

**Water Resources Institute
The University of Wisconsin-Madison**

**Annual Technical Report
2019**

Products

Reports

Booth, E. G., S. P. Loheide II, D. Bart, P. A. Townsend, and A. C. Ryzak. 2019. Linking groundwater and nutrients to monitor fen ecosystems using airborne imaging spectroscopy. (University of Wisconsin-Madison). Final Report, University of Wisconsin Water Resources Institute. 20p.

Lark, T., and Y. Xie. 2020. Mapping annual irrigation extent at 30-m resolution across the United States, 1997-2017. (University of Wisconsin-Madison). Final Report, UW-USGS Irrigation Mapping Project. 60 pp. [G19AC00080/2016WI354G](#).

McLellan, S. 2021. Detection of Sewage Contamination in Urban Areas of the Great Lakes. . (University of Wisconsin-Milwaukee). Final Report, University of Wisconsin Water Resources Institute. 3 pp. [WR16R005/2016WI354G](#).

Theses

Michaud, Alex. 2019. Long term performance of radon barrier in limiting radon flux from four uranium mill tailings containment facilities. M.S. Thesis. Geological Engineering, University of Wisconsin-Madison, Madison, WI.

Publications

Barker D, DeMaria A, Caraco D, Corsi S, Kinzelman J, Liner B, McLellan S, McFadden L, Nenn C. 2019. Detection of Wastewater Contamination - Knowledge Development Forum. Water Environment Federation, Water Science & Engineering Center, WSEC-2019-KDF_TR-001. [WR16R005/2016WI354G](#).

Fuhrmann, M., C. Benson, J. Waugh, M. Williams, and H. Arlt. 2019. Proceedings of the Radon Barriers Workshop July 25–26, 2018, NRC Headquarters, Rockville, MD. US Nuclear Regulatory Commission, NUREG/CP-0312. [WR15R008/2015WI359S](#).

Fuhrmann, Mark; Michaud, Alex; Salay, Michael; Benson, Craig H; Likos, William J; Stefani, Nicolas; Waugh, W. Joseph; Williams, Morgan M. Lead-210 profiles in radon barriers, Indicators of long-term Radon-222 transport. Applied Geochemistry, November 2019, Vol.110. DOI: 10.1016/j.apgeochem.2019.104434. [WR15R008/2015WI359S](#).

Janssen, S.E., R.F. Lepak, M.T. Tate, J.M. Ogorek, J.F. DeWild, C.L. Babiarz, J.P. Hurley, and D.P. Krabbenhoft. 2019. Rapid pre-concentration of mercury in solids and water for isotopic analysis. Analytica Chimica Acta 1054:95-103. <https://doi.org/10.1016/j.aca.2018.12.026>. [WR18R005/USGS G19AP00003](#).

Jeon, B., A. Scircle, J.V Cizdziel, J. Chen, O. Black, D.J. Wallace, Y. Zhou, R.F. Lepak, and J.P. Hurley. 2020. Historical deposition of trace metals in a marine sapropel from Mangrove Lake, Bermuda with emphasis on mercury, lead, and their isotopic composition. Journal of Soils and Sediments:1-11. [WR18R005/USGS G19AP00003](#).

Lepak, R.F., J.C. Hoffman, S.E. Janssen, D.P. Krabbenhoft, J.M. Ogorek, J.F. DeWild, M.T. Tate, C.L. Babiarz, R. Yin, E.W. Murphy, D.R. Engstrom and J.P. Hurley. 2019. Mercury Source Changes and Food Web Shifts Alter Contamination Signatures of Predatory Fish from Lake Michigan. *Proceedings of the National Academy of Sciences of the United States of America* 116:23600-23608. doi.org/10.1073/pnas.1907484116 **WR18R005/USGS G19AP00003**.

Magee, M.R., C.L. Hein, J.R. Walsh, P.D. Shannon, M.J. Vander Zanden, T.B. Campbell, G. Hansen, J.A. Hauxwell, G.D. LaLiberte, T.P. Parks, G.G. Sass, C.W. Swanston, M.K. Janowiak. 2019. Scientific advances and adaptation strategies for Wisconsin lakes facing climate change. *Lake and Reservoir Management* 35. doi: 10.1080/10402381.2019.1622612. **WR16R003/2016WI351B**.

Magee, M.R. 2019. Climate Wisconsin 2050. Scenarios of a State of Change: Lakes. Wisconsin Initiative on Climate Change Impacts (WICCI). <https://wicci.wisc.edu/wp-content/uploads/2019/12/climate-wisconsin-2050-lakes.pdf>

Parish, A.L., A.D. Kendall, A.M. Thompson, R.S. Stenjem, and D.W. Hyndman. 2019. Cellulosic biofuel crops alter evapotranspiration and drainage fluxes: Direct quantification using automated equilibrium tension lysimeters. *GCB Bioenergy* 11:505-516. <https://doi.org/10.1111/qcbb.12585W>. **R10R003/2010WI282O**.

Rosera, T.J., S.E. Janssen, M.T. Tate, R.F. Lepak, J.M. Ogorek, J.F. DeWild, C.L. Babiarz, D.P. Krabbenhoft and J.P. Hurley. 2019. Isolation of Methylmercury Using Distillation and Anion-Exchange Chromatography for Isotopic Analyses in Natural Matrices. *Analytical and Bioanalytical Chemistry* 412:681–690. doi.org/10.1007/s00216-019-02277-0. <https://doi.org/10.1007/s00216-019-02277-0>. **WR18R005/USGS G19AP00003**.

Rosera, T.J., S.E. Janssen, M.T. Tate, R.F. Lepak, J.M. Ogorek, J.F. DeWild, C.L. Babiarz, D.P. Krabbenhoft and J.P. Hurley. 2019. Isolation of Methylmercury Using Distillation and Anion-Exchange Chromatography for Isotopic Analyses in Natural Matrices. *Analytical and Bioanalytical Chemistry* 412:681–690. doi.org/10.1007/s00216-019-02277-0. **WR18R005/USGS G19AP00003**.

Stenjem, R.S., A.M. Thompson, K.G. Karthikeyan, B.J. Lepore, A.D. Kendall, and D.W. Hyndman. 2019. Quantity and quality of water percolating below the root zone of three biofuel feedstock crop systems. *Agricultural Water Management* 221:109-119. <https://doi.org/10.1016/j.agwat.2019.04.008>. **WR10R003/2010WI282O**.

Sun, X., R. Yin, L. Hu, Z. Guo, J.P. Hurley, R.F. Lepak, and X. Li. 2020. Isotopic tracing of mercury sources in estuarine-inner shelf sediments of the East China Sea. *Environmental Pollution*, 114356. **WR18R005/USGS G19AP00003**.

Yin, R, C. Deng, B. Lehmann, G. Sun, R.F. Lepak, J. P. Hurley, C. Zhao, G. Xu, Q. Tan, Z. Xie, and R. Hu. 2019. Magmatic-Hydrothermal Origin of Mercury in Carlin-style and Epithermal Gold Deposits in China: Evidence from Mercury Stable Isotopes. *ACS Earth and Space Chemistry* 3(8):1631-1639. DOI: 10.1021/acsearthspacechem.9b00111 **WR18R005/USGS G19AP00003**.

Yin, R., X. Pan, C. Deng, G. Sun, S.Y. Kwon, R.F. Lepak, and J.P. Hurley. 2020. Consistent trace element distribution and mercury isotopic signature between a shallow buried volcanic-

hosted epithermal gold deposit and its weathered horizon. Environmental Pollution, 113954. [WR18R005/USGS G19AP00003](#).

Information Transfer Program Products (see also below)

- Chronicles, volume 3 and 4 in 2019 and volumes 1, 2,3 and 4 in 2020
<https://chronicle.aqua.wisc.edu/view-all/>
- News releases at <https://www.wri.wisc.edu/news-categories/archive/> that range from “WRI Fellows Looks at What’s Ahead for Brook and Brown Trout Amid Wisconsin’s Changing Hydrology” to “Water Resources Postdoc Concludes Fellowship by Presenting Key Findings to the City of Waupaca”
- Wisconsin Water News Podcasts <https://www.seagrant.wisc.edu/audio/wisconsin-water-news/>
- “Wisconsin’s Groundwater Coordinating Council” video
<https://www.youtube.com/watch?v=DhWnMuP96aI&t=9s>
- “Winter Salting Guide” video
<https://www.youtube.com/watch?v=ct04luWoplM>

Information Transfer Program

The Information Transfer Program of the University of Wisconsin Water Resources Institute (WRI) supports the institute’s mission of addressing through research present and emerging water quality, quantity and management challenges. This is accomplished through the effective use of extension services and the implementation of a communications strategy.

The WRI Information Transfer Program has a complementary communications program that disseminates the University of Wisconsin Sea Grant College Program’s research findings and supports its extension and education efforts. Great efficiencies are achieved by advancing the branding and information transfer work of the two water programs.

Such efficiency and its resultant successes begin with an understanding of the intended audiences for WRI messages. WRI audiences are researchers, policy makers, decision makers, water managers, students and, in certain instances, members of the public.

The desired outcomes of the Information Transfer Program’s work are to 1) foster learning among the intended audiences, 2) encourage these audiences to perceive their role and actions related to water quantity, quality and management in an informed and perhaps reconsidered manner and 3) take action based on the information to be gained from the WRI’s research into Wisconsin-specific water issues.

An annual WRI Information Transfer Program strategy is developed. To implement the strategy, tactics and products are put into use throughout the year. The tactics and products for this reporting period are outlined in this report. The Wisconsin Water Library provides extension services and those activities are also detailed.

Tactics and Products

Much of WRI’s information is shared via an online publication store, <http://aqua.wisc.edu/publications>. Examples of the material include a handbook about

implementing green infrastructure and fact sheets about groundwater drawdown, nitrates and arsenic.

Another publication to note is the Aquatic Sciences Chronicle, which is produced and distributed quarterly. It highlights water research and the people who conduct water research and outreach. The Chronicle's dedicated readers consist of roughly 5,500 online and print subscribers, which includes local and state water-management agencies, and water-related non-governmental organizations. Readers are found in Wisconsin and across the country. The newsletters are also posted online. At aqua.wisc.edu/chronicle, all issues of the publication are archived and searchable. In 2020 due to the pandemic, two of the four issues were produced as electronic only because so many of the publication's subscribers were working remotely and those mailing addresses were not available to WRI staff.

Social media facilitates engagement with audiences. WRI is active on Facebook and Twitter. Through the Twitter account, for example, one analytical tool shows that WRI has the potential to deliver about 700,000 impressions a week. WRI also uses the social media tools Flickr and YouTube.

WRI's video catalog includes "What's a Spring," "Streams Neutralize Nitrates in Groundwater," "A New Measure of Groundwater Flow," "Got Oaks" and "Drought in Southwest Wisconsin as Told by Oaks." "Testing Well Water for Microorganisms" is the most popular video in the catalog. New in this reporting period were videos about the Wisconsin Groundwater Coordinating Council and a winter salt-use guide, which has already amassed more than 10,000 views. All of the videos are shared through the program's website and its YouTube channel, <http://www.youtube.com/user/UWASC/>.

Audio podcasts on water topics are very popular with visitors. Wisconsin Water News highlights a wide variety of water conversations. The catalog is broad with 32 titles at the time of this report writing and always expanding. In this reporting period, one podcast episode based on a WRI project was added.

The eight-episode "Aquifers and Watersheds" audio podcast series, which demystifies for general audiences these geological formations and the geoscience involved in studying them, can be found at bit.ly/1e5a1jQ.

At <http://www.seagrant.wisc.edu/home/Default.aspx?tabid=601&AudioGroupID=33> is a WRI-sponsored seven-part audio podcast series. "Water, Wisconsin and the Mercury Cycle" details mankind's historic uses of mercury, Wisconsin's water resources and mercury in Wisconsin waters. A major part of the series also focuses on WRI-funded research on mercury.

Finally, a newer audio podcast series, "Undercurrents: The Hidden Knowledge of Groundwater" drew about 650 visitors in this reporting period. It can be found at bit.ly/29hYqTF. The WRI website <http://www.wri.wisc.edu> orients visitors to the Wisconsin program. The site had about 84,000 visitors in this reporting period.

News releases on WRI projects and people are distributed as appropriate. In this reporting year, there were 26 news releases.

During this reporting period, the Water Library site <http://www.waterlibrary.aqua.wisc.edu>, was populated and usability monitored. The site is a portal to the breadth and depth of water-related scholarship in the state, and beyond. It is a way to explore on topics that align with visitors'

interest to facilitate greater interdisciplinary collaboration and exploration. The site had 6,698 users in this period for nearly 9,675 sessions in this reporting period. Funding opportunities, a listing of current research and a grouping of past research results were the top three website areas.

WRI staff conducted an educational event to commemorate the 2020 Groundwater Awareness Week in the Wisconsin State Capitol. It was one of the last events that was able to occur in person prior to the spread of the new coronavirus. The event provided an opportunity for relationship building: The University of Wisconsin-Madison lobbyists visited the exhibit. They continue to keep WRI top of mind when they work with state legislators—sharing material and seeking expertise where appropriate. This is a win because the program is very small in a very large university. About a dozen visitors to the booth identified as legislators. Other visitors included school groups and members of the public.

AWRA 2020 Annual Conference – Another Communication Tool

The Wisconsin Section of the American Water Resources Association conducts an annual meeting. WRI has long assisted with meeting planning and all the associated printed material for the event. WRI takes the lead on—and funds—the writing, editing, graphic design, printing and mailing of a conference registration brochure, and the writing, editing, graphic design and printing of the conference program. The 2019 conference took place before this reporting period. In 2020 and due to public health concerns surrounding COVID-19, the conference was cancelled. Yet, that decision came at a late date and staff at WRI had already completed the work to ensure proper notification of the learning and networking event.

Wisconsin's Water Library Reaches Into Communities

The Wisconsin Water Library is a unique resource for researchers, resource managers and all Wisconsin citizens. It contains more 30,000 volumes of water-related information about the Great Lakes and other waters of Wisconsin. The library includes a curricula collection, dozens of educational videos, children's collection, journals and newsletters. Each year, more than 1,000 publications circulate among interested patrons. The public health disruption in 2020 did reduce those circulation figures.

Wisconsin's Water Library continues to catalog all groundwater research reports from WRI projects into WorldCat and MadCat, two library-indexing tools. This ensures WRI's cutting-edge water exploration is broadly available locally, regionally, nationally and globally.

In addition to archival benefits, the library provides outreach by answering many in-depth reference questions on a wide range of water-related topics. It also provides a water research guide <http://researchguides.library.wisc.edu/waterscience>.

It is active on social media. It prepares recommended reading lists on topics such as climate change, groundwater, water conservation and water supply.

In partnership with the Wisconsin Department of Natural Resources and the Wisconsin Wastewater Operator's Association (WWOA), the library has continued its long-term assistance to current and future drinking water and wastewater operators in Wisconsin. The library has cataloged the essential technical manuals into the library's collection and provides loans to WWOA members around the state in support of their required state license examinations as well as in support of the educational needs of their daily work.

Using email, the library sends out a bimonthly “Recent Acquisitions List” to about 500 contacts. The message also includes recent updates to the library website and contact information for users to ask any water-related question. The library also supports an email account at askwater@aquawisc.edu, which is monitored daily.

The library maintains an extensive curriculum collection of guides with innovative approaches and other educational materials for teaching water-related science in K-12 classrooms. The curricula are available for checkout by all teachers and residents in Wisconsin. This circulation was also disrupted during this reporting period due to the pandemic. However, as vaccinations become more widespread in 2021, that will again change.

The librarian also has extensive experience providing programming to Pre-K children. She has put that experience to use in developing field-tested science, technology, engineering, art and math (STE(A)M) activities and packaging them into curriculum kits. Each kit contains several books, tips on a guided water-science experiment and other themed activities. The kits will eventually number 27 on topics such as the water cycle, aquatic invasive species and art and water. The current kits are Jump Around With Frogs, Does it Sink or Float and Once Upon a Pond. <https://waterlibrary.aqua.wisc.edu/for-parents-and-teachers-and-librarians/our-stem-kits/>The pandemic accelerated the librarian’s workplan to update online curriculum as many educators and families were seeking resources for distance enrichment. Seven of the 10 lessons plans were updated in this reporting period.

To build water literacy, the librarian is also active throughout the state offering educational enrichment at events to students, educators and adult learners. In this reporting period, most efforts took place pre-pandemic, yet she was able to reach an impressive number of people—669.

In this reporting period, staff also facilitated mentoring for 16 teachers on a Great Lakes research/educator cruise for Wisconsin teachers.

Products

- Chronicles, volume 3 and 4 in 2019 and volumes 1, 2,3 and 4 in 2020
<https://chronicle.aqua.wisc.edu/view-all/>
- News releases at <https://www.wri.wisc.edu/news-categories/archive/> that range from “WRI Fellows Looks at What’s Ahead for Brook and Brown Trout Amid Wisconsin’s Changing Hydrology” to “Water Resources Postdoc Concludes Fellowship by Presenting Key Findings to the City of Waupaca”
- Wisconsin Water News Podcasts <https://www.seagrant.wisc.edu/audio/wisconsin-water-news/>
- “Wisconsin’s Groundwater Coordinating Council” video
<https://www.youtube.com/watch?v=DhWnMuP96aI&t=9s>
- “Winter Salting Guide” video
<https://www.youtube.com/watch?v=ct04luWoplM>

Student Support

Number of students supported	Undergraduate	Graduate	Post-docs
104b	8	3	5
104g	1	3	0
NIWR-USGS internship	3	2	0
Coordination Grants	0	1	1
Total	12	9	6

Notable Achievements and Awards

In this reporting period, the University of Wisconsin Water Resources Institute placed five fellows within state agencies in successful partnerships that bring cutting-edge science to state rulemaking and decision making, while providing mentoring for these young scientists emerging into their chosen fields. Fellowships can start at one year but there has often been an expansion of the experience once both parties see the enormous benefits of the arrangement. In this reporting period, the thorny issues facing Wisconsin that the fellows have and are lending expertise into addressing include: surface water quality, groundwater quantity and quality in multiple areas of the state, PFAS level standards for drinking water, and the interplay of high-capacity wells and trout streams.

In this reporting period, work supported by the University of Wisconsin Water Resources Institute (WRI) led to awards. The Wisconsin section of the American Water Works Association presented its 2020 research award on a WRI-funded researcher. In conferring the award, the organization noted the researcher's work in evaluating how geochemistry affects sources of radium and its parent elements, as well as laboratory methods that more precisely quantify radium species in groundwater. It concluded: the work of this group pertaining to elemental cycling and mobility in general is very valuable to the water industry. WRI information transfer staff also won AVA Digital Awards for the Wisconsin Water News podcast catalog. The awards attract an average of 2,500 entries from around the world, from the businesses, non-profit organizations and academic institutions. The awards are administered and judged by the Association of Marketing and Communications Professionals.

Impact Of Changing Snow Cover And Frozen Ground Regimes On Groundwater Recharge

Project Type: Annual Base Grant

Project ID: 2019WI279B

Project Impact:

Sustainable management of groundwater (GW) resources requires quantification of inputs to aquifers through GW recharge as well as an understanding of interannual variability and the likely future trajectory of this flux. Changing snow cover and frozen ground regimes will likely alter both the quantity and timing of GW recharge in the Midwest. Our research is helping to determine the magnitude and direction of these changes. Results suggest that mid-winter melts and frozen ground play a significant role in determining the partitioning between GW recharge and runoff, but the effects are sensitive to many factors, including soil texture and the magnitude and temporal sequence of events. Analysis of historical data suggests that warming temperatures do not always lead to more recharge; future modeling will help us understand how warming temperatures may affect recharge. This research not only has implications for long-term GW management but also has implications for GW dependent ecosystems, agriculture, nutrient cycling, GW quality, baseflow, and flooding. Understanding the multifaceted feedbacks between frozen ground, infiltration, snow cover, and GW recharge is critical for predicting the ways in which water resources will be affected by climate variability in the future.

Mapping Annual Irrigated Lands In The U.S. To Support Irrigation Water-Use Estimation

Project Type: Coordination Grant

Project ID: 2019WI001S

Project Impact:

This project developed new highly detailed maps of irrigated agriculture across the entire United States for the period of 1997-2017 to fill critical gaps in the knowledge and understanding of irrigation use and dynamics at nationwide scales. Based on the 21 years of analysis, we detected considerable increases in irrigated area especially in the Midwest, Mississippi Alluvial Plain, and East Coast. These areas of growth were counterbalanced, in part, by hotspots of decreasing irrigated extent in locations like the central and southern High Plains Aquifer, southern California Central Valley and Arizona, and southeastern Florida. The developed mapping approach and associated data sets, which provide the most extensive and finest resolution characterization of US irrigation to date, helped reveal a new level of understanding of irrigated land use, land-use change, and associated water use. Furthermore, the methods and data are temporally applicable to other years for continuous monitoring of irrigated area over the contiguous U.S. The produced methodology and outputs are now being used by USGS water use researchers to estimate irrigated water consumption for the nation and support ongoing efforts related to the USGS water census and water budget estimation projects.

Microbial Drivers Of Mercury Methylation In Freshwater Eutrophic Systems

Project Type: National Competitive Grant

Project ID: 2019WI001G

Project Impact:

The toxin methyl mercury is made by microorganisms in some lakes but we cannot predict when or why. This project aims to identify the microbes responsible for methyl mercury production in a hydroelectric reservoir. Fish in the reservoir are contaminated with methyl mercury and this can expose humans to the toxin. We have identified regions of the reservoir in which microbes are actively producing methyl mercury and are sequencing their DNA to identify them. We have preliminary data to suggest that they are novel mercury methylators carrying out the production under conditions not previously known to encourage mercury methylation. Their DNA sequences will help us untangle the complex microbial activities that lead to methylation.

Importance of Bioavailability of Multiple Mercury Sources for Environmental Applications of Stable Isotopes

Project Type: National Competitive Grant

Project ID: G19AP00003

Project Impact:

Our research aims to utilize mercury (Hg) stable isotopes to elucidate Hg sources to the food web and provide a vital tool for site and risk assessment in Hg contaminated zones. With the use of the novel Rosera et al. (2019) methylmercury (MeHg) method, we can preconcentrate MeHg in natural matrices allowing the research community to analyze environmental Hg pools that were not previously accessible. Lastly, lab-based experiments and field collections of plankton and fish will serve as a key for connecting Hg contamination within sediments and waters to food web bioaccumulation.

Fate of groundwater phosphorus from septic systems near lakes

Project Type: Annual Base Grant

Project ID: 2020WI310B

Project Impact:

This work seeks to develop a method to estimate the amount of phosphorus from septic systems that enters lakes. The method considers both reactions of the phosphorus beneath a septic system and measuring phosphorus movement into a lake. The results will be used to develop a tool to predict the importance of septic systems to lake eutrophication.

Scientific Observation and Environmental Storytelling: Engaging Youth and Educators in Urban Settings to Improve Great Lakes Literacy

Project Type: Annual Base Grant

Project ID: 2020WI307B

Project Impact:

The Scientific Observation, Environmental Storytelling project provided educational opportunities to 133 students and professional development for 127 teachers. The project was responsive to needs that arose from the pandemic including providing interactive virtual learning sessions featuring on-the-ground field science and student crafted experiments.

Wisconsin Water Resources Fellowship: Collaborating with Water Managers Education - Year 4

Project Type: Annual Base Grant

Project ID: 2019WI278B

Project Impact:

The Wisconsin Water Resources Institute is in its sixth year of placing postgraduate fellows at state agencies. This past year, we placed two Wisconsin Water Resources Science-Policy fellows at the Wisconsin Department of Natural Resources to work on ecohydrology projects. Streams, rivers, and lakes in the upper Midwest are affected by both climatic variability and groundwater withdrawals for irrigation, and the relative importance of each may vary with time and location. As the frequency and intensity of climate warming, extreme precipitation events, and groundwater withdrawals increases, so does the urgency of our need to understand these emerging risks and untangle the impacts they have on aquatic ecosystems.

Working on parallel projects, Wisconsin Water Resources Science-Policy Fellows, Drs. Voter and Maitland, are developing models which advance our scientific understanding of the integrated effects of climate and groundwater withdrawals on aquatic ecosystems in the upper Midwest. Dr. Voter's work focuses on how these factors impact the water chemistry, plant and fish communities, and human uses of lake ecosystems in the Central Sands region of Wisconsin, while Dr. Maitland's work focuses on how these factors impact streamflow, water temperature, and the population dynamics of world-class trout fisheries in cool-coldwater streams. Both Fellows are working closely with natural resources managers at the DNR to ensure that these scientific advances are translated into tools that help managers holistically evaluate the effects of groundwater withdrawals scenarios under variable climate scenarios. Ultimately, their work will guide sustainable fishery and groundwater management in Wisconsin for years to come.

New proxy-based hydrological reconstructions over the past five centuries in southwest Wisconsin

Project Type: Annual Base Grant

Project ID: 2018WI373B

Project Impact:

Effective water resource management for the present and future requires a long-term temporal perspective on the variability of past water resources. A better understanding of past conditions allows water managers to make informed decisions regarding present and future groundwater availability and use. Short-term instrumental records, however, are insufficient to provide insight into the occurrence of rare, severe events that have caused pronounced economic, ecological, and social implications over longer time scales. This is problematic in light of numerous predictions that future extreme events will become more frequent and intense due to climate change. Wisconsin benefits from abundant water resources, yet droughts that occurred during the last century illustrate that we are vulnerable to extreme events. The influence of extreme drought has significant implications for the ecology and economy of our state, both of which are intimately connected to the natural environment.

Linking groundwater and nutrients to monitor fen ecosystems using airborne imaging spectroscopy

Project Type: Annual Base Grant

Project ID: 2018WI372B

Project Impact:

Calcareous fens are ecosystems with high conservation value in the state of Wisconsin. They are also highly dependent on consistent groundwater inputs, which both makes their health an excellent indicator of groundwater conditions and makes them susceptible to changes in groundwater conditions (e.g., decreased groundwater levels from pumping for irrigation or municipal uses). We used cutting-edge remote sensing technologies to develop an innovative and efficient method that assesses the health of calcareous fens and changes in groundwater conditions. We showed that hyperspectral remote sensing – which uses the part of the electromagnetic spectrum beyond what humans can see with their eyes – can accurately predict groundwater, vegetation, and soil characteristics. This new method of monitoring and assessing these important ecosystems offers an alternative to traditional methods of assessing fen health, which require expensive staffing and expertise resources. As ecosystems and the drivers that impact them continue to change in the near future, monitoring and assessment methods such as the one we developed will become increasingly important for adaptively and sustainably managing ecosystems and water resources.

Detection of Sewage Contamination in Urban Areas of the Great Lakes

Project Type: National Competitive Grant

Project ID: 2016WI354G

Project Impact:

Urban infrastructure is aging throughout the country, and the burden and scope of the problem is enormous. The 2021 American Society of Civil Engineers Report Card continues to rank the nation's wastewater conveyance/treatment systems as a D+ and sewage is regularly detected in urban rivers and coastal waters in the absence of recognized sewage overflows. Sewage pollution can enter surface waters from leaks in deteriorating pipes, subsequently infiltrating stormwater systems or groundwater, which transport contamination to rivers and beaches. Impairment of rivers and beaches by fecal pollution is an ongoing problem for water resource managers and threatens ecosystems and human health worldwide. The freshwater coasts of the Great Lakes are particularly sensitive to fecal pollution impacts as these bodies of water serve as drinking water sources to more than 40 million people in the US and Canada. The overall goal of this project was to develop an innovative approach for rapid, real-time and cost-efficient assessment of failing urban sewer infrastructure. We worked to validate instream optical sensors developed by USGS that could eventually replace the intensive sampling and analysis efforts that municipalities currently use to assess sewage inputs on a watershed basis. The success of real-time sewage detection in waterways will be directly applicable to TMDL watershed permitting efforts, in which the Menomonee watershed is one of three sites nationwide that is serving as a trial by the EPA.