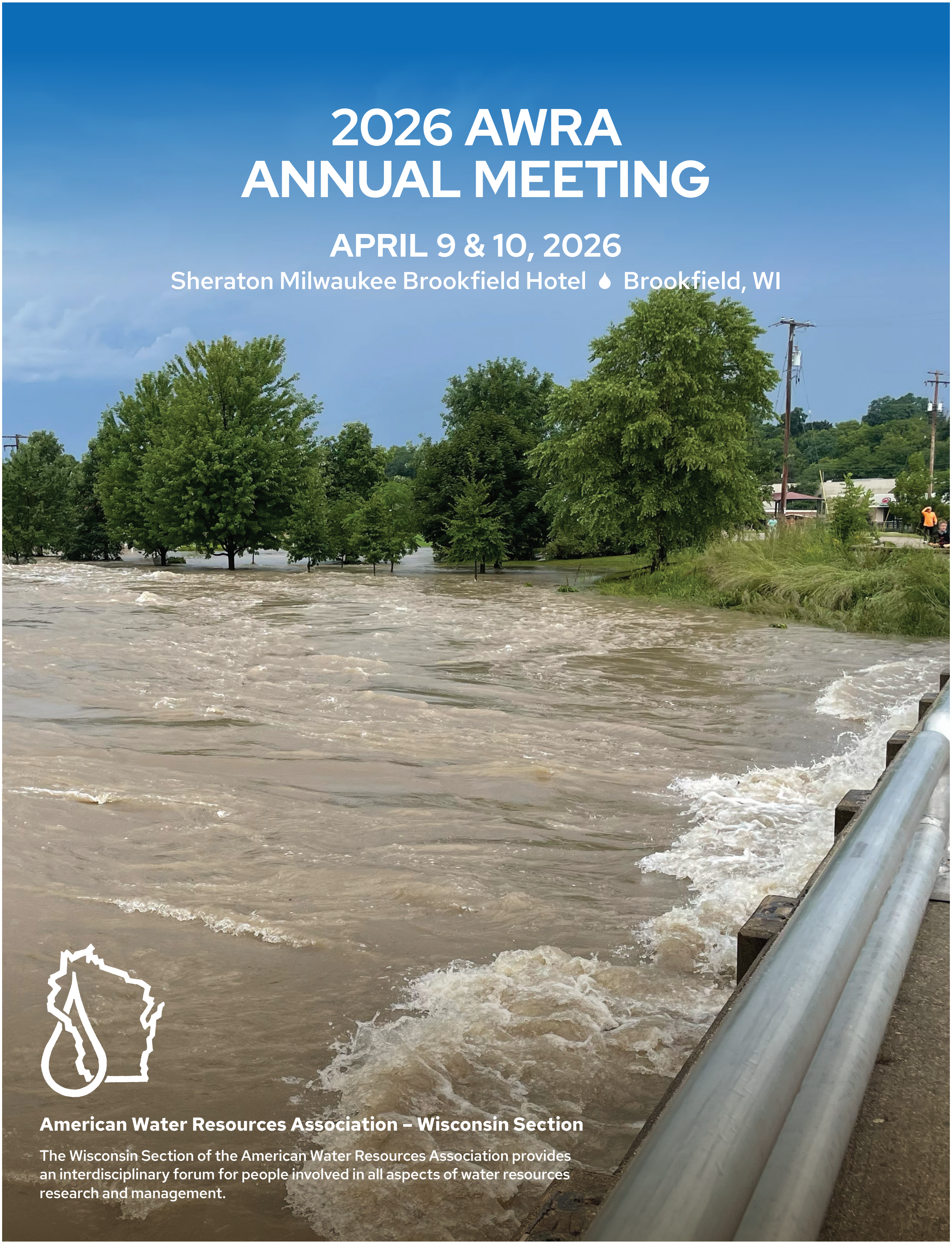
2026 AWRA ANNUAL MEETING

APRIL 9 & 10, 2026

Sheraton Milwaukee Brookfield Hotel • Brookfield, WI



American Water Resources Association – Wisconsin Section

The Wisconsin Section of the American Water Resources Association provides an interdisciplinary forum for people involved in all aspects of water resources research and management.

AMERICAN WATER RESOURCES ASSOCIATION - WISCONSIN SECTION

50TH ANNUAL MEETING

April 9 - 10, 2026

Support From:

Freshwater Collaborative of Wisconsin

University of Wisconsin Water Resources Institute

Wisconsin Department of Natural Resources

Center for Watershed Science and Education, UW-Stevens Point

Wisconsin Geological and Natural History Survey

U.S. Geological Survey Upper Midwest Water Science Center

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Brooke Payne University of Wisconsin – Stevens Point	Committee Member

The Wisconsin Section of the American Water Resources Association provides an interdisciplinary forum for people involved in all aspects of water resources research and management. The success of the section is due in part to the dedication of past and current members of our board of directors and conference planning committee. We heartily acknowledge the following individuals for their service, and we invite others to consider volunteering to ensure an ongoing dialogue among those committed to water resources research and management in the state of Wisconsin.

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AWRA BOARD OF DIRECTORS POSITION DUTIES

President (1-year term)

Shall provide leadership to the board by presiding at meetings, and shall, in consultation with the Board of Directors, appoint all committees, and shall perform all other duties incident to the office. The President shall prepare, in collaboration with the other members, an annual update of the Section's activities to be presented to the annual meeting of the Section and provided to the American Water Resources Association. The President must be a member of the American Water Resources Association.

Vice President (1-year term)

Shall support the President in leading the organization and perform the duties of the President when the latter is absent. The Vice President shall succeed to the office of President in the following year.

Secretary (2-year term, elected in even years)

Shall keep the minutes of the Section's meetings, shall issue notices of meetings, and shall perform all other duties incident to the office.

Treasurer (2-year term, elected in odd years)

Shall be responsible for all funds of the Section and the dues of the American Water Resources Association as agreed to between the Board of Directors and the American Water Resources Association. The Treasurer shall prepare an annual report and financial statement that is reviewed by the President and presented at the annual meeting.

General Board Directors (4 positions, 2-year term, staggered appointments)

Shall advise and support the overall direction of the Section. Specific duties for these positions shall be selected to support the current needs of the Section and be assigned by the President, in consultation with the Board of Directors.

BIOGRAPHIES OF CANDIDATES FOR THE AWRA WISCONSIN SECTION BOARD

Vice President

Ian Anderson is a hydrogeologist at the Wisconsin DNR. He spent 9 years reviewing high capacity wells in the Water Use section, until joining the CAFO program (Agricultural Runoff Management) in 2021. He holds a B.S. in Geology from UW-Eau Claire and an M.S. in Water Resources Management from UW-Madison. Ian has attended Wisconsin AWRA meetings since grad school and has cherished the opportunity for camaraderie, learning and forging collaborative relationships. He is particularly interested in the intersection of law and science, and how science communication can be improved to support better policymaking. As such, Ian would emphasize collaboration between researchers and policy makers if elected to the board.

Secretary

Brent Brown is a Senior Principal and registered Professional Engineer with SmithGroup, Inc. in their Milwaukee office. He practices water resources engineering and works on projects involving watershed and stormwater management, water quality trading and watershed adaptive management, urban stream rehabilitation, hydraulic and hydrologic assessments, water quality and biological monitoring, green infrastructure planning and design, park and public space design, state and federal permitting, and sediment dredging with beneficial re-use. Brent has a bachelor’s degree from the University of Wisconsin-Platteville in civil/environmental engineering and a master’s degree from the University of Illinois at Urbana-Champaign in environmental engineering. Brent has been practicing engineering for over 26 years.

Board Member, Student Engagement

Narayani Sunil Pillai is the Water Centric City Program Coordinator with the City of Milwaukee’s Environmental Collaboration Office. She coordinates the City’s Water Centric City Initiative, including implementation of the City’s Green Infrastructure Plan, and other key principles such as fishable/swimmable water, sustainable healthy water supply, and water leadership programs in Milwaukee. Narayani holds a Master of Environmental Studies degree from the University of Pennsylvania and a Bachelor of Technology degree in Computer Science & Engineering. Prior to her current role, Narayani worked as a Water Sustainability Coordinator with The Water Center at Penn, contributing to research on the environmental aspects of AI, water efficient data centers, water policy briefs, and coordinating leadership collaboratives for mid-career water sector professionals.

Board Member, Technical Chair

Sam Brockschmidt is a hydrogeologist in the Wisconsin Department of Agriculture, Trade, and Consumer Protection’s Bureau of Agrichemical Management. He received a BS in Geology from Purdue University in 2022, and an MS in Geoscience from UW - Madison in 2024. His master’s thesis research examined methods and impacts of increasing groundwater recharge on agricultural landscapes. Since attaining his MS, Sam has worked at DATCP, first as a research fellow examining the effectiveness of atrazine prohibition areas in Wisconsin and now as a hydrogeologist overseeing programs that sample surface water and private wells for pesticides in Wisconsin. Sam first attended AWRA as a graduate student in 2023 and has presented at the conference each year since.

PLENARY SPEAKERS

Shaili Pfeiffer

Shaili Pfeiffer is a Natural Resources Staff Specialist in the Bureau of Drinking Water and Groundwater at the Wisconsin Department of Natural Resources and previously worked in the then WDNR Office of Great Lakes. Shaili has spent the past 22 years working on various aspects of the Great Lakes – St. Lawrence Water Resources Compact, first with the public participation process before the agreements were signed in 2005, then Wisconsin's development of its Compact implementing legislation, and finally with the overall implementation of the Great Lakes Compact in Wisconsin and at the regional level. Shaili was the lead staff for the review of the City of Waukesha's diversion application and currently serves as the Regional Body and Compact Council Science Strategy Team co-chair. Shaili is also a member of the International Joint Commission's Water Quality Board. She received a master's degree in hydrogeology from the University of Wisconsin-Madison and a bachelor's degree in mathematics from Carleton College.

Plenary Panel

Coordinating and Supporting Water Work across Wisconsin: Maintaining our waters for future generations is everyone's business, and represents work by researchers, educators, consultants, planners, and outreach specialists. This panel features specialists from the public, private, and non-profit sectors and will explore questions about the future of water work in Wisconsin. What do different careers in water look like? What missions do different organizations support? And in times of constraints and uncertainty, how can organizations work together successfully to address water issues?

- Mike Cardiff, Moderator
- Christina Anderson, Associate Director, Wisconsin Land+Water
- Tory Kress, Senior Environmental Project Engineer at the Redevelopment Authority, City of Milwaukee
- Kevin Masarik, Director and Extension Specialist, Center for Watershed Science and Education (UW-Stevens Point)
- Mike Ursin, PG. Environmental Consultant and Wisconsin Area Leader for TRC Companies, Inc.

CONTENTS

PROGRAM SUMMARY

AWRA-WI at 50: Honoring Our Past, Shaping our Future

49th Annual Meeting of the
American Water Resources Association—Wisconsin Section

THURSDAY, April 9, 2026

9:30 - 11:00 am — **Registration (Brookfield Promenade)**

10:00 - 11:00 am — **Meet and Greet (Brookfield Promenade)**
Informal networking time with light refreshments and opportunities to win prizes. All attendees welcome and encouraged to participate.

11:00 - 1:00 pm — **Lunch (Brookfield 4-5)**
Welcome and Announcements
Business Meeting and Board Election
Lightning Talk: *Is it time for a "State of Wisconsin Joint Solicitation for Surface Water Research and Monitoring"? Tim Asplund, Wisconsin DNR*
Plenary Session Panel Discussion: *Coordinating and Supporting Water Work across Wisconsin, Mike Cardiff, facilitator*

1:05 - 2:45 pm — **Concurrent Sessions 1A, 1B, 1C**
Session 1A — **MMSD Water Resources Activities – Chaired Session**
Room: Brookfield 1-2
Moderator: Mitch Olds

1:05 — **Remote Sensing and Machine Learning for Green Stormwater Infrastructure Condition Assessment**
Omar Hegazy,* Marquette University

1:30 — **PFAS occurrence and potential biological implications in Lake Michigan tributaries near Milwaukee, WI during summer 2022.**
Owen Stefaniak, U.S. Geological Survey

1:55 — **MMSD Flood Management and Reconnecting Communities to the Kinnickinnic River**
Patrick Elliott, Milwaukee Metropolitan Sewerage District

2:20 — **Building the Milwaukee Estuary Dredged Material Management Facility**
Bridget Henk, Milwaukee Metropolitan Sewerage District

* Student presentation.

Session 1B **Groundwater Quality Management**
Room: Milwaukee 1
Moderator: Sue Swanson

1:05 **County-Level PFAS Response in Private Drinking Water Wells: Insights from Oneida and Eau Claire Counties**
Anna Hilger, Eau Claire City-County Health Dept

1:30 **A Decade of Research on Radium in Wisconsin Groundwater: Key Advances and Remaining Challenges**
Amy Wiersma, Wisconsin Department of Natural Resources

1:55 **The efficacy of prohibition areas for reducing atrazine concentrations in Wisconsin groundwaters**
Christopher Zahasky, University of Wisconsin-Madison

2:20 **Nitrification within Municipal Community Public Water Systems**
Jesse Jensen, Wisconsin Department of Natural Resources

Session 1C **Surface Water Quality**
Room: Milwaukee 2
Moderator: Tim Asplund

1:05 **Sorption Capacity and Removal Rates of Phosphorus from Surface Water Using Sorbents** Grace Hiley,* University of Wisconsin-Stevens Point

1:30 **A Tale of Two Nutrients: Investigating N and P Limitation in Wisconsin Streams with Nutrient Diffusing Substrates Improved**
Justin Chenevert, Wisconsin Department of Natural Resources

1:55 **Fifteen Years of Surface Water Pesticide Data in Wisconsin**
Sam Brockschmidt, Wisconsin Department of Agriculture, Trade, and Consumer Protection

2:20 **Taxonomy Matters, Water Dominates: Predicting PFOS Concentrations in Freshwater Fish Tissue Across Three States**
Michael Shupryt, Tetra Tech

2:45 - 3:00 pm **Break: Brookfield Promenade**

3:00 - 4:40 pm **Concurrent Sessions 2A, 2B, 2C**

Session 2A **USGS MMSD Corridor Study**
Room: Brookfield 1-2
Moderator: Matt Diebel

3:00 **U.S. Geological Survey and Milwaukee Metropolitan Sewerage District: Monitoring Habitat and Geomorphic Change Associated with Stream Restoration Activities, Milwaukee, WI**
Heidi Broerman, USGS Upper Midwest Water Science Center

3:25 **Baseline Abundance and Biovolume of Harmful-Algal-Bloom-Producing Cyanobacteria and Indicators of Sediment-Phosphorus Availability in Stream Sediment in the Milwaukee Estuary**
Hailey Trompeter, USGS Upper Midwest Water Science Center

3:50 **Water quality trends in the Milwaukee Metropolitan Sewerage District service area**
Matthew Diebel, USGS Upper Midwest Water Science Center

4:15 **Characterization of Microplastics in Surface Water and Sediment in Two Urban Creeks and in Wet and Dry Atmospheric Deposition Samples from Milwaukee, Wisconsin**
James Romano, USGS Upper Midwest Water Science Center

Session 2B **Groundwater Quality l**
Room: Milwaukee 1
Moderator: Athena Nghiem

3:00 **Cost-Effective Well Depth Estimation for Nitrate Drinking Water Compliance in Wisconsin using Causal Machine Learning**
Xindi Lin,* University of Wisconsin-Madison

3:25 **Drivers and Mechanisms of Phosphorus Mobility in the Hyporheic Zones: A Random Forest Analysis of a Multi-Year Hydrogeochemical Dataset**
Vy Le,* University of Wisconsin-Madison

3:50 **Revisiting molybdenum sourcing in southeastern Wisconsin groundwater through solid-phase geochemistry analyses**
Savannah Finley,* University of Wisconsin-Madison

4:15 **Quantifying Neonicotinoid Loss from Potato Production in the Wisconsin Central Sands**
Evan Freed,* University of Wisconsin-Madison

Session 2C — **Hydrogeology I**
Room: Milwaukee 2
Moderator: Ken Bradbury

3:00 — **Experimental insight into frozen flow processes: visualizations of cryosuction**
Eleanor Louise,* University of Wisconsin - Madison

3:25 — **Investigating Driftless Area hydrostratigraphy using hydrologic monitoring and geochemistry**
Rachel Breunig,* University of Wisconsin- Madison

3:50 — **Enhancing Aquifer Recharge with Gravity-fed Drywells in Surficial Till at Token Creek, WI**
Samantha Kershner,* University of Wisconsin-Madison

4:15 — **Ecohydrology of Ridge-and-Swale Systems in Door County, Wisconsin**
Eric Kastelic,* University of Wisconsin- Madison

4:40 - 5:30 pm — **Networking (Brookfield 3-4-5, Promenade)**

5:30 - 7:00 pm — **Dinner (Brookfield 4-5)**

Distinguished Service Award

Collaborating to Protect Wisconsin's Water Systems
Marissa Jablonski, Freshwater Collaborative

Lightning Talk: The water behind Wisconsin's Data Centers
Adam Freihoefer, Wisconsin DNR

Evening Plenary
Duluth to Quebec City: The Great Lakes Compact as a Governance Tool
Shaili Pfeiffer, Wisconsin Department of Natural Resources

7:00 - 9:00 pm — **Poster Session and Networking (Brookfield 3)**

7:00 - 10:00 pm — **Networking and Social (Brookfield 3)**

* Student presentation.

FRIDAY, April 10, 2026

7:30 - 8:30 am	**Board Breakfast Meeting (Wisconsin 1**
8:30 - 10:10 am	**Concurrent Sessions 3A, 3B, 3C**
Session 3A	**Climate and Water Resources** **Room:** Brookfield 1-2 **Moderator:** Anna Fehling
8:30	**Season-Ahead Statistical Forecasts of Wisconsin Winter Heating Degree Days** Feliz Boeing,* University of Wisconsin - Madison
8:55	**A national stream temperature model and how it can be applied in Wisconsin** Samantha Oliver, U.S. Geological Survey
9:20	**A Hydrologic Rube Goldberg Machine: Mitigating Water Loss on the Yahara Chain of Lakes** Madeline Gotkowitz, Wisconsin Department of Natural Resources
9:45	**Beyond the Numbers: Making Sense of Soil-Water-Balance Model Projections for Minnesota's Climate Future** Stephen Westenbroek, U.S. Geological Survey
Session 3B	**Urban Hydrology** **Room:** Brookfield 3 **Moderator:** Bill Selbig
8:30	**Contrasting Performance of an Urban Stormwater Biofilter for Particulate Versus Dissolved Pollutants** Bill Selbig, U.S. Geological Survey
8:55	**Evaluating Floodwater Infiltration and Storage in a Restored Floodplain of Underwood Creek, Wisconsin** Nicholas Corson-Dosch, U.S. Geological Survey
9:20	**Urban Soil Health: Restoring Disturbed Compacted Urban Soils as a Stormwater BMP** Stuart Schwartz, University of Maryland
9:45	**Quantifying the Hydrological Impact of Urban Forests** Bob Smail, Wisconsin Department of Natural Resources

Session 3C		**Groundwater Quality ll** **Room:** Brookfield 4 **Moderator:** Sam Brockschmidt
8:30		**Data to Model Pipeline for Understanding Geogenic Radium Mobility in Wisconsin Groundwater** Madeline Erb Suciu,* University of Wisconsin -Madison
8:55		**An Analysis of Regulatory Impacts on the Silurian Aquifer of Northeast Wisconsin** Ashley Muench, University of Wisconsin - Green Bay
9:20		**The Silurian Performance Standard: How it came to be. And is it effective?** Maureen Muldoon, Wisconsin Geological and Natural History Survey
9:45		**From data-focused investigations of groundwater sustainability to informing action in Richland County** Athena Nghiem, University of Wisconsin-Madison
10:10-10:30 am		**Break: Brookfield Promenade**
10:30-12:10 pm		**Concurrent Sessions 4A, 4B, 4C**
Session 4A		**Watershed Management** **Room:** Brookfield 1-2 **Moderator:** Steve Gaffield
10:30		**Changes in chloride concentration and flux from 2011 to 2023 in major U.S. tributaries to the Laurentian Great Lakes** Dustin Kincaid, U.S. Geological Survey
10:55		**Landfill to Lake: Removal of a Landfill for Improved Land Use** Steve Sellwood, TRC Environmental Corp
11:20		**The history of the Runoff Curve Number Method and how it limits our imagination of potential watershed futures** Eric Booth, University of Wisconsin - Madison
11:45		**A Reconstructing the Eutrophication of Gass Lake near Manitowoc, WI Since European Settlement Using Lake Sediment Chemistry** Peter Puleo, University of Wisconsin - Whitewater

Session 4B	**Hydrogeology ll** **Room:** Brookfield 3 **Moderator:** Chris Zahasky
10:30	**Using airborne electromagnetic surveys to aid in the investigation of groundwater resources in the Keweenaw Bay region of Michigan** Bridget Kaemming, U.S. Geological Survey
10:55	**Groundwater modeling of flood-prone seepage lakes in a glacial aquifer: calibrating to recent floods and assessing recharge sensitivity under geologic uncertainty** G. Graham, Wisconsin Geological Natural History Survey
11:20	**Simulating Contaminant Fate and Transport in the Prairie du Chien and Jordan Aquifers beneath the Twin Cities, MN using MODFLOW 6** Andrew Leaf, U.S. Geological Survey
11:45	**A look at old water use data in Wisconsin** Aaron Pruitt, Wisconsin Department of Natural Resources
Session 4C	**MMSD Flood of 2025** **Room:** Brookfield 4 **Moderator:** Mitch Olds
10:30	**From PLCs to Pixels: A Modern Water Data Pipeline** Zac Driscoll, Milwaukee Metropolitan Sewerage District
10:55	**An overview of impacts and mitigation of Southeastern Wisconsin's 1,000 year storm, August 2025** Mitch Olds, Milwaukee Metropolitan Sewerage District
11:20	**A probabilistic compound flood hazard assessment for coastal Milwaukee, WI** Adam Bechle, Wisconsin Sea Grant
11:45	**Integrating NEXRAD-II into a 20-gage mesonet to develop a spatially continuous high-resolution precipitation dataset** Andrew Brown, Milwaukee Metropolitan Sewerage District

12:10 – 12:30	**Closing Announcements and Student Awards** **Brookfield Promenade**
12:30	**Student Career Lunch** **Brookfield 5**

ABSTRACTS

Thursday, April 9, 2026

Lightning Talks

Is it time for a "State of Wisconsin Joint Solicitation for Surface Water Research and Monitoring"?

Tim Asplund, Wisconsin Department of Natural Resources

Wisconsin has a long and robust history of supporting groundwater research and monitoring under the auspices of the Groundwater Coordinating Council (GCC) and administered through a partnership between the Wisconsin DNR, DATCP, DSPS and the UW Aquatic Sciences Center, via the annual Joint Solicitation for Groundwater Research and Monitoring. This was set in motion by the landmark Groundwater Quality Law of 1983 and an ongoing appropriation in the State budget for UW's portion of the funding. Indeed, many of the research projects are showcased at the annual AWRA Meeting. This begs the question of why we don't have a similar mechanism or organizational structure in place to support surface water research and monitoring that addresses real world issues facing Wisconsin, such as PFAS and other emerging contaminants, adapting to climate extremes, nutrient loading and harmful algal blooms, and aquatic invasive species? There are certainly many examples of strong working partnerships between various UW campuses, USGS, Sea Grant and researchers at DNR and other state agencies, to fund actionable science and fulfill research priorities and needs, but these are dependent on individual programs and staff and fleeting funding sources, not institutionalized like the GCC and Joint Solicitation. This lightning talk will propose ideas and thoughts about ways to build on existing partnerships and funding mechanisms to create an analogous program for surface water research and monitoring.

The water behind Wisconsin's Data Centers

Adam Freihoefer, Wisconsin Department of Natural Resources

Water has long been an integral resource for Wisconsin's economy—from brewing and paper production to agriculture and mining. As proposed hyperscale data centers become part of community discussions and potentially part of the state's industrial landscape, important questions arise about their water use and potential impacts. This talk examines the role of water in the context of data centers and frames a discussion around key questions: How much water do data centers actually use, and where does that water come from?

Concurrent Sessions

Session 1A: MMSD Water Resources Activities

Remote Sensing and Machine Learning for Green Stormwater Infrastructure Condition Assessment

Omar Hegazy,* Marquette University, omar.hegazy@marquette.edu
Abhiram Pamula
Walter Mcdonald, Marquette University

With the increasing use of Green Stormwater Infrastructure (GSI) to manage urban runoff, inspection and maintenance of systems distributed across cities remain a major challenge. Remote sensing may be one approach to overcome this challenge through broad, frequent, and spatially distributed data across an entire city that could save both time and resources over in-person inspections. However, it is unclear how to use reflectance data of the surface from remote sensing for concrete maintenance indicators or actions. The goal of this study is therefore to classify the land cover of GSI sites using both drone and satellite remote sensing data and translate this classification into useful maintenance indicators. To do so, we collected remote sensing data over one year at 20 GSI sites in Milwaukee, WI using a drone with a multispectral camera (2-4 cm resolution), as well as high-resolution satellite data (30 cm). We then applied machine-learning algorithms to classify the land cover using categories unique to seasonal land cover changes. Our results indicate that land cover classifications (healthy plants, unhealthy plants, dead plants, and inorganic material) produce an accuracy up to 78% with satellite data and 92% with higher resolution drone data consistently across all seasons. Ultimately, the outcome of this work could lead to reduced cost and time required to effectively maintain GSI systems, thereby improving their efficiency and performance in managing stormwater runoff.

PFAS occurrence and potential biological implications in Lake Michigan tributaries near Milwaukee, WI during summer 2022

Owen Stefaniak, U.S. Geological Survey, ostefaniak@usgs.gov

The occurrence of per- and polyfluoroalkyl substances (PFAS) and their potential for ecological risk in surface waters near Milwaukee, WI were examined with surface water and bed sediment samples collected at 22 locations. PFAS are a group of synthetic compounds used for decades in commercial and industrial applications around the world. Many have been linked to a range of human health concerns and the public has increasingly begun to recognize these compounds as "forever chemicals" due to their resistance to environmental degradation. The Milwaukee area has five tributaries that drain into Lake Michigan, where the United States and Canada have identified PFAS as chemicals of mutual concern due to potential threats to human and environmental health. Sampling occurred across these five tributaries and selected sub-watersheds in 2022 to characterize PFAS distribution in the region. Samples were collected during multiple periods of low flow and rainfall runoff to determine how PFAS occurrence might be impacted by hydrologic variability. To assess locations and compounds of ecological concern, environmental concentrations were compared to water quality benchmarks, whole-organism effects, gene targets, and adverse outcome pathways for selected PFAS compounds. This work fills critical knowledge gaps about PFAS occurrence and potential ecological risks in the Milwaukee area and contributes to the growing body of literature on PFAS trends in Great Lakes tributaries.

* Student presentation.

MMSD Flood Management and Reconnecting Communities to the Kinnickinnic River

Patrick Elliott, Milwaukee Metropolitan Sewerage District, pelliott@mmsd.com

The Milwaukee Metropolitan Sewerage District (MMSD) is a regional government agency with authority to reduce flood risk along approximately 140 miles of stream corridors in Milwaukee County. In the 1960s and 1970s, flood management efforts relied on channel straightening and concrete lining to improve drainage. While these approaches provided limited localized benefits, they created public safety hazards, degraded water quality, and increased downstream flooding.

In the late 1990s, MMSD shifted its approach to emphasize watershed planning, updated stormwater regulations, and nature-based designs along the urban streams. MMSD has since invested approximately $630 million across Milwaukee County, removing more than 2,500 structures from the 100-year floodplain and restoring 4.5 miles of previously concrete-lined streams.

MMSD is currently advancing efforts within the Kinnickinnic (KK) River watershed, the most urbanized watershed in Wisconsin, with more than 700 structures at high flood risk and over 7 miles of concrete-lined streams. MMSD and local partners developed a comprehensive watershed plan to reduce flood risk, improve public safety, restore stream function, and reconnect residents to the stream corridors.

This presentation will describe the evolution of MMSD’s flood management program and highlight projects in the KK River watershed, including the completed Pulaski Park project and upcoming work in Jackson Park and along the KK River between 6th and 16th Streets.

Building the Milwaukee Estuary Dredged Material Management Facility

Bridget Henk, Milwaukee Metropolitan Sewerage District, bhenk@mmsd.com

Milwaukee Metropolitan Sewerage District (MMSD) is constructing the Milwaukee Estuary Dredged Material Management Facility (DMMF) project to provide disposal capacity for approximately 1.9 million cubic yards of contaminated spoils dredged from the Milwaukee, Menomonee, and Kinnickinnic Rivers and the Milwaukee Bay. This facility is a catalyst for a once in a generation opportunity to remove legacy contamination from the Milwaukee waterways. This presentation will include an overview of the Milwaukee Estuary Area Of Concern, the design of the DMMF and the construction to date.

Session 1B: Groundwater quality management

County-Level PFAS Response in Private Drinking Water Wells: Insights from Oneida and Eau Claire Counties

Anna Hilger, Eau Claire City-County Health Dept, anna.hilger@eauclairecounty.gov
Audrey Boerner, Eau Claire City-County Health Dept
Mark Pauli, Wisconsin Dept of Natural Resources

Statewide per- and polyfluoroalkyl substances (PFAS) drinking water testing in 2022-23 revealed PFAS above health advisory levels (HALs) in rural Eau Claire and Oneida county wells. To protect human health, multi-year responses facilitating additional drinking water testing in each county have been led by the Eau Claire City-County Health Department and WDNR Drinking Water and Groundwater Program, respectively.
The responses in each county have utilized different funding sources, outreach strategies, and local partnerships to encourage private well testing for at-risk well users and to aid in navigating available assistance programs. In Eau Claire County, over 280 private well PFAS samples have been collected across the county in a variety of land use settings, with 22% of those samples exceeding the Wisconsin DHS HAL and 64% with a PFAS detection. Focused sampling efforts in the towns of Drammen and Brunswick exhibited a 49% HAL exceedance rate. PFOA and PFOS are the most common HAL exceedances.
In Oneida County, sampling has been focused on the Town of Stella where over 245 private well PFAS samples have been collected, with 36% exceeding HALs and a 53% detection rate overall. Detections of PFAS in private wells are among the highest in the nation. Well compensation funding has been utilized to replace private wells for those that have meet eligibility requirements.

A Decade of Research on Radium in Wisconsin Groundwater: Key Advances and Remaining Challenges

Amy Wiersma, Wisconsin Department of Natural Resources, amy.wiersma22@gmail.com
Christopher Zahasky, University of Wisconsin-Madison
Madeline Gotkowitz, Wisconsin Department of Natural Resources
Matthew Ginder-Vogel, University of Wisconsin-Madison

Radium contamination remains one of the most widespread groundwater quality challenges for public water systems in Wisconsin, particularly within the Cambrian–Ordovician aquifer system. Collaborative, interdisciplinary research over the past decade has advanced understanding of radium sources, mobilization mechanisms, and well-scale behavior through integrated laboratory experiments, field studies, and modeling. This presentation synthesizes findings from these efforts, including (1) the distribution of radium and parent nuclides in aquifer materials; (2) geochemical controls governing radium release, including anthropogenic influences; (3) the influence of regional pumping and well-field interactions on radium transport; and (4) implications for well reconstruction. Our current research is in partnership with small municipal systems in south central Wisconsin, where wells have increasing radium levels and chemical treatment is regarded as prohibitively expensive. This project focuses on new data collection to reduce uncertainty in numerical models of radium fate and transport. Together, these studies provide a more complete understanding of radium dynamics in Wisconsin groundwater and highlight opportunities for more effective groundwater management.

The efficacy of prohibition areas for reducing atrazine concentrations in Wisconsin groundwaters

Christopher Zahasky, University of Wisconsin-Madison, czahasky@wisc.edu
Xindi Lin
Hyunseung Kang

Atrazine is one of the most heavily utilized herbicides in the United States for weed control in corn production areas. In response to increasing concentrations observed in groundwater above the EPA MCL of 3 μg/L, the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) established the Wisconsin Atrazine Rule, Ag 30 in 1992. This rule established several policies to reduce atrazine in groundwater, most notably by establishing areas where the application of atrazine is prohibited. This study utilizes 40 years of groundwater sampling data and a staggered-adoption difference-in-differences (SA-DiD) statistical model, which evaluates policy impacts by comparing trends between prohibited and non-prohibited areas, to assess the impact of these prohibition areas on atrazine and atrazine metabolite concentrations in groundwater. The results indicate that atrazine concentrations in wells within prohibition areas declined by 0.67 μg/L more than in wells outside prohibition areas by 2025, relative to the pre-policy baseline. In wells in the 98th percentile, the concentrations in prohibition areas dropped over 4 μg/L. These results highlight both the environmental persistence of atrazine in groundwater systems and the efficacy of atrazine regulation in improving groundwater quality. This study has important implications for the development and extension of management policies for other pesticides and for broader atrazine regulatory policy development.

Nitrification within Municipal Community Public Water System

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In August 2025, a reported case of methemoglobinemia in two young children residing in the Village of Williams Bay, Wisconsin, prompted a multi-agency investigation into potential nitrate and nitrite contamination within a regulated municipal community public water system. Although historical compliance sampling at the system's entry point indicated nitrate and nitrite concentrations well below Maximum Contaminant Levels (MCL), subsequent distribution system testing revealed elevated nitrite concentrations far exceeding the state and federal MCLs.

This after-action review - told through the perspective of the Wisconsin Department of Natural Resources - documents the events, response actions, and regulatory decisions that were made which led to the issuance of a "Do Not Drink" advisory and how the Williams Bay situation was ultimately resolved. The investigation identified the nitrification of elevated levels of ammonia - an unregulated contaminant - occurring within the distribution system as the reason for the exceedance.

Ammonia is commonly found in groundwater, originating naturally from organic matter breakdown and other human sources. The Williams Bay case revealed a critical gap in existing state and federal drinking water regulatory frameworks that may be failing to identify acute public health threats to consumers.

Sorption Capacity and Removal Rates of Phosphorus from Surface Water Using Sorbents

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Excessive phosphorus (P) loading leads to eutrophication in freshwater systems, creating harmful algae blooms and degrading ecosystem health. Phosphorus-sorbing materials (PSMs) offer a promising strategy for reducing the export of dissolved P. This study evaluated two PSMs: electric arc furnace (EAF) slag, an industrial by-product, and Poseidon Pellets™, an engineered lanthanum-modified bentonite pellet, using isotherm experiments and flow-through column tests. Isotherm experiments showed that slag and Poseidon Pellets™ had similar sorption capacities at a 1-hour residence time (1.26 mg/g and 0.4 mg/g for slag and Poseidon Pellets™, respectively), but at 4, 12, and 24-hour residence times the sorption capacity of Poseidon Pellets™ were approximately 5-9 times higher than slag (sorption capacities were 48.8, 39.4, and 39.8 mg/g for Poseidon Pellets™ at 4, 12, and 24-hr residence times, respectively). Flow-through column experiments, with an approximate 1-hour residence time, were run for 192 hours and revealed that slag had a slightly higher maximum sorption capacity (14.8 mg/g and 11.37 mg/g for slag and Poseidon Pellets™, respectively). Both sorbents desorbed P once P-free water was introduced, returning to baseline within 72 hours. Overall, slag appears to be slightly more effective at low residence times, while Poseidon Pellets™ provide significantly more P removal if residence times are greater than 1 hour.

A Tale of Two Nutrients: Investigating N and P Limitation in Wisconsin Streams with Nutrient Diffusing Substrates

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Excess nitrogen (N) and phosphorus (P) are primary drivers of stream eutrophication, but their relative roles in controlling algal growth in wadeable streams remain poorly understood. This uncertainty limits the ability to design effective nutrient management strategies tailored to specific regions or watersheds. We evaluated nutrient limitation using nutrient-diffusing substrate (NDS) bioassays in 56 wadeable streams across Wisconsin. Sites encompassed broad range of land uses and ambient total nitrogen (TN) and total phosphorus (TP) concentrations (TN: 0.22–15.17 mg/L; TP: 7–919 µg/L) with only weak correlation between TN and TP. Limitation responses varied: 41% of sites showed no limitation, 23% were N-limited, 20% co-limited by N and P, and 9% were P-limited. Mixed-effects models indicated that N and combined N×P treatments significantly stimulated algal accrual, whereas P alone had weak effects. Logistic regression identified ambient total N thresholds for a 50% probability of N limitation at 1.37–1.93 mg/L across total P gradients, while P limitation thresholds (14–29 µg/L) were well below Wisconsin's TP criterion. These findings suggest N currently exerts stronger control on algal growth and provides a plausible range of TN thresholds needed to constrain excess benthic algal growth in wadeable streams. These results underscore the need for dual-nutrient management strategies in Midwestern streams.

* Student presentation.

Fifteen Years of Surface Water Pesticide Data in Wisconsin

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The Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) is responsible for monitoring pesticides in Wisconsin's water resources. DATCP began collecting surface water samples to test for pesticides in 2008 and has continued to sample and test surface water for pesticides annually throughout the state for more than 15 years now. Continued annual testing has produced a large dataset of over 1000 samples, with considerable geographical and temporal breadth. This presentation provides a selection of surface water pesticide data collected in the first 15 years (2008 – 2022) of the DATCP surface water sampling program, along with insights and lessons learned from this dataset. The data indicate that pesticides are found in surface waters throughout Wisconsin. The magnitude of pesticide detections varies seasonally and is influenced by regional hydrogeologic settings, including the extent of groundwater and surface water interactions. The data also delineate a number of regions in the state where the concentrations of pesticides in surface waters exceed Wisconsin groundwater health-based thresholds and/or aquatic life benchmarks set by the US Environmental Protection Agency.

Taxonomy Matters, Water Dominates: Predicting PFOS Concentrations in Freshwater Fish Tissue Across Three States

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Perfluorooctane sulfonate (PFOS), one of many PFAS "forever chemicals", in wild fish populations remains a persistent public health concern. However, fish tissue testing is time-consuming, costly, and requires fish mortality limiting its widespread application. Using 3,831 paired fish–water samples from 185 sites in Colorado, Minnesota, and Wisconsin (2006–2023), we show that routine surface water monitoring reliably predicts PFOS concentrations in edible fish fillets. Species averaged tissue PFOS scales log linearly with water PFOS (R^2 = 0.57). Adding fish taxonomy modestly improves fit (R^2 = 0.70) while fish length, feeding guilds, and habitat preferences contribute little compared with water concentration. Decision tests tied to common advisory targets (5.3–200 ng/g) yield surface water thresholds of ~2.3–26.2 ng/L and strong classification abilities (AUC 0.85–0.97). Adopting a tiered framework that uses water PFOS to triage waters for fish sampling, trigger additional actions when water exceeds thresholds, and reserve fish testing for confirmation would reduce costs, limit fish mortality, and enable timely, consistent advisories. Surface water PFOS is a practical, defensible proxy for fish PFOS that can accelerate protections while improving efficiency.

Session 2A: USGS MMSD Corridor study

U.S. Geological Survey and Milwaukee Metropolitan Sewerage District: Monitoring Habitat and Geomorphic Change Associated with Stream Restoration Activities, Milwaukee, WI

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The U.S. Geological Survey began routine geomorphic and habitat data collection in Milwaukee-area streams in 2004, in partnership with the Milwaukee Metropolitan Sewerage District (MMSD). For 20 years data has been collected at 14 reference reach sites within the original sampling network; four additional sites have since been added. In the mid-twentieth century many streams in the Milwaukee area were concrete lined to quickly move flood water. These channels are now being replaced with more natural bedforms and banks to enhance migratory fish passage and public safety. Of the eighteen sites, five have been restored. Quantitative geomorphic and habitat data collection methods are fundamental to assessing restoration success. Metrics can be used to highlight and compare differences in geomorphological characteristics between restored and unrestored streams and illustrate changes involving fundamental geomorphic and ecological characteristics: channel morphology, streambank erosion, streambed size and form, riparian vegetation, and large wood. Additionally, advances in technology, improved methodologies, and a broader range of reference reaches may help streamline assessment efforts and provide new insights into restoration efficacy. Analyses may show the differences in the geomorphic characteristics of fish passage-focused restoration practices relative to unrestored urban streams, while also demonstrating the importance of quantitative geomorphic monitoring techniques.

Baseline Abundance and Biovolume of Harmful-Algal-Bloom-Producing Cyanobacteria and Indicators of Sediment-Phosphorus Availability in Stream Sediment in the Milwaukee Estuary

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Eutrophication and harmful algal blooms (HABs) are growing concerns in the Great Lakes. The Milwaukee Estuary currently has limited eutrophication problems and limited or no HABs problems; however, changes in stream hydrology could potentially enhance the release of legacy phosphorus from fine-grained stream sediment, thereby enhancing eutrophication and the production of HABs in tributaries to the Milwaukee Estuary. Despite the phosphorus TMDL for the Milwaukee River watershed, the abundance/biovolume of HABs-producing cyanobacteria and cyanotoxin presence in the system are largely unknown. A baseline study was done to assess the potential for nitrogen removal, phosphorus storage, and nutrient release in streambed sediment. In addition, eDNA techniques were used to identify algal species at tributary sites and estuary sites to determine the potential for fueling HABs in Milwaukee-area rivers and the Estuary. The objectives of this study were to describe the processes by which stream nutrients could cause estuary eutrophication, low dissolved oxygen, algal growth, and potential HABs. Results from this study indicate that HAB-producing cyanobacteria were present at some sites across the estuary. Based on these findings, stream rehabilitation projects that promote sediment deposition and accumulation of organic matter in the stream channel can increase nitrogen removal and phosphorus retention and therefore reduce the likelihood of developing HABs.

Water quality trends in the Milwaukee Metropolitan Sewerage District service area

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The Milwaukee Metropolitan Sewerage District (MMSD) conducts routine monitoring at 60 stream sites in and around their service area. Samples are analyzed for a broad suite of water-quality parameters, including nutrients, suspended solids, biochemical oxygen demand (BOD), fecal coliform, major ions, and metals. Through a collaborative effort, the US Geological Survey evaluated trends over time in 12 parameters at 51 of the monitoring sites with records ranging from 17 to 46 years (mean 34 years). Trends were analyzed with Weighted Regressions on Time, Discharge, and Season to separate the influence of streamflow variation on water quality from underlying trends. Results indicate that most measures of stream water quality in the Milwaukee area generally improved over the monitoring periods at most sites. For the 2004-24 period, where trends could be evaluated at most sites, mean annual flow-normalized concentrations of nitrate, total phosphorus, 5-day BOD, and total suspended solids decreased at over 75% of sites; high variability in fecal coliform concentrations meant that most trends were uncertain; and chloride increased at most sites but appears to have leveled off in the last decade. All analysis results, including flow-normalized and actual annual, seasonal, and daily concentration and flux estimates, are planned to be available on a public web dashboard and are intended to help MMSD assess the effectiveness of watershed management practices.

Characterization of Microplastics in Surface Water and Sediment in Two Urban Creeks and in Wet and Dry Atmospheric Deposition Samples from Milwaukee, Wisconsin

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Microplastics have emerged as a threat to aquatic ecosystems. This study sampled four streams in two Milwaukee-area watersheds for microplastics 100-microns and larger in size using modified field collection methods designed to capture particles across different mediums. Dominant land-use types in the watersheds guided stream sample-site selection and included 1) primarily residential and 2) a combination of industrial, commercial, and transportation. Water-sample collection characterized different hydrologic flow regimes, including low-flow and precipitation-runoff conditions. Streambed surficial sediment samples were collected. Wet and dry deposition were sampled to assess atmospheric microplastic contributions to the watersheds. Laboratory analysis provided microplastics shape descriptions, counts, polymer composition, and mass determination allowing for quantification of concentration by number of particles and mass by sample and polymer. Comparisons of polymer composition, relative abundance, and mass concentration across different land use types and hydrologic flow conditions will be presented along with an assessment of microplastics in atmospheric deposition. Our findings offer preliminary insights into the effectiveness of modified microplastic field-collection methods for small streams and atmospheric deposition and highlight how different urban land use categories contribute varying amounts of microplastics to watersheds.

Session 2B: Groundwater Quality I

Cost-Effective Well Depth Estimation for Nitrate Drinking Water Compliance in Wisconsin using Causal Machine Learning

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Nitrate is the most widespread groundwater contaminant in Wisconsin, a state where groundwater provides drinking water for two-thirds of the population. One of the most common ways to reduce nitrate levels in wells with chronic exceedances is to drill a deeper well or increase the casing depth of the existing well. However, the installation of deep wells is expensive, and it often is not clear what the target depth of new wells should be. This study develops a data-driven method to estimate the minimum well depth required for nitrate MCL compliance across the state. We first use machine learning with residual kriging to create a three-dimensional nitrate map across Wisconsin. Then, we employ ideas from causal inference to estimate the required well depth as a function of the spatial predictors. This study utilizes the publicly available groundwater nitrate measurements from 2020 to 2024 in Wisconsin and incorporates predictive variables such as land use, precipitation, soil drainage, concentrated animal feeding operations (CAFOs), static water levels, and well depth. The resulting map serves as a cost-effective policy tool for informing well installation depths in Wisconsin to avoid nitrate exceedances of drinking water standards.

Drivers and Mechanisms of Phosphorus Mobility in the Hyporheic Zones: A Random Forest Analysis of a Multi-Year Hydrogeochemical Dataset

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Phosphorus (P) transport in riverbanks is driven by complex interactions between hydrogeologic variability and redox geochemistry. River stage fluctuation shifts surface water-groundwater exchange, creating transient redox conditions that dictate P mobility. This study identifies drivers and mechanisms of P release in the Wisconsin River hyporheic zone using a two-year multivariate dataset (2023–2025) and high-frequency stage records to train a Random Forest (RF) machine learning model.

Monthly porewater samples were collected along two riverbank transects to characterize P distribution and geochemistry. The RF model effectively captures non-linear relationships, identifying the hyporheic gradient–driven by fluctuating river stage–and electrical conductivity as the primary drivers of P mobilization. Redox-sensitive parameters, specifically nitrate and dissolved oxygen, were also highly predictive, consistent with the reductive dissolution of iron oxides; however, these dynamics only emerge below specific thresholds.

* Student presentation.

Spatiotemporal analysis reveals that P concentrations spike following rapid river stage increases at specific distances from the bank. By examining partial dependence, the RF model provides a framework for identifying "hot moments" and "hotspots" of P release. These findings highlight the utility of machine learning in disentangling complex hydrogeochemical drivers, offering a scalable tool for site-specific management of nutrient mobility in river systems.

Revisiting molybdenum sourcing in southeastern Wisconsin groundwater through solid-phase geochemistry analyses

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Molybdenum (Mo) is an emerging groundwater contaminant in southeastern Wisconsin (SE WI), where concentrations often exceed the 90 ppb state health advisory level; yet its source and mobilization mechanisms remain unknown. Mo is commonly assumed to originate from deeper organic-rich or pyrite-bearing shale units; however, no solid-phase analyses have been done to directly evaluate controls on Mo release to groundwater in SE WI. This study investigates the source and mineralogic associations of Mo in Silurian dolomite and Maquoketa shale bedrock cores using a novel sequential extraction technique coupled with groundwater geochemistry to assess potential release mechanisms. Sequential extraction results show that despite elevated groundwater concentrations, total solid-phase concentrations are low (<3 ppm). While Mo is predominately hosted in sulfidic fractions at depth (~50% avg), the relative contributions vary substantially. The highest solid-phase concentrations occur in the shallowest core interval with dominate Mo associations shifting among exchangeable, carbonate/Fe-oxide, and sulfide phases even over narrow depth ranges. These results suggest that sulfidic material may act as both a source and a sink for Mo, while the prevalence of easily exchangeable phases indicates limited solid-phase retention and sustained aqueous mobility. This work highlights the role of lithology and diagenesis on trace element behavior in SE WI, with implications for groundwater management.

Quantifying Neonicotinoid Loss from Potato Production in the Wisconsin Central Sands

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Neonicotinoid insecticides account for over 25% of the global pesticide market and are frequently detected in groundwater due to their high solubility and persistence. The Wisconsin Central Sands Region (CSR), characterized by sandy soils, intensive irrigation, and shallow aquifers, is particularly vulnerable to agrochemical leaching. Despite widespread detection of neonicotinoids in CSR groundwater, field-scale quantification of parent compounds and transformation products remains limited.

This study quantifies thiamethoxam and imidacloprid leaching from potato production at the Hancock Agricultural Research Station. Twenty-four passive capillary wick lysimeters installed at 60 cm depth collect leachate across irrigation treatments (65%, 85%, 100%) with and without barley companion cropping. Samples

* Student presentation.

are analyzed biweekly during the growing season for parent neonicotinoids and transformation products using HPLC-MS/MS.

We hypothesize rapid post-application transformation with urea and desmethyl derivatives dominating by mid-season, and bimodal breakthrough patterns reflecting initial mobility and post-harvest remobilization. Results will provide the first field-scale neonicotinoid mass balance for the CSR, linking management practices to contaminant flux and informing groundwater protection strategies for vulnerable sandy agroecosystems.

Session 2C: Hydrogeology I

Experimental insight into frozen flow processes: visualizations of cryosuction

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Subsurface freezing occurs in Wisconsin and many regions around the world due to seasonal weather patterns and climate conditions. As colder temperatures propagate through the subsurface, parameters such as saturation, hydraulic conductivity, and permeability are altered by coupled thermodynamic, hydrologic, and mechanical processes. As the vadose zone freezes, these coupled interactions create dynamic hydraulic gradients that can cause flow toward the freezing front, which may impact recharge and groundwater-surface water exchange. This process, known as cryosuction, happens under complex environmental conditions that present experimental difficulty due to the high control needed for the thermo-hydraulic variables.
We experimentally investigated cryosuction-driven flow using controlled thermal gradients in a Hele-Shaw cell to quantify flux through mass balance and fluorescent dye imaging. The cell was placed within a freezer and set up to physically model a freezing front moving through the partially saturated subsurface. Saturation, flux, and temperature were recorded to characterize the response to changing thermal conditions. Timelapse photography was used to capture soil water and soil freezing characteristic curves to compare differences in saturation before and after freezing. These results provide insight into the relationship between changing thermal gradients and increased liquid flux during freezing and how cryosuction affects near surface unsaturated environments.

Investigating Driftless Area hydrostratigraphy using hydrologic monitoring and geochemistry

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In the Driftless Area, disappearing and reappearing stream reaches in deeply incised valleys testify to the complexity of surface water and groundwater interactions. Locally, streams crosscut loess (silty dust) deposits underlain by sequences of carbonate rocks, shale, and sandstone. These strata differ in fracture distributions and chemical weathering intensity, resulting in strong contrasts in hydraulic properties across multiple spatial scales. Understanding how hydrologically relevant units (i.e. hydrostratigraphy) control flow at a landscape scale is fundamental to predicting water resource quality and quantity. Yet, flow and hydrostratigraphy in the Driftless Area remain poorly understood.

We monitored a small, steep headwater catchment in Wyalusing State Park, WI for porewater, spring, and stream chemistry across two perched aquifers over two years. We use newly measured solid-phase chemistry from a 200 meter well and water chemistry endmember mixing analysis to characterize subsurface structure and flowpaths. Our results quantify variations in stream water sources with time and space, demonstrate the effects of loess on flow and chemistry, and highlight differences between types of springs contributing to streamflow which we interpret as differences between fracture flow and rock matrix interacting flow. These

* Student presentation.

results demonstrate the utility of paired hydrological and geochemical measurements to understand physical flow and transport at and beyond the catchment scale.

Enhancing Aquifer Recharge with Gravity-fed Drywells in Surficial Till at Token Creek, WI

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Large-scale Managed Aquifer Recharge (MAR) systems are vital for creating a sustainable groundwater resource in the Western United States due to limited water availability. MAR use in the Midwest has been minimal, likely due to land use requirements, cost, and an abundance of groundwater. Despite limited use in the Midwest, MAR systems that source from stormwater can provide benefits in reducing surface water flooding. In addition, many regions of the rural Midwest are already at risk of contamination from excess nutrients and pathogens associated with agricultural operations and septic systems (Moody, 1990), which can be diluted if high-quality water is infiltrated into the subsurface. Recharge may be enhanced economically by installing shallow drywells that allow deeper infiltration by bypassing the root zone. These drywells can benefit these areas where groundwater recharge is expected to be naturally low, including regions with dense, high-ET plant cover and areas where surficial soils are lower in permeability. In this study we assess the relative benefit of shallow drywells through: 1) field monitoring of a small drywell system; 2) comparison with estimated rates of natural recharge from a 1D model; and 3) an economic analysis relating lifecycle volumes of enhanced recharge to lifecycle costs. This study builds on other studies that have assessed small-diameter drywells by assessing performance under natural runoff conditions and evaluating system longevity.

Ecohydrology of Ridge-and-Swale Systems in Door County, Wisconsin

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Ridge-and-swale complexes (RCS) are coastal ecosystems where relic beaches along the Great Lakes form sandy forested ridges that alternate with interdunal, wetland swales. In RSCs groundwater controls vegetation composition and function. Groundwater hydrology is shaped by interacting regional flow from the uplands, local hydrologic inputs (precipitation) and outputs (evapotranspiration), and fluctuating Great Lakes Water Levels (GLWL). Yet, the future of these tightly coupled ecological and groundwater systems is uncertain as environmental conditions and GLWL change. This work aims to identify susceptibility to changing groundwater conditions using historical tree growth records from a RSC at the Ridges Sanctuary in Bailey's Harbor, WI. RSCs are ideal locations to study groundwater and GLWL interactions as water availability for forests in these systems is affected by variation in groundwater depth, which is regulated by both regional groundwater and GLWL. Analysis of 18 months of groundwater levels show spatial and temporal variability in diurnal groundwater response, indicating trees of the same species access groundwater differently throughout the RSC. Tree ring analysis of 120 trees has shown that growth varies by stand location. Ongoing analysis is identifying how individual tree growth varies within a stand from 1900-2025 to establish historic groundwater levels. Findings will help shape management of coastal aquifers under future climate and groundwater use.

* Student presentation.

Poster Session
Thursday, April 9, 2026

Reach Scale Restoration Projects Balance Against Watershed-Scale Processes in Urban Steams

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Within Wisconsin's Red Cedar Basin Watershed, there are a multitude of pressures on waterways. As cities expand, natural processes that promote stream health are altered for city growth, such as channelizing the stream, creating impervious surfaces, and directing stormwater flow. These effects are denoted as "urban stream syndrome." Galloway Creek, an urban stream on the south side of Menomonie, exhibits effects of urban stream syndrome, such as proximity to impervious surfaces resulting in flashier runoff, causing a threat to stream bank stability. Ongoing restoration efforts of the corridor, such as the planting of native sedges, shrubs, and trees, attempt to reduce erosion and filter pollutants. In this study, stream sedimentation processes were assessed using longitudinal quadrat sampling. Sediment was evaluated through coverage classes by particle size, classifying sediments by weight, and testing the depth of refusal at sample points. Wolman pebble counts were conducted to assess potential habitat suitability for macroinvertebrate species. The analysis of the data indicates that the depth of refusal was variable along the stream, and a high percentage of small particles was shown through all sites. These results indicate diversified substrates, heavy sediment loading, and a need for streambank restoration to improve habitat quality. Further projects should focus on reducing runoff volume and velocity, preventing sediment deposition and erosion issues.

Groundwater Transport and Nitrogen Fertilizer Decision Support Tools (GW & N DSTs) for Wisconsin

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To achieve drinking water source protection from nitrate, the most prevalent groundwater contaminant found in exceedance of the drinking water standard in Wisconsin, new tools are needed for communities, conservation departments, agricultural producers, and other stakeholders to identify groundwater-protective land management practices and understand groundwater transport time-lags to wells. This poster highlights capabilities of new Groundwater Transport and Nitrogen Decision Support Tools (GW & N DSTs) produced collaboratively by the USGS and the University of Wisconsin with the support of the Wisconsin Department of Natural Resources. These GW & N DSTs provide realistic estimates of nitrate leaching rates under common agricultural practices, evaluate reductions from conservation measures, and support the development of new conservation practices to reduce nitrogen concentrations in water. Additionally, nitrogen loss estimates are coupled with groundwater transport modeling to determine loss reduction goals on the landscape and the timeframe needed to reach water quality improvement at drinking water wells. A framework for ongoing and broader statewide collaboration is proposed for the purpose of continued development and improvement of GW & N DSTs, building a robust set of statewide resources to improve our capacity to mitigate nitrate contamination of state waters.

* Student presentation.

The Coastal Processes Manual: Estimating Coastal Risk in the Great Lakes Basin

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The 3rd Edition of the Coastal Processes Manual provides local officials, decision makers, zoning administrators, and other practitioners with a step-by-step guide to 21st century Great Lakes coastal concerns. The Manual describes how to estimate vulnerability and risk to extreme lake levels, storms, and erosion, and methods to build community resilience. The Manual covers comprehensive technical information on coastal processes with technical solutions and worksheets for users to apply to various local conditions. Chapters of special interest include Coastal Processes and Hydrology, Risk Assessment Basics, Coastal Flooding, Shoreline Recession and Slope Stabilization, Sediment Transport, Future Conditions in the Great Lakes, and Resilience Planning. Manual information will be shared with communities through regionally targeted workshops via the Wisconsin Coastal Management - Coastal Leadership Academy.

This presentation will describe the Wisconsin Coastal Processes Manual, how it differs from other resources available by being both a technical and hands-on resource, chapter content, and examples of how technical information is broken down and made user friendly through worksheets and case studies/real world examples.

Release of arsenic, nickel, and cobalt from Northeast Wisconsin's confined aquifer sediments under oxic and anoxic conditions

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The northeast Wisconsin Cambrian–Ordovician confined aquifer is an important groundwater resource, but some portions of the aquifer can source metals to groundwater under changing redox conditions. The Cambrian–Ordovician aquifer dips downward from west to east across the region, and previous studies have shown arsenic mobilization near the western recharge zone. The aquifer has also experienced dramatic drawdown and recovery in the potentiometric surface throughout its history. This study is an initial exploration of the metal mobilization risk associated with different geological materials and proximity to portions of the aquifer that have experienced drawdown.

Leaching experiments for four different aquifer materials were conducted under both oxic and anoxic conditions and aqueous metals concentrations were measured over time. In sediments with more sulfides, results show elevated concentrations of nickel, arsenic, and cobalt and limited impacts associated with oxidation. An important exception is elevated arsenic observed under anoxic conditions for one sediment. In sediments with less sulfide, results indicate that nickel and cobalt are more readily mobilized under oxic conditions.

These findings underscore the importance of evaluating regional geological and hydrological heterogeneity when evaluating potential risks to aquifer water quality, and future studies should focus on deeper characterization of sulfides associated with metals release.

Investigating Molybdenum Contamination in Southeastern Wisconsin Groundwater and the Adsorption to Surficial Soil

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Molybdenum (Mo) is a naturally occurring element necessary in trace amounts for human health. While typically found at 1 µg/L or less in groundwater, concentrations above the Wisconsin's Department of Health Advisory Level of 90 µg/L have been detected throughout southeast Wisconsin. When consumed in large quantities, Mo can lead to numerous health problems like liver dysfunction and gout. However, the definitive source(s) of Mo in this region has not been identified and questions have arisen regarding its source. One debated source is from surface applications of coal fly ash. To simulate this, batch sorption experiments were conducted using surficial soils collected from the UW-Parkside campus with varying physical and chemical properties to assess how surface-applied Mo may impact groundwater contamination. Our findings confirm that Mo remains mobile under alkaline conditions but that surficial materials do possess a finite sorption capacity. Groundwater samples obtained from monitoring wells on campus and from residential wells within a 2-mile vicinity are screened in different intervals (namely the underlying unconsolidated sediment or Silurian dolomite), but most wells exhibit high Mo concentrations. This understanding of surficial Mo mobility – in parallel with ongoing solid-phase bedrock cores analyses in the region by Finley et al. – is much needed to advance understanding of the elusive origin and environmental behavior of Mo in southeastern Wisconsin.

Processes Influencing Coldwater Fish Habitat Variability Across Lake States and Types

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Minnesota, Michigan, and Wisconsin combined have tens of thousands of glacially-formed lakes, often adopted as study systems due to significant long-term monitoring programs. Surface-level observations are frequently coherent across proximal lakes, however this is not necessarily reflective of conditions at various depths. Under the lens of coldwater fish habitat availability, full-lake profile observations can be investigated to evaluate mid-lake profile conditions controlled by dissolved oxygen consumed in the hypolimnion and water temperature warmed by the atmosphere (oxythermal habitat). Lakes typically exhibit significant intraseasonal and interannual variability, making it increasingly difficult to simplistically and deterministically characterize the oxythermal state of a lake. We leverage an expansive dataset of lake profiles compiled by members of the Midwest Glacial Lakes Partnership to calculate an oxythermal habitat metric (vertical habitat thickness) across time for hundreds of lakes. Random forest regression models were developed to elicit feature importance and better understand interannual controls on summertime fish habitat across various lake categories (hydrology, productivity, and depth) using season-ahead predictors. This work advances knowledge on how water quality and climate features directly and indirectly influence lake state and fish habitat, providing the potential for skillful predictions and tailored lake and fisheries management strategies.

* Student presentation.

Geochemical Redox Chemistry in a Hydrocarbon-Polluted Aquifer

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Hydrocarbon solvent mixtures that reach the subsurface have the potential to create strongly reducing conditions within an aquifer. These mixtures can be introduced to groundwater resources via leaks and spills from industrial activity. The resulting modifications to the redox chemistry of aquifer environments can result in the reductive dissolution of metal (hydr)oxide coatings, and the subsequent mobilization of geogenic contaminants to groundwater. The objectives of this research are to elucidate biogeochemical processes that control the mobilization and sequestration of iron and manganese oxides and geogenic contaminants that are associated with these oxide surfaces such as arsenic, strontium, and radium. Groundwater samples from an industrial spill site contaminated with halogenated hydrocarbon solvents in eastern Dane County, WI have been analyzed for metals, and laboratory leaching studies have been conducted to investigate contaminant mobilization mechanisms. The preliminary results of this research show a strong correlation between dissolved iron and manganese with elevated concentrations of arsenic, strontium, and radium. Further work will provide valuable guidance to water quality managers on the risks associated with hydrocarbon solvent spills and their effects on the mobilization of geogenic contaminants to groundwater resources, particularly those in the Midwestern Cambrian-Ordovician Aquifer System (MCOAS) in Wisconsin.

Using Groundwater Transport Models to Assess Cleanup Strategies at the Former Badger Army Ammunition Plant

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Past operations and waste disposal at the former Badger Army Ammunition Plant (BAAP) in Sauk County, Wisconsin contaminated soil and groundwater, leading to three contaminant plumes that extend offsite and now pose risks to private wells. To support cleanup, the U.S. Geological Survey developed groundwater transport models to simulate past and future movement of key contaminants: trichloroethylene (TCE) and two dinitrotoluene isomers. Historical models were calibrated to site water-quality data to estimate transport parameters and represent past plume behavior, while future models projected plume extents for 2020–2040 under three remediation scenarios: natural attenuation, low-effectiveness bioremediation, and high-effectiveness bioremediation. Historical model results show continued source loading was needed to match observed concentrations, TCE degradation rates remain low, and the central plume source is uncertain. Scenarios indicate natural attenuation would only offer minimal improvement, low-effectiveness bioremediation would achieve minor gains, and high-effectiveness bioremediation would deliver more substantial benefits. These findings underscore the importance of source loading patterns and biodegradation rates in remediation success. The models offer a framework for evaluating cleanup strategies, improving monitoring, and supporting risk-based groundwater management at BAAP.

* Student presentation.

Trends in Radium Across Groundwater of Wisconsin

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Elevated radium in public drinking water has been a persistent issue across Wisconsin. From 2000-2025, 166 out of >11,000 Wisconsin public water systems recorded a radium measurement above the U.S. Environmental Protection Agency's maximum contaminant level (MCL) of 5 picocuries per liter (pCi/L). Here, we summarize trends in measured radium activities over the last two decades. These records show areas and aquifers at risk for radium water quality issues. Statewide water quality and water treatment data from the DNR's Public Water Drinking System (DWS) were imported into ArcGIS pro to create maps displaying statewide radium activities and exceedances above the MCL for public drinking water systems. Using the treatment data, we separated radium concentrations in treated and untreated samples. Maps illustrate that elevated groundwater radium concentrations form a U-shaped pattern across southern Wisconsin, roughly corresponding with the extent of the Cambrian-Ordovician aquifer system. The density of radium exceedances is highest along a band in eastern Wisconsin, with clusters near Green Bay and Waukesha. However, the affected area is much broader and illustrates the high numbers of relatively small communities at risk for elevated radium.

Influence of regional geology on groundwater discharge to coastal wetlands of Lake Superior

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Groundwater in the Lake Superior Basin is a unique, pristine resource that remains poorly understood. Complex geology and lack of hydrogeologic data lead to uncertainty in aquifer properties, groundwater quality, flow patterns, and interactions with surface waters such as coastal wetlands.

The Wisconsin Geological and Natural History Survey, in partnership with the Department of Natural Resources, is conducting a groundwater study to improve our understanding of groundwater flow in the Lake Superior Basin. We are 1) characterizing groundwater in six coastal wetlands, and 2) developing six hydrogeologic cross-sections that illustrate the geologic materials and groundwater flow from the headwaters to each wetland. Field data collected in summer 2025 include water quality parameters, passive seismic estimates of depth to bedrock, water levels and temperatures in the wetlands, and borehole geophysical logging and hydraulic testing in two new bedrock wells.

This preliminary dataset refines our conceptual hydrogeologic model of the region. Wetlands fed by aquifers with limited storage, such as basalt or clay till, have little evidence of groundwater discharge, whereas

* Student presentation.

wetlands with sandy materials in the groundwater contributing area are often influenced by groundwater. A canoe survey of water-quality parameters within each wetland provides a snapshot that illustrates the mixing of source waters – rivers, groundwater discharge (if present), and Lake Superior.

Geomorphic Habitat Response Units for Urban Stream Rehabilitation, Milwaukee, Wisconsin

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Urban stream rehabilitation plans can benefit from knowledge of the landscape setting and vegetative communities that were adjacent to streams prior to urbanization. Downstream to upstream connections of these characteristics can be relevant for native migratory fish species that have a range of preferred spawning habitats. Based on a need for more quantitative data on these potential connections, the U.S. Geological Survey assembled geomorphic characteristics, surficial geology, and pre-Euro-American settlement vegetation for 333 kilometers of stream segments in the Kinnickinnic River and Menomonee River subbasins of the Milwaukee River, Wisconsin. Channel slopes ranged from less than 0.3 percent to greater than 2 percent, covering at least two channel morphology and bedform types spanning low-energy irregular and pool-riffle complexes. Postglacial surficial geology ranged from coarse-grained outwash sand and gravel to lacustrine silt and clay, allowing for a range of stream substrate sizes. Presettlement riparian vegetation was mainly forest, including forested uplands, forested lowlands, and to a lesser extent, conifer-dominated wetlands in headwaters. The resulting framework of geomorphic habitat response units can be used for planning, designing, and evaluating ongoing and future native fish passage and spawning habitat rehabilitation projects in other urban areas where concrete-lined channels are being replaced with more natural counterparts.

Evaluating water level management tradeoffs for environmental quality, recreation and agriculture on Buffalo Lake

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This study evaluated tradeoffs between environmental quality, recreational use, and agriculture for a proposed water level change on Buffalo Lake, an impoundment of the Fox River in Marquette County. The Buffalo Lake Dam is owned by the State of Wisconsin and operated to maintain winter and summer maximum levels. The Buffalo Lake Management District requested that DNR extend the duration of the summer maximum lake level to improve navigation and obtained a DNR Surface Water Grant to evaluate impacts of the proposed change on flooding, groundwater, wetlands, water temperature, agriculture, and shoreline erosion.

Surface water modeling of flood impacts highlighted the challenges of working with a 30-year-old Flood Insurance Study model. A new HEC-HMS reservoir model determined that impacts on flood levels and downstream flows would be minimal. GFLOW groundwater modeling delineated a zone up to about a mile from the lake in which groundwater is affected by the seasonal dam operation. Analytical aquifer dispersivity calculations determined that groundwater response to lake level change may be rapid enough to affect nearby farms during spring. Comparison of water level modeling with field and desktop wetland data suggests that impacts to wetlands should generally be small and could be positive. The study found that overall changes will be small, with some benefits and some impacts that could be mitigated through collaboration with local stakeholders.

Collecting Year-Round Baseline Data Prior to Implementation of Nanobubble Technology

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Eutrophication, the enrichment of water bodies with nutrients, represents a significant global concern. This process is accelerated by human activities, including agricultural and nonpoint pollution from expanding communities near lakes. While eutrophication occurs naturally over geological timescales, its acceleration has heightened ecological stress. The Tri-Lakes in Adams County, WI, illustrate this issue, having been listed on the WI Department of Natural Resources' impaired waters list since 2014 due to persistent algal blooms. In response, the Tri-Lakes Management District, in collaboration with EOR, is working to deploy nanobubbles units across the three lakes. Nanobubbles have been used in various fields, such as wastewater treatment and hydroponics, to enhance oxygenation. Previous research indicates that nanobubbles may be effective at large scales in mitigating hypoxia-induced oxygen limitation. However, most studies have been limited to laboratories or controlled lake environments. Meanwhile, there is less water quality data from winter periods, and it's known that winter water quality influences nutrient storage/releases that contribute to summer eutrophication. The objectives of this work were to quantify and compare seasonal variations in surface water nutrient concentrations during frozen conditions and the rest of the year and better understand drivers influencing water quality in these lakes.

Statistical Analyses of Arsenic Variability in Wisconsin

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While two-thirds of Wisconsin (WI) residents get their drinking water from groundwater resources, geogenic arsenic (As) has remained a persistent threat to groundwater quality throughout the state, with numerous wells exceeding the Maximum Contaminant Level (10 μg/L) each year. As-release in WI groundwater is argued to be driven by the oxidation of As-rich pyrite, abundantly found in discrete stratigraphy such as the Sulfide Cement Horizon. While the redox-dependent release of As from pyrite and iron-oxides is understood as the main driver of As mobility in the subsurface, the temporal variability of As release over time is still a major question, not only in WI but worldwide. Any temporal shifting between oxic and reducing conditions in an aquifer system can alter the mechanism of release and thus can contribute to spatiotemporal variability of As. Additionally, the natural variability and seasonality of As release may also be perturbed by anthropogenic forcings by groundwater pumping, organic matter spills, and more. Preliminary work has shown wells in WI with trends of increasing As concentration and high variability of As, especially those which vary in regard to Maximum Contaminant Level exceedances. Further statistical analyses, with data from the Groundwater Retrieval Network will identify the main drivers of As concentration variability and long-term trends in an attempt to predict future exposure of well-owners to As impacted groundwater both locally and state wide.

* Student presentation.

Wisconsin Geological and Natural History Survey's Borehole Geophysics Program

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The Wisconsin Geological and Natural History Survey (WGNHS) has been collecting borehole geophysics data since 1953 across all of Wisconsin. We are continuing that data collection still today. These logs are readily acquired and are used by the WGNHS, federal and state agencies, researchers, consultants, counties, and anyone else needing insight into the geology and groundwater flow systems of Wisconsin.
We collect a broad suite of logs using a variety of tools. For geologic and well bore characterization, we use total and spectral gamma, normal resistivity, caliper, and optical and acoustic borehole imaging. We characterize the borehole fluids using fluid temperature and conductivity. We also collect flow logs that show how fluids are moving in the boring during static and pumping conditions. In our collection we have 910 logs with the greatest depth logged by us of 2266 feet. New tools such as borehole magnetic resonance imaging are being evaluated.

The three logs in this presentation illustrate the utility of borehole geophysics and flow logging across the range of geology in Wisconsin. These examples are from Pittsville (crystalline), Pulaski (dolomite), and Verona (sandstone). They all include basic borehole geophysics and how it ties in with the associated flow logs to provide a deeper understanding of Wisconsin's groundwater resource. These three logs exemplify the WGNHS's continued objective to expand our ability to collect and distribute these basic data.

Natural Solutes and Signals for Characterizing Advection and Dispersion during Tracer Tests

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Traditional tracer tests that commonly utilize added non-reactive solutes to characterize advection and dispersion often incur considerable costs. However, field measurements of natural solutes such as chloride and natural signals such as conductance may be accurate proxies for traditional tracers at a fraction of the time and costs. The objective of this study was to evaluate the efficacy of natural chloride, conductance, and temperature as proxies, and to compare the relative costs of these proxies to traditional tracers. It was hypothesized that the natural solutes and signals would serve as accurate proxies for traditional tracers. A series of eight single-well injection-drift tests were performed, involving the injection of tracer-amended solutions into a well and subsequent monitoring of solute transport. Data was analyzed for breakthrough curve separation, residuals, errors, and strengths with respect to the traditional added halide tracer. The natural solutes and signals showed relative errors that increased as their signal strengths decreased. An inverse power-law relationship was observed between relative error and signal strength. The significance of this research is in its demonstration that natural solutes and signals can provide a reliable proxy for advective-

[*] Student presentation.

dispersive transport, when the signal strength is large. The cost analysis revealed a financial advantage using natural solutes and signals as proxies when ten or more tests are conducted.

Integrating Machine Learning for Improved Seasonal Forecasting of Coldwater Fish Habitat Stress

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Freshwater lakes in the Upper Midwest are warming earlier and staying warmer longer, threatening coldwater fish like cisco due to prolonged periods of low oxygen and elevated temperature (oxythermal stress). Managers need reliable seasonal forecasts of this stress, but traditional linear models fail to capture the nonlinear climate–lake interactions driving habitat loss. This study assesses whether machine learning (ML) models can enhance seasonal forecasting of Cumulative Viable Habitat Thickness (CVHT). Using 42 years of climate teleconnections and spring data, Random Forest and XGBoost were compared against the standard Principal Component Regression (PCR). Across five Wisconsin lakes, XGBoost significantly enhanced predictive accuracy, nearly tripling the baseline skill in Big Muskee Lake (R^2 increased from 0.28 to 0.68). ML also improved probabilistic forecasting, with XGBoost achieving an RPSS of 0.77 for categorizing habitat years. These findings confirm that nonlinear climate controls on oxythermal stress are more effectively captured by ML. Results support developing an operational seasonal decision tool, helping fisheries biologists anticipate habitat compression and plan adaptive responses to climate-driven stress on coldwater fish communities.

Assessing the feasibility of handheld spectral gamma measurements on well cuttings for radionuclide detection and radium quantification

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Elevated radium (Ra) in the Midwestern Cambrian–Ordovician aquifer system presents risks to drinking water quality. Since Ra is sourced from uranium (U) and thorium (Th) in aquifer materials, reliable methods for quantifying these radionuclides are necessary. This study evaluates if handheld spectral gamma measurements on well cuttings can serve as a practical alternative to borehole logging for estimating radionuclide concentrations. Time-calibration measurements conducted on representative samples of well cuttings from a rotosonically drilled well in western Wisconsin allow assessment of how measurement duration and sample quantity affects the stability of K, U, and Th concentration measurements. Laboratory spectral gamma measurements show substantial variation in mean values and standard deviations across different measurement times, with inconsistent stabilization at longer counting times. Comparisons with the borehole log reveal large differences in both magnitude and depth trends for K, U, and Th. Preliminary results suggest that spectral gamma measurements on well cuttings may not reliably reproduce downhole radiometric signatures or provide consistent radionuclide concentrations. Consequently, spectral gamma analysis of well cuttings may have limited utility for screening for elevated radium risk in drinking water wells.

* Student presentation.

Analyzing PRISM Winter Precipitation Data in Central Wisconsin

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The amount, timing, and type of precipitation over the course of a year is the primary driver of hydrologic activity in a watershed. While most of the United States receives rain as the primary form of precipitation, high elevations and Northern latitudes receive significant portions of their precipitation as snow. In these regions, quantifying winter precipitation is crucial to understanding the hydrology of a given region. While the snow depth is certainly a valuable statistic, the fraction of snow that is made up of water is more valuable for hydrologic investigations. The snow-water equivalent (SWE) is the melted rainwater equivalent of a given snowfall and is the quantity of water that enters the watershed with spring snowmelt. The varied conditions in which snow forms, along with the impact of wind, create added complexity capturing the true quantity of water that falls, leading to difficulty quantifying winter precipitation using traditional weather stations.

This project investigated the accuracy of PRISM (Parameter-elevation Regressions on Independent Slopes Model) precipitation data over the winter months by comparing PRISM to SWE measurements at four locations in Central Wisconsin. New snowfall, along with total snowfall, was sampled by measuring the dimensions and weight of a snow core. These dimensions were then used to measure SWE and snow density. Ultimately, the goal is to determine in what applications PRISM can be relied on to measure winter precipitation.

PFAS Transport in Agricultural Soils in Central Sands, Wisconsin

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Per-and polyfluoroalkyl substances (PFAS) are often found in agricultural soils due to land application of biosolids and atmospheric deposition. However, PFAS transport in variably-saturated agricultural soils remains poorly studied. This study evaluates PFAS mobility using a combination of soil column experiments and numerical modeling. Laboratory experiments include intact and homogenized soil columns cored from agricultural soils in the Central Sands region of Wisconsin. All columns were amended with a biosolid (Milorganite) and half of the columns received a powdered dolomite amendment at the surface. Several PFAS compounds with a range of different chain lengths were also applied at the surface of each. Columns were then subjected to episodic infiltration based on historical precipitation data, and the leachate was collected at the base of the column for PFAS analysis. Preliminary results indicate limited reduction in PFAS leaching associated with dolomite amendments, though additional sample analysis is ongoing. HYDRUS-1D modeling simulations are used to understand PFAS transport under two contrasting scenarios: clean precipitation through PFAS-contaminated soils, and PFAS-contaminated precipitation through clean soils. The modeling scenarios analyze the influence of organic carbon content on PFAS, compound-specific, sorption (Kd) behavior. Results are intended to improve understanding of PFAS transport in agricultural soils and inform land application practices.

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WAV Sampling Data Analysis of the Pike River

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Water quality is a concern in rivers. Improper levels of river dynamics can negatively impact plant and wildlife health, rendering the monitoring of these to be important. Our sampling took place in the Pike River at the USGS monitoring shed (# 04087257) and just south of where the Pike River crosses Highway A in Kenosha, Wisconsin (53144).
Within rivers, it is important to regularly test dissolved oxygen, temperature, turbidity, pH, streamflow velocity, nitrates, phosphates, and the biotic index because these dynamics tell us the health of a river as it applies to climate change and pollution. Because of this, a partnership between the University of Wisconsin-Madison and the Wisconsin Department of Natural Resources created a volunteer program to preserve, protect, and restore Wisconsin's streams and rivers called Water Action Volunteers (WAV) to make the study of these dynamics possible across the state.
Our sampling was done in association with WAV through the University of Wisconsin-Parkside in our GEOS 445: Environmental Sampling, Monitoring, and Assessment course. From this data, we were able to make inferences about the overall health of the river while also contributing information to an ongoing citizen-science project.

Baseflow Sampling as Proxy for Groundwater Quality Suitability Map of Wisconsin

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Groundwater quality monitoring is of vital importance to the state of Wisconsin, yet the construction, maintenance, and sampling of wells can be costly. Sampling of streams during baseflow, which constitutes sustained low flow via groundwater discharge, may serve as a proxy for groundwater quality monitoring. However, anthropogenic factors that affect the water table, runoff, and direct discharge to surface water streams can mischaracterize true baseflow contribution to streamflow. The goal of this study was to assess the suitability of baseflow sampling as a proxy for groundwater quality within the existing statewide streams database. A weighted overlay analysis was conducted using publicly available data for the state of Wisconsin that considered land use, impervious surface coverage, wastewater treatment plant effluent discharge locations, surficial pumping wells, aquifer boundaries, and soil characteristics. Cross validation of suitable sites with existing USGS gaging stations that collect continuous water quality metrics may shed new light on historical groundwater quality conditions and provide future long-term monitoring. This novel framework is intended to be scaled to the county level, where higher resolution spatial data, including addition of tile drainage networks, and seasonal meteorological data will provide more precise boundaries of suitable baseflow sampling locations.

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PFAS Risk Communication: A Needs Assessment of Public Health Communicators

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PFAS (per- and polyfluoroalkyl substances), often called "forever chemicals," are synthetic compounds widely used in products such as firefighting foams, non-stick cookware, food packaging, and personal care items. As detection methods improve, PFAS have emerged as a significant public health concern. This study examines how public health communicators address PFAS in drinking water and what barriers they face in rural areas – where residents often rely on private wells. Preliminary findings reveal major challenges, such as limited accessible information for non-scientific audiences, lack of local testing and data, uncertainty about responsibility and remediation strategies, and high testing costs. These barriers often compound with resource constraints, particularly in counties without dedicated environmental health departments. This research highlights the need for clearer communication tools and affordable testing options to support effective PFAS outreach in rural communities. University of Wisconsin-Madison Division of Extension and Wisconsin Sea Grant will integrate these findings into tools for local health professionals. This research was done in fulfillment of the requirements for Honors in the Major in Life Sciences Communication at the University of Wisconsin-Madison College of Agricultural and Life Sciences.

Spatial and temporal phytoplankton dynamics along the Lake Winnebago-Fox River-Green Bay continuum

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Lower Green Bay is a Great Lakes Area of Concern (AOC) with a history of eutrophication and toxin-producing cyanobacteria blooms. Lake Winnebago, the largest lake in Wisconsin located approximately 40 miles upriver of Green Bay, drains into the lower Fox River and also suffers from eutrophication and harmful phytoplankton blooms. It is unclear if bloom dynamics within the lake influence or seed blooms in the Fox River or Green Bay. To determine the potential of the Fox River to transport blooms from Lake Winnebago to Green Bay, the U.S. Geological Survey established a network of sites along the Lake-River-Bay continuum and collected monthly samples over one year. The phytoplankton community composition, other indices of primary producers (e.g., chlorophyll), and potential drivers (e.g., nutrients) were compared spatially and temporally. As expected, cyanobacteria were consistently a significant portion of the phytoplankton community. However, noticeable differences in the cyanobacteria community were evident among sites and these differences were most pronounced during warmer, low-flow periods. Collectively, these results suggest Lake Winnebago may contribute directly or indirectly to phytoplankton dynamics in Green Bay, but notable community differences between the lake and bay indicate that local factors also play an important role, potentially warranting management efforts beyond Lake Winnebago to remove the AOC's beneficial use impairment.

* Student presentation.

Quantifying effects of peatland restoration on groundwater storage regimes and hydrologic exchanges

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The wetlands in Necedah National Wildlife Refuge formed thousands of years ago as glaciers receded, providing invaluable ecosystem services. The area was ditched in the early 1900s to control the water and develop the rich, organic soil into farmland. This “drainage dream” era did not last long without healthy wetlands to protect from fires and floods, but the disturbance severed connections between aquifers, surface water, and floodplains. Recently, the U.S. Fish and Wildlife Service began plugging ditches to direct water back into natural channels. To support long-term management of restored peatlands, we began research to document soil properties and monitor hydrologic exchanges.

Fieldwork in the summer and fall of 2025 involved the installation of piezometers with pressure transducers at transects in unrestored, restored, and to-be-restored sites. Hydraulic conductivity testing will be performed on cores collected in the central peat pots and surrounding sand ridges. A combination of core data and quantified surface and groundwater fluxes will inform conclusions about restoration impact on hyporheic exchange regimes and floodplain characteristics. Enhanced surface and subsurface hydrologic connections provide flood mitigation, fire protection, carbon sequestration, and nutrient regulation benefits as peatlands partially regain water storage capacity. We will highlight the experimental design of the project, present our hypotheses, and illustrate preliminary data.

Lessons from the past: Leveraging museum specimens to advance freshwater biomonitoring

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Biomonitoring is used to complement other measures of water quality because the distribution of biological organisms can predicably shift in response to environmental change. The work of William Hilsenhoff was fundamental to the application of benthic macroinvertebrates for biomonitoring. The Hilsenhoff collection and other reference material continues to provide a vital resource for future biomonitoring innovation, but its data remain largely inaccessible. Fundamentally, the accurate interpretation of biomonitoring data requires updated taxonomic information so changes in assemblages can be appropriately linked to environmental perturbations. Furthermore, shifts in occurrence patterns may reflect fluctuations in geographical distributions indicative of larger scale change or management actions. Therefore, we aim to 1) harmonize taxonomic data for sensitive invertebrate taxa and 2) document changes in occurrence by comparing records available from partner institutions and publicly available data. These activities will support the accurate calculation of metrics for regulatory and community science monitoring efforts while also identifying locations for contemporary sampling needed for evaluating long-term trends. In addition, the digital records of specimens generated from across the state will, like the Hilsenhoff collection itself, become an on-going and growing asset for regulatory professionals, members of the public involved in community science, and other researchers.

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Hydroclimatic Influence on Groundwater Nitrate Variability in Western Wisconsin

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Wisconsin relies extensively on groundwater for agricultural and private use, which can increase vulnerability to contamination risks under increasing climatic precipitation and recharge conditions. Nitrate (NO3-), a highly soluble and persistent anion derived from manure and fertilizer inputs, is concerning due to its rapid transport throughout the vadose zone and its associated human health risks, including methemoglobinemia in infants.

In collaboration with a regional farmer-led watershed council, nearly one hundred private wells with various use cases have been tested across Western Wisconsin since 2018 to assess nitrate dynamics at both seasonal and interannual scales. Over this period, the region has experienced the wettest precipitation year followed by three consecutive drought years, allowing for a regional assessment of climate-driven variance in groundwater quality. Nitrate concentrations at each site were analyzed in relation to hydrologic parameters including monthly precipitation intensity to assess how climatic extremes can affect contaminant fluxes. Wells in the area draw from either sandstone or dolostone aquifers, which allows for a comparison of differing geologic systems. Most wells have shown relatively stable nitrate concentrations, while others show monthly variance that correlate with precipitation data.

Final analysis will be reported back to the watershed council to support land management strategies to reduce nitrate loading in groundwater.

Finding a Standard Secchi Disk for Great Lakes

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The secchi disk is one of the earliest scientific instruments ever developed in the modern fields of limnology and oceanography. Due to its simplicity and extensive historical data available for comparison, the secchi disk continues to be a popular measurement of water quality today. It is generally accepted that a 20cm black-and-white disk is used in freshwater lakes and a 30cm white disk is used in oceans. However for Great Lakes and other inland seas, the type of secchi disk varies among users between the two types above and a unique 30cm black-and-white variety which captures the freshwater nature of the black-and-white pattern as well as the increased size needed when used in the deep, clear water of oceans and seas.

The Milwaukee Metropolitan Sewerage District is a regional government commission which manages wastewater, flood control and water quality in the greater Milwaukee area of southeastern Wisconsin. The District's Freshwater Resources Monitoring program has studied and collected data on the surface waters of southeastern Wisconsin for 50 years. It has used a 20cm black-and-white secchi disk in the past, but in 2025 a

* Student presentation.

pilot study began to compare this disk design with a 30cm black-and-white design. Study design and preliminary results are shared here in hopes of approaching a standard secchi disk design for Great Lakes and inland seas.

Estimating Groundwater Recharge and Evapotranspiration using the Water Table Fluctuation Method

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Estimating evapotranspiration for an ecosystem's water budget can be particularly challenging. In an unconfined aquifer, plants with roots that interact with the water table are able to extract groundwater and transpire it to the atmosphere. The Water-Table Fluctuation (WTF) Method was developed and applied frequently for groundwater recharge and others have used this method to calculate evapotranspiration (ET). Assuming the changes in water table elevation are plant mediated transpiration, measured changes in the water level in combination with the specific yield can be used to understand plant interactions with shallow groundwater and estimate ET resulting from phreatophytes.

Previously, shallow wells screened across the water table were installed on Isherwood Farms in Portage County, WI, USA. The area is a mixed agricultural, coniferous, deciduous, and shrub forested area with groundwater in close proximity to the land surface. Wells were instrumented with Solinst 3001 LTF15 level loggers and water levels were monitored on a 30-minute interval. Measurements were adjusted to account for barometric pressure. The WTF method was then applied to the data in order to quantify evapotranspiration variability within a growing season as well as between growing seasons and vegetation types. Water level information was compared to weather data to validate recharge and ET estimates, allowing for a better understanding of recharge and ET dynamics in shallow groundwater environments.

Shifting trends in streamflow and stream temperature across Great Lakes tributaries

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The Laurentian Great Lakes are the largest surface freshwater system in the world and are vulnerable to the intensifying hydrologic cycle. Across much of the basin, rising air temperatures are contributing to earlier snowmelt, increased precipitation intensity, and more precipitation falling as rain rather than snow. This hydrologic intensification, coupled with increasing stream temperatures, can lead to disruptions in critical fish life cycle stages, more severe harmful algal blooms, and more frequent flash floods and droughts. Despite these concerns, changes in flow regimes and their co-occurrence with ecologically important stream temperatures remain relatively understudied in Great Lakes tributaries. To address this knowledge gap, we analyzed spatial and temporal trends in streamflow timing, magnitude, and variability, plus stream temperature metrics using publicly available daily streamflow and stream temperature data from USGS gages across the US portion of the Great Lakes basin. We found that trends have shifted in several signatures, including but not limited to mean and maximum stream temperature, streamflow variability, and the

* Student presentation.

magnitude and timing of 7-day low streamflows, but the magnitude of changes varied geographically. Understanding these historical changes and identifying the most vulnerable tributaries can help pinpoint key drivers and enable natural resource managers to plan adaptation strategies.

Prevalence of antimicrobial resistance in contaminated private drinking wells in Wisconsin.

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Martin Collins, Wisconsin State Laboratory of Hygiene

Private drinking water wells supply water to over one million Wisconsin residents, yet unlike public water systems, they are not subject to routine microbial or antimicrobial resistance (AMR) monitoring. Agricultural land use and vulnerable hydrogeologic settings may facilitate the introduction of antimicrobial resistant bacteria (ARB) and antimicrobial resistance genes (ARGs) into groundwater used for drinking. While indicator organisms such as E. coli are routinely used to assess fecal contamination in private wells, these tests provide no information on resistance profiles or pathogenic potential. This study evaluates private drinking water wells as potential environmental reservoirs of clinically relevant antimicrobial resistance in Wisconsin. Archived bacterial isolates recovered from contaminated private wells will be screened for selected resistance determinants commonly reported in agricultural and environmental systems. A subset of isolates will undergo whole genome sequencing to characterize resistance genes, mobile genetic elements, and genomic features associated with environmental persistence and dissemination. Results will improve understanding of private drinking water as a potential exposure pathway for antimicrobial resistance and inform future risk assessment, monitoring strategies, and water resource protection efforts in agricultural regions.

Characterizing PFAS Contamination in Stormwater Outfalls, Milwaukee County, WI

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The frequency and spatial variability of per- and polyfluoroalkyl substances (PFAS) in stormwater outfalls remain poorly understood, even though they have become persistent contaminants of concern in urban environments. This study investigates PFAS distribution in stormwater discharges across Milwaukee County, Wisconsin, encompassing a range of land-use types. Stormwater samples from several outfalls were collected in both dry (baseflow) and wet (rainfall) conditions, and they were examined for 40 different types of PFAS compounds. Most samples had detectable PFAS concentrations with significant variation across land uses and hydrologic conditions. The results show that PFAS mass loads were frequently higher in wet-weather samples than in dry-weather samples, indicating increased mobilization during runoff events. Moreover, perfluoro butanoic acid, or PFBA, was the most common and predominant compound found at most sampling sites, ranging from 6.5 ng/L to 297 ng/L, frequently surpassing the levels of legacy PFAS, such as PFOS and PFOA. The observed temporal and spatial variability highlights how local infrastructure, storm dynamics, and land-use characteristics affect the pathways by which PFAS are transported. These findings contribute to our understanding of the presence of PFAS in urban stormwater and provide crucial information for future management of PFAS-contaminated runoff in urban drainage systems and the development of effective mitigation strategies.

* Student presentation.

Extreme Variation in Chemical and Isotopic Signatures of Waters Along the Niagara Escarpment in Wisconsin

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The Niagara Escarpment in Wisconsin represents a complex hydrogeologic boundary where waters from multiple sources interact across contrasting geologic material. This study characterizes the chemical and isotopic variability of waters associated with the Escarpment to better distinguish sources while exploring the potential use of these constituents as environmental tracers. Samples were collected from deep confined aquifers, unconfined aquifers (Pleistocene and Silurian), and surface waters along and downstream from the Escarpment. Major ions, trace metals, and stable O&H isotopes were used to characterize the waters. Results reveal extreme variation in both chemical and isotopic compositions across relatively short spatial scales. Confined aquifer waters displayed elevated Li (12.4-41.1 ppb), Sr (2.8-11.8ppb), and B (115.6-212.7 ppb), while major ion concentrations for Cl (7.3-121.8 ppm), NO3 (BDL), and SO4 (34.3-143.2 ppm) were lower than some surface water samples. Surface waters exhibited a broad range of chemical and isotopic values for Li (0-48.3 ppb), Sr (0.1-10.5 ppb), B (6.2-335.7 ppb), Cl (11.5-358.8 ppm), NO3 (0-76.9 ppm), SO4 (4.4-516.0 ppm), and O&H isotopes. Several streams showed elevated dissolved solids, comparable to nearby confined aquifer waters, reflecting groundwater extraction for municipal supply followed by discharge from wastewater treatment facilities back into surface waters.

Assessing Soil Health to Reduce Agricultural Impacts on Lake Michigan

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The local waterways in Racine and Kenosha, Wisconsin, are frequently at risk of polluting Lake Michigan due to agricultural runoff like fertilizers. This can lead to an excess amount of nutrients within the waterways and promote eutrophication. This is crucial to control, as algae blooms can be detrimental to native aquatic wildlife and pose a risk to the safety of the drinking water that Lake Michigan provides to surrounding communities.

Students at the University of Wisconsin-Parkside collaborated with the Eco-Justice Center in Racine, Wisconsin, to monitor the pH, nitrate, and carbon levels in the soil. Eco-Justice is a non-profit environmental education center and organic farm. Alex Weyenberg, the Land Stewardship Manager, mentioned his concern with the health of the soil and compost applications on the farm. By monitoring these parameters, the overapplication of nutrients to the soil, which could lead to agricultural runoff, is prevented. Soil samples from four areas were analyzed in the SC Johnson lab at UW-Parkside. Results indicate neutral soil pH, generally low but variable nitrate levels, and carbon levels within expected ranges. These results will help Eco-Justice maintain appropriate compost application rates and reduce the risk of agricultural runoff.

* Student presentation.

In-situ optical sensors for estimating general and human-specific fecal bacteria in Milwaukee streams

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Pathogens and bacteria are common causes of impaired waters and illness in recreators. Sampling for bacteria characterizes contamination and informs illness risks, but it is restricted to discrete events with delayed results. In-situ sensors relying on optical properties of water offer continuous data to estimate bacteria levels, but accuracy and transferability of models must be understood to inform application. For two years (2022 – 2024) at four stream sites in Milwaukee, we measured water temperature, tryptophan-like fluorescence (TLF), fluorescent dissolved organic matter (fDOM), and turbidity. Samples (n = 674) were analyzed for general (*E. coli*, fecal coliforms) and human-specific (Bacteroides, Lachnospiraceae) bacteria. Bacteria concentrations were modeled from sensor data for each site; parameters were selected based on model accuracy and parsimony. General and human-specific bacteria were detected in >97% and >80% samples per site, respectively. Models correctly predicted 54 – 68% of observed exceedances of the E. coli national criteria. Compared to turbidity alone, TLF and fDOM improved model accuracy—modestly in some cases but markedly for general bacteria at some sites. Site-specific models improved estimates of general bacteria compared to site-generalized models, whereas human bacteria models were less sensitive to site, which may facilitate transferability. Use of optical sensors depends on the bacteria target and site-specific calibration.

Mapping and Analysis of Arsenic and Associated Metals in Wisconsin Groundwater

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Dave Johnson, WDNR

Arsenic in groundwater has received attention due to its serious public health effects. The Wisconsin Department of Natural Resources (WDNR) has implemented policies to mitigate arsenic risk and currently recognizes five regions with elevated arsenic. While arsenic distribution is known to vary across Wisconsin, no comprehensive map has been constructed using all available arsenic data. We present a new statewide arsenic map constructed in ArcGIS Pro using 109,858 groundwater samples. This analysis shows that arsenic is heterogeneously distributed across the state due to differences in bedrock geology, sulfide mineral distribution, and redox conditions. We recognize seven regions with anomalous arsenic concentrations. Mapping of nickel and cobalt shows similar spatial relationships in some regions. The research includes the first analysis of dissolved arsenic in Florence County, where wells completed in Precambrian bedrock show a higher median concentration and exceedance percentage than wells in glacial sediments. In Winnebago and Outagamie counties, the highest arsenic concentrations occur along the recharge area near the Ancell-Prairie du Chien contact. A temporal analysis of wells in these two counties demonstrates that WDNR special well casing requirements have been effective at reducing arsenic concentrations. This study presents a new tool for assessing arsenic distributions in Wisconsin groundwater that will be valuable for decision-making and future research.

Baseline water quality and flow conditions near the Bend Copper-Gold Deposit, Taylor County, WI

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The WGNHS, with support from the U.S. Forest Service, is monitoring water chemistry and levels and assessing groundwater interactions along the North Fork of the Yellow River in Taylor County. The work addresses a need for hydrogeological characterization near the Bend Copper-Gold Deposit where Canadian mining company GreenLight Metals drilled six exploration boreholes in 2025 and plans to drill up to 20 additional drillholes in 2026. If a mine were ever proposed or developed, or if there were other changes to land use in the area, these data would serve as a reference for management of water resources.

Monitoring includes records of water levels and temperature at surface water stations and wells screened in glacial sediments, seasonal sampling of groundwater and surface water for chemical analysis, measurements of hydraulic gradients at mini-piezometers, and canoe surveys of the North and South Fork of the Yellow River. The USGS also manages a staff gage on the river. Baseline data indicate that water quality is very good. Concentrations of ions in surface waters and groundwater are stable and low or at background levels. Surface waters are more dilute than groundwater. Monitoring of water levels indicates that shallow groundwater at the site flows from the southeast towards the north and west, and towards the North Fork of the Yellow River. The October 2023 canoe survey of the river shows that pH and specific conductance increase downstream, indicating gaining conditions.

Sentinel Flood Networks: Cost-Effective Urban Monitoring Systems to Alert Communities of Pluvial Flash Floods

Sean Thiboldeaux, US Geological Survey (USGS), sthiboldeaux@usgs.gov

Flash flooding driven by intense precipitation can rapidly overwhelm urban stormwater infrastructure. These events often occur on highly localized scales and with little advance notice. In response, cities nationwide are seeking innovative, cost-effective strategies to deliver timely warnings and mitigate community impacts, while simultaneously investing in long-term infrastructure improvements.

Localized hydrologic monitoring can help mitigate the risks posed by pluvial flash flooding, yet conventional systems are often prohibitively expensive at the scale required for actionable data. Emerging technologies such as Internet of Things (IoT) devices—offering lightweight telemetry, extended battery life, and compact footprints—are well-suited for urban monitoring. When integrated with cloud computing platforms capable of processing large volumes of real-time data, these devices provide cities with a cost-effective alternative to traditional systems, enabling timely insights and improved resilience.

As part of the Next Generation Water Observing System (NGWOS) program, the U.S. Geological Survey has built a pilot network in Madison, WI to test the feasibility of these systems and provide a template for other communities across the country. This presentation will highlight important aspects of IoT devices, their use in flood detection networks, and integration into web applications, dashboards and real-time alert messaging systems.

Monitoring Streambank Erosion Rates and Impacts on Water Quality on the Pike River, Southeast Wisconsin

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Streambank erosion can negatively impact surface water quality in rivers and streams. Hawthorn Hollow Nature Sanctuary and Arboretum is a nonprofit environmental organization in Kenosha County that connects the community to nature through educational programs. Our research was conducted as part of a Community-Based Learning project with the University of Wisconsin-Parkside.

The South Branch of the Pike River runs through Hawthorn Hollow. Historically, much of the Pike River watershed has been characterized as impaired due to the presence of various pollutants (Root-Pike Basin | Wisconsin DNR, 2020). The goal of this work was to identify areas of active erosion along a 25.7 foot section of streambank on the Pike River. Weekly measurements of bank erosion rates from 40 erosion pins, turbidity levels, weather conditions, and temperature were collected. These parameters provide insight into the physical processes of the banks along the Pike River. Based on the results, erosion was evident in many areas of the site with a correlation to inclement weather events, such as rainfall and snowmelt.
Continued monitoring is recommended along with preventive measures such as planting native vegetation. As a nature sanctuary, monitoring water quality and erosion is critical to protecting the site and ensuring the health of Lake Michigan.

Quantifying Leachable Phosphorus from Leaves of Three Tree Species

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Anita Thompson, University of Wisconsin-Madison
Bill Selbig, United States Geological Survey

Stormwater runoff leaches phosphorus (P) from fallen tree leaves on impervious surfaces in urban areas, polluting waterways via eutrophication. Our previous research has shown that between 15 and 100% of total leaf P can be leached from leaves in a 48-hour period. The goal of this study is to quantify the amount of P (mgP/g leaf) that can be leached from three different tree species: Crab Apple, Freeman Maple, and White Ash. Leaves are leached in water for 48 hours and samples are collected at six intervals for analyzing Dissolved Reactive and Total Kjeldahl Phosphorus (DRP and TKP). TKP samples undergo sulfuric acid tube digestion, and DRP and TKP samples are analyzed on an EASYCHEM 200 Discrete Analyzer. Assuming a first-order rate process for P release, the P leaching data will be fit to a generalized negative exponential equation. Then, ANOVA and post-hoc Tukey tests will be performed in R to determine significance between species. Results will inform the maximum amount of P that can be leached from the leaves and the rates at which P is released. Results will also aid municipalities and urban foresters when making decisions on which trees to plant and how frequently to collect fallen leaves to improve water quality. Finally, results will be used to build the inventory of trees with available P concentration data in the i-Tree Canopy Stormwater Calculator, a free tool to simulate how trees, leaves, and their management affect annual stormwater runoff pollutant loads.

* Student presentation.

Beyond PFAS: A Broader Look at Contaminants of Emerging Concern in Wisconsin Groundwater

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Carla Romano, Wisconsin Department of Natural Resources

Public and regulatory attention on emerging contaminants has largely centered on PFAS, yet a broader suite of emerging contaminants poses challenges for Wisconsin groundwater. This poster presents a more holistic framework with emphasis on "contaminants of emerging concern," defined not only as newly detected chemicals, but also as substances with emerging human or ecological health concerns, increasing environmental occurrence, or rising public and regulatory attention. Building on this definition, we outline key criteria used to identify contaminants of emerging concern and present a priority list relevant to Wisconsin groundwater. For each prioritized contaminant, we provide brief summaries describing why it is of concern, its major sources, associated monitoring and management challenges, anticipated implications for water supply management, and key research questions. While PFAS remain a central concern, other priority contaminants—such as neonicotinoids, manganese, microplastics, lithium, and pharmaceuticals—pose additional challenges for groundwater management. This presentation aims to broaden the conversation beyond PFAS and highlight the range of contaminants that the water community, including policy-makers and researchers, should be prepared to address.

Wisconsin Coastal Leadership Academy: Building Local Capacity for Coastal Resilience

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The Wisconsin Coastal Leadership Academy is a workshop being developed to help local governments build their capacity to address Great Lakes coastal hazards. Wisconsin's Great Lakes coastal communities face mounting risks from flooding, erosion, storms, and fluctuating lake levels. Despite the wealth of data and resources available, many local leaders report feeling overwhelmed and lacking the capacity to identify and implement effective resilience strategies. In response, the Wisconsin Coastal Management Program (WCMP) and the University of Wisconsin Sea Grant Institute (WISG) are partnering to pilot a Wisconsin Great Lakes Coastal Leadership Academy (CLA). Modeled after Michigan's successful CLA framework, this initiative will develop and deliver a targeted coastal hazards and adaptation strategies curriculum, tailored to the needs of Wisconsin communities. Through an in-person pilot workshop, local officials, planners, and decision-makers will gain a foundational understanding of coastal processes, risk assessment, and adaptation strategies, using place-based examples. This presentation will describe the CLA's development, curriculum content, workshop structure, highlight how the program addresses expressed local needs, supports long term resilience planning, and offer opportunities for feedback and input.

Behavior and drivers of event-scale runoff and nutrient export from Wisconsin agricultural fields

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Margaret Phillips, Soil and Environmental Sciences Department, UW-Madison

Rain and snowmelt events drive nutrient export from farm fields. As the water cycle intensifies, agricultural areas of the Midwest are expected to see increased precipitation and a shift from snow to rain. There is a need to better understand the relationship between precipitation events and runoff behavior from a range of farm fields. To address this need, we synthesized 162 field-years of event-scale runoff and surface nutrient export data from 34 farm fields monitored by the Wisconsin Discovery Farms Program from 2004-2023. We delineated 16,213 individual precipitation events, for which 14% (2,261) generated observable runoff. Less than half of runoff events (41.2%) occurred during periods with frozen soil, but contributed to on average 60.5% of total annual discharge. In addition, over half of annual total nitrogen and soluble reactive phosphorus were exported during events with frozen soil conditions. A random forest model identified landscape features and agricultural practices as important predictors of runoff generation across the study fields. Together, this work can help tease apart hydroclimatic and biophysical factors that drive runoff behavior, which can help farmers tailor land management decisions in response to changing precipitation and runoff.

Friday April 10, 2026

Concurrent Sessions

Session 3A: Climate and Water Resources

Season-Ahead Statistical Forecasts of Wisconsin Winter Heating Degree Days

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Long, cold winters are one of the defining characteristics of Wisconsin climate, however, there is considerable year to year variability and long-term trends in wintertime characteristics. Heating Degree Days (HDD) is a metric quantifying how many degrees the daily average temperature falls below 65°F. HDD accumulation is defined as the sum of all HDDs across December, January, and February. In addition to offering insights on winter temperature, HDD accumulation also shows significant correlations with mean annual snow depth, total annual snowfall, accumulated winter season severity index (AWSSI), and winter and annual residential natural gas consumption. This study examines the predictability of HDD accumulation across Wisconsin using a machine learning model conditioned on local and large-scale hydroclimatic predictors at a 1-month lead time to generate probabilistic tercile forecasts. Results indicate skillful tercile prediction of below average, average, and above average conditions for both station and statewide data compared to climatology. These predictions may provide useful information for emergency managers, hazard planners, and resource managers to take proactive preparedness measures prior to the winter season.

A national stream temperature model and how it can be applied in Wisconsin

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Jeremy Dias, U.S. Geological Survey
Galen Gorski, U.S. Geological Survey
Janet Barclay, U.S. Geological Survey
Lauren Koenig, U.S. Geological Survey

Water temperature plays an important role in the function of streams, as it can limit fish habitat and controls a wide range of physical and biological processes. The USGS published a stream temperature model to contribute to assessments of water availability across the United States. The model was built using 10M observations and predicts daily historical stream temperature (1980-2021) across 58k stream segments. To leverage hydrologic connectivity and thus spatial autocorrelation along the stream network, we used a large-scale graph neural network. Across CONUS, the model performed well, with mean site-level RMSE <2°C. However, there was higher error at sites where stream temperature is decoupled from air temperature (below dams, sites with large groundwater inputs). Tradeoffs between spatial extent and spatial resolution may limit the ability of a national model to resolve local heterogeneity in stream temperature that is relevant to state-specific water resource questions. In this presentation, we will demonstrate how researchers can access and use these stream temperature predictions and explore how relevant these predictions are for use in Wisconsin. For example, we'll explore how the model characterizes features of the thermal regime that are relevant to native fish, whether the model can distinguish stream reaches in Wisconsin with large groundwater signatures, and how well the magnitude and direction of stream temperature trends can be recreated across the state.

* Student presentation.

A Hydrologic Rube Goldberg Machine: Mitigating Water Loss on the Yahara Chain of Lakes

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Aaron Pruitt, Wisconsin DNR

In 2003, Madison Gas & Electric and UW–Madison sought to withdraw surface water from Lake Mendota for campus power plants. At that time, regional concerns included declining heads in the Elk Mound aquifer and very low flows on the Yahara River. The DNR issued a Conditional Water Loss Approval (CWLA) that requires water loss mitigation by 1) pumping groundwater to surface water during low-flow conditions and 2) infiltrating stormwater year-round to recharge groundwater.

The DNR's recent review of the CWLA shows changes in hydrologic conditions, with more precipitation, greater flood risk, and higher groundwater. Twenty years of data show that pumping groundwater to supplement low flows on the Yahara generally meets intended objectives. For example, in 2023 groundwater pumped into the lakes equaled 14% of the average flow on the lower Yahara. However, infiltrating storm water has several unintended negative consequences and less benefit than expected.

The CWLA requirements reflect a conceptual model that prioritized maintaining mass balance across the entire chain of lakes, and the approval implements water loss mitigation through complex manipulation of the hydrologic system. In practice, the mitigation measures affect limited areas within a heavily managed system. This review demonstrates that temporal change in climate, groundwater use, and societal priorities effects the success of these mitigation efforts.

Beyond the Numbers: Making Sense of Soil-Water-Balance Model Projections for Minnesota's Climate Future

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Climate change is expected to bring many hydrologic changes to the Upper Midwest in future years. Minnesota communities need information about potential future changes in water budget components to make informed decisions and build resiliency. At last year's conference, we reported on a collaboration between the U.S. Geological Survey and the University of Minnesota Climate Adaptation Partnership. We used the USGS Soil-Water-Balance (SWB) model with UM's daily weather projections to generate daily potential groundwater recharge, evapotranspiration, crop water demand, and surface runoff grids statewide for a historical period (2000 to 2022) and two future periods (2040-2059 and 2080-2099). Building on this effort, the task of translating SWB model results to the real world begins. In this talk we consider the ways in which the model results may inform decisions on the ground, as well as highlight features of the modeled future projections that need to be treated with care.

Session 3B: Urban hydrology

Contrasting Performance of an Urban Stormwater Biofilter for Particulate Versus Dissolved Pollutants

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James Romano, USGS

A biofilter in Milwaukee, Wisconsin was monitored over a three-year period (2022–2024) to quantify changes in runoff volume and pollutant loads of solids, nutrients, major ions, and trace metals. The biofilter demonstrated consistent hydrologic benefits, reducing runoff volume by an average of 86 percent, thereby mitigating the impact of runoff on stormwater infrastructure. Similarly, substantial reductions in total suspended solids (99 percent), total phosphorus (86 percent), and particulate metals (>80 percent for most analytes) were observed. However, performance for dissolved constituents was variable. Dissolved phosphorus and several dissolved metals, including manganese, nickel, iron, and arsenic exhibited net export, likely due to organic-rich media composition, redox conditions, or interactions with road salt application in the winter. Notably, sodium showed net export despite relatively stable chloride loads, suggesting cation exchange dynamics and lag in the timing of release influenced by seasonal road salt inputs. These results highlight the limitations of conventional biofilter designs in sequestering dissolved-phase pollutants and underscore the need for advanced media formulations. As such, careful management of vegetation, limited use of organic matter, and influence of winter deicing practices should be considered.

Evaluating Floodwater Infiltration and Storage in a Restored Floodplain of Underwood Creek, Wisconsin

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Faith Fitzpatrick
Paul Juckem

The U.S. Geological Survey evaluated four methods for estimating floodplain infiltration and storage during overbank floods at a restored reach of Underwood Creek in Wauwatosa, WI. From 2018 to 2021, we monitored groundwater levels, vertical temperature profiles, and stream stage, and used high-resolution topographic data to estimate surface water storage and infiltration into the unsaturated zone. Simple estimation methods based on empirical infiltration rates and flood data generally agreed with more complex methods that incorporated soil properties, hydraulic gradients, and temperature profiles. All methods showed that vertical infiltration during floods was minimal, averaging only 0.08% to 0.52% of total flood volume. Infiltration rates across the floodplain varied with hydraulic gradients, influenced by floodwater depth and groundwater levels, and soil permeability. Gradients favorable for infiltration typically occurred at the onset of flooding as water spread onto the floodplain but gradients often reversed as groundwater rose and unsaturated storage decreased. This pattern was consistent during the study period, indicating infiltrated water likely returned to the stream via the hyporheic zone during and after floods, attenuating flood peaks but not reducing flood volume. Results underscore the importance of considering surface–groundwater interactions, soil properties, and unsaturated storage when evaluating floodplain infiltration for flood mitigation.

Urban Soil Health: Restoring Disturbed Compacted Urban Soils as a Stormwater BMP

Stuart Schwartz, Center for Urban Environmental Research and Education (CUERE), University of Maryland Baltimore County, stu_schwartz@umbc.edu

In Wisconsin and throughout the Great Lakes' urban watersheds, standard land development with modern cut-and-fill mass grading results in an urban pervious landscape that limits infiltration and vegetation success, and amplifies stormwater runoff. Consequently, much of the urban pervious landscape might best be described as grass growing in a thin veneer of topsoil over compacted fill. Environmental and hydrologic services can be purposefully restored using sustainable grading practices that reestablish urban soil health. This presentation describes the family of sustainable grading practices that can reliably restore urban hydrologic services and a consistent method to quantify the runoff reduction from soil decompaction and amendment to support stormwater credits. The presentation illustrates and describes implementation and performance monitoring results from a set of demonstration projects, including our collaborative demonstration project with the City of West Allis, WI. The work presented here supports the Wisconsin Standards Oversight Council's ongoing effort to develop a Wisconsin Technical Standard focused on Urban Soil Health with an emphasis on storm water management. Disturbed compacted urban soil profiles represent both a significant overlooked hydrologic legacy, and a significant opportunity to advance stormwater management and restore hydrologic function in the urban pervious landscape.

Quantifying the Hydrological Impact of Urban Forests

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Urban trees and forests play a critical role in the urban hydrological cycle by both physically interrupting and slowing flood flows and by transpiring water into the atmosphere leaving soils more capable of absorbing precipitation. And through the concurrent process of evaporative cooling, urban forests also provide a critical benefit for local communities reducing summer temperatures and offsetting urban heat island effects. Unfortunately, the scale and extent of urban forest benefits has been difficult to quantify given their diffuse effects and heterogeneous distribution. However, a variety of datasets created by USGS, NWS, and WDNR have recently been made available that can used to quantify the benefits of urban forests. This presentation will demonstrate how high resolution urban landcover data created by the WDNR can be used to quantify water flux and evaporative cooling showing how urban forests can be managed and optimized to provide the most benefits. Further, these data will be used to show how various landcover features, especially water availability, mitigate these effects.

Session 3C: Groundwater Quality ll

Data to Model Pipeline for Understanding Geogenic Radium Mobility in Wisconsin Groundwater

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Elevated radium in groundwater affects many water utilities in Wisconsin. Well reconstruction or water treatments are expensive and not always successful. Existing geologic and geophysical information, such as total gamma logs, provide insight into source rocks that may be enriched in radium; however, we have harnessed vertically discrete information on the presence of radium parent isotopes (U-238 and Th-232) and radium sorption behavior to improve simulations of radium transport. Our workflow utilizes spectral gamma data, lithologic information, and – in some cases – pXRF data, to model radium activity in municipal wells in SE Wisconsin. The spectral gamma constraints in-situ activities of radium isotopes Ra-226 and Ra-228. These concentrations are integrated with existing regional-scale groundwater flow models to construct a radial axisymmetric model chosen for its quick run time and ability to handle high uncertainty in parameters. Pumping rates and hydraulic head data are obtained from the local water utilities. Radium sorption information may be estimated from lithologic or pXRF data, when available. This new data-to-model workflow aims to provide water utilities with cost-effective well design for long-term radium mitigation.

An Analysis of Regulatory Impacts on the Silurian Aquifer of Northeast Wisconsin

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In eastern Wisconsin, a combination of Silurian dolostone bedrock dissolution, thin soil, and animal and organic waste land application have led to pathogen contamination (*E. coli*, coliform, etc.) and Brown Water Incidents (BWIs - discoloration and/or a manure-like odor) in well water. When waste is spread, surface water can carry associated contaminants and particulates into groundwater via sinkholes/fractures and direct infiltration through thin soils. Most private wells in the Northeast region of the Silurian rely on water from the Silurian aquifer, posing a human-health risk. In 2007, the Northeast Wisconsin Karst Task Force recommended manure spreading regulations in high-risk Silurian areas, which 2 counties implemented. In 2018, NR151.075 implemented geologically specific manure spreading regulations in 13 Silurian counties. Research published in 2015 looked at the impacts of implementing winter manure spreading restrictions on well water quality in Manitowoc, Brown, Calumet, and Kewaunee counties. Preliminary results of a follow-up study exploring the impacts of NR151.075 show that regulations and changes farmers made reduced groundwater contamination. After NR151.075 was implemented, documented reports of well contamination declined. When spreading is avoided on shallow soil, large particles filter out, thus reducing BWIs and causing smaller contaminants like nitrates and pathogens to persist, and multiple-well pathogen contamination incidents decreased.

* Student presentation.

The Silurian Performance Standard: How it came to be. And is it effective?

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Northeast Wisconsin is underlain by the Silurian fractured-dolomite aquifer. Dairy farming and associated crop production comprise the primary land use, and manure is commonly applied to crop land. In areas where soils are thin, there is a history of "brown water" events in private wells. The Wisconsin Geological & Natural History Survey (WGNHS) began researching the hydrogeology of the Silurian aquifer in the 1980’s. Initially the research focused on one county, but a brown-water event in a neighboring county in 2005 led to the creation of the Northeast Wisconsin Karst Force, which recognized the regional geologic nature of the issue and developed preliminary policy recommendations. The growth of concentrated animal feeding operations (CAFOs) led to the formation of an engaged group of citizen advocates who raised awareness of the issues and who chose to litigate. Research collaboration with microbiologists elucidated the extent and sources of contamination and highlighted human health concerns. In Fall 2016 the WDNR convened a Technical Advisory Committee tasked with recommending changes to the NR151. Those changes, which call for reduced manure applications where the depth to rock is less than 20 feet, went into effect in 2018.

Subsequently, the WGNHS, in collaboration with the USGS, has created better depth-to-bedrock maps for the region. A monitoring project has tried to assess the effectiveness of the rule and many CAFOs have installed wastewater treatment facilities.

From data-focused investigations of groundwater sustainability to informing action in Richland County

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Despite being a water-rich state, Wisconsin has many anthropogenic and naturally-occurring groundwater quality issues that can lead to adverse health effects. The sustainability of groundwater is of concern for agricultural and rural communities that rely on groundwater for irrigation and drinking water. Private wells are especially vulnerable as monitoring falls under the responsibility of the well-owner. In 2024, a group of citizens from Richland County created the Richland Resilience Group and identified a priority and knowledge gap on groundwater vulnerability in their community. Residents expressed interest in private well testing and thanks to a community-based water research grant from Water@UW-Madison and the Morgridge Center for Public Service, a new project was established. This project is a partnership between Richland Resilience Group, Southwestern Wisconsin Regional Planning Commission, Richland County Land Conservation Department, Clean Wisconsin and the WATER Lab at UW-Madison. After a pilot testing round in August 2025, the team launched a groundwater sampling campaign in Richland County and hosted an Open House for community members to meet with scientists, local government leaders, non-profit outreach and public health experts in Fall 2025. With the goal of providing accessible information on Richland groundwater, this project highlights the importance of working together with the local community to do actionable science based on community-led questions.

Session 4A: Watershed Management

Changes in chloride concentration and flux from 2011 to 2023 in major U.S. tributaries to the Laurentian Great Lakes

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Chloride (Cl) concentrations have increased in the Great Lakes since the mid-1800s, raising concerns about freshwater ecosystem impacts. As such, there is interest in quantifying trends of tributary Cl fluxes to the lakes. To this end, we used 13 water years (2011-2023) of U.S. Geological Survey data from 24 major U.S. Great Lakes tributaries to estimate concentrations and fluxes using Weighted Regressions on Time, Discharge, and Season (WRTDS). Median daily concentrations ranged from 2.9-307.6 mg L-1 across tributaries, often with little seasonal variation. Trends in seasonal concentrations more often decreased than increased, and no single season exhibited a greater frequency of change. Median annual area-normalized fluxes (yields) ranged from 1-87 t yr-1 km-2, with spring contributing the largest seasonal fluxes in most tributaries. Twelve tributaries showed changes in annual yield (six increasing, six decreasing). Increasing yields were commonly associated with increasing streamflow trends, suggesting enhanced transport rather than watershed storage of Cl. Seasonal yield changes were widespread, with frequent increases in fall and winter, but few in spring. Tributaries with the highest concentrations and yields drained urban, population-dense watersheds with elevated road salt use, rather than the snowiest watersheds. These results identify priority tributaries and seasons for targeted management that may reduce Cl fluxes to the Great Lakes.

Landfill to Lake: Removal of a Landfill for Improved Land Use

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A closed, unlined landfill in Monroe County was completely removed in 2025 to allow for the expansion of a sand mine. The landfill removal process included investigation and characterization of the landfill waste and potential contamination, preparation of a removal plan for agency approval, and oversight of excavation activities to ensure proper management of wastes. Waste and contaminated soil associated with the closed landfill were completely removed and the Wisconsin Department of Natural Resources approved mining of the sand below the former landfill. The mine reclamation plan includes conversion of the sand mine to a public access lake. Following mining, the former landfill footprint will be reclaimed as open water and lake shoreline for the benefit of wildlife and residents of Monroe County.

The history of the Runoff Curve Number Method and how it limits our imagination of potential watershed futures

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Arguably, the most widely used hydrologic model in the world is the Runoff Curve Number Method (RCNM). Although it was originally developed and released in 1954 by the USDA out of necessity to provide guidance for

building flood detention structures, its algorithm that empirically estimates runoff depth given inputs of storm rainfall and a soil/land-management parameter – the Curve Number (CN) – has remained unchanged. Despite criticism on its lack of mechanistic representation, its "good enough" reputation and incumbent power have kept it at the core of hydrologic design. It also remains because no more accurate alternative has been offered that so easily represents many (not all) land management conditions.

But we argue – using a case study of a watershed planning project in the Coon Creek Watershed – that the limited land management conditions represented in CN tables and insufficient representation of important hydrologic processes have led to the RCNM limiting potential watershed futures. Specifically, when interventions often described as Natural Flood Management – including distributed infiltration practices and improvements in soil health – are not adequately captured in a model, they are implicitly ignored in formal planning processes and, thus, very difficult to widely implement. Pathways to expand the scope of these imagined futures include the difficult but necessary work of bridging the divide between hydrologic engineers and research hydrologists.

Reconstructing the Eutrophication of Gass Lake near Manitowoc, WI Since European Settlement Using Lake Sediment Chemistry

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Many lakes in Wisconsin have been polluted with nutrients following urbanization and agricultural development. Unfortunately, there is limited documentation of longer-term impacts to many Wisconsin lakes since European settlement. Here, we reconstruct changes to lake sediment chemistry over the recent past due to shifts in nutrient loading, organic matter source, and sediment delivery to Gass Lake (44.053°N, 87.731°W) near Manitowoc, Wisconsin. Sediment core 24-GL-U3 (0.96 m long) was collected from the depocenter of Gass Lake in June 2024. To establish a chronology, we submitted two terrestrial plant samples for radiocarbon analysis and sediment samples for ^{210}Pb dating. To assess changes to Gass Lake sediments over time, we measured X-Ray Fluorescence (XRF), magnetic susceptibility, %$CaCO_3$, total organic carbon (TOC), total nitrogen (TN), δ^{13}C, and δ^{15}N values of sediments. Tentatively, we suspect that the entire 24-GL-U3 core spans the past ~200 years. High resolution XRF and magnetic susceptibility data show an increase in episodic clastic inputs to the lake. TOC, TN, δ^{13}C, and δ^{15}N results illustrate how increased development in the watershed following European settlement led to increased nutrient loading and aquatic productivity in Gass Lake. This shows that changes to pollution and productivity can be indirectly reconstructed in lakes across Wisconsin as needed using lake sediment cores, with implications for lake management and restoration.

Using airborne electromagnetic surveys to aid in the investigation of groundwater resources in the Keweenaw Bay region of Michigan

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The Earth Mineral Resources Initiative within the U.S. Geological Survey utilizes geophysical methods to map geology and mineral resources across the United States. Recent airborne electromagnetic (AEM) surveys that were flown across the Upper Peninsula of Michigan can also be used to better understand water resources by providing information about hydrogeologic properties and bedrock geometry. Together, the U.S. Geological Survey and the Keweenaw Bay Indian Community (KBIC) are leveraging the available AEM data to inform a groundwater flow model of watersheds near KBIC. This model will be used by KBIC to better understand their groundwater resources. We developed the groundwater model in two phases. The first phase used a GFLOW model (a 2-D, analytic element model) to obtain a better understanding of the regional groundwater flow and to provide boundary conditions for more detailed modeling in second phase. The second phase used the AEM data to inform the hydrostratigraphy for a detailed 3-D MODFLOW model. The goal of the work is to use the MODFLOW model to delineate a groundwatershed for the KBIC reservation and to better understand groundwater–surface water interactions with streams.

Groundwater modeling of flood-prone seepage lakes in a glacial aquifer: calibrating to recent floods and assessing recharge sensitivity under geologic uncertainty

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Recent groundwater flooding in the Chequamegon-Nicolet National Forest (northern WI) caused extreme and variable lake-level rises across a watershed with minimal surface hydrologic connectivity. This study examines geologic controls behind these patterns. We developed a numerical model of groundwater flow (MF6) using regional well records, remotely sensed lake levels, and hydrologic field data. Sparse well data leave aquifer structure poorly constrained, motivating two conceptual models: a homogeneous aquifer and a heterogeneous model with zones of varying hydraulic conductivity based on geologic mapping, well logs, and iterative calibration. Exploring these alternatives allows evaluation of how geologic uncertainty affects simulated flood responses.

Adding heterogeneity sharpened the simulated groundwater divide, improved fit with lake-level patterns, and better reflected local hydraulic gradients measured in the field. Transient calibration at Pigeon Lake using a stable isotope mass balance method to constrain fluxes shows both models reproduce lake-groundwater exchange within expected ranges. However, at the regional scale, some areas remain poorly represented due to sparse subsurface data. Projections applied to both calibrated models show that Pigeon Lake levels are sensitive to long-term increases in recharge, with a 15% increase in recharge leading to lake levels that are similar to historical flood peaks.

[*] Student presentation.

Simulating Contaminant Fate and Transport in the Prairie du Chien and Jordan Aquifers beneath the Twin Cities, MN using MODFLOW 6

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Weapons manufacturing at the former Twin Cities Army Ammunition Plant (TCAAP) in Arden Hills, MN resulted in the release of trichloroethene (TCE) and 1,4 dioxane into the Prairie du Chien and Jordan units of the deep bedrock aquifer, forming a ~5 mile long contamination plume. In the 1980s and 1990s, remedial efforts included soil removal and soil vapor extraction near the source areas; "pump and treat" efforts are ongoing. In 2021, the U.S. Army Environmental Command initiated a project with the U.S. Geological Survey to better understand the behavior and fate of the plumes, and to support ongoing remedial pumping. A 16-layer MODFLOW 6 groundwater flow model was developed using detailed bedrock and Quaternary mapping from the Minnesota Geological Survey. The model simulates a complex groundwater flow system influenced by buried valleys, aquifer heterogeneity, numerous lakes, high-capacity pumping, and the geometry of the Mississippi River. Mass transport is simulated in a locally refined area of the model grid, using the MODFLOW 6 Groundwater Transport Model. Input parameters for flow and transport were estimated simultaneously for an ensemble of plausible model realizations, allowing concentrations and the plume shape to inform uncertain hydraulic parameters. Results capture observed decreasing concentration trends in many places but indicate a likely need for continued pumping through 2042. Multi-objective optimization under uncertainty may help improve pumping efficiency.

A look at old water use data in Wisconsin

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With implementation of reporting requirements from the Great Lakes Compact, the DNR has collected self-reported water use from over 13,000 high-capacity wells across the state since 2010. The Water Use Section makes those data available through online query tools, story maps, reports, and site-specific data requests. Water use data from before 2010 was reported to the DNR, but it was collected in a non-systematic way over a few periods of time, including in the 1980's and in the mid-2000's. In 2023, the DNR reviewed and added over 45,000 years of annual water use reporting from nearly 10,000 from this older dataset to the Water Use database.

Some of the data overlaps with current water use reporting, and the data in that overlapping period is reasonably comparable. Over half of the older water use data comes from irrigation wells, and we can use this to construct an average per-well withdrawal from irrigation wells. Average per-well irrigation withdrawals were generally much higher in the 1980's, and peaked in 1988, a year of severe drought. While average per-well irrigation withdrawals are lower on average in the past decade, dry years such as 2012 still result in the second highest average per-well withdrawal. The smaller average per-well withdrawal in the past decade is also offset by an increase in the number of irrigation wells. This older data is now incorporated into the DNR's Water Use database and available through online tools and standard data requests.

Session 4C: MMSD flood of 2025

From PLCs to Pixels: A Modern Water Data Pipeline

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Mitch Schutte, Milwaukee Metropolitan Sewerage District

MMSD manages one of the largest and most complex water data ecosystems in the region, generating billions of records each year across flow monitoring, water quality, precipitation, and operational systems. Turning data at this scale into usable insight requires more than storage—it requires intentional pipelines, modern analytics, and compelling visualization.

This talk will showcase how MMSD is building a contemporary water data pipeline that emphasizes data availability, reproducibility, and exploratory analysis. It will highlight tools and technologies used to work across disciplines and data scales, including R- and Python-based analytics, interactive web applications built with Shiny and Quarto, and high-performance workflows designed for very large datasets. Examples will focus on rapid visualization, quality control, and iterative, exploratory analysis that supports operational insight, rather than traditional static reporting.

An overview of impacts and mitigation of Southeastern Wisconsin's 1,000 year storm, August 2025

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On August 9-10, 2025, Southeastern Wisconsin experienced a 1,000-year storm with an average rainfall of over eight inches in 24 hours. One rain gauge on the Northwest side of Milwaukee recorded a state record of 14.55 inches during that time period, which equates to over 40% of the typical annual precipitation. The flood waters that came with this storm damaged houses, businesses, and public infrastructure, leading to the second largest Federal Emergency Management Agency disaster of 2025 with over $195 million dollars already spent on private homes alone. Despite the massive amounts of damage the region suffered, it could have been much worse, if not for the investments in green and grey infrastructure from various regional partners over the last several decades, which reduced the flood waters and their impact. This presentation highlights how the storm developed with record-setting rainfall, the damage caused to the Milwaukee area, and how the Milwaukee Metropolitan Sewerage District's assets helped mitigate this massive storm that hit some of the most urbanized watersheds in the state.

A probabilistic compound flood hazard assessment for coastal Milwaukee, WI

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Michael Notaro, University of Wisconsin-Madison

The risk of flooding due to the combination of high Lake Michigan water level events and rainfall is being investigated for coastal Milwaukee. Simultaneous extreme rainfall and high lake levels can compound to increase the severity of flooding, often overwhelming local drainage systems and stormwater infrastructure. Modeling in Delft3D-FM is being used to assess the risk of flooding due to high lake levels, seiches, storm surges, and waves, as well as riverine flow and rainfall. Historical events are simulated to evaluate the model's performance and support the development of the model. Compound flood event return periods are then probabilistically determined under present and future scenarios. Direct economic damage due to compound flooding are estimated from land use and building structure data, combined with damage functions. The model is also being used to explore potential reductions in flooding from countermeasures like breakwaters, floodwalls, wetlands, and flood storage. The resulting distribution of flood risk for each countermeasure will be used to assess the impact of the countermeasure. A stakeholder advisory board has been guiding this effort to ensure results are relevant to the Milwaukee community, providing input on priority study areas, model performance, and countermeasure selection.

Integrating NEXRAD-II into a 20-gage mesonet to develop a spatially continuous high-resolution precipitation dataset

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The Milwaukee Metropolitan Sewerage District's (MMSD) conveyance system is precipitation driven, and is managed minutely based on observed rainfall. Radar data are an immensely valuable source of continuous precipitation data for MMSD to model, learn from, and respond to precipitation events in real time.

MMSD uses a 20-sensor mesonet to model and analyze precipitation in its 423-square-mile service area, sufficient to provide regional averages but not spatially-continuous measurements. The Water Systems Monitoring Group (SysMON) developed open-source infrastructure to fuse MMSD's mesonet observations with real-time radar observations, creating a bias-corrected, 250-meter by 0.5-degree, 4-6 minute spatiotemporal estimate of rainfall across the service area. The python-based suite of tools, based on open-source radar processing libraries wradlib and ARM-pyART, include:
1) a dashboard to visualize and compare radar-based quantitative precipitation estimates with mesonet observations;
2) Three-dimensional visualization tools for storm events, leveraging VTK;
3) A Dask-based distributed processing pipeline to manage 30 gigabytes of data per storm event.

This advancement will enable more granular modeling of conveyance system response to precipitation events and enable detailed assessments of green infrastructure performance. Future developments include integration with conveyance and plant data, and deployment to inform real-time operations.

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