AMERICAN WATER RESOURCES ASSOCIATION - WISCONSIN SECTION

47TH ANNUAL MEETING

April 25 - 26, 2024

Support From:

Freshwater Collaborative of Wisconsin

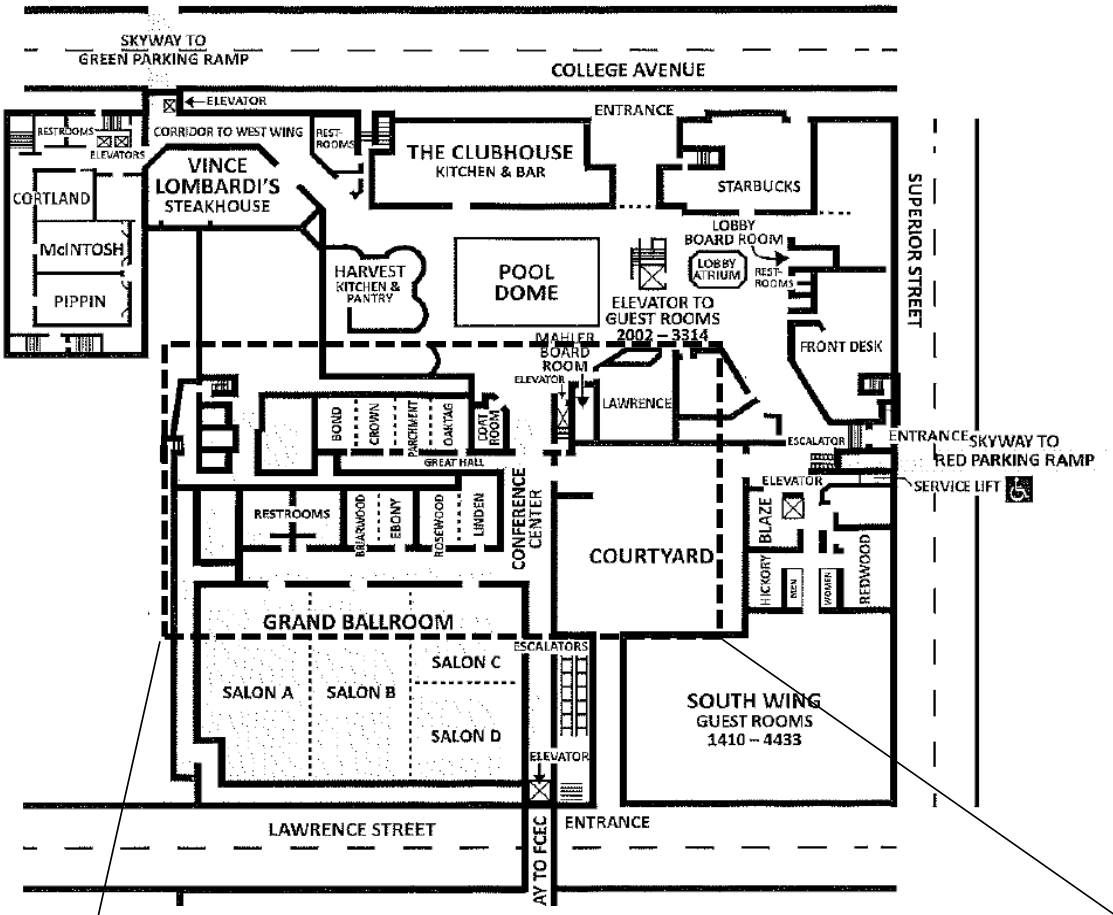
University of Wisconsin Water Resources Institute

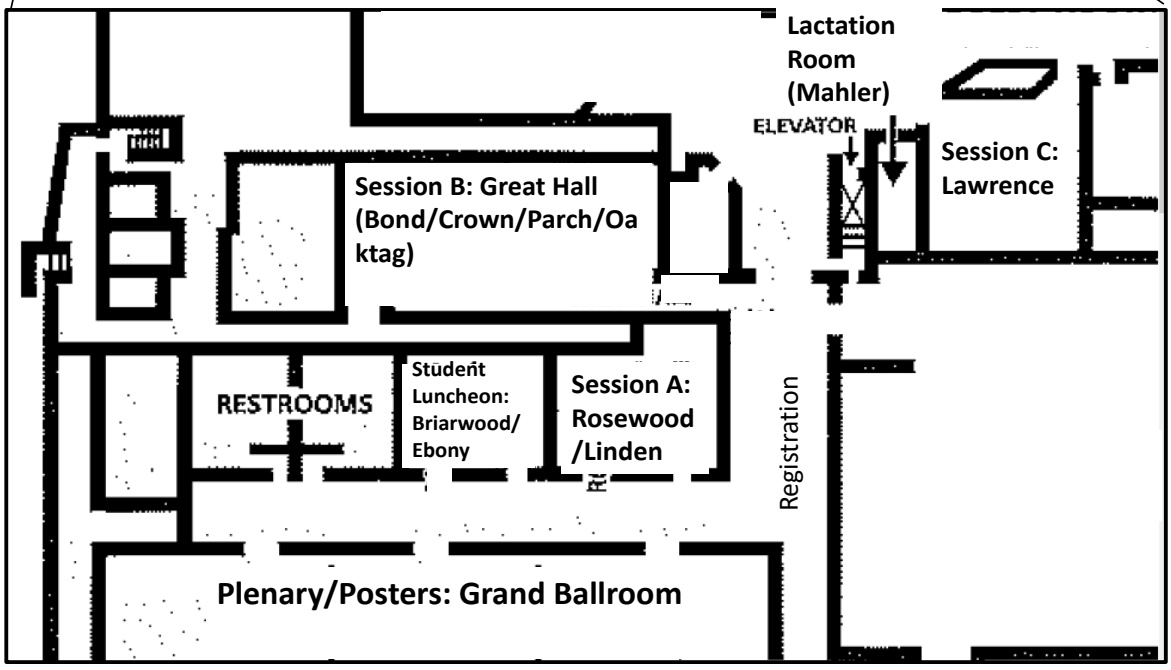
Wisconsin Department of Natural Resources

Center for Watershed Science and Education, UW-Stevens Point

Wisconsin Geological and Natural History Survey

U.S. Geological Survey Upper Midwest Water Science Center


SKYWAY TO GREEN PARKING RAMP
COLLEGE AVENUE
ELEVATOR
RESTROOMS
ELEVATORS
CORRIDOR TO WEST WING
REST-ROOMS
VINCE LOMBARDI'S STEAKHOUSE
CORTLAND
McINTOSH
PIPPIN
ENTRANCE
THE CLUBHOUSE
KITCHEN & BAR
STARBUCKS
LOBBY BOARD ROOM
LOBBY ATRIUM
REST-ROOMS
HARVEST KITCHEN & PANTRY
POOL DOME
ELEVATOR TO GUEST ROOMS 2002 – 3314
SUPERIOR STREET
MAHLER BOARD ROOM
ELEVATOR
LAWRENCE
FRONT DESK
BOND
CROWN
PARCHMENT
OAKTAG
COAT ROOM
GREAT HALL
ESCALATOR
ENTRANCE
SKYWAY TO RED PARKING RAMP
SERVICE LIFT
ELEVATOR
RESTROOMS
BRIARWOOD
EBONY
ROSEWOOD
LINDEN
CONFERENCE CENTER
COURTYARD
BLAZE
HICKORY
MEN
WOMEN
REDWOOD
GRAND BALLROOM
ESCALATORS
SALON A
SALON B
SALON C
SALON D
SOUTH WING GUEST ROOMS 1410 – 4433
ELEVATOR
LAWRENCE STREET
ENTRANCE
AY TO FCEC


Lactation Room (Mahler)
ELEVATOR
Session C: Lawrence
Session B: Great Hall (Bond/Crown/Parch/Oaktag)
RESTROOMS
Student Luncheon: Briarwood/ Ebony
Session A: Rosewood /Linden
Registration
Plenary/Posters: Grand Ballroom

BOARD OF DIRECTORS

Mitch Olds Milwaukee Metropolitan Sewerage District	Past-President
Aaron Pruitt Wisconsin Department of Natural Resources	President
Meg Haserodt USGS Upper Midwest Water Science Center	President-Elect
Matt Diebel USGS Upper Midwest Water Science Center	Vice President
Eric Booth Department of Agronomy, UW-Madison	Treasurer
Brent Brown Jacobs Engineering Group (formerly CH2M), Milwaukee	Secretary
Paul Dearlove Clean Lakes Alliance	Director-at-Large
Amy Wiersma Wisconsin Geological and Natural History Survey	Director-at-Large

PROGRAM COMMITTEE

Anna Fehling Wisconsin Department of Natural Resources	Technical Co-Chair
Nic Buer USGS Upper Midwest Water Science Center	Technical Co-Chair
Hayley Olds USGS Upper Midwest Water Science Center	Communications Chair/ Webpage Manager
Elizabeth White UW-Madison Aquatic Sciences Center	WRI Representative

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.

Mary Anderson
Max Anderson
Andrew Aslesen
Tim Asplund
Jean Bahr
Roger Bannerman
Bill Barnwell
William Batten
Amanda Bell
Gretchen Bohnhoff
Eric Booth
George Bowman
Laurel Braatz
Ken Bradbury
Brent Brown
Bryant Browne
Nicolas Buer
John Cain
Linda Campbell
Chris Carlson
Doug Cherkauer
Laura Chern
Katherine Clancy
Doug Clark
Paul Dearlove
Matt Diebel
Doug Dube
John Elder
Bill Elman
Anna Fehling
Kevin Fermanich
Mike Fienen
Steve Gaffield
Paul Garrison
Madeline Gotkowitz
Grace Graham
Tim Grundl
David Hart
Megan Haserodt
Jeff Helmuth
Ron Hennings
Susan Hill
Paulette Homant
Peter Hughes
Randy Hunt
James Hurley
Dave Johnson
Paul Juckem
Pat Jurcek
Steve Karklins
Galen Kenoyer
John Konrad
Kirk Kopitske
Dave Krabbenhoft
George Kraft
Jim Krohelski
Michael Kvitrud
Dale Lang
John Laumer
Andy Leaf
Mike Lemcke
Dave Lindorff
Mike Llewelyn
John Luczaj
Fred Madison
Brian Mahoney
Bruce Markert
Kevin Masarik
Carol McCartney
Paul McGinley
Chris Mechenich
Maureen Muldoon
Vern Norman
Vladimir Novotny
Hayley Olds
Mitch Olds
Meredith Ostrom
Dave Ozsvath
John Panuska
Mike Parsen
Dale Patterson
Mike Penn
Marie Peppler
Don Pirrung
Austin Polebitski
Ted Powell
Aaron Pruitt
Gary Raasch
Bruce Rheineck
Mike Rupiper
Rada Sandheinrich
Rosalie Schnick
Jo Ellen Seiser
Bill Selbig
Kari Sherman
John Skalbeck
William Sloey
Bill Sonzogni
Earl Spangenberg
Fred Spangler
Bob Stelzer
Jeff Steuer
Ron Stieglitz
Will Stites
Rick Stoll
Todd Stuntebeck
Sue Swanson
Don Theiler
John Tinker
Joan Underwood
Randy Videkovich
Stu Walesh
Kathy Webster
Amy Wiersma
Don Winter
Tom Wirth
Philip Younger

AWRA BOARD OF DIRECTORS POSITION DUTIES

President (1-year term)

Shall preside at meetings, 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 Secretary and Treasurer, an annual report of the Section's activities to be presented to the annual meeting of the Section and to be forwarded by the Secretary to the President of the American Water Resources Association.

President-Elect (1-year term)

Shall perform the duties of the President when the latter is absent and shall succeed to the office of President in the following year. Historically has helped to recruit plenary and keynote speakers, has helped coordinate the nomination and election of officers, and performed other responsibilities related to the annual conference.

Vice President (1-year term)

Shall perform the duties of the President-Elect when the latter is absent. Some of the duties that the vice-president has helped with in the past include recruiting moderators for the general sessions, assisting with the technical program review, and performing other miscellaneous duties as assigned.

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's accounts shall be audited at the close of each year as directed by the President. The Treasurer shall prepare an annual report and financial statement for presentation at the annual meeting.

Director-at-Large (2 positions, 2-year term, staggered appointments)

Shall serve on the Board of Directors to help manage the affairs of the Section including administration, program development and supervision of financial affairs.

BIOGRAPHIES OF CANDIDATES FOR THE AWRA WISCONSIN SECTION BOARD

Director-at-Large
Madeline Gotkowitz

Madeline Gotkowitz works as a hydrogeologist in the Water Use Section, Bureau of Drinking Water and Groundwater at the Wisconsin DNR. She recently returned to Wisconsin following four years as a member of Montana AWRA. No stranger to Wisconsin, Madeline has 30 years' experience addressing hydrogeologic issues across the state. She served as Secretary of Wisconsin AWRA from 1999 through 2001 and has attended more Wisconsin AWRA meetings than she cares to count. Her professional career has benefitted greatly from the vibrancy of Wisconsin AWRA; the state-wide meeting provides a welcoming arena for discussions about hydrology and research, and it fosters collaboration between students, university programs, and professionals at state agencies, non-profit organizations, and the private sector. Madeline looks forward to contributing to AWRA and the fundamental role it plays in support of the wise use and management of Wisconsin's water resources.

Secretary
Brent Brown

Brent Brown is a registered Professional Engineer for Jacobs Engineering Group (formerly CH2M) in their Milwaukee office. Mr. Brown practices water resources engineering and works on projects involving ecosystem protection and restoration, habitat and fluvial geomorphic assessments, watershed and storm water management, low-impact development stormwater controls, sediment dredging and dewatering and airport deicing fluid control. Mr. Brown 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. Mr. Brown has been employed with Jacobs for 23 years.

President-Elect
Matt Diebel

Matt Diebel is a hydrologist with the U.S. Geological Survey's Upper Midwest Water Science Center in Madison, WI. My work focuses on water quality of rivers and lakes, with an emphasis on statistical analysis of temporal and spatial patterns. On the Wisconsin AWRA board, I am particularly interested in promoting student career development and involvement in the organization.

Vice President
Mike Cardiff

Mike Cardiff is professor of hydrogeology at the Department of Geoscience, UW-Madison. He holds bachelor's degrees in geology and mathematics from Oberlin College (2001), as well as master's and doctoral degrees in civil and environmental engineering from Stanford University (2005, 2010 respectively). He has 20 years of experience in the water resources field, including work related to contaminated site remediation, hydrologic and geophysical aquifer characterization, numerical modeling, and the social science of hydrology. Prof. Cardiff is the current department chair for geoscience at UW-Madison, and also serves as co-chair of the water@UW-Madison campus-wide umbrella organization. As a new board member, his goals would be to expand membership among state professionals and to expand educational and career opportunities for members.

PLENARY SPEAKER

Dan Egan

Dan Egan for many years covered the Great Lakes for the *Milwaukee Journal Sentinel*. Now he writes occasional long-form pieces about climate change for national media outlets, including the New York Times, and is a senior water policy fellow at the University of Wisconsin-Milwaukee's School of Freshwater Sciences. He is the author of *The Devil's Element: Phosphorus and a World Out of Balance* and the New York Times best seller *The Death and Life of the Great Lakes*. Twice a finalist for the Pulitzer Prize, he has won the Alfred I. duPont–Columbia University Award, John B. Oakes Award, AAAS Kavli Science Journalism Award, and J. Anthony Lukas Work-in-Progress Award. A graduate of the Columbia Journalism School, he lives in Milwaukee with his wife and children.

Wisconsin AWRA Strategic Planning Review

Over a year ago, Wisconsin AWRA launched a strategic planning process. As part of that process, the members of Wisconsin AWRA spent time together at the 2023 annual meeting charting the experiences that they were finding powerful – and exploring the experiences that they wanted to have with Wisconsin AWRA in the future. Come learn how that conversation is shaping the vision and strategies of Wisconsin AWRA. Our strategic planning facilitator, Alison S. Lebwohl, is looking forward to sharing her perspective on the strategic planning process and results – and the power of your voice and your listening.

Dr. Marissa Jablonski and the Freshwater Collaborative

We are all connected! Despite historical incentives pushing research to be done in silos, we share one water, one soil, one air across the globe. To address water challenges such as PFAS, phosphorus pollution and other issues, water research must be highly collaborative. It must pull together stakeholders who are invested to solve a problem and share their perspective. Students will need to be prepared to work across disciplines, states, countries. Dr. Jablonski will offer insight from her work in global development on how to translate across multiple languages – lingual, cultural, disciplinary.

Dr. Jablonski is an accomplished water engineer, environmental advisor, and executive director of the Freshwater Collaborative who has worked in more than 45 countries on Earth. She has a strong vision for the future of water in the world that includes stakeholder engagement in a way that is easy to follow and extremely impactful. She is a terrific public speaker including having given multiple TEDx talks.

CONTENTS

Program Summary	**10**
Lightning Talks	**20**
1A: Agrochemicals Affecting Surface Water/Groundwater Quality	**21**
1B: Modeling 1	**24**
1C: Green Infrastructure	**27**
2A: Water Quality	**29**
2B: Hydrogeology	**32**
2C: Management & Communication	**35**
Poster Session	**38**
3A: PFAS	**50**
3B: Climate Change	**53**
3C: Aquatic Biology	**55**
4A: Nutrients and Sediment in Surface Water	**58**
4B: Modeling 2	**61**
4C: Agricultural Management	**64**
Index	**66**

PROGRAM SUMMARY

47th Annual Meeting of the
American Water Resources Association—Wisconsin Section

THURSDAY, April 25, 2024

9:30 - 11:00 a.m.	**New Member Meet and Greet (Grand Ballroom Lobby)**
9:30 - 11:00 a.m.	**Registration (Grand Ballroom Lobby)**
11:00 - 12:35 p.m.	**Lunch (Grand Ballroom)** **Welcome and Announcements** **Strategic Planning Update** **Bylaws Update and Board Election** **Distinguished Service Award** **Freshwater Collaborative – Marissa Jablonski**
12:35 - 12:50 p.m.	**Lightning Talks (Grand Ballroom)**
1:05 - 2:45 p.m.	**Concurrent Sessions 1A, 1B, 1C**
Session 1A	**Agrochemicals Affecting Surface Water/Groundwater Quality** **Room: Rosewood/Linden** **Moderator: Ken Potrykus**
1:05	**Evaluation of PFAS Leaching from Biosolids and Mitigation Potential of Biochar Through Undisturbed Soil Columns** Michael Holly, University of Wisconsin-Green Bay, hollym@uwgb.edu
1:30	**Effect of Groundwater Contaminant Mixture on Gastrointestinal Cell Viability** Chamia Chatman,* University of Wisconsin-Madison, cchatman@wisc.edu
1:55	**Potential Synergistic Effects of Sorption and Biodegradation on Input of Imidacloprid to Wisconsin Central Sands Region Groundwater** Eric Roden, University of Wisconsin-Madison, eroden@geology.wisc.edu
2:20	**Agricultural Chemicals in Wisconsin Groundwater: DATCP 2023 Statewide Survey** Carla R. Romano, Wisconsin Department of Agriculture, Trade and Consumer Protection, carla.romano@wisconsin.gov

* Student presentation.

Session 1B	**Modeling 1** **Room: Great Hall (Bond/Crown/Parchment/Oaktag)** **Moderator: Michael Fienen**
1:05	**Stream Temperature Modeling to Assess Restoration Effectiveness in a Warming Climate** Ben Sellers,* University of Wisconsin-Madison, bsellers2@wisc.edu
1:30	**Forecasting Future Stream Temperatures in the Beaver Creek Basin in South Central Alaska** Andrew Leaf, U.S. Geological Survey, Upper Midwest Water Science Center, aleaf@usgs.gov
1:55	**Snakes on the Plain: Python Tools for Water Management on the Central Sand Plain (and Beyond)** Michael Fienen, U.S. Geological Survey, mnfienen@usgs.gov
2:20	**Using a Farmer Survey-Informed SWAT+ Model to Examine Disproportionality of Nutrient Loading in a Wisconsin Watershed** Andrew Hillman,* University of Wisconsin-Madison, adhillman@wisc.edu
Session 1C	**Green Infrastructure** **Room: Lawrence** **Moderator: Mitch Olds**
1:05	**Rapid Assessment of Green Infrastructure to Identify Factors that Affect System Longevity** Mari Danz, U.S. Geological Survey, medanz@usgs.gov
1:30	**Remote Sensing and Machine Learning Application to Urban BMP Monitoring** Matt Dupasquier,* Marquette University, matthew.dupasquier@marquette.edu
1:55	**Mitigating Antibiotic Resistance in the Environment: Evaluating the Potential of Green Stormwater Infrastructure** Kassidy O'Malley,* Marquette University, kassidy.omalley@marquette.edu
2:45 - 3:00 p.m.	**Break: Grand Ballroom Lobby**

* Student presentation.

3:00-5:05 p.m. **Concurrent Sessions 2A, 2B, 2C**

Session 2A **Water Quality**
Room: Rosewood/Linden
Moderator: Matthew Ginder-Vogel

3:00 **Quantifying Leachable Phosphorus from Common Urban Tree Species**
Collin A. Klaubauf,* University of Wisconsin-Madison, klaubauf@wisc.edu

3:25 **Perchlorate, Metals, Organic Compounds, and Lead Isotopes in Groundwater, Surface Water, Shallow Groundwater, and Soil Within and Near the Middleton Municipal Airport, Middleton, Wisconsin, 2022**
Laura Schachter, U.S. Geological Survey, lschachter@usgs.gov

3:50 **Aquifer Microbial Reduction-oxidation Reactions at a Uranium Contaminated Site**
Catherine Pettinger,* University of Wisconsin-Madison, cpettinger@wisc.edu

4:15 **Water Quality Analysis of Tributaries in the Geneva Lake Watershed**
Dale Splinter, University of Wisconsin-Whitewater, splinted@uww.edu

4:40 **Fecal Source Tracking for Antibiotic Resistance Genes in Private Wells in Southwest Wisconsin**
Joel Stokdyk, U.S. Geological Survey, jstokdyk@usgs.gov

Session 2B **Hydrogeology**
Room: Great Hall (Bond/Crown/Parchment/Oaktag)
Moderator: Madeline Gotkowitz

3:00 **Decisions in Depth-to-Bedrock and Groundwater Mapping, Data Driven Versus Geologic Interpretation**
David Hart, Wisconsin Geological and Natural History Survey, djhart@wisc.edu

3:25 **Use of Airborne EM Survey for Hydrogeologic Characterization for Regional High-Capacity Water Supply Development, Wabash River, Indiana**
Pat Jurcek, INTERA, pjurcek@intera.com

* Student presentation.

3:50	**Groundwater Demand and Assessment of Wisconsin's Crystalline Aquifer** Madeline Gotkowitz, Wisconsin Department of Natural Resources, madeline.gotkowitz@wisconsin.gov
4:15	**USGS National Water Use Estimates: A Wisconsin Perspective** Will Dougherty, Wisconsin Department of Natural Resources, william.dougherty@wisconsin.gov
4:40	**Enhancing and Quantifying Groundwater Recharge: Insights from Field Experiments and Infiltration Modeling** Samuel Brockschmidt,* University of Wisconsin-Madison, sbrockschmid@wisc.edu

Session 2C	**Management & Communication** **Room: Lawrence** **Moderator: Nicolas Buer**
3:00	**Rural Resident Perceptions of Wisconsin's Waters** Catherine Christenson,* University of Wisconsin-Madison, cchristenso4@wisc.edu
3:25	**Developing Stakeholder Relationships and Addressing Natural Resource Issues at a Watershed Scale: A Case Study in the Black Earth Creek Watershed** Nicolas Buer, U.S. Geological Survey, nbuer@usgs.gov
3:50	**Soil Health and Water Quality Intersections in Agriculture** Jessica Jurcek,* Minnesota Department of Agriculture, jurcek@wisc.edu
4:15	**Shoreland Improvements or Disturbances: A Hedonic Price Model for Northeastern Wisconsin** Susan Borchardt,* University of Wisconsin-Milwaukee, borcha48@uwm.edu
4:40	**Quantifying the Impact of Land Use on Treatment Costs: A Study of Municipal Groundwater Systems in Wisconsin** James Price, University of Wisconsin-Milwaukee, priceji@uwm.edu
5:05-5:30 p.m.	**Networking**
5:30-7:00 p.m.	**Dinner and Evening Plenary**

* Student presentation.

Grand Ballroom
Dan Egan

7:00-10:00 p.m. **Poster Session, Networking and Social (Grand Ballroom)**

Poster Session

Quantifying Neonicotinoid and Nitrate Leaching Potential from Potato Production at Field Scale
Carl Betz,* University of Wisconsin-Madison, cbetz2@wisc.edu

Health Risk from Waterborne Human and Livestock Pathogens During Swimming, Kayaking, and Fishing
Tucker Burch, U.S. Department of Agriculture-ARS, tucker.burch@usda.gov

Evaluating Association of Runoff Risk Advisory Forecasts with Private Well Contamination in Kewaunee County, WI
Rachel Cook, U.S. Department of Agriculture-ARS, rachel.m.cook@usda.gov

Modified Phragmites Biochar for Phosphorus and Nitrogen Removal in Agricultural Runoff Treatment Systems
Jordan Deau,* University of Wisconsin-Green Bay, deauja11@uwgb.edu

Alternative Hemodialysis Ultrafilter for Sampling Microbes in Water
Aaron Firnstahl, U.S. Geological Survey, Upper Midwest Water Science Center, afirnstahl@usgs.gov

Inventory and Analysis of Flowing Artesian Wells in Bayfield County, WI
Grace Graham,* Wisconsin Geological and Natural History Survey, grace.graham@wisc.edu

Determining Flow Rates and Flow Sources in Pipes Using Temperature Data
Omar Hegazy,* Marquette University, omar.hegazy@marquette.edu

Long-Term Assessment of the Impacts of Age, Fine Sediments, and Vegetation on Infiltration Rates in Green Stormwater Infrastructures
Eimienwanlan Ibhagui,* Department of Civil, Construction, and Environmental Engineering, Marquette University, eimienwanlan.ibhagui@marquette.edu

Design and Calibration of a Nitrate Decision Support Tool for Groundwater Wells in Wisconsin, USA.
Paul Juckem, U.S. Geological Survey, pfjuckem@usgs.gov

Exploring the Influences on Temporal Variation in Phosphorus Transport and Release in the Hyporheic Zone of the Wisconsin River
Vy Le,* University of Wisconsin-Madison, vple@wisc.edu

* Student presentation.

Stable Isotopic Evaluation of Recharge Into the Karstified Silurian Aquifer in Kewaunee County, Wisconsin
John Luczaj, University of Wisconsin-Green Bay, luczajj@uwgb.edu

Improving the Representation of Cold Season Hydrology in SWAT
Jaya Muehlman,* University of Wisconsin-Madison, muehlman@wisc.edu

Hydrostratigraphic Characterization of the Sinnipee Dolomite in Jefferson County, Wisconsin
Maureen Muldoon, Wisconsin Geological and Natural History Survey, muldoon@wisc.edu

Chloride in the Milwaukee River: A Mass Discharge Approach
Sophia Norenberg,* University of Wisconsin-Milwaukee, norenbe4@uwm.edu

Characterization of Algal Bloom Dynamics in the Fox River From Lake Winnebago to Green Bay
Hayley Olds, U.S. Geological Survey, Upper Midwest Water Science Center, htolds@usgs.gov

Raising Awareness of Drowning Risks in the St. Louis River Estuary Using Interactive StoryMaps
Sarah Peterson,* University of Wisconsin-Madison, speterson26@wisc.edu

Spatiotemporal Trends of Drinking Water Contaminants for Wisconsin Municipal Wells Throughout the Midwestern Cambrian Ordovician Aquifer System
Savannah Finley,* University of Wisconsin-Madison, sefinley@wisc.edu

Barnes Creek Wetland Mitigation Bank
Angie Rayniak,* UW Parkside, fiebe001@rangers.uwp.edu

Investigation of Long-Term Drinking Water Security for the Town of Campbell and La Crosse County, WI
Paul Summers,* University of Wisconsin-Madison, jpsummers2@wisc.edu

Use of Solid Phase Adsorption Toxin Tracking (SPATT) to Determine the Presence of Harmful Algal Blooms (HABs) in Freshwater Systems
Hailey Trompeter, U.S. Geological Survey, htrompeter@usgs.gov

Initiatives Associated with the New County Hydrogeologist Position at the Wisconsin Geological and Natural History Survey
Amy Wiersma, Wisconsin Geological and Natural History Survey, amy.wiersma@wisc.edu

Applying End of Pipe Treatment to Green Stormwater Infrastructure with Flow Modulation of Both Active and Passive Controls to Improve Sediment Removal
Joseph Branca,* Walter McDonald, Marquette University, joseph.branca@marquette.edu

* Student presentation.

FRIDAY, April 26, 2024

7:30 - 8:30 a.m. **Board Breakfast Meeting (Briarwood/Ebony)**

8:30 - 10:10 a.m. **Concurrent Sessions 3A, 3B, 3C**

Session 3A

PFAS
Room: Rosewood/Linden
Moderator: Andrew Aslesen

8:30 **Prevalence and Source Tracing of PFAS in Shallow Groundwater Used for Drinking Water in Wisconsin, USA**
Jordan Schutz, Wisconsin Department of Natural Resources, jordan.schutz@wisconsin.gov

8:55 **Evaluating PFAS Prevalence in Lake Superior Tributaries and Estimating Potential Bioeffects**
Matthew Pronschinske, U.S. Geological Survey, mpronschinske@usgs.gov

9:20 **PFAS Transport and Profiling in Soil Vadose Zone**
Yanan Zhao,* University of Wisconsin-Milwaukee, zhao76@uwm.edu

9:45 **PFAA Transport in the Vadose Zone - Results from Meter-Scale Experiments and Implications for Upscaling**
Elizabeth Runge,* University of Wisconsin-Madison, erunge@wisc.edu

Session 3B

Climate Change
Room: Great Hall (Bond/Crown/Parchment/Oaktag)
Moderator: Tim Asplund

8:30 **Coastal Processes Manual, 3rd Edition: Building Resilience Among Coastal Great Lakes Communities**
Helena Tiedmann, Wisconsin Sea Grant/Wisconsin Coastal Management Program, helena.tiedmann@wisconsin.gov

8:55 **2023 Flash Drought: Hydrologic Response & Water Use Trends**
Adam Freihoefer, Wisconsin Department of Natural Resources, adam.freihoefer@wisconsin.gov

* Student presentation.

9:20	**Shoreline Response to Water Level Fluctuations in Madeline Island, Lake Superior, WI** Sarah Peterson,* University of Wisconsin-Madison, speterson26@wisc.edu
9:45	**The Effects of Shifting Snowmelt and Rainfall Regimes on Streamflow Across the Upper Midwest** Margaret Zimmer, U.S. Geological Survey, mzimmer@usgs.gov
Session 3C	**Aquatic Biology** **Room: Lawrence** **Moderator: Hayley Olds**
8:30	**Impact of Recharge and Fecal Contamination on Microbial Communities in a Karst Aquifer** Joe Heffron, U.S. Department of Agriculture-ARS, joseph.heffron@usda.gov
8:55	**Comparison of Fish Indices of Biological Integrity (F-IBI) Before and After Stream Restoration in the Milwaukee Metropolitan Area** Kathryn Johncock, U.S. Geological Survey, kjohncock@usgs.gov
9:20	**Aquatic Environmental DNA (eDNA) as a Tool to Assess Aquatic Communities in River Systems in the Greater Milwaukee Area** James Romano, U.S. Geological Survey, jromano@usgs.gov
9:45	**Diagnosing the WHY in Stream Ecological Conditions Using Biological Sensitivity to Common Environmental Pollutants** Laura Bates,* University of Wisconsin-Madison, lmbates2@wisc.edu
10:10 - 10:30 a.m.	**Break: Grand Ballroom Lobby**
10:30 - 12:10 p.m.	**Concurrent Sessions 4A, 4B, 4C**
Session 4A	**Nutrients and Sediment in Surface Water** **Room: Rosewood/Linden** **Moderator: Kevin Masarik**
10:30	**Changes in Phosphorus and Suspended Solids Loading in the Fox River, Northeastern Wisconsin, 1989–2021** Dale Robertson, U.S. Geological Survey, Upper Midwest Water Science Center, dzrobert@usgs.gov

* Student presentation.

10:55	**Stream Corridor Sediment Sediment-Bound Phosphorus Budget for an Agricultural Tributary to the Lower Fox River, 2023** Heidi Broerman, U.S. Geological Survey, hbroerman@usgs.gov
11:20	**Waterborne Geophysical Constraints on Soft-Sediment Occurrence and Dune Scaling in Rainy River and Lake of the Woods** Collin Roland, U.S. Geological Survey, croland@usgs.gov
11:45	**Long-Term Trends of Total Suspended Sediment and Discharge for Management Practice Evaluation at Fort McCoy, Wisconsin** Robert Rosner, U.S. Geological Survey (USGS), rrosner@usgs.gov
Session 4B	**Modeling 2** **Room: Great Hall (Bond/Crown/Parchment/Oaktag)** **Moderator: Paul Juckem**
10:30	**A Reduced Dimension Groundwater Flow and Transport Modeling Approach to Evaluate the Contribution of Radium Sources in the Midwestern Cambrian-Ordovician Aquifer System** Christopher Zahasky, University of Wisconsin-Madison, czahasky@wisc.edu
10:55	**Application of a Nitrate Decision Support Tool for Groundwater Wells in Wisconsin, USA** Paul Juckem, U.S. Geological Survey, pfjuckem@usgs.gov
11:20	**Development of a Groundwater Contaminant Transport Model at the Former Badger Army Ammunition Plant to Support Remediation Efforts** Nicholas Corson-Dosch, U.S. Geological Survey, Upper Midwest Water Science Center, ncorson-dosch@usgs.gov
11:45	**Populating Wisconsin Urban Database (WIUDB) With Field Collected Data to Calibrate Urban Runoff Models** Judy Horwatich, U.S. Geological Survey, jahorwat@usgs.gov
Session 4C	**Agricultural Management** **Room: Lawrence** **Moderator: Steven Hall**
10:30	**Controls on Nitrate Removal from Saturated Riparian Buffers in Tile-Drained Agricultural Watersheds** Steven Hall, University of Wisconsin-Madison, steven.hall@wisc.edu

10:55	**Investigating Potential of Biochar Amendments to Vegetative Filter Strips: A Column Study** Joseph Sanford, University of Wisconsin-Platteville, sanfordj@uwplatt.edu
11:20	**Effects of Cover Crop Implementation on Nutrient and Sediment Losses at Field Edges in the Lower Fox River Basin** Isaac Mevis, U.S. Geological Survey - Upper Midwest Water Science Center, imevis@usgs.gov
11:45	**Sustainable Agriculture in Wisconsin?** John Skalbeck, University of Wisconsin - Parkside, skalbeck@uwp.edu
12:10	**Closing Announcements and Student Awards** **Registration Area (hallway)**
12:30	**Student Career Lunch** **Room: Briarwood/Ebony**

Lightning Talks
Thursday, April 25, 2024
12:35 p.m.

Helping the Public Understand the Drivers of Water Quality Change

Paul Dearlove, Clean Lakes Alliance, paul@cleanlakesalliance.org

Clean Lakes Alliance uses various tools to increase community awareness and understanding around the topic of water quality change. Learn how an innovative LakeForecast monitoring initiative, a first-of-its-kind "State of the Lakes" report card, and other strategies are used to track and communicate a variety of water quality health metrics around greater Madison, WI.

Sustainable Yield and the Groundwater Budget Myth

Anna Fehling, Wisconsin Department of Natural Resources, anna.fehling@wisconsin.gov

Sustainable groundwater use is a concept that has been discussed for decades but still is poorly defined and understood. In The Groundwater Budget Myth, Bredehoeft and others (1982) address the common misconception that sustainable pumping is achieved when the pumping rate equals the rate of recharge, a misconception that still prevails today. There is also confusion about what is meant by sustainable yield: even pumping at steady state (the traditional definition of sustainable yield) can harm water resources and other wells. In this talk we will revisit Bredehoeft's classic arguments and discuss misconceptions about groundwater use.

Let's Use Streams for Nitrate Monitoring in the Central Sands

David Hart, Wisconsin Geological and Natural History Survey, djhart@wisc.edu

Let's use streams for nitrate monitoring in the central sands. This can work because there is little runoff to streams in this region and we have a pretty good groundwater flow model to estimate the contributing zones to stream reaches. Benefits of this approach are ready and long-term access to the monitoring locations (possibly by canoe), no expensive infrastructure needed besides a bridge, it's scalable since if you want to check a larger area you can just go downstream, less likely to miss something since values represent an integrated concentration for an area and not just a single flow line to a well. Problems include "smearing" of results since values represent an integrated concentration for an area and not just a single flow line to a well, greater dependence on modeling results, might need to wait a long time to see any changes, especially if looking at a larger area, and additional stream bed and stream denitrification adds to confusion. In conclusion, maybe this will be useful and maybe not, but its ease of implementation (possibly by canoe) makes it worth a try.

Session 1A:
Agrochemicals Affecting Surface Water/Groundwater Quality
Thursday, April 25, 2024
1:05 p.m.

Evaluation of PFAS Leaching from Biosolids and Mitigation Potential of Biochar Through Undisturbed Soil Columns

Michael Holly, University of Wisconsin-Green Bay, hollym@uwgb.edu
Kpoti Gunn, UW-Green Bay
Daniel Keymer, UW-Stevens Point
Joseph Sanford, UW-Platteville

Land application of biosolids recycles nutrients and reduces the need for commercial fertilizers. However, per- and polyfluoroalkyl substances (PFAS) may leach from biosolids, resulting in groundwater contamination. We measured PFAS leaching from land applied biosolids through undisturbed soil column trials and evaluated the treatment potential of amending biosolids with biochar. Treatments consisted of a control (soil only), soil amended with biosolids, and soil receiving a mixture of biosolids and biochar. Concentrations of total PFAS in leachate were significantly affected by soil location and site history. One-time application of biosolids may result in groundwater contamination, as PFAS concentrations in leachate exceeded the local groundwater standard (a combined perfluorooctanoic acid and perflourooctanesulfonic acid groundwater concentration of 20 ng L-1) at three locations. Legacy PFAS may pose a risk to human health years after biosolid application, as a control column from a site with an intensive history of biosolid application exceeded PFAS groundwater standards. Incorporation of biochar with biosolids during application mitigated PFAS (specifically from soils with elevated leaching potential) through significant reductions of C7 – C10 perfluoroalkyl carboxylic acids and C4, C6 – C8 perfluorosulfonic acids (40 to 64% reduction in measured Σ28 PFAS).

Effect of groundwater contaminant mixture on gastrointestinal cell viability

Chamia Chatman,* University of Wisconsin-Madison, cchatman@wisc.edu
Erica Majumder, UW-Madison

The exposome represents the summation of endogenous and exogenous exposures which influence health outcomes. In our environment it is well documented that there is a plethora of chemicals detected in groundwater, air, or soil. Therefore, we aimed to elucidate the potential chemical-biological interactions and adverse outcome pathways associated with complex mixtures of agricultural chemicals detected in the 2021 Department of Agriculture, Trade and Consumer Protection's (DATCP) Groundwater Quality Report. We determined that Portage, Waushara, Waupaca, and Pepin counties contained levels of atrazine (ATR), nitrate (NO3-), and imidacloprid (IMI) either above the enforcement

* Student presentation.

standard or preventative action limit. However, chemical prioritization with toxEval indicated that only ATR had an exposure-activity ratio above the threshold of 0.001. Further evaluation of ATR, NO3- and IMI using checkerboard assays determined that combinations of 10 µg/mL of IMI + 10 µg/mL ATR and 10 µg/mL ATR + 1.25 µg/mL of NO3- causes the greatest growth inhibition to chicken cecal microbiome samples. In addition, Caco-2 cells exposed to this agricultural chemical mixture leads to decreased cell viability after a 24 h exposure compared to the equivalent mixture and each chemical singularly. In summary, the preliminary data suggests that an equipotent mixture leads to decreased cell viability after a 24 h exposure compared to the equivalent mixture and each chemical singularly.

Potential Synergistic Effects of Sorption and Biodegradation on Input of Imidacloprid to Wisconsin Central Sands Region Groundwater

Eric Roden, University of Wisconsin-Madison, eroden@geology.wisc.edu
Inna Popova, UW-Madison

Imidacloprid (IMD) and other neonicotinoid pesticides are relatively mobile and slow to degrade in soils, resulting in significant risk for input to groundwater. This is particularly true in environments like the Central Sands Region (CSR) of Wisconsin where soils are hydraulically conductive, and the water table is relatively shallow. We used literature data on IMD sorption properties and biodegradation kinetics to construct a preliminary one-dimensional model of IMD reactive transport in unsaturated sandy soils using the public domain software package Hydrus 1-D. Although the model is based on soil physical and hydrological information from the Hancock Agricultural Research Station, the goal of the work was to create a generalized tool that could project the long-term movement of IMD through the unsaturated zone under different scenarios of IMD sorption and biodegradation. The results indicate that both sorption and biodegradation individually delay/retard downward migration of IMD to the water table; however, neither process ultimately prevents contaminant breakthrough. In contrast, the presence of both sorption and biodegradation leads to a dramatic reduction in downward IMD transport, because sorption slows down the rate of migration through the unsaturated zone, thus allowing the relatively slow biodegradation process to take effect. Our findings highlight the need for specific information on the IMD sorption and biodegradation properties of CSR soils.

Agricultural Chemicals in Wisconsin Groundwater: DATCP 2023 Statewide Survey

Carla R. Romano, Wisconsin Department of Agriculture, Trade and Consumer Protection, carla.romano@wisconsin.gov

Between March and August 2023, the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) conducted a statewide survey to evaluate the presence of agricultural chemicals in Wisconsin groundwater. Using a random sampling approach, 380 private potable wells were selected for analysis, with around half of them being resampled from the 2016 survey. Samples collected were analyzed for 106 pesticide compounds and nitrate. The data unveiled that 43% of Wisconsin private

potable wells contained at least one pesticide or pesticide metabolite. Metolachlor ESA, alachlor ESA, and atrazine TCR (the sum of atrazine and atrazine metabolites) exhibited the highest detection rates among tested pesticide compounds. Nitrate and imidacloprid, a neonicotinoid insecticide, were the only compounds that exceeded health standards or health advisory levels. Statistical analysis explored relationships between detection rates and cultivated land or well properties. To assess temporal changes, a trend analysis was conducted for some of the detected compounds in private wells between prior surveys and 2023, revealing varied trends, with most exhibiting stable detection rates over time. This study offers a comprehensive overview of agricultural chemicals in Wisconsin groundwater, emphasizing the need for continued monitoring and regulatory measures to ensure private well water safety.

Session 1B:
Modeling 1
Thursday, April 25, 2024
1:05 p.m.

Stream Temperature Modeling to Assess Restoration Effectiveness in a Warming Climate

Ben Sellers,* University of Wisconsin–Madison, bsellers2@wisc.edu
Eric Booth, UW–Madison

Water temperature is a critical determinant in the health of stream ecosystems driven by groundwater discharge, shading, channel geometry, and air temperature. In a warming climate, watershed managers are interested in adapting stream restoration techniques to mitigate increasing stream temperatures. Our work centers on the West Fork Kickapoo (WFK) watershed in the central Driftless Area of Wisconsin, a highly regarded recreational trout fishery, due to its prioritization by non-profit and government-led habitat restoration projects. The WFK's fishery is a product of cold summer stream temperatures which were restored in the late 20th century through the introduction of soil conservation measures leading to more upland infiltration, recharge, and groundwater discharge to streams. However, these improvements are expected to reversed by the mid-21st century as air temperature increases due to climate change.

To predict the effect of future climate and management scenarios on stream temperature in the WFK watershed, thermodynamic and hydraulic models have been developed using Heatsource 9. Calibration and validation of this model leverages an observational dataset of stream conditions, compiled during the summer of 2023. This presentation will report the methods used in the modeling process as well as the results of modeled scenarios, including changes in channel geometry and shading, on stream temperature.

Forecasting Future Stream Temperatures in the Beaver Creek Basin in South Central Alaska

Andrew Leaf, U.S. Geological Survey, Upper Midwest Water Science Center, aleaf@usgs.gov
Megan Haserodt, USGS Upper Midwest Water Science Center
Benjamin Meyer, Kenai Watershed Forum
Stephen Westenbroek, USGS Upper Midwest Water Science Center
Joshua Koch, USGS Alaska Science Center

In many places, coldwater ecosystems are facing increasing pressure from anthropogenic warming. Groundwater discharge can buffer the effects of rising air temperatures but is also subject to warming depending on source depth(s) that are not always well understood. This study examined stream temperatures and the water balance for a small coastal watershed on the Kenai Peninsula in south central Alaska— an area that has some similarities to many parts of northern Wisconsin, including glacial geomorphology, cold winters and vulnerability to warm-season heatwaves. Baseflow separation

* Student presentation.

indicates an 80% baseflow component, but much of this could come from thermally sensitive riparian wetlands and shallow groundwater. In recent decades, observed maximum 7-day temperatures have consistently exceeded statistical (regression-based) projections. Here we simulate total streamflows and temperatures with a physics-based model that links the Soil Water Balance, MODFLOW 6 and SNTEMP codes on a 7-day timestep. Advantages of the physics-based model include insight into the spatiotemporal distribution of stream temperatures and how rising temperatures might affect the water balance. Absolute projections of stream temperature rise remain difficult to constrain due to sparse and potentially unreliable future climate projections, and uncertainty in the thermal sensitivity of the groundwater component.

Snakes on the Plain: Python Tools for Water Management on the Central Sand Plain (and Beyond)

Michael Fienen, U.S. Geological Survey, mnfienen@usgs.gov
Aaron Pruitt, Wisconsin Department of Natural Resources

Efficient evaluation of stream depletion and drawdown from new and existing wells is a cornerstone for the review and approval of high-capacity groundwater withdrawals in Wisconsin. Analytical solutions, implemented in spreadsheets, calculate potential impacts. Important limitations to the spreadsheet approach include: a limited number of wells/impacts to evaluate at one time; no mechanism to compare alternate solutions; and no framework in which to evaluate uncertainty.

We addressed these limitations through development of a python-based package called PyCap. In this modular framework, it is straightforward to evaluate combinations of proposed and existing wells with multiple impact points. Through superposition, the combinations of wells and impacts is practically unlimited. Furthermore, different solutions can be switched out easily in the modular framework. As a standalone code, we can leverage the PEST++ uncertainty analysis framework to evaluate the impacts of uncertain inputs on conclusions from the tool. By combining this python framework with a spreadsheet input file and using interactive Jupyter notebooks, WDNR staff make calculations without learning python.

The PyCap tool enables analyses on potential impacts in situations that would have otherwise required a numerical model at a fraction of the investment needed for developing such model. The introduction of uncertainty analysis allows the WDNR to incorporate the likelihood of impacts into their decisions.

Using a Farmer Survey-Informed SWAT+ Model to Examine Disproportionality of Nutrient Loading in a Wisconsin Watershed

Andrew Hillman,* University of Wisconsin-Madison, adhillman@wisc.edu
Amber Mase, UW-Madison Division of Extension
Margaret Kalcic, UW-Madison
Anita Thompson, UW-Madison
Ken Genskow, UW-Madison
Joe Bonnell, Wisconsin Department of Natural Resources

* Student presentation.

Disproportionality in watershed science refers to the hypothesis that in many watersheds, a majority of pollutants can originate from a small number of high-risk source areas, which in the Midwestern context are often agricultural fields. The level of disproportionality in a watershed is governed by two major factors, farmer behavior (management) and the physical landscape. In this study, a SWAT+ (Soil and Water Assessment Tool Plus) model was augmented with management information from a farmer survey to investigate disproportionality in the Sinsinawa Watershed in Grant County, WI and Jo Daviess County, IL. The farmer survey was administered in early 2023 by mail and contained questions about farm operations, conservation attitudes and adoption, and nutrient management practices. The SWAT+ model used for this study simulates nutrient losses at the field-scale. Management of the fields, in terms of conservation practices and nutrient management, is based on specific survey responses. This results in simulated management that is more reflective of local conditions as a baseline. The model will be run in various scenarios to isolate the impact of both management and the physical landscape on disproportionality, compared to the baseline. Understanding in what ways farm management and the physical landscape affect disproportionality of nutrient loading has ramifications for water quality policy design, outreach programs, and further research across the Midwestern U.S.

Session 1C:
Green Infrastructure
Thursday, April 25, 2024
1:05 p.m.

Rapid Assessment of Green Infrastructure to Identify Factors that Affect System Longevity

Maria Danz, U.S. Geological Survey, medanz@usgs.gov

Impermeable surfaces prohibit the natural infiltration of precipitation into the soil. Because infiltration plays a key role in water retention and pollutant removal, urban centers can contribute to flooding and surface water contamination. Green infrastructure (GI) practices have been widely implemented to mitigate some of these consequences. A shortfall of GI systems is their potential to become ineffective over time. The goal of this investigation was to identify controlling factors leading to long term functionality of one of the more widely used forms of GI: biofiltration systems. A rapid assessment technique was developed to measure readily available parameters that influence the success or failure of a system. This protocol was utilized by USGS offices in seven states to collect data from biofilters across a variety of soils, age, vegetation, and construction designs. The aggregated data was evaluated using a SHAP (SHapley Additive exPlanations) analysis model to identify which of the 37 quantitative and qualitative parameters have the highest influence on functionality. Infiltration rate was used as the primary indicator of functionality. Results can be used to assist the decision-making process for future GI implementation by identifying which parameters have most influence on performance.

Applying End of Pipe Treatment to Green Stormwater Infrastructure with Flow Modulation of Both Active and Passive Controls to Improve Sediment Removal

Joseph Branca,* Marquette University, joseph.branca@marquette.edu
Walter McDonald, Marquette University

Stormwater runoff from urban surfaces transports pollutants, such as suspended solids, to downstream water bodies, leading to significant degradation of water quality. Green stormwater infrastructure (GSI) can mitigate these pollutants; however, the concentrations of pollutants in the effluent of GSI can still be high relative to influent concentrations. The goal of this study is to address this challenge by integrating end-of-pipe treatment baffles into GSI underdrains as a final treatment step to remove particulate pollutants. To meet this goal, two end-of-pipe baffles with flow modulation were designed, tested in a laboratory, and installed at the underdrain of two bioswales located in Milwaukee, WI. For captured storm events, solids in the baffles were vacuumed, dried, weighed, and sieved. Results indicate that the baffles are able to provide additional solids removal from the underdrain of GSI. The outcomes of this study aim to provide valuable insights into additional treatment steps for GSI that can help to improve pollutant mitigation and protect downstream water quality.

* Student presentation.

Remote Sensing and Machine Learning Application to Urban BMP Monitoring

Matt Dupasquier,* Marquette University, matthew.dupasquier@marquette.edu
Walter McDonald, Marquette University

The advancement of green infrastructure best management practices (BMP's) in urban cities has led to increased operations and maintenance costs. One way for municipalities to achieve cost-savings is through automated monitoring that can quickly assess operations and maintenance needs; however, existing cost-effective technologies to do so are limited. Remote sensing data from drones and satellites may be able to meet this gap through high spatial and spectral resolution data. This data can be analyzed to gain information on BMPs that can augment or replace information gained from in-person surveys of BMP sites. The goal of this study is to apply machine learning algorithms to remotely sensed satellite and drone data to classify imagery of BMP sites into categories that can be used to assess maintenance needs. To do so, high resolution drone and satellite imagery collected in 2022-2023 were utilized to classify 9 BMPs in Milwaukee, WI into 4 landcover categories (healthy plants, unhealthy plants, dead plants and organic material, and inorganic material) using machine learning algorithms. Results found that supervised machine learning algorithms were able to yield accurate results when classifying both drone imagery (>85%) and high-resolution satellite imagery (>65%). These models were used in summer and fall 2023 to identify and check BMP sites within Milwaukee, WI to assess maintenance needs. Overall, the models have demonstrated potential for future research and development.

Mitigating Antibiotic Resistance in the Environment: Evaluating the Potential of Green Stormwater Infrastructure

Kassidy O'Malley,* Marquette University, kassidy.omalley@marquette.edu
Walter McDonald, Marquette University
Patrick McNamara, Marquette University

Urban stormwater is a concern for the dissemination of emerging contaminants, specifically antibiotic resistance genes (ARGs). Stormwater can transport ARGs downstream, including into green stormwater infrastructure (GSI), where ARGs can accumulate and potentially become long-term reservoirs for resistance. However, the capability of GSI to remove ARGs and their impact on ARG diversity in stormwater remain uncertain. This study aims to determine how GSI bioretention systems alter the concentration and diversity of ARGs in urban stormwater runoff. To do so, stormwater samples were collected at three points: (1) effluent of a storm drain diverting runoff from a highway overpass, (2) effluent of a consecutive rock swale, and (3) the underdrain of a bioretention basin representing the effluent of the entire system. The analysis of stormwater samples consisted of qPCR to measure ARG removal rates through the bioretention system, metagenomic sequencing to explore ARG diversity in stormwater and assess how GSI influences this diversity, and combining the samples with surface water to monitor the impact of GSI effluent on ARG abundance and diversity in surface water. Results from this analysis will be presented, as well as a comparison of the concentration and diversity of ARGs in GSI effluent with those in a traditional storm drain outfall. From these outcomes we will determine the potential of full-scale GSI systems for reducing the risk of ARG dissemination in urban stormwater.

* Student presentation.

Session 2A:
Water Quality
Thursday, April 25, 2024
3:00 p.m.

Quantifying Leachable Phosphorus from Common Urban Tree Species

Collin A. Klaubauf,* University of Wisconsin-Madison, klaubauf@wisc.edu
Laxmi R. Prasad, UW-Madison
William R. Selbig, U.S. Geological Survey
Anita M. Thompson, UW-Madison

Urban runoff containing high amounts of nutrients like nitrogen (N) and phosphorus (P) has long been established as a driver of surface water eutrophication. In residential areas, a primary source of nutrients is derived from leaf litter and other organic debris. P contained in leaves is leached and transported by stormwater to surface water at end-of-pipe locations. The majority of P is in the dissolved phase which can be difficult to remove using conventional treatment practices, leaving source control as the only viable option. Additional tools are needed to help forecast how different tree species may improve or hinder contributions of nutrients to runoff. For this reason, 10 common street tree species from around the country were chosen to evaluate the effect of species and regional climate on leachable P from tree leaves. Laboratory experiments were conducted to characterize P leaching dynamics and statistical models will be developed to predict time variable P release from different species. This information will be integrated into a modified version of the U.S. Forest Service's iTree model to provide locally-specific estimates of impacts on stormwater volume reduction and water quality changes for a different mixture of tree species. Results of the new i-Tree model can then be used to not only provide an assessment of current conditions but also help managers gain insight by proactively tailoring a future planting scenario that minimizes nutrients in runoff.

Perchlorate, Metals, Organic Compounds, and Lead Isotopes in Groundwater, Surface Water, Shallow Groundwater, and Soil Within and Near the Middleton Municipal Airport, Middleton, Wisconsin, 2022

Laura Schachter, U.S. Geological Survey, lschachter@usgs.gov
Todd Stuntebeck, USGS

The USGS, in cooperation with the Town of Middleton, completed a study to characterize the occurrence and sources of perchlorate, selected metals, and selected organic compounds in samples of groundwater, surface water, shallow groundwater, and soils within and near the Middleton Municipal Airport. The airport is a regional, general aviation facility located within the City of Middleton, Wisconsin that has hosted an annual fly-in event. In July 2021, the event featured a fireworks display, and recent studies show a relationship between the presence of perchlorate and selected heavy metals in water resources and soils following firework displays.

* Student presentation.

For this study, almost all perchlorate concentrations were below the limit of detection, except one groundwater sample and one surface water site on the southern edge of airport property, at which the highest concentration of perchlorate (2.2 ug/L) occurred near the peak of a June 2022 runoff event. Several metals associated with fireworks (e.g. titanium, barium) had notably elevated concentrations in shallow groundwater and soils in sites immediately adjacent to or downgradient of the fireworks launch location. Lead was below the screening limit of detection in all drinking water samples, and lead isotope analysis suggests a mixture of sources from the environment and aviation fuel. Organic compounds related to fuels and solvents were detected in a selection of surface water samples, both upgradient and downgradient of the Airport.

Aquifer Microbial Reduction-Oxidation Reactions at a Uranium Contaminated Site

Catherine Pettinger,* University of Wisconsin-Madison, cpettinger@wisc.edu
Allondra Woods, UW-Madison
Ray Johnson, RSI EnTech, LLC, Contractor to the U.S. Department of Energy Office of Legacy Management
Charles Paradis, UW-Milwaukee
Erica Majumder, UW-Madison

Groundwater contamination at uranium mill sites continues to present a challenge at sites across the United States and the world. Typical remediation strategies take advantage of microbial reduction reactions to immobilize uranium; generally U(VI) is more soluble compared to U(IV). However, this strategy is limited by U(IV) abiotic reoxidation if strong reducing conditions are not maintained. This study aims to decipher microbial contribution to U speciation during and after oxic carbonate-poor injections followed by oxic carbonate-rich injections at a former uranium mill site near Riverton, WY. We performed nine redox tests on groundwater microorganisms collected at the site in August 2023 compared to sterile groundwater controls. Sites tested included within, upgradient, and downgradient of the former source zone. From these it was seen that microorganisms at various locations across the aquifer are capable of Fe, Mn, and SO4 reduction. These microbial reactions could influence U mobility through depletion of Fe- and Mn-oxides that create sorption sites for U. If U is bound to metal oxides, then activity changes of these microorganisms due to injections will change U mobility. Continued experiments are being conducted to decipher how the microbial community responds to injection conditions and how this influences uranium speciation.

Water Quality Analysis of Tributaries in the Geneva Lake Watershed

Dale Splinter, University of Wisconsin-Whitewater, splinted@uww.edu
Jeff Olson, UW-Whitewater

Important aspects of the water resources in Wisconsin are enhancing, maintaining, and sustaining them for future generations. Assessing water quality is a key entity in the preservation of this valuable natural resource. A study was designed to assess the status of water quality indicators (TSS, TP, N, TKN, NH3) in

* Student presentation.

tributaries entering Geneva Lake in southeast Wisconsin. Within the Geneva Lake watershed 16 locations were selected for sampling in 2021. In 2022, two additional sites were added to the sampling design. Sampling was designed following the 2020 WisCALM methodology. The water samples analyzed in this study were collected over a six-month period and analyzed at the Wisconsin State Lab of Hygiene. Results indicate that spatial differences exist in water quality across the watershed. The tributary with the highest TP entering the lake is Big Foot Creek. Using a formula provided from the WDNR, Big Foot Creek clearly exceeded the water quality criterion of 0.075 mg/L. The highest values of TKN and NH3 are also located in Big Foot Creek. The highest values (8.44 mg/L) of nitrate and nitrite (as N) are found in an unnamed tributary between Williams Bay and Fontana. Values are more than double any of the other tributaries in the watershed. Continued investigations and analysis are ongoing, but it appears that landcover plays a role in the spatial distribution of water quality in the watershed.

Fecal Source Tracking for Antibiotic Resistance Genes in Private Wells in Southwest Wisconsin

Joel Stokdyk, U.S. Geological Survey, jstokdyk@usgs.gov
Sarah Opelt, U.S. Department of Agriculture
Aaron Firnstahl, USGS
Rachel Cook, USDA
Joe Heffron, USDA
Tucker Burch, USDA
Maureen Muldoon, Wisconsin Geological and Natural History Survey

Antimicrobial resistance poses a significant public health problem, with 2.8 million drug resistant infections annually in the United States. Groundwater is a reservoir of antibiotic resistance genes (ARGs), which originate in human wastewater and livestock manure. However, the relative contribution of livestock and human feces to ARG contamination of water is unknown because few studies consider multiple fecal sources simultaneously. We examined ARG occurrence for private wells in southwest Wisconsin where groundwater is influenced by septic systems, cow manure, and pig manure, which are potential sources of ARGs. Samples collected across 4 seasons were tested for 13 ARGs and 17 microbial source tracking markers for wastewater and livestock manure. Private wells (n = 138) were contaminated by human wastewater (64 wells), cow manure (33 wells), and pig manure (13 wells). Of 138 wells, 120 were positive for at least one ARG, and 66% of ARG detections co-occurred with human wastewater or livestock manure. The likelihood of detecting individual ARGs differed by fecal source, with detection of some ARGs more likely with wastewater than manure and vice versa. Total ARG detections associated with wastewater was greater than manure, consistent with the greater frequency of wastewater-positive wells. Examining ARGs where multiple fecal sources influence wells allows a novel assessment of the relative contributions of manure and septic systems to ARG occurrence in groundwater.

Session 2B:
Hydrogeology
Thursday, April 25, 2024
3:00 p.m.

Decisions in Depth-to-Bedrock and Groundwater Mapping, Data Driven Versus Geologic Interpretation

David Hart, Wisconsin Geological and Natural History Survey, djhart@wisc.edu
Lisa Haas, WGNHS
Matt Rehwald, WGNHS
Esther Stewart, WGNHS

Hydrogeologists routinely use and interact with both depth to bedrock, water table, and potentiometric surface maps in their work but they might not have considered how the maps were created. Maps are interpretations of data and here at the WGNHS we recognize different strategies for creation of maps. Two common strategies include a data driven approach versus geologic and hydrogeologic interpretation. It is important to understand some of the advantages and issues with these two approaches when viewing and using these maps.

We provide two pairs of examples to understand the differences between these approaches. The first pair of contrasting mapping approaches are depth to bedrock interpretations for the Silurian dolomite in Dodge County. In the data driven instance, the data was input into a geostatistical algorithm in ArcGIS Pro to create the map. Some decisions were made on the data weighting and kriging parameters but the results were not manually altered. In contrast, when applying the geologic interpretation approach, all lines were drawn by hand, taking into account the geologic processes such as bedrock and glacial erosion and deposition while matching the available data. The second pair of maps are water table maps for Juneau County where one map used the kriging method and the other was drawn by hand.

Proper use of these maps is improved by understanding the methodologies used in their creation.

Use of Airborne EM Survey for Hydrogeologic Characterization for Regional High-Capacity Water Supply Development, Wabash River, Indiana

Pat Jurcek, INTERA, pjurcek@intera.com

As part of a large industrial development program, Indiana has proposed to develop a 50 to 100 million gallon per day (mgd) ground water supply in an alluvial aquifer adjacent to the Wabash River. Horizontal collector wells will need to be located where sufficient permeable sand and gravel deposits are present and hydraulically connected to the Wabash River. An airborne EM (AEM) survey was conducted in July 2023 over an approximately 12 square mile area to further characterize the hydrogeologic properties of the unconsolidated aquifer and Wabash River stream bed. The AEM data was processed and inverted to produce 2-D and 3-D electrical resistivity models of the unconsolidated aquifer. Test borings, domestic well logs and high-capacity irrigation well logs were incorporated into

the geophysical inversion modeling to improve model resolution. Model results generally had better correlation with test borings as compared to the domestic and irrigation well logs. The AEM survey was able to estimate the depth to bedrock, the inferred water-table, and lateral and vertical variations in lithology in the unconsolidated aquifer. The AEM survey results will be used to identify potential horizontal collector well sites where additional work exploratory work will be conducted to estimate safe yield. AEM results will also be incorporated into a regional ground water flow model needed to assess the impact of planned water withdrawal on the Wabash River alluvial aquifer system.

Groundwater Demand and Assessment of Wisconsin's Crystalline Aquifer

Madeline Gotkowitz, Wisconsin Department of Natural Resources, madeline.gotkowitz@wisconsin.gov
Anna Fehling, WDNR
Rachel Greve, WDNR

Most of Wisconsin benefits from prolific groundwater resources or access to fresh water from the Great Lakes basin. However, water supply in much of north-central Wisconsin is limited to groundwater pumped from low-storage crystalline bedrock formations. Although this aquifer yields little water to wells, fractured crystalline rock is the only available target for groundwater development where sand and gravel deposits are thin or absent.

To meet water demand, villages, dairies and cheese plants in western Marathon County drill clusters of low-yield wells and manage these well fields across large properties. The Department of Natural Resources' High-Capacity Well Program regulates wells on properties where total capacity exceeds 70 gallons per minute. When reviewing applications for new wells, we assess drawdown and stream depletion near the well field using hydrologic parameters derived from published studies of Wisconsin's crystalline aquifer and similar geologic settings. However, the site-specific nature of discrete fracture networks leads to high uncertainty in our local-scale estimates of groundwater drawdown and recovery. To improve our understanding and analysis of hydrologic resources in this region, the DNR is focusing on improvements in metering water use and increasing groundwater level monitoring. Although more data won't make more water, better information may improve risk assessment and help identify avenues for additional water conservation.

USGS National Water Use Estimates: A Wisconsin Perspective

Will Dougherty, Wisconsin Department of Natural Resources, william.dougherty@wisconsin.gov

In November 2023, the United States Geological Survey released nationwide water use estimates for irrigation, public supply, and thermoelectric power generation at a monthly, HUC 12 resolution. This dataset is structured to provide a consistent input dataset for Integrated Water Availability Estimates, but it is also directly comparable to the monthly water use withdrawal reporting DNR collects on an annual basis groundwater and surface water users.

Comparing the two datasets identifies differences between the modeling estimation techniques employed by the USGS and the user reported withdrawal volumes collected by the DNR. The comparison of the datasets also highlights the appropriateness of using each dataset to answer specific

questions. This presentation will highlight key differences between the USGS datasets and Wisconsin's reporting data; preliminary analysis shows large differences in thermoelectric water use while irrigation and municipal estimates tend to be closer.

Enhancing and Quantifying Groundwater Recharge: Insights from Field Experiments and Infiltration Modeling

Samuel Brockschmidt,* University of Wisconsin-Madison, sbrockschmid@wisc.edu
David Hart, Wisconsin Geological & Natural History Survey
Dante Fratta, UW-Madison
Samantha Krueger, UW-Whitewater
Michael Cardiff, UW–Madison

With climate change creating uncertainty about Wisconsin's future climate, securing Wisconsin's groundwater quantities is critical. Therefore, increasing clean groundwater recharge, particularly in rural areas where irrigation water use and evapotranspirative losses are both high, can help increase our groundwater resources' security. Several passive methods for enhancing recharge exist, such as drywells and infiltration trenches, but limited work has been published assessing the efficacy of these techniques in rural settings. We conducted a series of field experiments in July and August 2023 near a planted crop field in southern Wisconsin to investigate the effectiveness of recharge enhancement techniques compared to natural conditions. We also developed 1D and 2D numerical simulations of the experimental conditions to compare with our field experiments. In this presentation, we present an analysis of our experiments and simulation results to examine the quantity of groundwater recharge and how this recharge impacts water chemistry and quality using recharge enhancement methods.

* Student presentation.

Session 2C:
Management & Communication
Thursday, April 25, 2024
3:00 p.m.

Rural Resident Perceptions of Wisconsin's Waters

Catherine Christenson,* University of Wisconsin-Madison, cchristenso4@wisc.edu
Michael Cardiff, UW-Madison
Ken Genskow, UW-Madison
Bret Shaw, UW-Madison

A state-wide survey was conducted in Wisconsin to assess rural residents' perceptions of water safety and availability, perceived risks to water, sources of information on which they rely, and how water is used and treated in the home. Surveys were sent via mail to 1,500 randomly-selected households across 16 counties in Wisconsin between April and June 2023. 481 survey responses were received. Results indicate that while many rural residents had confidence in the safety of their water for all purposes (60%), they also perceived significant risks associated with water quality. Residents perceived quite a bit or a great deal of risk from pesticides (47%), PFAS (39%), and nutrients (34%) in water supplies. In contrast, less than 20% of respondents perceived significant risk from factors that influence water supply. About 60% of rural residents reported seeing little to no information about water in their community, and the most used sources of information related to water issues include local news and friends/family or neighbors. The highest levels of trust as sources of information were for water experts including private well testers and staff at state/federal regulatory agencies, county conservation departments, and the UW System. Perspectives on specific risks varied geographically across the state, indicating a localized perspective on water risks. Our results indicate that water professionals in the state can improve communication strategies to reach rural populations.

Developing Stakeholder Relationships and Addressing Natural Resource Issues at a Watershed Scale: A Case Study in the Black Earth Creek Watershed

Nicolas Buer, U.S. Geological Survey, nbuer@usgs.gov

Water resource problems affecting communities are complex and can take large investments of money and expertise to understand and fix. A common challenge is securing funding to bring projects that address water resource issues to fruition. It's often difficult to secure funding through traditional approaches (e.g., grants) or to find a single funder to support the work. This presentation will highlight an approach the USGS has used to build support for water quality projects, involving collaboration with regional entities to develop local stakeholder relationships and a grassroots funding model. Working with multiple local entities within a region, we have been able to develop funding for large scale, multi-year monitoring projects. This approach requires more time and effort due to the need for continuous communication with prospective cooperators; however, the benefits to this approach are numerous, including an involved, informed, and supportive base of local and regional stakeholders. Cost sharing

* Student presentation.

also decreases the overall burden on individual stakeholders while providing a stable funding base. Recently, this model was successfully used to continue and expand monitoring efforts across the Black Earth Creek Watershed near Madison, Wisconsin to inform citizens and emergency managers about changes in water quality and quantity due to climate change and urbanization. Here, we'll discuss the lessons learned and approaches for developing this type of funding model.

Soil Health and Water Quality Intersections in Agriculture

Jessica Jurcek,* Minnesota Department of Agriculture, jurcek@wisc.edu

Expanding the adoption of soil health practices on farms is key to protecting water quality and building resilience to climate change. However, the specialized and expensive equipment required to incorporate these practices into a farming operation creates a barrier to their adoption at a greater scale even after producers are convinced of the benefits of soil health practices. Minnesota is addressing that challenge by providing up to 50% cost-share for soil health equipment through the Soil Health Financial Assistance Program (SHFAP). Learn about the successes, challenges, and trajectory of this novel public financial assistance initiative. The SHFAP began with a $500,000 appropriation to test the interest in soil health equipment grants. The response was overwhelming, with more than 230 applications requesting a total of more than $6.5 million. Recognizing the demand, the Minnesota Legislature awarded an additional $4.75 million to the program over the 2024 to 2025 biennium. Presenters will provide details about how support for the SHFAP was built through a series of stakeholder meetings, outreach, and other engagement led by key state agricultural organizations. Providing cost share for the purchase of soil health equipment is an effective vehicle through which to achieve state water quality goals. Presenters will share how Minnesota achieved the implementation of this novel program, focusing on how other states can implement similar opportunities.

Shoreland Improvements or Disturbances: A Hedonic Price Model for Northeastern Wisconsin

Susan Borchardt,* University of Wisconsin-Milwaukee, borcha48@uwm.edu
James Price, UW-Milwaukee

Shoreland development, encompassing features such as boat lifts, manicured lawns, artificial beaches, and erosion control measures, yields significant benefits for property owners. Nevertheless, this development is linked to heightened sediment and pollutant loading, which, in turn, adversely affects aesthetics, recreation, and habitat conditions for fish and other aquatic species. In this study, a hedonic property model was employed, analyzing 847 property sales along Wisconsin inland lakes. The model considered various shoreland development features, using data from 62 lakes surveyed comprehensively under the Wisconsin Department of Natural Resources (WDNR) Lake Shoreland and Shallows Habitat Monitoring Program. Results show positive correlations between sales prices and certain development features, including artificial beaches, erosion control measures, and structures in the littoral zone, after controlling for housing characteristics and lake fixed effects. On the other hand, features such as manicured lawns, floating and emergent plants, and structures in the riparian zone showed no significant correlation with prices. To gauge the welfare effects of shoreline development,

* Student presentation.

property owner's willingness to pay values were derived from the hedonic model. These values can be compared to the welfare loss stemming from sediment and pollutant loading caused by development to inform shoreland management decisions.

Quantifying the Impact of Land Use on Treatment Costs: A Study of Municipal Groundwater Systems in Wisconsin

James Price, University of Wisconsin-Milwaukee, priceji@uwm.edu

Safeguarding source waters from contamination is often considered an essential component of drinking water provision. Whether these efforts are cost-effective relative to in-plant treatment options requires an understanding of hydrological, chemical, and biological processes, as well as knowledge of how treatment costs are affected by changes in source water quality. Quantitative evidence on the latter relationship is limited. This study estimates cost functions for municipal groundwater systems in Wisconsin, which relate treatment cost to production volume, factor input prices, and source water quality, where water quality is proxied by the amount of cropland in proximity to wellheads. Results suggest that, on average, increasing cropland relative to other land types by 1% is associated with a 0.23% increase in variable treatment costs and a 0.36% increase in total treatment costs. These relationships, however, vary according to factors like the static well level, casing depth, and well depth. The findings offer insight into the potential avoided-cost benefits of wellhead protection.

Poster Session
Thursday, April 25, 2024
7:00 – 9:00 p.m.

Quantifying Neonicotinoid and Nitrate Leaching Potential from Potato Production at Field Scale

Carl Betz,* University of Wisconsin-Madison, cbetz2@wisc.edu
Geoffrey Siemering, UW-Madison
Matthew Ginder-Vogel, UW-Madison
Francisco Arriaga, UW-Madison

Neonicotinoids are a class of insecticides widely used in agriculture; they are highly toxic to insects but less toxic to mammals than alternatives such as carbamates or organophosphates. Concerns have arisen, however, over the safety of neonicotinoid insecticides due to the possibility of negative impacts on nontarget organisms. The Central Sand Plain of Wisconsin, a region with a high level of vegetable production, has coarse, well-drained soils and a shallow water table which make the area vulnerable to groundwater contamination from agrochemicals. The Wisconsin Department of Agriculture, Trade, and Consumer Protection has detected neonicotinoid insecticides in groundwater in the Central Sand Plain. Nitrate concentrations in private wells and irrigation wells are also frequently above the maximum contaminant level for drinking water set by the United States Environmental Protection Agency. Our research uses passive capillary wick lysimeters to quantify the leaching potential of neonicotinoids and nitrates from potato fields under different management practices.

Health Risk from Waterborne Human and Livestock Pathogens During Swimming, Kayaking, and Fishing

Tucker Burch, U.S. Department of Agriculture-ARS, tucker.burch@usda.gov
Joel Stokdyk, U.S. Geological Survey
Aaron Firnstahl, USGS
Sarah Opelt, USDA-ARS
Rachel Cook, USDA-ARS
Joseph Heffron, USDA-ARS
Amanda Brown, Polk County Conservation
Claire Hruby, Drake University
Mark A. Borchardt, USDA-ARS, retired

Many recreational waterways can become contaminated by pathogens from humans and livestock. These pathogens cause acute gastrointestinal illness (AGI) when ingested during recreational water use, but prevailing levels of health risk for many sites and activities are unknown. We assessed risks posed to recreators during swimming and limited contact activities like kayaking and fishing for six sites on rivers in the Des Moines, Iowa metropolitan area. Water samples (n = 147) collected over two years were tested for a variety of waterborne pathogens, and AGI risk was estimated using quantitative microbial risk assessment (QMRA). Risk estimates varied from 1 to 83 AGI cases per 1,000 recreators depending

* Student presentation.

on site and activity. Swimming risk for two sites exceeded USEPA's 2012 acceptable risk benchmark of 36 AGI cases per 1,000 recreators. Risk estimates for other sites and limited contact activities were generally below the benchmark. Risk was examined relative to the presence of human, cow, pig, and bird feces using microbial source tracking to provide insights about the sources of elevated health risk; risk was highest when multiple fecal sources were present. Elevated concentrations of the fecal indicator *E. coli* did not always match periods of elevated AGI risk determined by QMRA. Results inform risk mitigation initiatives at the sites studied and provide context for understanding risk associated with similar activities and sites in Wisconsin and other Midwest states.

Evaluating Association of Runoff Risk Advisory Forecasts with Private Well Contamination in Kewaunee County, WI

Rachel Cook, U.S. Department of Agriculture-ARS, rachel.m.cook@usda.gov
Sarah Opelt, USDA-ARS
Aaron Firnstahl, U.S. Geological Survey
Jessica Sherman, USDA-ARS
Tucker Burch, USDA-ARS
Joseph Heffron, USDA-ARS

Rural residents use private wells for drinking water in northeast Wisconsin. Groundwater quality can change rapidly in the region's fractured bedrock aquifer, but residents lack the means to assess real-time water quality in their wells. We aim to evaluate the Runoff Risk Advisory Forecast (RRAF) system for alerting private well users to degraded water quality. RRAF is an online tool, developed by the National Weather Service, for predicting risk of manure runoff to surface water. Previous work suggests its predictions may also be associated with groundwater contamination. To evaluate these associations, 36 private wells in Kewaunee County were sampled throughout 1 year during a range of RRAF predictions. Water samples (n = 205) were tested for fecal indicator bacteria (FIB: total coliforms, E. coli, and Enterococci), human and bovine microbial source tracking (MST) markers, and nitrate. Overall, 19 wells were positive for at least one FIB or MST marker, and nitrate concentrations averaged 2.4 mg NO3-N/L (median 0.036 mg NO3-N/L). Nine wells were positive for FIB or MST markers in multiple sampling events, including 1 well positive in 5 of 6 events. FIB detections were most common in spring and fall, while MST detections were most common in February. Nitrate concentrations varied by well ($p < 2\times10^{-16}$) and sampling event ($p = 0.017$). These data delineate temporal variability in the study area's groundwater quality and enable evaluation of its association with RRAF predictions.

Modified Phragmites Biochar for Phosphorus and Nitrogen Removal in Agricultural Runoff Treatment Systems

Jordan Deau,* University of Wisconsin-Green Bay, deauja11@uwgb.edu
Michael Holly, UW-Green Bay
Sean Babasin, UW-Green Bay

* Student presentation.

Phragmites Australis biochar was evaluated as a sustainable solution to remove dissolved phosphorus (P) and nitrogen (N) from agricultural runoff. Modifications were made to the phragmites prior to pyrolysis which include the addition of aqueous metals and activating using a strong base. Cement and lime were added to biochar and then subsequently pelletized to create a media with mechanical strength. The modified media were tested using bench-scale flow through columns with a hydraulic retention time of one minute and an influent phosphate/nitrogen concentration of 0.5mg P L-1 and 0.2 mg N L-1 respectively. At hour 40, the P sorption (g/kg) highest performing medium was treated with calcium chloride treatment at 1.77 g P kg-1, followed by the unmodified phragmite biochar at 1.39 g P kg-1, and the strong base activated media at 1.37 g P kg-1. At hour 40, N sorption (g/kg) was greatest for the potassium hydride treated biochar followed by the unmodified biochar pellet 1.84 g N kg-1, and the unmodified phragmite biochar at 1.18 g N kg-1. Further modifications and treatment are required prior to field adoption for runoff treatment (i.e. desorption capabilities, optimization of metal additions) and field scale evaluation.

Alternative Hemodialysis Ultrafilter for Sampling Microbes in Water

Aaron Firnstahl, U.S. Geological Survey, Upper Midwest Water Science Center, afirnstahl@usgs.gov
Gabi Doughan, Iowa State University
Sarah Opelt, U.S. Department of Agriculture-Agricultural Research Service
Rachel Cook, USDA-ARS
Joel Stokdyk, USGS, Upper Midwest Water Science Center
Tucker Burch, USDA-ARS
Joseph Heffron, USDA-ARS
Mark Borchardt, USDA-ARS
Locke Karriker, Iowa State University

Pathogen concentrations in groundwater are often low and require concentrating large sample volumes for reliable detection. Dead-end ultrafiltration is a standard method for capturing a wide variety of viruses, bacteria, and protozoa from water. The Asahi Kasei Rexeed™ hemodialyzer is the most widely used ultrafilter for pathogen sampling and is cited in standard methods of the Environmental Protection Agency, Centers for Disease Control and Prevention, and Food and Drug Administration. However, Asahi Kasei operations have concluded in the United States, so a suitable replacement hemodialyzer is needed. Our objective was to evaluate the recovery of another commercially available hemodialyzer (Nipro Elisio™) and compare it to the Asahi Kasei Rexeed™ hemodialyzer. Seven microbes (2 bacteria, 4 viruses, and 1 protozoa) were added to 10L of dechlorinated tap water and concentrated using both hemodialyzers (n=6). After concentration, samples were analyzed by qPCR, and results were compared to control samples (n=6) to evaluate recovery. Recovery efficiencies ranged from 17% to 98% (Rexeed™) and 10% to 100% (Elisio™) depending on microbe, and recoveries for each microbe were comparable between the two filter types. Both filters had a better recovery for protozoa than bacteria and viruses. Results demonstrate the Nipro Elisio™ hemodialyzer is a viable alternative to the Asahi Kasei Rexeed™ hemodialyzer for large volume dead-end ultrafiltration.

Inventory and Analysis of Flowing Artesian Wells in Bayfield County, WI

Grace Graham,* Wisconsin Geological and Natural History Survey, grace.graham@wisc.edu
Sue Swanson, WGNHS
Pete Chase, WGNHS

The Wisconsin Geological and Natural History Survey (WGNHS) recently completed an inventory and analysis of flowing artesian wells in Bayfield County, WI. Working in cooperation with Bayfield County, and funded by the WDNR, the goals of the project were to map the distribution of flowing wells, and to conduct field visits and water sampling at a geographically representative selection of wells.

Records of 166 flowing wells were identified from well construction reports, other maps or archives, and by word-of-mouth. Historical values of artesian head were available for 57% of the records and historical flow rates were available for 25% of the records.

Field surveys of 50 flowing wells were conducted in October 2022. The surveys described location, water use, well construction, one-time flow rate, minimum potentiometric surface elevation, and water chemistry conditions as measured in 2022. Overall, water quality in Bayfield County's artesian aquifer is high. Many parameters that indicate human influences on water quality (for example sodium, chloride, nitrate) were measured at background levels or not detected. Hierarchical cluster analysis of well water quality revealed two distinct clusters, and suggests differences in groundwater residence times and amounts of mixing along flow paths.

Determining Flow Rates and Flow Sources in Pipes Using Temperature Data

Omar Hegazy,* Marquette University, omar.hegazy@marquette.edu
Walter McDonald, Marquette University

Sanitary sewer systems are subject to infiltration and inflow (I/I) from rainfall events where unwanted stormwater enters into the sewer network. This can cause sewage backups and overload at wastewater treatment plants, resulting in sanitary sewer overflows or basement backups that pose serious risks to human and environmental health. Determining sources of I/I requires extensive monitoring that is either spatially limited to discrete points that must infer upstream processes or subject to dry weather methods (CCTV, smoke testing, etc.) that cannot capture I/I during peak events. This study aims to overcome these shortcomings through a novel approach to monitoring the volume of I/I entering sewer systems through Distributed Temperature Sensing (DTS) that can estimate flow rates at 1-m increments throughout a sewer system. To do so, this study seeks to (1) establish a correlation between water inflow volumes and temperature across different environmental conditions and (2) improve estimates of flow using temperature measurements and conservation of mass and energy principles. Preliminary results indicate that flow estimates based upon temperature may be able to identify and quantify specific sources of I/I. The outcomes of the proposed approach may be able to capture sewer flows at unmatched spatial and temporal scales, thereby improving accuracy and reducing costs of determining I/I sources.

* Student presentation.

Long-Term Assessment of the Impacts of Age, Fine Sediments, and Vegetation on Infiltration Rates in Green Stormwater Infrastructures

Eimienwanlan Ibhagui,* Marquette University, eimienwanlan.ibhagui@marquette.edu
Anthony Parolari, Marquette University

Green stormwater infrastructures (GSIs) are engineered stormwater control measures designed to tackle stormwater issues such as runoff volume, peak flow, and pollution. The efficiency of GSI systems in controlling stormwater relies on their ability to infiltrate runoff received from impervious surfaces. However, concerns have been raised regarding the reduced efficiency as they age due to clogging. Research has shown that fine sediments are among the factors that impact the performance of GSIs. But long-term studies of the influence of age, fine sediments, and vegetation on infiltration rate are still lacking, resulting in little understanding of the mechanisms by which GSIs underperform. To date, numerous previous primary studies and reviews in the GSI field have recommended long-term investigations to bridge these knowledge gaps. This study measures the accumulation of soil fines and organic matter in the topsoil layers of 14 infiltration basins. Soil samples and hydraulic properties were collected and measured in situ and analyzed in the laboratory; vegetation was characterized via satellite-derived indices. With this data, a statistical model was developed to predict infiltration rate. This knowledge will benefit stormwater managers by improving the understanding of the influence of fine sediments and vegetation on GSI performance, informing appropriate GSI maintenance, and providing insight into the underperformance of stormwater infiltration systems.

Design and Calibration of a Nitrate Decision Support Tool for Groundwater Wells in Wisconsin, USA

Paul Juckem, U.S. Geological Survey, pfjuckem@usgs.gov
Nicholas Corson-Dosch, USGS
Laura Schachter, USGS
Christopher Green, USGS
Kelsie Ferin, UW-Madison
Brian Austin, Wisconsin Department of Natural Resources
Eric Booth, UW-Madison
Christopher Kucharik, UW-Madison
Leon Kauffman, USGS

We developed a nitrate decision support tool for groundwater wells (GW-NDST) to assist resource managers with understanding how nitrate leaching rates at the surface translate to nitrate concentrations in wells and associated time-lags between land management change and well concentrations. The GW-NDST uses output from support models including: 1. simulated nitrate leached below the root-zone from a dynamic ecosystem model (Agro-IBIS), 2. groundwater age distributions from a machine learning model trained on groundwater age tracers, and 3. oxygen and nitrate reduction rates from a multivariate regression model. Spatially distributed parameters, including support-model output multipliers, were conditioned on more than 34,000 nitrate targets in a state-wide calibration using an Iterative Ensemble Smoother technique implemented in PEST. The calibration exhibited minimal clustering of parameters near their lower or upper bounds and little bias in residuals up to

* Student presentation.

about 20mg-N/L. For measured concentrations above 20mg-N/L, the tool's performance is likely hindered by a lack of site-specific information, such as farm-specific management inputs for the Agro-IBIS model. Prediction uncertainty is estimated from 450 posterior Monte Carlo realizations, with simulated concentration uncertainty from the realizations overlapping 78% of all target concentrations. The educational aspects (especially time lags) of the tool add value beyond what is currently available to most resource managers.

Exploring the Influences on Temporal Variation in Phosphorus Transport and Release in the Hyporheic Zone of the Wisconsin River

Vy Le,* University of Wisconsin-Madison, vple@wisc.edu
Erin Berns-Herrboldt, UW-Green Bay
David Hart, Wisconsin Geological and Natural History Survey
Grace Halstead, UW-Madison
Amy Workman, UW-Madison
Christopher Zahasky, UW-Madison

Elevated phosphorus (P) in surface waters can lead to eutrophication and impact aquatic health, human health, and local economies. Hyporheic zones represent an important reservoir for P storage. River stage fluctuations, groundwater surface-water interactions, seasonal climate variability, and biogeochemical processes can influence the transport, transformation, and sorption of P in the hyporheic zone. Phosphorus fate and transport are expected to be especially complex on managed rivers where sudden and episodic pulses of water from dam releases or large precipitation events may cause reversals in hyporheic flow and impact the stability of P sorbed in the hyporheic zone. This study aims to evaluate P fate and transport as a result of transient river stage changes associated with a dam-controlled reach of the Wisconsin River north of Wisconsin Dells. Sediment and pore water samples were collected quarterly to characterize the temporal variability of P quantities and phases in aqueous and sediment samples and to evaluate mechanisms of competitive sorption to sediments. Results highlight that changes in river stage lead to changes in biogeochemical redox conditions, which transform the phase and affect the mobility of phosphate adsorbents. Understanding how episodic water fluxes in the hyporheic zone control P transport and transformation may have important implications for land and water management decisions.

Stable Isotopic Evaluation of Recharge into the Karstified Silurian Aquifer in Kewaunee County, Wisconsin

John Luczaj, University of Wisconsin-Green Bay, luczajj@uwgb.edu
Amber Konrad, UW-Green Bay
Mark Norfleet, UW-Green Bay
Andrew Schauer, ISOLAB, University of Washington

Ground water contamination is a long-standing problem in the karstified Silurian dolostone of rural northeastern Wisconsin, especially in areas with thin soils over bedrock, where as many as 60% of the wells show evidence of fecal contamination. We present the results of a citizen science supported

* Student presentation.

water-isotope study in Kewaunee County, Wisconsin to evaluate aquifer recharge processes in the critical zone and to demonstrate the viability of time-series stable isotope data as a supplement to traditional water quality indicators in a contamination-prone aquifer. A new regional meteoric water line was also constructed for Green Bay, Wisconsin, providing reasonable isotopic ranges for aquifer recharge events.

Volunteer homeowners collected water samples from domestic wells for a period of 14 months to provide a measure of long-term isotopic variation in produced water and to determine whether event-driven responses could be identified using δ18O and δ2H isotopic values. Three shallower wells with a prior history of contamination exhibited significant seasonal variation, while the deepest well with the greatest soil thickness (above bedrock) showed less variation. For moderate precipitation events, the shallowest well showed as much as 5–13% of produced water coming from direct recharge, with smaller contributions for deeper wells. Our case study provides a clear example of how citizen science can collect useful time-series isotopic data to support groundwater recharge studies.

Improving the Representation of Cold Season Hydrology in SWAT

Jaya Muehlman,* University of Wisconsin-Madison, muehlman@wisc.edu
Laxmi Prasad, UW-Madison
Anita Thompson, UW-Madison
Sushant Mehan, South Dakota State University
William Osterholz, United States Department of Agriculture
Kevin King, USDA
Francisco Arriaga, UW-Madison
Margaret Kalcic, UW-Madison

Agricultural nutrient runoff from the Midwest degrades water quality nationwide, generating algal blooms from the Great Lakes to the Gulf of Mexico. In cold regions such as the north-central US, much of the yearly nutrient runoff occurs between the start of winter and spring thaw. Hydrological models such as the Soil and Water Assessment Tool (SWAT) are widely used by regulatory agencies and the scientific community to evaluate land use and climate regime impacts on water resources. SWAT is limited in simulating cold region processes, such as freeze-thaw cycles and water movement in frozen soils. The SWAT model assumes that at 0°C soil surface temperature, the soil profile is frozen and pauses simulation of infiltration, percolation, and subsurface drainage. In reality, the soil typically freezes at temperatures below 0°C. We are improving the representation of cold-season hydrology using laboratory and field data to govern freeze and thaw thresholds in SWAT. The goal is to assess the accuracy of an improved SWAT model in predicting cold-season runoff and nutrient transport when compared with data from two fields, one in Wisconsin and one in Ohio. Both fields have in-field and edge-of-field monitoring of soil temperature and tile and surface runoff. Enhancing SWAT's parameterization of cold season processes across the north-central US will ultimately improve model predictions and help stakeholders make more informed farm management decisions to improve water quality.

* Student presentation.

Hydrostratigraphic Characterization of the Sinnipee Dolomite in Jefferson County, Wisconsin

Maureen Muldoon, Wisconsin Geological and Natural History Survey, muldoon@wisc.edu
Esther Stewart, WGNHS
Pete Chase, WGNHS

Previous hydrostratigraphic characterizations of fractured dolomite aquifers in Wisconsin have shown that these aquifers have a bi-modal distribution of hydraulic conductivity with low-permeability values for the rock matrix and high-permeability values for the fractures. This study investigated the hydraulic conductivity distribution of Sinnipee dolomites conducted as part of the Jefferson County Statemap project.

Sixteen straddle-packer tests, with an open interval of 4.63 ft, were conducted in a borehole located in a quarry near Sullivan, WI. The tests, designed to sample the range of lithologies and to test specific fracture zones, yielded hydraulic conductivity values that range over six orders of magnitude. Slug tests conducted on unfractured sections of the hole exhibited a typical exponential recovery of water levels and were analyzed using the Hvorslev method. Slug tests conducted in intervals containing fractures commonly exhibited an oscillatory response and were analyzed using the Springer-Gelhar method.

The hydraulic conductivity values measured in this study are similar to the range of values noted by Stocks (1998) for the Sinnipee dolomites in Dodge County. The Sinnipee in eastern Wisconsin exhibits lateral facies changes from north to south (Choi, 1998). We are investigating the lithostratigraphic controls on the hydraulic conductivity distribution within the Sinnipee and whether lithostratigraphy can be used as a predictor of hydrostratigraphy.

Chloride in the Milwaukee River: A Mass Discharge Approach

Sophia Norenberg,*University of Wisconsin-Milwaukee, norenbe4@uwm.edu
Kamryn Veith, UW-Milwaukee
Max Garcia, UW-Milwaukee
John Folena, UW-Milwaukee
Charles Paradis, UW-Milwaukee

Chloride contamination is of particular concern in the Milwaukee River due to the large amount of road salt used in the Milwaukee metropolitan area and the river's ultimate discharge into Lake Michigan. This study aims to quantify the mass of chloride being discharged through two sites along the Milwaukee River—Estabrook and Hubbard Parks—and the potential influence of the Capitol Street bridge as a point source for chloride contamination. Conductivity, depth, and temperature probes at Estabrook and Hubbard Parks, along with USGS stream gage data, were employed to analyze chloride mass discharge trends during 2023 and 2024. Daily average precipitation and stream hydrographs were also used to characterize the influence of precipitation events and baseflow on chloride concentrations and mass discharge. Results revealed a direct relationship between chloride mass discharge and stream discharge. An inverse relationship between electrical conductivity and stream discharge suggested possible dilution effects from precipitation events. Although Hubbard Park exhibited higher chloride mass discharge, potentially due to its downstream position, the Capitol Street Bridge's influence was considered. Both

* Student presentation.

sites remained within USEPA standards for acute and chronic chloride concentrations. Comparison with an urban site of the Root River revealed similar trends and comparable mass discharges, emphasizing the need for ongoing monitoring and effective water quality management strategies.

Characterization of Algal Bloom Dynamics in the Fox River from Lake Winnebago to Green Bay

Hayley Olds, U.S. Geological Survey Upper Midwest Water Science Center, htolds@usgs.gov
James Larson, USGS, Upper Midwest Environmental Science Center
Luke Loken, USGS, Upper Midwest Water Science Center
Sophia Lafond-Hudson, USGS, Upper Midwest Water Science Center
Keegan Johnson, USGS, Upper Midwest Water Science Center
Paul Reneau, USGS, Upper Midwest Water Science Center
Carrie Givens, USGS, Upper Midwest Water Science Center

Harmful algal blooms (HABs) are observed nearshore in Green Bay numerous times per summer, but there is uncertainty about where and how these HABs form. Potential mechanisms include transport from upstream algal biomass or formation locally, within the system. Like nutrients, algal biomass can be fluvially transported and thus may influence the initiation and total biomass of HABs frequently observed nearshore in Green Bay. While blooms have been observed upstream from Green Bay in the Fox River and Lake Winnebago, HAB occurrence within and transport through these aquatic systems has not been systematically monitored. To determine the potential of the Fox River to transport algal blooms and contribute to Green Bay HABs, the U.S. Geological Survey, in partnership with the Wisconsin Department of Natural Resources, established a network of ten sites to collect algal bloom samples from Lake Winnebago down the Fox River to Green Bay during the growing season. The composition of the samples was compared to determine if they were isolated individual blooms or if they had similar composition resulting from downstream transport and potential seeding. Chlorophyll-a and phycocyanin sensors and cameras were deployed at a subset of sites to provide continuous data to inform sampling timeframes and to provide context for discrete sampling results. This information is intended to inform potential management actions to address Green Bay HABs.

Raising Awareness of Drowning Risks in the St. Louis River Estuary Using Interactive StoryMaps

Sarah Peterson,* University of Wisconsin-Madison, speterson26@wisc.edu
Mira Potter, UW-Madison
Josh Anderson, UW-Madison
Chin Wu, UW-Madison

River drowning in the St. Louis River Estuary (SLRE) is an underrated hazard in the Laurentian Great Lakes. Different from coastal drowning due to rip currents induced by wave actions or rapid water fluctuations, there is a knowledge gap about the possible contributing factors to river drowning and awareness of dangerous river drowning. This poster, for the first time, will show the characterization of drowning epidemiology including timing, location, sex and gender of historical drowning incidents in the SLRE from 2003 to 2023. Possible causes for the river drownings like whitewater, currents and undercurrents, eddies, cold water, thin ice, and obstructions will be revealed and discussed. Through

* Student presentation.

interactive ArcGIS StoryMaps, we aim to raise awareness of overlooked river drowning and provide imminent drowning risks for river and waterfront communities in the SLRE.

Spatiotemporal Trends of Drinking Water Contaminants for Wisconsin Municipal Wells Throughout the Midwestern Cambrian Ordovician Aquifer System

Savannah Finley,* University of Wisconsin-Madison, sefinley@wisc.edu
Juliet Ramey-Lariviere, UW-Madison
Matthew Ginder-Vogel, UW-Madison

Groundwater supplies approximately two-thirds of Wisconsin residents their drinking water, however, this water may be contaminant-rich in areas across the state. This study identifies geographically distributed wells with elevated groundwater concentrations and distinguishes how their concentrations are changing over time. Common drinking water contaminants (NO3, Mn, Ra, F, U, Cl, As, and Fe) are characterized in the unconfined and confined regions throughout Wisconsin's Midwestern Cambrian-Ordovician aquifer system through 2023. Here we explore public raw drinking water data, accessed through the Wisconsin Department of Natural Resources, to visualize spatial and temporal variations of contaminant concentrations. Higher levels of Fe and Ra are seen in the confined region with maximum values ranging from 2.76 – 270.00 mg/L and 10.54 – 44.90 pCi/L respectively. While As and Mn contamination is dominant in the unconfined region with maximum values spanning 0.044 – 8.00 mg/L and 2.40 – 180.00 mg/L respectively. This comprehensive approach conducts correlation analyses between drinking water contaminants to discern patterns of interconnectedness. Using a 3D geographic information system mapping software, QGIS, Brown, Waukesha, Fond du Lac, and Outagamie County are identified as hotspots of elevated contaminant concentrations. The results of this research provides information about the ability of the aquifer to serve as a continued source of drinking water for Wisconsin residents.

Barnes Creek Wetland Mitigation Bank

Angie Rayniak,* University of Wisconsin-Parkside, fiebe001@rangers.uwp.edu
Megan Strautmann, UW-Parkside

Wetlands provide a dynamic ecosystem that not only helps to control flooding and soil erosion but also provides an essential habitat for hundreds of species of plants and animals. However, wetlands are one of the most threatened habitats across the United States. Currently, over 50% of wetlands in the lower 48 states have been lost, mainly due to human-induced activities like farming and development, and are continually declining at a rate of 60,000 acres per year. Although development is necessary as our population increases, the need for more protection and a plan to help restore natural areas back into wetlands is just as important.

The Wetland Mitigation Banking Program is designed to control the unavoidable loss of wetlands, by restoring or creating wetlands at another suitable location. Developers purchase credits from the program to compensate for the loss of wetlands due to their development impacts. These wetland banks then restore the wetland environment on their land by recreating the ecosystem, away from the

* Student presentation.

threat of development. Residing in the Southwest Lake Michigan Basin, the Barnes Creek Wetland Mitigation Bank is 400 acres of legacy farmland, where 200+ acres are being restored to their previous wetland conditions. This location is great for a mitigation bank, as the properties of the land, the topography, plants, and soil, are ideal for wetland creation. There has been substantial progress in restoration over the past several years.

Investigation of Long-term Drinking Water Security for the Town of Campbell and La Crosse County, WI

Paul Summers,* University of Wisconsin-Madison, jpsummers2@wisc.edu
Michael Cardiff, UW-Madison
David Hart, Wisconsin Geological and Natural History Survey
Maureen Muldoon, WGNHS
Randall Hunt, U. S. Geological Survey
Christopher Zahasky, UW-Madison

Extensive use of aqueous film forming foams (AFFFs) at or adjacent to the La Crosse Regional Airport in west-central Wisconsin has contaminated local groundwater with per- and polyfluoroalkyl substances (PFAS). Multiple source zones have been identified. Sampling results from domestic wells in the Town of Campbell on French Island indicate a primary plume migrating to the southeast; however, concentrations of PFAS in other wells indicate additional transport pathways. This study will create an island-scale groundwater flow and transport model by incorporating new observational and geophysical data, near-surface sediment analyses, and insights from a regional-scale La Crosse County flow model. The hydrostratigraphy underlying the Town of Campbell will be evaluated using existing well data coupled with new passive seismic and time-domain electromagnetic surveys. The source zones and plume extents were constrained using a recently compiled PFAS sample database. Flow and transport models for French Island, along with uncertainty estimates for these simulations, are presented in light of this new data. This study illustrates how the large dataset of observations from the town of Campbell is valuable for understanding and refining transport parameters affecting PFAS movement in our numerical model. These updated models are key for forecasting plume migration and understanding how the underlying Mt. Simon aquifer can be protected and used as a long-term water supply.

Use of Solid Phase Adsorption Toxin Tracking (SPATT) to Determine the Presence of Harmful Algal Blooms (HABs) in Freshwater Systems

Hailey Trompeter, U.S. Geological Survey, htrompeter@usgs.gov
Hayley Olds, USGS
Kathryn Johncock, USGS
Victoria Christensen, USGS
Joshua Rosen, USGS

Harmful algal blooms (HABs) are becoming increasingly common in freshwater systems. They occur when toxin-producing algae grow excessively in a body of water, potentially leading to the production of harmful toxins that can negatively impact water quality, aquatic life, and human health. Characterizing the toxicity of HABs can be challenging, costly, and time consuming. For this study, we compare

* Student presentation.

different techniques for constructing, deploying, and analyzing Solid Phase Adsorption Toxin Tracking (SPATT) passive samplers, which are a cost-effective way to determine if toxins are present in algal blooms. SPATTs are deployed in a water body for 1-2 weeks to allow toxins to adsorb to their synthetic resin and accumulate algal toxins over time. Resin from the SPATTs undergo solid-phase extraction to identify the cyanotoxins present. Since 2019, the USGS Upper Midwest Water Science Center has constructed, deployed, and analyzed SPATT samplers at aquatic monitoring sites in Wisconsin, Minnesota, and Michigan, as well as National Parks across the nation. Our results have provided valuable insight on HAB toxicity at these locations and have the potential for widespread distribution and use.

Initiatives Associated with the New County Hydrogeologist Position at the Wisconsin Geological and Natural History Survey

Amy Wiersma, Wisconsin Geological and Natural History Survey, amy.wiersma@wisc.edu
Matthew Rehwald, WGNHS
Peter Schoephoester, WGNHS
Maureen Muldoon, WGNHS
David Hart, WGNHS
Sue Swanson, WGNHS

In 2021 the Wisconsin State Legislature passed Bill 727 (also known as the “nitrate” bill), which created a new hydrogeologist position at the Wisconsin Geological and Natural History Survey (WGNHS). This three-year position that began in March 2023 develops groundwater resource information primarily at county or local scales and assists state and local governments, industries, and the public in interpreting and using the information. Initiatives associated with this position fall within three main areas, including 1) county groundwater studies, 2) groundwater data accessibility, and 3) groundwater outreach and education. County groundwater studies typically generate products including 1:100,000-scale water table elevation, recharge, and groundwater susceptibility maps that provide baseline information for stakeholders. Preliminary results will be shared for the current groundwater study in Burnett County. Initiatives related to increasing groundwater data accessibility include digitization of existing groundwater-related maps to a modern GIS format and the creation of an interactive web tool that shows the status of WGNHS geologic and hydrogeologic maps in each county. Examples of outreach and education efforts include development of an online groundwater education course for county staff and officials in collaboration with UW-Extension colleagues, training county staff on geolocating wells, and assisting counties with accessing and using existing county groundwater data.

Session 3A:
PFAS
Friday, April 26, 2024
8:30 a.m.

Prevalence and Source Tracing of PFAS in Shallow Groundwater Used for Drinking Water in Wisconsin, USA

Jordan Schutz, Wisconsin Department of Natural Resources, jordan.schutz@wisconsin.gov
William Phelps, Wisconsin DNR

Samples from 450 homes with shallow private wells throughout the state of Wisconsin (USA) were collected and analyzed for 44 individual per- and polyfluoroalkyl substances (PFAS), general water quality parameters, and indicators of human waste as well as agricultural influence. At least one PFAS was detected in 71% of the study samples, and 22 of the 44 PFAS analytes were detected in one or more samples. Levels of PFOA and/or PFOS exceeded the proposed Maximum Contaminant Levels of 4 ng/L, put forward by the U.S. Environmental Protection Agency (EPA) in March 2023, in 17 of the 450 samples, with two additional samples containing PFHxS $\gtrsim$ 9 ng/L (the EPA-proposed hazard index reference value). Those samples above the referenced PFAS levels tend to be associated with developed land and human waste indicators (artificial sweeteners and pharmaceuticals), which can be released to groundwater via septic systems. For a few samples with levels of PFOA, PFOS, and/or PFHxS > 40 ng/L, application of wastes to agricultural land is a possible source. Overall, the study suggests that human waste sources, septic systems in particular, are important sources of perfluoroalkyl acids, especially ones with ≤8 perfluorinated carbons, in shallow groundwater.

Evaluating PFAS Prevalence in Lake Superior Tributaries and Estimating Potential Bioeffects

Matthew Pronschinske, U.S. Geological Survey, mpronschinske@usgs.gov
Steve Corsi, U.S. Geological Survey
Sarah Elliott, USGS
Martin Shafer, Wisconsin State Laboratory of Hygiene
Kaitlyn Gruber, University of Wisconsin-Madison
Christy Remucal, UW-Madison

Several PFAS compounds are Great Lakes binational chemicals of mutual concern, and WI, MN, and MI issued fish consumption advisories for PFOS in Lake Superior rainbow smelt–emphasizing the importance of characterizing PFAS prevalence and potential bioeffects. In this study of 28 Lake Superior tributaries with various potential PFAS sources, water samples were collected during event flow and baseflow, and sediment samples were collected at each site. PFAS were detected in 97% of water samples and 59% of sediment samples. Among 33 PFAS analytes, 17 were detected in water and 17 in sediment. Thirteen PFAS were common to both sample media; 12 were never detected. Total water sample concentrations were generally low (~10 ng/L), except at Newton, Miller, and Sargent Creek (up to 391 ng/L). Maximum concentrations in water were from PFOS and PFHxS. PFBA was most frequently detected in water (93%), and its median concentration was greatest. Total sediment sample concentrations were generally low (~40 ng/kg), except at Newton and Muggun Creek (up to 797 ng/kg),

PFOS was detected most frequently. To assess potential bioeffects, sampled water concentrations were compared to existing aquatic benchmarks and alternative benchmarks derived from in-vivo and in-vitro studies in ECOTOX and ToxCast. This assessment indicated some PFAS, particularly PFOS and PFHxS, pose potential ecological risks despite low anthropogenic influence in the studied basins–highlighting PFAS potency and ubiquity.

PFAS Transport and Profiling in Soil Vadose Zone

Yanan Zhao,* University of Wisconsin-Milwaukee, zhao76@uwm.edu
Shangping Xu, UW-Milwaukee
Yin Wang, UW-Milwaukee

Per- and polyfluoroalkyl substances (PFAS) represent a class of synthetic chemicals, which have been widely used since the 1950s. PFAS contamination has been reported across the world and has posed risks to humans, animals, and the environment. In this study, we investigated the vertical profiling of PFAS in soil vadose zone using intact cores collected from a contaminated site in Wisconsin, US. The result showed that the PFAS vertical migration rate was negatively related to the octanol-water distribution coefficient (Dow) of PFAS. Specifically, for PFAS with the same end functional group, their migration rate in vadose zone decreased with the increasing fluoroalkyl chain length. For PFAS with the same fluoroalkyl chain length, the migration rate of sulphonic acid was smaller than that of carboxylic acid. For all the PFAS detected in this study, the concentration of PFAS increased first with the increased vadose zone depth and then decreased. Our results show that both vadose zone depth and PFAS structure can affect PFAS retention in vadose zone. Additionally, Hydrus-1D was used to simulate the trend of PFAS vertical profiling, which matched well with the experimental data. The results of this work provided experimental evidence and suggested that vadose zone can be an important reservoir and potential long-term source of PFAS.

PFAA Transport in the Vadose Zone -- Results from Meter-Scale Experiments and Implications for Upscaling

Elizabeth Runge,* University of Wisconsin-Madison, erunge@wisc.edu
Paul Summers, UW-Madison
Christy Remucal, UW-Madison
Christopher Zahasky, UW-Madison

Per- and poly-fluoroalkyl acids (PFAAs) are a group of contaminants that have gained significant attention due to their persistence, bioaccumulation potential, and adverse effects on human health and the environment. Understanding the transport behavior of PFAAs in the vadose zone is crucial for effective remediation. The primary objective of this study is to characterize PFAAs transport in unsaturated porous media. The following research was conducted using a large rectangular column and varying sediment sizes. Short and long-chain PFAA species were introduced at the column's top, followed by a steady-state flow of deionized water. Samples were analyzed using liquid chromatography-mass spectrometry (LC-MS) analysis. Results show that retention of PFAAs within the column is enhanced as the saturation level decreases, due to a larger air-water interfacial area.

* Student presentation.

Additionally, there was greater retention of long-chain PFAAs species compared to their short-chain counterparts. By quantifying retardation as a function of spatially variable saturation conditions, this study enables a more accurate assessment of PFAAs transport behavior in natural subsurface environments.

Session 3B:
Climate Change
Friday, April 26, 2024
8:30 a.m.

Coastal Processes Manual, 3rd Edition: Building Resilience among Coastal Great Lakes Communities

Helena Tiedmann, Wisconsin Sea Grant/Wisconsin Coastal Management Program, helena.tiedmann@wisconsin.gov
Hannah Paulson, Wisconsin Sea Grant/Wisconsin Coastal Management Program

Great Lakes communities face unique challenges related to coastal processes and hazards such as fluctuating lake levels, flooding, storms, and erosion. Bringing scientific research and technical assistance to coastal communities is therefore critical to building long-term resilience. The upcoming 3rd Edition of the Coastal Processes Manual, a product of Wisconsin Sea Grant in collaboration with the Wisconsin Coastal Management Program, seeks to provide technical guidance to local decision makers, planners, zoning officials, consultants, and other coastal professionals. Building on previous editions authored by Wisconsin Sea Grant coastal engineer J. Philip Keillor, the 3rd Edition will provide a technical overview of coastal processes and hazards, with a specific emphasis on coastal flooding, erosion, and low water level hazards along Wisconsin's Lake Michigan and Lake Superior coasts. With additional chapters on risk, mitigation, and resilience planning, the manual is designed to provide coastal professionals with the information needed to take action to protect both property and ecological resources. Accompanying the publication of the newest manual edition will be an outreach effort aimed at sharing these technical resources with those on the frontlines to ultimately increase coastal resilience in the Great Lakes region.

2023 Flash Drought: Hydrologic Response & Water Use Trends

Adam Freihoefer, Wisconsin Department of Natural Resources, adam.freihoefer@wisconsin.gov
Aaron Pruitt, Wisconsin DNR
Will Dougherty, Wisconsin DNR

Between 2017 and 2020, Wisconsin observed consecutive years of above normal precipitation resulting in groundwater flooding and record high water levels and stream flows. Precipitation amounts reverted to average amounts starting in 2022 across the Upper Midwest. And in 2023 Wisconsin experienced a flash drought, with the state going from no signs of drought in late May to nearly the entire state in some level of drought by late July. During this time streams went dry and reliance on groundwater for irrigation and other uses increased. This presentation examines the impact the 2023 drought had on Wisconsin streamflow and groundwater levels as well as water use when compared to the last decade and the most recent drought (2012).

Shoreline Response to Water Level Fluctuations in Madeline Island, Lake Superior, WI

Sarah Peterson,* University of Wisconsin-Madison, speterson26@wisc.edu
Chin Wu, UW-Madison

Shorelines have experienced significant changes (advancement and retreat) with extreme water level fluctuations, impacting coastal communities, properties, habitats, and coastal management practices in the Great Lakes. While shoreline response to water level fluctuations has been studied in the Great Lakes, results seem to vary from study to study. In this talk, we will depict how shorelines respond to changing water levels around Madeline Island, WI in Lake Superior, as an example. Possible factors like wave climate, beach substrate, sediment availability, and coastal structures contributing to variability in shoreline response will be discussed. Furthermore, findings from this research will guide coastal management and decision-making along diverse coasts in the Great Lakes.

The Effects of Shifting Snowmelt and Rainfall Regimes on Streamflow Across the Upper Midwest

Margaret Zimmer, U.S. Geological Survey, mzimmer@usgs.gov
Samantha Oliver, USGS
James Fallon, USGS

Snowmelt plays an integral role in spring flooding and summer low flows across the Upper Midwest. However, increasingly wetter and warmer winters and springs are anticipated to result in earlier snowmelt and a smaller proportion of annual precipitation that falls as snow. Understanding how this changing precipitation regime will influence streamflow behavior and the health of aquatic ecosystems is critical for informing water resource and land management decisions. Here, we used daily streamflow from >350 US Geological Survey stream gages in Michigan, Wisconsin, and Minnesota coupled with daily climate data (e.g., air temperature, snowpack, and precipitation) from NOAA datasets to quantify changes in streamflow and precipitation behavior and to identify causal relationships. Our results highlight a shifting streamflow peak in spring that is spatially variable across the Upper Midwest and dependent on both the timing and type of precipitation. Similarly, summer low flows are influenced by shifting snowmelt timing and magnitude, but this is spatially variable and dependent on a number of climatic factors. These findings provide insight into not only how streamflow has been influenced by changes in precipitation thus far, but also what we may expect into the future.

* Student presentation.

Session 3C:
Aquatic Biology
Friday, April 26, 2024
8:30 a.m.

Impact of Recharge and Fecal Contamination on Microbial Communities in a Karst Aquifer

Joe Heffron, U.S. Department of Agriculture-ARS, joseph.heffron@usda.gov
Rachel Cook, USDA-ARS
Aaron Firnstahl, U.S. Geological Survey
Joel Stokdyk, USGS
Tucker Burch, USDA-ARS

Subsurface microbial communities can affect groundwater pollution through interactions with contaminants, but little is known about these communities and their response to surface influence. Our goal was to relate differences in microbial communities to fecal contamination from domestic sewage and livestock manure. Microbial communities were characterized in water samples (n = 138) from private wells in Kewaunee County, WI via Illumina 16S amplicon sequencing. Relative abundance and diversity were assessed relative to land use, geology, groundwater recharge, and microbial source tracking (MST) markers for human and bovine fecal contamination. Groundwater communities were similar across the county, which may reflect similar land use, similar groundwater conditions, and/or the rapid and interconnected flow of water through the karst aquifer. Preliminary evidence indicates changes in relative abundance of prominent microbial taxa in response to groundwater recharge. In contrast, human and bovine MST markers were associated with subtler changes to microbial community structure. Groundwater microbial communities established under the recurring influence of human and bovine inputs may respond more to recharge events than to specific fecal events. The long-term impacts of contamination on groundwater communities require further study.

Comparison of Fish Indices of Biological Integrity (F-IBI) Before and After Stream Restoration in the Milwaukee Metropolitan area

Kathryn Johncock, U.S. Geological Survey, kjohncock@usgs.gov
Faith Fitzpatrick, USGS
Michelle Nott, USGS
Matthew Diebel, USGS
Amanda Bell, USGS
Ryan Ennis, USGS

Historically, urban streams have undergone human-induced re-engineering, resulting in unnatural flow, degraded habitat, and loss of species richness and biodiversity. With a goal of increasing ecological health and better managing flood conditions, a series of stream restoration projects have been completed in the Milwaukee Metropolitan area over the last 30 years. These efforts include the removal of concrete-lined channels, dams, and drop structures; installation of fish passage systems; and overall re-naturalization of the stream bed and riparian habitat. To better understand the impacts of these restorative actions, the USGS characterized the health of the fish community in 18 stream reaches pre-

and post-restoration utilizing USGS long-term monitoring data collected from 1993 to 2022. This effort included the use of Wisconsin Department of Natural Resources developed formulas that compute the Fish Indices of Biological Integrity (F-IBI) based on stream size, water temperature, and other morphological characteristics. Each F-IBI is composed of metrics and scores that can be translated into a final rating to characterize the quality of the fish assemblage within the sampled section of a stream. Using these metrics, USGS assessed the change in F-IBI over time to provide insight into whether these restorative projects have improved resident fish populations. This work will aid local managers in future management decisions regarding stream restoration in an urban setting.

Aquatic Environmental DNA (eDNA) as a Tool to Assess Aquatic Communities in River Systems in the Greater Milwaukee Area

James Romano, U.S. Geological Survey, jromano@usgs.gov
Hayley Olds, USGS
Michelle Nott, USGS

Degraded urban streams, like those in Milwaukee, WI experience considerable stress and contamination, which may influence organismal abundance and biodiversity. However, quantifying what organisms are present can be labor intensive, costly, and require specialized expertise. Aquatic environmental DNA (eDNA) is a technique that identifies DNA shed by organisms in the environment. eDNA can be a powerful tool to study the presence/absence, abundance, and biodiversity of organisms within a water body. The objective of this study is to pair eDNA sequencing with traditional ecological sampling to investigate the differences in community composition between methods and better understand the biodiversity in urbanized rivers. We paired eDNA samples with long-term traditional whole organism sampling of fish, invertebrates, and algae in 15 rivers in the greater Milwaukee area in the summer of 2022 and 2023. The 2022 fish eDNA samples and electrofishing sampling data were compared to highlight the similarities and differences of the observed communities between the two methods. eDNA samples were also used to identify locations that may have invasive or sensitive species that were not represented from the traditional method of electrofishing. This biological information will help inform the Milwaukee Metropolitan Sewerage District (MMSD) and other local water resource managers about river systems that may need targeted rehabilitation efforts or may be threatened by invasive species.

Diagnosing the WHY in Stream Ecological Conditions Using Biological Sensitivity to Common Environmental Pollutants

Laura Bates,* University of Wisconsin-Madison, lmbates2@wisc.edu

Diatoms and macroinvertebrates have served as a foundation for indicating the ecological condition of freshwater streams for years. Statewide standards for environmental pollutants can serve as an excellent starting-point for water quality monitoring, but the complexities and interactions between biological assemblages and environmental stressors warrant a closer look at smaller-scale associations. Despite ongoing water quality monitoring, Wisconsin's streams and lakes are suffering from, or under severe threat of, eutrophic conditions. Significant management efforts to reduce phosphorus loading

* Student presentation.

are required to offset the effects of phosphorus and climate change. Clear and concise information on local stream ecological condition and water quality can help in achieving nutrient reduction goals more effectively and efficiently. This research uses biological sensitivity to common environmental pollutants to explore why individual streams within the Green Lake Watershed are exhibiting certain ecological conditions. Diatoms are the critical base of the ecological food web and are often left out of water quality indication studies. Site location, stream restoration, and nutrient thresholds play a key role in influencing species abundances of diatoms. Results of this study can help advise and advocate for future nutrient reduction strategies.

Session 4A:
Nutrients and Sediment in Surface Water
Friday, April 26, 2024
10:30 a.m.

Changes in Phosphorus and Suspended Solids Loading in the Fox River, Northeastern Wisconsin, 1989–2021

Dale Robertson, U.S. Geological Survey, Upper Midwest Water Science Center, dzrobert@usgs.gov
Matthew Diebel, USGS
Sarah Bartlett, NEW Waters, the brand of the Green Bay Metropolitan Sewerage District
Kevin Fermanich, University of Wisconsin-Green Bay

The Fox River and inner bay of Green Bay have been listed as impaired for low dissolved oxygen and degraded habitat, with excess total phosphorus (TP) and total suspended solids (TSS) listed as the likely causes. To determine if actions throughout the basin are improving water quality, we examined changes in TP and TSS concentrations and loads at the Lake Winnebago Outlet, De Pere, and the mouth of the Fox River from 1989 to 2021. Loads and changes in loads were estimated with the Weighted Regressions on Time, Discharge, and Season (WRTDS) program. TP and TSS concentrations and loads increased downstream from the Lake Winnebago outlet to the mouth of the Fox River. Although TP and TSS concentrations decreased from 1989 to 2021 at De Pere and the mouth of the Fox River, there was little change in loading because of an increase in precipitation and flow. After adjusting for changes in flow (flow-normalization with WRTDS), TP and TSS loads at the Winnebago Outlet changed very little but significantly decreased at De Pere and the mouth of the Fox River. These decreases may be from implementation of agricultural conservation practices, reductions in point-source discharges, and increased deposition of sediment and phosphorus in recently dredged areas of the Lower Fox River. Additional studies are needed to determine the relative importance of each of these actions and whether the decrease in concentrations and flow-normalized loads will continue to be observed in the Fox River.

Stream Corridor Sediment Sediment-Bound Phosphorus Budget for an Agricultural Tributary to the Lower Fox River, 2023

Heidi Broerman, U.S. Geological Survey, hbroerman@usgs.gov
Faith Fitzpatrick, USGS
James Blount, USGS
Isaac Mevis, USGS

The East River, an agricultural tributary to the Lower Fox River and Green Bay in Wisconsin, has known excessive phosphorus (P) and suspended sediment loads that contribute to habitat related impairments and downstream algal blooms. As part of the Great Lakes Restoration Initiative, the U.S. Geological Survey conducted a stream corridor sediment budget study to estimate the spatial distribution of near-channel erosion and in-channel deposition of sediment and sediment-bound P. In August 2022, erosion and deposition were estimated along 15 stream reaches using rapid geomorphic assessments (RGAs)

and sediment samples were collected and analyzed for total phosphorus concentrations. The field-based estimates were applied to an expanded stream network constructed from a hydro-enforced 10-meter digital elevation model. A 0.01 square kilometers drainage area threshold was used for channel delineation to account for ephemeral as well as perennial reaches. Extrapolation of the RGA estimates to the entire stream network yield an estimated 17,000 megagrams/year of erosion and 3,000 megagrams of bed deposition. Near-channel erosion contributes about 10,000 kilograms/year of fine-grained (silt and clay) sediment-bound P and approximately ~1500 kilograms, of P is stored in fine grained bed deposits. These results suggest that in a given year, most of the sediment eroded from near-channel regions in the East River is transported downstream rather than stored in the channel.

Waterborne Geophysical Constraints on Soft-Sediment Occurrence and Dune Scaling in Rainy River and Lake of the Woods

Collin Roland, U. S. Geological Survey, croland@usgs.gov
Paul Reneau, USGS
Ann Baker, USGS
Faith Fitzpatrick, USGS
Will Lund, USGS

Lake of the Woods (LOW) is an important environmental resource in Northern Minnesota. Despite reductions in phosphorus loading from its main tributary, the Rainy River, extensive algal blooms in LOW continue, suggesting that internal loading is an important component of nutrient cycling in this system. In 2023, the U.S. Geological Survey conducted a manual probe and geophysical survey for soft, fine-grained, silt and clay deposits in the Rainy River through its outlet at Fourmile Bay to further explore this potential source of phosphorus to LOW. Manual probe measurements revealed that soft sediment deposits with thicknesses greater than 0.5 feet were concentrated along bank-marginal deposits, tributary mouths, and backwaters of the lower reaches of the Rainy River and portions of Fourmile Bay. Ground penetrating radar and sub-bottom seismic profiles provided additional spatial constraints on soft sediment distributions. Sidescan sonar images revealed that dunes are nearly ubiquitous in the main channel suggesting minimal presence of soft sediment deposits. The combination of manual probing and geophysical surveys helped to define the extent and thickness of soft sediment deposits relative to other bedforms along the varying hydrodynamic and geomorphic environments throughout the lower Rainy River and Fourmile Bay.

Long-Term Trends of Total Suspended Sediment and Discharge for Management Practice Evaluation at Fort McCoy, Wisconsin

Robert Rosner, U. S. Geological Survey, rrosner@usgs.gov
Matthew Diebel, USGS

The United States Geological Survey (USGS) and the Department of Defense-Fort McCoy began a water quantity and quality monitoring project in 2008 to assess the impact of military and conservation activities on two streams that encompass military training land use. In addition, a cranberry farming operation located within the military base is being evaluated in response to an impaired waters listing. The project monitored streamflow, water temperature and total suspended solids (TSS) at three small, headwater streams: Stillwell Creek, Silver Creek and the La Crosse River. USGS determined annual TSS

concentration and fluxes to address the impaired waters status of Stillwell Creek and evaluate management practices implemented by Fort McCoy on all streams. At each site, annual TSS loads generally increased until 2020 and decreased since 2021. The main driver of TSS loading is precipitation through its effect on streamflow. Interannual streamflow variability makes it difficult to evaluate the impact of watershed changes on TSS loading. The Weighted Regression on Time, Discharge and Season (WRTDS) model (Hirsch and others, 2010) eliminates interannual variability and uses flow normalization to determine long-term trends in concentration and flux. This project explored using WRTDS and its variants to investigate long-term trends in TSS concentration and flux at Fort McCoy streams. These analyses may help Fort McCoy evaluate watershed changes and better inform management decisions.

Session 4B:
Modeling 2
Friday, April 26, 2024
10:30 a.m.

A Reduced Dimension Groundwater Flow and Transport Modeling Approach to Evaluate the Contribution of Radium Sources in the Midwestern Cambrian-Ordovician Aquifer System

Christopher Zahasky, University of Wisconsin-Madison, czahasky@wisc.edu
Amy Wiersma, Wisconsin Geological and Natural History Survey
Madeline Gotkowitz, Wisconsin Department of Natural Resources
Matt Ginder-Vogel, UW-Madison

Increasing radium activity has been observed in municipal water supplies extracted from the Midwestern Cambrian-Ordovician aquifer system. Despite ongoing efforts to mitigate radium activity, uncertainty remains about the flow, transport, and reaction processes driving radium mobilization in these complex groundwater systems. In this study, we developed a radial-symmetric MODFLOW groundwater flow and transport model to evaluate the relative contribution of different geologic units and transport processes on radium activity in extracted groundwater. A grid refinement study was performed to ensure that the model can accurately capture diffusion-driven transport from the hypothesized source rocks. Results of sensitivity analysis and comparisons with well activity measurements provide new insights on the impact of well completion and aquifer management activities on the mobility of radium and other geogenic contaminants in the Midwestern Cambrian-Ordovician aquifer system.

Application of a Nitrate Decision Support Tool for Groundwater Wells in Wisconsin, USA

Paul Juckem, U.S. Geological Survey, pfjuckem@usgs.gov
Laura Schachter, USGS
Nicholas Corson-Dosch, USGS
Christopher Green, USGS
Brian Austin, Wisconsin Department of Natural Resources

Nitrate is the most widespread contaminant in drinking water wells across Wisconsin, but concentrations could be lowered through agricultural management practices that reduce nitrate leaching rates. A nitrate decision support tool (GW-NDST) for groundwater wells in Wisconsin was developed to aid with estimating the magnitude and time lag of reductions needed to achieve concentration goals. The GW-NDST uses output from three primary support models: 1. simulated nitrate leaching below the root-zone from a biosphere model (Agro-IBIS), 2. groundwater age distributions from a machine learning model trained on groundwater age tracers, and 3. estimated oxygen and nitrate reduction rates. Six forecasting scenarios allow users to assess how future leaching rates relate to future well concentrations and associated lag times. The scenarios include estimating concentrations on a specified future date given 1. no change, 2. a specified amount of leaching reduction, or 3. a specified percent reduction; further scenarios calculate 4. the reduction magnitude needed to reach a goal concentration by a specified future date, 5. the percent reduction needed to reach that goal by the

future date, or 6. the time required to meet a concentration goal given a specified leaching rate reduction. Finally, users are given the flexibility to modify all model calibration parameters thereby allowing assessment of alternative model assumptions and conceptualizations based on local knowledge.

Development of a Groundwater Contaminant Transport Model at the Former Badger Army Ammunition Plant to Support Remediation Efforts

Nicholas Corson-Dosch, U.S. Geological Survey, Upper Midwest Water Science Center, ncorson-dosch@usgs.gov
Howard Reeves, USGS
Laura Schachter, USGS
Megan Haserodt, USGS
Daniel Feinstein, USGS

Munitions production at the former Badger Army Ammunition Plant (BAAP) in Sauk County, WI led to localized groundwater contamination. The nature of the contamination has been studied since the early 1980s through an extensive well-drilling and sampling program that continues to present day. Various remedial efforts have been conducted at BAAP that have improved groundwater quality, but some contaminants persist. Three plumes currently extend offsite from BAAP towards the Wisconsin River, posing a potential water quality risk for nearby private wells. This talk will provide an overview of a groundwater flow model that was developed by the USGS to better characterize the groundwater flow system, and the ongoing development of a groundwater transport model to forecast the fate of contamination at BAAP. Ultimately, the contaminant transport model may be used to evaluate the effectiveness of additional remedial measures and will help support future management decisions under uncertainty. We'll also highlight challenges of modeling uncertain transport processes despite the long history of data collection and the strategies we used to cope with those challenges.

Populating Wisconsin Urban Database (WIUDB) with Field Collected Data to Calibrate Urban Runoff Models

Judy Horwatich, USGS, jahorwat@usgs.gov

Increased stormwater volume and TSS loadings from urban surfaces cause harmful effects to the aquatic ecosystems. Quantifying pollutants from outfalls poses a challenge to variability in flow. Administrators rely on models to assess compliance plans for pollutant reduction performance standards and TMDL. To improve modeling performances, this project populated the WIUDB with results from thousands of measured events. Datasets from WIUDB were statistically evaluated to produce regression for the urban landuses. This project then used observed rains and volumes from source areas (SA) to produce nine runoff curves to predict event volumes from impervious areas (parking lots, pitched and flat roofs, residential and commercial roads, freeways) and pervious areas (silty, clayey and freeway). Also observed rain and TSS concentrations produced ten SA event-mean concentration curves to predict loadings commercial and industrial parking lots, residential pitched roofs, commercial and industrial flat roofs, commercial roads, driveways, landscape, undeveloped and pervious freeway). We updated WinSLAMM parameters with regressions and made 92 sites files. Selected SA sites were calibrated and validated by comparing the predicted results against observed

datasets. Landuses, sites with multiple SAs (residential, institutional, commercial, industrial, and freeway) then verified the model. The WIUDB, SA regressions, and the process to calibrate, validate and verify can improve urban models.

Session 4C:
Agricultural Management
Friday, April 26, 2024
10:30 a.m.

Controls on Nitrate Removal from Saturated Riparian Buffers in Tile-drained Agricultural Watersheds

Steven Hall, University of Wisconsin-Madison, steven.hall@wisc.edu
Matthew Leeford, UW-Madison
Thomas Isenhart, Iowa State University

Saturated riparian buffers are a promising new edge-of-field practice for nitrate removal in tile-drained agricultural watersheds. The NRCS has published a conservation practice standard for saturated buffers, yet factors that influence differences in nitrate removal among sites remain poorly understood. We tested whether changes in organic carbon and soil respiration following perennial vegetation establishment could predict nitrate removal among 10 saturated buffers in Iowa. Time since riparian vegetation establishment on previously cropped soils varied from three to thirty years among sites. Respiration measured in intact soil cores in the lab, a measure of carbon availability to microbes, increased rapidly within years of buffer establishment and doubled relative to croplands after 14 years. Our initial data indicate that increased soil respiration correlated with nitrate removal from shallow groundwater, likely by alleviating carbon limitation of denitrification. Total organic carbon also tended to increase with time since buffer establishment, but trends were strongly mediated by soil texture differences among sites. These findings indicate that saturated riparian buffers may be a promising nitrate removal strategy even in soils with relatively low organic carbon, because of the potential for riparian vegetation to increase carbon availability to denitrifying microbes. We will discuss opportunities and unknowns for establishing this water quality practice in Wisconsin.

Investigating Potential of Biochar Amendments to Vegetative Filter Strips: A Column Study

Joseph Sanford, University of Wisconsin-Platteville, sanfordj@uwplatt.edu

Vegetative treatment areas (VTAs) are a common practice for treating on-farm runoff from silage bunkers and feedlots. The runoff from these areas contain high concentration of nutrients, and the VTA systems help reduce the risk to surface waters by infiltrating the runoff into soil systems. In recent years, concerns have risen regarding the impact to groundwater quality from these systems, specifically with the leaching of nitrate through the systems. Recent studies have found that nitrate leaching can be significantly higher in VTA systems compared to production agricultural fields. Biochar amendments in production agricultural fields have been highlighted as a potential method to aid in reducing nitrate leaching. This study looked at using biochar produced from different feedstocks and at different temperatures, and its ability to reduce nitrate leaching in soil columns when silage bunker runoff was applied over the course of 6 months. The results indicate that high temperature biochar has the potential to significantly reduce nitrate leaching in these systems, but only temporarily, suggesting the need for potential pre-treatment to recover nutrients.

Effects of Cover Crop Implementation on Nutrient and Sediment Losses at Field Edges in the Lower Fox River Basin

Isaac Mevis, U.S. Geological Survey, Upper Midwest Water Science Center, imevis@usgs.gov
Brittany Hanrahan, USGS
Matthew Komiskey, USGS

The Great Lakes Restoration Initiative (GLRI) is a multi-agency collaboration that seeks to address some of the largest threats to the Great Lakes, including nearshore health and nonpoint source pollution. The Fox River Basin, WI, a tributary to Lake Michigan, has been identified as a priority watershed targeted for restoration because of ecosystem impairments such as harmful algal blooms fueled by excess nutrients. The planting of cover crops is a widely-adopted conservation practice identified by the Natural Resources Conservation Service to reduce nutrient contributions from agricultural fields.

The U.S. Geological Survey monitored runoff, nutrient, and sediment losses before and after cover crop implementation at the edges of four fields in the Lower Fox River Basin from 2013-2021. Results were mixed, but overall suggest decreases in nitrate and suspended sediment losses after the implementation of cover crops. Total phosphorus losses remained largely unchanged, while dissolved phosphorus increased. Runoff from the fields increased as well, identifying that both the amount of an available nutrient source and transport to the field edge are important components of agricultural nutrient losses. Farm-management modifications to accommodate the transition to cover crops (including tillage and nutrient application) were likely important factors affecting both nutrient source and transport.

Sustainable Agriculture in Wisconsin?

John Skalbeck, University of Wisconsin-Parkside, skalbeck@uwp.edu

The USDA defines sustainable agriculture as “farming in such a way to protect the environment, aid and expand natural resources and to make the best use of nonrenewable resources”. The United Nations estimates that global population will increase from the current 8 billion to 9.7 billion in 2050. These factors highlight the important role of sustainable agriculture. Recognition of historical and current agricultural habits is vital in formulating future sustainable best practices.

The Union of Concerned Scientists outline facets of agricultural good stewardship from environmental sustainability based on: healthy soils and erosion prevention, wise water management, minimizing air and water pollution, carbon storage on farms, climate change resiliency, and promoting biodiversity. Economic and social sustainability ensures that farms of any size are profitable and contribute to the local economy, promote equity and justice among workers, generate health food, and priorities people and community over corporate profits. Best practices include: crop rotation and diversity, no-tilling methods, cover crop planting, livestock and crop integration, integrated pest management, adopting agroforestry practices, and implement systems approach suited to the landscape.

The details of sustainable agriculture are highly dependent on the geographic and economic fabric of the producing and consuming communities. The challenge for agriculture remains in balancing the sustainability tenets.

Index

Anderson, Josh, 46

Arriaga, Francisco, 38, 44

Austin, Brian, 42, 61

Babasin, Sean, 39

Baker, Ann, 59

Bartlett, Sarah, 58

Bates, Laura, 56

Bell, Amanda, 55

Berns-Herrboldt, Erin, 43

Betz, Carl, 38

Blount, James, 58

Bonnell, Joe, 25

Booth, Eric, 24, 42

Borchardt, Susan, 36

Borchardt, Mark A., 38, 40

Branca, Joseph, 27

Brockschmidt, Samuel, 34

Broerman, Heidi, 58

Brown, Amanda, 38

Buer, Nicolas, 35

Burch, Tucker, 31, 38, 39, 40, 55

Cardiff, Michael, 34, 35, 48

Chase, Pete, 41, 45

Chatman, Chamia, 21

Christensen, Victoria, 48

Christenson, Catherine, 35

Cook, Rachel, 31, 38, 39, 40, 55

Corsi, Steve, 50

Corson-Dosch, Nicholas, 42, 61, 62

Danz, Maria, 27

Dearlove, Paul, 20

Deau, Jordan, 39

Diebel, Matthew, 55, 58, 59

Doughan, Gabi, 40

Dougherty, Will, 33, 53

Dupasquier, Matt, 28

Elliott, Sarah, 50

Ennis, Ryan, 55

Fallon, James, 54

Fehling, Anna, 20, 33

Feinstein, Daniel, 62

Ferin, Kelsie, 42

Fermanich, Kevin, 58

Fienen, Michael, 25

Finley, Savannah, 47

Firnstahl, Aaron, 31, 38, 39, 40, 55

Fitzpatrick, Faith, 55, 58, 59

Folena, John, 45

Fratta, Dante, 34

Freihoefer, Adam, 53

Garcia, Max, 45

Genskow, Ken, 25, 35

Ginder-Vogel, Matthew, 38, 47, 61

Givens, Carrie, 46

Gotkowitz, Madeline, 33, 61

Graham, Grace, 41

Green, Christopher, 42, 61

Greve, Rachel, 33

Gruber, Kaitlyn, 50

Gunn, Kpoti, 21

Haas, Lisa, 32

Hall, Steven, 64

Halstead, Grace, 43

Hanrahan, Brittany, 65

Hart, David, 20, 32, 34, 43, 48, 49

Haserodt, Megan, 24, 62

Heffron, Joseph, 31, 38, 39, 40, 55

Hegazy, Omar, 41

Hillman, Andrew, 25

Holly, Michael, 21, 39

Horwatich, Judy, 62

Hruby, Claire, 38

Hunt, Randall, 48

Ibhagui, Eimienwanlan, 42

Isenhart, Thomas, 64

Johncock, Kathryn, 48, 55

Johnson, Ray, 30

Johnson, Keegan, 46

Juckem, Paul, 42, 61

Jurcek, Pat, 32

Jurcek, Jessica, 36

Kalcic, Margaret, 25, 44

Karriker, Locke, 40

Kauffman, Leon, 42

Keymer, Daniel, 21

King, Kevin, 44

Klaubauf, Collin A., 29

Koch, Joshua, 24

Komiskey, Matthew, 65

Konrad, Amber, 43

Krueger, Samantha, 34

Kucharik, Christopher, 42

Lafond-Hudson, Sophia, 46

Larson, James, 46
Le, Vy, 43
Leaf, Andrew, 24
Leeford, Matthew, 64
Loken, Luke, 46
Luczaj, John, 43
Lund, Will, 59
Majumder, Erica, 21, 30
Mase, Amber, 25
McDonald, Walter, 27, 28, 41
McNamara, Patrick, 28
Mehan, Sushant, 44
Mevis, Isaac, 58, 65
Meyer, Benjamin, 24
Muehlman, Jaya, 44
Muldoon, Maureen, 31, 45, 48, 49
Norenberg, Sophia, 45
Norfleet, Mark, 43
Nott, Michelle, 55, 56
Olds, Hayley, 46, 48, 56
Oliver, Samantha, 54
Olson, Jeff, 30
O'Malley, Kassidy, 28
Opelt, Sarah, 31, 38, 39, 40
Osterholz, William, 44
Paradis, Charles, 30, 45
Parolari, Anthony, 42
Paulson, Hannah, 53
Peterson, Sarah, 46, 54
Pettinger, Catherine, 30
Phelps, William, 50
Popova, Inna, 22
Potter, Mira, 46
Prasad, Laxmi R., 29, 44
Price, James, 36, 37
Pronschinske, Matthew, 50
Pruitt, Aaron, 25, 53
Ramey-Lariviere, Juliet, 47
Rayniak, Angie, 47
Reeves, Howard, 62
Rehwald, Matt, 32, 49
Remucal, Christy, 50, 51
Reneau, Paul, 46, 59
Robertson, Dale, 58
Roden, Eric, 22
Roland, Collin, 59
Romano, Carla R., 22
Romano, James, 56
Rosen, Joshua, 48
Rosner, Robert, 59
Runge, Elizabeth, 51
Sanford, Joseph, 21, 64
Schachter, Laura, 29, 42, 61, 62
Schauer, Andrew, 43
Schoephoester, Peter, 49
Schutz, Jordan, 50
Selbig, William R., 29
Sellers, Ben, 24
Shafer, Martin, 50
Shaw, Bret, 35
Sherman, Jessica, 39
Siemering, Geoffrey, 38
Skalbeck, John, 65
Splinter, Dale, 30
Stewart, Esther, 32, 45
Stokdyk, Joel, 31, 38, 40, 55
Strautmann, Megan, 47
Stuntebeck, Todd, 29
Summers, Paul, 48, 51
Swanson, Sue, 41, 49
Thompson, Anita M., 25, 29, 44
Tiedmann, Helena, 53
Trompeter, Hailey, 48
Veith, Kamryn, 45
Wang, Yin, 51
Westenbroek, Stephen, 24
Wiersma, Amy, 49, 61
Woods, Allondra, 30
Workman, Amy, 43
Wu, Chin, 46, 54
Xu, Shangping, 51
Zahasky, Christopher, 43, 48, 51, 61
Zhao, Yanan, 51
Zimmer, Margaret, 54