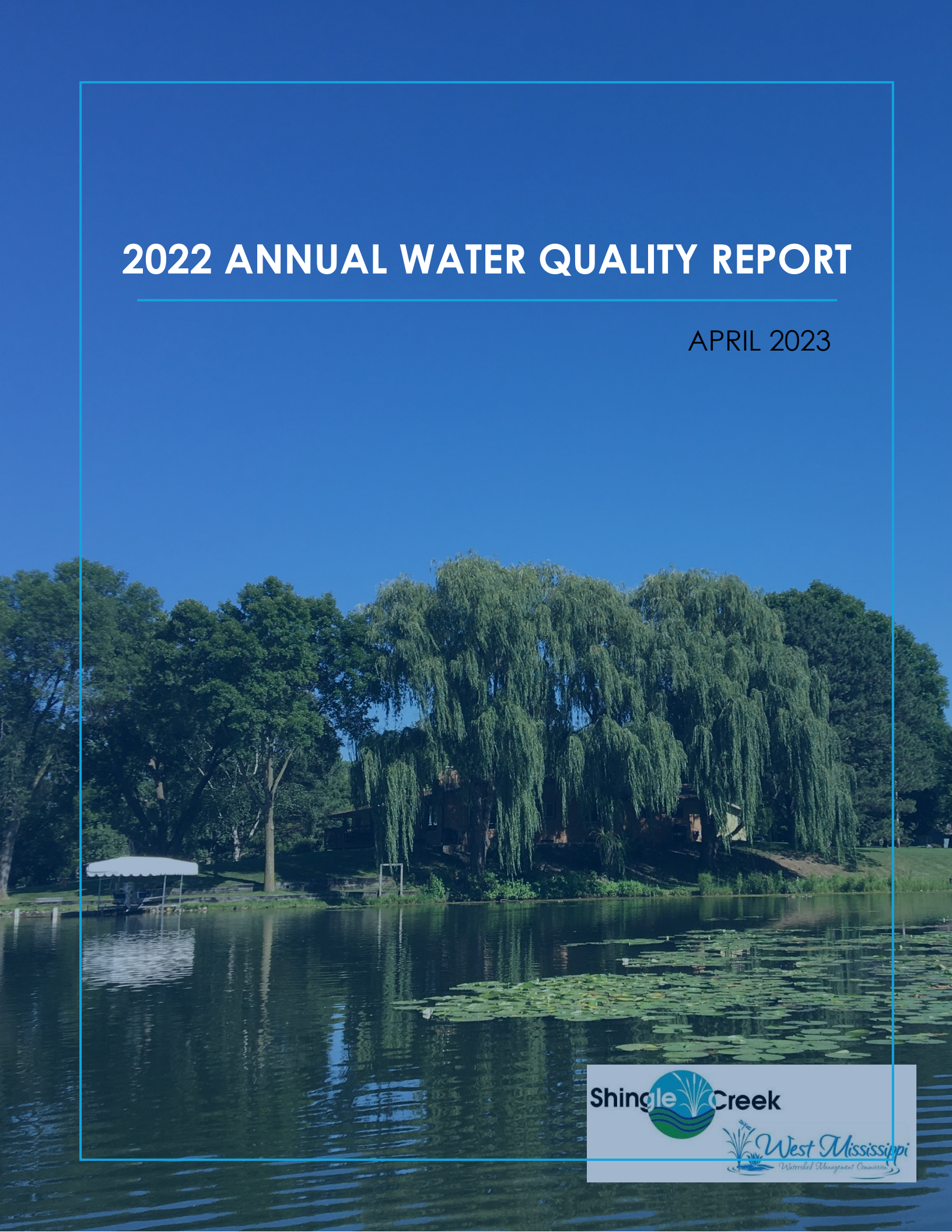
# 2022 ANNUAL WATER QUALITY REPORT

APRIL 2023



Shingle Creek

West Mississippi

Watershed Management Commission

## The Monitoring Program

Staff conducts fish survey on Shingle Creek, Brooklyn Center MN.

The Shingle Creek and West Mississippi Watershed Management Commissions annually monitor water quality in the lakes, streams and outfalls of the watersheds. Data has been collected from Shingle Creek since 1996 and at West Mississippi River outfalls since 2010. In 2012 Shingle Creek expanded its volunteer-based lake monitoring program to start systematic detailed lake monitoring. The program has also expanded to incorporate fish, macroinvertebrate, and aquatic vegetation monitoring in the lakes and streams. Student and adult volunteers collect additional lake water quality and stream macroinvertebrate data. A Water Quality report summarizing current and historic conditions in the watersheds has been published annually since 1998. Surface water quality in the watersheds is typical of urban lakes and streams in the Twin Cities metropolitan area. Agriculture followed by urban development have changed drainage patterns, increased pollutants to the waters, and reduced habitat for aquatic and terrestrial life. Both Shingle Creek and Bass Creek do not meet state water quality standards for chloride, bacteria, and dissolved oxygen, and have severely impacted fish and macroinvertebrate communities. Thirteen of the 16 lakes were listed as Impaired Waters of the State because of their high concentrations of phosphorus. Diagnostic and feasibility studies completed between 2007 and 2011 have identified actions that can be taken in the watersheds to help improve water quality.

In the more than ten years since the results have been heartening. Three of the impaired lakes **now meet state standards** and have been removed from the list of Impaired Waters and two others now meet the standards and are scheduled for removal in 2024. Long-term stream water quality monitoring shows a **clear improvement** in suspended sediment and nutrient concentrations in both Shingle Creek and Bass Creek, a result of ongoing efforts to stabilize streambanks, increase the frequency of street sweeping, enhance erosion control on construction sites, and install Best Management Practices to treat stormwater before it is discharged into the streams. However, chloride concentrations in the streams, mostly from road salt applied in the winter for snow and ice control, continue to be high.

### *Why Do We Monitor?*

- To quantify the **current status** of streams and lakes throughout the watershed and compare to water quality standards.
- To quantify **changes over time**, or trends, in stream and lake water quality
- To **identify problem areas** for potential BMPs
- To quantify the **effectiveness** of implemented BMPs throughout the watershed

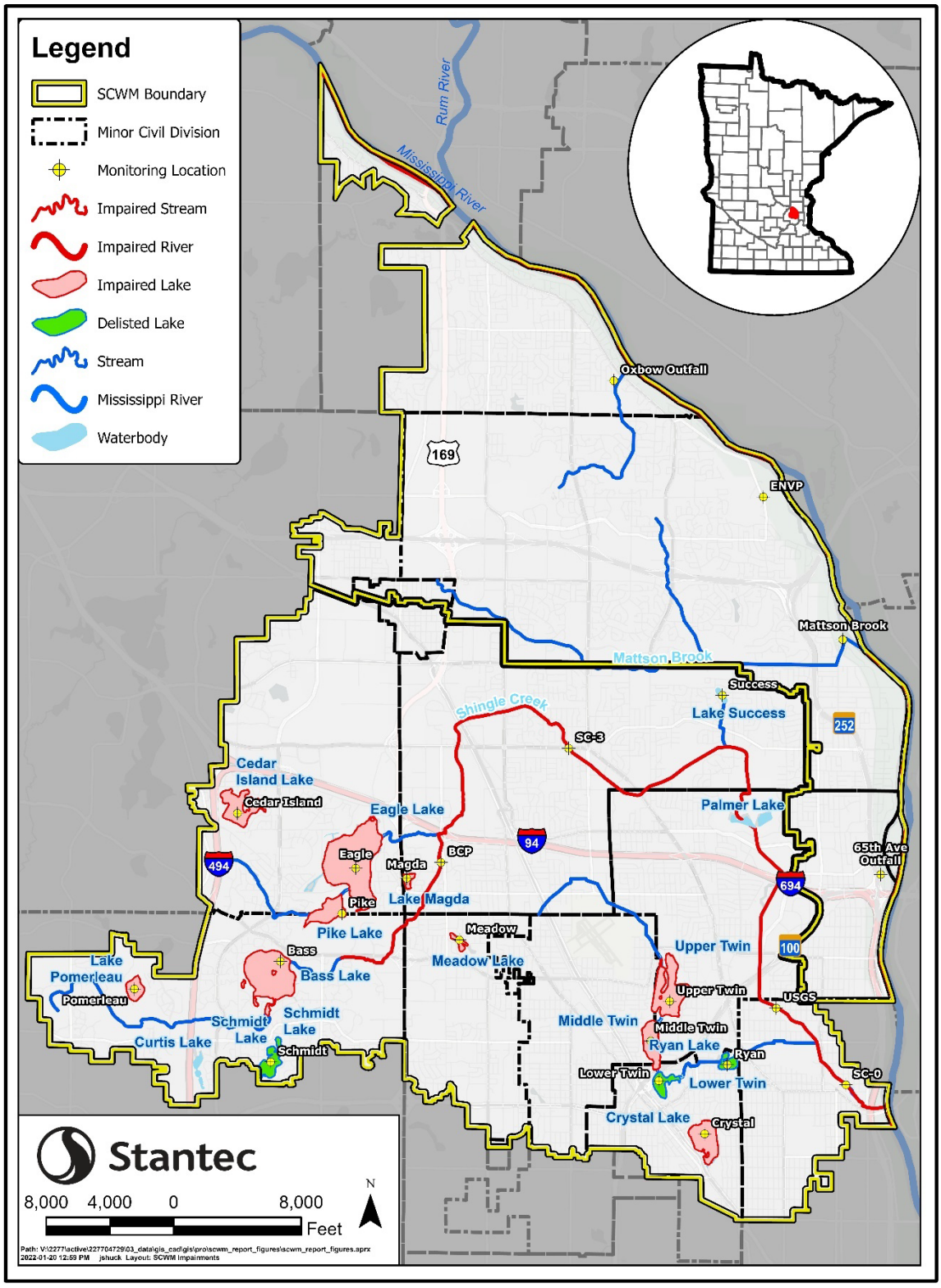



**Figure 1. Impairments in the Shingle Creek and West Mississippi Watersheds.**

# What's in the watershed?

## West Mississippi

- 25 square miles
- High impervious urban development (25%) and low-moderate impervious urban development (38%)
- 4 stream sites and 18.3 miles of streams
- No lakes, few wetlands

## Middle Shingle Creek

- 15 square miles
- High impervious urban development (45%) and low-moderate impervious urban development (28%)
- 1 stream and 10.34 miles of streams
- 2 lakes: Success and Palmer

## Upper Shingle Creek

- Headwaters of Shingle Creek
- 13 square miles
- High impervious urban development (28%) and low-moderate impervious urban development (26%)
- 3 streams and 16.2 miles of streams
- 8 lakes: Bass, Pomerleau, Schmidt, Cedar Island, Pike, Eagle, Magda, Meadow

## Lower Shingle Creek

- Shingle Creek discharges to the Mississippi River
- 17 square miles
- High impervious urban development (71%) and low-moderate impervious urban development (8%)
- 2 streams and 18.9 miles of streams
- 5 lakes: Upper Twin, Middle Twin, Lower Twin, Crystal, and Ryan

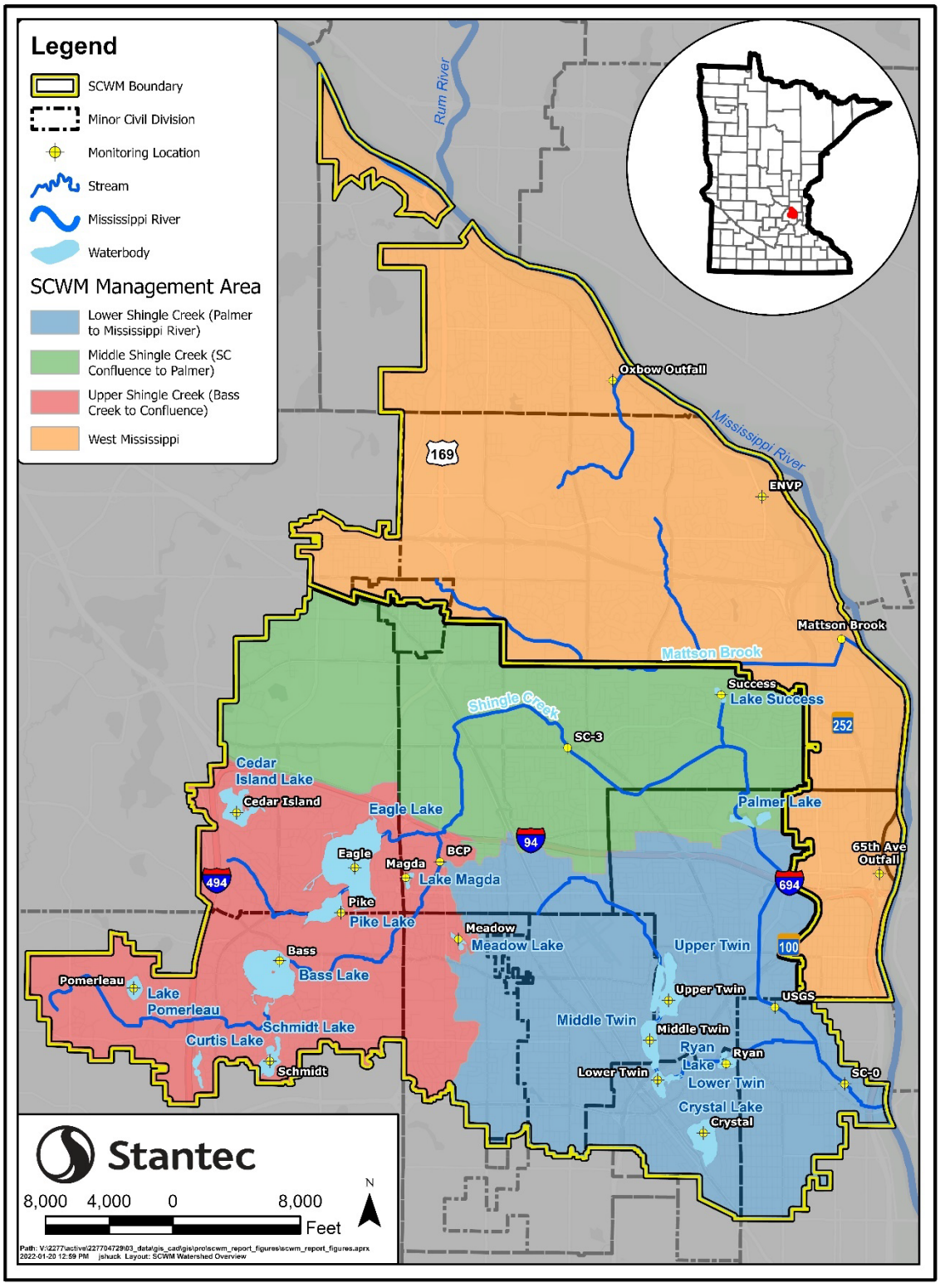



**Figure 2. Overview and monitoring locations of the Shingle Creek and West Mississippi Watersheds.**

# Monitoring in 2021

## Stream Monitoring

***Routine Flow and Water Quality:*** Three sites along Bass and Shingle Creek were monitored biweekly from April through October: near the stream's outlet to the Mississippi River in Minneapolis (SC-0); mid-watershed in Brooklyn Park (SC-3); and in Bass Creek (BCP) in the upper watershed. Winter chloride was sampled monthly from November through March at the three locations mentioned and the USGS gage site (SC-1). In the West Mississippi Watershed, Environmental Preserve (ENVP) was monitored monthly April through October and 65$^{th}$ Avenue was monitored year-round.

***River Watch:*** Stream macroinvertebrates are typically monitored by high school students at two sites on Shingle Creek through the Hennepin County River Watch program, however the program has been affected by the COVID-19 pandemic. Shingle Creek at Park Center High School has been monitored for 24 years by science students from the school. Shingle Creek at Webber Park was monitored by students from Patrick Henry High School between 2001 and 2012, then in 2018, 2019, and 2021 by students from the Avail Academy. No River Watch monitoring occurred in 2022.

## Lake Monitoring

***Routine Water Quality:*** Water quality in Magda and Schmidt Lakes were monitored biweekly from June through September as part of Shingle Creek's routing monitoring program. Aquatic vegetation was surveyed once in late spring and once in late summer. The fish community of Magda was sampled.

***CAMP:*** Each year the Commission sponsors volunteer lake water quality monitoring through the Met Council's Citizen Assisted Monitoring Program (CAMP). Upper Twin, Lower Twin, and Bass Lakes were monitored in 2022.

Staff finds Northern (Pike) while conducting fish survey on Schmidt Lake in 2019, Plymouth MN.

***Grant Projects:*** Crystal and Meadow Lakes were monitored from June through September for water quality as part of grant projects. These lakes have all been listed as impaired for nutrients and are undergoing active management. Crystal Lake underwent invasive carp removals in Summer 2021 and 2022. Crystal Lake received its first dose of alum in September 2021, followed by a second dose in September 2022. Water quality monitoring in the lakes has helped our understanding of changes in lake health following management activities. Meadow Lake underwent a drawdown in November 2021 to reduce fathead minnows and consolidate loose sediment.

# 2022 in Review

This summary provides an overview of findings and conditions in the two watersheds in 2022. A more detailed assessment and data are available in the technical appendices, which can be found at shinglecreek.org/water-quality.html.

## Rainfall

Water quality in lakes, streams and wetlands is heavily influenced by precipitation and storm water runoff. 2022 was a dry year. Precipitation in 2022 in the Shingle Creek and West Mississippi watersheds was well below the historic average (1992-2021) in June, July, September and October. Total rainfall in 2022 was 25.0 inches, 8.6 inches below the historic average of 33.7 inches.

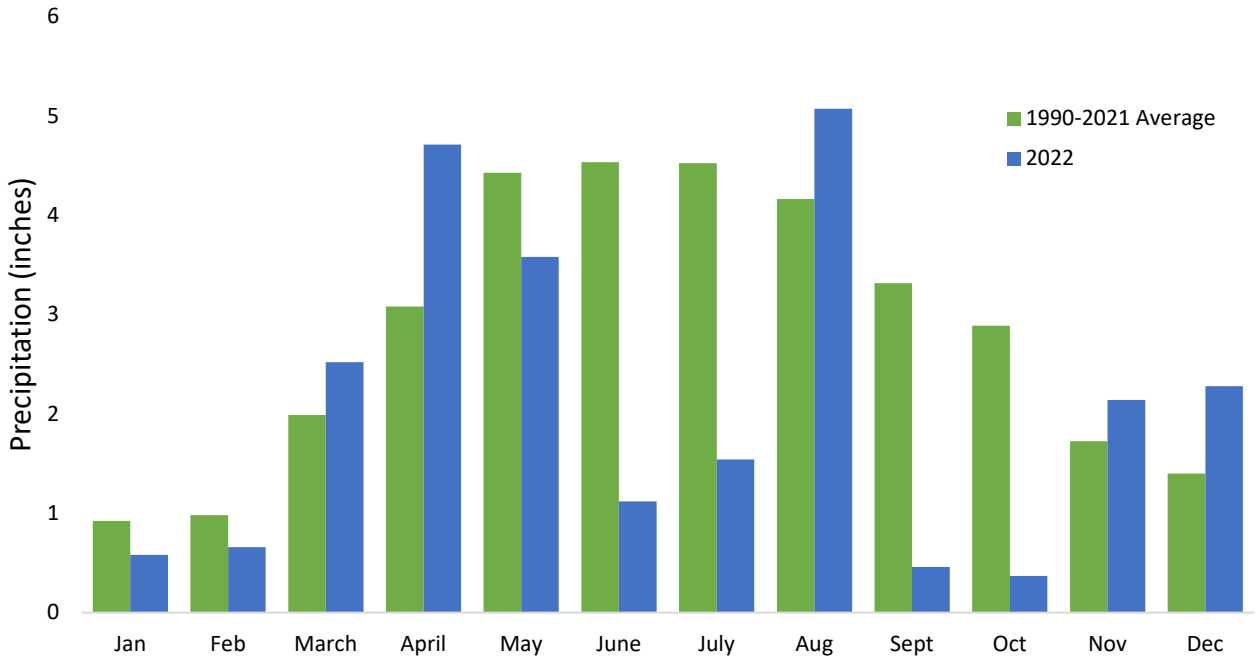



**Figure 3. Monthly precipitation totals at the New Hope weather station for 1990-2021 and 2022.**

## Streams

Stream sites in Shingle Creek and West Mississippi Watersheds are monitored during normal, baseflow conditions (routine monitoring) and during rainfall events (storm monitoring) when flow is higher. Runoff during storms carries pollutants into the stream and can contribute to downstream water body impairments. Stream water quality during storms is often worse than during routine monitoring.

## Shingle Creek

Fluctuations in flow at all the monitored Bass and Shingle Creek sites (BCP, SC-3, SC-0) and at the USGS gage site were similar across sites and was largely driven by rainfall events in the watershed (Figure 4). 2022 was a relatively dry year compared to historic precipitation averages (Figure 3). Like 2021, the small amount of runoff resulted in low TP and TSS loading to the watershed.

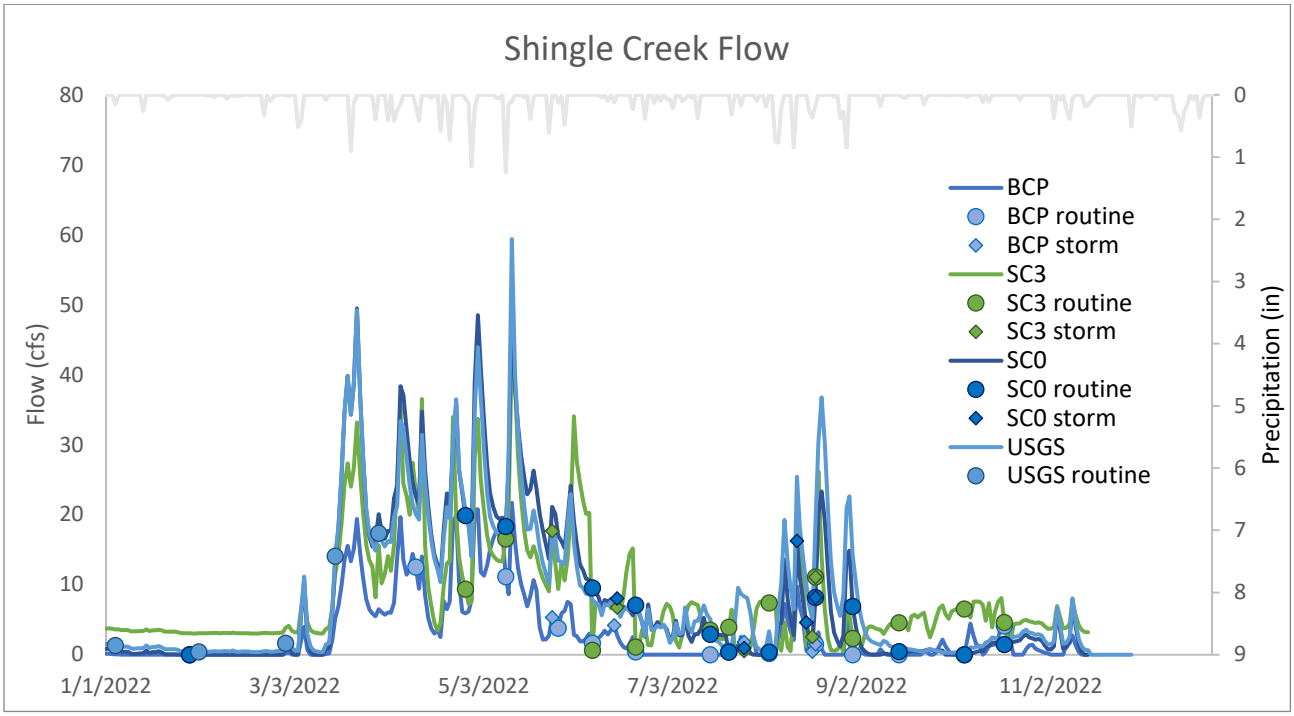



**Figure 4. Flow, sample timing, and precipitation at monitored stream sites in the Shingle Creek Watershed during 2022.**

Water quality at the Shingle Creek stream sites is generally worse during storm event monitoring (Figure 5). Average concentrations of chloride, *E. coli*, TP, and TSS during storm events were higher than during routine monitoring, with the exception of chloride. Chloride samples were collected year-round but were highest during winter routine monitoring when road salt application occurs.

Annual pollutant loads of TP, TSS, and chloride were estimated for each monitoring site by multiplying the mean pollutant concentration by the annual volume of runoff at each site. Loads are highest near the Shingle Creek site SC-3. This is likely due to flow being highest at this site.

**Table 1. Annual pollutant loads at each Shingle Creek routine monitoring site.**

| Site | TP Load (lbs/acre/year) | TSS Load (lbs/acre/year) | Chloride Load (lbs/acre/year) |
|---|---|---|---|
| BCP | 0.11 | 13.1 | 154 |
| SC-3 | 0.13 | 13.4 | 158 |
| SC-0 | 0.07 | 8.9 | 65 |

***Trends:*** Water quality data has been collected in Shingle Creek since 1996, and the most recent trend analysis (2021) shows significant changes to stream water quality. Soluble phosphorus concentrations are improving (decreasing) in both Shingle (SC-0 and SC-3) and Bass Creeks (BCP). TP and TSS has been significantly reduced at SC-0. Trends were not detected for dissolved oxygen, *E. coli*, or nitrogen.

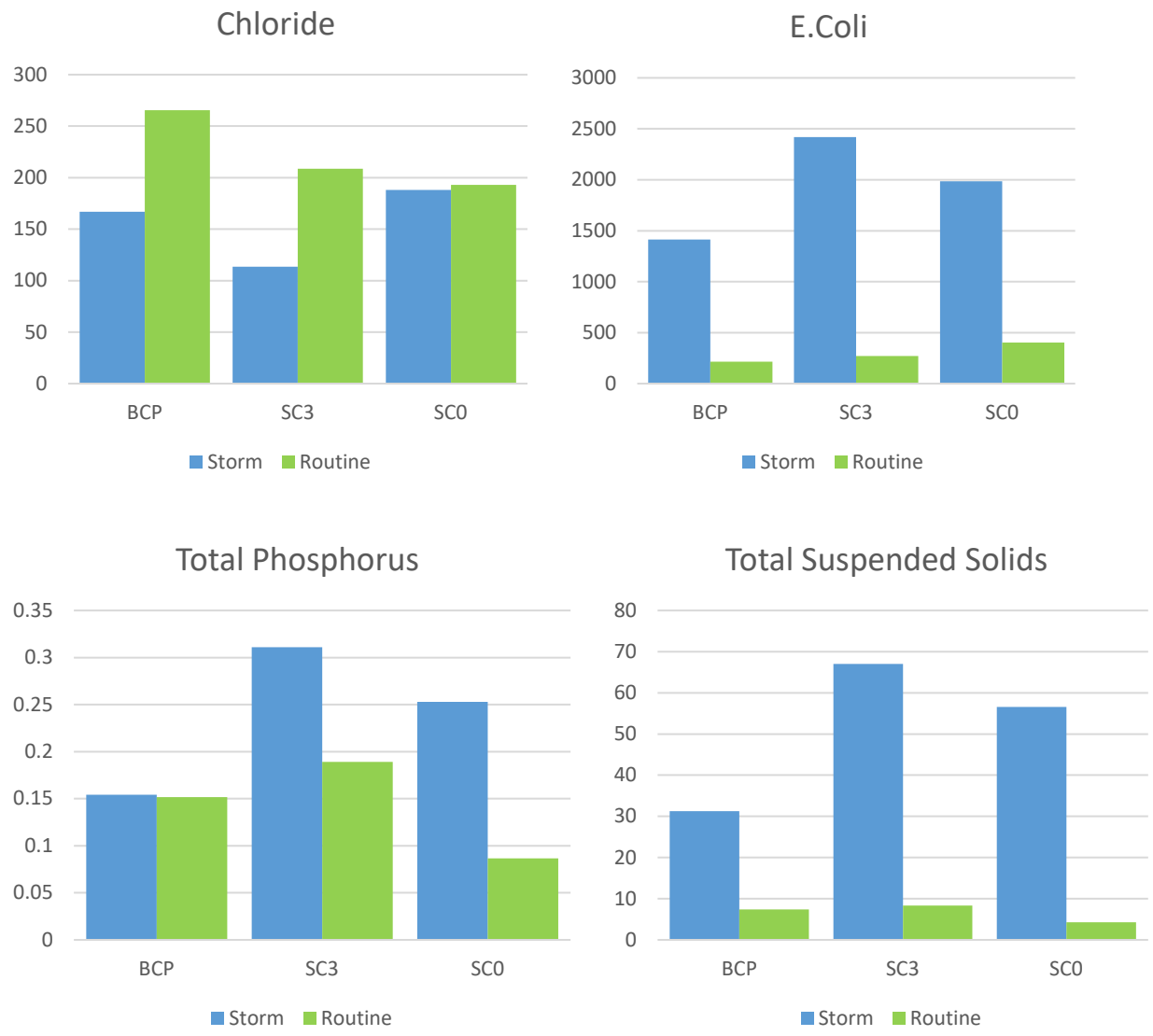



**Figure 5. Average concentration of water quality parameters at Shingle Creek sites sampled during storm and routine monitoring in 2022.**

## West Mississippi

Level at the ENVP site was monitored starting April 2022, and the 65th Ave site was monitored for the entire year. The ENVP site data is shown as level (**Figure 6**) and the 65th Ave site data is shown as cubic feet of flow (**Figure 6**). Level and flow were highest following precipitation events.

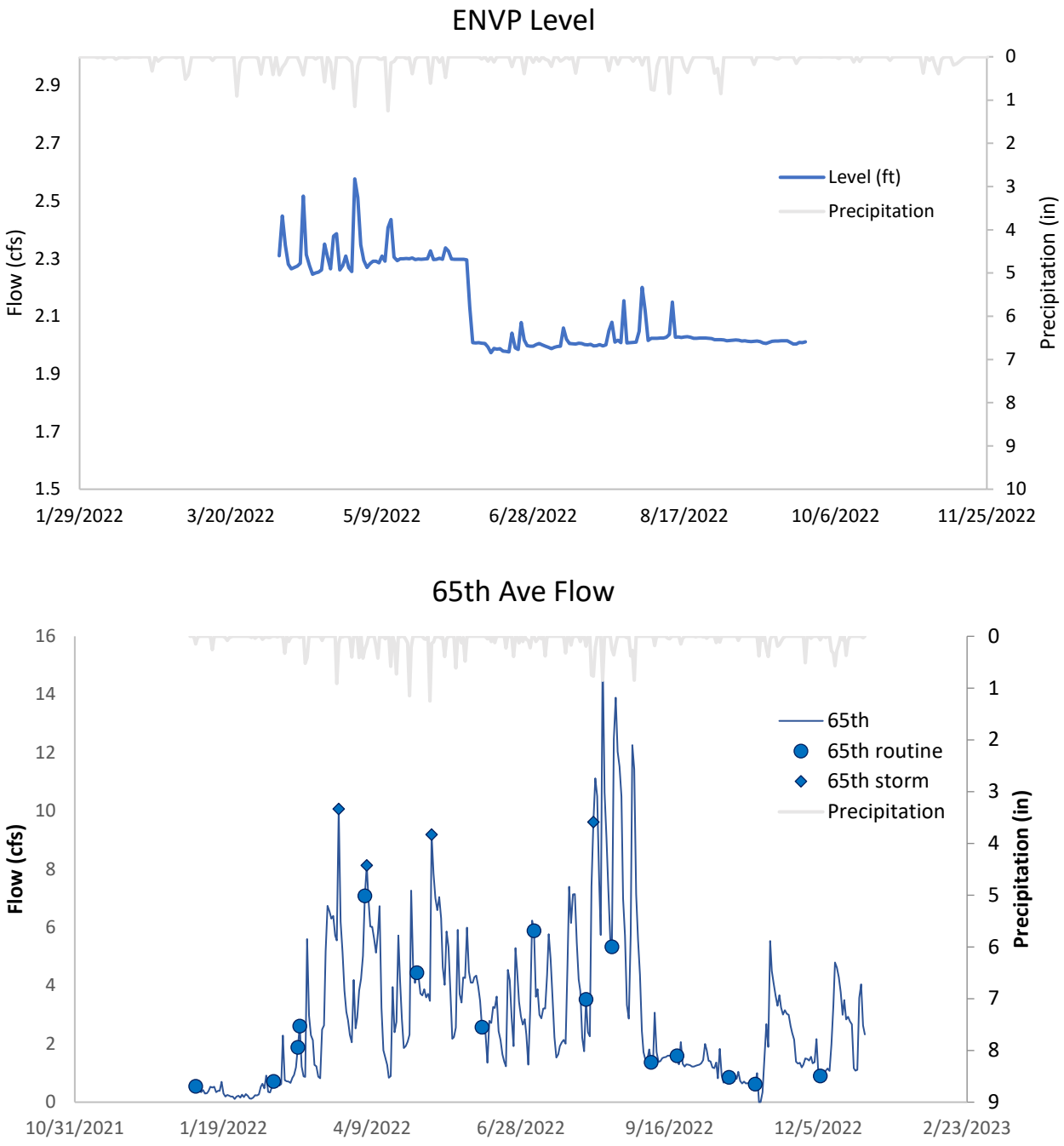



**Figure 6. Level and Flow, sample timing, and precipitation at monitored stream sites in the West Mississippi Watershed during 2022.**

Similar to Shingle Creek stream sites, water quality (*E. coli*, TP, TSS) at West Mississippi sites was worse during storm events (Figure 7). Chloride is not monitored at ENVP during winter months but is still higher in routine samples indicating a dilution effect of storm events on chloride concentrations.

Annual pollutant loads of TP, TSS, and chloride were estimated for the 65th Ave site by multiplying the mean pollutant concentration by the volume of runoff during the monitoring season at each site. Year-round flow data for the ENVP site were not available, preventing the calculation of an annual pollutant load.

**Table 2. Annual pollutant loads at 65th Ave site.**

| Site | TP Load (lbs) | TSS Load (lbs) | Chloride Load (lbs) |
|---|---|---|---|
| 65th Ave | 60 | 732 | 190,098 |

***Trends:*** Water quality data have been collected in the West Mississippi watershed since 2010. Trend analysis did not detect any trends in TP, ortho-P, TSS, *E. coli,* or chloride concentrations at ENVP. Chloride concentrations have significantly increased at 65th Ave, likely due to the addition of winter monitoring at the site in 2020, 2021 and 2022 capturing snowmelt runoff. TP, ortho-P, and *E. coli* have significantly increased at 65th Ave.

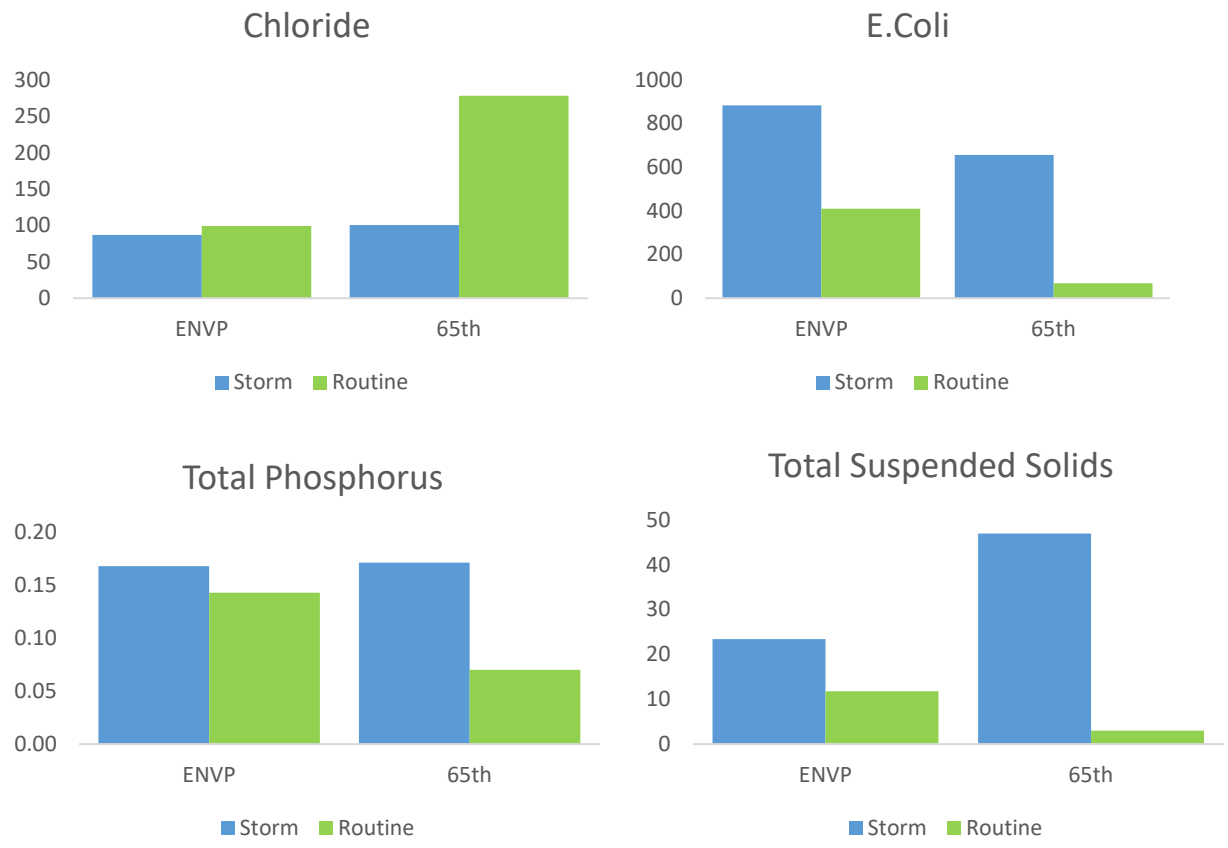



**Figure 7. Average concentration of water quality parameters at West Mississippi sites sampled during storm and routine monitoring in 2022.**

## Chloride

Salt is entering our lakes and streams in the form of chloride from the use of road salt to deice, for water softening, and from fertilizer, manure, and dust suppressants. Once a water body is polluted with salt, it is virtually impossible to remove it. **All it takes is 1 teaspoon of salt to contaminate 5 gallons of water permanently!** Salt is of particular concern in the Shingle Creek watershed because Shingle and Bass Creeks are impaired due to chloride. The chloride impairment affects fish, plants, and invertebrates that live in and near the streams; high chloride concentrations disrupt organisms' ability to function and can result in a stream devoid of life.

In many water bodies, the relationship between chloride concentrations and specific conductivity is linear, meaning specific conductivity measurements can be used to estimate chloride concentrations. Specific conductivity and flow data are collected every 15 minutes at the USGS gage station on Shingle Creek, providing a long-term, continuous dataset to evaluate changes over time and other patterns. Figure 8 shows estimated chloride concentrations and flow at the USGS site in 2022. The highest chloride concentrations occur in winter and early spring when snowmelt events carry recently applied road salt into the creek. In summer, rain events usually result in a dilution in chloride concentrations.

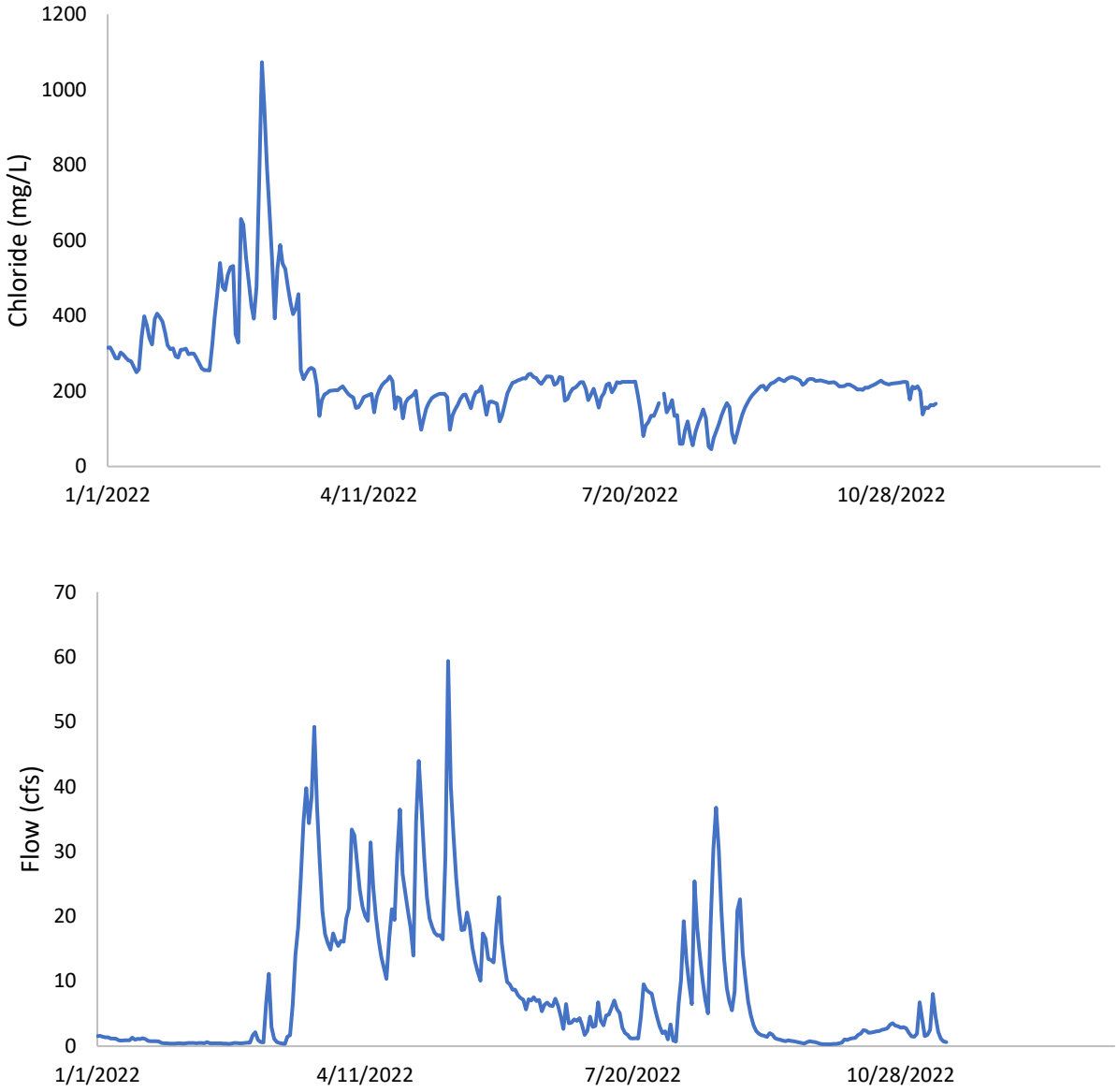



**Figure 8. 2022 estimated chloride concentrations and flow at the USGS gage site on Shingle Creek at Queen Ave in Minneapolis.**

## Lakes


Staff navigate a lake during early spring sampling.

Four lakes were monitored by the Commission in 2022 as part of the routine monitoring program or grant projects. Lakes were visited from early June through September. Water quality in the lakes was measured as Secchi depth (a measure of water quality), TP concentration, and chlorophyll-*a* concentration. Submersed aquatic vegetation (SAV) communities were surveyed in all five lakes. The health of the SAV community was measured using the Floristic Quality Index (FQI) and species richness. Phytoplankton and zooplankton samples were taken in all four lakes in late summer to assess the plankton community. This is the third year implementing plankton samples to the routine monitoring program, which helps inform a holistic view of lake health at every trophic level.

A brief overview of water quality, SAV, and phytoplankton for all four monitored lakes is provided below. For more detailed data and analysis including fisheries assessments, methods, and long-term water quality data, see Appendix D.

## Magda Lake

Magda Lake, New Hope MN

Magda is a shallow lake in New Hope, MN. Water quality in the lake was sampled approximately biweekly from May through September 2022. One SAV surveys was completed in mid-June. The phytoplankton and zooplankton communities were sampled in late summer. The fish community was surveyed in 2022.

Magda is impaired for nutrients. Water quality in the 2022 monitoring season mostly met the State's shallow lake standards (Figure 9). TP generally met the standard of 60 ug/L for most of the monitoring period except the late spring and early fall. Chlorophyll-a, a measure of algal abundance in lake water, remained below the standard of 20 ug/L for most of the monitoring period except the late spring and early fall. Water clarity, measured as Secchi depth, declined over the monitoring period, falling below the standard from the middle of summer threw early fall.

The zooplankton and phytoplankton communities of Magda Lake were sampled on August 10$^{th}$, 2022. Lake Magda was highly dominated by a diverse assemblage of cyanobacteria phytoplankton (Figure 10) at a low concentration. Cyanobacteria domination is typical for Minnesota lakes in August and the diversity of genera and low concentration are not a sign of a harmful algae bloom. Figure 11 shows the zooplankton community in Magda Lake. The lake contained 100% Nauplii. Nauplii are the early stage of many zooplankton species. Their abundance in summer indicates a healthy zooplankton community with a plentiful food source.

The aquatic vegetation in Lake Magda was surveyed once in 2022. Lake Magda showed a low species diversity (Figure 12) and did not meet the FQI shallow lake threshold. Seven submerged species were identified with coontail, waterweed, and straight-leaved pondweed being the predominate species. While these species may be considered a nuisance at high levels, all the predominate plants are native species. Curly-leaf pondweed (CLP), a non-native species of concern, was surveyed in the lake, but is currently in very low abundance. While CLP was surveyed in low abundance, the survey was conducted July 16$^{th}$ which is late in the CLP growing season. Higher abundance of CLP is likely.

A fish survey was conducted on July 20$^{th}$, 2022. Two fish species were sampled during the fish survey: black bullhead, and fathead minnow. Bullheads and fathead minnows are most tolerant of low oxygen levels and large numbers of these species are commonly seen in lakes that experience winterkill events.

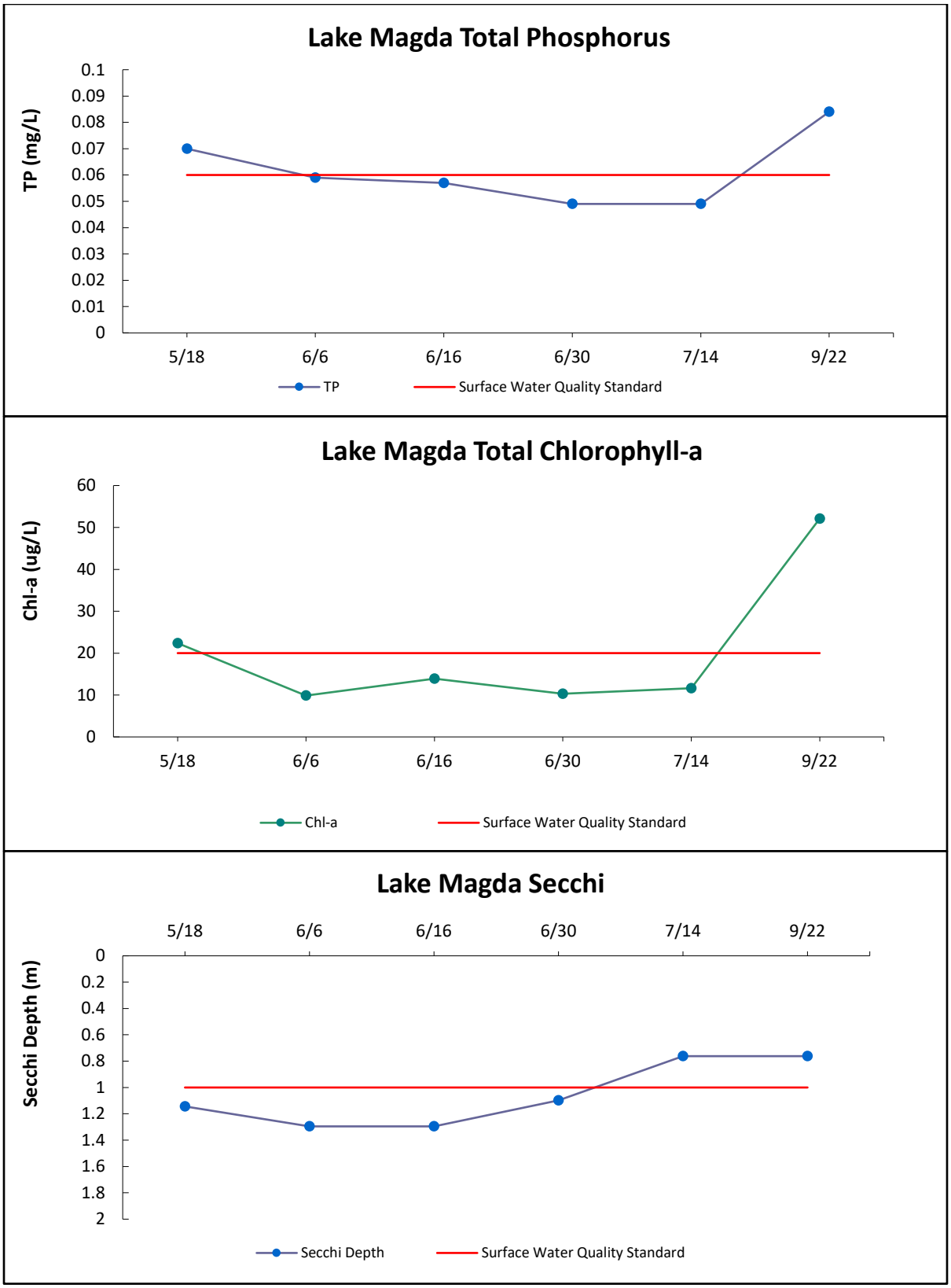



**Figure *9*. Water quality parameters in Magda Lake during the 2022 monitoring season.**

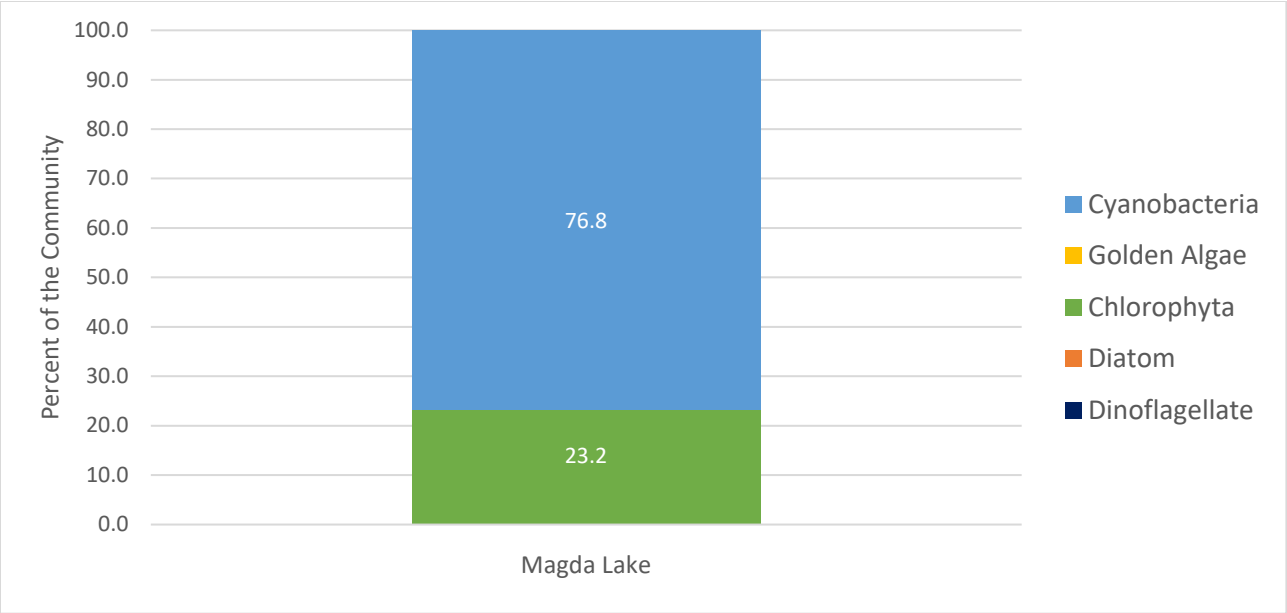



**Figure 10. Phytoplankton community as relative percentage in August 2022 in Magda Lake.**

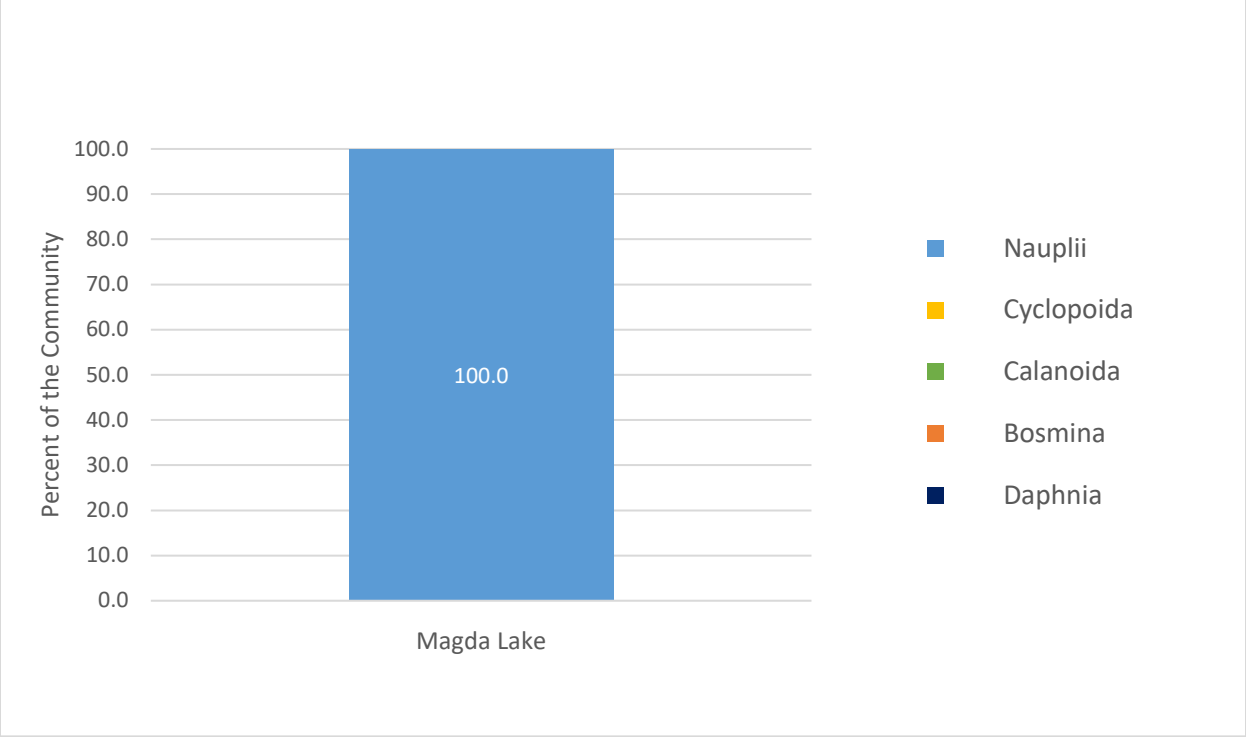



**Figure 11. Zooplankton community as relative percentage in August 2022 in Magda Lake.**

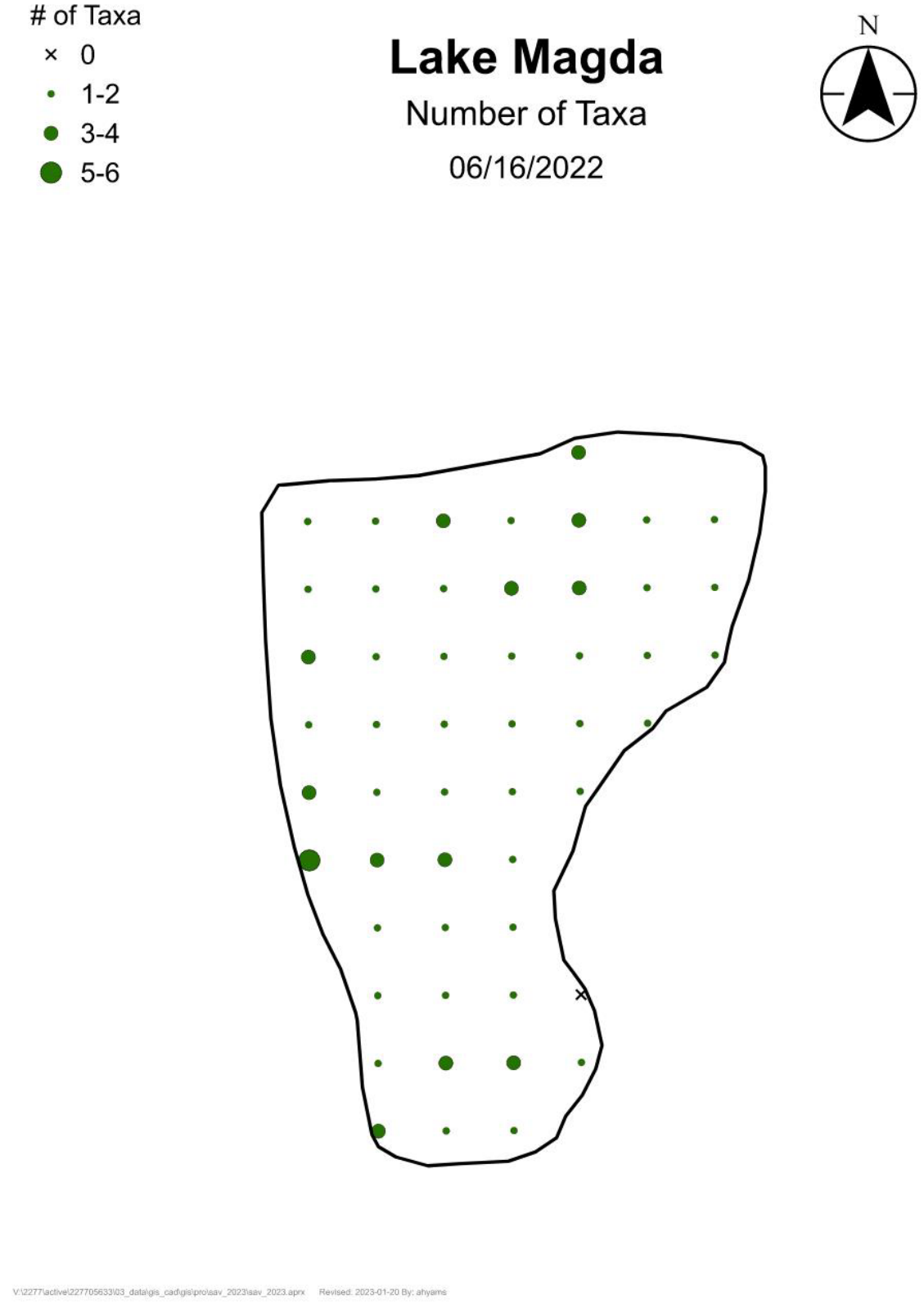



**Figure 12. Submersed aquatic vegetation (SAV) showing number of taxa found at each location on Magda Lake during the mid-summer survey.**

## Schmidt Lake

View of dense vegetation on Schmidt Lake, Plymouth

Schmidt Lake is a suburban waterbody located in Plymouth, MN. Water quality in the lake was sampled biweekly from mid May through September 2022. Two SAV survey were completed in June and August. The phytoplankton and zooplankton communities were sampled in mid-August.

Schmidt Lake is no longer listed as impaired. Figure 13 shows TP, chlorophyll-a, and Secchi depth over the course of the monitoring season. Data are shown against the shallow lake standard for reference. Total phosphorus met the standard of 60 ug/L. Chlorophyll-a peaked in mid-summer but met the standard of 20 ug/L throughout the whole summer. The increase in chlorophyll-a occurred simultaneously with decreased water clarity. However, the water clarity also remained above the standard of 1 m Secchi depth reading.

Analyses of the phytoplankton and zooplankton community represents a healthy ecosystem. The phytoplankton community was dominated by cyanobacteria with some green algae present (Figure 14). The cyanobacteria present were a diverse assemblage and in low concentrations which is a typical phytoplankton community for Minnesota lakes in August. The zooplankton community is dominated by *bosmina* (Figure 15), which are a group of zooplankton that can feed on low quality food sources like cyanobacteria and have an advantage in late summer. Although the sample was dominated by *bosmina* at 54%, there is a healthy mix of other zooplankton which reflects a healthy zooplankton community and a strong base of the food web.

The aquatic vegetation was surveyed twice in 2022 to capture both the late and early growing season. Schmidt Lake showed a moderate species diversity (Figure 16) with an FQI rating lower than the shallow lake threshold. The Schmidt Lake FQI scores were 15.8 and 16.4 for the early and late season. The FQI threshold is 17.8 for shallow lakes. Schmidt lake showed a positive trend in aquatic vegetation through the growing season. Early season, the lake was dominated by curly-leaf pondweed and Eurasian water milfoil (EWM). Following treatment for EWM and the seasonal decrease in curly-leaf pondweed, other native species increased in abundance. Notably, water celery and flat-stemmed pondweed increased in abundance.

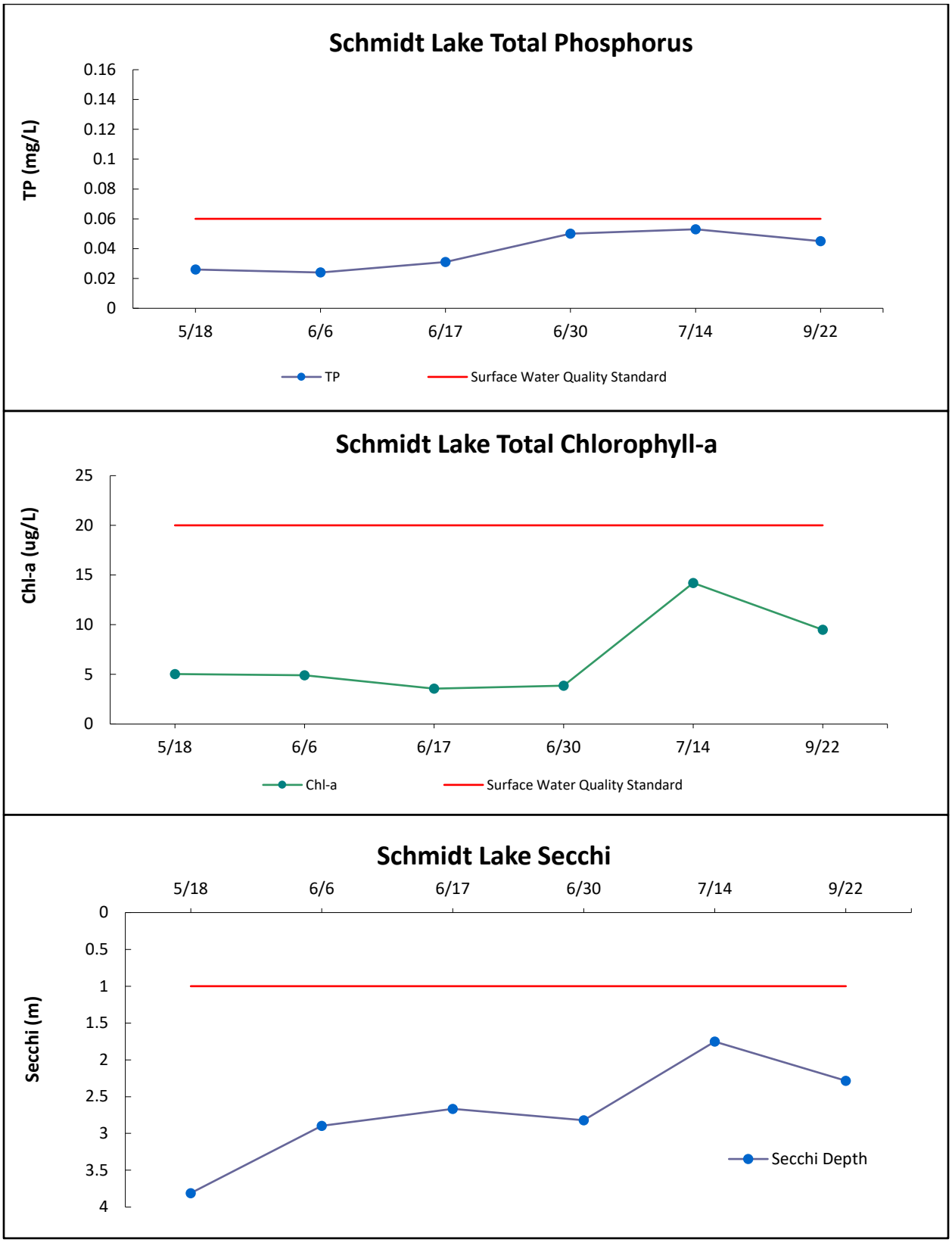



**Figure 13. Water quality parameters in Schmidt Lake during the 2022 monitoring season.**

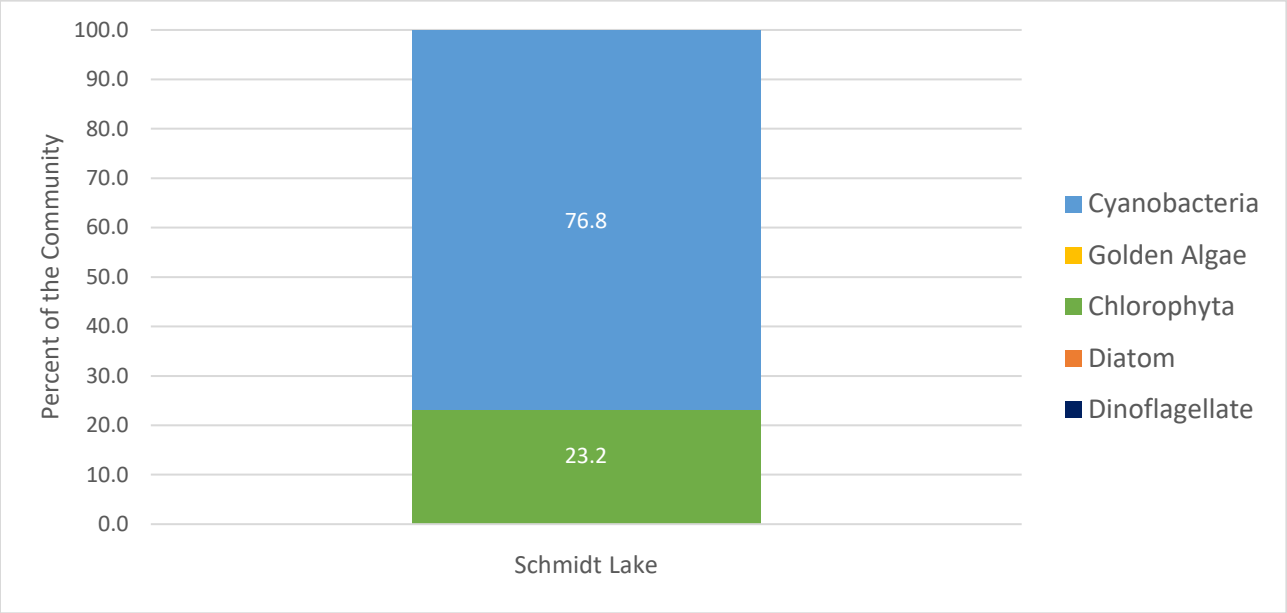



**Figure 14. Phytoplankton community as relative percentage in August 2022 in Schmidt Lake.**

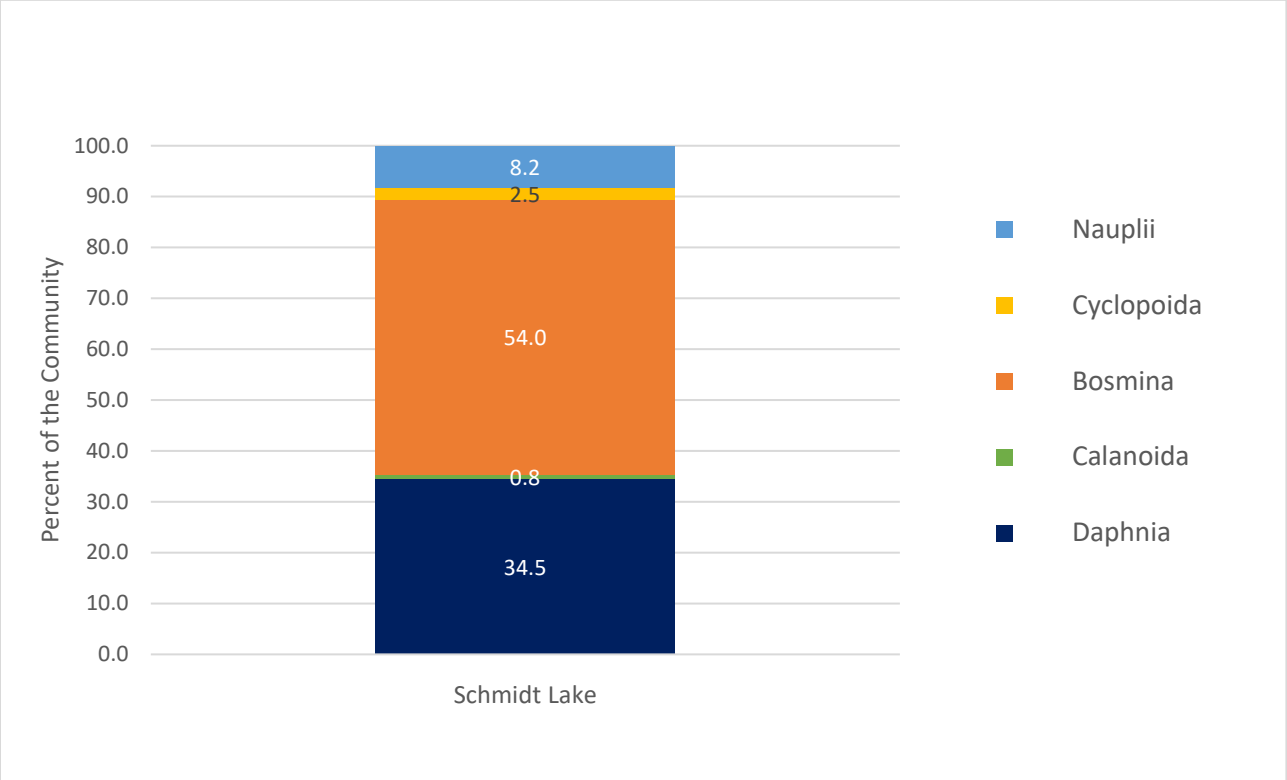



**Figure 15. Zooplankton community as relative percentage in August 2022 in Schmidt Lake.**

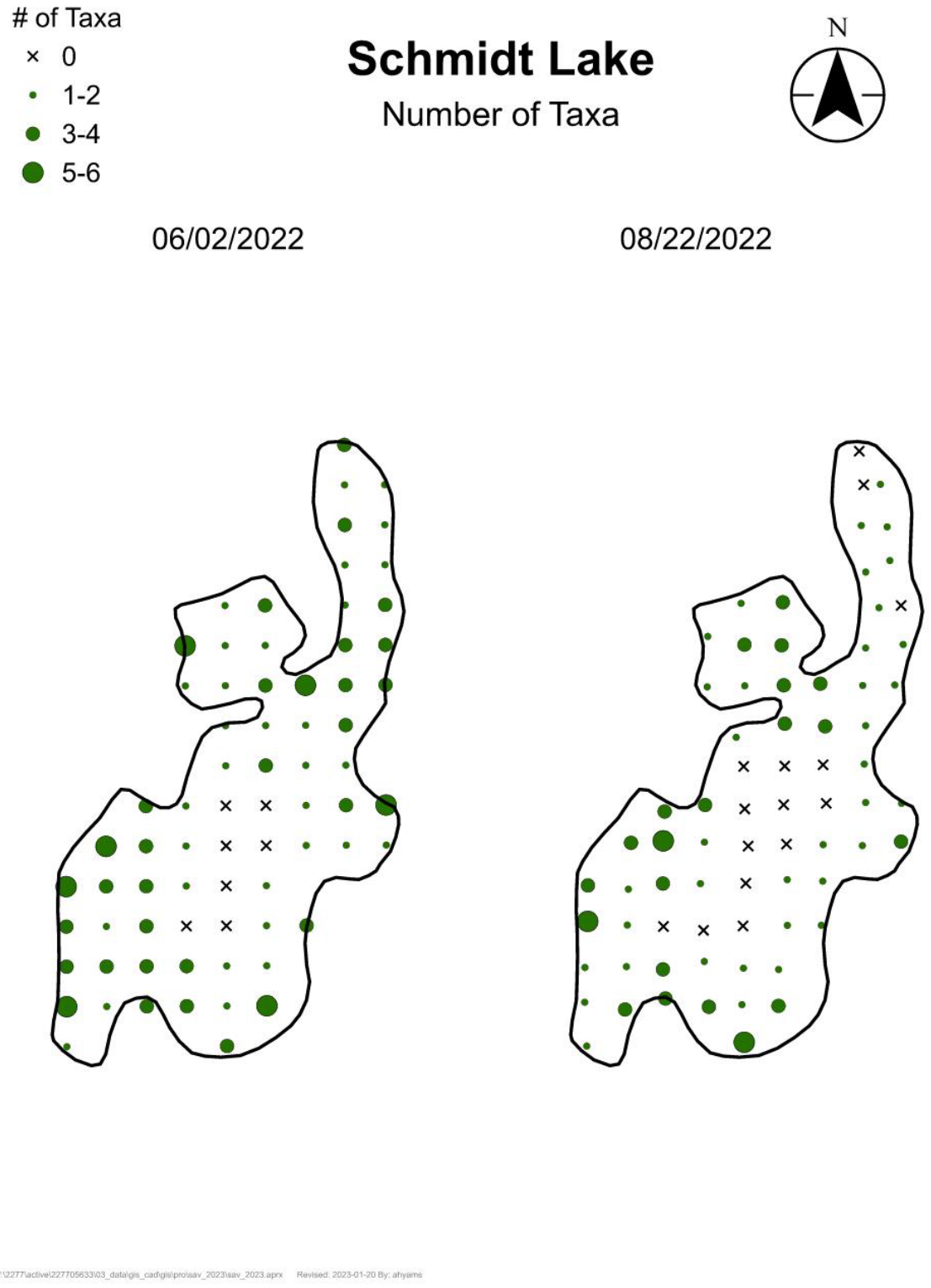



**Figure 16. Submersed aquatic vegetation (SAV) showing number of taxa found at each location on Lake Success during the early and late summer surveys.**

## Meadow Lake

Meadow Lake, New Hope MN.

Meadow Lake is a shallow lake in New Hope, MN. Water quality in the lake was sampled from mid-May through September 2022. One SAV survey was completed in late July 2022. The phytoplankton and zooplankton communities were sampled in mid-August.

Magda Lake is impaired for nutrients and underwent a drawdown in the Winter of 2021/2022. Water quality measurements over the course of the summer are shown in Figure 17. Phosphorus concentrations exceeded the standard for the full sampling season increasing as the summer progressed. Chlorophyll-a concentrations increased in mid-summer, exceeding eutrophication standards and indicating an algae bloom, then decreased to below standards in late September. Secchi depth decreased over the course of the summer and did not meet the water quality standard.

An analysis of the phytoplankton and zooplankton within the lake indicated a healthy community. The phytoplankton community had some diversity with diatoms, chlorophyta, and cyanobacteria (Figure 18). Cyanobacteria dominated the sample which is typical for Minnesota lakes in August. The concentrations were low and there were multiple cyanobacteria species observed, which indicates a balanced phytoplankton community. The zooplankton community is nauplii-dominated with a healthy mix of other mature zooplankton (Figure 19). Nauplii are the early stage of many zooplankton species. Their abundance in summer indicates a healthy zooplankton community with a plentiful food source.

The aquatic vegetation in Meadow Lake was surveyed once in 2022. Meadow lake showed a moderate species diversity (Figure 20) with an FQI rating lower than the shallow lake threshold. A concern for the Meadow Lake vegetation community is the presence of curly-leaf pondweed. Other native species were also found in high abundance including bushy pondweed and leafy pondweed. The vegetation community in Meadow Lake is very dense and the entire lake is vegetated.

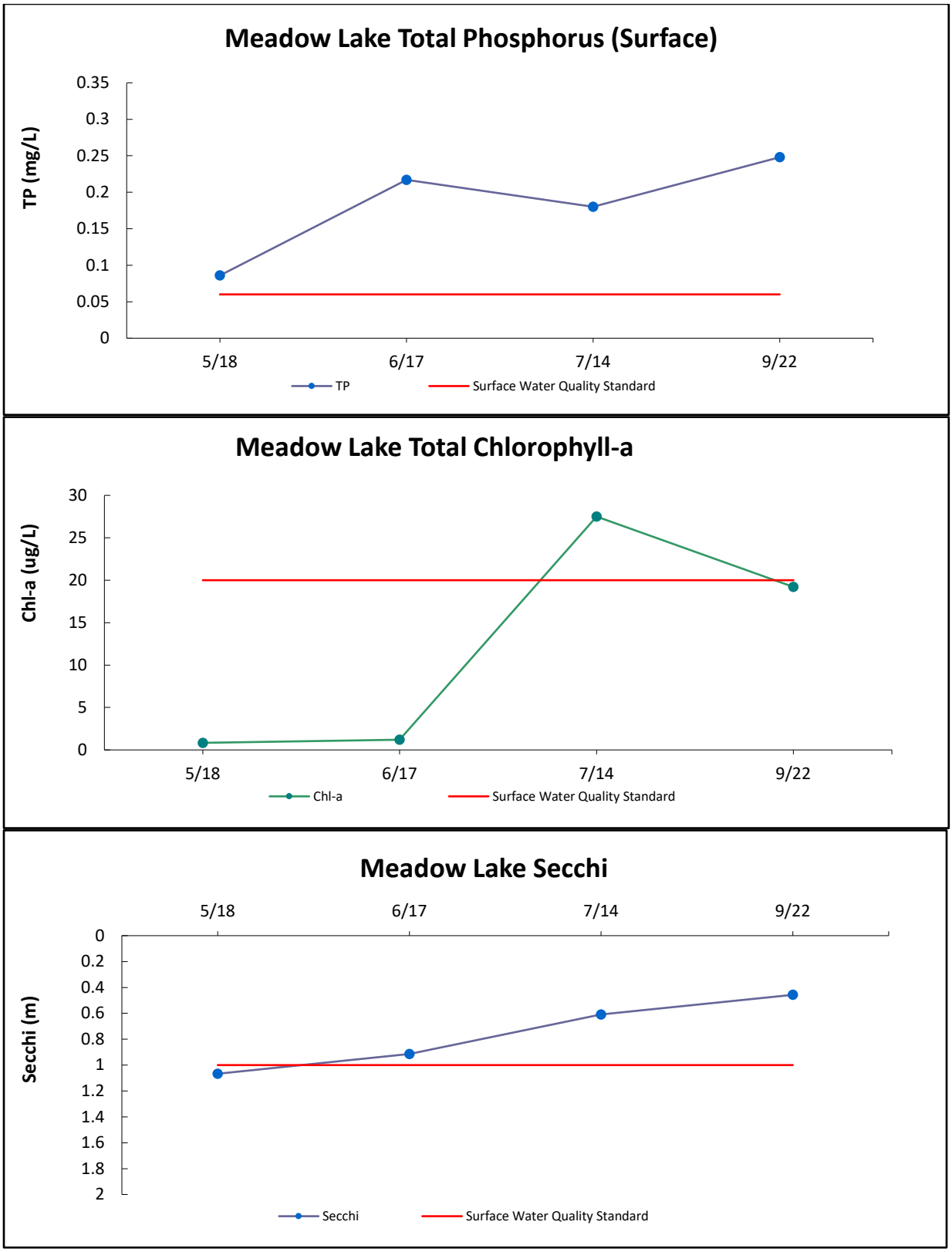



**Figure 17. Water quality parameters in Meadow Lake during the 2022 monitoring season.**

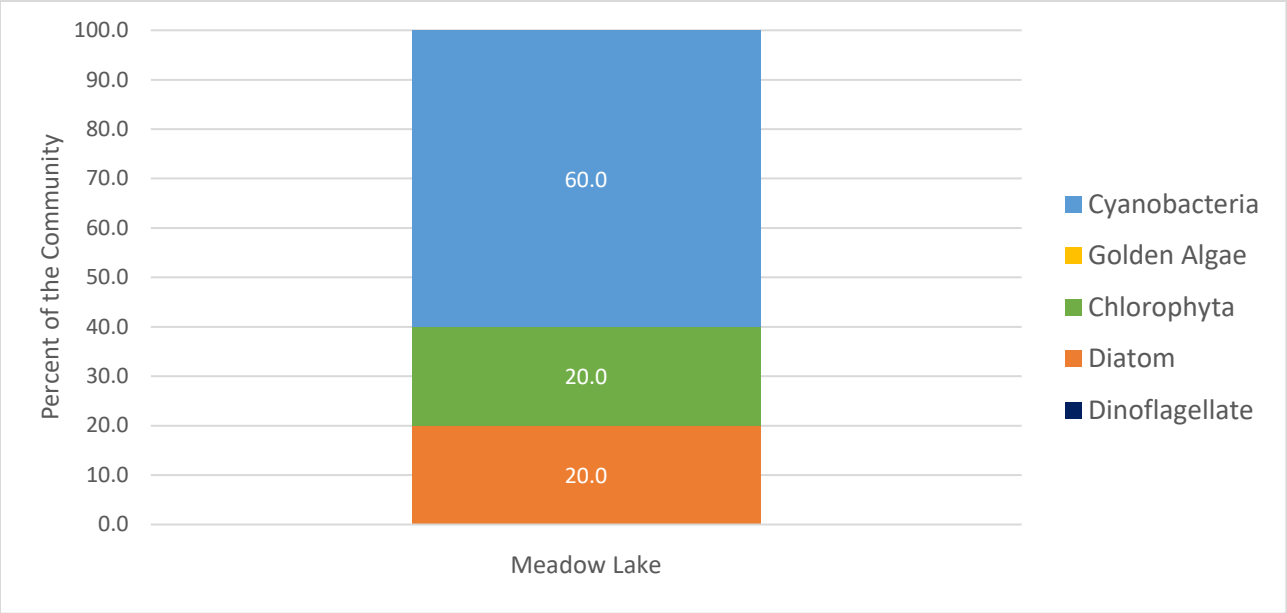



**Figure 18. Phytoplankton community as relative percentage in August 2022 in Meadow Lake.**

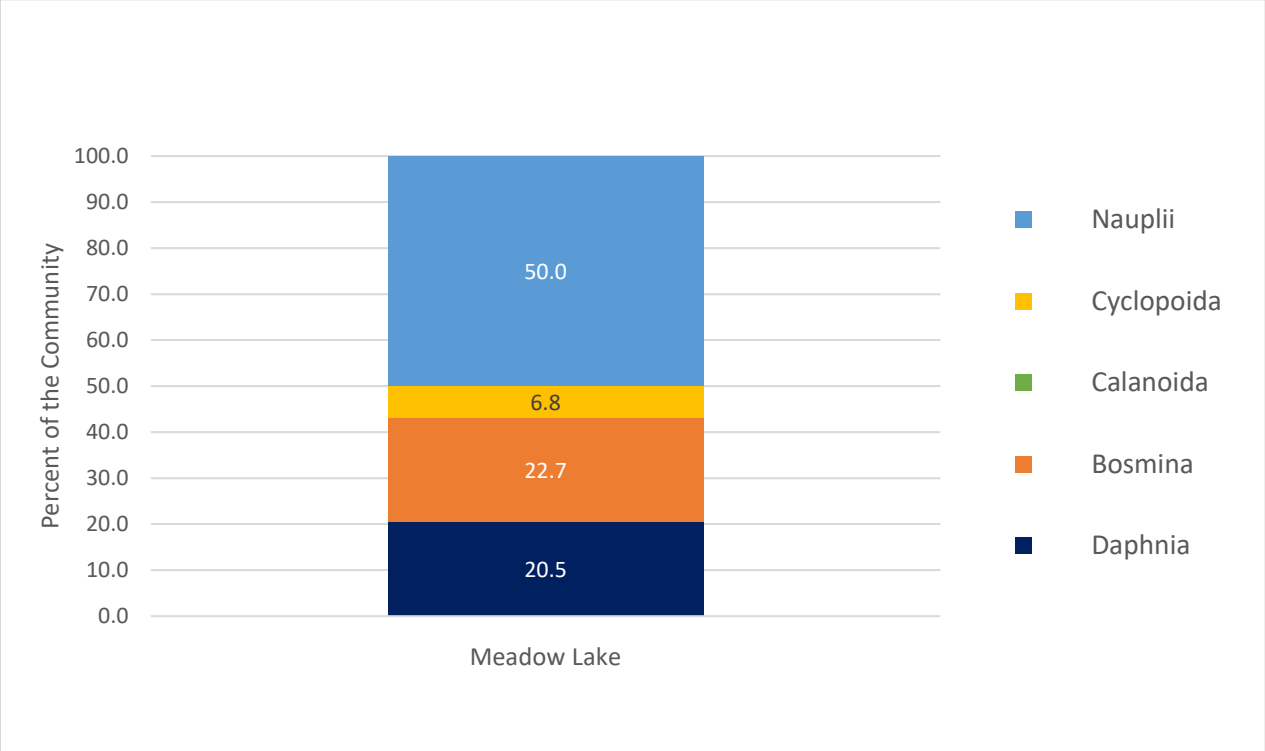



**Figure 19. Zooplankton community as relative percentage in August in Meadow Lake.**

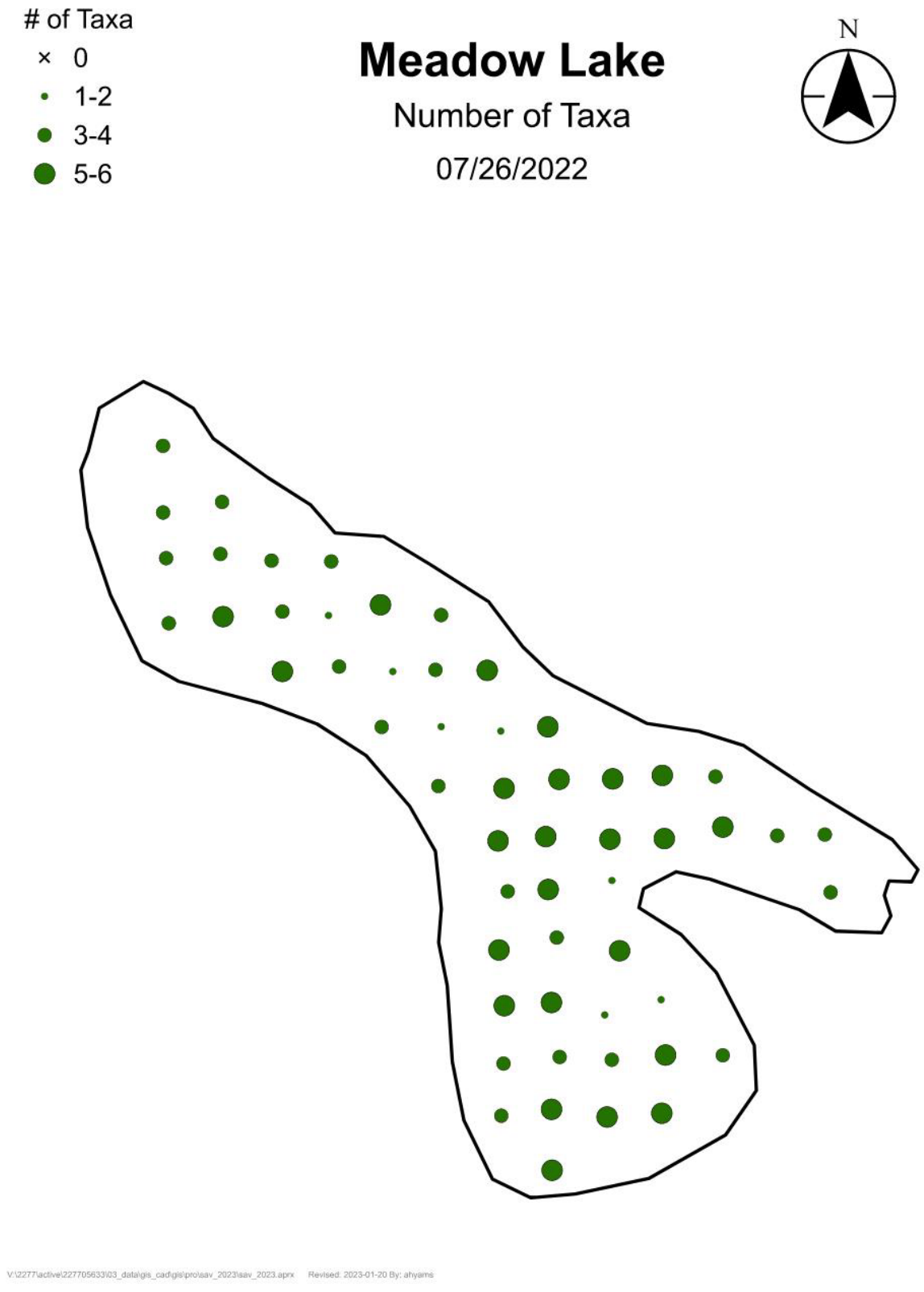



**Figure 20. Submersed aquatic vegetation (SAV) showing number of taxa found at each location in Meadow Lake in late July.**

## *Crystal Lake*


Crystal Lake, Crystal MN.

Crystal Lake is a deep lake in Robbinsdale. Water quality in the lake was sampled biweekly from mid-May through September 2022. An early and late summer SAV survey was completed on the lake in 2022. The phytoplankton communities were sampled in late summer.

Crystal Lake is impaired for nutrients and is undergoing active management by the Commission. Over 7,600 common carp have been removed from the lake in in 2021 and 2022, and the lake received its first alum treatment in September 2021 to reduce internal phosphorus loading. The second alum treatment was applied on September 30th, 2022.

Surface TP exceeded the deep lake eutrophication standard in mid-June and remained above the standard for the remainder of the summer in (Figure 21). Chlorophyll-a concentrations similarly exceeded the standard during all monitoring events except the first sampling date in May. Secchi declined over the summer and did not meet the eutrophication standards except for the first sampling event in May. TP samples taken from the hypolimnion show a peak in mid-summer with concentrations declining in August and September. See Appendix D for historic and hypolimnion data.

An analysis of the phytoplankton in Crystal Lake was made up completely of cyanobacteria, with only a negligible fraction of chlorophyl-a (Figure 22). Concentrations of cyanobacteria were very high and only one genus. The sole genus was *Microcystis*, which is an aggressive, bloom-forming cyanobacteria that has the potential for toxin production. The presence of only *Microcystis* and such high concentrations indicate the likelihood of a HAB. The zooplankton community is very diverse with no dominate species which indicates a healthy zooplankton community and a strong food web base (Figure 23).

The aquatic vegetation was surveyed twice in 2022 to capture both the late and early growing season. Crystal Lake showed a low species diversity (Figure 24) and the lake FQI was significantly lower than the deep lake threshold. The Crystal Lake FQI scores were 7.5 and 6.4 for the early and late season. The vegetation community did not change much throughout the season and the results of both surveys are similar. The only submerged taxa identified was the non-native species curly-leaf pondweed.

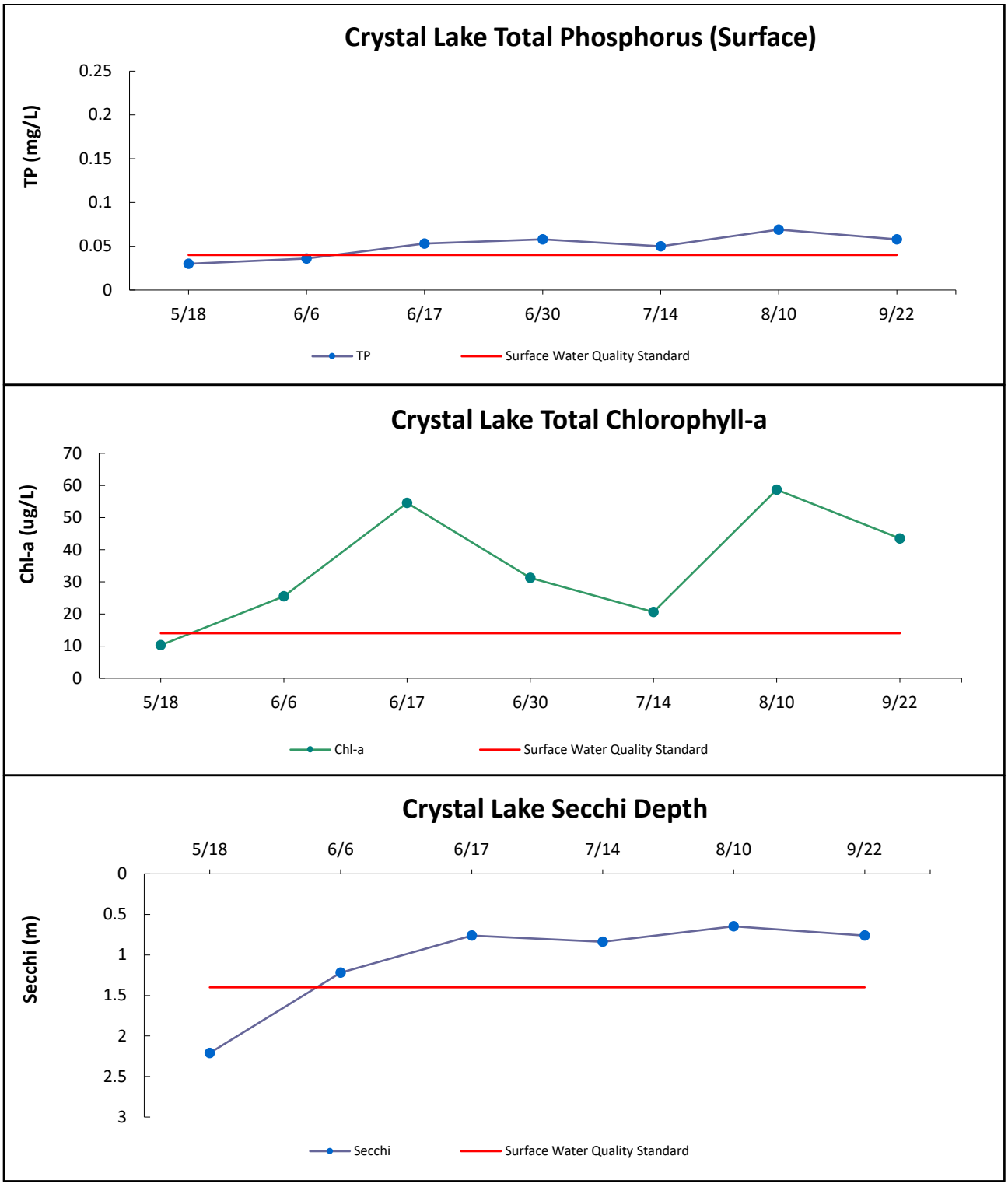



**Figure *21*. Water quality parameters in Crystal Lake during the 2022 monitoring season.**

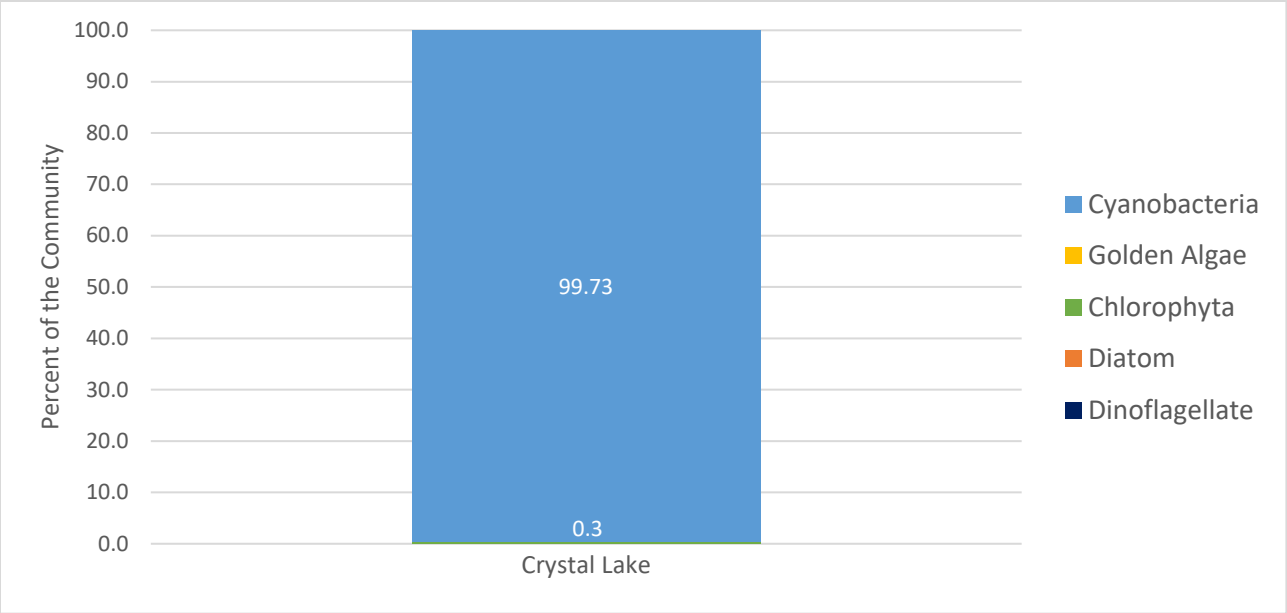



**Figure 22. Phytoplankton community as relative percentage in August 2022 in Crystal Lake.**

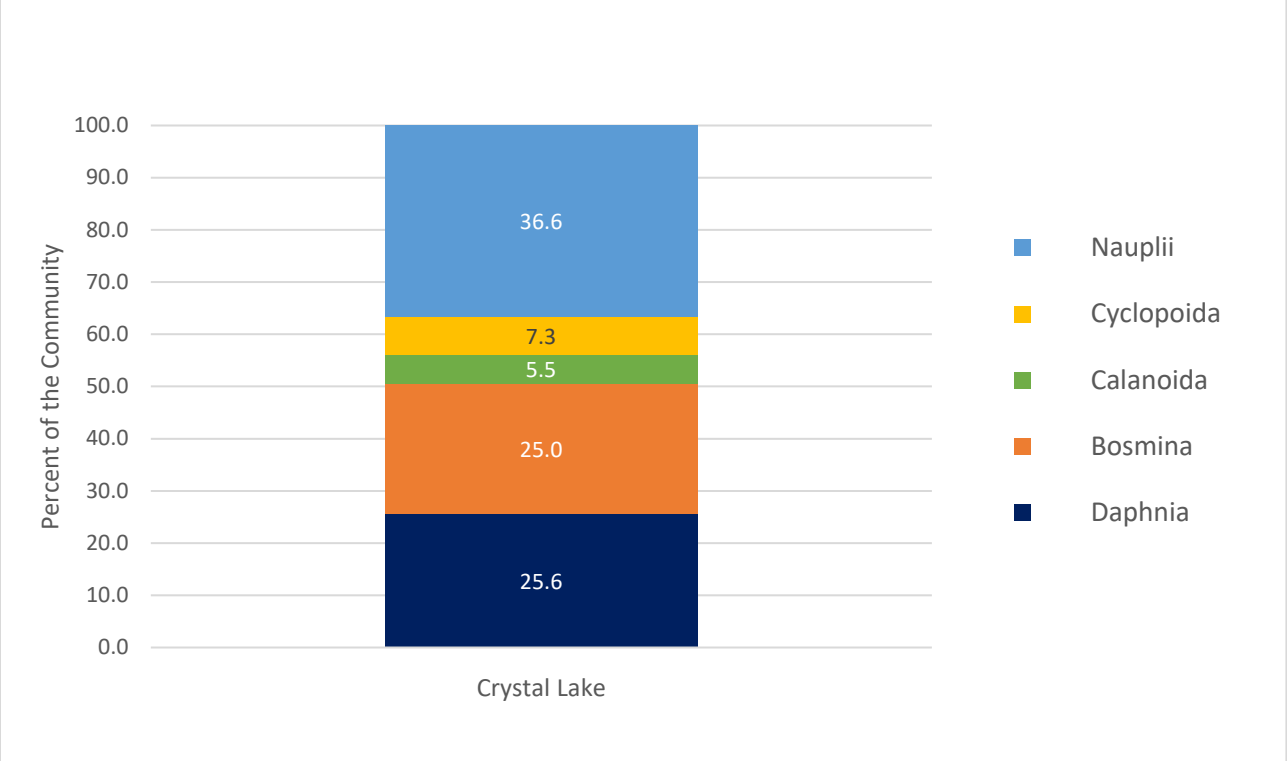



**Figure 23. Zooplankton community as relative percentage in August 2022 in Crystal Lake.**

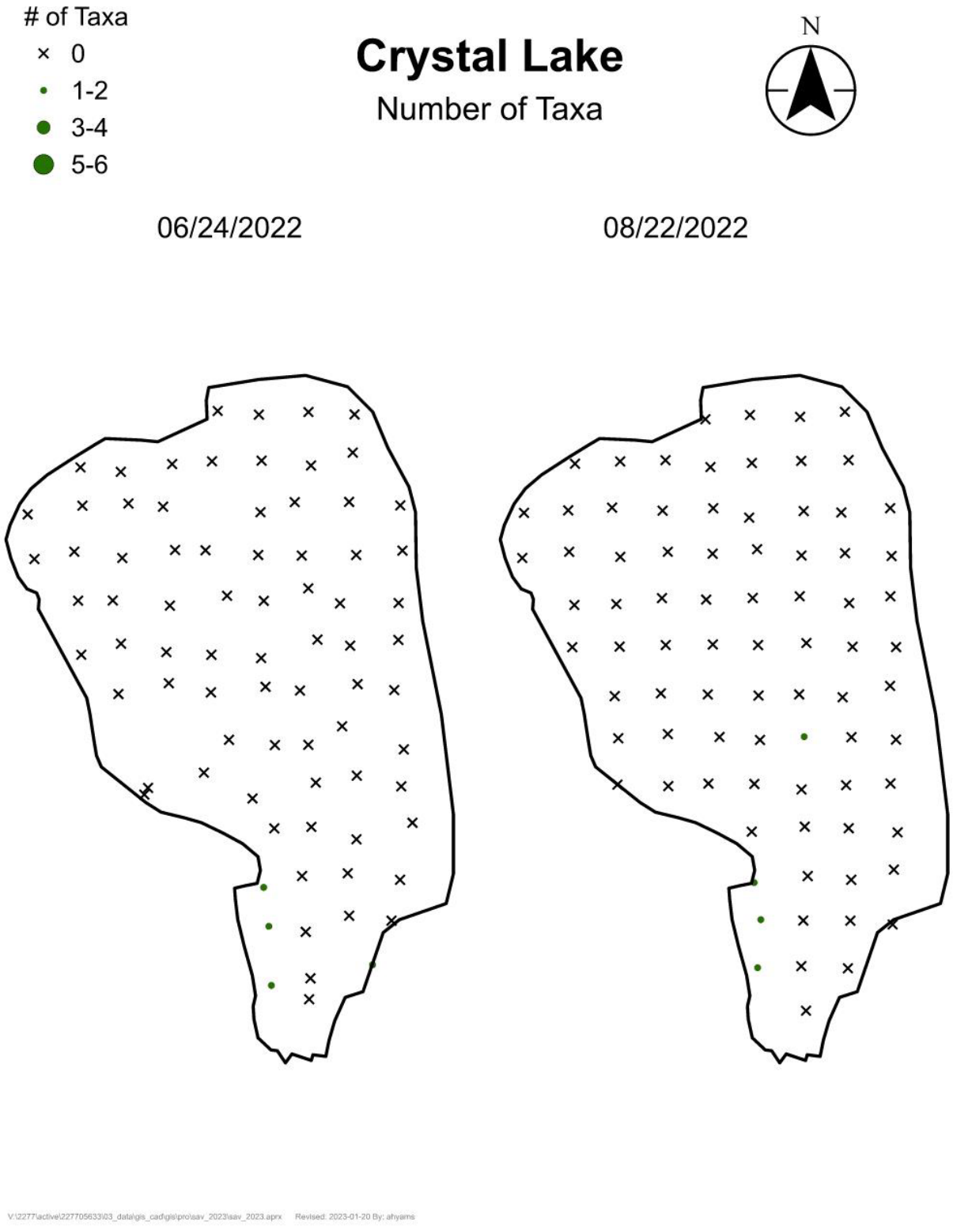



**Figure 24. Submersed aquatic vegetation (SAV) showing number of taxa found at each location in Crystal Lake during the early and late summer survey.**

## Moving Forward

Routine and storm monitoring will continue on Bass and Shingle Creeks in 2023. The 65th Ave outfall and the Mattson Brook stream in West Mississippi will also be monitored by the Commission.

Upper and Middle Twin Lakes will undergo routine lake monitoring in 2022. Early and late summer SAV surveys will be done on both lakes. Phytoplankton and zooplankton community monitoring will continue. Volunteer monitoring through the CAMP program are planned for Meadow, Ryan, and Lower Twin Lakes.

As part of ongoing active management projects, Crystal Lake will be monitored for SAV and an additional year of carp removals will occur. Curly-leaf pondweed management is planned for Bass and Meadow Lakes, and a late-season SAV survey is planned for Bass Lake. In addition, as part of the Eagle Lake Subwatershed Assessment and Lake Management Plan, Eagle and Pike Lakes will have two SAV surveys and sediment cores taken.