2020 STATE OF THE LAKES

(PHOSPHORUS REDUCTION REPORT COMING THIS SUMMER)

Clean and healthy lakes are truly the benchmark of a healthy community, which is why Clean Lakes Alliance created a one-of-a-kind *State of the Lakes Report* and prioritizes the tracking and public reporting of Greater Madison's five lakes' overall condition each year. Additionally, we provide progress snapshots on phosphorus-reducing actions occurring across a 384-square-mile watershed, ensuring that we remain accountable to our lake-cleanup goals.

Considerable investments in conservation practices have led to declines in sediment and phosphorus concentrations entering the lakes. These practices have laid a solid foundation for future water quality improvements. The latest analyses show **these actions are making a positive difference, even though land-use change and an increasingly wetter climate are conspiring to overwhelm these impacts.** The fact that we now can confirm declines in sediment and phosphorus concentrations in monitored headwater streams is a testament to the influence of conservation measures getting adopted across the landscape. If it were not for increasing storm runoff and stream flow occurring over the same time period, these actions would have likely resulted in less phosphorus delivery and better overall lake conditions (see Figure 1).

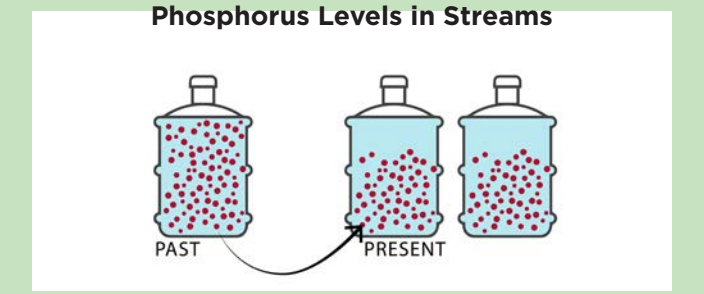


Figure 1: Illustration showing that while conservation practices are helping to reduce phosphorus concentrations in the stream tributaries feeding our lakes, increased runoff and stream flows are delivering more to the lakes in total. Figure adapted from an original image created by SmithGroup.

To this day, all five lakes unfortunately remain federally "impaired" for failing to meet basic water quality and usability standards under the Clean Water Act. These impairments are primarily caused by the excess phosphorus pollution contained in stormwater runoff that washes off surrounding lands. We see that evidence not only in the monitoring data as described above, but also in the recurring cyanobacteria (blue-green algae) blooms and beach closures that shape the experiences we have with our lakes.

WETTER SPELLS TROUBLE

Stormwater runoff acts as the main delivery system for everything that ends up in our lakes. That includes most of the phosphorus that turns the lakes green, soupy, and thick with algae. Runoff occurs when rainfall is prevented from soaking into the ground or cannot be absorbed by vegetation. As more rain falls on frozen or hardened landscapes, the flow of pollutants increases from the land surface into downstream waterbodies.

In total, 42.56 inches of precipitation fell during the 2020 "water year" (Oct. 1, 2019 – Sep. 30, 2020) based on data from the Dane County Regional Airport gauge. This continues a trend of above-average rainfall for our area, with normal being 34.48 inches. In fact, multiple record-setting events were seen in the last several years alone, with historically unprecedented rainfall recorded during the flood of August 2018. All months of the 2020 water year, except August, exceeded the normal rainfall amounts based on 1981-2010 averages. As Dr. Stephen Vavrus describes in his article on pages 16-17, our region is not only getting progressively wetter, it is also seeing a greater frequency of larger and higher-intensity storms (Figure 2).

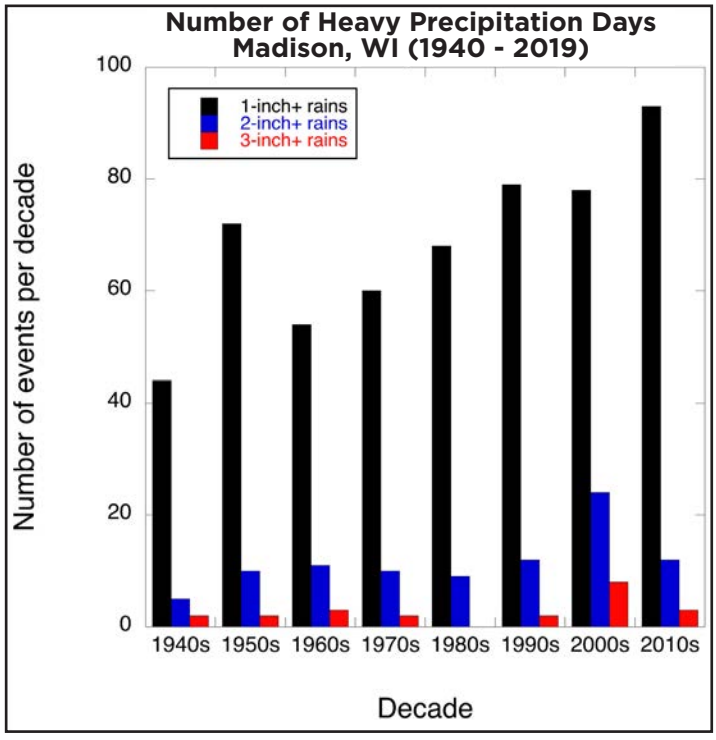


Figure 2: Number of heavy precipitation days recorded in Madison by decade (credit: S. Vavrus)

NATURE'S DELIVERY SYSTEMS

Water flows from north to south as it is funneled from the watershed and through the Yahara chain of lakes. Like arteries, the Yahara River and several tributary streams feed the lakes a constant supply of water and nutrients, including phosphorus. Gauging stations on many of these streams collect data on flow volumes and phosphorus concentrations. The data allow scientists to estimate the mass of algae-fueling phosphorus that is getting delivered to the lakes (called "loading").

Figure 3 shows how much phosphorus Lake Mendota's monitored streams delivered to the lakes during the 2020 water year compared to prior years. This is shown as total pounds along the left-hand, vertical axis. The goal is to get that number down to an annual average of 32,600 pounds for Lake Mendota (and 47,600 pounds for all five lakes combined). Total rainfall amounts by water year are also shown, even though timing, intensity, and frequency are better predictors of runoff conditions. These values are shown as total inches of precipitation along the right-hand, vertical axis.

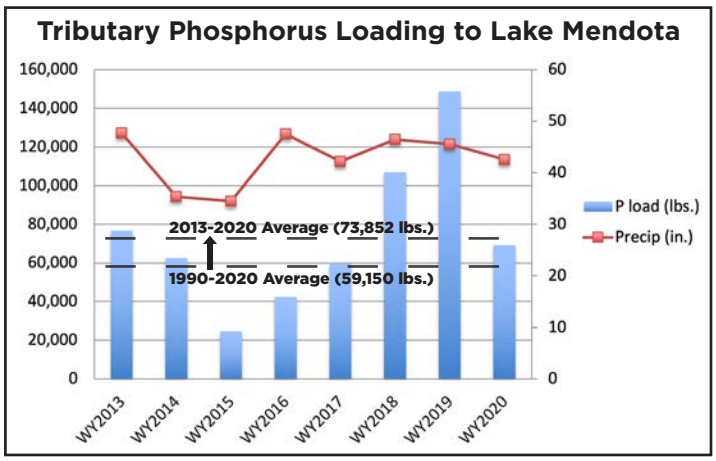
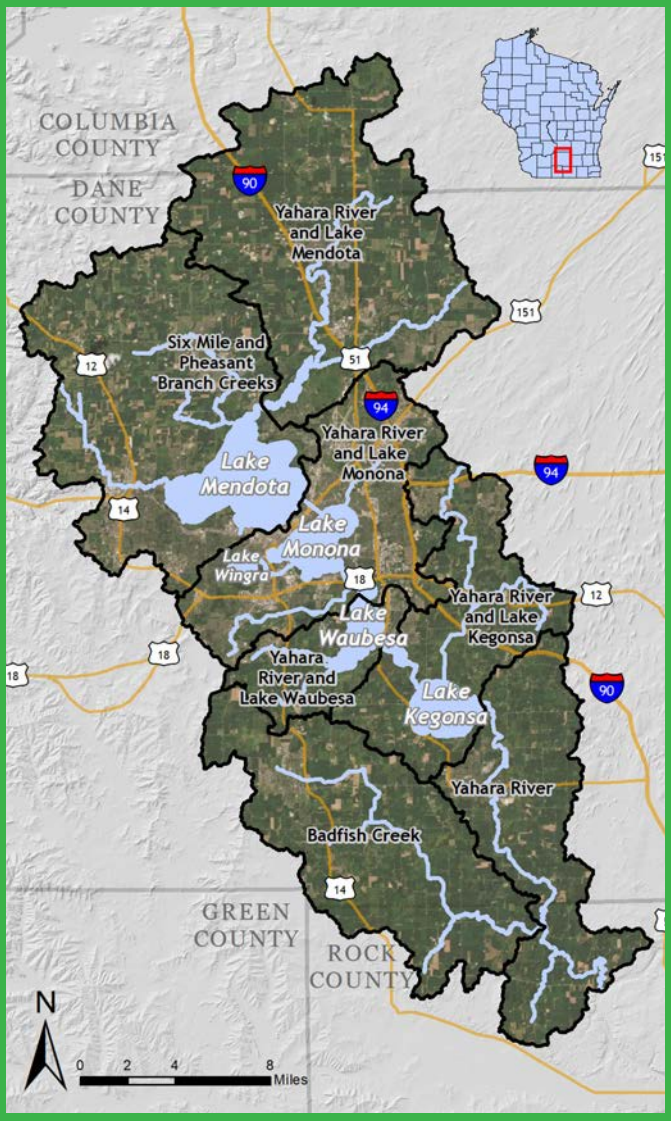


Figure 3: Phosphorus loads (in pounds) delivered to Lake Mendota through its monitored stream tributaries by water year. Also shown is total precipitation (in inches) during these time periods. Loading data source: T. Stuntebeck, USGS

Sitting at the top of the chain and receiving most of the watershed drainage, the condition of Lake Mendota is a good indicator for how the downstream lakes will be impacted. Lake Mendota is also the lake with the greatest number of monitored streams; with Pheasant Branch Creek, Dorn Creek, Sixmile Creek, and the Yahara River all being closely tracked. During the 2020 water year, the roughly 70,000 pounds of phosphorus loading to Lake Mendota exceeded the long-term average (1990-2020) by 18%. Nonetheless, it was about half of what was measured during the prior year, at which time most of the phosphorus was delivered during early-March runoff events. Typically, more than half of the total amount of phosphorus entering our lakes each year occurs during the January-March time period when rain falls on frozen, snow-covered ground.

YAHARA RIVER WATERSHED



WHAT IS A WATERSHED?

A watershed is defined by the part of the landscape that channels rainfall and snowmelt to creeks, streams, and rivers that flow into a single waterbody, like a lake. As the water flows over the landscape, it picks up pollutants, such as phosphorus, that cause water quality problems. Actions can be taken on the landscape to slow the water and filter out the pollutants.

LANDSCAPE ACTIONS MAKE A DIFFERENCE

Despite a widening gap between the total amount of phosphorus getting delivered to the lakes and the goal, **updated analyses show that conservation practices are having a positive impact**. These practices include the planting of vegetative buffers along streams and ditches, stormwater collection basins, leaf-free urban streets, low-disturbance manure injection (see photo pg. 32), and a host of other rural and urban strategies. In fact, if climate and

runoff volumes were held constant, an analysis performed by Dane County Land and Water Resources Department showed that the amount of phosphorus delivered to Lake Mendota would have decreased by 36% over the last two decades thanks to such actions.

Photo: Low-disturbance manure injection is an example of a conservation practice farmers use to help prevent manure from washing off fields.

Unfortunately, increasing runoff volumes are effectively masking and overwhelming these impacts. As depicted earlier in Figure 1, while phosphorus concentrations in our streams have declined over time, higher stream flows due to runoff-producing climate and landscape changes are increasing the total amount delivered. According to data and analysis provided by the Capital Area Regional Planning Commission, approximately 11,000 acres of the watershed were developed between 2000-2015. While conservation practices are working, much more will be needed to overcome changing rainfall and land-use patterns that are affecting the watershed. If successful, and we reach our phosphorus goal, lake-response models estimate that we can double the number of summer days when our lakes are clear and free of the types of cyanobacteria blooms that close beaches.

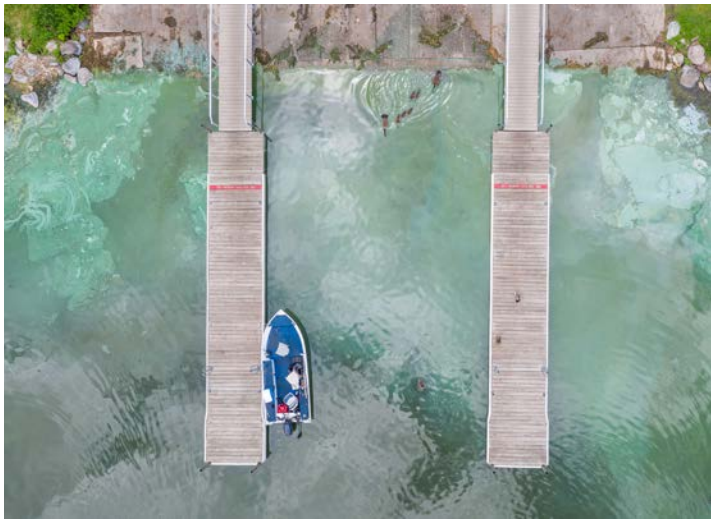


Photo: Aerial view of a cyanobacteria bloom at Lake Farm County Park on Lake Waubesa in June of 2020, courtesy Robert Bertera

PHEASANT BRANCH CONSERVANCY RESTORATION

Pheasant Branch Conservancy expansion north of Lake Mendota

Clean Lakes Alliance and other community partners are helping Dane County complete the restoration of a 160-acre addition to the popular Pheasant Branch Conservancy. Prairie- and wetland-restoration activities were initiated following the 2019 acquisition of a former dairy farm, with ongoing work designed to maintain the property's rural character, increase wildlife habitat, absorb floodwaters, and help capture sediment and phosphorus to protect area water quality. At the time of its purchase, the approximately $10 million price tag represented the largest conservation investment for a land acquisition in Dane County's history.

When the restoration is complete, nearly five million gallons of runoff water and 550 pounds of phosphorus will be prevented from entering the Yahara lakes each year.

"Our restoration project to expand the Pheasant Branch Conservancy furthers our efforts to mitigate flooding, improve water quality, and preserve this treasured outdoor space for years to come," said Dane County Executive Joe Parisi.

Clean Lakes Alliance volunteers have been removing invasive plants to help control runoff and improve wildlife habitat in Pheasant Branch Conservancy for the last 10 years. Recently, Clean Lakes Alliance donors and business partners, like Alliant Energy and Hy Cite Enterprises, were excited to contribute to a Seed the Need fund that we will use to support land improvement on the newly purchased land next to the Conservancy.

Ceremonial seed spreading at Pheasant Branch Conservancy

WHAT LAKE MENDOTA TELLS US

Our lakes are reflections of their watersheds, and phosphorus is the main driver of their overall water quality conditions. It is a natural element and critical plant nutrient found in soil, leaves, manure, fertilizers, and other material. Because it is found in short supply compared to other critical nutrients, managing sources of phosphorus can control how much algal growth is possible. While phosphorus can enter the lakes in different forms and through various pathways, it is what we put on and do to the land surface that most impact downstream waters.

Because of the COVID-19 pandemic and other factors, mid-lake phosphorus concentrations and water clarity readings could only be obtained for Lake Mendota during the 2020 season. Fortunately, this large headwater lake is a good general indicator for what is happening throughout the chain.

Figure 4 shows Lake Mendota's summer median total phosphorus concentration for 2020 compared to the prior seven years. Phosphorus levels have recently been trending higher and are considered "fair" by Wisconsin Department of Natural Resources standards.

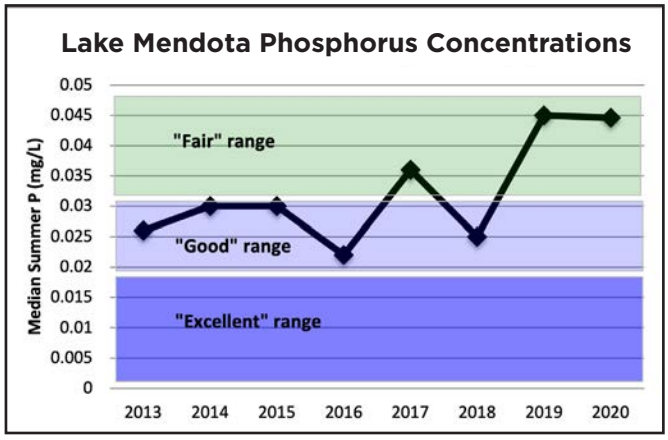


Figure 4: Lake Mendota median summer phosphorus concentrations (in mg/L). Data source: R. Lathrop, UW-Madison Center for Limnology Honorary Fellow

Figure 5 shows Lake Mendota's summer median water clarity for 2020 compared to the prior seven years. Values represent the depth to which a transparency-measuring device, called a Secchi disk, can be seen when lowered from the water surface. Clarity readings remain in the "good" range, but are beginning to edge closer to "fair" conditions.

Photo: Urban runoff shown on Lake Mendota at James Madison Park after a heavy rain event

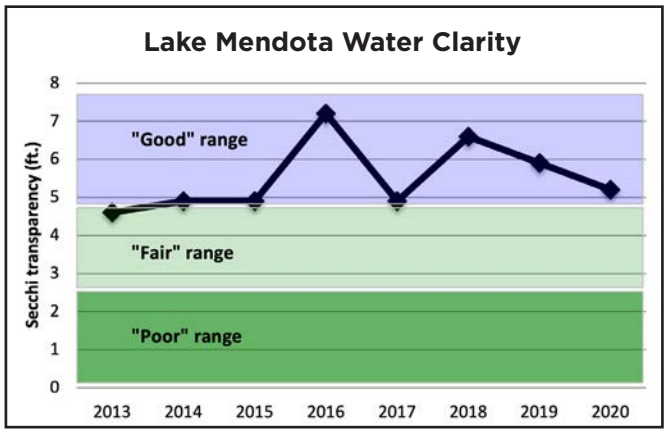


Figure 5: Lake Mendota median summer water clarity (in feet of transparency as measured by a Secchi disk). Data source: R. Lathrop, UW-Madison Center for Limnology Honorary Fellow

THE LAKE USER EXPERIENCE

Ultimately, we want our lakes to be safe and swimmable, and free of the cyanobacteria blooms and *E. coli* contamination that can close beaches. Thanks to the dedication of Clean Lakes Alliance's all-volunteer monitoring network, a total of 71 near-shore reporting stations were active across all five lakes during the 2020 season (Figure 6). Trained monitors donated an estimated 580 hours of combined volunteer time, delivering 2,294 near-real-time condition reports from approximately Memorial Day to Labor Day. All this information was made available via interactive maps at LakeForecast.org, as well as through the free Apple and Android app of the same name.

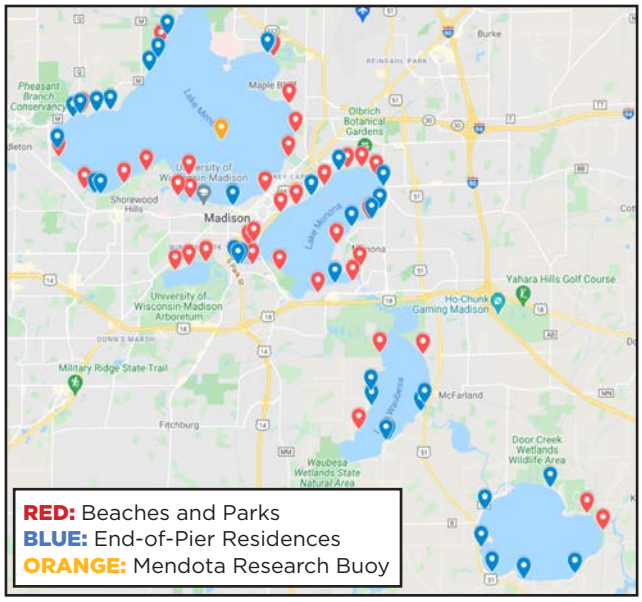


Figure 6: "LakeForecast" monitoring station locations.

The number of days when one or more monitors reported "strong evidence" of a cyanobacteria bloom is summarized for each lake (Figure 7). By comparing the number of 'algal days' to the total number of unique sampling days for each lake, we can generate a percentage that better represents the number of blooms witnessed each year.

This method eliminates over reporting in situations when different monitors report the same algal bloom. Compared to 2019, monitors documented more "strong evidence" of cyanobacteria blooms on Waubesa and Kegonsa. In contrast, lakes Mendota and Monona experienced notable declines in reports. Lake Wingra remained consistent with no reports of "strong" cyanobacteria blooms.

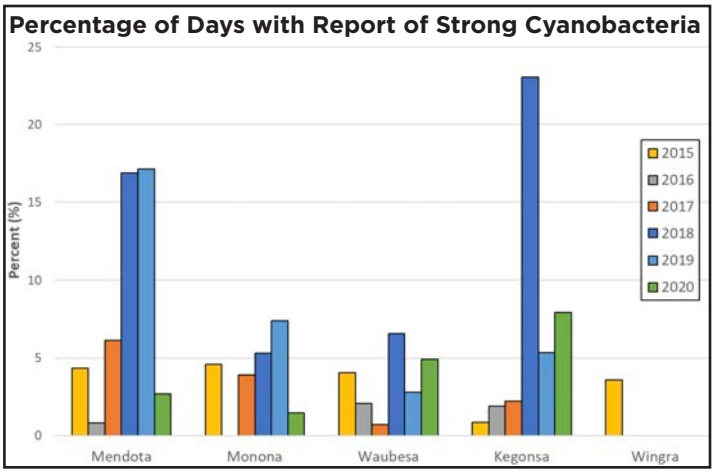


Figure 7: LakeForecast monitors reporting "strong evidence" of a cyanobacteria bloom represented as a percentage of total sampling days

Near-shore water clarity reports did not reveal any consistent trends across each lake when compared to 2019 and prior years. Lakes Monona and Wingra demonstrated a marked improvement in water clarity, while lakes Mendota and Waubesa displayed similar results to 2019. Only Lake Kegonsa reported a decline in water clarity with average transparency tube readings for August and September representative of "fair" water clarity. The high rainfall total measured in July may have had lasting, negative impacts on water clarity as the season progressed.

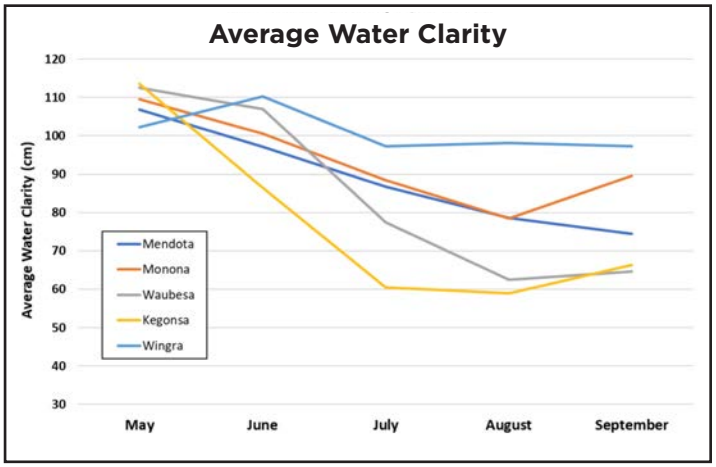


Figure 8: Change in average near-shore water clarity by lake during the course of the 2020 season (measured in centimeters of transparency using a 120-centimeter turbidity tube; murky is 0 to 50 cm, fair is 50 to 80 cm, good is 80 to 120 cm of transparency)

Average clarity decreased throughout the summer with a peak decline in August (Figure 8). This phenomenon was consistent across each lake, and is somewhat typical as algal activity increases with rising water temperatures.

As for beach closures, there were 103 total "closure days" documented during the 2020 summer-recreation season (Figure 9). Closure days represent the number of days each monitored beach had to be closed due to unsafe water conditions. These unsafe conditions were usually due to the presence of elevated and potentially harmful levels of *E. coli* and/or toxin-producing cyanobacteria.

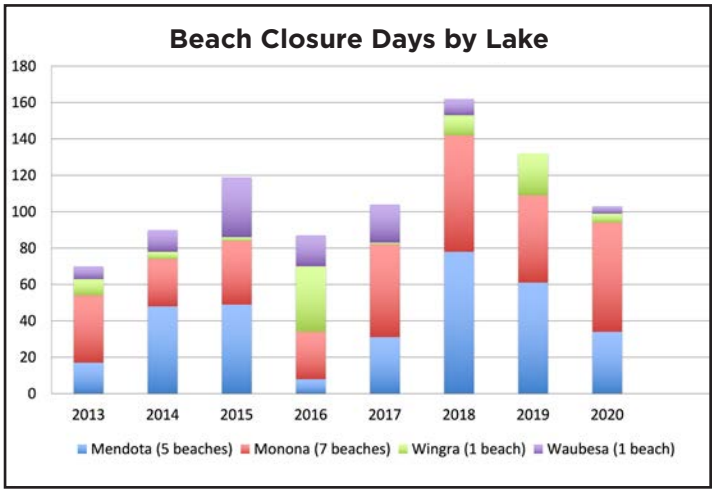


Figure 9: Beach closure days by lake from 2013-2020 (Data source: Public Health Madison and Dane County)

LOOKING AHEAD

Clean Lakes Alliance has convened a community coalition of 19 member organizations, called the Yahara CLEAN Compact, to build on past efforts and cultivate new opportunities to improve the condition and usability of our lakes and beaches. You can read more about the Compact on pages 22-23. With coalition members affirming that our phosphorus-loading goal and action priorities are still valid, efforts are now focused on finding improved ways to ramp up the implementation of these actions, capitalize on improved scientific understandings, and target resources where we can get the greatest bang for the buck.

We also want to hear from you! What thoughts and ideas do you have for our lakes? Visit the website below to find out how you can get involved and help shape how we move forward together.

Learn more about the
Yahara CLEAN Compact:
cleanlakesalliance.org/yahara-clean