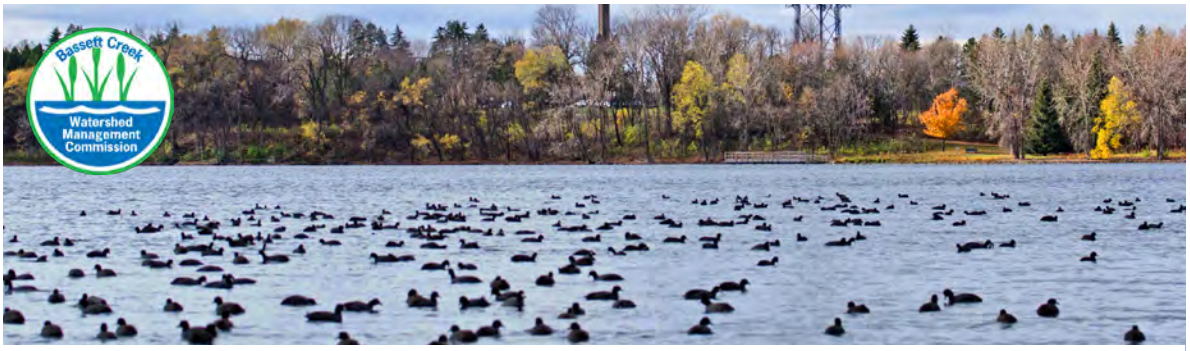
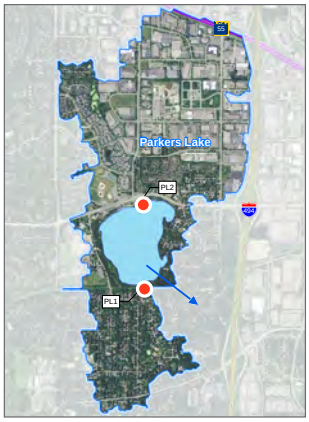




Parkers Lake 2021 water quality monitoring

Monitoring water quality in Parkers Lake

The Bassett Creek Watershed Management Commission (BCWMC) has monitored water quality conditions in the watershed's 10 priority lakes and six ponds since 1972. This monitoring is done to detect changes or trends in water quality and evaluate the effectiveness of efforts to preserve or improve water quality. A summary of 2021 monitoring efforts for Parkers Lake is provided below; more comprehensive information can be found on pages 2-8.

At a glance: 2021 monitoring results

In 2021, the BCWMC monitored Parkers Lake for:

- Water chemistry (nutrients, chlorophyll *a*, chloride).
- Water measurements (e.g., clarity, dissolved oxygen).
- Phytoplankton and zooplankton (microscopic plants and animals).
- Macrophytes (aquatic plants).

Results of 2021 monitoring show Parkers Lake met the applicable Minnesota Pollution Control Agency (MPCA) and Bassett Creek Watershed Management Commission (BCWMC) water quality standards for total phosphorus, chlorophyll *a*, and Secchi disc (a measure of clarity). Trend analyses show a significant reduction (improvement) in summer average total phosphorus concentrations over the past 10 years (95-percent confidence level) but no significant changes in chlorophyll *a* and Secchi disc.

Parkers Lake is considered impaired due to high chloride levels, particularly near the bottom of the lake. All chloride measurements were well below the MPCA maximum chloride standard. Chloride concentrations in the upper two meters (6.6 feet) were well below the MPCA chronic standard, but most near-bottom measurements failed to meet this standard. Other results include:

- The lake plant community was of fair-to-good quality, based on the number of species in the lake and the FQI values compared to the Minnesota Department of Natural Resources Plant IBI thresholds.
- Curly-leaf pondweed (CLP) was found less frequently in 2021 (compared to 2018), but density was similar.

About Parkers Lake

BCWMC classification	Priority-1 deep lake
Watershed area	1,065 acres
Lake size	97 acres
Average depth	12 feet
Maximum depth	37 feet
Ordinary high water level	935.9 feet (NGVD29)
Normal water level	934.2 feet (NAVD88)
Downstream receiving waterbody	Medicine Lake
Location (city)	Plymouth
MPCA impairments	Chloride, mercury in fish tissue
Aquatic invasive species	Eurasian watermilfoil, curly-leaf pondweed
Public access	Yes (boat launch)

- Observations of Eurasian watermilfoil (EWM) were similar in June 2018 and 2021, but the August 2021 frequency was slightly higher. EWM density was similar in both years.
- The 2021 numbers of phytoplankton and zooplankton were within the range observed since 1982.
- An aquatic invasive species (AIS) suitability analysis indicates the water quality of Parkers Lake meets the suitability requirements for rusty crayfish, faucet snail, zebra mussels, starry stonewort, and spiny waterflea. However, the sodium and specific conductance levels were too high to be suitable for the Chinese mystery snail. Hence, this species would likely survive but may not thrive in Parkers Lake.

Recommendations

- Implement best management practices to reduce chloride loading to the lake including those identified in the BCWMC Parkers Lake Chloride Reduction Project (CIP PL-7).
- Identify management measures to improve the quality of the lake's plant community and survey vegetation annually to facilitate early detection of aquatic invasive species.
- Continue water quality and biological monitoring at a 3-year frequency.

Water chemistry monitoring: 2021

Total phosphorus levels

While phosphorus is necessary for plant and algae growth, excessive phosphorus leads to excessive growth, decreased water clarity, and water quality impairment.

- **BCWMC/MPCA standard:** 40 micrograms per liter (µg/L) or less
- **Range:** Low of 16 µg/L in July to a high of 36 µg/L in late August
- **Summer average:** 24 µg/L (met BCWMC/MPCA standard)

Chlorophyll *a* levels

Chlorophyll *a* is a pigment in algae and generally reflects the amount of algae growth in a lake. Clear lakes generally have chlorophyll *a* levels less than 15 micrograms per liter (µg/L).

- **BCWMC/MPCA standard:** 14 µg/L or less.
- **Range:** Low of 1.1 µg/L in early May to a high of 11 µg/L in late September
- **Summer average:** 6.3 µg/L (met BCWMC/MPCA standard)

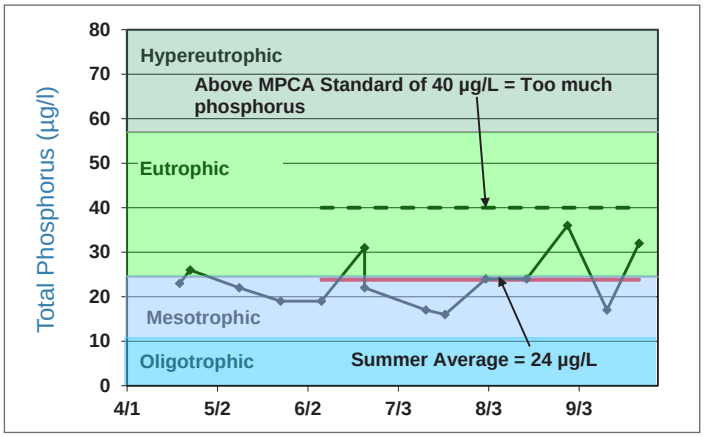
Water clarity

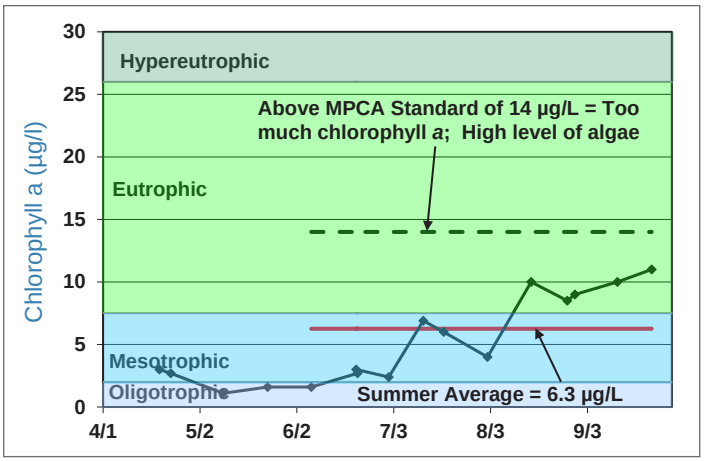
Water clarity is affected by the amount of algae and other suspended materials in a lake. It is usually measured by lowering an 8-inch "Secchi" disc into the lake (see photo below); the depth at which the disc's alternating black-and-white pattern is no longer visible is considered a measure of the water's transparency (or clarity).

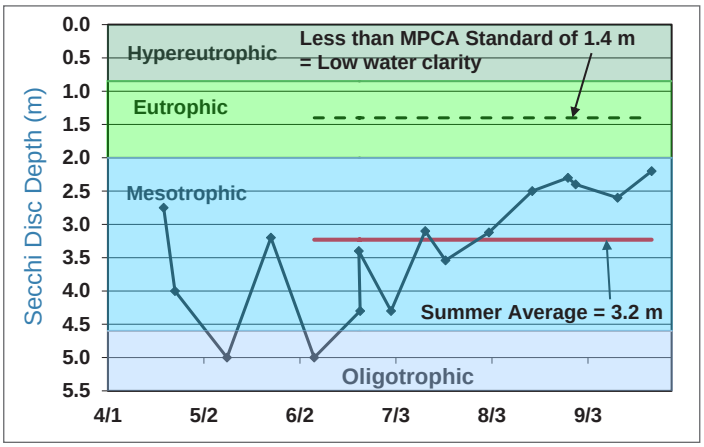
- **BCWMC/MPCA standard:** 1.4 meters or more.
- **Range:** From 2.2 meters in late September to 5.0 meters in early May and early June
- **Summer average:** 3.2 meters (met BCWMC/MPCA standard)

Definitions

- **Hypereutrophic:** Nutrient-rich lake conditions characterized by frequent and severe algal blooms and low transparency
- **Eutrophic:** Lake condition characterized by abundant accumulation of nutrients supporting dense growth of algae and other organisms; decay of algae can reduce lake oxygen levels
- **Mesotrophic:** Lake condition characterized by medium levels of nutrients and clear water
- **Oligotrophic:** Lake condition characterized by a low level of dissolved nutrients, high oxygen content, and sparse algae growth







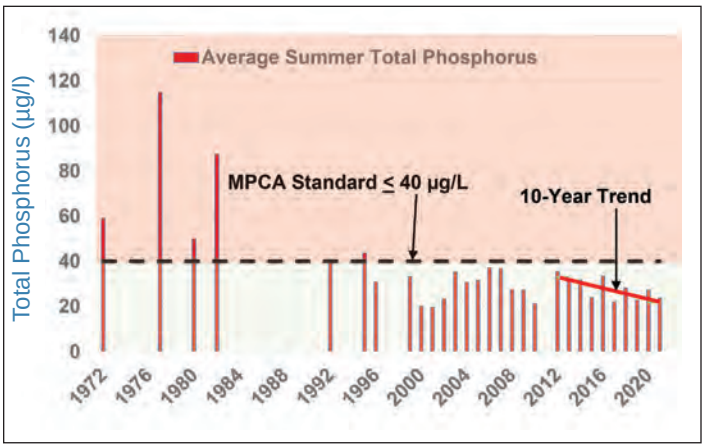
Water chemistry monitoring from 1972–2021: historical trends

Water quality in Parkers Lake has been monitored since 1972. Summer averages (June through September) of total phosphorus, chlorophyll *a*, and Secchi disc depth from 1972–2021 are shown in the figures at right. One or more of these parameters failed to meet BCWMC/MPCA standards from 1972 through 1995. Summer average total phosphorus and Secchi disc values have met the BCWMC/MPCA standard since 1996 and chlorophyll a concentrations since 2016. From 1972–2021, 97 percent of summer average Secchi disc depths and 82 and 61 percent of summer average concentrations of total phosphorus and chlorophyll *a*, respectively, met the BCWMC/MPCA standards. Summer averages of total phosphorus, chlorophyll *a*, and Secchi depth met the BCWMC/MPCA standards in 2021.

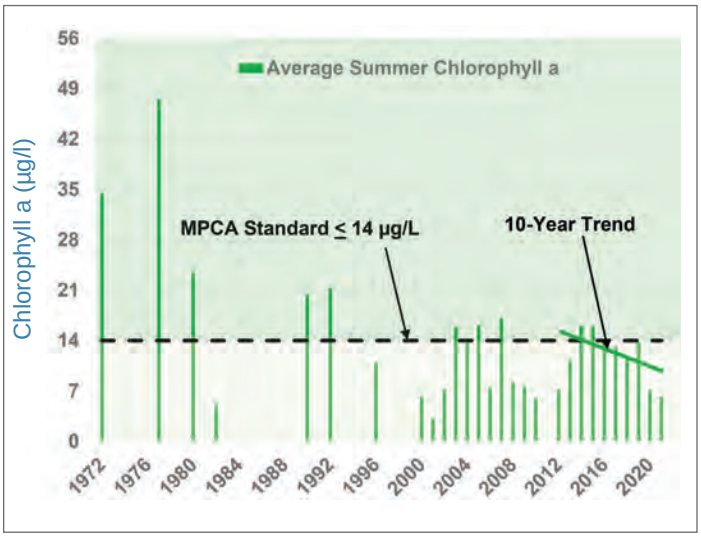
Trend analyses show a significant reduction (improvement) in summer average total phosphorus concentrations over the past 10 years (95-percent confidence level). Although summer average chlorophyll *a* concentrations and Secchi disc depths did not change significantly over the past 10 years, the data show:

- Declining (improving) summer average chlorophyll *a* concentrations.
- Increasing (improving) summer average Secchi disc depths.

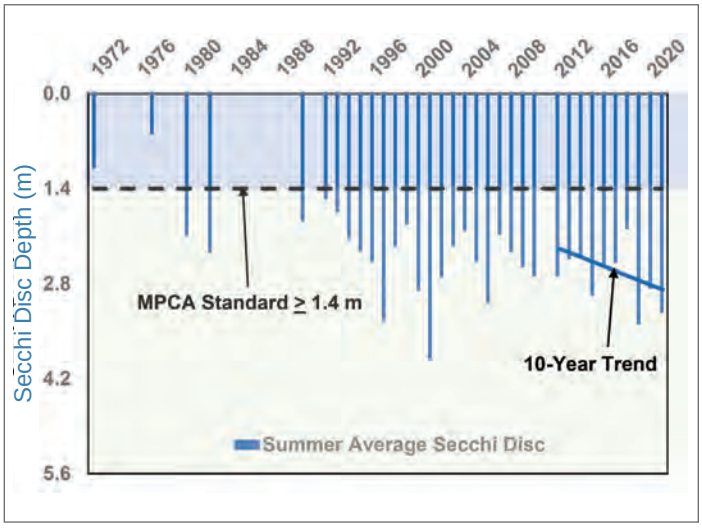
Total phosphorus trends



Chlorophyll *a* trends

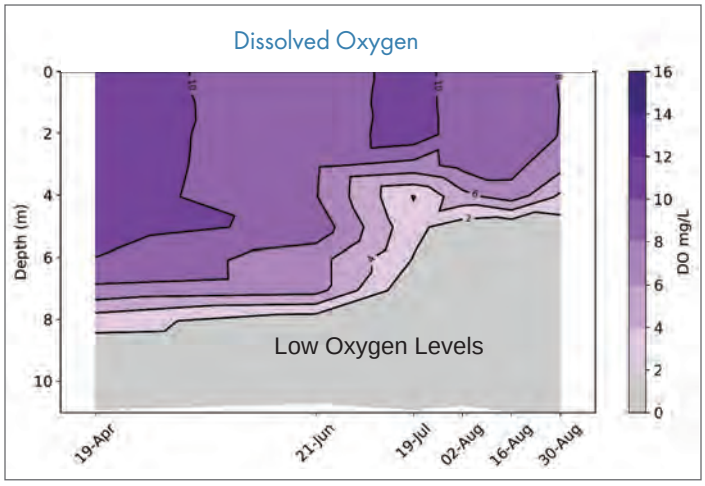


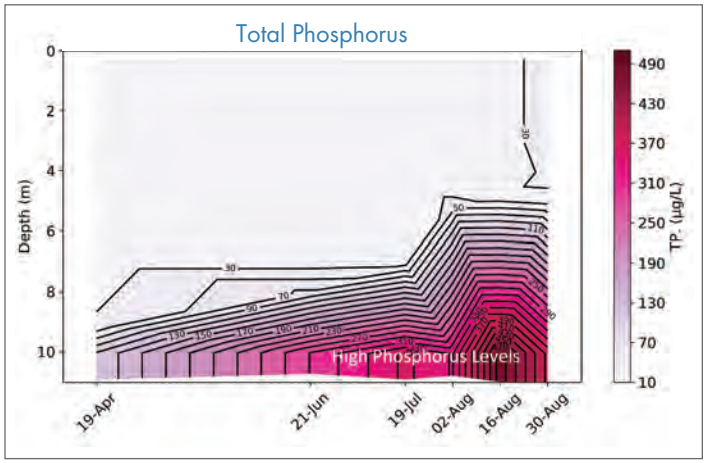
Water clarity trends



Phosphorus loading from sediment

The release of phosphorus stored in lake-bottom sediments when oxygen levels are low is described as "internal phosphorus loading from sediment." Low oxygen levels (<2 mg/L) were found at depths from about 8 meters to the bottom of Parkers Lake from April through July and 5 meters to the bottom during August and September (see figure below). Internal phosphorus loading from sediment during this period caused near-bottom phosphorus concentrations to consistently increase (see figure below). Because the lake remained stratified (separated into layers) throughout the monitoring period, the high phosphorus concentrations were confined to the bottom of the lake. The surface water phosphorus concentrations reflected good water quality and met the MPCA standard throughout the monitoring period.





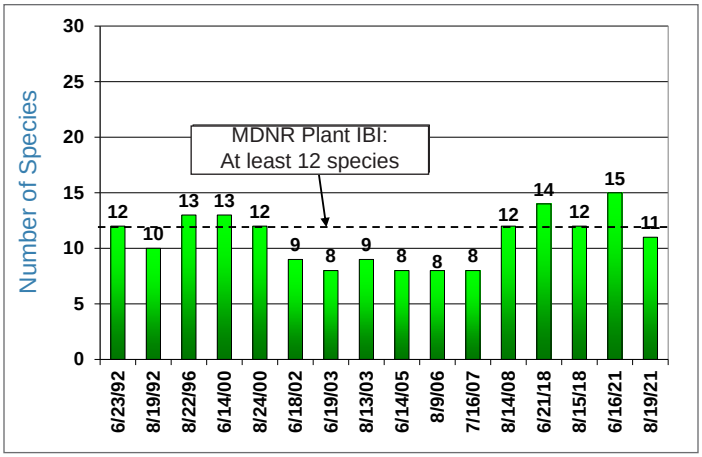
Macrophytes (aquatic plants)

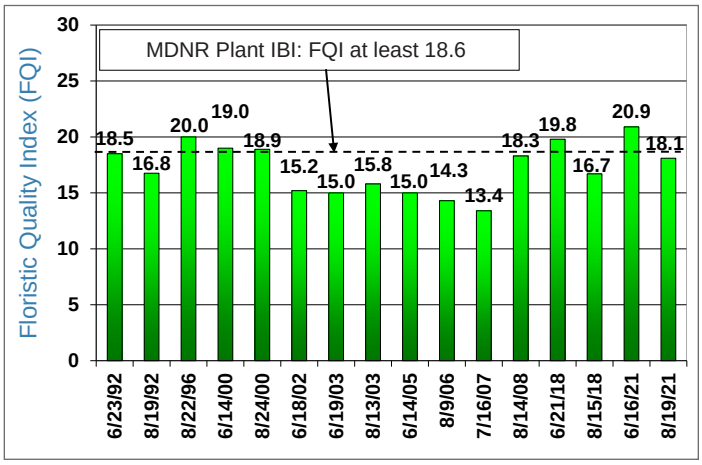
Lake Plant Eutrophication Index of Biological Integrity (IBI)

Eutrophication (excessive nutrients) may have detrimental effects on a lake, including reductions in the quantity and diversity of plants. The MNDNR developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication. The Lake Plant Eutrophication IBI includes two metrics: (1) the number of species in a lake and (2) the "quality" of the species, as measured by the Floristic Quality Index (FQI). The MNDNR determined a threshold for each metric. Lakes that score below the thresholds contain degraded plant communities and are likely stressed from anthropogenic (human-caused) eutrophication.

Plant survey data from 1992 to 2021 were assessed to determine Plant IBI trends. The figures on page 5 show Parkers Lake FQI scores and the number of species for that period compared to the MNDNR Plant IBI thresholds.

- **Number of species:** A deeper water lake, such as Parkers Lake, meets the MNDNR Plant IBI threshold when it has at least 12 species. During the period examined, the number of species in Parkers Lake ranged from eight to 15 and was better than the MNDNR Plant IBI threshold on eight occasions between June 1992 and June 2021. Fewer species were present from 2002 through 2007.
- **FQI values (quality of species):** The MNDNR Plant IBI threshold for deeper water lakes, as measured by FQI, is a minimum value of 18.6. During the period examined, FQI values ranged from 13.4 to 20.9 and were better than the MNDNR Plant IBI threshold in August 1996, June and August 2000, June 2018, and June 2021. The lake's plant community was of poorer quality from 2002 through 2007.
- **2021 results:** Both the number of species and FQI values were better than the MNDNR Plant IBI thresholds in June. However, in August, the number of species and FQI values were poorer than the MNDNR Plant IBI thresholds.





Aquatic invasive species

In 2021, two aquatic invasive species were known to be present in Parkers Lake.

Curly-leaf pondweed (*Potamogeton crispus*): In 2021, curly-leaf pondweed (CLP) was found at 29 percent of sample points in June. It was not observed in August due to a natural die-off in late June, which added phosphorus to the lake. In June, 80 percent of the CLP-infested sample points had a low density of CLP (i.e., a density of 1 on a scale of 1–5); the remaining sample points had a medium density of CLP (i.e., 2–3 on a scale of 1–5).

CLP frequency declined between 2018 and 2021—from 39 percent in June 2018 to 29 percent in June 2021 and from 4 percent in August 2018 to not observed in August 2021. June average CLP density was the same in 2018 and 2021 (1.2 on a scale of 1–5). August average CLP was 1.0 in 2018 and not observed in August 2021.

Eurasian watermilfoil (*Myriophyllum spicatum*): In 2021, Eurasian watermilfoil (EWM) increased in frequency between June and August—from 60 percent in June to 76 percent in August. The average EWM density in the lake was 1.9 (on a scale of 1–5) during both June and August.

Some areas of the lake had problematic EWM conditions during both June and August.

June EWM frequency and density were very similar in 2018 (61 percent frequency and 2.2 density) and 2021 (60 percent frequency and 1.9 density). August frequency was slightly higher in 2021 (76 percent) than 2018 (71 percent), but average density was similar in 2018 (2.0) and 2021 (1.9).

Suitability of Parkers Lake for aquatic invasive species (AIS)

A large number of AIS currently residing in Minnesota have not yet been observed in Parkers Lake but could be introduced. For example, both zebra mussels and starry stonewort are present in nearby Medicine Lake. To evaluate whether Parkers Lake water quality would support the introduction of six AIS (starry stonewort, zebra mussels, spiny waterflea, faucet snail, Chinese mystery snail, and rusty crayfish), a suitability analysis for each species was performed.

The analysis compared 2021 water quality data in Parkers Lake with the water quality conditions required for each species, specifically evaluating total phosphorus, chlorophyll *a*, Secchi disc depth, trophic state index, water temperature, dissolved oxygen, specific conductance, calcium, magnesium, sodium, alkalinity, hardness, and calcium carbonate. The results indicate the water quality of Parkers Lake meets the suitability requirements for rusty crayfish, faucet snail, zebra mussels, starry stonewort, and spiny waterflea. However, the sodium and specific conductance levels were too high to be suitable for the Chinese mystery snail. Hence, this species would likely survive but may not thrive in Parkers Lake.

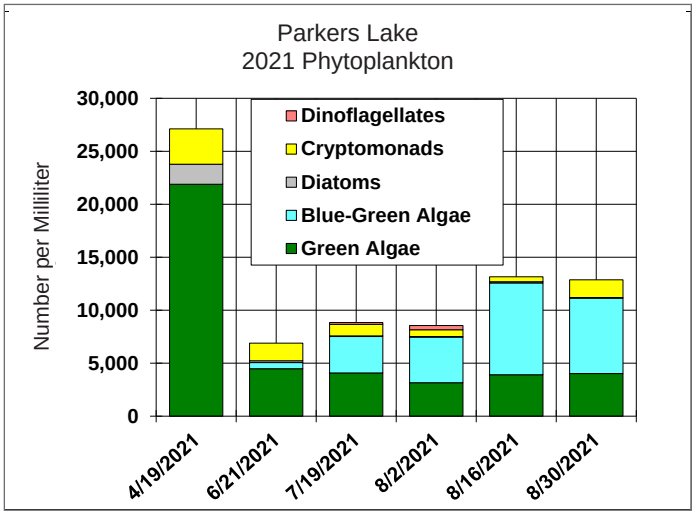

The Chinese mystery snail

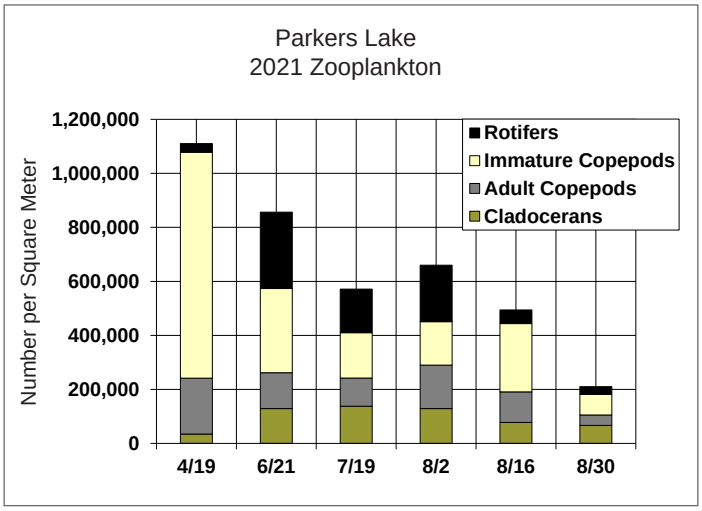
Phytoplankton and Zooplankton

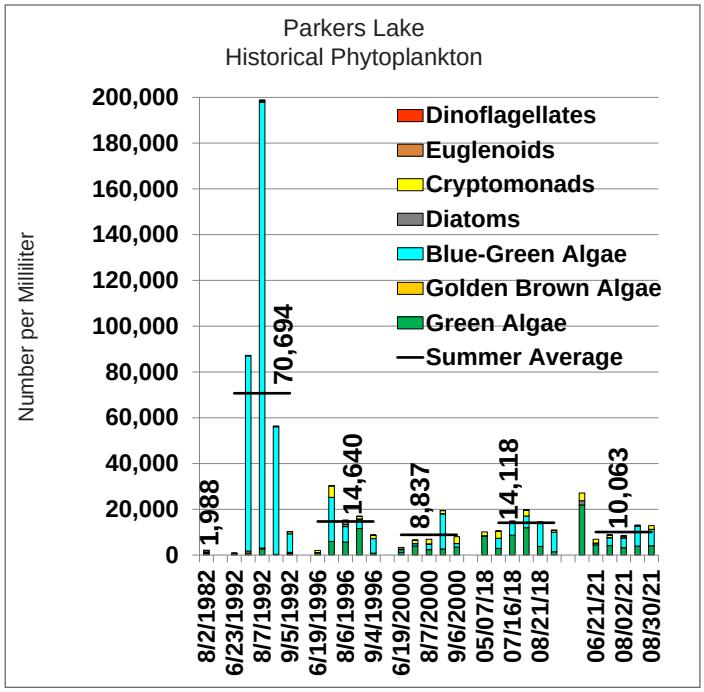
Samples of phytoplankton, microscopic aquatic plants, were collected from Parkers Lake to evaluate water quality and the quality of food available to zooplankton (microscopic animals). Phytoplankton numbers declined from April to June and remained low through September, reflecting the lake's good water quality. Cryptomonads and green algae, good sources of food for the lake's zooplankton, were present throughout the monitoring period (see figure below). 2021 phytoplankton numbers were within the range of numbers observed since 1982.

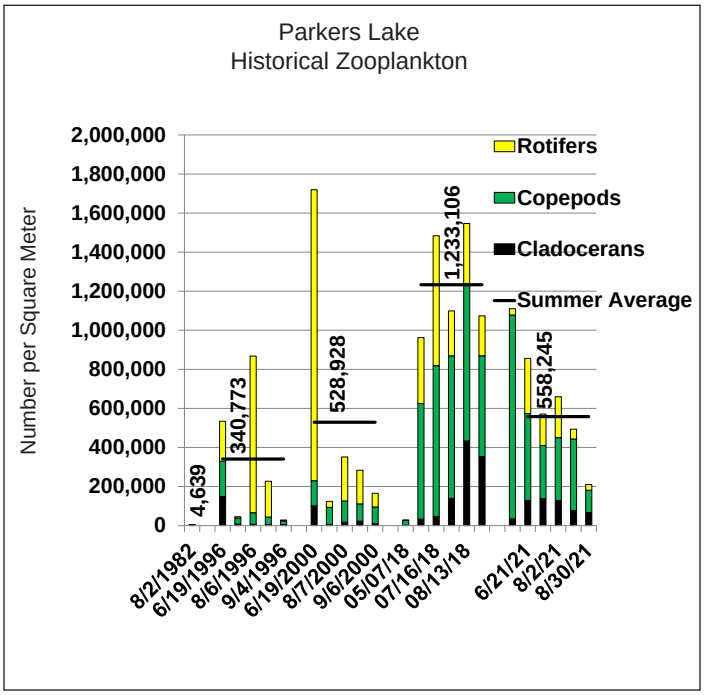
Blue-green algae, which are associated with water quality problems and can be a source of health concerns, were present from June through August and dominant in August. The World Health Organization (WHO) has established that lakes with blue-green algae densities of less than 20,000 cells per milliliter pose no risk to the health of humans or pets. In 2021, blue-green algae numbers were below this threshold during all monitoring events.

2021 zooplankton numbers were within the range of numbers observed since 1982. All three groups of zooplankton (rotifers, copepods, and cladocerans) were represented throughout 2021 (see figure below). Immature copepods dominated the community except in early August when immature and adult copepods co-dominated the community. Because copepods do not graze as heavily on algae as the larger cladocerans, they generally have a limited impact on the lake's water quality. This suggests that future Parkers Lake water quality efforts should focus on phosphorus management to reduce the nutrients that contribute to algae growth.









Chloride levels from 1972–2021

Chloride concentrations in area lakes have increased since the early 1990s, when many government agencies switched from sand or sand/salt mixtures to salt for winter road maintenance. When snow and ice melt, the salt goes with it, washing into lakes, streams, wetlands, and groundwater. It only takes 1 teaspoon of road salt to permanently pollute 5 gallons of water. And, once in the water, there is no way to remove chloride. High chloride levels are toxic to sensitive organisms and disrupt natural lake mixing, causing lower dissolved oxygen in bottom waters and associated impacts on benthic organisms and nutrient cycling.

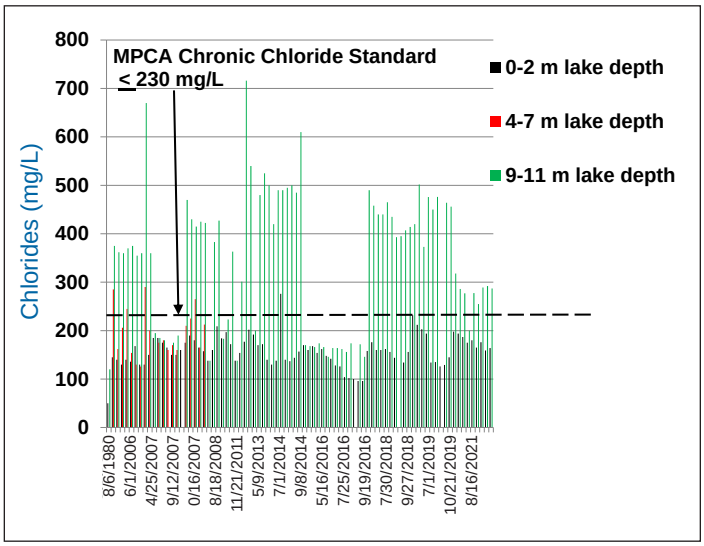
Because high concentrations of chloride can harm fish and plant life, the MPCA established maximum and chronic chloride standards. The maximum standard is the highest concentration of chloride that aquatic organisms can be exposed to for a brief time with zero-to-slight mortality. The chronic standard is the highest chloride concentration that aquatic life can be exposed to indefinitely without causing chronic toxicity. Chronic toxicity is defined as a stimulus that lingers or continues for a long period of time, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, reproduction impairment, harmful changes in behavior, and other nonlethal effects. A lake is considered impaired if two or more measurements exceed the chronic criterion (230 mg/L) within a 3-year period or one measurement exceeds the maximum criterion (860 mg/L).

2021 surface chloride measurements ranged from 159 mg/L in late September to 198 mg/L in April. Near-bottom chloride measurements ranged from 200 mg/L in early August to 464 mg/L in April. All of the surface measurements met the MPCA chronic and maximum chloride standards. All of the near-bottom measurements met the MPCA maximum chloride standard but failed to meet the MPCA chronic chloride standard—with the exception of one early August measurement.

Parkers Lake has been listed as impaired for chlorides since 2014. As shown in the figure at right, chloride concentrations in the lake's bottom waters (9–11 meter depths) have failed to meet the MPCA chronic chloride standard during most years from 2006 through 2021. During this period, when chloride concentrations in the deeper waters exceeded the MPCA chronic chloride standard, annual chloride averages for the entire lake also generally exceeded the MPCA chronic standard. An exception occurred in 2021 when the annual chloride average was slightly below the MPCA chronic standard despite all but one near-bottom chloride concentration exceeding the MPCA chronic standard.

Monitoring of the lake by the City of Plymouth indicates chloride impairment in Parkers Lake is due to chloride loading from the lake's watershed; lower watershed chloride loading to Parkers Lake generally correlated with a lower chloride concentration in the lake. Lower chloride loading to the lake in 2016 reduced the lake's chloride concentration enough to meet the MPCA chronic chloride standard. Chloride loading to the lake in 2021 was lower than 2017 through 2019, but not as low as 2016. 2021 chloride concentrations in the lake were lower than 2018 and 2019 concentrations, but higher than 2016.

The City of Plymouth's monitoring in two of the lake's subwatersheds found the northern subwatershed, PL2, has a much higher chloride loading rate than the southern subwatershed, PL1. Subwatershed PL2—189 acres, is about 49 percent impervious, and the land use is primarily multi-family residential and industrial. Subwatershed PL1—258 acres, is about 19 percent impervious, and land use is primarily residential. The map on page 1 shows the sample locations for subwatersheds PL1 and PL2. Chloride loading to Parkers Lake from 2013 through 2021 is shown in Table 1 on page 8.



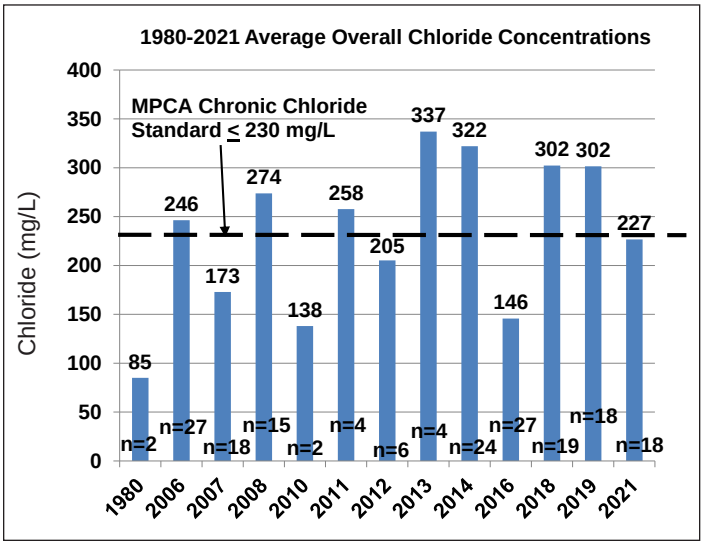


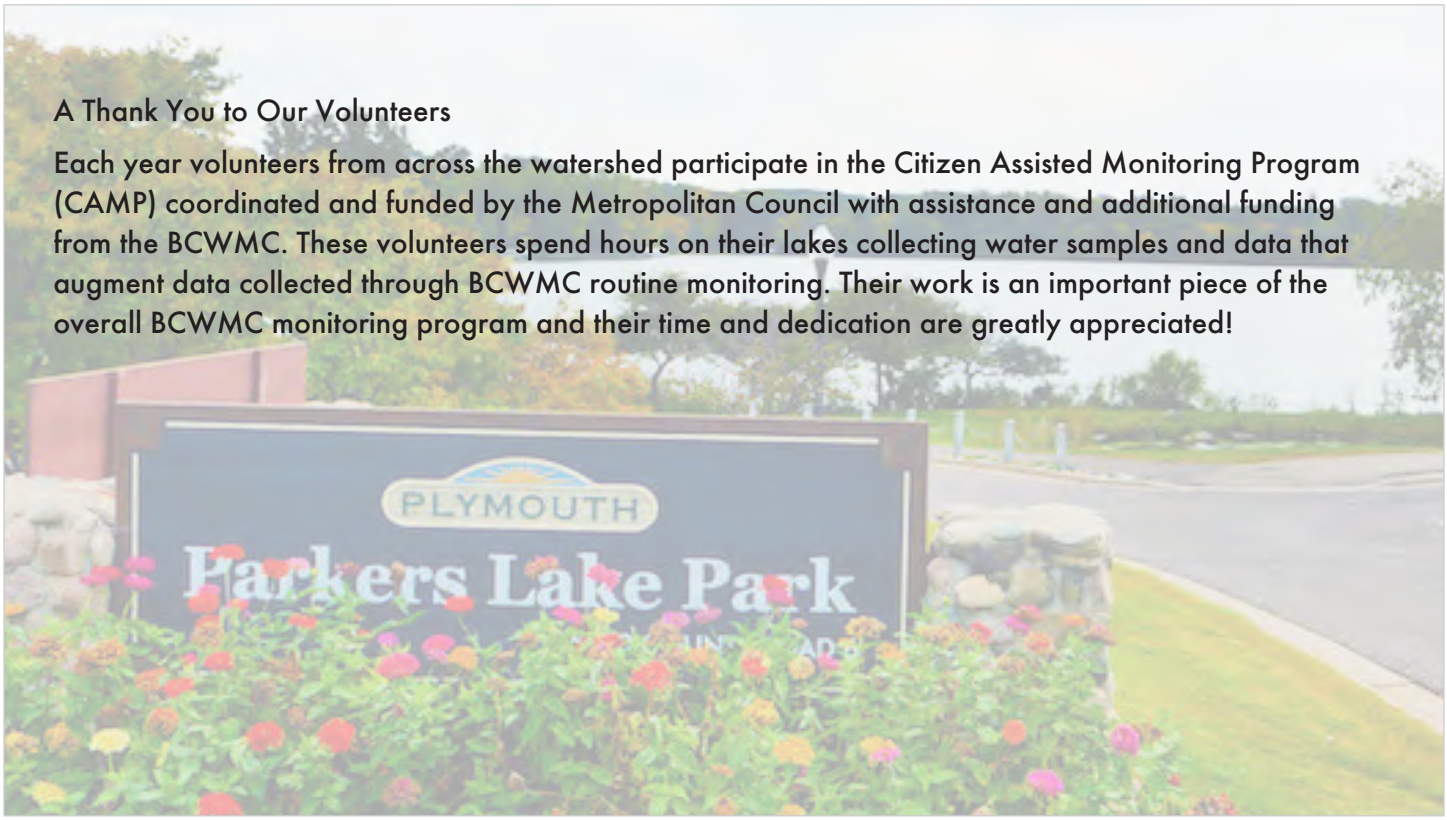
Table 1

City of Plymouth data collected by Three Rivers Park District

Year	PL1 (19% impervious)		PL2 (49% impervious)		Total Chloride Loading from PL1 and PL2 (lbs/year)	Parkers Lake Average Annual Chloride Concentration (mg/l)
	Chloride Loading (lbs/year)	Chloride Loading (lbs/acre)	Chloride Loading (lbs/year)	Chloride Loading (lbs/acre)		
2013	3,239	12.6	105,991	561	109,230	337
2014	1,158	4.5	55,650	294	56,808	322
2015	1,052	4.1	161,814	856	162,866	–
2016	1,797	7.0	66,855	354	68,652	146
2017	4,904	19.0	122,460	648	127,364	–
2018	4,701	18.2	138,692	734	143,393	302
2019	926	3.6	84,831	449	85,757	302
2020	679	2.6	71,449	378	72,128	–
2021	532	2.1	73,146	387	73,678	227

A Thank You to Our Volunteers

Each year volunteers from across the watershed participate in the Citizen Assisted Monitoring Program (CAMP) coordinated and funded by the Metropolitan Council with assistance and additional funding from the BCWMC. These volunteers spend hours on their lakes collecting water samples and data that augment data collected through BCWMC routine monitoring. Their work is an important piece of the overall BCWMC monitoring program and their time and dedication are greatly appreciated!



Bassett Creek Watershed Management Commission
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Cleaner, healthier water for a growing community