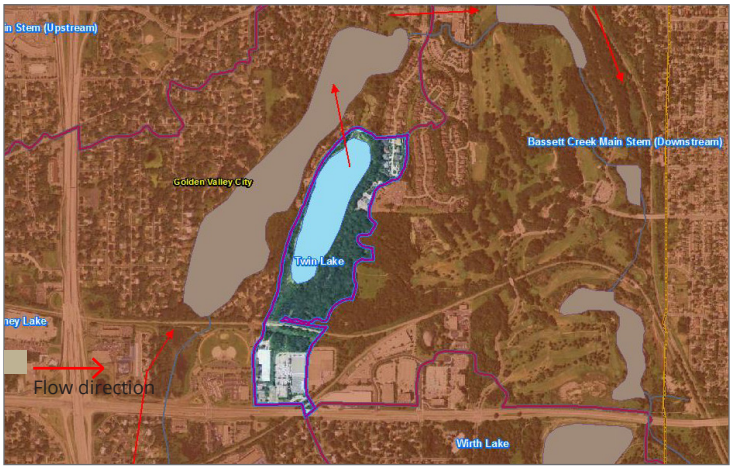
Twin Lake 2017 water quality monitoring



About Twin Lake

BCWMC classification	Priority-1 deep lake
Watershed area	131 acres
Lake size	21 acres
Average depth	26 feet
Maximum depth	56 feet
Ordinary high water level	831.9 feet
Normal water level	827.2 feet
Downstream receiving waterbody	Sweeney Lake
Location (city)	Golden Valley
MPCA impairments	None
Aquatic invasive species	Curly-leaf pondweed
Public access	Yes (parkland)

Monitoring water quality in Twin 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 2017 monitoring efforts on Twin Lake is provided below; more comprehensive information can be found on pages 2–7

At a glance: 2017 monitoring results

In 2017, the BCWMC monitored Twin 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 2017 monitoring show that Twin Lake met applicable Minnesota Pollution Control Agency (MPCA) and BCWMC water quality standards for lakes and the long-term data suggests the lake has generally maintained good water quality conditions over the past 20 years. In addition, the plant community currently meets the Minnesota Department of Natural Resources (MDNR) plant index of biotic integrity (IBI) standards (see page 5).

Recommendations

- Continue water quality and biological monitoring.
- Evaluate effectiveness of first aluminum sulfate (alum) treatment (2015), and proceed with 2nd treatment
- Continue to implement best management practices and capital improvement projects in the lake's watershed.

Water chemistry monitoring: 2017

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: Total phosphorus concentrations ranged from a low of 15 µg/L in April to a high of 22 µg/L in May. All concentrations were within the mesotrophic category (moderate nutrient content).
- Summer average: 16 µg/L (met BCWMC/MPCA standard).

Chlorophyll a levels

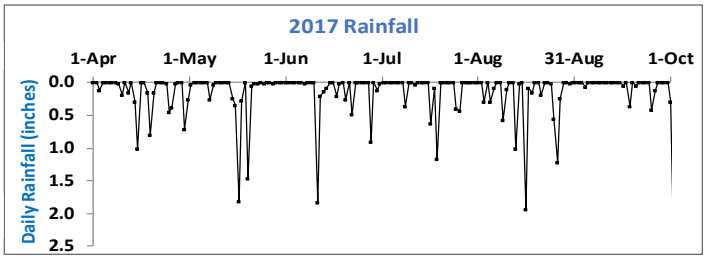
Chlorophyll a is a pigment in algae and generally reflects the amount of algae growth in a lake. Lakes which appear clear generally have chlorophyll a levels less than 15 micrograms per liter (µg/L).

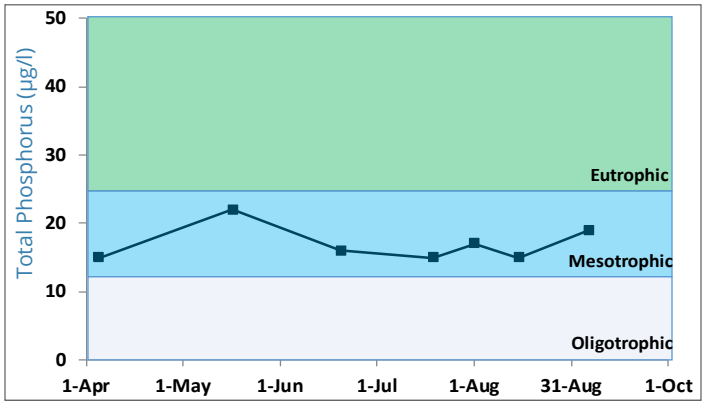
- BCWMC/MPCA standard: 14 µg/L or less.
- Range: Chlorophyll a concentrations ranged from a low of 2.5 µg/L in June to a high of 5.6 µg/L in April. Throughout 2017, chlorophyll a concentrations were in the mesotrophic or oligotrophic category, indicating good water quality conditions.
- Summer average: 3.1 µg/L (met BCWMC/MPCA standard).

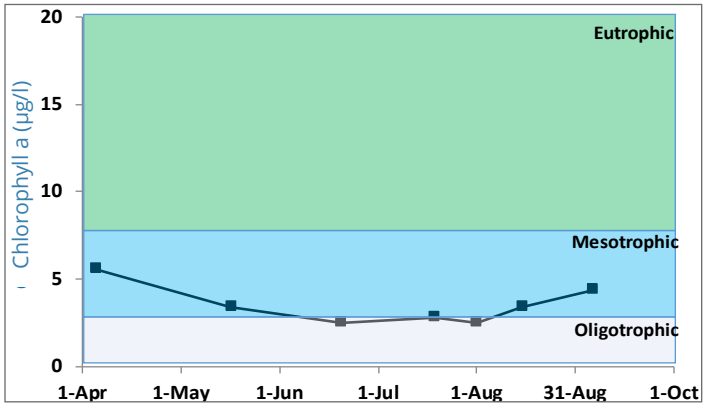
Water clarity

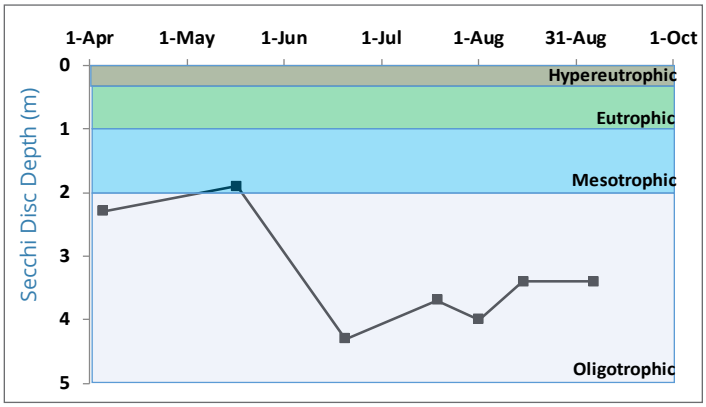
Water clarity is often affected by sediment and the amount of algae or other photosynthetic organisms in a lake. It is usually measured by lowering an 8-inch "Secchi" disc into the lake; the depth at which the disc's alternating black-and-white pattern is no longer visible is considered a measure of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

- BCWMC/MPCA standard: 1.4 meters or more..
- Range: From 4.3 meters in June to 1.9 meters in May.
- Summer average: 3.8 meters (met BCWMC/MPCA standard).









Definitions

- ***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
- ***Hypereutrophic:*** Nutrient-rich lake conditions characterized by frequent and severe algal blooms and low transparency
- ***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

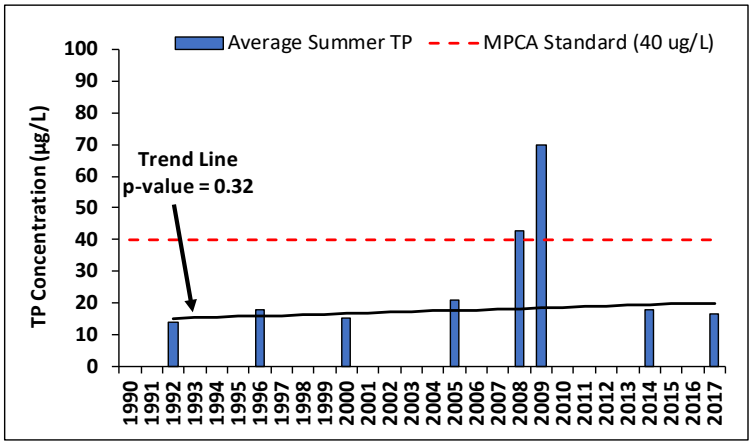
Water chemistry monitoring from 1992–2017: historical trends

Water quality in Twin Lake has been monitored since 1992. Total phosphorus, chlorophyll a, and Secchi disc transparency summer averages (June through September) for years with a minimum of four sample events are shown in the figures to the right. Summer averages for phosphorus have met BCWMC/MPCA standards in 6 of the 8 years monitored since 1992. Chlorophyll a concentrations and Secchi disc depth have meet the standard in 7 of the 8 monitored years. Trend analyses for Twin Lake suggests the trend lines presented in the figures to the right are not statistically significant (p-values all greater than 0.05).

Water quality in Twin Lake showed improved conditions in 2017 following the 2015 alum treatment and it is expected that water quality will continue to improve. It is recommended that the Commission continue monitoring water quality in Twin Lake over the next few years to evaluate the effectiveness of the 2015 alum treatment.

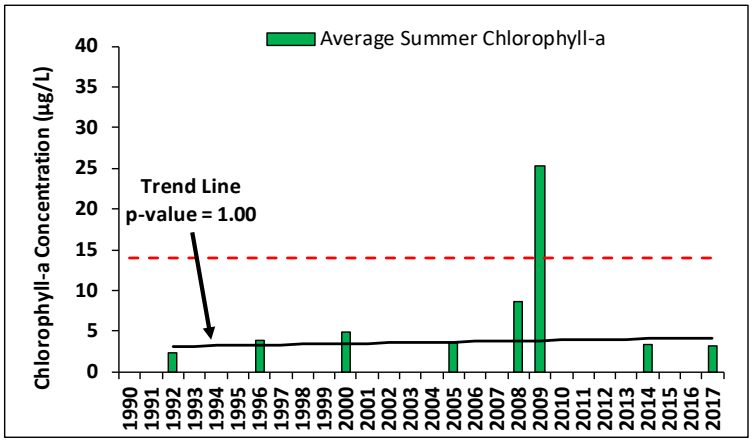
Total phosphorus trends

Note: Graphs and trend lines do not include CAMP data



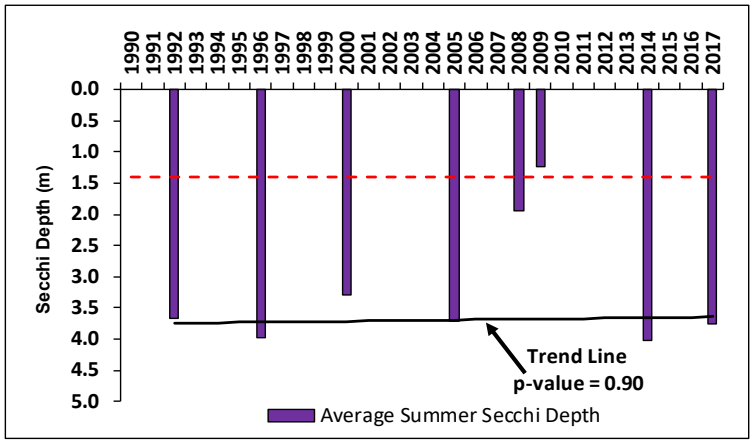
Chlorophyll a trends

Note: Graphs and trend lines do not include CAMP data



Water clarity trends

Note: Graphs and trend lines do not include CAMP data

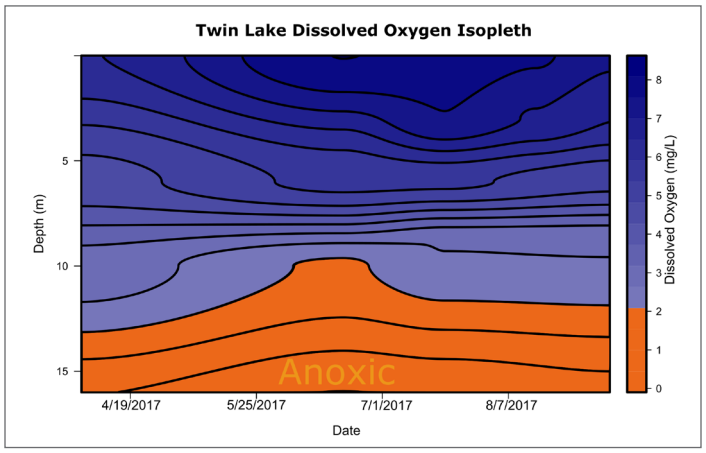


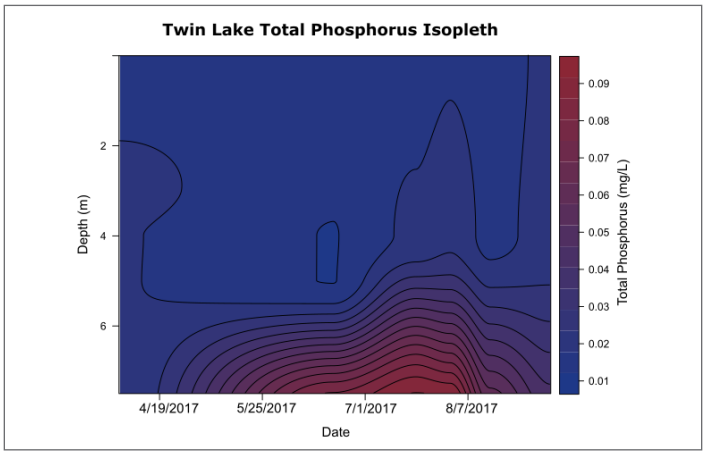
Phosphorus loading from sediment (2017)

The release of phosphorus stored in lake-bottom sediments when oxygen levels are low is described as “internal phosphorus loading from sediment.” A feasibility study for Twin Lake (Barr, 2013) and previous monitoring data and analysis (Barr, 2015) found internal phosphorus loading from sediment to be a significant source of lake phosphorus in Twin Lake. According to these studies, phosphorus diffuses out of the lake’s sediments and is conveyed to surface waters through weakening of the thermocline and/or wind-mixing events. In order to reduce the diffusive flux of phosphorus from the sediment, an aluminum sulfate (alum) treatment was conducted on Twin Lake in May 2015. The alum treatment is expected to maintain Twin Lake’s water quality for 20 to 30 years or longer.

Prior to the alum treatment, average hypolimnetic (deep water) phosphorus concentrations in Twin Lake ranged from a low of approximately 250 µg/L in the early 1980s to a high of approximately 1,200 µg/L in 2014 (Barr, 2015). The 2017 monitoring data indicate that the average hypolimnetic phosphorus concentration was significantly lower (~150 µg/L) than pre-treatment concentrations. These results suggest the Twin Lake alum treatment is currently working and has successfully reduced hypolimnetic and surface water phosphorus concentrations in Twin Lake. However, water quality may not tell the entire internal loading story for Twin Lake.

An important nuance of alum treatments is differentiating between water quality improvements and reductions in sediment phosphorus release. Obviously, total phosphorus reductions in the surface water and hypolimnion indicate that the initial alum half-dose has reduced phosphorus release from sediments in the near term. However, short term water quality improvements may not be an indicator that the mobile phosphorus pool in Twin Lake sediments has been sufficiently reduced. Many times, even in the case of lakes that did not receive enough alum, water quality improvements are observed over a short time period (1-5 years). Recent scientific literature suggest that follow up sediment coring after alum treatments has provided critical information on the amount of mobile phosphorus in sediments that has been inactivated. The commision collected sediment cones for Twin Lake following the 2015 alum treatment and will be using the results of this analysis to determine how to proceed with the second treatment.





Macrophytes

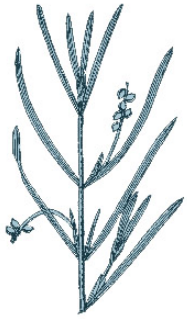
Lake Plant Eutrophication Index of Biological Integrity (IBI)

The Minnesota Department of Natural Resources (MDNR) recently developed metrics to determine the overall health of a lake's aquatic plant community. The Lake Plant Eutrophication Index of Biological Integrity (IBI) is used by the MPCA to determine whether a lake is meeting the federal Clean Water Act standards intended to protect aquatic life. The plant 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).

Twin Lake plant survey data from 1992 through 2017 were assessed to determine plant IBI. The figures below show the number of species and FQI for that period compared to the MDNR plant IBI impairment threshold. During the period examined, the number of species in Twin Lake has ranged from 11 to 20, exceeding the impairment threshold of at least 12 species for the majority of the surveys. FQI values ranged from 19.9 to 25.9, which also exceeds the impairment threshold (18.6 minimum). This means that Twin Lake is not considered impaired in terms of its ability to support aquatic plant life.

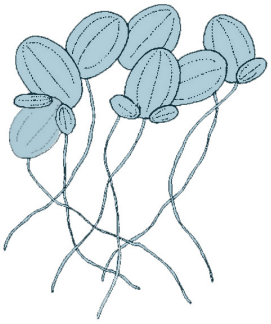
Commonly found aquatic species

Coontail
Ceratophyllum demersum

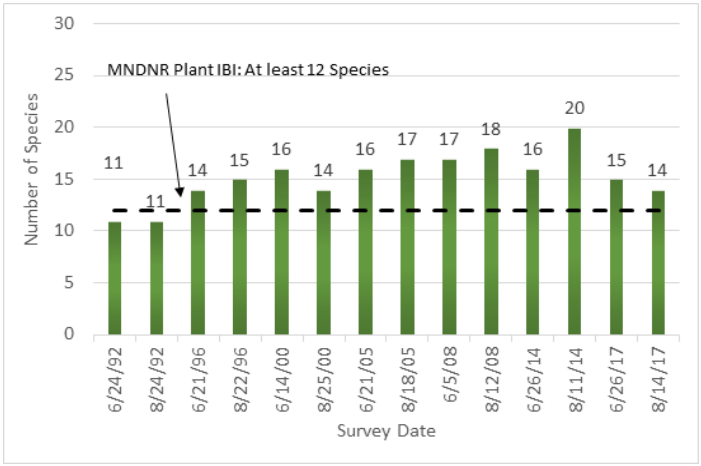


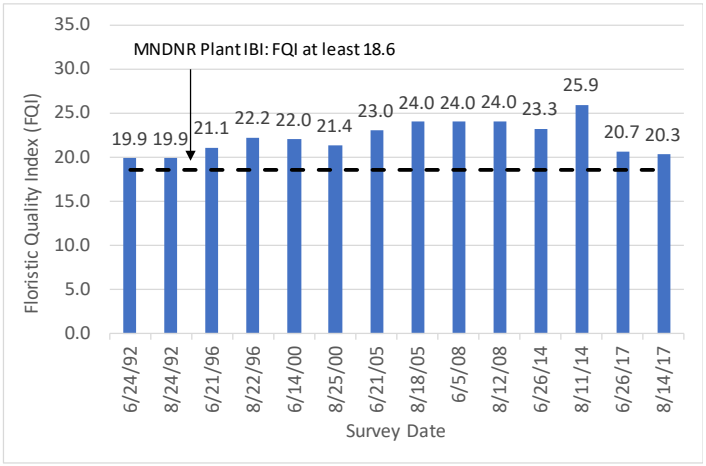
Flatstem pondweed
Potamogeton zosteriformis

Curly-leaf pondweed
Potamogeton crispus



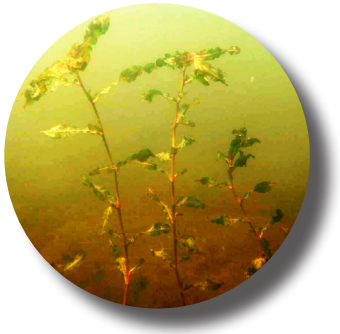
Common duckweed
Lemna minor





Aquatic invasive species

In 2017, one aquatic invasive species was observed in Twin Lake, curly-leaf pondweed. Curly-leaf pondweed was noted at approximately 7% of the sample points during the June 2017 survey. Though prevalent, the curly-leaf pondweed coexisted with native plants at relatively low densities.



Curly-leaf pondweed

Increased use of chloride for road maintenance has had an impact on chloride levels in Twin Cities metro area lakes, including Twin Lake.

Chloride levels in 2017

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 melts, 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.

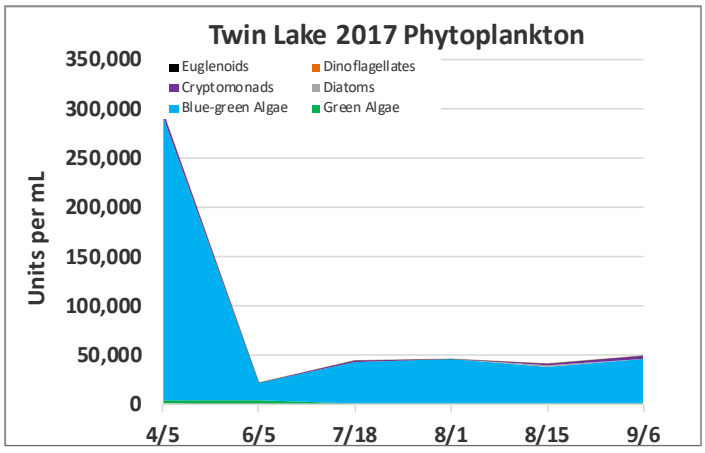
Because high concentrations of chloride can harm fish and plant life, the MPCA has established a chronic exposure chloride standard of 230 mg/l or less.

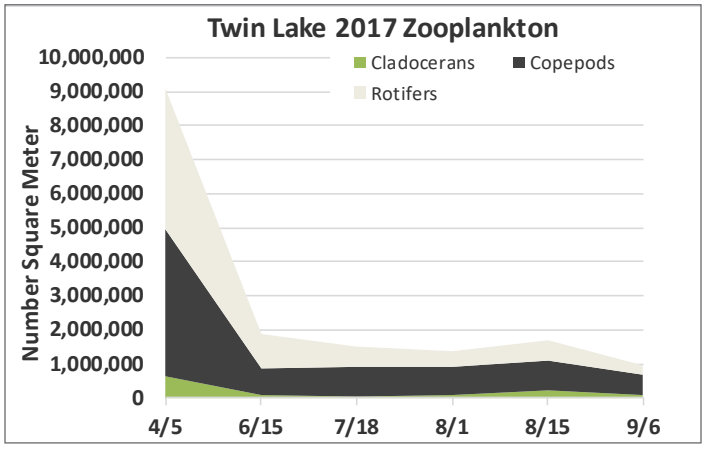
- Range of chloride concentrations in Twin Lake: From a high of 116 mg/L , measured in June, to a low of 110 mg/L, measured in April
- Average concentration: 112 mg/L (meets MPCA standard)

Phytoplankton and zooplankton

Samples of phytoplankton, microscopic aquatic plants, were collected from Twin Lake to evaluate water quality and the quality of food available to zooplankton (microscopic animals). As shown in the figure below, phytoplankton numbers were highest in April and then declined in June and remained relatively consistent throughout the rest of the summer growing season. Blue-green algae, a poor food source for zooplankton, were dominant in Twin Lake throughout the 2017 monitoring season. In high concentrations blue-green can be a source of health concerns. Blue-green algae concentrations were below 50,000 cells per milliliter form June to September which suggest a low risk of adverse health impacts to lake users.

Unlike phytoplankton, zooplankton do not produce their own food. As "filter feeders," they eat millions of small algae; given the right quantities and species they can filter the volume of an entire lake in a matter of days. They are also a valuable food source for planktivorous fish and other organisms. The numbers and community composition of zooplankton in Twin Lake were consistent with previous years. Small rotifers and copepods were prevalent throughout the summer. Cladocerans were also observed throughout the entire monitored period, however at significantly lower concentrations compared to rotifers and copepods.





Chlamydomonas, a type of green algae found in Twin Lake

Filinia longiseta, a rotifer found in Twin Lake

Twin Lake fish

In September, 2013 the BCWMC contracted with Blue Water Science to conduct a trap net survey on Twin Lake. A total of ten fish species were sampled during this survey with bluegill sunfish and yellow bullheads being the most abundant species. Gamefish species included largemouth bass and northern pike. Certain fish species such as common carp, in high abundance, can cause adverse water quality impacts in lakes. No common carp were sampled in Twin Lake although they were found in neighboring Sweeney Lake during a joint survey conducted in 2013.

Bassett Creek Watershed Management Commission
952.270.1990
bassettcreekwmo.org