BENEATH THE SURFACE

DATA SUMMARY | **16** LAKES, **3** SUMMERS, **1** COUNTY

USE THIS **2024 REPORT** TO INVESTIGATE AND CLARIFY THE COMPLEX RELATIONSHIPS BETWEEN LAND, WATER, AND LIVING ORGANISMS IN KOSCIUSKO COUNTY.

LILLY CENTER FOR LAKES & STREAMS | GRACE COLLEGE

Dr. Nate Bosch
Director

In the Lilly Center's new podcast, the Lake Doctor Podcast, my cohost, Suzie Light, and I tell stories about research that **illuminate a better future** for our lakes and streams. This year, our team was excited to add two lakes to our yearly sampling. Collecting quality data from Silver and Waubee lakes not only builds our understanding of our lakes but also means we can provide an important service. Lake residents on these two lakes can now take advantage of the Lilly Center's **weekly toxin alert** system.

You can find data from 16 lakes in this edition of Beneath the Surface. The information in this publication will **equip you**, your family, organization, or agency to look after these incredible resources.

I am grateful to The Papers and the K21 Health Foundation for making Beneath the Surface possible!

This library of data shows patterns and differences in the health of our lakes, which in turn reveal **specific management steps**. After looking at the data, I encourage you to follow the action steps on page 33 and share them with your neighbors or community. You can find a digital copy at *lakes.grace.edu/bts*.

We invite you to dive Beneath the Surface with us!

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LAKE DATA

MISSION & VISION

The Lilly Center for Lakes & Streams uses research, education, and collaboration to make the lakes and streams of Kosciusko County clean, healthy, safe, and beautiful.

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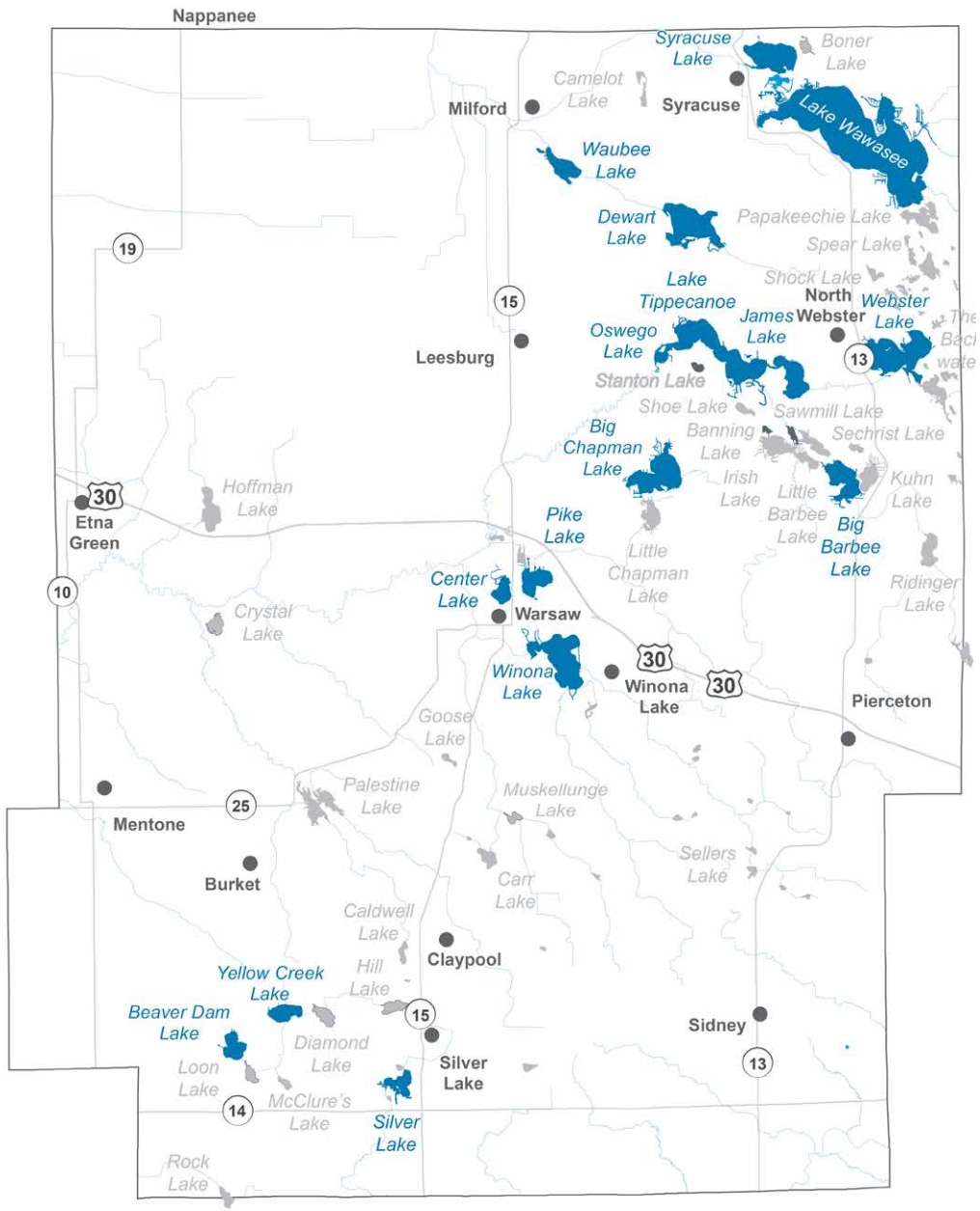


What is *Beneath the Surface?*

Beneath the Surface is a condensed form of the data Lilly Center staff and students gathered on 16 lakes during the summers of 2022-24. Reviewing several years of data helps us accurately compare and contrast data points and dissect any potential changes that may have occurred.

How should you use this report?

We want you to understand this data and use it to make the best decisions for your local lakes and their watersheds. That's what this report helps us do: **investigate and clarify the complex relationships** between land, water, and living organisms.

How do we conduct lake research?

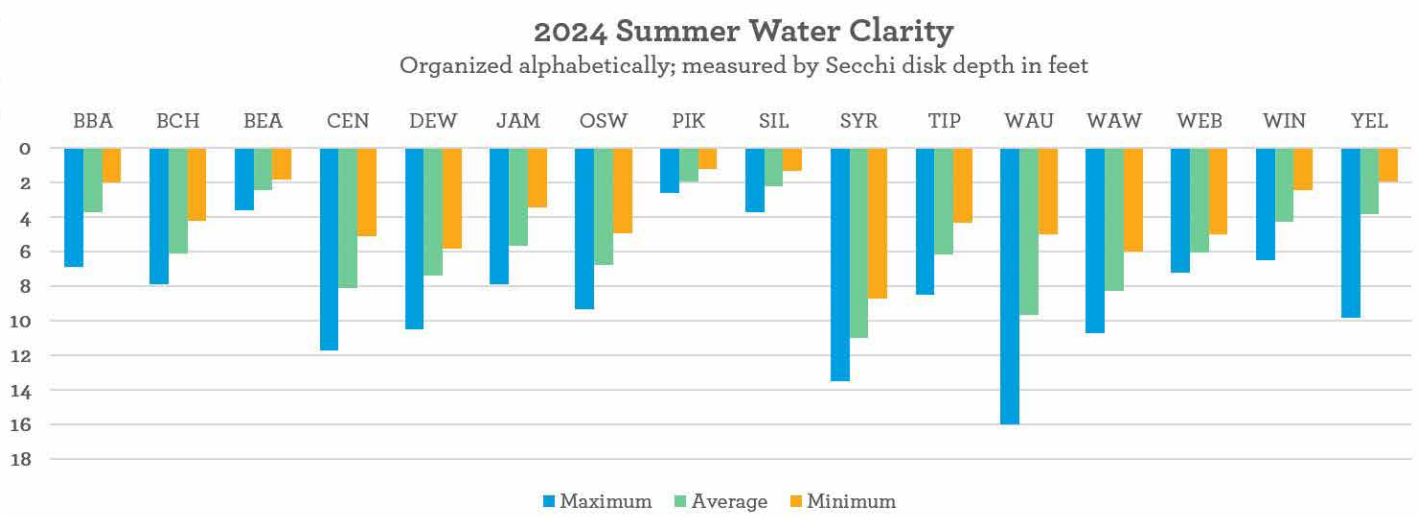
Every week from the beginning of June through the middle of August, the Lilly Center research team samples 12 all-sport lakes in Kosciusko County (since 2012), Center and Pike (since 2015), and Silver and Waubee lakes (since 2023), and seven public swimming beaches (since 2018).

Each lake is sampled at its deepest point to get a full vertical profile of its temperature, dissolved oxygen, pH, and conductivity. Nutrient samples are collected from one meter above the bottom and one meter below the surface to observe both distinct layers of lake water in the summer.

At all 16 lakes, we take **microcystin** and **saxitoxin** (blue-green algae toxins) samples from the top six feet of open water and the top three feet at seven public beaches. Measurements and notes are also recorded on atmospheric conditions, past and present weather, resident observations, and recent management work. See page 8 for more information on blue-green algae.

WATER CLARITY

Imagine going for a plunge in your lake. When you look down and see your toes – that's water clarity! Factors like sediment, runoff, and algae growth fueled by nutrients influence water clarity. Lilly Center scientists measure clarity by lowering a black and white disk, called a **Secchi** (sehkey) **disk**, into the water. They record clarity as the average depth at which the disk disappears and reappears. Nutrients can come from inflowing streams and from sediment at the bottom of the lake that is stirred up by waves or boat propellers. These nutrients lead to increased algae growth, contributing to murky water in which you cannot see your toes! Learn more about nutrients on page 6.



This Secchi disk graph shows the maximum, average, and minimum depths we observed at each lake during the summer of 2024. The **average** Secchi disk reading was **5.9 ft**. This average is nearly one foot less than the averages from the 14 standard lakes sampled in 2023 (6.7 ft) and 2022 (6.8 ft). Syracuse Lake had the deepest average clarity this summer (**11 ft**). Like last year, the lakes in the Great Lakes watershed exhibited the highest average water clarity, including Waubee Lake (9.7 ft) and Lake Wawasee (8.3 ft). Pike Lake had the lowest Secchi depth average at **1.9 ft** followed by Silver Lake (2.2 ft) and Beaver Dam (2.4 ft). In 2023, Secchi depth data showed that water clarity increased from south to north. The three southernmost lakes in the county exhibited the lowest average water clarity (2.8 ft) this summer compared to 9.1 ft in the Great Lakes watershed. The lakes in the upper Tippecanoe watershed had a slightly deeper average Secchi depth (5.7 ft) compared to the four lakes located in the middle Tippecanoe watershed (5.1 ft).

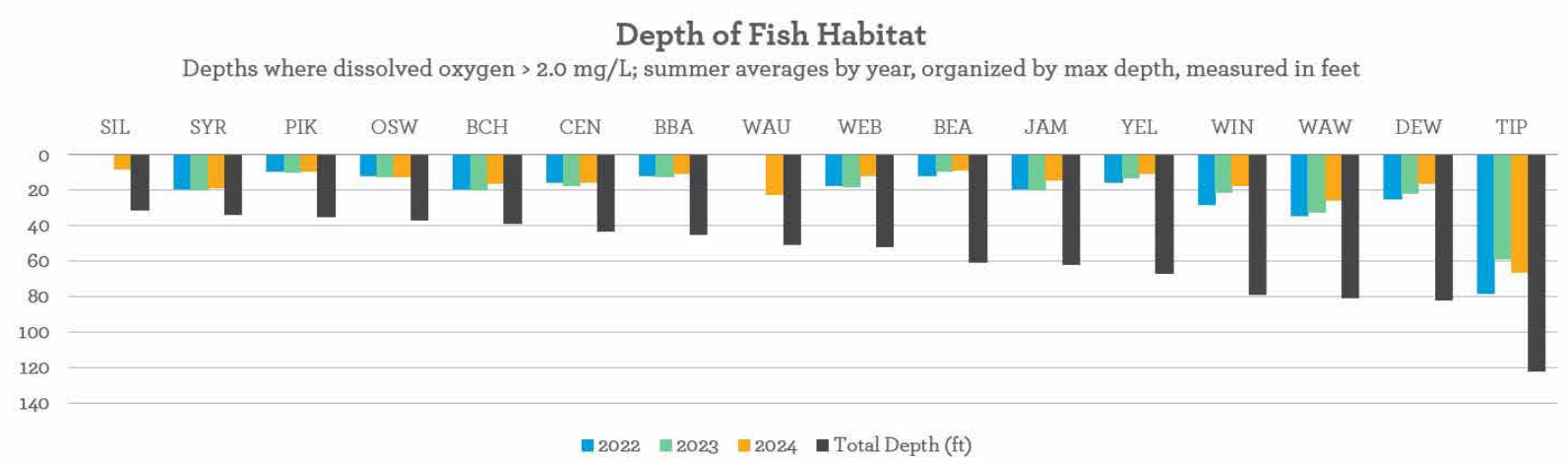
LAKE ABBREVIATIONS

These abbreviations will be used throughout Beneath the Surface.

Beaver Dam..... BEA
Big Barbee..... BBA
Big Chapman..... BCH
Center..... CEN
Dewart..... DEW
James..... JAM
Oswego..... OSW
Pike..... PIK

DISSOLVED OXYGEN

Dissolved oxygen is an indicator of water quality in our lakes. When enough dissolved oxygen is present, a lake can support a wide variety of aquatic critters. Dissolved oxygen also must be recharged through wind and wave action mixing oxygen from the atmosphere into the water. Excess aquatic plants and algae produce oxygen but can use it up quickly at night or when they die off. By reducing the amount of material decomposing at the bottom of the lake, we can slow algae growth and make more oxygen available for fish. The lakes in this graph are organized from shallowest to deepest at their deepest point.



Fish require a concentration of at least **2.0 milligrams per liter (mg/L)** of oxygen in the water to survive, so the depth of habitat is where dissolved oxygen is greater than or equal to 2.0 mg/L of oxygen. That oxygen concentration is a bare minimum, however. Many fish species need three or more times that amount of oxygen to thrive and produce healthy offspring.

The depth of dissolved oxygen averaged **17.8 ft** in 2024. Dissolved oxygen depths do not vary much within each lake across the years. However, the county's deeper lakes tend to have dissolved oxygen further down in the water column. Lake Tippecanoe had the deepest average depth of usable fish habitat (66.3 ft), followed by Wawasee (25.9 ft) and Waubee (22.6 ft). Like water clarity, the lakes with the most oxygenated habitat are in the Great Lakes watershed, while the lakes with the least oxygen are in the lower Tippecanoe watershed. The three southern lakes had some of the shallowest usable habitats: Silver Lake (7.9 ft), Beaver Dam Lake (8.9 ft), and Yellow Creek Lake (10.8 ft).

Lake abbreviations continued.

Silver.....SIL
Syracuse.....SYR
Tippecanoe.....TIP
Waubee.....WAU
Wawasee.....WAW
Webster.....WEB
Winona.....WIN
Yellow Creek.....YEL

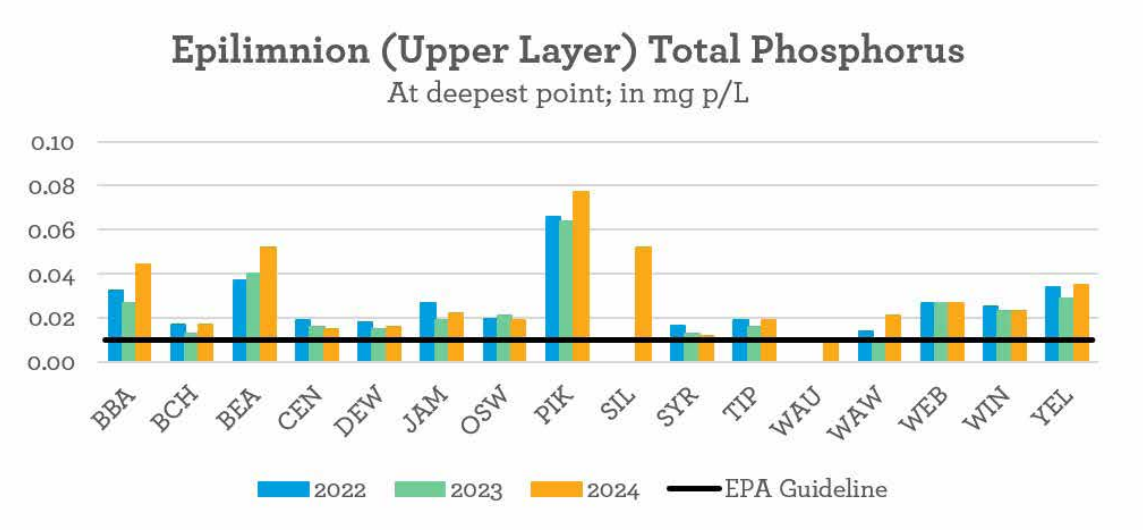
TOTAL PHOSPHORUS, TOTAL NITROGEN

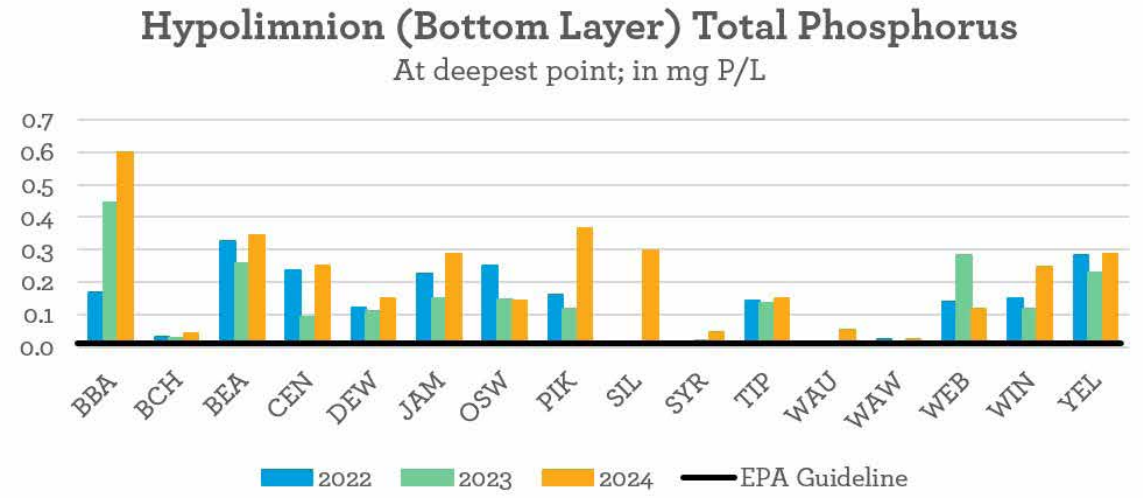
Just like an ice cream cake has distinct layers of flavored ice cream, lakes also have layers. The top layer of water, the **epilimnion**, and the bottom layer, the **hypolimnion**, do not mix in the summer. Our teams take samples from both layers to gain a complete picture of a lake's nutrient levels. These graphs show nutrients, **phosphorus** and **nitrogen**, in both water layers. They are the "limiting factors" in our lakes. In other words, by limiting these nutrients, we can improve other health indicators of our lake like water clarity and depth of fish habitats.

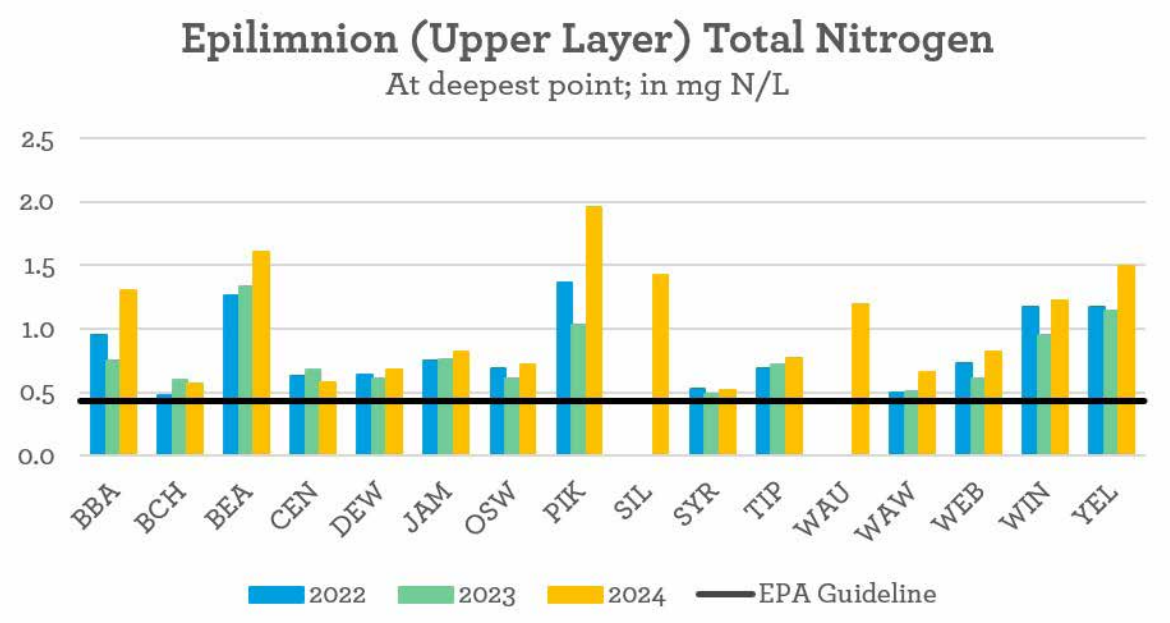
The black bar on each graph shows the threshold that the EPA designates as a water quality guideline for a minimally affected lake in our ecoregion. Although it is a low bar, it is a high goal! All of our lakes need help to reduce the nutrient load they receive from runoff, decomposition, and fertilizer use.

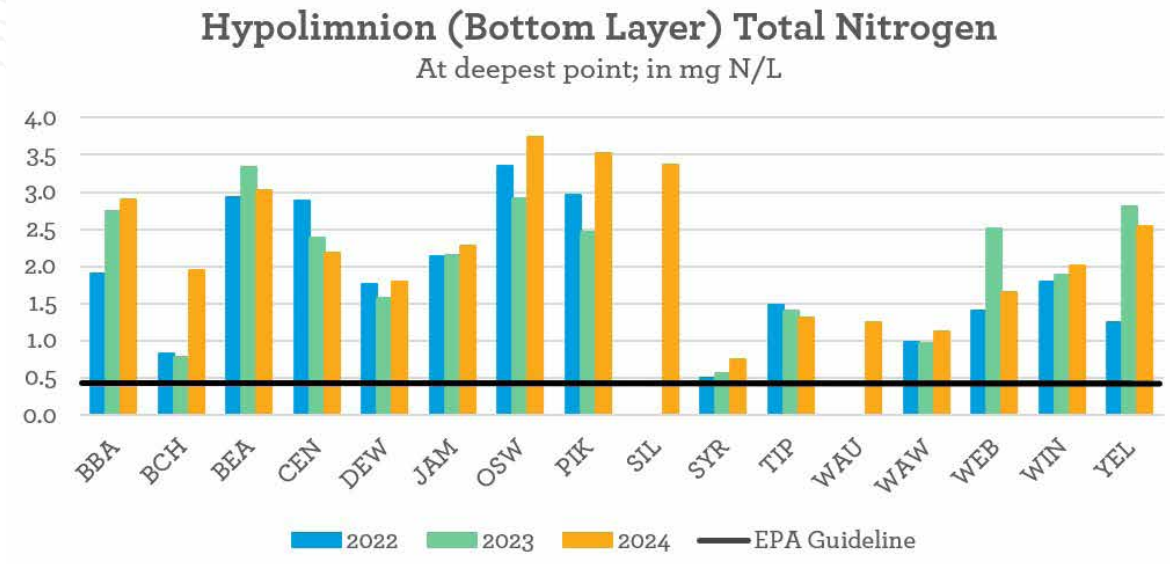
Note that the scales on these graphs are different, highlighting the fact that there are typically more nutrients in the hypolimnion than epilimnion in our lakes. That indicates that nutrients are coming from the bottom sediments of the lakes in addition to inflowing streams.

The EPA guideline for total phosphorus is **0.010 mg P/L** (milligrams of total









phosphorus per liter). The average total phosphorus across all 2024 epilimnion samples was **0.029 mg P/L**, while the hypolimnion was **0.213 mg P/L**. Epilimnetic total phosphorus is slightly higher across all lakes in 2024 compared to 2023 and 2022. This is true for total phosphorus in the hypolimnion as well.

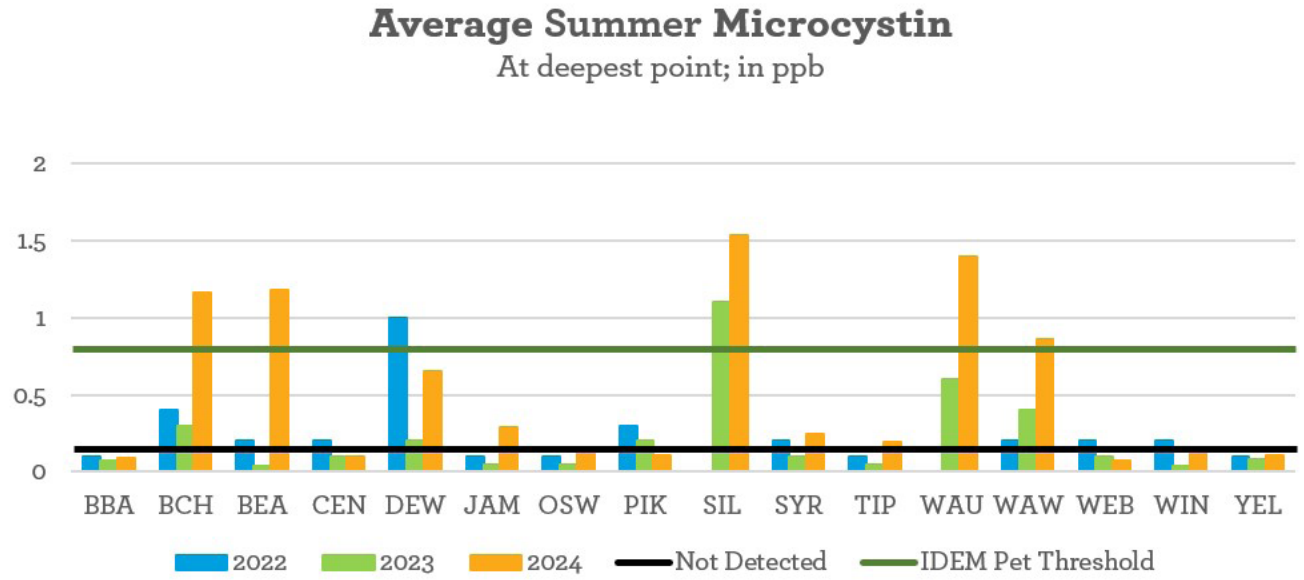
The average total nitrogen levels also increased in the epilimnion and hypolimnion in 2024 compared to previous years. The EPA total nitrogen guideline is **0.43 mg N/L**. The 2024 average total nitrogen was **1.02 mg N/L** (milligrams of total nitrogen per liter) in the epilimnion and **2.21 mg N/L** in the hypolimnion. These levels were 0.77 mg N/L (epilimnion) and 2.03 mg N/L (hypolimnion) in 2023. Current nitrogen levels are also higher than those recorded in 2022.

It is easy to see from the graphs that many lakes exhibited total phosphorus and total nitrogen concentrations that were higher in 2024 compared to the previous two summers. This could be due to an extremely wet April and May in 2024. This spring, Kosciusko County received over 11 inches of rainfall during April and May compared to only 5.3 in. and 5.7 in. in 2022 and 2023, respectively.

Nutrients like phosphorus and nitrogen are essential for life. But, like ice cream, too much can be unhealthy! Turn to page 33 to discover ways you can help make your lake healthier.

BLUE-GREEN ALGAE

Unlike harmless green algae, blue-green algae (BGA) is a natural freshwater bacteria that can produce toxins. Every species of BGA depends on nutrients such as phosphorus and nitrogen to grow. BGA can take advantage of excess nutrients and grow rapidly, resulting in a bloom. However, toxins may be present even without a visual bloom. Though BGA are abundant in our lakes, data shows that microcystin toxins are usually below the safety thresholds for pets **(0.8 ppb)**. This summer, Big Chapman Lake residents alerted us to a bloom which resulted in levels above the human safety threshold **(8.0 ppb)**. You can see those results on pages 28 and 29.



Indiana Department of Environmental Management's (IDEM) microcystin exposure thresholds

Human Recreation Caution
8.0 ppb
Dog Recreation Prohibited*
0.8 ppb

**State lakes & ponds*

What we learned

The summer of 2024 was a great year to be a cyanobacteria. About eleven inches of rain in April and May and a warm spring may have created a favorable environment for cyanobacteria growth and the toxins they produce. The graph above shows the average microcystin concentrations at the 16 lakes we sampled this summer. Most of the lakes exhibited microcystin levels higher than the previous two summers.

Did you receive our weekly microcystin update emails this summer? These data are just a taste of what we discovered while sampling. Stay in the loop when you follow this QR code and sign up for weekly microcystin updates, or visit *lakes.grace.edu/blue-green-algae* to learn more.

In some cases, those increases were substantial. This year, average microcystin levels were more than double the previous two years. Microcystin concentrations averaged **0.52 ppb** in 2024 compared to 0.24 in 2022 and 0.22 in 2023. In 2023, less than 4% of the samples collected (open water and shore) exceeded IDEM's pet threshold. This summer, over **21%** of the samples had microcystin levels that exceeded the pet safety threshold of 0.8 ppb.

Sharp-eyed residents around Big Chapman Lake alerted us to a blue-green algae bloom that appeared before our typical sampling season began. Analysis by our lab indicated that microcystin levels were many times higher than the safety threshold for humans. Turn to page 29 to learn more about our observations.

Average percent of algae population that is BGA to date

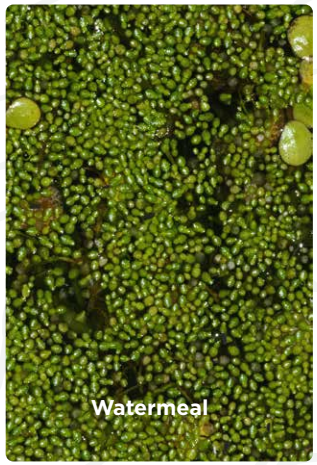
Summer microcystin samples over the dog threshold (0.8)

Percent of identified BGA species that can produce toxins

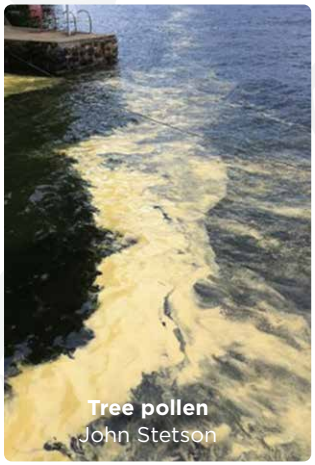
BGA Look-alikes

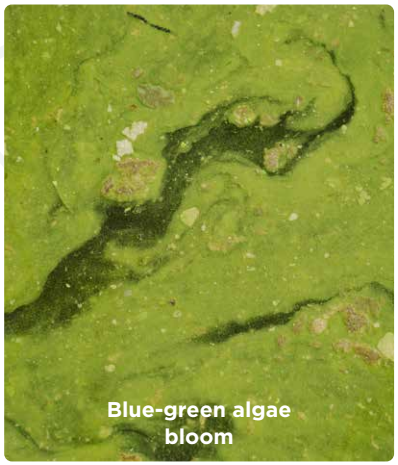
Can you identify a blue-green algae bloom? Reporting blooms to the Lilly Center activates a quick response to test the bloom for toxins to keep you and your pets safe. Call **574-372-5281** or email **lakes@grace.edu** to report a bloom sighting.


Duckweed


Watermeal


Green algae
naturalakes.com


Tree pollen
John Stetson

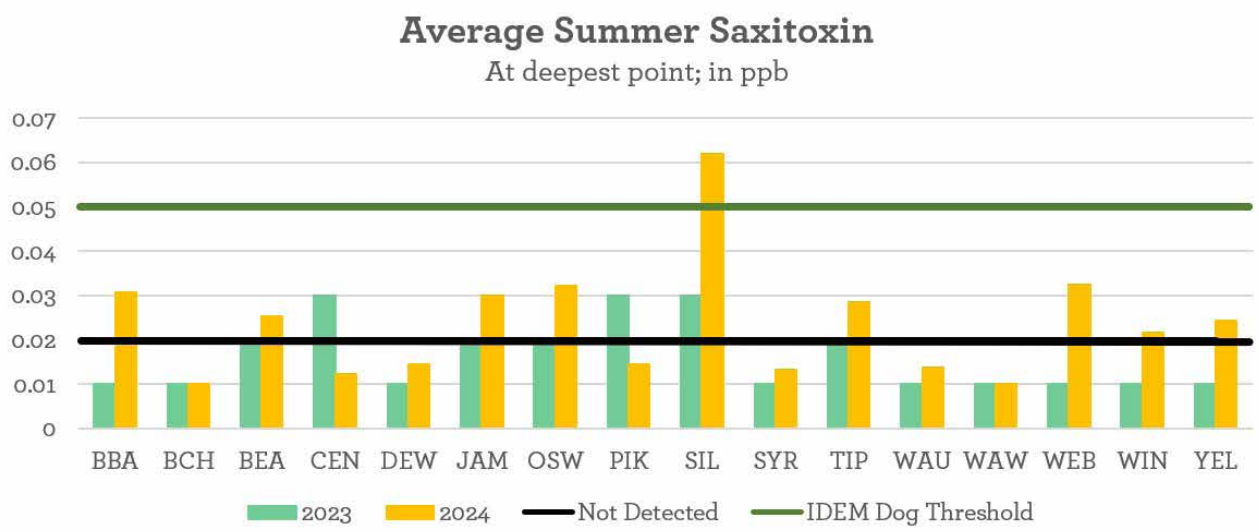

Blue-green algae bloom

The Lilly Center relies on volunteer captains to facilitate strategic lake research. Some boat captains provide snacks for our team or bring their dogs for extra loving! Thank you to the following boat captains for their investment in their lake:

Jerry & Cindy Gackenheimer, Ron England, Lon Sloan, Larry Emmeck, Al Schmidt, John O'Neill, Wayne Kubek, Max Mock, Mike McCarty, Steve Hepler, Anna Leuer, Joe Mahlie, Diane Quance, Anna & Jim Spaulding, Dave & Susan Brumley, Brett Burch, Jay Cole, Rick Elliott, Lori Dodson, Fran Allen, Omer Kropf, Mike Tynan, Scott Smith, Eric Beckdell, Jane Finch, Frank Levinson, Jan Heckleman, Jeff Herdrich, Jack Dabler, Garry England, Terry Tucker, Bill Gordon, Jack Sutton, Whitey Russell.

SAXITOXIN

Thanks to results from last year's Decade Lake Study, we determined that a second blue-green algae toxin deserved further investigation. More research is needed to better understand **saxitoxin** and the triggers that cause BGA to produce and release this toxin. But like microcystin, saxitoxin can cause harm to pets and humans in elevated quantities. (**0.05 ppb** and **0.8 ppb** respectively). Stay tuned as we continue to gather data about saxitoxin, identify areas of improvement, and suggest solutions for prevention.



Indiana Department of Environmental Management's (IDEM) saxitoxin exposure thresholds

Human Recreation Caution
0.8 ppb
Dog Recreation Prohibited*
0.05 ppb

**State lakes & ponds*

What we learned

Saxitoxin levels were higher in 2024 than in 2023, similar to the trend seen with microcystin. Only Center and Pike lakes saw a drop in saxitoxin concentrations this summer. Despite the general increase, most saxitoxin levels remained well below the dog safety threshold of 0.05 ppb. The exception was Silver Lake, where the average saxitoxin concentration reached 0.06 ppb. Six out of ten samples from Silver Lake exceeded the safety limit for dogs.

Given the rise of microcystin and saxitoxin this summer, we might expect their levels to increase together. In some cases, like Silver Lake, that is what happened — both toxins showed high concentrations. However, in other lakes where microcystin levels spiked, saxitoxin did not follow suit. For example, at Waubee, Wawasee, Big Chapman, and Beaver Dam lakes, microcystin levels increased substantially, but saxitoxin stayed the same or even decreased. Webster Lake showed the opposite pattern, with an increase in saxitoxin and a drop in microcystin.

We will continue studying saxitoxin and digging into the data to **explore potential connections** between the production of these two toxins.

E. COLI

Like cyanobacteria, which produce toxins, ***Escherichia coli***, commonly known as ***E. coli***, is a bacterium that lives in water, the environment, and even in the intestines of people and pets. Most *E. coli* are harmless, but some strains can produce digestive issues or cause serious health problems. Now, after several years of strenuous protocols and proficiency tests, **our lab is certified** by the Indiana State Department of Health to test for *E. coli*. We specifically recognize lab assistant Connor Frentzel for the years of detailed work he contributed to this program. From writing standard operating procedures, researching best practices, and training new students, Connor has shown a high level of commitment to excellence. We also thank microbiologist Dr. Joe Frentzel and research technician Jed Harvey for their oversight and help.

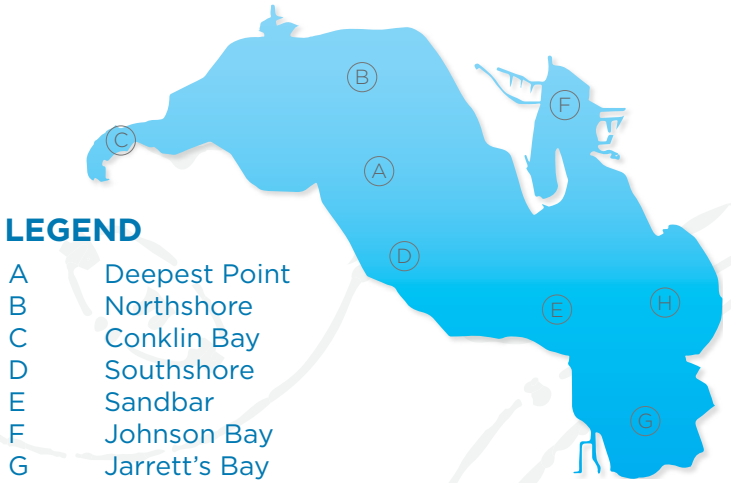
This certification gives us great confidence in the results of our tests. Collecting *E. coli* data will help us **serve our community better**, adding another tool to our toolbelt. By understanding *E. coli* more deeply, we can identify the presence of excess nutrients and eventually diagnose where those nutrients are coming from.

Left: Connor Frentzel, lab assistant; Dr. Joe Frentzel, microbiologist; Katie Sullivan, Indiana Department of Health; Jed Harvey, research technician. Top Right: Katie Sullivan verifies a technique used by Connor Frentzel. Bottom Right: E. coli *wells fluoresce (glow) under UV light when* E. coli *is present.*

The *E. coli* program and certification project to enhance our understanding of nutrients in our lakes is possible thanks to financial support from Marylou Hipskind, Henry Havel, Pete Smith, Tom Hayhurst, Doug & Karen Grant, the K21 Health Foundation, and the Luminous Foundation.

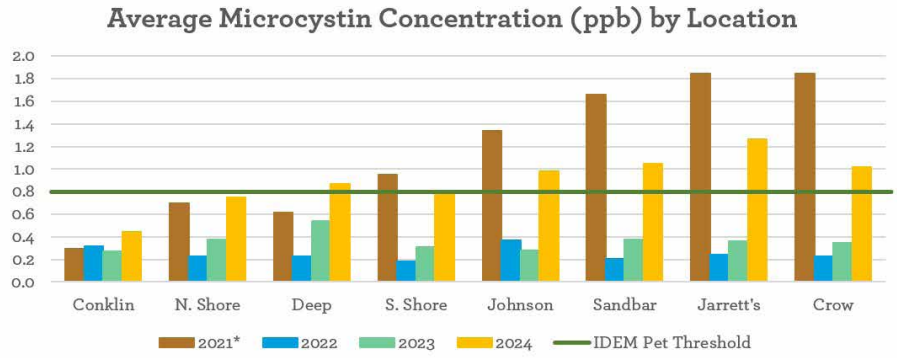
SPATIAL VARIABILITY STUDY

Now in its fourth year (and third full summer), the Lake Wawasee spatial variability study seeks to answer a frequently asked question: **do microcystin levels vary across a lake?** Lake Wawasee, Indiana's largest natural lake, provides a stage for this research thanks to its size. Here, we look at how toxin results vary across this beautiful lake.



LEGEND

A	Deepest Point
B	Northshore
C	Conklin Bay
D	Southshore
E	Sandbar
F	Johnson Bay
G	Jarrett's Bay
H	Crow Bay



Unlike the previous two years, observations recorded this summer indicate spatial variability differences in microcystin levels at sampling locations from west to east. The four western sampling sites have average microcystin levels around the 0.8 ppb pet safety threshold. The four eastern locations have average microcystin concentrations noticeably higher than the pet threshold. Generally speaking, toxin levels increased from west to east. A similar pattern was also noticeable in 2021, another high year for microcystin levels across the county. Conversely, 2022 and 2023 were low microcystin years and did not exhibit much variability in toxin levels among the sampling locations. Based on our research to date, there seems to be a connection between spatial variability of toxins and when high levels of microcystin are present in the lake. However, we must view the data from 2021 with caution. Sampling that year did not begin until the last week of June. Consequently, several weeks of missing data could impact the averages displayed here.

We will **continue collecting spatial variability data** to identify specific connections between differences in toxin levels across Lake Wawasee. Stay tuned for next year!

Thanks to the support of two generous Lake Wawasee families, the Finches and the Herdrichs, as well as generous support from the K21 Health Foundation, the Lilly Center was able to sample these seven additional sites on Lake Wawasee. The additional data from this study provides insight into potential management steps on other lakes as well.

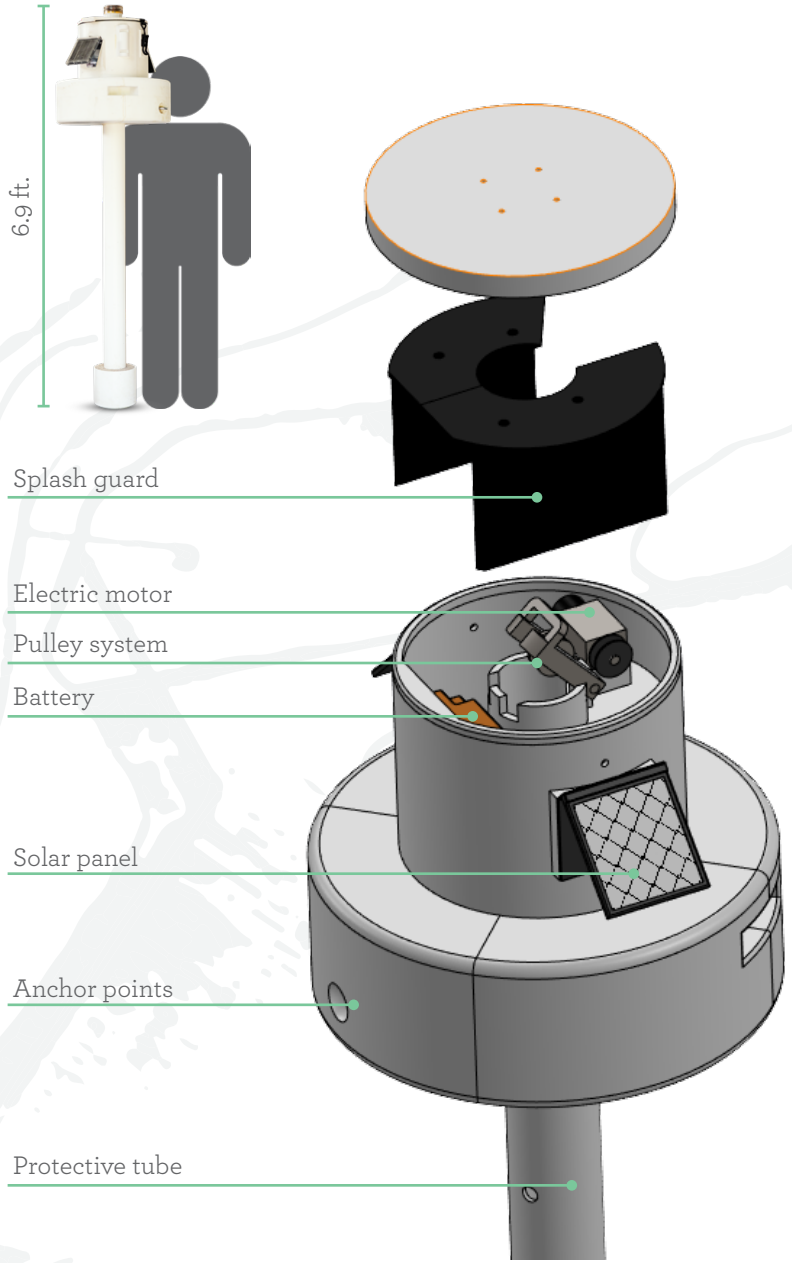
LAKE WAWASEE RESEARCH BUOY

An important aspect of our blue-green algae research is collecting data between regular sampling times. In other words, we want to better understand the changes that occur **before, during, and after a toxic algae bloom**. In order to capture that information every day, we partnered with the Engineering Department at Grace College to develop a research buoy.

This summer, in consultation with Lilly Center researchers, the engineering students built a completely new buoy with an important upgrade: **a pulley system**. Blue-green algae have the unique ability to increase or decrease their buoyancy to find the perfect level of sunlight in the water. By using a pulley system, the probe in the buoy can now take readings down to 30 feet. An electric motor will lower the probe four times per day at specific intervals and take readings at several depths.

The probe, which is identical to the one we use in lake sampling, will also collect data on phycocyanin, chlorophyll a, dissolved oxygen, temperature, conductivity, salinity, total dissolved solids, turbidity, and depth. Together, this information will **increase our understanding** of the factors that trigger blue-green algae to release their toxins — and point us toward solutions to **prevent harmful algae blooms** in the future!

Look for more information we collect during the summer of 2025 from the research buoy in next year's Beneath the Surface!



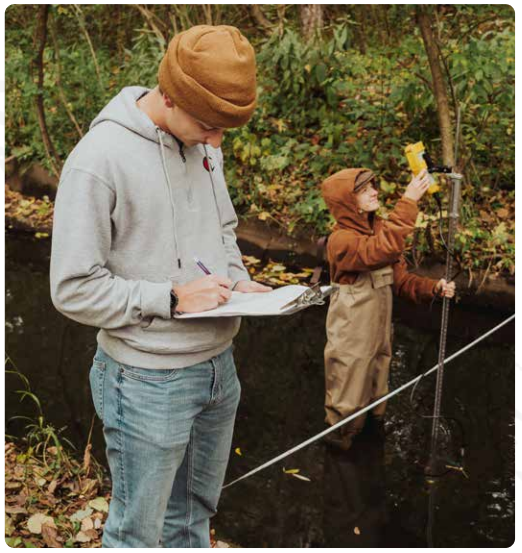
The research buoy is possible thanks to Alex Levinson, Alan Tehan, the Herdrich family, Grace College, and Dr. Fred Wentorf. Their support, expertise, and financial gifts are key to providing quality data and deepening our understanding of our lakes to create a safe place to live & play.

STREAM SENSORS

Streams are a **perennial** source of water, nutrients, and sediments for our lakes. Their health directly influences a lake's health. That's why the Lilly Center has studied major streams surrounding 7 lakes since 2014. In 2023, we installed a 13th stream sensor at the inflow of Pike Lake, and in 2024, we installed a 14th sensor at the outflow of Pike Lake. The Lilly Center also monitors inflows and outflows around Winona, Wawasee, Syracuse, Tippecanoe, Oswego, and James Lakes.

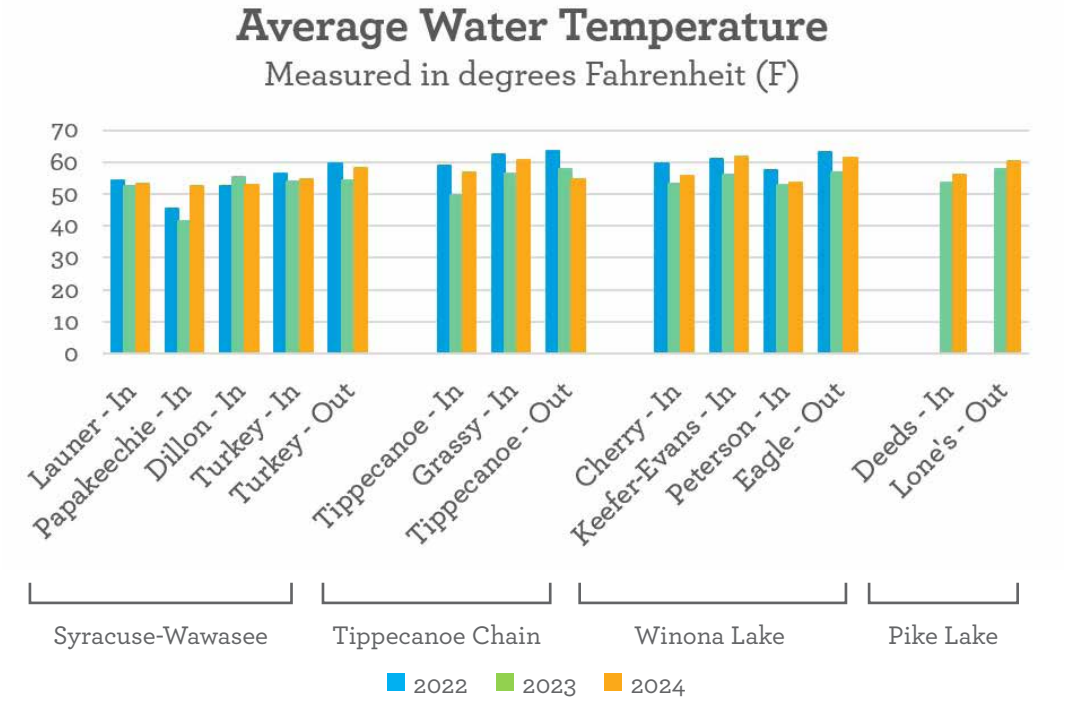
These remote stream sensors give us a picture of a lake's "diet." by collecting data every hour. This way, we can pinpoint where **excess nutrients** may be present and create solutions to prevent them from entering in the future. Lilly Center research teams visit each stream site every other week, rain or shine, snow or sun. You can see images of the teams during all seasons (and even during Dinner in Cherry Creek fundraiser) collecting data from a variety of streams at right.

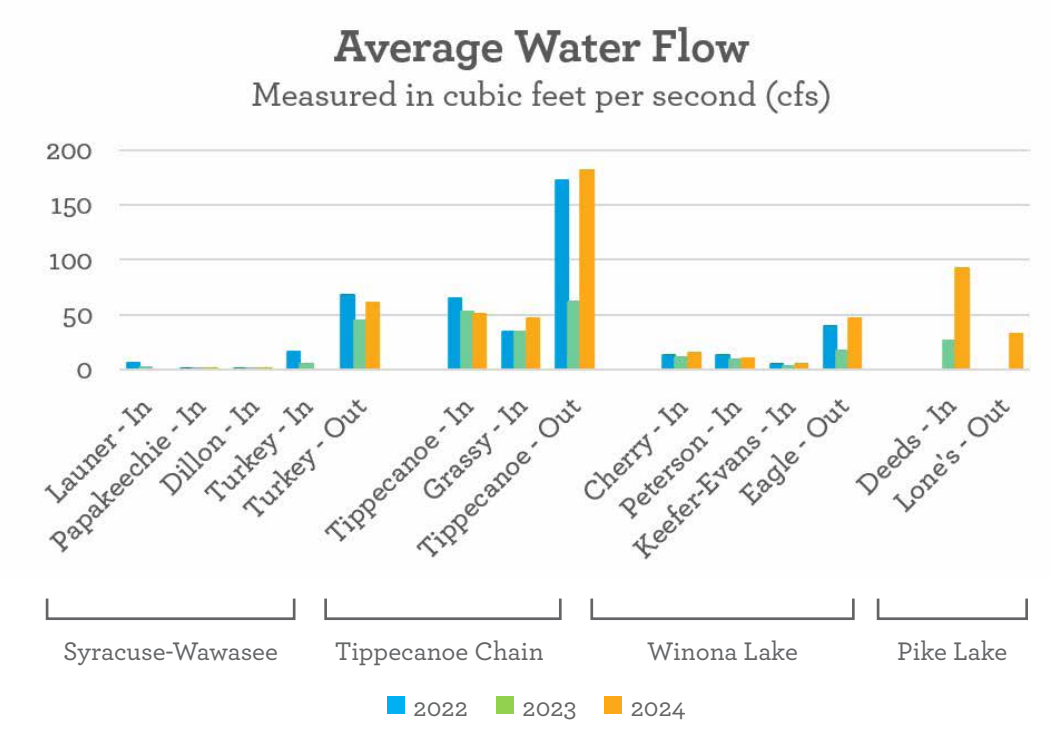
Average water temperatures for our streams increased slightly in 2024 after a decrease from 2022 to 2023. The average temperatures remain lower than those recorded in 2022. Similarly, stream flows were also higher in 2024 compared to last year and are similar to flow rates recorded in 2022. The stream sensors allow us to gather **detailed long-term data** that we can couple with other data to help us



Left: Stream sampling happens in all weather, all year long! Right: College interns record data as it is taken from a stream. It will be checked by a different team member later.

Above: Attendees at the Dinner in Cherry Creek fundraiser received a live demonstration of the stream sampling process, narrated by Dr. Nate Bosch.





detect trends in water quality around the watershed. While it may not seem exciting on its own, the ability to collect daily information regarding daily streamflow is a powerful tool. Pairing our stream sensor data with nutrient samples collected in the field allows us to create **nutrient budgets** for our lakes. Nutrient budgets can help us identify how many nutrients are entering our lakes and where they are coming from. Using a long-term dataset like this can help us monitor changes in the watershed and potentially measure the impacts of agricultural best management practices, wetland restoration projects, and other projects aimed at **improving water quality**.

Did you know that all of our stream flow data is available on our website for free? By viewing the Live Data page, you can see the water depth, temperature, and other parameters from the comfort of your home.

Visit our website to dive deeper into stream data:

lakes.grace.edu/research/live-data.

LILLY CENTER PARTNERS

We work with each of these organizations to analyze or provide relevant data. We also co-host events, provide lake-focused presentations, and collaborate on other activities within the county's watersheds. It is a privilege to work with dozens of individuals and businesses, including many more not on this list!

LAKE ASSOCIATIONS

Consider becoming a member of your local lake association to participate in the work already being done to protect your lake.

BARBEE LAKES PROPERTY OWNERS ASSOCIATION
North Webster, IN | barbeelakes.org

BEAVER DAM
Claypool, IN

CENTER LAKE CONSERVATION ASSOCIATION
Warsaw, IN

CHAPMAN LAKES CONSERVATION ASSOCIATION
Warsaw, IN | chapmanlake.com

DEWART LAKE PROTECTIVE ASSOCIATION
Syracuse, IN | dewartlake.org

LAKE TIPPECANOE PROPERTY OWNERS ASSOCIATION
Leesburg, IN | ltpo.org

PIKE LAKE ASSOCIATION
Warsaw, IN

SILVER LAKE ASSOCIATION
Silver Lake, IN

SYRACUSE LAKE ASSOCIATION
Syracuse, IN

WAUBEE LAKE ASSOCIATION
Milford, IN

WAWASEE PROPERTY OWNERS ASSOCIATION
Syracuse, IN | wawaseepoa.org

WEBSTER LAKE CONSERVATION ASSOCIATION
North Webster, IN | lakewebster.net

WINONA LAKE PRESERVATION ASSOCIATION
Winona Lake, IN

YELLOW CREEK LAKE CONSERVATION CLUB
Claypool, IN

GOVERNMENTAL & CONSERVATION ORGANIZATIONS

Searching for an expert on local environmental efforts or ongoing statewide projects? Reach out to one of these organizations!

CITY OF WARSAW STORMWATER UTILITY
Warsaw, IN | warsaw.in.gov/301/stormwater-utility

U.S. ENVIRONMENTAL PROTECTION AGENCY
epa.gov

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Indianapolis, IN | in.gov/idem

INDIANA DEPARTMENT OF NATURAL RESOURCES
Indianapolis, IN | in.gov/dnr

KOSCIUSKO COUNTY CONVENTION, RECREATION AND VISITORS BUREAU
Warsaw, IN | visitkosciuskocounty.org

KOSCIUSKO COUNTY SOIL AND WATER CONSERVATION DISTRICT
Warsaw, IN | kosciuskoswcd.org

THE WATERSHED FOUNDATION
North Webster, IN | watershedfoundation.org

WAWASEE AREA CONSERVANCY FOUNDATION
Syracuse, IN | wacf.com

K21 HEALTH FOUNDATION

Warsaw, IN | k21healthfoundation.org

In 2012, the K21 Health Foundation provided the initial funding for the Lilly Center's cyanobacteria (blue-green algae) research. They share our vision for healthy communities around healthy waterways and continue to provide invaluable support. Most recently, they invested over $300,000 into the Lilly Center's research. Their support also provides equipment for in-house water testing and toxin analysis and will provide resources for continued development and proactive measures to protect public health.

GRACE COLLEGE

Winona Lake, IN | grace.edu

The Lilly Center was founded and is based at Grace College. Over the years, our connection with the School of Science and Engineering has proven exceedingly valuable; the Lilly Center's research would be incomplete without the expert insight of the department's professors. The Lilly Center also works closely with the School of Education and other departments on campus, drawing from a seemingly endless supply of resources and knowledge. The Lilly Center employs over 40 Grace College interns every year.

syracuse & wawasee

At over 3,000 acres of surface area, Lake Wawasee is Indiana's largest natural lake. Together, Lake Wawasee and Syracuse Lake are important economic drivers in Kosciusko County thanks to lakefront property values, tourism, and recreation.

SYR

Surface area	411 acres
Max. depth	34 ft
Avg. depth	13 ft
Watershed	24,498 acres

WAW

Surface area	3,006 acres
Max. depth	81 ft
Avg. depth	22 ft
Watershed	24,448 acres

MICROCYSTIN

The blue-green algae toxin microcystin was higher at the open water sites of Wawasee and Syracuse compared to the previous two years. Despite only two samples at the Wawasee open water site being above the pet threshold (1.9 ppb and 2.2 ppb), the average concentration in 2024 was 0.9 ppb. This level was much higher than the averages recorded in 2022 and 2023. Syracuse open water samples averaged 0.2 ppb this summer compared to 0.1 ppb in 2023. Maximum and average microcystin concentrations in Syracuse this year were similar to those observed in 2022. Surprisingly, microcystin levels at Syracuse Community Center Beach were lower this summer than in 2023.

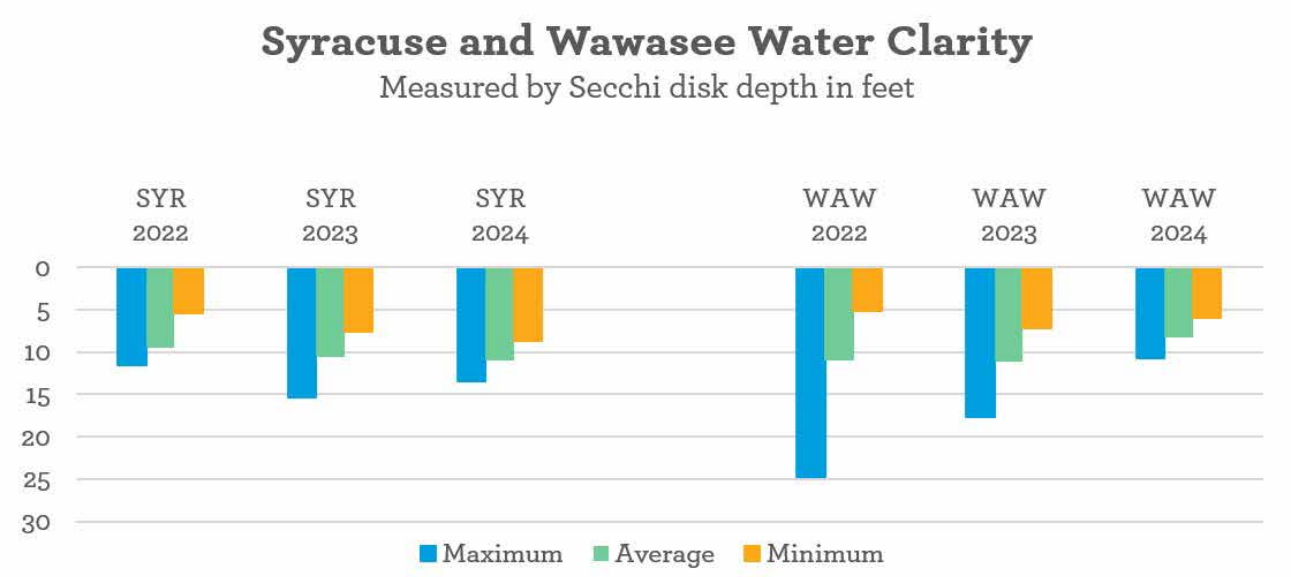
Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Wawasee Open Water	max.	0.7	2.2	2.2
	avg.	0.2	0.4	0.9
Syracuse Open Water	max.	0.5	0.2	0.7
	avg.	0.2	0.1	0.2
Syracuse Community Center Beach	max.	0.3	1.6	0.4
	avg.	0.2	0.3	0.2
Syracuse Hoy's Beach	max.	0.6	0.4	0.6
	avg.	0.3	0.2	0.2

Measured in parts per billion (ppb)
nd - no toxin detected

WATER CLARITY

Syracuse Lake exhibited an increase in water clarity this summer which has continued since 2021. Although not shown on the graph below, the average Secchi depth in 2021 was 8.4 ft. Average water clarity increased to 9.5 ft in 2022, 10.6 in 2023, and 11 ft this summer. Average Secchi depth at Lake Wawasee was lower this year (8.3 ft) compared to 2023 (11.1 ft) and 2022 (10.8 ft).



LIMIT of FISH HABITAT

SYR 18.7'
WAW 25.9'

WATER CLARITY

SYR 11.0'
WAW 8.3'

AVERAGE TEMPERATURE

SYR 78.3˚F
WAW 76.4˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

dewart & waubee

Waubee Lake and Dewart Lake each have unique aspects compared to other lakes in the region. Waubee is consistently one of the clearest lakes with over 9.7 feet of visibility. Dewart Lake is the third deepest lake in the county at 82 feet deep.

DEW

Surface area	554 acres
Max. depth	82 ft
Avg. depth	16 ft
Watershed	5,059 acres

WAU

Surface area	187 acres
Max. depth	51 ft
Watershed	9,370 acres

MICROCYSTIN

Microcystin levels at both lakes were substantially higher in 2024 compared to previous years. At Waubee, microcystin levels averaged 1.4 ppb and 1.2 ppb at the open water and beach locations, respectively. The maximum levels we recorded were 4.0 ppb (open water) and 2.7 ppb (beach). While these concentrations are well above the pet threshold of 0.8 ppb set by IDEM, they are still much lower than the human safety threshold of 8.0 ppb. Similarly, microcystin concentrations at Dewart this summer were substantially higher than those observed in 2023 and 2022.

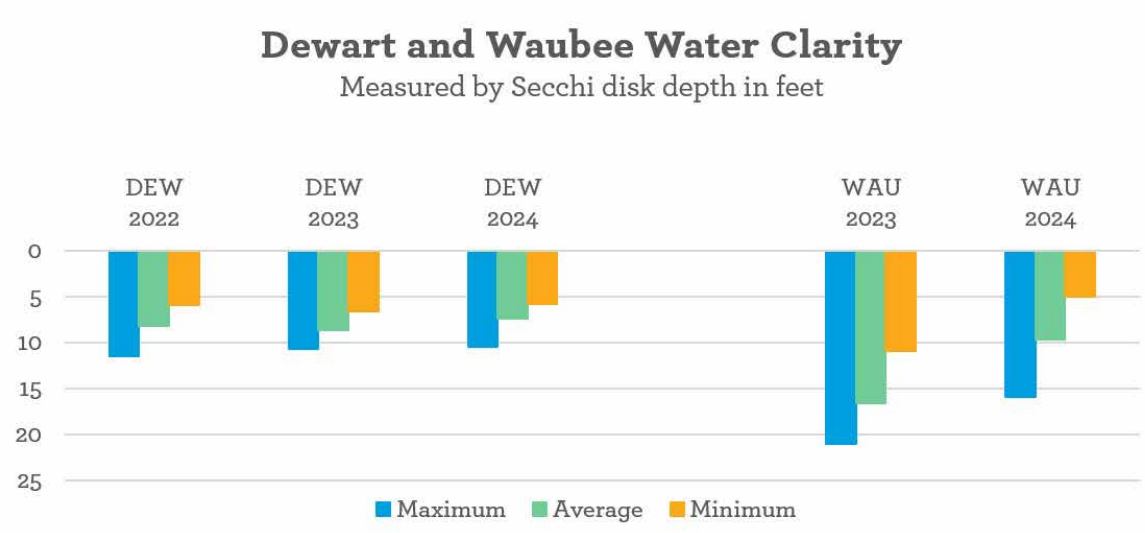
Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Waubee Open Water	max.		0.8	4.0
	avg.		0.4	1.4
Waubee Beach	max.		1.9	2.7
	avg.		0.6	1.2
Dewart	max.	1.3	0.7	1.7
	avg.	0.2	0.3	1.0

Measured in parts per billion (ppb)
nd - no toxin detected

WATER CLARITY

Water clarity on Dewart Lake has been relatively consistent over the last three years, ranging from 7.4 ft this summer to 8.6 ft in 2023. Conversely, the average Secchi depths recorded at Waubee Lake in 2023 and 2024 were quite different. In 2023, Waubee's average water clarity was 16.7 ft compared to only 9.7 ft this summer. It is important to note that the average Secchi depth this year is based on ten samples collected throughout the summer. In 2023, Waubee was part of the Decade Lake research project. As a result, Secchi depth was only recorded once per month in June, July, and August. Waubee is one of two lakes we incorporated into the yearly sampling regime in 2024 (the other is Silver Lake, on page 30).



LIMIT of FISH HABITAT

DEW 16.4'
WAU 22.6'

WATER CLARITY

DEW 7.4'
WAU 9.7'

AVERAGE TEMPERATURE

DEW 78.4˚F
WAU 77.4˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

james & oswego tippecanoe

Lake Tippecanoe is Indiana's deepest natural lake. Thanks to its above-average clarity, it also has an extensive fish habitat of nearly 60 feet. Together, James, Tippecanoe, and Oswego lakes make for great areas of fishing and recreation.

JAM

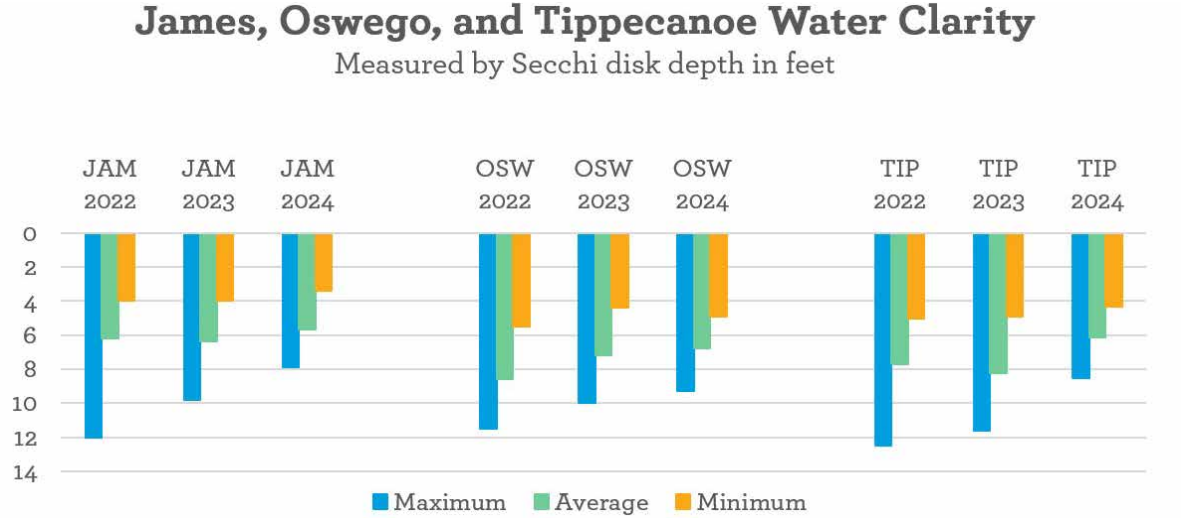
Surface area	278 acres
Max. depth	62 ft
Avg. depth	27 ft
Watershed	35,776 acres

OSW

Surface area	78 acres
Max. depth	37 ft
Avg. depth	13.7 ft
Watershed	72,847 acres

TIP

Surface area	876 acres
Max. depth	122 ft
Avg. depth	37 ft
Watershed	72,847 acres



WATER CLARITY

James, Oswego, and Tippecanoe lakes all experienced decreases in water clarity in 2024. James Lake averaged 5.7 ft of clarity this summer, about six inches less than the previous two years. Secchi depth readings on Oswego averaged 6.8 ft in 2024, a two-foot drop since 2022. However, the difference is minimal compared to 2023 (7.2 ft). Clarity on Lake Tippecanoe was 7.7 ft in 2022 and 8.2 ft in 2023 but decreased to 6.1 ft in 2024.

MICROCYSTIN

As with many of the lakes, an increase in the concentration of microcystin in the Tippecanoe Lake chain was evident this summer. Compared to 2022 and 2023, all three lakes in the chain had higher average or maximum microcystin levels in 2024. There were no detectable levels of microcystin in Tippecanoe and Oswego last year. James Lake exhibited the highest concentration of microcystin in 2024, with an average level of 0.3 ppb and a maximum of 1.2 ppb. Despite these increases from the previous years, of the 30 samples collected at the three lakes, only two observations were above the pet safety threshold of 0.8 ppb. Additionally, over half of the samples had such low toxin levels that they could not be detected by the testing procedure.

Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
James (Little Tippy)	max.	0.3	0.2	1.2
	avg.	0.1	<0.1	0.3
Tippecanoe	max.	0.1	nd	0.7
	avg.	0.1	nd	0.2
Oswego	max.	0.3	nd	0.4
	avg.	0.1	nd	0.1

Measured in parts per billion (ppb)
nd - no toxin detected

LIMIT of FISH HABITAT

JAM	14.4’
OSW	12.5’
TIP	66.3’

WATER CLARITY

JAM	5.7’
OSW	6.8’
TIP	6.1’

AVERAGE TEMPERATURE

JAM	78.7˚F
OSW	79.8˚F
TIP	78.9˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

big barbee & webster

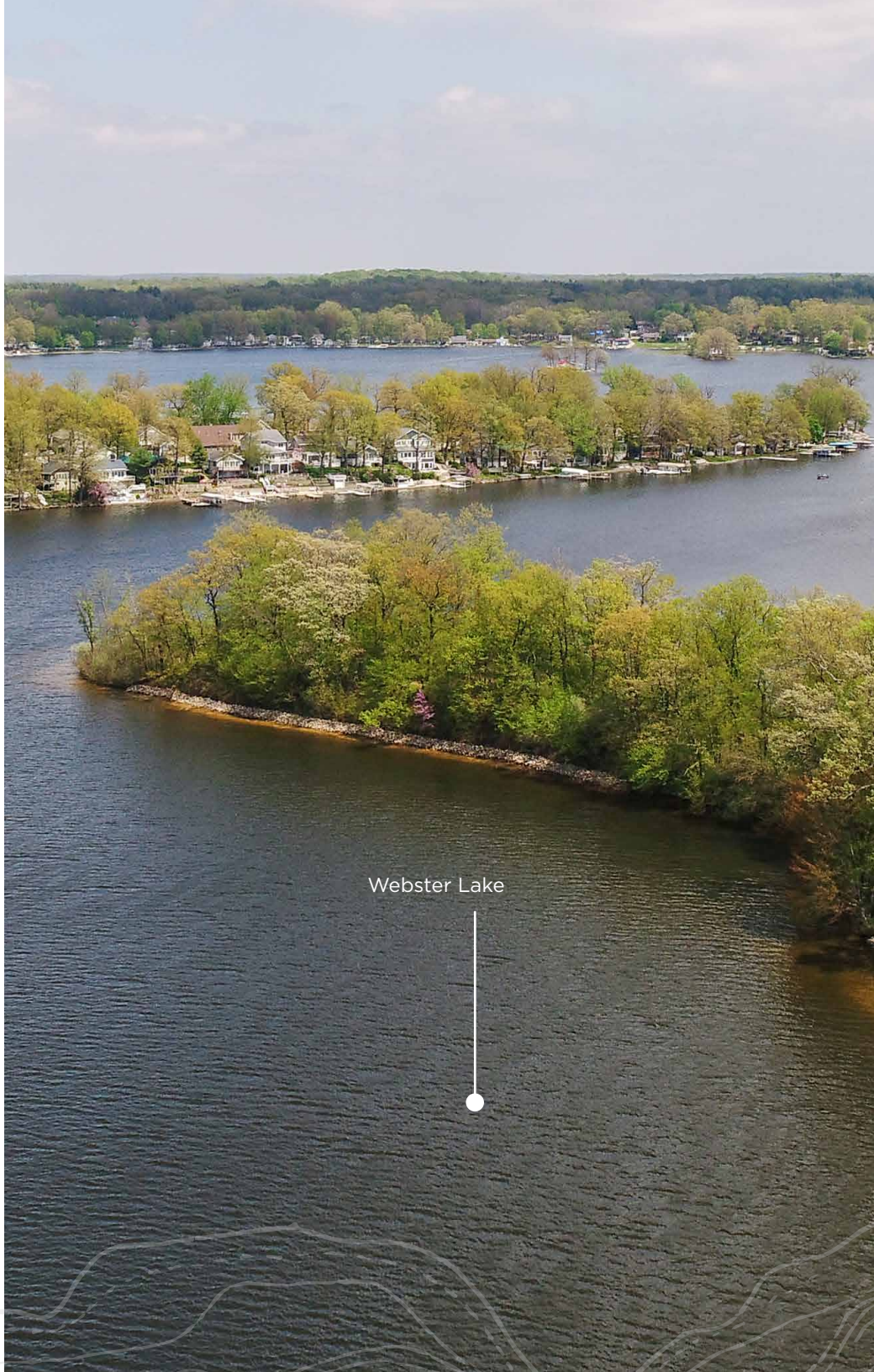
Webster Lake is home to the Dixie Boat, Indiana's oldest sternwheeler excursion boat. Visitors and locals alike enjoy taking in the sites from the deck of the Dixie. Nearby, Big Barbee was part of the Lilly Center's sewer impact study. You can learn more about this research at lakes.grace.edu.

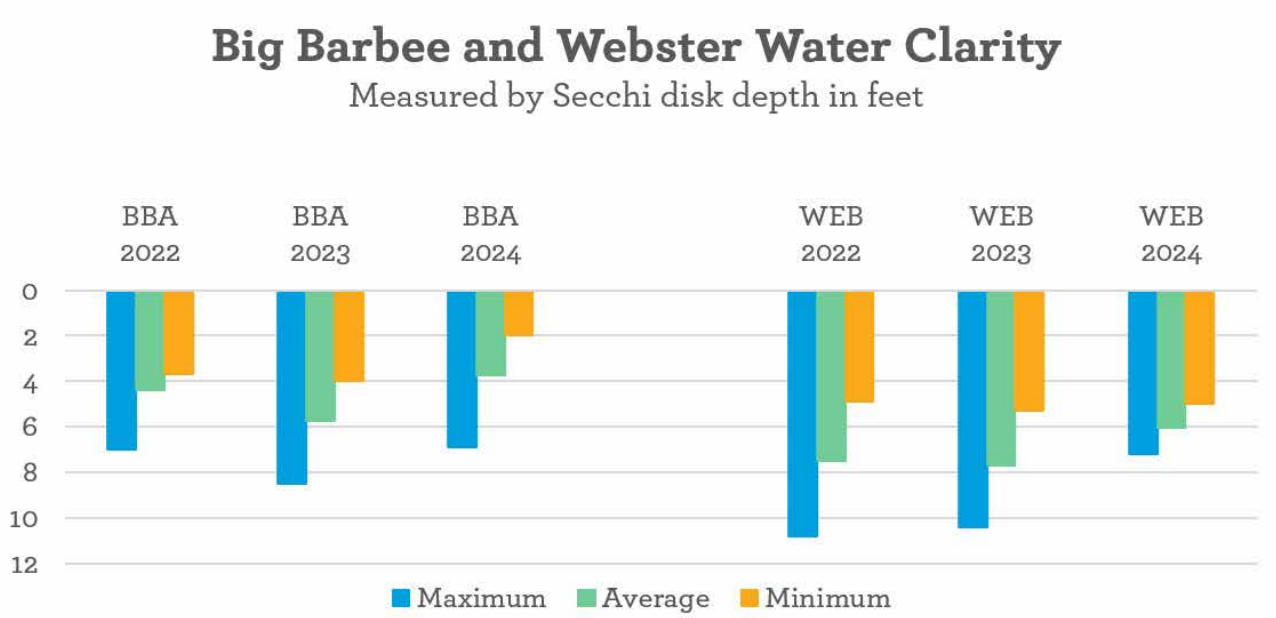
BBA

Surface area	311 acres
Max. depth	45 ft
Avg. depth	15.6 ft
Watershed	28,737 acres

WEB

Surface area	653 acres
Max. depth	52 ft
Avg. depth	12.5 ft
Watershed	31,459 acres





WATER CLARITY

After a couple of years of increasing Secchi depth readings on Big Barbee, water clarity decreased in 2024 to an average of 3.7 ft. This is a two-foot decrease from 2023. Similarly, water clarity at Webster Lake decreased by approximately 1.5 ft from 2023 to 2024. The average Secchi depth recorded at Webster in 2023 was 7.7 ft. This year, water clarity averaged 6.1 ft at the lake.

MICROCYSTIN

Despite considerable decreases in water clarity at these two lakes, microcystin concentrations were similar to the previous two years. This summer, Big Barbee exhibited lower levels of microcystin compared to 2022 but higher than last year. The Webster Lake open water site had no detectable levels of microcystin. This is the third consecutive year that microcystin has decreased at the lake. Observations from Webster Beach were also lower in 2024 compared to 2022 and similar to last year's concentrations.

Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Big Barbee	max.	0.4	nd	0.3
	avg.	0.1	nd	<0.1
Webster Open Water	max.	0.5	0.2	nd
	avg.	0.2	0.1	nd
Webster Beach	max.	0.3	0.2	0.2
	avg.	0.2	0.1	<0.1

Measured in parts per billion (ppb)
nd - no toxin detected

LIMIT of FISH HABITAT

BBA 10.5'
WEB 12.1'

WATER CLARITY

BBA 3.7'
WEB 6.1'

AVERAGE TEMPERATURE

BBA 78.8˚F
WEB 78.4˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

center & pike & winona

Despite being geographically near each other, these lakes display different characteristics. Center Lake continues to be the clearest of the three, even with its urban context. Over the last few years, Winona and Pike lakes have had shoreline restoration work done in an effort to improve their health.

CEN

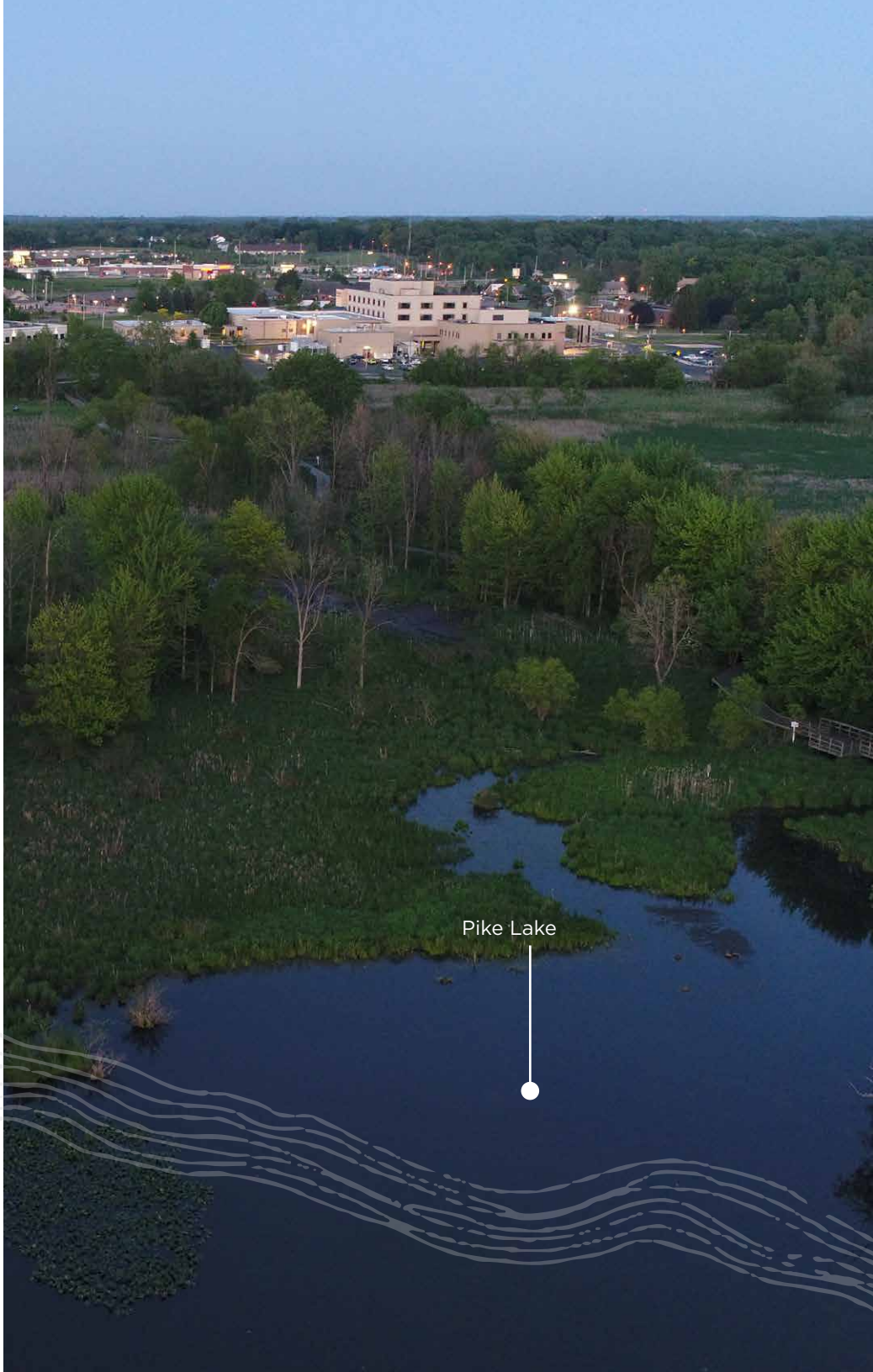
Surface area	120 acres
Max. depth	43 ft
Avg. depth	16.5 ft
Watershed	9,611 acres

PIK

Surface area	228 acres
Max. depth	35 ft
Avg. depth	14 ft
Watershed	23,405 acres

WIN

Surface area	571 acres
Max. depth	79 ft
Avg. depth	30 ft
Watershed	18,730 acres



Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Center Open Water	max.	0.3	0.3	0.2
	avg.	0.2	0.1	0.1
Center Beach	max.	0.3	0.2	0.3
	avg.	0.2	0.1	0.1
Pike Open Water	max.	0.6	0.5	0.3
	avg.	0.3	0.2	0.1
Pike Beach	max.	0.4	0.4	0.3
	avg.	0.3	0.2	0.1
Winona Open Water	max.	1.3	0.2	0.4
	avg.	0.2	<0.1	0.1
Winona Beach	max.	0.2	nd	1.0
	avg.	0.1	nd	0.3

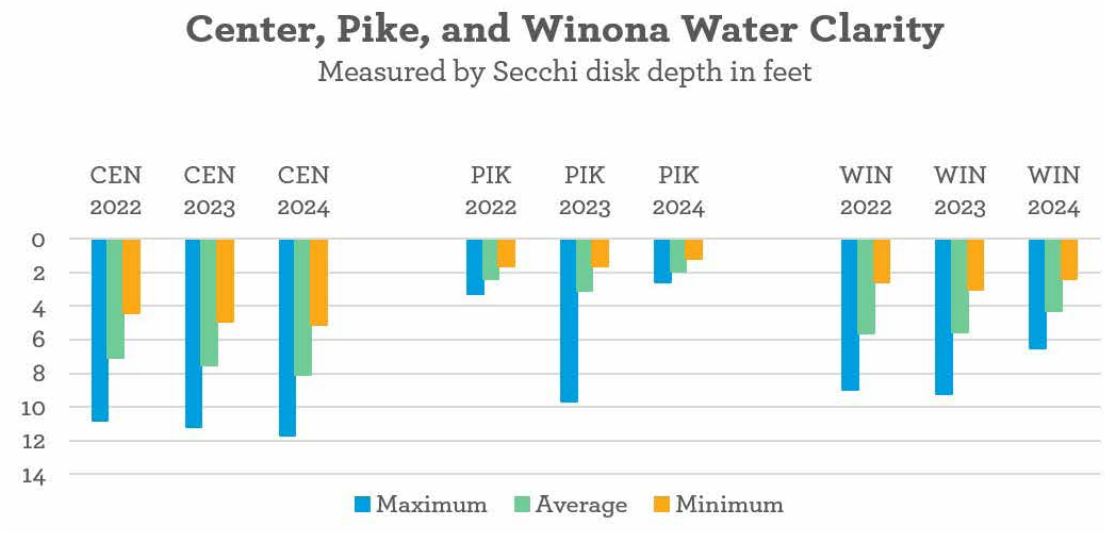
Measured in parts per billion (ppb)
nd - no toxin detected

MICROCYSTIN

Microcystin concentrations varied between these three lakes in 2024. The Pike Lake open-water location has seen a consistent decrease in the maximum and average microcystin levels over the last three years. In 2022, Pike Lake microcystin levels averaged 0.3 ppb, decreased to 0.2 ppb in 2023, and then to 0.1 ppb this summer. The maximum concentrations also declined by 0.1 ppb each year. Pike Lake's beach also exhibited decreasing microcystin levels. Center Lake concentrations are down slightly from the previous two years, averaging 0.1 ppb in 2024 compared to 0.2 in 2022. Center Beach's average microcystin concentrations were also similar to years past. At Winona Lake, microcystin levels increased slightly from 2023 but are lower than those observed in 2022. The average (0.3 ppb) and maximum (1.0 ppb) microcystin concentrations at Winona Beach were higher in 2024 than in the previous two years. No detectable levels of microcystin were observed in 2023.

WATER CLARITY

In contrast to many of the lakes this summer, water clarity at Center Lake increased. Secchi depth averaged 8.1 ft this summer compared to 7.1 ft in 2022 and 7.5 ft in 2023. Pike and Winona lakes exhibited decreases in water clarity, averaging 1.9 ft and 4.3 ft in 2024, respectively. This was a one-foot decrease in water clarity from 2023 at Pike Lake and a 1.2-ft decrease in Winona Lake's clarity.



LIMIT of FISH HABITAT

CEN	15.4'
PIK	9.5'
WIN	17.4'

WATER CLARITY

CEN	8.1'
PIK	1.9'
WIN	4.3'

AVERAGE TEMPERATURE

CEN	77.4°F
PIK	76.6°F
WIN	76.9°F

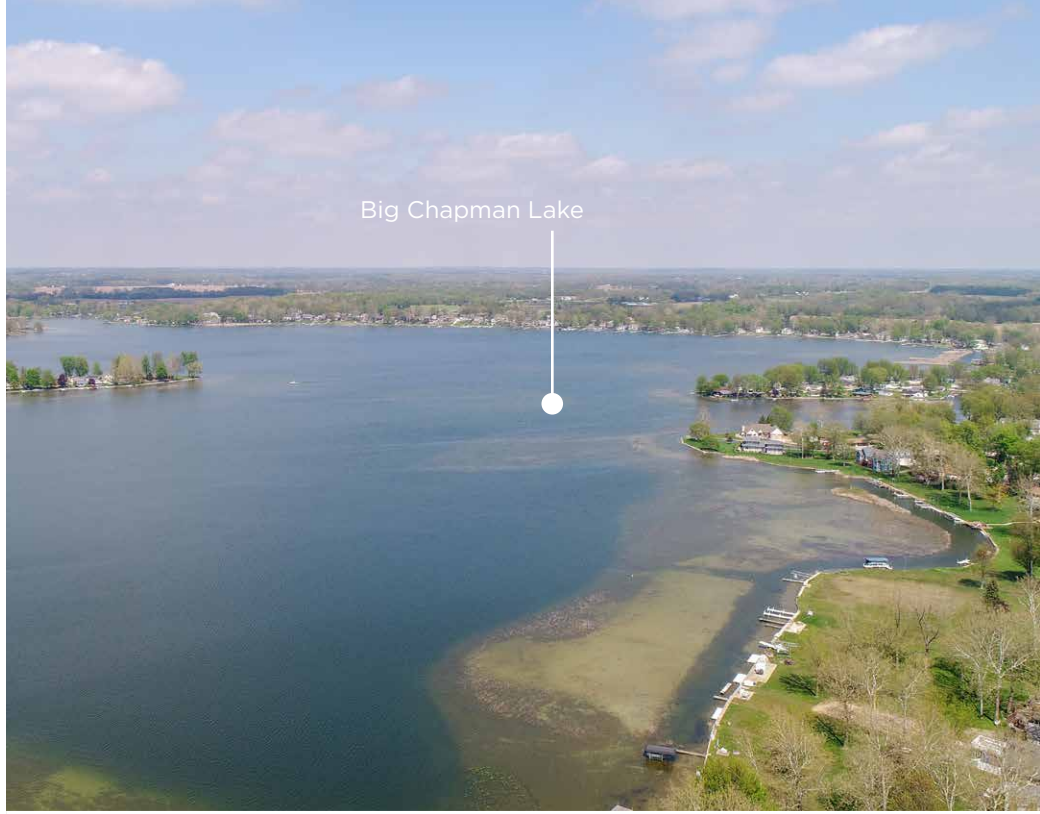
ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

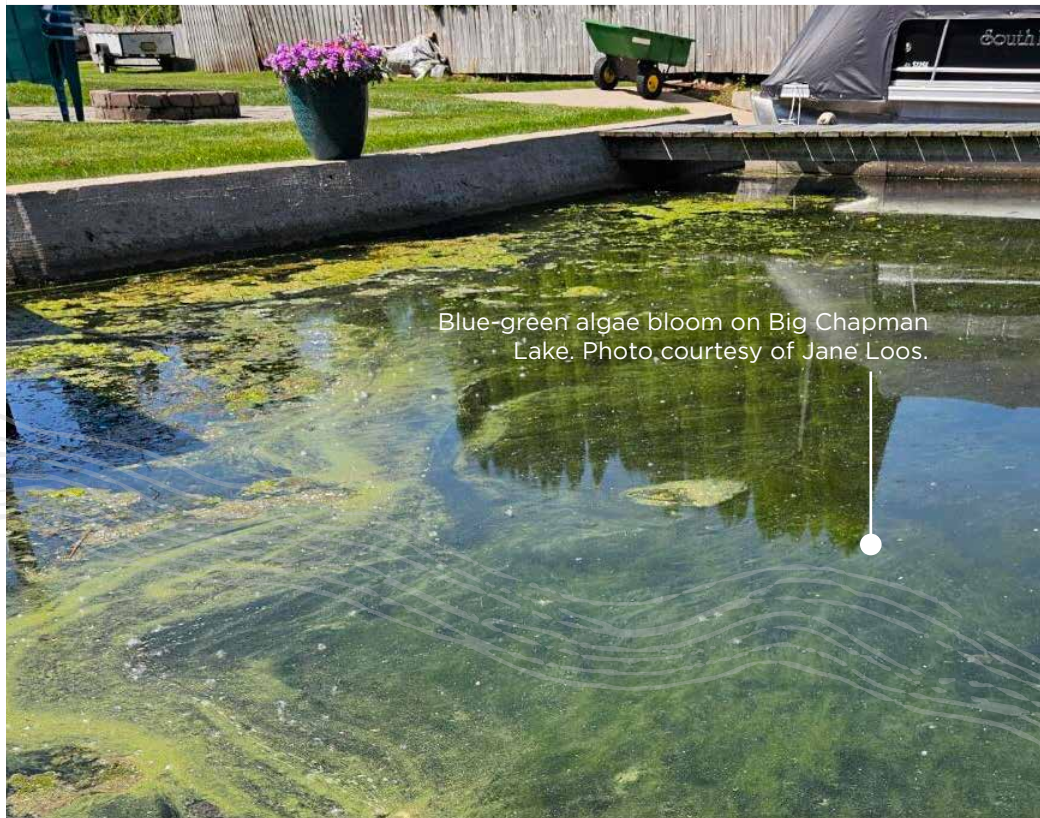
big chapman

Despite being outside of our normal sampling times, lake residents around Big Chapman Lake identified several blue-green algae blooms in late spring. Testing by the Lilly Center's field and lab teams confirmed that the toxin levels were above the human safety threshold. See the facing page for more data and analysis.

BCH

Surface area	504 acres
Max. depth	39 ft
Avg. depth	12.5 ft
Watershed	4,500 acres





Blue-green algae bloom on Big Chapman Lake. Photo courtesy of Jane Loos.

MICROCYSTIN

Microcystin levels at Big Chapman have been consistently high compared to many of the other lakes in the county. This year was no exception. Big Chapman averaged 1.2 ppb, and the maximum value observed was 1.8 ppb. The lake also experienced several isolated blooms in channels and along shorelines (see section below). The concentrations this summer were much higher than in past years.

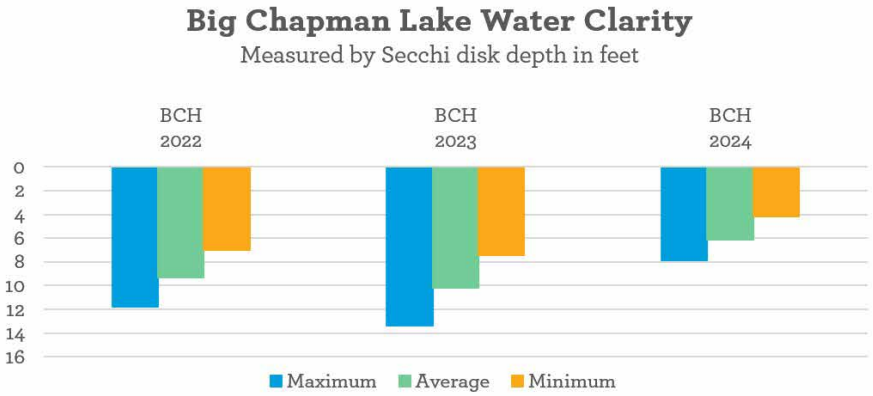
Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Big Chapman	max.	0.9	0.5	1.8
	avg.	0.4	0.3	1.2

Measured in parts per billion (ppb)
nd - no toxin detected

WATER CLARITY

Big Chapman Lake had a substantial decrease in water clarity from 2023 to 2024. The average Secchi depth at this lake last year was 10.2 ft. Clarity dropped to 6.1 ft this summer. Similarly, the average Secchi depth this summer was also much lower than in 2022 (9.3 ft). This decrease in clarity was likely due to prolific algae blooms seen on the lake this summer.



BLUE-GREEN ALGAE BLOOMS

In mid-May, before the start of our sampling season, homeowners north of Nelly's Bay reported an algae bloom to the Lilly Center. The research team collected a water sample and analyzed it in our lab. Results showed that microcystin toxin levels measured 160.4 ppb. According to IDEM, the human safety threshold is 8.0 ppb. After notifying homeowners and the Chapman Lake Conservation Association, the Lilly Center implemented a plan to track microcystin levels across the lake. After three days, toxin levels at the original bloom location decreased to 1.7 ppb. The Lilly Center measured four additional locations, including Nelly's Bay (0.3 ppb), the mouth of Nelly's Bay (0.3 ppb), and the deepest point on Chapman (nd).

Despite reduced levels, another channel off of Nelly's Bay recorded concentrations of 41.4 ppb, well above the human safety threshold. The Lilly Center returned the following week and tested water samples from the original location (0.8 ppb), the middle of Nelly's Bay (0.2 ppb), and the second channel bloom (4.0 ppb).

While it is difficult to pinpoint what caused these blooms, rainfall in April and May this year totaled over 11 inches compared to approximately 5 inches the previous two years. This excess rainfall likely brought in more nutrients to feed the blue-green algae and created the right conditions for a bloom.

LIMIT of FISH HABITAT

BCH 16.1'

WATER CLARITY

BCH 6.1'

AVERAGE TEMPERATURE

BCH 78.1˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

beaver dam & yellow creek & silver

Beaver Dam and Yellow Creek lakes have the unique distinction of being two lakes not yet home to a particular invasive species: zebra mussels. Ensuring that boats are clean and dry before using them in a new lake helps prevent harmful invasive species from spreading.

BEA

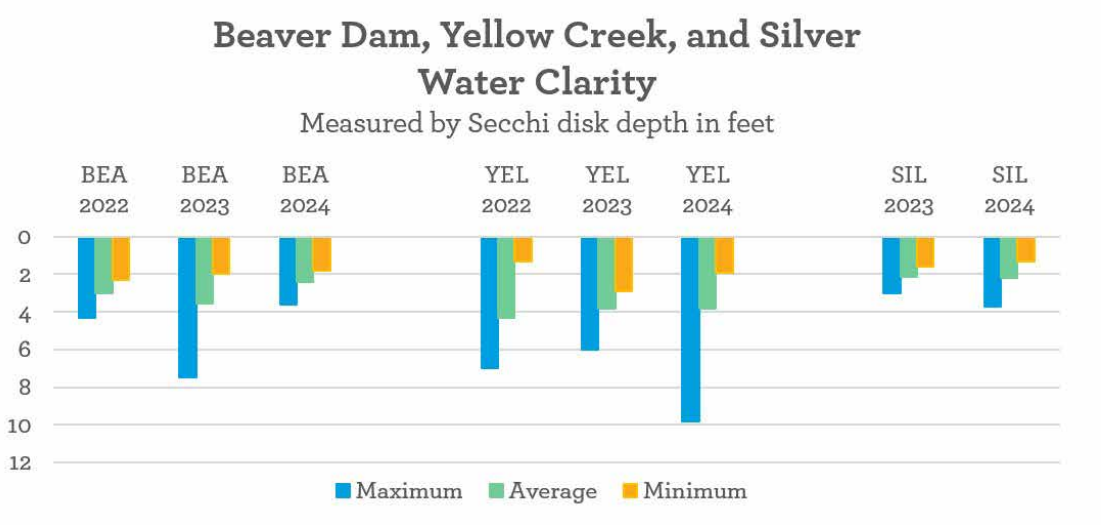
Surface area	155 acres
Max. depth	61 ft
Av. depth	15.6 ft
Watershed	1,266 acres

SIL

Surface area	102 acres
Max. depth	31 ft
Watershed	3,300 acres

YEL

Surface area	155 acres
Max. depth	67 ft
Avg. depth	31.6
Watershed	2,160 acres



WATER CLARITY

Secchi depths at Yellow Creek and Silver lakes have remained relatively stable over the last couple of years. The average water clarity at Yellow Creek was 4.3 ft in 2022 and 3.8 ft in 2023 and 2024. Silver Lake Secchi depth averaged 2.2 ft this year and 2.1 ft in 2022. Water clarity at Beaver Dam Lake has been more variable over the last three years. Secchi depth averaged 2.4 ft this year compared to 3.0 ft and 3.5 ft in 2022 and 2023, respectively.

Summer Microcystin Concentrations

Sampling Location		2022	2023	2024
Beaver Dam Open Water	max.	0.5	nd	2.5
	avg.	0.2	nd	1.2
Silver Open Water	max.		2.2	2.4
	avg.		1.1	1.5
Yellow Creek Open Water	max.	0.1	0.2	0.2
	avg.	0.1	0.1	0.1

Measured in parts per billion (ppb)
nd - no toxin detected

MICROCYSTIN

Both Beaver Dam and Silver lakes experienced high concentrations of microcystin in 2024. Silver Lake saw high levels in 2023, but the average and maximum concentrations for the cyanobacterial toxin were even higher this summer. Microcystin levels averaged 1.5 ppb this year compared to 1.1 ppb last year. Maximum concentrations increased from 2.2 ppb in 2023 to 2.4 ppb in 2024. Eight of the ten samples from Silver Lake exceeded IDEM's pet safety threshold of 0.8 ppb. Beaver Dam Lake recorded no detectable levels of microcystin in 2023. However, this summer, microcystin levels averaged 1.2 ppb with a maximum value of 2.5 ppb. Microcystin concentrations at Yellow Creek Lake have remained consistently low compared to Beaver Dam and Silver. No microcystin levels above 0.2 ppb have been observed during the last three summers.

LIMIT of FISH HABITAT

BEA	8.9'
SIL	7.9'
YEL	10.8'

WATER CLARITY

BEA	2.4'
SIL	2.2'
YEL	3.8'

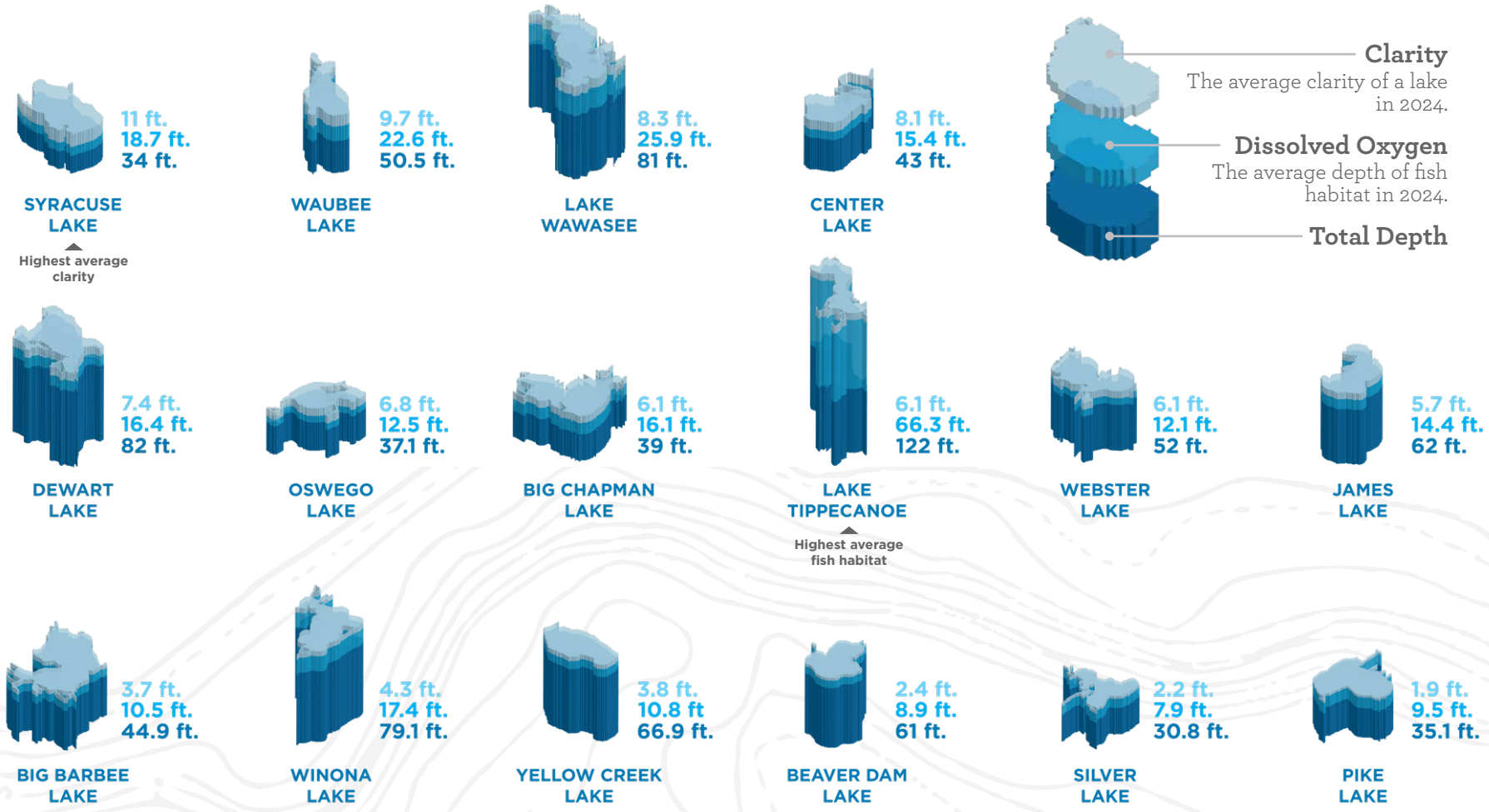
AVERAGE TEMPERATURE

BEA	79.4˚F
SIL	80.2˚F
YEL	78.7˚F

ALL NUMBERS IN THIS SIDEBAR ARE AVERAGES FROM 2024 RESEARCH

HOW CLEAR IS MY LAKE?

If your lake is clear, that must mean it is clean, right? From a scientific perspective, a clean lake does not have to be clear – and a clear lake is not always clean. Water clarity is an important metric to understand the health of a lake. The Lilly Center's research team uses a black and white Secchi (sehkey) Disk to measure water clarity. Generally, lakes that are clearer have fewer nutrients and, by extension, less algae. However, a clear lake **may be hiding bacteria, pesticides, or toxins**, like the ones algae produce. The lakes in Beneath the Surface are organized below by the highest average clarity.



Taking steps to improve the water clarity of your lake can make your lake more enjoyable, and healthier, and even have an impact on your home's value. Learn more about the ways water clarity has an impact on many aspects of lake life by visiting *lakes.grace.edu/field-notes*.

BEST PRACTICES TO TRY AT HOME

Having the information is one thing; how can you act on what you have learned? The answer will look a little different for every lake. At the Lilly Center, we make sure every research project we do has a local application. Consider joining your lake association (page 16) to share in the efforts happening on your shoreline.

DON'T PUT YARD WASTE IN YOUR LAKE

Collect your leaves, branches, and grass clippings for removal according to your local guidelines. Also, be sure not to sweep them into the street and cause them to clog storm drains. As the leaves decompose, they release extra nutrients that algae and plants can use to flourish.

USE LESS FERTILIZER ON YOUR LAWN

Specifically, try to use phosphorus-free fertilizer (look for a 0 as the middle number on the bag). When fertilizer gets washed into a lake, it acts as a stimulant for plants and algae and can even lead to harmful algae blooms. Look back at pages 6-7 to see current phosphorus levels.

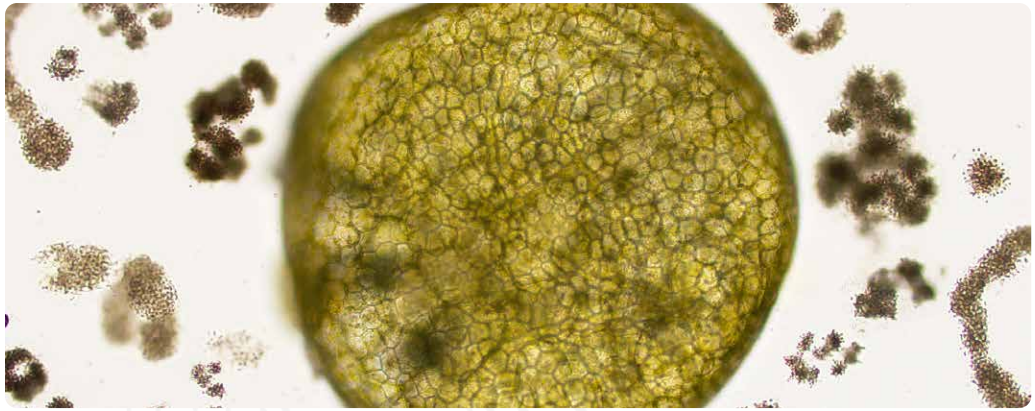
PRACTICE MINDFUL BOATING

Boating with the health of your lake in mind keeps nutrients trapped in the lake floor, reducing the chances of harmful algae blooms. Here's the bottom line: look for at least 10 feet of water depth before creating a wake.

Do you learn best with hands-on education? Lilly Center events are a great way to learn about best management practices by rubbing shoulders with other like-minded individuals. Visit the Lilly Center's Facebook page (**@centerforlakes**) or **lakes.grace.edu/events** to view our events on our community event calendar so you can experience your lake in a new way!

LILLY CENTER PROJECTS

These current and ongoing research projects are part of the Lilly Center's mission to help you make informed decisions for your lake's future. You can read blog posts and studies about each of these and other research projects on our website: **lakes.grace.edu.**



Microcystis, a toxin-producing cyanobacterium, surrounds a larger duckweed.

BLUE-GREEN ALGAE RESEARCH

The elevated microcystin toxin levels this summer are a reminder of why the Lilly Center exists: to make Kosciusko County's lakes & streams clean, healthy, safe, and beautiful. Yearly toxin testing, algae research, and nutrient budgets build a picture of what goes on beneath the surface of our lakes. Our goal? To predict and eventually be able to prevent toxic blooms and keep our community and pets safe. Visit the Lilly Center's Expert Blue-Green algae guide at **lakes.grace.edu/research/blue-green-algae**.

STREAM SENSORS

Stream sensors help us find potential patterns between the presence of cyanobacteria and their toxins in the lakes and identify where unique strategies may be required. The Lilly Center can monitor the "diet" of the lakes: what nutrients enter, leave, and get stored up, and in what amounts. By simultaneously gathering stream data from multiple lakes, our researchers can make insightful comparisons such as identifying unique threats or shared opportunities. Learn more about stream sensors on **page 14**.

STUDENT SUPPORT

The educational programs and scientific research run by the Lilly Center would not be possible without the 40+ interns who join the team every year. These students come from various backgrounds and work together with one purpose: to make our lakes clean, healthy, safe, and beautiful. By investing in current college students for the duration of their college careers, we can launch future environmental professionals into our region.

Some careers include:

- environmental consulting
- environmental law
- conservation districts
- Indiana Department of Natural Resources

and much more! Learn more about Lilly Center interns at **lakes.grace.edu**.

Sign up for our monthly e-newsletter

Get curated environmental news and local lake research delivered to your inbox. Scan the QR code or follow the link to sign up.

lakes.grace.edu/get-involved

Listen to the Lake Doctor Podcast

The **Lake Doctor Podcast** is your leading podcast for locally sourced science & news. Listen wherever you get your podcasts.

Make an investment

It takes a team to make research, education, and collaborative efforts possible. Use the QR code to see giving options, or go to **lakes.grace.edu/give.**

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LILLY CENTER FOR
LAKES
& STREAMS

GRACE
COLLEGE

OUR MISSION & VISION

The Lilly Center for Lakes & Streams conducts research, provides resources, engages and educates residents, and collaborates with local organizations to make the lakes and streams of Kosciusko County clean, healthy, safe, and beautiful.

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