



## Annual Update for the National Center for Water Quality Research

January 6, 2023

The National Center for Water Quality Research (NCWQR) at Heidelberg University is widely known for research on factors that influence the water quality of streams and rivers. The mission of our organization is to generate knowledge about the dynamics of water and soil resources in order to improve water quality and availability. Our ultimate vision is a world where scientific research informs the sustainable use of water and soils thereby preserving these resources for future generations.

The NCWQR is organized around 5 key focus areas: long-term research, short-term research, field and watershed scale modeling, education, and service. Below we summarize the current status and future goals for each of these focus areas. For other specific details on the NCWQR, please visit our website: <https://ncwqr.org>

### Focus Area Updates

#### Long-term research:

*Heidelberg Tributary Loading Program* — The NCWQR is centered around the Heidelberg Tributary Loading Program (HTLP), where we monitor 23 rivers and streams primarily in Ohio (except for 1 in Michigan). The goal of the HTLP is to quantify the loads of sediment and nutrients that leave those watersheds. This data is instrumental in state and federal management of water quality in the region. Over the past year, we analyzed over 10,000 samples as part of the HTLP and added two new analytes (dissolved organic carbon and total dissolved nitrogen) to a subset of our sampling locations. We added 10 real-time multi-parameter sondes to [many of our sampling locations](#), which allowed us to discontinue the in-laboratory conductivity analysis. With the newly freed time, we have since added a weekly analysis of major algal groups from each HTLP location using a fluoroprobe. We also uploaded the HTLP data onto a Zenodo database allowing us to have a DOI (digital online identifier) to help people better cite our data (<https://doi.org/10.5281/zenodo.6606949>). Finally, we transitioned to a new laboratory database management system that streamlined the data input drastically and we've subsequently upgraded computers throughout the laboratory.

We have maintained our connection with the [COMPASS project](#) (coastal observations, mechanisms, and predictions across systems and scales) being led by Pacific Northwest National Laboratory and regionally by University of Toledo and are providing essential data and data interpretation to the research effort.

We are continuing to work with new sensor technology in conjunction with our current monitoring to improve our data output as well as working with technology creators to help encourage the development of needed sensors in the water quality monitoring space.

This year we published four papers associated with the HTLP. One was on long-term chloride trends in Lake Erie tributaries, which found large increases in the Cuyahoga River watershed ([Kane et al. 2022, J. of Great Lakes Research](#)). Another was through a collaboration with the US EPA examining the effect of different sampling strategies on the performance of various load estimation models ([Kamrath et al. 2023 J of Hydrology](#)). The main finding being that continued daily sampling is recommended for the best accuracy in load calculations. A third paper examined the effect of external versus internal nutrient loading on algal toxins in Grand Lake St. Marys, finding that while winter and spring tributary loads influenced the overall seasonal bloom toxicity, variation from week to week was driven by in-lake concentrations ([Jacquemin et al. 2023, Harmful Algae](#)). The final paper was a commentary on an algal toxicity model claiming that reaching phosphorus load reduction goals would increase the toxicity of Lake Erie algal blooms ([Stow et al. 2022, J of Great Lakes Research](#)). The commentary noted a number of flaws in the interpretation of the model results and that the model was far too simplistic to be applied to a large ecosystem such as Lake Erie in that manner.

*Pilot Watershed Program* — Last year we collaborated with [Jay Martin at The Ohio State University \(OSU\)](#) to get funding through the USDA NRCS RCPP AFA program to implement practices in one of our paired watersheds to assess the necessary amount of conservation practices needed to reduce dissolved phosphorus to the target reduction levels. This year, we renewed our water monitoring funding for the next five years as a part of the USDA-NRCS Conservation Effects and Assessment Program (CEAP). By approaching this project with the water monitoring separate from the larger implementation grant, we are able to remain part of the [CEAP watershed assessments network](#) to ensure our results gain broader, nationwide coverage. Funding through CEAP includes a part-time research technician to assist with subwatershed sampling.

*H2Ohio Wetland Monitoring Program Team* — We have been monitoring wetlands constructed throughout the state as part of the H2Ohio program and [the LEARN Wetland Monitoring Program Team](#), which is a unique collaboration among Ohio's top universities. This past year we hired a dedicated wetland research technician and anticipate hiring a part-time technician this upcoming year (shared with the pilot watershed above) to assist in field sample collection. Along with sampling our three wetlands for nutrient levels, we also purchased and installed water level sensors throughout the wetlands and added a [citizen-science water level tracker \(CrowdHydrology\)](#) at the Headwaters Wetland in Crawford County. Our efforts will continue to expand in this project. In the past year we added 7 wetland locations on top of the three we were monitoring previously, and we expect to add an additional 4 over the next year. We are also exploring the possibility of including a Heidelberg property in the H2Ohio program.

### Short-term research:

We explore more specific research questions building on past knowledge and the HTLP findings through shorter-term research funding. This year, we have been finishing up analysis in collaboration with OSU, USGS, and ONU that assesses the importance of ditches, streams, and rivers as a source or sink of phosphorus as water moves from agricultural fields out to Lake Erie. This is essential to understand so that we can better anticipate the response the end of the watershed will have to changes on the land. A paper from this effort was recently published finding that streambed sediments are currently a sink for phosphorus in the Maumee watershed, but this could change if stream concentrations of phosphorus decrease ([Kreiling et al. 2023, STOTEN](#)).

We are also in the last year of a project in collaboration with the [University of Nebraska's Water Sciences Laboratory](#) quantifying the concentration of veterinary antibiotics in Lake Erie tributaries. This information can help us understand any risks to human health and better understand the impact of livestock operations on water quality in the region. Finally, we are in the middle of a project to test sensors developed by the company [Bionymer](#) that will analyze for pH, ammonium-nitrogen, and orthophosphate.

We received 2 new grants this year from [the Ohio Department of Higher Education Harmful Algal Bloom Research Initiative program \(HABRI\)](#). One includes funding to hire a postdoctoral research associate to help analyze and visualize trends in watershed nutrient loads across the Western Lake Erie Basin, combining our results with the USGS sampling locations. The ultimate goal is to provide a tool that is understandable to the public to detect changes in nutrient loading to Lake Erie, but also maintain a statistically rigorous approach. The other HABRI project is led by Jim Hood at OSU with colleagues from OSU and University of Montana to examine the contribution of nanoparticle phosphorus to loads entering Lake Erie and the bioavailability of that nanoparticle phosphorus. This project will help us better understand the forms of phosphorus that can stimulate algal blooms and how to better reduce this phosphorus through conservation practices.

### Field and Watershed Scale Modeling:

In this work, we are using and improving watershed-scale models (i.e., SWAT) and field-scale models (i.e., NTT) to examine the influence of agricultural practices on nutrient runoff and how climate change will influence these practices. This past year we successfully completed a pilot study named [PLUS-UP](#) that uses NTT in a market-based approach for a pay-for-performance style practice implementation. The project had \$50,000 worth of credits purchased to implement practices (cover crops and no till) on 30 fields in the Western Lake Erie Basin. To do this, we developed a simplified approach to data entry and field verification. The success of this project has now led into a phase 2 project based in the Saginaw Bay area to address nutrient management (PLUS-UP 2). We are excited about the possibility that this project will be applicable in any region where NTT has been verified.

As part of the Pilot Watershed Project mentioned above, we are using a watershed-scale model (SWAT+) to understand the effect of agricultural conservation practices on watershed loads in Shallow Run and Potato Run. This modeling effort should provide us an idea of the extent of conservation practices needed to reduce phosphorus loads and how effective the selected suite of practices will ultimately be.

### Education:

This past year was the inaugural summer for the Baker Summer Scholar program. This is a summer internship supported by the Baker Family in recognition of our founding director, Dr. David B. Baker. Kaiden Murphy, Junior in Biology and Environmental Science, was our summer intern and she worked on deploying and assessing new nitrate-nitrogen sensors we had acquired over the spring. We also had two computer science students over the past year work with Nate Manning and Laura Johnson on various data analysis projects. One of the students presented this project as a poster at the annual student research conference at Heidelberg.

We helped organize and hosted a variety of tours and science days for K-12 students both as part of the NCWQR and through the Sandusky River Watershed Coalition, including an Agriculture in the Classroom program for Seneca County schools, a Watershed Day with Buckeye Central Middle School, and a tour for Brunswick High School science students.

In addition, NCWQR staff taught Watershed Management (Jakob Boehler), the History of the Great Lakes (Nate Manning), and GIS Lab (Judy Smith; Doug Kane taught the lecture). Doug Kane and Aaron Roerdink, who work with the NCWQR during the summer, teach full time during the school year in the Department of Biology and Environmental Science and the Department of Chemistry and Biochemistry, respectively.

### Service:

Our current service includes the private well-testing program, contract sample analysis, the Sandusky River Watershed Coalition, and involvement in a multitude of advisory and task groups.

As part of the private well-testing program, we analyzed over 100 samples in the past year. Unfortunately, the instrument we use to analyze for metals needs to be replaced and we are no longer able to offer that service. We are seeking funding for a replacement. Moving forward, we'll need to decide how to invest in the well-testing program given the limited analytes that we offer.

The Sandusky River Watershed Coalition (SRWC) is a stand-alone organization that is hosted by the NCWQR. This year the SRWC organized and hosted multiple events, including the annual Sandusky River clean sweep (Fremont in June and Tiffin/Crawford County in September), a tour of OSU Stone Laboratory on Gibraltar Island in Lake Erie, the annual River Run 5K at Steyer Nature Preserve, a member appreciation event at Tiffin Brewery, a series of volunteer invasive species removal events in collaboration with Tiffin City Parks and Seneca County Parks, and the educational outreach noted above. In 2023, the SRWC is planning to also organize a water career fair at Heidelberg for local high schools and universities, start a monthly school program during the school year to teach about the importance of watershed health, and conduct summer stream quality monitoring days for the public. For more information and learn how to be involved, visit <https://sanduskyriver.org/>.

The NCWQR also assisted the City of Tiffin in dry weather inspections of storm drains to satisfy the requirements of their storm water permit and sampled at Garlo Heritage Nature Preserve for Seneca County Parks, which included installation of a [CrowdHydrology citizen-science water level tracker](#).

Other service conducted at the NCWQR includes participation in various advisory groups, task teams, or workshops. Over the past year, this included:

- The Great Lakes Water Quality Annex 4 Adaptive Management Task Team
- The Cleveland Water Alliance Citizen Science Standards workshop
- The Joint Aquatic Sciences Meeting Program Committee
- Sandusky Scenic River Advisory Council
- The Ohio Lake Management Society Board
- The Saginaw Bay Water Monitoring Program Planning Team
- The Lake Erie and Aquatic Network Board
- A National Science Foundation proposal review panel
- Manuscript reviews for Journal of Environmental Quality, Environmental Science & Technology, Hydrologic Processes, Journal of Great Lakes Research, Science of the Total Environment, and Ecological Informatics
- Gave over 25 presentations over the past year. These included scientific conferences (Joint Aquatic Sciences Meeting, International Conference on Toxic Cyanobacteria, Soil and Water Conservation Society, Phosphorus Week, State of Lake Erie), agricultural groups, state and federal agencies, citizen groups, and other research working groups

## The NCWQR in the Media

### Newspaper Articles:

#### Annual Western Lake Erie Harmful Algal Bloom Forecast for 2022:

- <https://bgindependentmedia.org/data-questions-flow-as-annual-forecast-predicts-another-smaller-harmful-algae-bloom/>
- <https://www.toledoblade.com/local/environment/2022/06/30/below-average-bloom-predicted-for-western-lake-erie-this-summer/stories/20220630118>

#### Harmful Algal Bloom Forecast end of season update:

- <https://www.toledoblade.com/local/environment/2022/07/20/western-lake-erie-algal-bloom-summer-2022-predictions-and-reports/stories/20220720115>
- <https://bgindependentmedia.org/harmful-algae-bloom-to-be-more-severe-than-projected/>

#### Harmful Algal Bloom end of season assessment:

- <https://www.toledoblade.com/local/2022/11/18/lake-erie-algae-bloom-record-season/stories/20221116129>

#### Other stories about Lake Erie and nutrient enrichment:

- <https://www.dispatch.com/story/business/2022/05/06/what-ohio-farmers-doing-reduce-algae-blooms/7322286001/>
- <https://www.circleofblue.org/2022/world/danger-looms-where-toxic-algae-blooms/>
- <https://www.greatlakesnow.org/2022/06/phosphorous-reduction-toxic-algae/>

### Videos:

USDA video titled “Science-Based Solutions: Leveraging Partnerships to Protect the Western Lake Erie Basin”

<https://www.youtube.com/watch?v=-LB8qg97pfw>

Panel Discussion from the Sustainable Phosphorus Alliance forum titled “Are we protecting our waters?”

[https://www.youtube.com/watch?v=hOAMbnK3\\_UY](https://www.youtube.com/watch?v=hOAMbnK3_UY)

Annual Western Lake Erie Harmful Algal Bloom Forecast for 2022:

<https://www.youtube.com/watch?v=-UgnR3OFiy0>

### Documentary Film:

The Erie Situation:

<https://www.theeriesituation.com/>

<https://youtu.be/IJLCPedUiPg>

## Future Plans and Goals

*These include slight updates from 2022 and we noted areas in **bold** with significant progress over the past year.*

Continue to be a premier center for water quality monitoring relative to watershed loadings

- **Increase our capacity to take on additional monitoring needs (wetlands, coasts)**
- **Be open and supportive for testing new sensor technologies**
- **Consider adding new analytes when feasible and useful**
- Be proactive in updating and upgrading field and analytical equipment to ensure successful operations and continued relevance
- **Standardize annual reporting of HTLP watersheds along with quality control and assurance reporting**
- Produce reports or papers focused on non-Lake Erie watersheds
- Host workshops to bring together researchers to develop new proposals

Help expand educational programs to train the next generation of water scientists

- **Continue to teach and collaborate with the watershed science specialization**
- **Work with Heidelberg to further develop and/or expand the watershed science specialization**
- **Continue the Baker Summer Scholar program**
- Explore summer opportunities for high school students
- Develop career exploration opportunities through the SRWC

Expand service to the community

- Develop an outreach program for farmers, agricultural retailers, or local soil and water conservation districts based on our field scale modeling research (NTT/ACPF)
- Consider updating well testing capabilities to meet demand
- Expand and seek increased support for the Sandusky River Watershed Coalition
- **Develop closer ties to other watershed groups, soil and water conservation districts, or municipalities within rivers that we monitor**

Enhance our long-term stability through endowments and foundational support

- Work with Heidelberg's new grant officer to seek foundational support
- Work with Heidelberg Office of Advancement to attract endowments

Increase our academic outputs and take better advantage of our long-term data sets

- Begin a rotating postdoctoral associate fellowship program
- **Develop and maintain collaborative networks with regional universities and agencies to research questions related to our long-term data**
- Develop a program to work with graduate students at other universities, such as supporting the summer stipend of a student at a nearby university

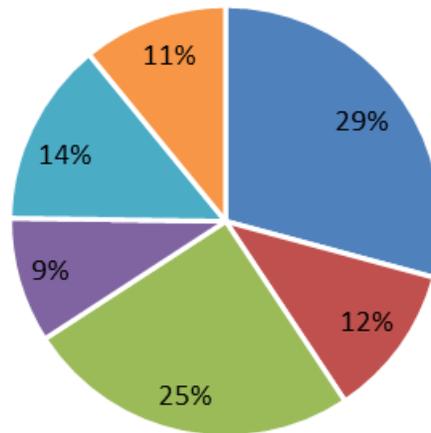
Expand our communications and outreach so people know what we do and why it matters

- Start the process of being able to create a press release for major findings
- Send regular updates to Heidelberg to post in announcements or news
- Update website(s) more regularly
- **Continue social media presence**
- Develop story maps, infographics, podcasts, and/or videos on our research
- Investigate the potential for funding a dedicated person for this work

## Financial Summary 2022

In fiscal year 2022 (July 1, 2021 - June 30, 2022), our overall expenses were \$1,128,006. Most of our expenses (66%) were in personnel (salaries, wages, and benefits) or supplies and equipment costs, with the remaining 34% in outside contracts, other, or indirect costs. Other expenses include electricity for sampling stations, internal sampling charge, membership dues, food service, professional development, mileage, and Heidelberg's overhead charge. The proportion of expenses by category were similar to the average of 2016-2020.

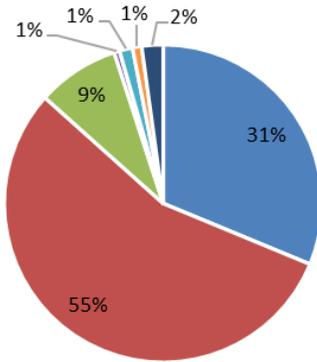
### NCWQR Expenses 2022



Expenses	2022	Average (2016-2020)
Salaries and Wages	\$ 329,209	\$ 441,153
Fringe Benefits	\$ 129,591	\$ 122,214
Supplies and Equipment	\$ 283,705	\$ 250,124
Outside Contracts	\$ 106,181	\$ 149,005
Other	\$ 156,230	\$ 126,204
Indirect Costs	\$ 123,090	\$ 193,246
<b>Total</b>	<b>\$ 1,128,006</b>	<b>\$ 1,281,946</b>
<i>Carry Over</i>	<i>\$ 139,568</i>	<i>\$ 157,662</i>

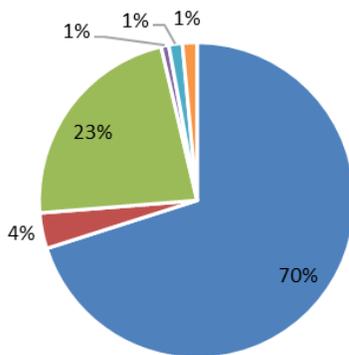
A majority of the revenue to support the NCWQR activities was from the State of Ohio (55%), either as the line item in the state operating budget or from various state agencies (Ohio DNR, Ohio EPA, Ohio Dept of Higher Education). We also received substantial support from the Federal Government (31%) through USDA-Natural Resources Conservation Service, NOAA Ohio Sea Grant, EPA Great Lakes Restoration Initiative, or Department of Energy. The remaining revenue was from various sources including other municipalities or state governments, non-profit and for-profit organizations, endowments, and contract or well test analyses. Most revenue was for support of the HTLP (70%) or short-term research (23%). Other revenue (7%) was to support the field and watershed scale modeling, well testing, contract analyses, and miscellaneous activities (SRWC, endowments).

NCWQR Revenue by Source  
2022



Net Revenue by Source	2022	Average (2016-2020)
Federal	\$ 352,488	\$ 225,001
State of Ohio	\$ 624,612	\$ 644,799
Other Government	\$ 94,467	\$ 122,885
Nonprofit	\$ 6,358.20	\$ 103,983
For-Profit	\$ 15,000	\$ 104,789
Endowments	\$ 10,555	\$ 3,050
Contract	\$ 24,527	\$ 77,439
<b>Total</b>	<b>\$ 1,128,006</b>	<b>\$ 1,281,946</b>

NCWQR Revenue by Activity  
2022



Net Revenue by Activity	2022	Average (2016-2020)
HTLP	\$ 790,569	\$ 732,286
Modeling	\$ 41,232	\$ 165,037
Short-term Research	\$ 254,803	\$ 194,787
Well Testing	\$ 8,812	\$ 29,863
Contract	\$ 15,714	\$ 47,577
Miscellaneous	\$ 16,875	\$ 112,397
<b>Total</b>	<b>\$ 1,128,006</b>	<b>\$ 1,281,946</b>