43rd Indiana Water Resources Association Symposium
November 7, 2024
MADE@Plainfield, Plainfield, Indiana

SYMPOSIUM ABSTRACTS

Sponsored by:

Thursday, November 7, 2024

*Note: * = student presenter*

Time	Topic	Speaker
MODERATOR: David Lampe, U.S. Geological Survey		
9:00	Intro and ice breaker	David Lampe U.S. Geological Survey dclampe@usgs.gov
KEYNOTE		
9:40	10-year update of the Indiana Chamber of Commerce water study	Jack Wittman INTERA, Inc. jwittman@intera.com

Author: Jack Wittman, PhD, VP Eastern Water at INTERA, Inc.

Abstract:
Water policy in the State of Indiana, like much of the humid Eastern half of the country, is a mix of now-outdated governance structures that in some locations are ill-equipped to address water management. We base our action on 50-year-old statutes that may suggest ways to make decisions about the resource during seasonal water shortages but offer little insight on navigating the problems embedded in competing water uses. Indiana does not require withdrawal "impact" analyses before installing new groundwater wells or surface water intakes. Instead, our agencies react when and where problems arise after the new system begins operation.

What was advanced thinking 50 years ago may no longer be adequate. The current approach is simple and economical, but it cannot address the questions of long-term regional water availability or water management. By waiting for consequences before acting, the impacts of new development in the basin may not become evident until investments have already been made. As argued in the first State Chamber Water Report (2014), this approach misses the central question facing the state: How do we manage withdrawals to supply current and future users? What are the regional limits of the resource?

Other states are facing the same problem. To reduce these uncertainties and risks, our neighboring states are altering the way they manage new development and increasing their understanding of their water resources. States are using customized tools like regional models and public discussions about priorities to identify the needs of all water users.

Effectively, many midwestern states are adapting the regional planning approach famously developed by the Texas Water Development Board to create state-supported but locally implemented regional water supply plans. In each case, these regional plans are then summarized and explained to become the continuously updated state water plan. However, every state has unique water management challenges. The state examples mentioned in this report should be viewed as data points as Indiana policy makers determine what is best for Indiana. It is also worth noting that some states support water management and infrastructure needs with significant dollars through the state budget.

While Indiana does not yet have statutes that require regional/state water planning, in the last decade, many of the elements have been tested and, in some instances, put in place for a transition to collaborative water management.

This presentation focuses on the updated findings (some are hold-overs from the 2014 report) and then lists recommendations for new state water policy. The recommendations outline the next steps to continue the work to implement collaborative riparian state water policy.

MODERATOR: Garth Lindner, Indiana Department of Natural Resources, Division of Water

10:40	Characterizing drought to inform regional water planning in the Central Indiana Region	Luke Johnstone Mundell and Associates, Inc. LJohnstone@mundellassociates.com

Authors: Johnstone, Luke J., Mundell & Associates, Inc.; John A. Mundell JMUNDELL@mundellassociates.com; Tyler Balson tbalson@mundellassociates.com

Abstract:
Recent stresses to Indiana's water supply and demand have fueled a surge in water resource discussions in both the public and private sectors. Concurrently, State authorities have funded a multitude of technical investigations meant to inform regional water-planning efforts and increase water resiliency across the State. A recent technical report focusing on the Central Indiana Region quantified the water availability for future economic growth by referencing hydrologic conditions during the 2007-2017 timeframe. The investigation identified the 2012 drought conditions as critical when assessing the region's water availability and indicated a more severe drought could exhaust the region's current resources. While there seems to be a widespread acknowledgement that 2012 was a dry year in Indiana, there is a notable lack of critical assessment of this consensus. Was this the drought of record? Was this a short or long-term drought? Were the reservoirs full or already stressed at the start of 2012? What is the likelihood that a more severe drought will occur in the next five, ten, or twenty years? Regional water planning demands answers to these types of questions. A critical review of the 2012 drought conditions was completed using historical Central Indiana precipitation records and the results were compared to the reported water availability in the region from 2007-2017. The review found that there is a high probability that an annual drought similar to 2012 will occur in the next 10 to 20 years. Moreover, the impacts of any acute drought observed between 2007-2017 was potentially mitigated by the overall wet time period in which they occurred. The implications of this drought assessment and potential impact on characterizing the current water availability in the region could be drastic and highlight the need for further drought risk characterization.

11:00	Can we have healthy rivers and streams as our climate changes?	Bob Barr Indiana University – Indianapolis rcbarr@iu.edu

Author: Robert Barr
Center for Earth and Environmental Science
Department of Earth Sciences, Indiana University – Indianapolis

Abstract:
Indiana's changing climate is putting additional pressure on already compromised water resources. An almost complete loss of wetlands together with significant loss of floodplain functions is making adapting to changing precipitation patterns difficult. The threat to the few remaining wetland areas and to Indiana's streams and rivers is large. Despite continuing attempts to improve water quality and quantity concerns Indiana streams are still considered some of the most threatened in the nation, with over 25,000 miles of Indiana rivers and streams too

polluted for recreation and swimming. Many of the problems stem from over two hundred years of modifying the landscape for agriculture and urban development; with both land uses increasing runoff and reducing infiltration. Here we are going to consider a set of tools and practices that when combined may help to reduce the threats from climate change and enable Indiana's aquatic ecosystems to continue to improve.

11:20	Fish assemblages of the Wabash River prior to modification of upstream dam releases	Mark Pyron Ball State University mpyron@bsu.edu

Authors: Mark Pyron, Max Stafford, Noah Dilley
Department of Biology, Ball State University, Muncie, IN

Abstract:
Three reservoirs were constructed on the upper Wabash River (Indiana, USA) in the 1970s to help with flood control. The management of these reservoirs resulted in altered hydrology from the natural flow regime. This likely impacted the native species life cycles, diversity, and abundance, while promoting invasive species. The US Army Corps of Engineers and The Nature Conservancy proposed a collaborative project on the Wabash River in 2022 involving the implementation of several pulse flow events during the spring, summer, and fall periods, when storage water is available. We used historical and recent fish assemblage collections to provide baseline data prior to flow modifications. Future fish collections are planned to test if fish assemblages improve following flow restoration. Current collections indicate that species richness increased in recent years. A Sustainable Rivers Program workshop recommended modifying dam releases with low, moderate, and high flow events. We predict further improvement for future fish assemblages of the upper Wabash River.

11:40	The Listening Year at Big Walnut Creek	Eliza Brown DePauw University elizabrown@depauw.edu

Composer: Eliza Brown
Associate Professor of Music
Cassel Grubb University Professor of Music, 2023-2028
DePauw University

Abstract:
The Listening Year at Big Walnut Creek is an evening-length piece of music that explores the changing sonic ecology of a creek-side site over the course of a year. Scored for cello, percussion, and electronic audio, the music incorporates and responds to a year of weekly field recordings made at Big Walnut Creek in the DePauw University Nature Park. Throughout the recording year, and while composing the piece, I consulted with scientists, environmentalists, arts colleagues, and community members to help interpret the site and its sounds. The form and musical material of the resulting piece reflect the sounds, morphology, and ecology of the creek and its adjacent riparian and agricultural zones, as well as the transformative experience of engaging in this year-long environmental listening practice. I will discuss the work's recording, interpretation, and creation phases, and share audio excerpts from the field recordings and score.

Time	Topic	Speaker
MODERATOR: Mark Basch, Indiana Department of Natural Resources, Division of Water		
1:30	Using 3-D geologic modeling to understand groundwater monitoring data	Liberty Flora INTERA, Inc. LFlora@intera.com

Author: Liberty Flora, INTERA, Inc.

Abstract:

Morgan County, Indiana has adopted a proactive approach to water resource management through a comprehensive county-wide water study. Central to this study is the implementation of a real-time groundwater level monitoring network, designed to record and analyze local groundwater fluctuations. Additionally, a detailed 3-D conceptual geologic model was developed to interpret aquifer geometries and properties. Using the collected groundwater level data with surface water level data from USGS stream gages, the 3-D geologic model was utilized to interpret the recorded groundwater level fluctuations. This presentation will detail the methodologies employed to analyze water level fluctuations using the 3-D geologic model.

1:50	Collaboration and coordination of efforts for the development of successful, long-term water quality monitoring programs	Katherine Barrett St. Joseph River Commission, Notre Dame University kbarrett@macog.com

Authors: Dr. Katherine Barrett, St. Joseph River Basin Commission & Holy Cross College at Notre Dame
Shae Medlen, AmeriCorps member at the St. Joseph River Basin Commission

Abstract:

For many years, agencies have conducted water quality monitoring of rivers throughout the St. Joseph River Basin (SJRB), the third largest watershed of Lake Michigan. However, the monitoring approach (i.e., period of record, frequency of sampling, water quality variables, and data collection methods) varies across agencies and counties due to differences in both funding and short- and long-term goals. Many water quality efforts, furthermore, are of short duration or sporadic in the frequency of sample collection. These factors present a formidable challenge to stakeholders who seek to identify trends in water quality across time and locations and identify sources of impairment, which is an essential step in implementing remedial efforts.

This talk showcases two new strategic water-quality monitoring programs that were developed in Steuben and LaGrange Counties, both of which share two major sub-watersheds (the Fawn and Pigeon Rivers) within the SJRB. Several stakeholders and agencies participated in the development of and goal setting for each of these county-wide monitoring programs. Importantly, each county successfully applied for and were awarded several grants from community foundations. Since summer 2023, the water-quality monitoring programs in Steuben and LaGrange County have resulted in the collection of nearly 60 consecutive weeks worth of water quality data from 30 streams across several shared watersheds. The data collected from each program include weekly measurements of *E. coli*, phosphorus, nitrate, chloride, total suspended solids, and other relevant parameters that paint a detailed picture of the condition of water quality in the region.

The resulting monitoring data have been used to identify and confirm suspected sources of fecal coliform bacterial contamination and other sources of pollution, and this talk will present a snapshot of the water-quality data results from these programs. Through these programs, organizations such as the St. Joseph River Basin Commission and county Soil and Water Conservation Districts have extended their workforce to partner with organizations such as AmeriCorps. AmeriCorps members who have served these programs have gained valuable lab experience and have made valuable contributions to watershed stewardship. Because of the expansion of these programs and the level of engagement that these programs have fostered, further conversations with other counties in the SJRB and discussions surrounding coordinating sampling efforts across county boundaries are occurring.

MODERATOR: Jessica Weir, Indiana Department of Environmental Management		
2:30	Laboratory experiment on fate and transport of eDNA on clean and loaded streambeds	Kush Paliwal* Purdue University kpaliwal@purdue.edu

Authors: *Kush Paliwal, Antoine F. Aubeneau, and Rao S. Govindaraju
Lyles School of Civil Engineering, Purdue University, West Lafayette, Indiana 47907, USA

Abstract:
Environmental DNA (eDNA) refers to the DNA that is extracted from field samples containing various biological remnants such as molecules, cells, or tissues. Measuring eDNA obtained from water samples has emerged as a sensitive and non-invasive tool for estimating species distribution. However, determining the origin of eDNA remains challenging, particularly in lotic environments. The interpretation of collected eDNA data from experiments or surveys thus far has been hindered by a significant amount of unexplained variability. To explain this seemingly unpredictable transport behavior, a simple conceptual model is proposed where eDNA settles out of the water column and accumulates on riverbeds. Subsequent settling and resuspension events influence downstream transport patterns and contribute to variable local concentrations. Laboratory experiments of eDNA transport under both clean (limited and enhanced hyporheic exchange) and eDNA-loaded streambeds revealed distinct patterns of eDNA transport. On the clean streambed, there was a smooth breakthrough curve with little noise. However, on the eDNA-loaded streambed, transport patterns were more complex. Retention measurements of eDNA on the clean bed provided insights into exchange processes occurring between the water column and the sediment bed. These exchanges could account for variations in accumulation and random movement of eDNA particles as well as their average travel distance under different hyporheic fluxes. Experimental findings indicate para-fluvial processes play a crucial role in environmental-DNA transport within lotic environments, and a better understanding of the relevant transport processes will allow better source identification.

2:50	Nutrient stoichiometry influences phytoplankton community composition and dissolved organic matter in the lower Ohio River	Lindsey Rasnake* Indiana University – Bloomington lrasnake@iu.edu

Authors: *Lindsey Rasnake, *Tanya Iyer, and Todd Royer
O'Neill School of Public and Environmental Affairs
Indiana University, Bloomington

Abstract:
The Ohio River drains a large and diverse watershed and supplies drinking water to more than 4 million people. Blooms of cyanobacteria typically develop on the river each summer and at times result in dangerous toxin concentrations, prompting recreation and drinking water advisories. These events present a major threat to public and ecological health. Loading of nitrogen (N) and phosphorus (P) to the river promotes algal growth, but the mechanisms by which nutrient stoichiometry shifts riverine phytoplankton communities to favor cyanobacteria remain poorly understood. We hypothesize that dissolved silicon (DSi), a critical nutrient for diatoms, influences phytoplankton composition and can be a contributing factor to cyanobacterial blooms. Historical records for the river show frequent depletion of DSi, which limits the growth of diatoms and shifts the phytoplankton community to favor non-siliceous algae. We present historical and new data for the river. To investigate the role of DSi in facilitating blooms of cyanobacteria in the lower Ohio River, we sampled three sites along a 50-river-mile stretch from Cannelton, IN to Evansville, IN. For each site, we collected nutrient and other data 7 times during the 2023 water year. We used N, P, and DSi concentrations to assess the extent to which stoichiometric conditions in the river favored diatoms over non-siliceous algae and cyanobacteria. We collected samples for analysis of phytoplankton by PhycoTech Inc, where samples were quantified and archived using a semi-automated Imaging Flow CytoBot. Identified algae were placed in broad functional groups: diatoms, non-toxigenic cyanobacteria, and cyanobacteria with potential to produce toxins. For most of the 2023 growing season, DSi:N:P ratios indicated abundant DSi relative to N and P (DSi:N > 2 and DSi:P > 40), suggesting stoichiometric conditions favored diatoms. However, in August the ratios dropped sharply (DSi:N to <1 and DSi:P to <16), likely as a result of diatom uptake of DSi. The most abundant cyanobacteria were *Aphanocapsa*/*Aphanothece*, though they never represented more than 8% of the phytoplankton

biovolume. Additionally, we examined a hypothesis that changing composition of phytoplankton would affect the quantity and quality of dissolved organic carbon (DOC) in the river. DOC ranged from < 1 to 3.5 mg/L with increases in DOC concentration during high flow in December 2022 and during the height of the growing season during the late summer of 2023. We did not observe a harmful cyanobacterial bloom during water year 2023. Our results indicate that nutrient stoichiometry influences phytoplankton composition in the Ohio River, but that large cyanobacterial blooms require a confluence of other factors, such as flow and temperature, in addition to favorable stoichiometric conditions.

3:10	School Branch tile drain study: Assessing variability of discharge, nutrients, and E. coli from tile drains in a small agricultural watershed	Aubrey Bunch U.S. Geological Survey aurbunch@usgs.gov

Author: Aubrey Bunch, Supervisory Biologist, USGS Ohio Kentucky Indiana Water Science Center,
Dawn Piotrowski, Christopher Kephart, Jeff Frey
USGS Ohio Kentucky Indiana Water Science Center

Abstract:
The School Branch watershed in Hendricks County, Indiana has been the focus of many studies on water quality, but sources influencing the quantity and quality of water within the study area are not well defined. In the midwestern United States, the use of subsurface drainage systems ("tile drains") are necessary to increase the area of arable lands and improve crop yields. Tile flow can account for a large amount of total annual watershed discharge and can have a large influence on the hydrology of a watershed. Drainage classes for soils in the School Branch watershed range from somewhat poorly drained to poorly drained, resulting in highly tiled agricultural fields. In order to better understand the influence of the near subsurface drainage on the flow and water quality within School Branch, the USGS in collaboration with Indiana Department of Environmental Management completed a study to: 1) assess the variability of discharge, nutrients, and Escherichia coli (*E. coli*) among tiles within the stream reach in variable conditions; 2) define how the tiles may influence stream hydrology and water quality; and 3) determine implications for future research and management within the basin. Following three rain events of varying intensity, water-quality parameters and flow rates were measured, and discrete water quality samples were collected for nutrients and E. coli at all flowing tiles within a 1-mile stream reach and at upstream and downstream surface-water sites. Instantaneous flow, nutrient concentration, nutrient load, water-quality parameters, and E. coli concentrations were compared among the tiles and the stream reach for each of the three sampling dates. Nutrient concentrations and instantaneous flow were used to calculate instantaneous nutrient loads from tiles and at the surface-water sites. Tiles contributed from 26.5 to 66% of increased flow between the surface-water sites. Tiles in the study area contributed between 34.7 and 87.4 percent of the increased total nitrogen load and 19.7 to 65.9 percent of the increased total phosphorus load for the downstream site relative to the upstream surface-water site for the three rounds of sampling. The tiles with the largest loads for total nitrogen and total phosphorus for all three sampling dates had moderate nutrient concentrations, but the highest instantaneous flow rates. The E. coli samples showed elevated concentrations both in the surface water and in tile samples. Microbial source tracking samples were collected in following years to identify potential sources of this fecal contamination in the stream.

3:30	USGS Next Generation Monitoring of groundwater/surface-water interaction and nutrients along the Kankakee River	Matthew Hardebeck U.S. Geological Survey mhardebeck@usgs.gov

Author: Matthew J. Hardebeck
United States Geological Survey

Abstract:
Through the U.S. Geological Survey's Next Generation Water Observing System Program, an agricultural headwaters site along the Kankakee River in northwestern Indiana was established to better understand the interaction of groundwater and surface water, along with nutrient fate and transport within this portion of the Kankakee Outwash and Lacustrine Plain. Considered a "testbed" for new technologies and advanced data collection, this project collects and serves to the public real-time data of many hydrologic sources that exist between the crop field and nearby channelized river. Ten groundwater wells screened at three different target depths were installed parallel to the river

and instrumented with sensors for measuring water level, water temperature, specific conductance, pH, dissolved oxygen, continuous nitrate, and oxidation-reduction potential specific to groundwater-chemistry reactions. Additionally, two wells were outfitted with real-time heat-pulse groundwater flowmeters that record groundwater-flow velocity and direction. This is used to determine how groundwater movement and nutrient transport are affected during groundwater/surface-water interaction. Three wells of different depths, and the surface waters of the Kankakee River, are sampled quarterly for nutrients, major inorganics, and stable isotopes. A weather station adjacent to the well cluster collects atmospheric data that is used to calculate potential evapotranspiration, and about 0.5 mile west of the cluster within the field, a Cosmic Ray Neutron sensor measures soil moisture within a 250-meter radius. River stage at the site is measured with a stage-only gage, but a super gage is located about 0.25 mile downstream. Real-time vertical temperature profilers at varying depths within the streambed provide temperature data used for modeling groundwater seepage through the streambed. These groundwater and surface-water data are supplemented by a suite of additional data collection activities that include geophysical surveys, distributed temperature sensing, and streambed seepage measurements. This presentation will identify monitoring-system successes and shortcomings as well as data gaps and unnecessary redundancies, evaluate the performance and value of new technologies, and highlight some observations that have been made during the period of data collection.

Poster Presentations:		
MODERATOR: Laura Esman, Purdue University		
POSTER 1	Visualizing Indiana County Water Withdrawals by Use and Month	Maddie Milharcic* Purdue University mmilharc@purdue.edu

Authors: *Maddie Milharcic and Jane Frankenberger
Department of Agricultural and Biological Engineering, Purdue University

Abstract:

Data collected by the Indiana Department of Natural Resources for each significant water withdrawal facility (SWWF) provide a rich source of information about water use in Indiana, yet there is not an easy way for the public to visualize the impact of these withdrawals. Irrigation water use, which varies widely by season, is particularly poorly understood by many water stakeholders. For this poster, IDNR SWWF data was aggregated by county and by month, averaged over three years, and plotted in a large series of charts to visualize how withdrawals change throughout the year in each county. These charts can increase public understanding of water usage and provide a foundation for informing policy recommendations related to water withdrawals.

POSTER 2	Simulation of the effect of groundwater storage and withdrawals in the Wabash River Basin	Ayomide Adepeju* Purdue University aadepeju@purdue.edu

Authors: *Ayomide G. Adepejua[3,4] , Laura C. Bowling[2,3,4] , Keith A. Cherkauer[1,3,4]

Affiliations:

[1]Agricultural and Biological Engineering, Purdue University;
[2]Agronomy, Purdue University;
[3] Purdue Hydrologic Impacts Groups, Purdue University,
[4]Ecological Sciences and Engineering, Purdue University

Abstract:

Effective groundwater management is crucial in mitigating potential conflicts arising from the increasing demand for large volumes of water for industrial purposes in traditionally water-abundant areas. Groundwater storage and withdrawals are important parts of the water cycle, but their effects are often neglected by surface hydrological models. Improving a conventional macroscale hydrologic model such as the Variable Infiltration Capacity (VIC) model by adding an unconfined subsurface layer representing aquifer storage and a groundwater flow pathway to the model makes it possible to better represent the effect of the groundwater resources in the water cycle.
The modified VIC model has been used to study how streamflow and water tables are affected by groundwater withdrawal and storage. This work shows how streamflow changes with large groundwater exchange between tributaries, using the Wabash watershed area as the study area. This research will help in improving the management of surface water and groundwater resources in communities.

POSTER 3	Characterizing flash drought duration and frequency across the Midwest USA	Vikas Poonia Indiana University – Indianapolis vgpcivilengineer@gmail.com

Authors: Vikas Poonia[1] and Lixin Wang[2]

[1]Center of Excellence in Water Management, Maulana Azad National Institute of Technology Bhopal, M.P., India
[2]Department of Earth and Environmental Sciences, Indiana University Indianapolis, Indianapolis, Indiana, USA

Abstract:

Rapid onset droughts, commonly known as 'flash droughts', are notable for their sudden onset and rapid intensification, which can significantly impact ecosystems, water resources, and agriculture. These characteristics of FDs pose distinct challenges for their forecast, monitoring, and mitigation. This study focuses on the flash drought characterization across the Midwest region of the United States of America – Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. Flash droughts from 2000 to 2022 have been studied using GLDAS-2/Noah daily soil moisture data that were transformed into 5-day intervals (pentads). All the states in our research are vulnerable to flash droughts, although the frequency and duration of these events vary. With more than ten

instances, Ohio had the highest frequency of droughts, while western states like Missouri and Iowa had fewer. An analysis of duration in flash droughts reveals that severe droughts typically last 20 to 60 days in Wisconsin, but are generally shorter in Ohio, despite having a larger incidence of droughts. In Michigan and Indiana, there were also prolonged episodes of severe drought, lasting up to two months. Flash droughts can occur quickly in the Midwest due to the region's continental climate, which is marked by large variations in temperature and precipitation. Variables such as soil texture and crop composition further influence drought sensitivity. The study emphasizes that customized drought management measures that consider these geographical features and the interaction of meteorological and human influences are required to effectively mitigate the effects of flash droughts in the Midwest,.

POSTER 4	3-D Groundwater flow measuring device	Ayobami Oni* Purdue University aoni@purdue.edu

Authors: *Ayobami Oni[1], David Lampe[3], Lance Grunh[3], Matthew Howell[4], Zaven Arra[4], Keith Cherkauer [1], and Jacob Hosen [2]

[1]Department of Agricultural and Biological Engineering, Purdue University.

[2]Department of Forestry and Natural Resources, Purdue University

[3]United States Geological Survey (USGS)

[4]River Restoration Intelligence and Verification (RRIV)

Abstract:

Accurate measurement of groundwater flow is essential for effective and sustainable water resource management, environmental monitoring, climate adaptation strategies, and remediation processes. Traditional methods, such as nested piezometers, often fail to capture the three-dimensional complexities of groundwater dynamics and flow parameters, leading to suboptimal data accuracy. Borehole groundwater flow sensors exist, but these specialized devices are extremely expensive and existing devices only detect flow in two dimensions. This study introduces a novel 3D Groundwater Flow Measuring Device (3D-GFMD) designed to enhance the precision and ease of measuring spatial and temporal variations in groundwater flow. The device will provide continuous data on flow direction and velocity in three dimensions. The 3D-GFMD employs an array of thermistors placed around a central heat source. The heat source generates a heat plume, and the temperature sensors track the position of the plume, which travels in the direction of the flow. The temporal and spatial data collected are processed on-board the sensor and a three-dimensional flow vector is reported along with any desired raw sensor outputs. The device is designed to deliver telemetry to a central server continuously via wireless LoRaWAN or SDI-12 cable. For redundancy, data are also collected via SD card. The device will be tested in various hydrogeological settings, including confined, and unconfined aquifers. Data collected will be compared against the fully functional model developed via CFD (Computational Fluid Dynamics) software (Ansys and OpenFOAM) to validate accuracy and reliability. The simulated system on both Ansys and OpenFOAM will be compared against the observational data generated in the laboratory using the USGS test chamber to assess the performance of the device. Upon satisfactory performance, the device will undergo field testing at the USGS groundwater station in Indianapolis and will be subjected to various hydrological conditions to further evaluate its responsiveness and adaptability to diverse scenario in groundwater wells. The 3D-GFMD reduces costs and allows for continuous unattended groundwater flow measurement.

POSTER 5	Climatology and trends of drought-flood abrupt alternation events in the contiguous United States: A focus on Indiana	Tian Yang* Indiana University – Bloomington ty11@iu.edu

Authors: *Tian Yang and Zhiying Li
O'Neill School of Public and Environmental Affairs
Indiana University - Bloomington

Abstract:
Drought-Flood abrupt alternation (DFAA) events, characterized by rapid transitions from floods to droughts (FD) and droughts to floods (DF) within a short period of time (typically around one month), pose significant risks to agriculture, ecosystems, and human wellbeing. For example, drought can deplete water availability for crops, while subsequent flooding can lead to waterlogging or nutrient loss, exacerbating adverse impacts on crop yield. However, the characteristics of DFAA events including their frequency and seasonality remain insufficiently understood, especially in agriculture-dominated states like Indiana. In this study we investigate the climatology and trends of DFAA events in the Contiguous United States (CONUS) from 1895 to 2023 using the 1-month Standardized Precipitation Evapotranspiration Index (SPEI) derived from the NOAA nClimGrid-Monthly dataset. We compare decadal shifts across four sub-periods within the 129-year period and quantify statistical trends using the non-parametric Mann-Kendall test. We also assess the spatial differences between Indiana and the overall pattern of the CONUS. Results show that, climatologically, DF and FD events are more frequent in the Northern Great Plains of the CONUS. A moderate portion of the CONUS has statistically significant trends ($p<0.05$) in the frequency of DF and FD events over time. These trends are predominantly clustered in the Northern Great Plains, coincident with the region with the greatest climatological frequency of DFAA events. Regarding seasonality, DF events tend to occur in the spring (March-April-May), while FD events tend to occur in the winter (December-January-February). In Indiana, central and northern Indiana have higher frequencies of DF and FD events. Over the four sub-periods (1895-1924, 1925-1954, 1955-1984, 1985-2023), the frequency of DFAA events in Indiana is almost twice the national average, suggesting a greater vulnerability to such abrupt hydroclimatic shifts in the state. Future work will focus on the underlying drivers of DFAA events, including their connections to water quality and crop yield. Our findings aim to contribute to mitigation strategies that could reduce economic losses driven by increasing hydroclimatic variability.

POSTER 6	Combined effects of cover cropping and no-tillage on leachate nitrate and greenhouse gas emissions under producer-managed fields	Yu Peng* Indiana University – Indianapolis yp24@iu.edu

Authors: *Yu Peng and Lixin Wang
Department of Earth and Environmental Sciences,
Indiana University - Indianapolis (IUI), Indianapolis, IN, USA.

Abstract:
As two widely adopted nature-based climate solutions (NbCS) in agricultural production systems, cover crops and no-tillage have been brought into sharp focus for their potential to reduce leachate nitrate and simultaneously mitigate GHG emissions. However, the combined effects of cover crops plus no-till (CCNT) practice on controlling leachate nitrate and mitigating GHG emissions are still debated, particularly regarding their actual performance in producer-managed fields. To address this, we partnered with a local farm in Indiana to investigate how CCNT practices influence leachate nitrate levels and GHG emissions compared to traditional no-tillage (NT) practices. We also aimed to understand how these impacts vary with different CCNT strategies. Our findings indicate that using CCNT significantly reduced leachate nitrate levels by 6.29 ± 0.89 mg/kg compared to NT, while also increasing global warming potential (GWP) by 15.15%. Moreover, CCNT with interseeding mixtures was more effective in reducing nitrate leaching than winter rye CCNT, with reductions of -4.91 ± 0.59 mg/kg (-86.36%) for interseeding mixtures versus -4.88 ± 0.65 mg/kg (-77.75%) for winter rye. Notably, winter rye CCNT did not increase GWP compared to NT, while interseeding mixtures resulted in a 19.95% increase in GWP. In summary, CCNT demonstrated significant potential for nitrate reduction compared to NT, with interseeding mixtures outperforming winter rye, although with slightly higher GHG emissions. These results can inform on-farm practices and increase confidence in the nitrate-reducing potential of CCNT.

POSTER 7	Enhancing remote sensing techniques for monitoring and mitigating harmful algae blooms in north-central United States inland waters	Nileshwari Yewle Purdue University (post-doc) nyewle@purdue.edu

Authors: Nileshwari Yewle, Isaac Bradford, and Keith Cherkauer
Dept. of Agricultural and Biological Engineering,
Purdue University, West Lafayette, IN

Abstract:
As water quality faces mounting pressures from environmental and anthropogenic factors, there is an urgent need to. identify and address potential threats in multiple waterways to safeguard both human and ecosystem health. In the North-Central United States, inland lakes are vital for ecosystem services, but their health is increasingly at risk, particularly from harmful algal blooms (HABs). While remote sensing has been used to identify lakes experiencing algal blooms, the goal of this NASA-funded study is to improve the rapid quantification of the biogeochemical state of lake water by remote analysis of optical and thermal properties so that preconditions leading to HABs in Midwestern U.S. lakes can be identified and the timing predicted. For the 2023 and 2024 field seasons, we have monitored the biogeochemical state, optical and thermal properties, and hydraulic mixing conditions of four reservoirs: Lake Schafer and Lake Freeman, a hydrologically connected set of lakes on the Tippecanoe River north of West Lafayette, Indiana, and Mississinewa Lake and Salamonie Lake which are flood control reservoirs in the headwaters of the Wabash River. We used imagery from multispectral and hyperspectral cameras aboard unmanned aircraft systems and satellite remote sensing platforms, balanced by analysis of supplemental water samples and spectral reflectance measurements collected by boat to quantify the current biogeochemical state of these water systems. The project builds on previous work that developed methods for improved quantification of the linkage between the optical and thermal properties and the biogeochemical state of the Wabash River. Here we provide an overview of field work and analysis conducted and lessons learned over two field seasons. Data are being compiled into a database and will be used to build a predictive model of harmful algal bloom risk using optical properties, supplemental land use, and weather information

POSTER 8	Microplastics and heavy metals in crayfish and sediments: a comparative analysis between pollution accumulation in streams and retention ponds in Hamilton County, Indiana	Mya Whaley* Indiana State University mwhaley4@sycamores.indstate.edu

Authors: *Mya Whaley, Dr. Jennifer Latimer, Dr. Jeffery Stone, Dr. Chad Yost, *Justin VanGilder
Indiana State University

Abstract:
While microplastics and heavy metals have been found in virtually every setting on the planet, research is necessary to understand how they impact freshwater ecosystems and biogeochemical cycles. The focus of this research is to study microplastics and mercury in crayfish and sediments. Crayfish are a keystone species among the macroinvertebrates, while also serving as an important food source for mammals and birds. Crayfish also live on or in sediments, which make them an ideal organism to study the links between sedimentary metal concentrations and bioaccumulation. For this research, microplastic and heavy metal concentrations in both sediment and crayfish samples are being quantified to understand how the presence of microplastics influence heavy metal pollution in freshwater streams and retention ponds in both rural and more urban areas. By analyzing the types of microplastic found in these systems, we can investigate how, or if, microplastics vary between urban and rural settings, and study the relationships between microplastics and heavy metals in aquatic ecosystems.

This research will produce new data for 32 freshwater systems in Hamilton County, Indiana, analyzing concentrations of microplastic (MP) and heavy metals, such as mercury, in 64 sediment and ~150 crayfish samples. At each site, submersed sediment and floodplain samples were collected and stored in glass jars at room temperature. Crayfish, if present, were collected using kick nets, stored in a bait bucket, euthanized using 70%

ethanol, stored in bags, and frozen until analysis. Water quality tests (dissolved oxygen, pH, turbidity, temperature, conductivity, creek length and depth) were also collected at each site.

POSTER 9	The utilization of crayfish as indicators of stream health in Indiana streams	Justin VanGilder* Indiana State University jvangilder@sycamores.indstate.edu

Authors: *Justin VanGilder, Gwen Schmiedel, Makayla Sura, *Mya Whaley, Dr. Jennifer Latimer
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Abstract:

Mercury is a naturally occurring metal; however, the mercury cycle has been significantly impacted by the burning of fossil fuels. After being released from sources like coal-fired power plants, elemental mercury (Hg) is oxidized and deposited into aquatic ecosystems. Bacteria transform the oxidized mercury (HgO) into methylmercury (CH3Hg) which is bioavailable and toxic. Methylmercury bioaccumulates within fatty tissues and biomagnifies through the food chain. As omnivores, crayfish hold an intermediate trophic position, consuming a myriad of living and nonliving flora and fauna. Their diet and status as biotic engineers make crayfish a sentinel species. This research is part of larger water quality investigations on the use of crayfish as biotic indicators of stream health. The goals are to further our understanding of how mercury enters and travels through freshwater systems; understand what, if any, role mercury pollution plays in the species assemblage, distribution, and size of crayfish in Indiana streams; and to discover if invasive crayfish species have a greater tolerance for mercury, which could play a role in their ability to outcompete native species. This research has been ongoing for several years and samples have been taken throughout the state of Indiana. Preliminary data suggests that crayfish do bioaccumulate mercury in their tissues and that different species seem to tolerate a wide range of mercury exposures in the streams they inhabit. Results also reveal that disparate crayfish species seem to bioaccumulate mercury at differing levels. These results, while tentative, could help further our understanding of the mercury cycle in Indiana streams as well as an environmental factor in the propagation of invasive species.

POSTER 10	Whitewater River weir dam post-removal assessment, Richmond, Indiana	Morgan Ball*, Ella Gallagher*, and Gwyneth Martin* Earlham College meball22@earlham.edu, elgalla22@earlham.edu gemartin22@earlham.edu

Authors: *Morgan Ball, *Ella Gallagher, *Gwyneth Martin, Shannon Hayes, Andrew Moore
Earth & Environmental Science Department, Earlham College
*Katherine Liu, Department of Geography, Indiana University - Bloomington

Abstract:

We assessed changes to the East Fork Whitewater River following the removal of a 2-m high weir dam in September 2023. Suspended sediment associated with dam removal moved through the survey area almost immediately, resulting in a sediment peak visible on a stream gauge 4 km downstream approximately 11 hours after removal began. To study the fate of coarser sediments that made up the bulk of the former dam pool (see Liu et al., this conference) and determine how riverbed and channel morphology changed following dam removal, we resurveyed 12 cross sections and a long profile of the channel bed using total stations in July-August 2024. Velocity and water quality parameters were also measured throughout the study area.

We found that the large pool behind the dam no longer exists, and the channel in that area has become much narrower and shallower, with riffles developing as the channel bed equilibrates to a new base level. In spite of significantly increased water velocity in the vicinity of the former dam pool, water quality parameters like dissolved oxygen concentrations and temperature have not improved. Most of the sediment previously stored behind the dam has been deposited in pools and runs within 350 m of the former dam, although we measured deposition up to 650 m downstream.

In the approximately 10 months between dam removal and our survey, the watershed experienced multiple high-flow events, but none larger than a 2-yr flood that occurred on 11 April 2024. We conclude that dam pool sediment moves even at relatively low discharges in the initial year following dam removal, and hypothesize that sediment movement will require larger and larger flows to mobilize with increasing time after dam removal. We will continue to monitor our cross-sections in future years, and hope that this ongoing work can serve as a case study for other low head dam removals in the Midwest.

POSTER 11	Coarse grain size and mobile sediment result in minimal contaminant storage behind a low-head dam in Richmond, Indiana	Katherine Liu* Earlham College and Indiana University – Bloomington kmliu@iu.edu

Authors: *Katherine Liu, now at Department of Geography, Indiana University - Bloomington
Shannon Hayes, Andrew Moore, *Alexander Doyle, *Madison Huelskamp
Earth & Environmental Science Department, Earlham College

Abstract:
In September 2023, the city of Richmond, Indiana removed an approximately 2-meter high, run-of-river, dam to increase ecological connectivity, eliminate a safety hazard, and improve water quality of the East Fork Whitewater River. A pre dam removal assessment of sediments stored behind the dam found lower contaminant concentrations than anticipated, likely due to coarse grain size and high channel bed mobility. This assessment documented the impact of the dam on river morphology and water quality during two summers and characterized the composition and contaminant concentrations of the sediment wedge retained by the dam.

Our initial 2021 survey estimated that the dam pool was approximately 370 m long and contained approximately 7,400 m^3 of sediment. Cores collected for chemical and grain-size analysis found the sediment accumulated behind the weir dam to be bimodal, with a poorly sorted pebble population mixed with moderately-sorted, coarse sand. Cores taken outside of the main channel were commonly capped with moderately well-sorted, fine sand.

Analysis of 12 sediment samples for metals, pesticides, PCBs, polycyclic aromatic hydrocarbons, total petroleum hydrocarbons, and cyanide found only trace amounts of metals and hydrocarbons, and did not detect any legacy pesticides or PCBs. This finding was surprising, given the extensive industrial history of the Whitewater Gorge.

Resurveying 10 cross sections and the riverbed long profile in 2022 found that approximately half of the estimated sediment volume surveyed in 2021 had eroded out from behind the dam in the year between the surveys. The peak flow for water year 2022 was only equivalent to a 3-year flood. We attribute the lack of significant contaminant concentrations in dam pool sediment to the absence of fine-grained particles for contaminants to adhere to, and the fact that the sediment is mobile even during relatively small floods.

POSTER 12	State backflow protection regulations and water utility responsibilities introduction	James Probst Winstel Controls Inc. jamesp@winstelcontrols.com

Authors: James Probst
Winstel Controls Inc., Indianapolis, Indiana

Abstract:
• Importance of backflow prevention: Highlight the critical role of backflow prevention in safeguarding potable water supplies from contamination.
• Overview of presentation: Outline the key topics to be covered, including utility liabilities, backflow programs, prevention assemblies, and Q&A.

Water Utility Liabilities
• Legal and regulatory framework: Discuss relevant state laws and regulations governing backflow prevention.
• Potential consequences of failure: Explore the potential liabilities and penalties faced by utilities in cases of

backflow-related contamination.
• Case studies: Present real-world examples of utility liability and the resulting outcomes.

Utility Backflow Programs
• Program components: Describe the essential elements of effective utility backflow programs, such as:
    o Risk assessment
    o Installation requirements
    o Testing and maintenance schedules
    o Enforcement mechanisms
• Best practices: Share successful strategies and innovative approaches adopted by utilities to manage backflow risks.

Backflow Prevention Assemblies
• Types of assemblies: Explain the different types of backflow prevention assemblies (e.g., double check valves, reduced pressure, pressure type vacuum breakers) and their applications.
• Selection criteria: Discuss factors to consider when selecting the appropriate assembly for specific situations to protect against potential contaminants.
• Maintenance and testing: Emphasize the importance of regular maintenance and testing to ensure the continued effectiveness of backflow prevention assemblies.

POSTER 13	The Listening Year at Big Walnut Creek (audio station)	Eliza Brown DePauw University elizabrown@depauw.edu

Composer: Eliza Brown
Associate Professor of Music
Cassel Grubb University Professor of Music, 2023-2028
DePauw University
Abstract:
The Listening Year at Big Walnut Creek is an evening-length piece of music that explores the changing sonic ecology of a creek-side site over the course of a year. Scored for cello, percussion, and electronic audio, the music incorporates and responds to a year of weekly field recordings made at Big Walnut Creek in the DePauw University Nature Park. Throughout the recording year, and while composing the piece, I consulted with scientists, environmentalists, arts colleagues and community members to help interpret the site and its sounds. The form and musical material of the resulting piece reflect the sounds, morphology and ecology of the creek and its adjacent riparian and agricultural zones, as well as the transformative experience of engaging in this year-long environmental listening practice. I will discuss the work's recording, interpretation, and creation phases and share audio excerpts from the field recordings and score.