

Upper Midwest Water Science Center Capabilities

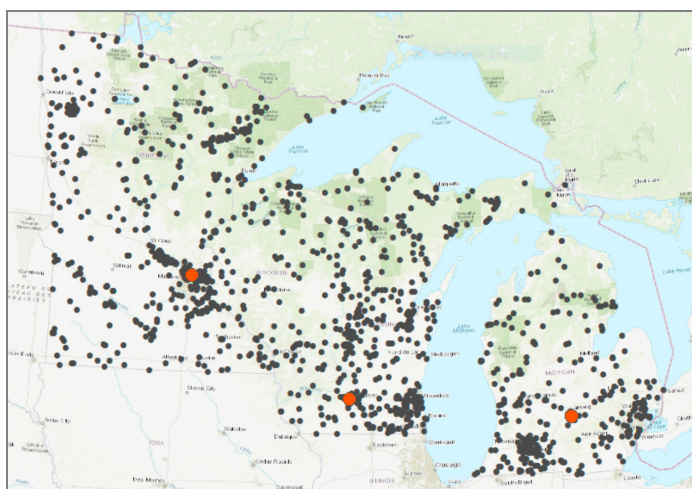
The **Upper Midwest Water Science Center (UMid WSC)** monitors and studies the water resources of Michigan, Minnesota, and Wisconsin. Since the USGS began to measure Upper Midwest streamflow in 1883, our mission has been to collect high-quality hydrologic data and to conduct unbiased, scientifically sound hydrologic investigations about our Nation's water resources. Over time, the focus of our work has evolved to meet the changing needs of those who use our information—from general hydrologic and geologic appraisals to innovative, issue-oriented research to supporting decision-makers who protect environmental and public health. With offices in all three states, we are uniquely poised to address the monitoring and science needs at local, state, regional, and national levels. Our staff consists of scientists, technicians, and support personnel who are committed to providing accurate and timely information, and we strive to advance USGS science and find applied solutions to problems faced by our partners.



Hydrologic data collection

The UMid WSC has a long history of providing hydrologic information that accurately quantifies and describes water resources throughout Michigan, Minnesota, and Wisconsin. We work in cooperation with local, State, and other Federal agencies, as well as Tribes, universities, and nonprofits to provide scientific information used to manage water resources.

To effectively assess water resources, we investigate the occurrence, distribution, quantity, movement, and chemical



Map of UMid WSC main offices (orange dots) and active streamgaging sites (dark gray dots).

and biological quality of surface water and groundwater. We use standardized USGS methods to operate real-time streamgages, water-quality stations, and groundwater stations, many of which are a part of national monitoring networks. Most of the data we collect are available to the public through the USGS National Water Information System (NWIS) at <https://waterdata.usgs.gov/>.

Approximate number of UMid WSC monitoring stations in Michigan, Minnesota, and Wisconsin

	Water quantity	Water quality
Streams and rivers	483	89
Lakes	41	3
Groundwater	238	50

Our hydrologic data are used by our partners for flood forecasting and emergency flood response; estimating water use and water availability; designing and operating hydroelectric power, flood control, water supply, and wastewater facilities; designing and sizing bridges and culverts; preventing and abating pollution; ensuring the safety and availability of recreational resources; guiding environmental restoration efforts; understanding the impacts of land-use change and climate variability; and more.

Water resource studies

Aquatic Contaminants

The Aquatic Contaminants Team studies the occurrence, distribution, and ecological and human-health effects of organic, inorganic, and microbiological contaminants in the environment. Aquatic contaminant studies are conducted at local and national scales in environments that have been disturbed by urban and agricultural activities, supporting efforts like predicting beach water quality, tracking groundwater contaminants to protect drinking water supplies, and determining ecosystem vulnerabilities to inform fish and wildlife management activities. Key capabilities of the **Aquatic Contaminants Team** include:

- **Creative sampling design:** Our collaborative partnerships result in creative solutions that incorporate efficient, appropriate, and innovative techniques to meet each study's individual needs.
- **Statistical modeling:** We use statistical modeling techniques to provide a probabilistic framework that allows resource managers to include risk into their decision-making process.
- **Aquatic toxicity impacts:** We evaluate adverse effects on aquatic environments, using data-driven analysis, laboratory-based bioassay testing, and in-situ organism exposures.
- **Software package development:** We develop open-source software packages to put environmental data into context and provide decision-making tools.

Environmental Microbiology

The Environmental Microbiology Team researches the role microorganisms play in ecosystem processes and the effect they have on water quality and availability. We investigate the influence waterborne microorganisms have on the health of aquatic resources, wildlife, and people, providing science that supports the use and protection of water resources. Key capabilities of the **Environmental Microbiology Team** include:

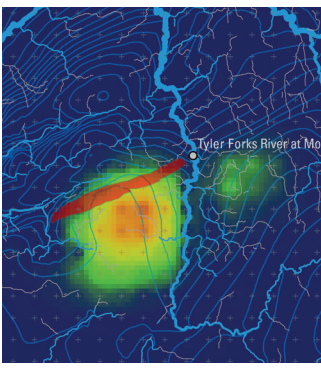
- **Pathogens:** We investigate how disease-causing microorganisms from human and agricultural activities affect the quality and availability of groundwater, rivers, and lakes for consumption and recreation.
- **Antimicrobial resistance:** We research how antimicrobial resistance genes persist in and move through groundwater and surface water to evaluate the potential spread of antimicrobial resistance through environmental pathways.
- **Environment and host microbiome modulation:** We assess how environmental stressors and contaminant exposure influence the microbial community dynamics of an environment and the microbiome of fish and wildlife inhabiting that environment.

Groundwater Characterization

The Groundwater Characterization Team combines hydrologic, chemical, and geophysical techniques to increase our understanding of the physical movement and geochemical evolution of groundwater. We utilize our expertise in methods like recharge estimation, water-source analysis, groundwater-age dating, and water-use tracking to quantify groundwater flows and quality through all parts of the hydrologic cycle, providing resource managers with the information they need to effectively meet the needs of the life that depends on groundwater. Key capabilities of the **Groundwater Characterization Team** include:

- **Groundwater availability and sustainability:** We determine the occurrence and sources of groundwater and estimate how much can be sustainably used. We investigate how groundwater pumping affects surface waters.
- **Groundwater recharge and flows:** We find where water enters the ground, where it flows to, and where it returns to the surface. We research how changes in land use and climate effects these flows.
- **Groundwater quality:** We measure what substances are in groundwater, where they came from, how they're changing, and what is causing those changes.





Groundwater and Watershed Modeling

The Groundwater and Watershed Modeling Team focuses on the application of analytical and numerical models to water-resource questions. This team seeks to quantify, understand, and predict the interplay of surface-water and groundwater resources. We work with collaborators within and outside USGS to develop modeling software, and we apply modeling software to problems of local, regional, and national interest. Key capabilities of the **Groundwater and Watershed Modeling Team** include:

- **Groundwater-flow modeling:** We apply groundwater-flow models to help answer local and regional questions on groundwater resource availability.
- **Coupled groundwater/surface-water modeling:** We develop and apply modeling techniques to study the impact of pumping on groundwater availability and ecosystem sensitivity to changes in groundwater inputs or outputs.
- **Transport and fate modeling:** We study the movement of natural and introduced contaminants in groundwater.
- **Soil water balance recharge modeling:** We develop and support modeling software used to estimate potential groundwater recharge.
- **Model parameter estimation and evaluation of model uncertainty:** We collaborate with an international consortium of colleagues to develop methods and techniques for improved model parameter estimation and evaluation of model prediction uncertainty.

Integrated Ecosystem Studies

The Integrated Ecosystems Studies Team conducts studies that combine multiple areas of research to evaluate ecosystem functions, health, and stressors within lakes, rivers, and river mouths. Changes in the aquatic ecosystem such as a fish kill or harmful algal bloom are often early indicators of major water quality issues. The Integrated Ecosystem Studies Team integrates baseline assessments with known ecological changes to determine stressors in the ecosystems. Study areas may be local, state-wide, regional, or national in scope. Key capabilities of the **Integrated Ecosystems Studies Team** include:

- **Lake monitoring:** Evaluate lake water levels and quality; focusing on community needs from recreation to water-quality concerns
- **Watershed and lake modeling:** Develop models to track and evaluate nutrient impacts to receiving water bodies to aid in watershed planning for mitigation and restoration
- **Ecological Condition Assessments:** Assess aquatic ecology and environmental stressors for changes in physical, chemical, and biological conditions of lakes and rivers
- **Harmful Algal Bloom Evaluation:** Investigate conditions that lead to Harmful Algal Blooms and evaluate how and why the toxins may affect other organisms.

River and Coastal Processes

The River and Coastal Processes Team has the expertise to address important surface water issues in the Upper Midwest. Key capabilities of the **River and Coastal Processes Team** include:

- **Sediment monitoring:** Sampling and real-time surrogates improve load calculations, support State regulatory and restoration programs, and inform Federal maintenance of commercial navigation channels.
- **Geomorphic assessments:** Our contributions have been critical for evaluating changes caused by recent historic flooding in the Lake Superior Basin.
- **Flood inundation maps:** Used by communities for flood preparedness, emergency response and recovery, mitigation and planning, and environmental assessment.
- **Hydraulic models:** Used in restoration planning and evaluation, invasive species prevention and management, topobathy surveys, and ecological flow analysis.
- **Inland oil spill response:** We have advanced scientific understanding of fate and transport of spilled diluted bitumen and developed spill response tools that will result in more rapid interagency spill responses to reduce ecological damages.

Water Quality Networks and Assessments

The Water Quality Networks and Assessments Teams use advanced instrumentation to collect data used to evaluate

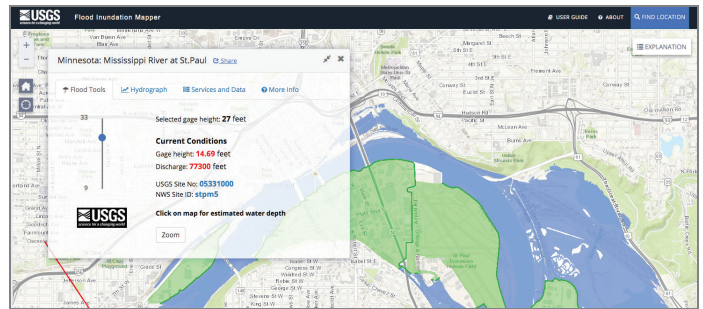
water-quality issues caused by nonpoint pollution. Rural investigations focus on conservation practices and their effects on water quality in watersheds often heavily influenced by agriculture. Urban projects evaluate single practices and end-of-pipe treatment devices. These research efforts provide critical information to help managers make informed decisions, formulate watershed management plans, and evaluate the effectiveness of implemented plans. Key capabilities of the **Water Quality Networks and Assessments Teams** include:

- **Nonpoint evaluation:** We provide expertise in study design, instrumentation, data collection, modeling, and data analyses for both rural and urban nonpoint-source research projects.
- **Instrumentation:** We are leaders in monitoring water quality in rural and urban watersheds, using advanced applications of instrumentation and technology to support study design, data collection, and data analysis.
- **Edge-of-field monitoring:** Edge-of-field monitoring provides information about the amounts and timing of runoff, sediment, and nutrients (such as nitrogen and phosphorus) moving from agricultural fields into adjacent waterways. Information gathered from edge-of-field studies also allows for a rapid assessment of implemented conservation practices.

Unique capabilities

USGS Mercury Research Lab

The USGS Mercury Research Lab is a national leader and major contributor in advancing mercury research and science. We provide expert assistance to a wide-range of partners, including the execution of research studies, sample analysis, methods development for field and lab procedures,



data interpretation, and report publication. Some of our specialties include low-level speciation, isotope analysis (mercury source “fingerprinting”), and high-resolution mass-spectroscopy.

Microbiology Labs

Two Biosafety Level (BSL-2) laboratories, the Laboratory for Infectious Disease and the Environment (LIDE, located in Marshfield, WI) and the Michigan Bacteriological Research Laboratory (MI-BaRL, located in Lansing, MI), develop field and laboratory tools to address existing and emerging microbial concerns.

TC Chamberlin Modeling Center

Our TC Chamberlin Modeling Center provides advanced computing leadership by developing, implementing, and disseminating state-of-the-art techniques and tools for effective model development and application of High-Throughput Computing (HTC) to modelers.

Web Informatics and Mapping (WIM)

Web Informatics and Mapping develops web-based tools that support USGS science and other federal science initiatives. Our projects range from full-featured interactive applications to limited-scope data visualizations. Our collective expertise in cartography, science, and web technology allows us to create custom products that are practical, intuitive, and focused on our partners’ needs.

Data & Technology Innovation Center

The Data & Technology Innovation Center focuses on enhancing our science efforts using new and existing hardware and software products, techniques, and methods. Our team's goal is to re-imagine current methods of data collection, interpretation, and presentation in innovative ways in order to lower cost, improve our science, and deliver more effective products.



To learn more about the **USGS Upper Midwest Water Science Center** or to collaborate with us, please contact:

John Walker, Center Director
jfwalker@usgs.gov
608-821-3810

www.usgs.gov/umid-water