effort to achieve. If you're ready to join the movement, please get involved. Milwaukee Riverkeeper offers many fun and exciting opportunities to help protect, restore, connect and advocate for our waters. Whether you lend a hand, make a financial contribution, or advocate for healthy rivers, every small action makes a difference.

STAY CONNECTED:

www.milwaukeeriverkeeper.org

OUR IMPACT AT A GLANCE

INDIVIDUAL CHANGE

36,017

COMMUNITY MEMBERS REACHED

13,735
INDIVIDUAL ACTIONS

5,832
INDIVIDUALS VOLUNTEERED

We envision a future where all people can enjoy the healthy waterways of the Milwaukee River Basin.

MOVEMENT BUILDING

48
COALITIONS & PARTNERSHIPS

440
OUTREACH & EDUCATION OPPORTUNITIES

1200
STUDENTS REACHED

COMMUNITY CHANGE

115,000
POUNDS OF TRASH REMOVED

108
LETTERS & COMMENTS SENT TO DECISION MAKERS

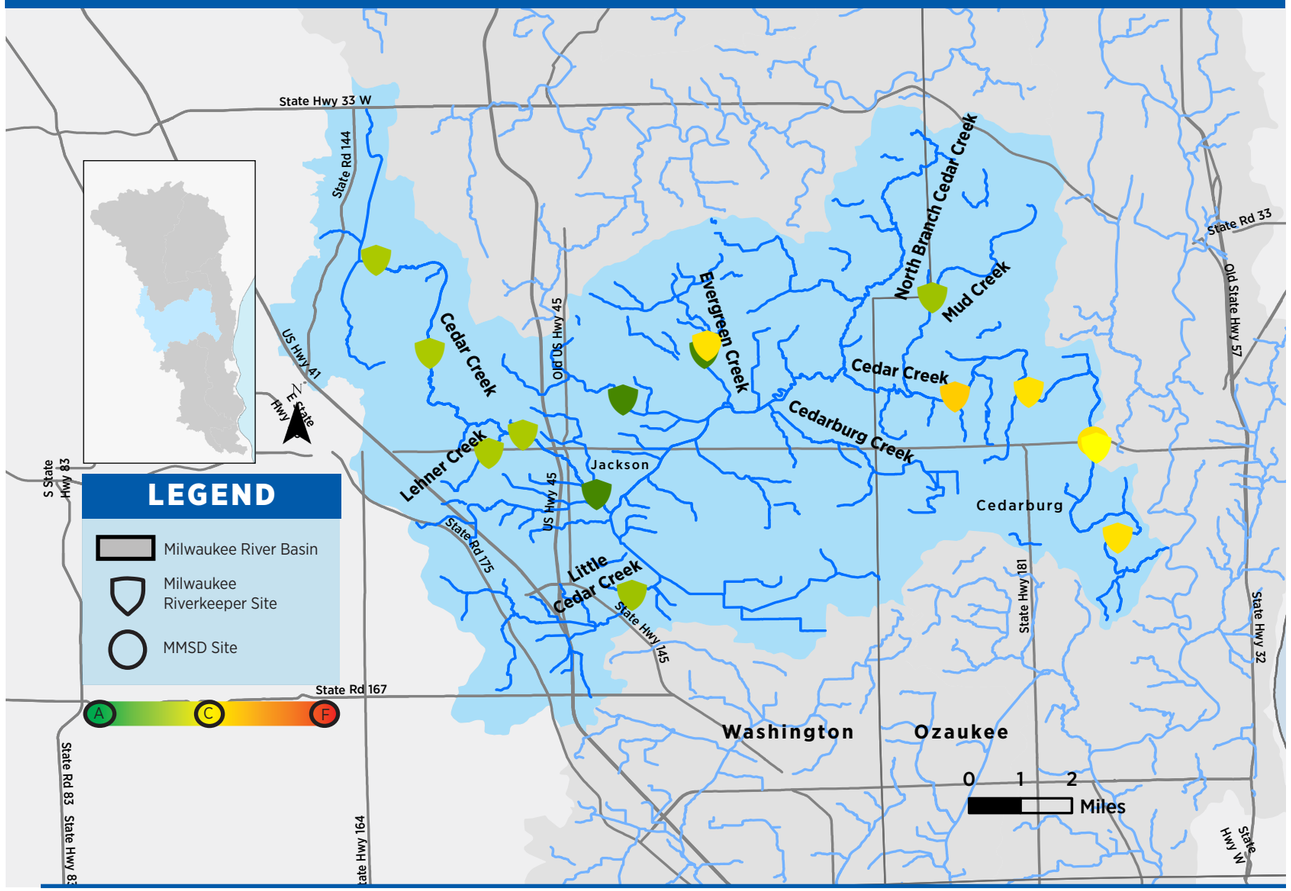
LET'S CELEBRATE

- The State introduced a bill to encourage responsible road salt application
- The State budgeted $125M to address PFAS contamination
- The City of Milwaukee began educating & enforcing the plastic straw ban
- Third Ward Area of Concern sediment remediation project completed
- Fish passage constructed at Kletzsch Park Dam
- Completed two fish passage feasibility studies in Northern Watersheds

Make an impact!

DONATE

CEDAR CREEK SUBWATERSHED | C+



QUICK FACTS

RIVER MILE FACTS

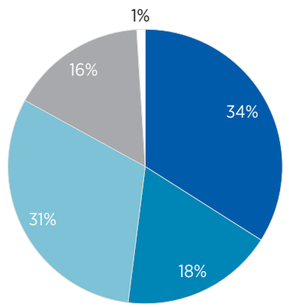
92 mi.
total miles

0 mi.
of trout streams

54 mi.
of impaired waters

LAND USE BREAKDOWN

- Agriculture
- Wetland
- Grassland/Forest
- Urban/Developed
- Not Included



2022 MONITORING

16 total sites

147 total site visits

Milwaukee Riverkeeper Data Contribution:

70% of total sites **17** volunteers **155** volunteer hours

2022 DATA SUMMARY

A result of positive improvements to bacteria, phosphorus, and turbidity scores, the Cedar Creek Subwatershed grade has steadily improved from a D+ in 2018, to a C+ in 2022. The Subwatershed received the healthiest score since our 2017 report, and continues to meet standards for temperature, dissolved oxygen, chloride, and turbidity. Phosphorus and bacteria grades improved by over 10% from the previous year, meeting standards 57% and 65% of the time, respectively.

Excessive instream phosphorus can have multiple impacts, resulting in nuisance algae growth, lower water clarity, and dissolved oxygen extremes. Excessive levels of bacteria can pose potential health risks to those using waterways for recreation. Agricultural runoff is a major source of bacteria and phosphorus pollution in Cedar Creek, with about one third of land in the subwatershed being used for farming.

Both Ozaukee and Washington counties promote farm bill funding programs aimed at improving soil and water quality within the Subwatershed. Keeping topsoil, considered a nonrenewable resource, in place is important for productive crop yields now and in the future. The Counties provide education and outreach on best practices that preserve soil and water health, such as keeping continuous living cover on land; sponsoring farmer-to-farmer information sharing collaboratives; creating connections between municipalities and farmers looking to engage in policy solutions, like water quality trades or adaptive management; and providing equipment rentals, such as “interseeders” that allow producers to pilot soil conservation initiatives. Improving and protecting soil health directly protects water quality by reducing soil loss, reducing the need for fertilizers and pesticides, and minimizing runoff of pollutants like bacteria and phosphorus to waterways. Using sustainable agricultural practices not only improves water and soil quality, but helps farmers, too. The overall phosphorus grade has steadily improved from 38% in 2017 to 57% in 2022; a strong indicator that this hard work is paying dividends.

Chloride levels in Cedar Creek remain healthy. Zero of the 117 miles of chloride impaired waterways within the Basin are located in the Cedar Creek Subwatershed. Milwaukee Riverkeeper’s road salt monitoring program has conducted significant monitoring efforts throughout the Cedar Creek Subwatershed since 2019. High chloride levels can negatively impact aquatic life within streams, and freshwater mussels are especially sensitive to this pollutant. Low chloride levels in the Cedar Creek Subwatershed could be one reason why there is a thriving freshwater mussel population here.

2022 WATERSHED PARAMETER GRADES

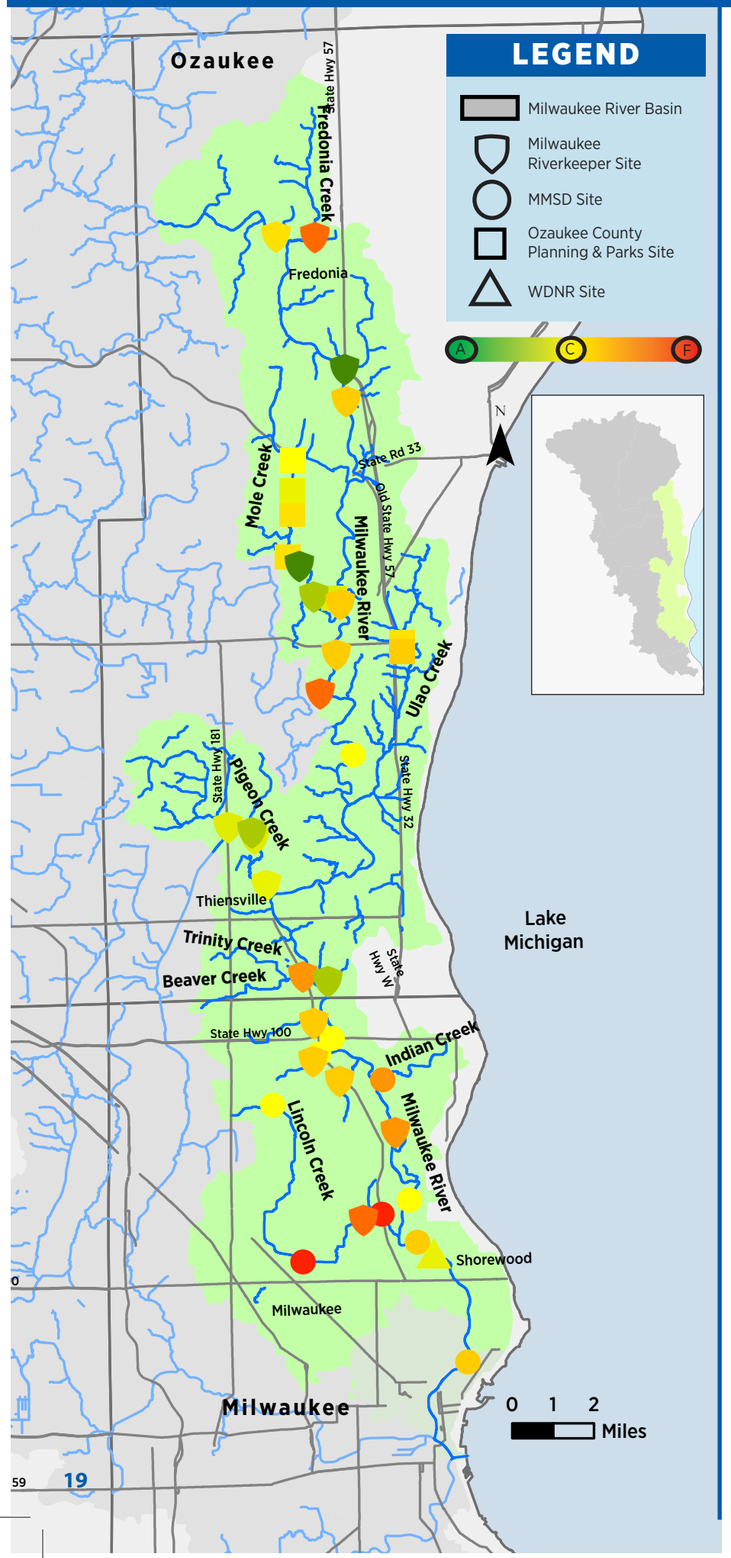
	A	B	C	D	F	TOTAL	GRADE CHANGE
SUBWATERSHED			C+			77.25%	↑
Temperature	A					100.0%	=
Dissolved Oxygen	A					96.23%	↓
pH	A					100.0%	=
Turbidity	A					94.29%	↑
Phosphorus					F	56.79%	↑
Chloride	A					100.0%	=
Specific Conductivity					F	2.38%	↓
Bacteria				D		65.08%	↑

MACROINVERTEBRATE BIOTIC INDEX: FAIR — 2.39 ↑

DID YOU KNOW?

Dams and other human created barriers not only prevent fish from reaching upstream habitat, but affect other life in the stream, too. For example, native freshwater mussels require a fish host to reproduce; when fish are trapped below a dam it prevents mussel populations from growing and expanding geography.

SOUTH BRANCH MILWAUKEE RIVER SUBWATERSHED | C-



QUICK FACTS

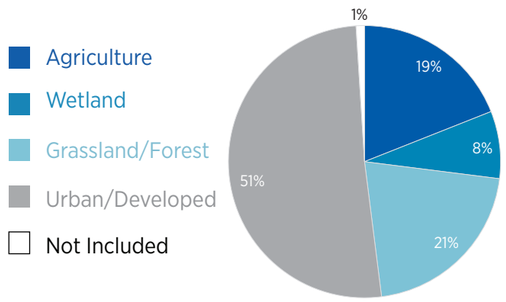
RIVER MILE FACTS

232 mi.
total miles

0 mi.
of trout streams

147 mi.
of impaired waters

LAND USE BREAKDOWN



2022 MONITORING

41 total sites

452 total site visits

Milwaukee Riverkeeper Data Contribution:

37% of total sites

251 volunteer hours

16 volunteers

2022 DATA SUMMARY

The South Branch Subwatershed scored a C- in 2022, moving out of the D category for the first time in 6 years. Improvements to chloride, bacteria, turbidity, and phosphorus levels resulted in the Subwatershed meeting water quality standards 72% of the time. Phosphorus and bacteria grades improved by over 10% each compared to the previous year, and while this is progress, these parameters still did not meet water quality standards the majority of the time in 2022. Unlike the three other subwatersheds in the Milwaukee River Watershed, the South Branch's land use contributes pollutants from a larger variety of sources. The subwatershed is primarily urban (51%) with farmland, forests and wetlands making up the rest of the land use. Both phosphorus and bacteria enter waterways through animal waste, whether that is from pets, wild animals, or livestock; and through human waste, from leaking sewage lines and failed septic tanks, as well as treated wastewater.

Since 2015, over 2.5 miles of Ulao Creek, a 9-mile tributary of the South Branch, has been restored by Ozaukee County Parks and Planning and its partners as part of a large-scale habitat restoration project. Multiple stream reaches have been converted from linear agricultural ditches into more natural, curving and meandering streams, which are better connected to floodplains. The restoration project in Ulao Creek has moved into the maintenance phase, and monitoring efforts have been reduced to fewer sites in 2022. This resulted in fewer data points being collected than the previous year, which is likely a contributing factor to the overall grade improvement in the South Branch of 3-5%. Milwaukee Riverkeeper has partnered with Ozaukee County to ensure data will be collected by volunteers at key sites along Ulao Creek and other Ozaukee County streams in the future.

There are many ongoing efforts to improve stream connectivity in the South Branch. Several major dams like North Avenue, Estabrook Park, Chair Factory, Lime Kiln, Newburg and Waubeka have been removed. Where some barriers still remain, like at the Mequon-Thiensville Dam, a fish passage has been created to route fish around this barrier. A few unpassable dams still remain, including the Bridge Street Dam in Grafton. A fish passage is currently being constructed around Kletzsch Park Dam, and another passage is being designed at Estabrook Falls. Removal of dams not only improves water quality and connectivity for aquatic life within the stream, it also improves safety for paddlers. Some obstacles on the South Branch may still require paddlers to portage, depending on the skill of the paddler. Rapids adjacent to former dams like Lime Kiln, Chair Factory, and North Avenue can be tricky to paddle during different flow conditions.

2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
SUBWATERSHED			C-			72.11%	↑
Temperature	A					100.0%	=
Dissolved Oxygen	A					97.24%	↑
pH	A					99.68%	=
Turbidity		B-				80.73%	↑
Phosphorus					F	46.28%	↑
Chloride	A					97.67%	↑
Specific Conductivity					F	5.47%	↑
Bacteria					F	51.93%	↑

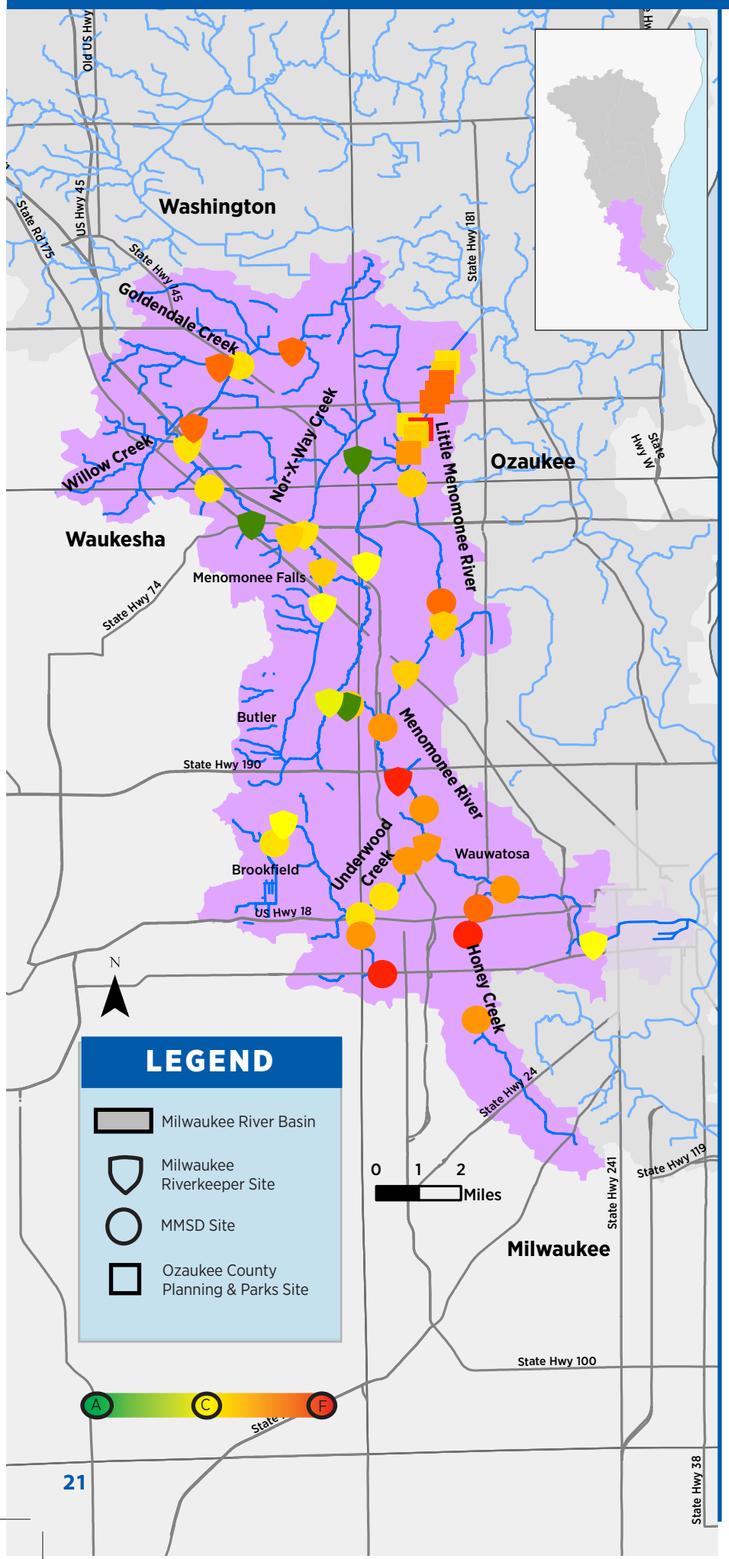
MACROINVERTEBRATE BIOTIC INDEX

FAIR — 2.19 ↓

DID YOU KNOW?

Paddlers can get more information about access, scout out routes and learn about hazards, by using the Milwaukee Urban Water Trail Map and visiting mkeurbanwatertrail.org.

MENOMONEE RIVER WATERSHED | D+



QUICK FACTS

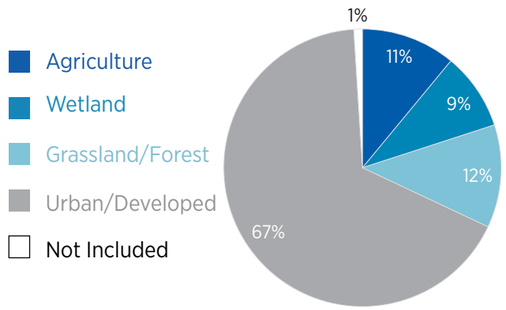
RIVER MILE FACTS

134 mi.
total miles

0 mi.
of trout streams

89 mi.
of impaired waters

LAND USE BREAKDOWN



2022 MONITORING

47 total sites

456 total site visits

Milwaukee Riverkeeper Data Contribution:

37% of total sites

255 volunteer hours

24 volunteers

2022 DATA SUMMARY

The Menomonee River Watershed scored a D+ (68%) in 2022, a 2.5% grade improvement from the previous year. Many parameters remained fairly stable. Water quality standards were largely met for dissolved oxygen, turbidity, chloride, and temperature. Like other watersheds in the Milwaukee River Basin, the Menomonee River Watershed struggles with phosphorus, conductivity, and bacteria levels.

Due to snowfall levels totaling 20 inches less than the previous year, the need for snow clearing and road salt application was significantly reduced during 2022. This resulted in the chloride grade improving by nearly 7%. Keeping chloride out of the stream is important because just one teaspoon of road salt permanently pollutes 5 gallons of freshwater. Freshwater aquatic life cannot tolerate chloride; toxic levels impact fish, mussels, and macroinvertebrates (aquatic bugs). Aquatic bugs are often overlooked, but they make up the base of the food chain for life instream and on the land, as many of these insects spend much of their life in our waters and then grow wings and emerge from the stream.

Despite the improvement in grade, 72 miles of stream in the Menomonee River Watershed are considered impaired for chloride pollution. These impaired waterways run through the communities of Menomonee Falls, Brookfield, Elm Grove, Wauwatosa, Milwaukee, and West Allis. Municipalities throughout the watershed are beginning to take steps to curb their salt use and implement new, more sustainable deicing techniques.

The streambanks of rivers and streams as well as adjacent land is known as the riparian area. These areas play an important role in infiltrating water and managing flooding, and their size and quality can heavily impact water quality. Natural streambanks with deep rooted plants absorb and slow water down, unlike streambanks that are covered in cement or shallow-rooted turf grass, where water runs quickly over the surface and into the stream. Large stretches of Underwood Creek and Honey Creek are currently confined in concrete lined channels and there are several reaches trapped in underground concrete tunnels. These highly altered streams provide little wildlife habitat or chance for runoff to be slowed or absorbed. MMSD has removed large portions of concrete from Underwood Creek, and the Village of Elm Grove has plans to "daylight" an underground section of Underwood Creek in the village center and restore 900 feet of stream to a more natural, meandering condition. The streambank and riparian areas will be restored with native vegetation, which will help protect the creek from stormwater runoff filled with phosphorus, sediment, chloride, and bacteria, and will decrease flow rates to help prevent erosion and allow for fish to pass upstream. There are also plans to restore large concrete-channelized sections of Honey Creek in the next few years.

2022 WATERSHED PARAMETER GRADES

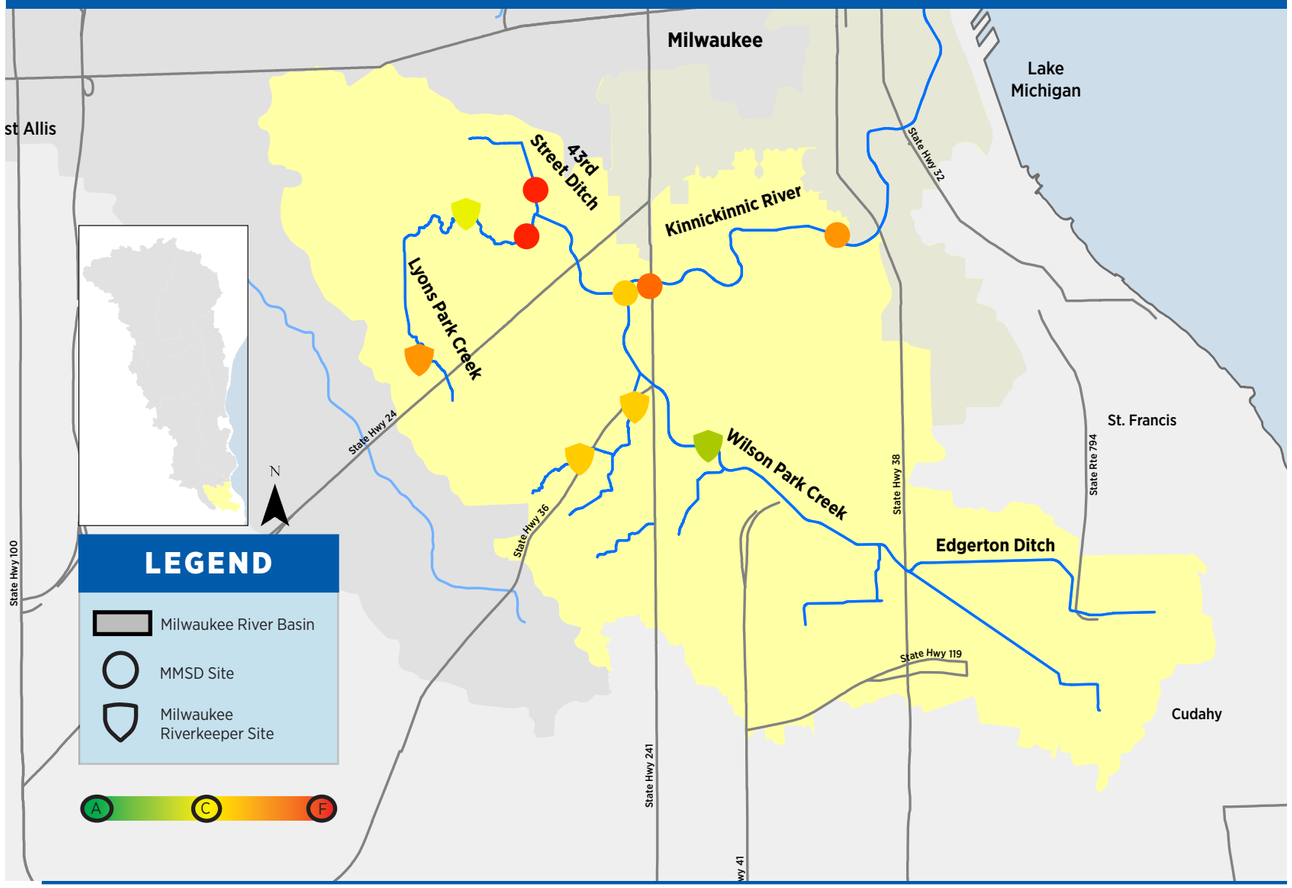
	A	B	C	D	F	TOTAL	GRADE CHANGE
WATERSHED				D+		67.48%	↑
Temperature	A					100.0%	=
Dissolved Oxygen	A					94.15%	↑
pH	A					99.72%	=
Turbidity			C+			77.92%	↓
Phosphorus					F	41.87%	↓
Chloride		B+				86.71%	↑
Specific Conductivity					F	6.72%	↑
Bacteria					F	30.38%	↓

MACROINVERTEBRATE BIOTIC INDEX: FAIR — 2.12 ↓

DID YOU KNOW?

Community members can help lessen the impact of road salts by shoveling early and often, limiting use of salt (it only takes one coffee cup to deice a driveway or 10 sidewalk squares), and only applying road salt when and where necessary.

KINNICKINNIC RIVER WATERSHED | D-



QUICK FACTS

RIVER MILE FACTS

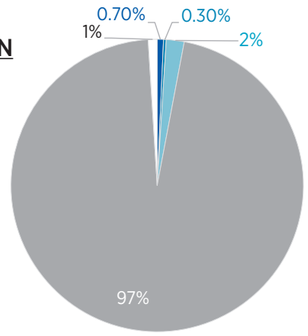
37 mi.
total miles

0 mi.
of trout streams

22 mi.
of impaired waters

LAND USE BREAKDOWN

- Agriculture
- Wetland
- Grassland/Forest
- Urban/Developed
- Not Included



2022 MONITORING

11 total sites

181 total site visits

Milwaukee Riverkeeper Data Contribution:

45% of total sites

7 volunteers

123 volunteer hours

2022 DATA SUMMARY

The Kinnickinnic River Watershed scored a D- in 2022, meeting water quality standards 63% of the time, which is a small improvement of 2% from the previous year. The Watershed is the smallest, most densely populated area in the Milwaukee River Basin. Nearly all of the land is developed and covered in concrete, with the exception of a handful of parks and parkways along the river.

In the past, most of the streams in the Kinnickinnic River Watershed were straightened and concrete was added to streambeds and streambanks to move surface water runoff quickly away from neighborhoods to minimize flooding. Over the years, this has had detrimental impacts to water quality, aquatic habitat, and public safety. Channelizing the water into a slide-like construction quickly conveys runoff to rivers, speeds up flow, and easily transports pollutants like chloride, sediment, and bacteria downstream. Without streambank vegetation, or a more natural meandering river that is connected with vegetated floodplains and wetlands, water does not slow down or soak in. While parts of the Kinnickinnic River remain trapped in concrete, major concrete removal projects have begun and will continue into the future. Removing concrete channels, and allowing the river to retake a more natural form, creates an environment that is better for water quality and better protects the safety of the community.

Turbidity standards were met 63% of the time in 2022, a decrease in grade of 15% from 2021. This makes some sense as the 2022 growing season was wetter than 2021 in southeast Wisconsin, so there was likely more runoff. Rainfall is not the only factor impacting turbidity levels. Soil from streambank erosion, improperly protected construction activities, and urban runoff also impact the turbidity grade. Sediment particles can increase water temperature, block sunlight, and carry nutrients, like phosphorus, that can be released into the water slowly over time. Nutrients can lead to algae or aquatic plant growth on the surface of the water, which can impede light from reaching bottom-dwelling organisms. Street sweeping, proper construction erosion control practices, and catching water where it falls with green infrastructure can help decrease runoff and the amount of sediment and pollutants entering the Kinnickinnic River and its tributaries.

2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
WATERSHED				D-		62.80%	↑
Temperature	A					100.0%	=
Dissolved Oxygen	A-					93.29%	↑
pH	A					98.68%	↑
Turbidity				D		63.33%	↓
Phosphorus					F	46.21%	↓
Chloride			C			74.78%	↑
Specific Conductivity					F	10.27%	↑
Bacteria					F	13.85%	↑

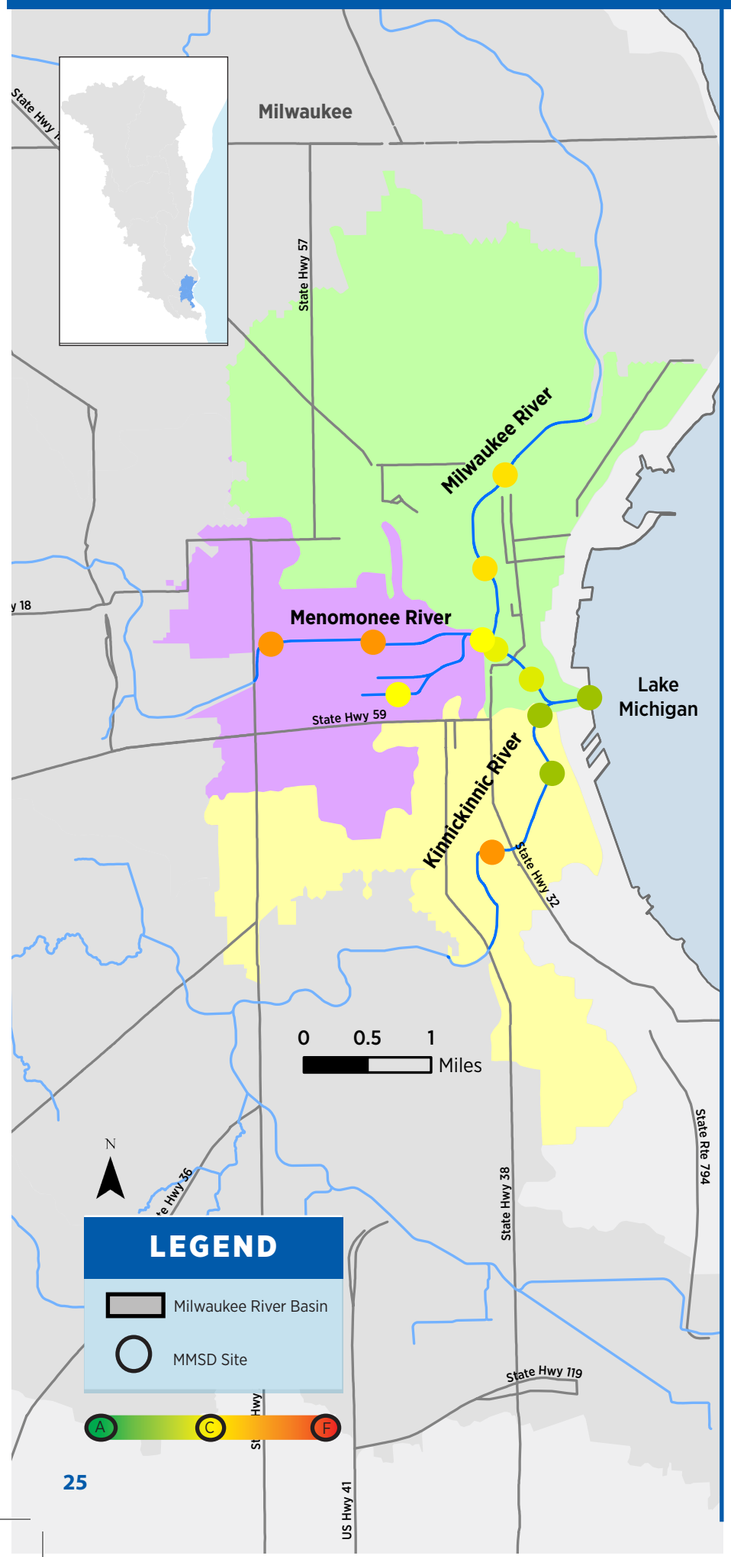
MACROINVERTEBRATE BIOTIC INDEX: POOR — 1.97 ↓

DID YOU KNOW?

Local governments are taking steps to implement smart salting practices to protect waterways and keep roads safe. Currently, most available winter maintenance products applied contain chloride. To learn more about best road salt practices, visit our website.

In contrast to the amount of rainfall in 2022, snowfall levels were nearly half compared to 2021. As a result, the Kinnickinnic River Watershed's chloride grade improved by almost 20%, meeting the standard 75% of the time. This is the best chloride score in the watershed since 2015. While overall grades have improved, when analyzing data only from the winter months, chloride levels only met standards 53% of the time. Sections of the main branch of the Kinnickinnic River at 27th Street and 43rd Street experienced chloride spikes that were twice the acute toxicity level in February and March.

MILWAUKEE RIVER ESTUARY | C



QUICK FACTS

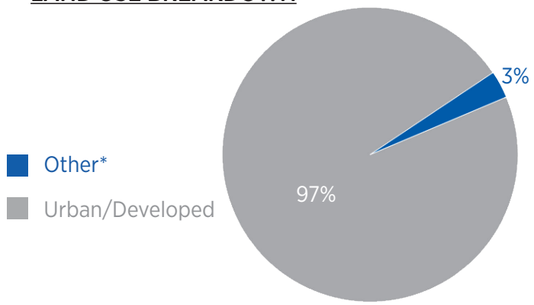
RIVER MILE FACTS

9 mi.
total miles

0 mi.
of trout streams

9 mi.
of impaired waters

LAND USE BREAKDOWN



**Includes grassland and other unidentified land uses*

2022 MONITORING

13 total sites

220 total site visits

MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

Milwaukee Riverkeeper does not monitor in this area due to deep river depths that make it unsafe or inaccessible for volunteers. MMSD primarily monitors this area from their research vessel, the Pelagos.

2022 DATA SUMMARY

The Milwaukee River Estuary, once a vast area of marsh and wetlands that was heavily modified by humans as the City of Milwaukee developed, is a unique area. Water from the Milwaukee, Menomonee, and Kinnickinnic River Watersheds all drain through the Estuary into Lake Michigan, and water quality in the Estuary is heavily impacted by Lake water surging upstream. Given this influence, this area is graded separately from its larger watersheds. This is the smallest area graded within the Milwaukee River Basin, and most heavily influenced by the Lake, and urban development and activities.

The Estuary was the only area within the Milwaukee River Basin to decrease in grade during 2022. Comparing 2021 to 2022, the overall grade dipped slightly, going from a C+ to a C. Turbidity grades dropped by 10% in 2022, landing at a C-. Increased turbidity levels have not been this elevated since 2018, a year with almost double the amount of precipitation. The Kinnickinnic River Watershed, just upstream of the Estuary, also struggled with turbidity levels in 2022 and likely contributed to the lower turbidity grade in the Estuary. Sources of turbidity and sediment in urban environments often come from exposed soil surfaces, roads, and construction. The high turbidity levels likely contributed to a lower phosphorus grade; as sediment levels increase, phosphorus levels generally follow. During 2022, the phosphorus grade dropped over 8%, going from a C to a D.

The Estuary is part of Milwaukee's Areas of Concern, which means that legacy contamination from Milwaukee's industrial past still sits at the river bottom and interferes with river health. There are ongoing efforts to remove polluted sediment. For example, the Burnham Canal in the Menomonee River section of the Estuary has been cleaned up and is being restored to a wetland. In 2021-2022, a protective cap of sand and gravel was placed over the area where contaminated sediments were removed and a stable wetland base was constructed. In a few years, once the base fully settles, the wetland construction will start. Wetlands improve water quality in many ways and reduce sediment loading to the water, while improving wildlife habitat.

The WDNR Sturgeon Rehabilitation Project, in coordination with Riveredge Nature Center, rears and releases baby sturgeon into the Estuary every fall, to reestablish a once present sturgeon population. Released sturgeon begin their life within the Estuary and harbor, eventually spending decades out in Lake Michigan. After 15-20 years, reproductively mature sturgeon return back to the Milwaukee River to spawn. For sturgeon eggs and young to survive and thrive, nutrient and sediment pollution levels need to be low. Turbidity and phosphorus grades have remained fair to good in the Estuary, and continued improvement in water quality in the estuary, and upstream rivers, will be important to sustaining any future populations of sturgeon. Read more about the Sturgeon Rehabilitation Project on page 27 of this report.

2022 WATERSHED PARAMETER GRADES

	A	B	C	D	F	TOTAL	GRADE CHANGE
ESTUARY			C			75.11%	↓
Temperature	A					100.0%	=
Dissolved Oxygen	A-					90.00%	↑
pH	A					100.0%	=
Turbidity			C-			72.27%	↓
Phosphorus				D		65.91%	↓
Chloride	A					97.27%	↓
Specific Conductivity					F	23.18%	↑
Bacteria				D-		60.12%	↑

MACROINVERTEBRATE BIOTIC INDEX — N/A

DID YOU KNOW?

The Dredged Material Management Facility (DMMF) construction begins in early 2024. This facility will hold contaminated material from the Area of Concern dredging projects. In total, dredging in the Area of Concern will restore 11 miles of stream in the downtown area of all three rivers.

MILWAUKEE RIVER LAKE STURGEON: REHABILITATION PROJECT

Habitat loss, paired with overfishing, led to the lake sturgeon being locally extinct from the Milwaukee River. The once prevalent lake sturgeon were physically blocked from moving upstream to their native spawning habitats as dams were constructed across the Milwaukee River Watershed in the late 1800s. Combined efforts to remove dams to increase river connectivity, habitat and water quality improvements, ban fishing or harvesting sturgeon, and control point and nonpoint source pollution have made it possible for the reintroduction of lake sturgeon into the Milwaukee River.

Efforts to improve sturgeon habitat in the Milwaukee River include the removal of the North Avenue, Estabrook and Lime Kiln dams. Where dams cannot be removed, fish passages-alternative routes for fish to move around the dam-are being implemented. The Mequon-Thiensville fish passage was completed in 2010, and construction on fish passages at Kletzsch Park Dam and Estabrook Falls will be completed in the coming years.

The Wisconsin Department of Natural Resources' (WDNR) Milwaukee River Sturgeon Rehabilitation Project works to establish and monitor stocks of lake sturgeon in the Milwaukee River. Lake sturgeon rehabilitation in the Milwaukee River began in 2003, and in the spring of 2006, a streamside rearing facility (SRF) was built to raise fish using Milwaukee River water. The SRF is located at Riveredge Nature Center in Newburg, Wisconsin, in the East and West Branch of the Milwaukee River Watershed. Streamside rearing is a technique of raising migrating fish by using water from the river they are being released to, allowing the young fish to imprint on the waterway and increase returns to the river when they reach maturity.

To establish a population of lake sturgeon in the Milwaukee River, the WDNR has a goal to raise 1,000 or more lake sturgeon each year from the SRF. Each year, gametes (reproductive cells of the fish) are collected from a healthy stock of lake sturgeon in the Wolf River. The fertilized eggs are transported to the SRF at Riveredge Nature Center, and volunteers at the center care for the growing sturgeon over the next 4 months. Most of the 1,000 eggs grow to become large fingerlings, averaging 7".

Before the fingerling sturgeon are released into the inner harbor near the mouth of Lake Michigan, they are marked so they can be easily identified as originating from the Milwaukee River SRF. If the sturgeon is large enough, it will be implanted with a passive integrated transponder or PIT tag. Each PIT tag has a unique ID that is transmitted when the tag comes in close contact with a reader installed in the river. By assigning each fish a PIT tag before stocking, growth can be measured each time it is recaptured during fish surveys. PIT tags can also help estimate mortality rates and movement patterns. Releasing the sturgeon is a combined effort at Sturgeon Fest with the WDNR and Riveredge Nature Center. Members of the public "adopt a sturgeon" and release each one by hand into the inner harbor of Lake Michigan. Over 20,000 lake sturgeon have been stocked since 2006.

Each year, WDNR conducts a survey targeting juvenile lake sturgeon within and just outside of the Milwaukee Harbor. A total of 174 lake sturgeon from the Milwaukee River SRF have been captured during this survey. The age of the recaptured fish ranged from 1-6 years old and ranged from 12"- 34.3" in size. On average, lake sturgeon from the SRF are growing more than 4.5 inches per year after release. This suggests that after stocking they have access to suitable habitat and food for at least the first 6 years of life. It is common for lake sturgeon over 6-7 years old to leave their nursery habitat in search of habitat suitable for the next 10-20 years of their life as they mature. Because we have not detected any sturgeon greater than 7 years old in our juvenile survey, it is likely that the older fish are searching for these habitats in areas of Lake Michigan beyond the Milwaukee Harbor.

As they mature, the sturgeon will return to the Milwaukee River to spawn. With a recently installed permanent PIT reader in the bed of the Milwaukee River, it is possible to monitor upstream and downstream movements of individual fish, allowing for an accurate yearly estimate of how many sturgeon utilized the Milwaukee River. In the first two years of operation, the PIT reader detected 40 sturgeon, most ranging from 12-15 years old.

Lake sturgeon are a slow maturing species. Male lake sturgeon typically spawn for the first time at age 15, while female sturgeon typically spawn for the first time at age 20. WDNR tracking has seen male sturgeon returning to the river in the spring in relatively low numbers, but no spawning has been observed. Female lake sturgeon have not yet been documented in the Milwaukee River. In the next 5-10 years, females from the early years of the rehabilitation project should be reaching maturity, and hopefully we will see them return to the Milwaukee River. When females return, it is hoped they find suitable spawning habitat and willing males to spawn in the Milwaukee River once again.

The sturgeon rehabilitation program is off to a tremendous start. The continued success of the program largely relies on improvements to available habitat in the Milwaukee River Watershed. Dam removal has allowed adult sturgeon to migrate upstream to better spawning habitat, although there are still dams impeding fish between Lake Michigan and the upper reaches of the Watershed. For this program to be successful, the sturgeon need to produce enough offspring to improve and sustain the population. Sturgeon eggs and young sturgeon are very sensitive to nutrient and sediment pollution. High concentrations of nitrogen and phosphorus compounds may directly impact larval development, as well as growth in sturgeon using the river as nursery habitat during their first year of life. Reducing phosphorus, sediment, and bacterial pollution will be a critical step toward establishing a self-sustaining sturgeon population in the Milwaukee River.

Harvesting sturgeon in the Milwaukee River is illegal. If you see harvesting, report it to the WDNR at 1-800-TIP-WDNR.

ABOUT THE AUTHOR

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BUILDING A COMMUNITY OF SCIENTISTS

After more than a decade, Milwaukee Riverkeeper has developed one of the most influential water monitoring programs in the state of Wisconsin. Milwaukee Riverkeeper's Executive Director, Jennifer Bolger Breceda, and resident Riverkeeper, Cheryl Nenn shed light on the impact and success of the program in this interview.

How did our monitoring program begin?

NENN: When we started the monitoring program at Milwaukee Riverkeeper, there was minimal monitoring happening in the Basin. It began as a fun way to connect the community to our rivers, but as we formalized the program there was debate over the value of community science. Dwindling agency resources and capacity issues made formalizing a citizen water quality monitoring framework attractive to the Wisconsin Department of Natural Resources (WDNR). This set forth the protocols, equipment, training, and quality of data, which still guides community monitoring efforts in Wisconsin today. This framework allowed the state to build a larger database of high quality and replicable data for assessing waterway health and prioritizing management actions. We became a "pilot" program for that effort in 2006.

Why is collecting water quality data critical for water advocacy?

BOLGER BRECEDA: Simply put, data driven facts prove that something needs to change. It allows for matters to be prioritized and for solutions to include more precise strategies. Our data shows which pollutants are causing issues and helps to identify the source of pollution, too. It helps municipalities and agencies better understand how to manage water resources and public spaces. In the world of water advocacy, collecting water quality data can save a river.

NENN: Having good water quality data grounds our advocacy in fact versus belief or opinion. For example, from the beginning, we selected monitoring sites upstream and downstream of dams to better understand the impacts of these structures and their impoundments on water quality in the Basin. The data was useful in documenting problems associated with dams, and we used this in our arguments for their removal. Several dams have been subsequently removed, including, most recently, the Estabrook Dam. We are using our data now to urge the Village of Cascade to remove their dam.

What does the water quality monitoring program bring to the table besides the data?

NENN: Our volunteers become local experts in what is normal and what is not normal for their waterways. They identify problems that are impacting our watersheds, including identification of pollution events, illegal dumping, over-salting, oil spills, land use issues (e.g., erosion, or poor construction site stormwater control, obstructions, or access issues), and wildlife concerns. We've built a community of water protectors by cultivating responsibility and a sense of ownership over their streams.

BOLGER BRECEDA: Our program takes stewardship and protection of our waterways to a deeper level. We have many monitors who have been monitoring for decades. This return rate validates that monitoring is a meaningful experience and demonstrates a deep commitment to our mission.

What are some unintended outcomes of this work?

BOLGER BRECEDA: I think the combining of our data with other agencies/NGOs has deepened our impact by providing more information and transparency to the public about the health of their local waterways.

NENN: Our monitoring volunteers have become engaged in every level of our work beyond the program.

What has surprised you about this work?

NENN: I never thought we'd be training public and private road salt applicators about responsible salting practices, but there was no one else ready to take that on when we started. This work has evolved into a statewide effort. Our data shows the sheer scale of the issue by helping identify over 117 miles of chloride impaired waters.

How does our monitoring program compare to others?

BOLGER BRECEDA: We have one of the biggest and longest-standing water quality monitoring programs in the region. And probably the nation and world, too, but I can't say that with total certainty. As state and federal agency budgets dry up, we are being relied upon more and more to provide this critical information.

NENN: Elements of our monitoring program have been shared with other Waterkeepers and watershed groups in the US and around the globe. We have been able to help train other Waterkeepers in Ladakh (northern India) to test water, and to mentor other programs, such as our London Waterkeeper in detecting illicit discharges of sewage.

How does our work ultimately impact efforts to protect clean water?

BOLGER BRECEDA: As climate change impacts are felt around the world, we must protect and restore our freshwater systems. We want the next generation to have improved ecosystems, not degraded ones. Our work serves as a model to the rest of the region. While we are working to protect and restore the waters in Milwaukee, we are building the next generation of water stewards who will understand what is needed to keep our waterways swimmable, fishable and drinkable.

NENN: By keeping a watchful eye on industry, State and Federal regulators know that there are community groups ready to find solutions and hold polluters accountable. For example, Milwaukee Riverkeeper and partners filed a notice of intent to sue the state of Wisconsin for their failure to enact phosphorus regulations (as stipulated in the Clean Water Act) in 2009. This pressure led to the creation of phosphorus standards for Wisconsin's waterways, the first set in the country. This year, we also worked with US Waterkeepers to conduct PFAS sampling and to document their pervasiveness in surface water nationwide. We teach and learn from other Waterkeepers so we can push science and policy forward to better protect clean water globally.

MILWAUKEE RIVERKEEPER
MONITORING MILESTONES

2006 — Milwaukee River Basin Water Quality Monitoring program officially launches.

2008 — Stream Monitor of the Year Award (Cheryl Nenn)

8-year partnership with Dr. Sandra McLellan's lab begins to identify sources of human bacteria in stormwater in the lower Menomonee and Kinnickinnic Rivers.

2010 — The first Annual Milwaukee River Basin Report Card was published, focusing on the Milwaukee River, with all 3 rivers included in future report cards.

2011 — Winter Road Salt Monitoring program pilot begins. This data is key to pushing advocacy and educational efforts to reduce road salt use.

Total Phosphorus Monitoring pilot project begins to establish baseline conditions and trends.

2012 — Stream Monitoring Coordinator of the Year Award (Joe Rath)

2015 — 3-year Aesthetics Monitoring program begins to assess the visual degradation of Milwaukee's waterways.

2016 — Emerging Contaminant Monitoring program begins in partnership with CLEAR MKE to identify compounds in surface water from medicines to personal care products.

2017 — Wisconsin Stream Monitoring Award (Milwaukee Riverkeeper)

Launched Mussel Monitoring program emphasizing the importance of surveying native freshwater mussels.

2021 — Aesthetics Beneficial Use Impairment is officially removed from Milwaukee Area of Concern.

2023 — PFAS surface water monitoring project launched.

WATER QUALITY PARAMETERS

Water quality data is assessed against a set of ideal targets to determine the health of our waterways. Where there is a regulatory standard, or federal guidance for a parameter, that is generally listed as the goal. In some cases, in-house targets were created based on the reasonable potential of a stream to support fish and recreational activities.

WATER TEMPERATURE: Each aquatic organism's survival is limited by its tolerance to changes in water temperature. As a result, temperature ranges can be used to classify aquatic ecosystems. Drastic changes in water temperature can have significant impacts on aquatic life and biodiversity of streams. It is also important to note that temperature impacts the amount of dissolved oxygen water can hold.

Warm Stream < 31.7°C
Cold Stream < 22.0°C

DISSOLVED OXYGEN: Dissolved oxygen (DO) is a measure of the amount of oxygen dissolved in a volume of water. The amount of oxygen found in our rivers is influenced by stream velocity, substrate, and water temperature. Generally speaking, as temperature increases, dissolved oxygen decreases and vice versa. Oxygen is essential for every organism's survival. Therefore, not only is DO an important water chemistry parameter, it can be a limiting feature for aquatic life.

Warm Stream > 5.0 mg/L
Cold Stream > 6.0 mg/L

pH LEVEL: pH is a measure of the amount of hydrogen (H+) ions in water. pH ranges from 0 to 14 (0 being the most acidic, 14 being the most basic) with a value of 7 representing a "neutral" solution. Milwaukee River Basin streams generally run on the basic side of neutral, with values typically between 7 or 8 on the pH scale

pH 6 - 9

TURBIDITY: Turbidity, or water clarity, affects both the light and energy inputs available to aquatic ecosystems. Our volunteers measure turbidity using transparency tubes. These are clear, plastic tubes that are filled and/or emptied of stream water until they reveal a black and white pattern on the bottom of the tube (similar to a lake secchi disc). A height of at least 54.7 cm of stream water in a 120 cm transparency tube indicates healthy water. A turbidity level of <10 NTU is ideal for aquatic life, and was used as the target for stream health. This is equivalent to 54.7 cm or greater. MMSD does not use transparency tubes but instead uses sensors to directly test the turbidity values of water in units of FNU (a similar turbidity unit to NTU). A turbidity level of <10 FNU was used as a target for MMSD data.

<10 NTU
<10 FNU

PHOSPHORUS: Phosphorus, measured as Total P, is an essential nutrient for plants, animals, and aquatic life. Phosphorus is typically low to absent in natural freshwater systems. Human activities have led to large inputs of phosphorus into our rivers and lakes. These activities include fertilization of lawns and agricultural fields, sewage treatment discharge, and the addition of phosphorus into our water supply as an anti-corrosion inhibitor for old, lead pipes. Excess phosphorus entering our waterways causes growth of nuisance algae as well as a cascade of water quality problems. Monthly water samples are shipped to the State Lab of Hygiene for total phosphorus analysis.

Large Streams < 0.1 mg/L
Small Streams <0.075 mg/L

MACROINVERTEBRATES: To grade river health based on aquatic macroinvertebrate surveys, Milwaukee Riverkeeper volunteers use a simple biotic index. This survey was developed by a group of Wisconsin scientists, which is specifically designed for streams in Wisconsin. Index score classifications range from Good-Fair-Poor. Due to macroinvertebrates relative immobility, they provide a good overall indicator of the health of a certain stream segment and tend to be classified per tolerance to a range of oxygen conditions.

"Good" (2.6 – 3.5)

CHLORIDE: High chloride concentrations in rivers and streams are toxic to aquatic organisms. Road salt runoff constitutes a large source of chloride. Elevated levels of chloride can disrupt an organism's ability to maintain a natural internal water balance, which leads to impaired survival, growth, and/or reproduction. High levels of chloride can be acutely or instantly toxic to fish; lower levels of chloride over a longer period of time or chronic exposure can be just as toxic.

Chloride (Acute) <757 mg/L
Chloride (Chronic) <395 mg/L

CONDUCTIVITY: Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by charged particles (ions), which can be both positive (cation) and negative (anion). Conductivity in streams is naturally affected by geology. Bedrock streams tend to have lower conductivity, whereas streams passing through clay soils tend to have higher conductivity. Human discharges to streams —such as discharge of industrial waste (e.g., heavy metals), sewage, or other "charged" contaminants such as chloride, phosphate, and nitrate —can raise conductivity.

150 – 500 µS/cm*

**Milwaukee Riverkeeper acknowledges that the current target for conductivity contained in U.S. EPA guidance may be too stringent; however, for consistency with previous years analyses, the target has remained the same. Further research needs to be done to determine an appropriate target moving forward.*

BACTERIA: High bacteria concentrations impact not only stream health, but also public health. Regulatory agencies such as MMSD and WDNR regularly test for fecal coliform and *E. coli* bacteria in surface waters. Milwaukee Riverkeeper continues to expand its bacteria monitoring in areas outside of MMSD's service areas.

Fecal coliform <200 CFU/100mL
***E. coli* <235 CFU/100mL**

DATA SUMMARY

LOCATION	OVERALL	WATER TEMPERATURE	DISSOLVED OXYGEN	PH	TURBIDITY	PHOSPHORUS	MACRO-INVERTEBRATES	CHLORIDE*	CONDUCTIVITY*	BACTERIA
MILWAUKEE RIVER BASIN	C-	A	A	A	B-	F	FAIR	A-	F	F
MILWAUKEE RIVER WATERSHED	C	A	A	A	B+	F	FAIR	A	F	F
North Branch Milwaukee River Subwatershed	C	A	A-	A	A	F	FAIR	-	F	F
Cedar Creek Subwatershed	C+	A	A	A	A	F	FAIR	A	F	D
East & West Branch Milwaukee River Subwatershed	B-	A	A	A	A	F	GOOD	-	F	F
South Branch Milwaukee River Subwatershed	C-	A	A	A	B-	F	FAIR	A	F	F
MENOMONEE RIVER WATERSHED	D+	A	A	A	C+	F	FAIR	B+	F	F
KINNICKINNIC RIVER WATERSHED	D-	A	A-	A	D	F	POOR	C	F	F
MILWAUKEE RIVER ESTUARY	C	A	A-	A	C-	D	-	A	F	D-

***NOTE:** Year round data from MMSD heavily impacts final chloride and conductivity grades. MMSD only monitors sites in the Menomonee and Kinnickinnic River Watersheds, and the southern portion of the South Branch Milwaukee River Subwatershed. Hence, the grades in the southern half of the Basin are heavily skewed towards MMSD data.

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