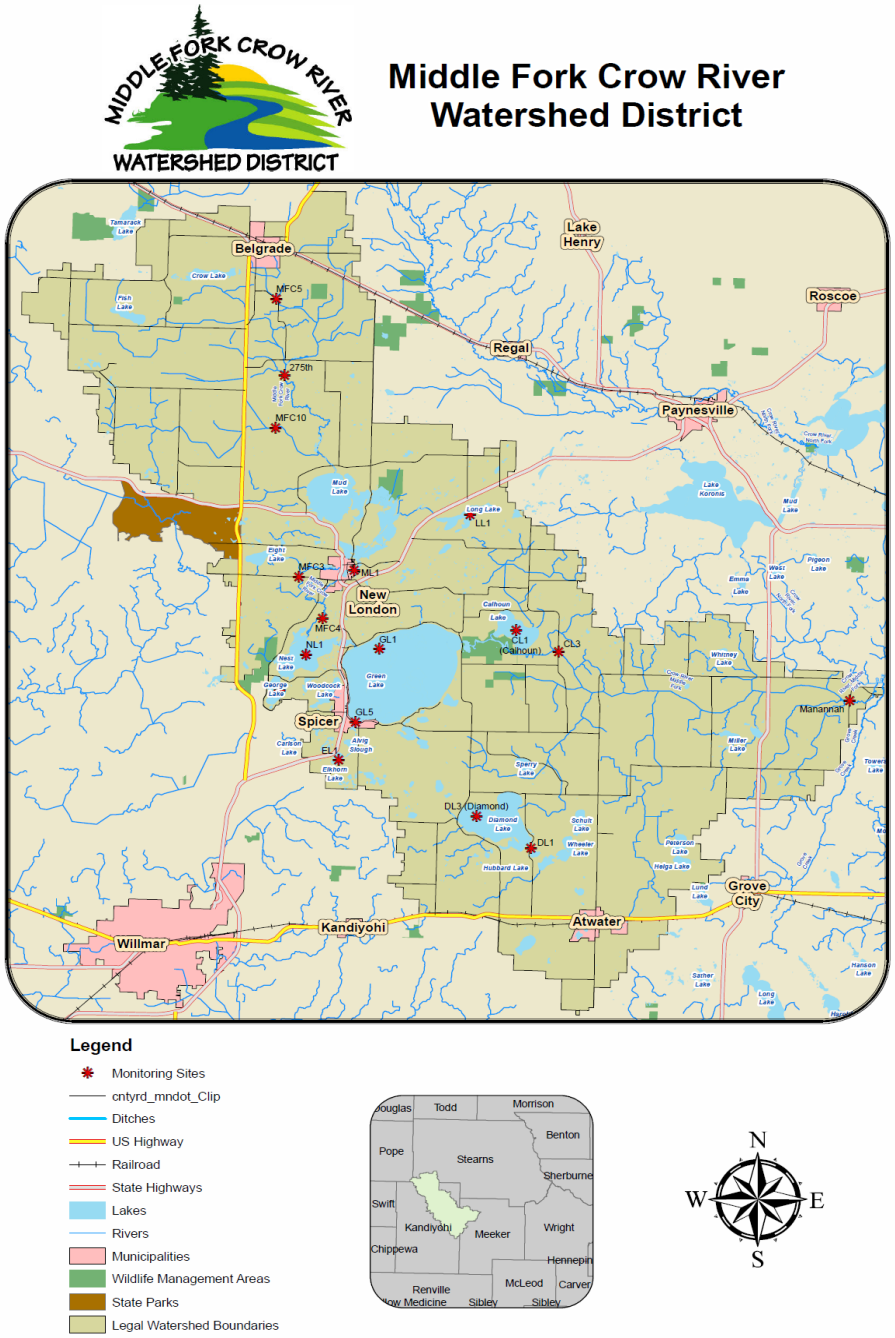
Monitoring

Middle Fork Crow River
WATERSHED DISTRICT

Purpose of Water Monitoring

The Middle Fork Crow River Watershed District (MFCRWD) was formed in 2005 to protect and preserve water quality in the Middle Fork Crow River watershed. Monitoring plays a vital role for the District to achieve this goal. Results from the District monitoring program help us assess water quality trends in the watershed and provide information on where to target best management practices. To help track long-term changes, 5 stream sites have been established and the 8 major lakes in the watershed are thoroughly monitored every year. In addition to major lakes the District also monitors the Hubbard, Schultz, Wheeler chain of lakes. Along with monitoring specific to District projects. District staff and several volunteers conduct monitoring. To determine if the watershed is reaching water quality goals, monitoring data is evaluated on an annual basis.



Monitoring Methods and Tools

Volunteers and staff members monitor lake and stream water quality, stream flow, and precipitation throughout the watershed using chemical analysis, secchi disks, secchi tubes, flow gauging equipment, a multiparameter water quality meter, and rain gauges.

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

Middle Fork Pour Point
Manannah

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Watershed area: 173,220 acres

River Length: 48.8 miles

Watershed Population: 12,979

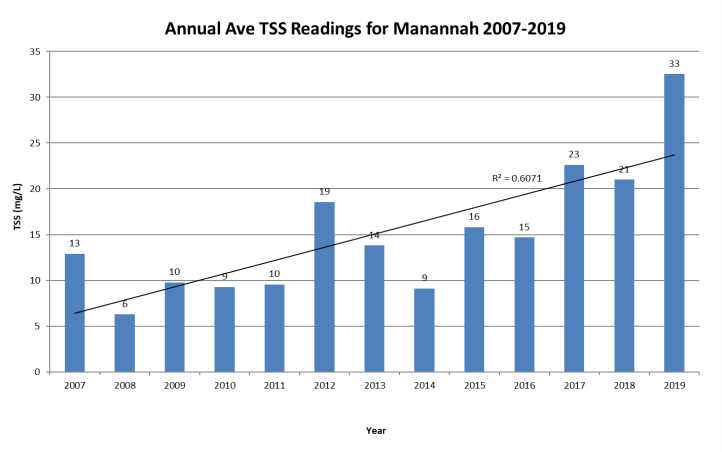
Predominant land use :
Agriculture (88,988 acres)

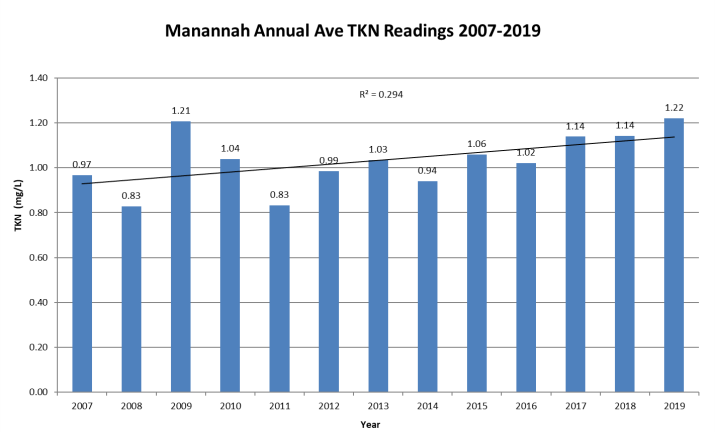
Watershed Cities
Atwater, Belgrade, New London, Spicer

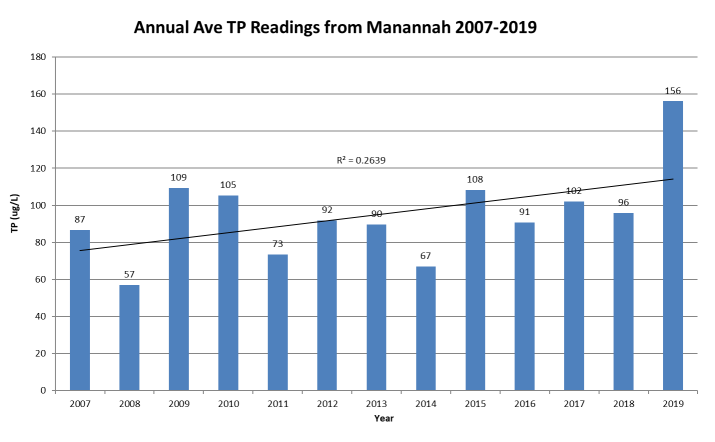
Watershed Counties
Kandiyohi, Meeker, Pope, Stearns

Lakes
Calhoun, Diamond, Elkhorn, George, Green, Long, Mud, Nest

Below you will see 3 graphs one for total suspended solids, total kjeldahl nitrogen, and total phosphorus. The last two years have been very wet which accounts for some of the increase in values.

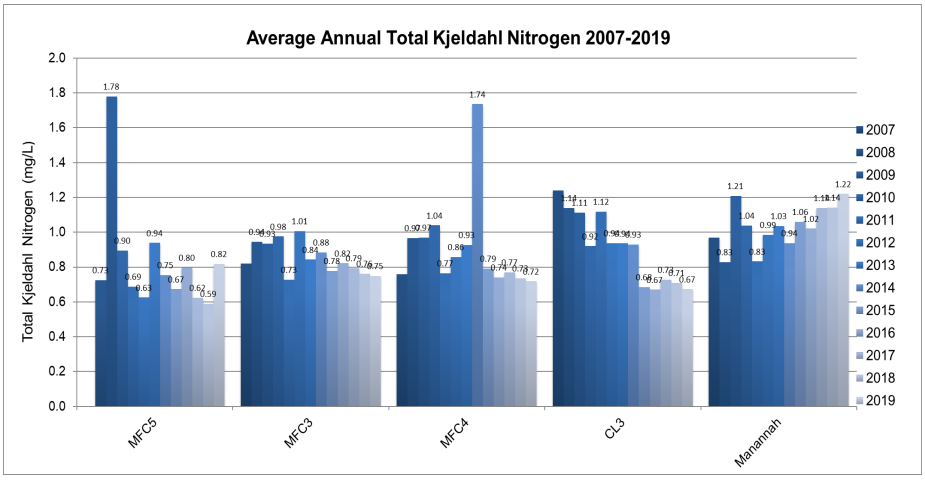


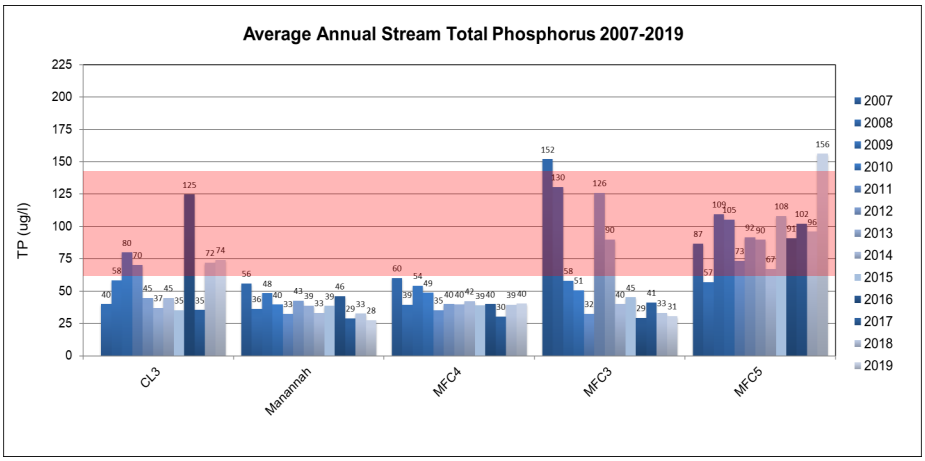


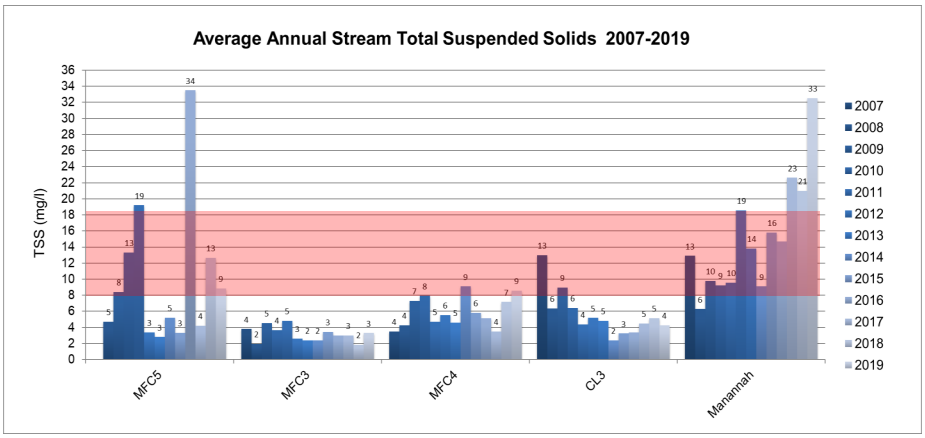


Streams Monitoring

Middle Fork Crow River
WATERSHED DISTRICT







CL3 Monitoring Site

MFC4 Monitoring Site

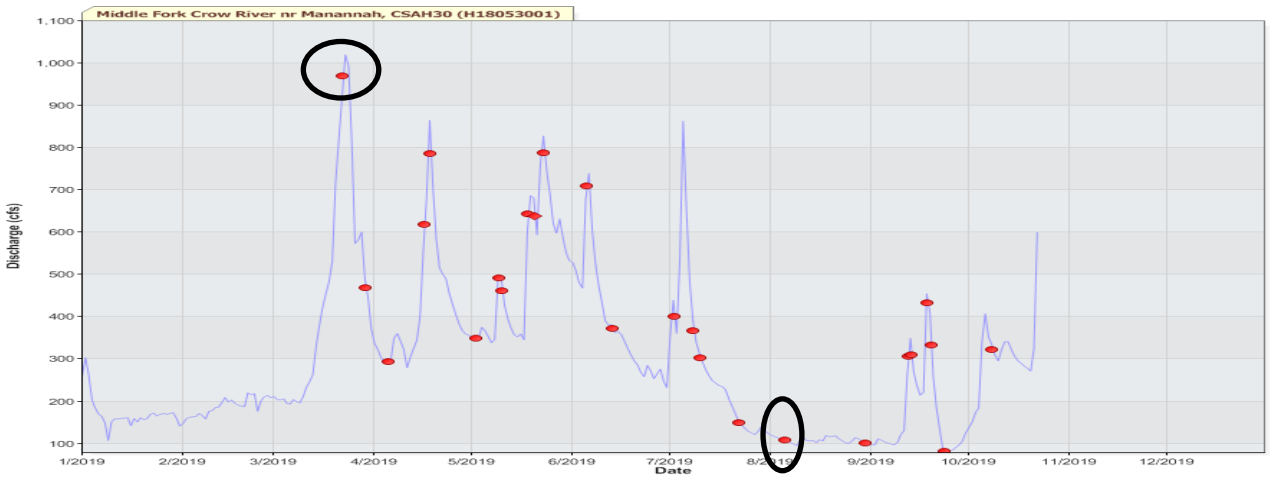
To the left you will see three graphs one for Total Kjedahl Nitrogen, Total Phosphorus, and Total Suspended Solids. The Red boxes on the graphs indicate the typical measurements one might find based on the North Central Hardwood Forest Ecoregion for streams. Total Kjeidahl Nitrogen does not have established typical values.

Middle Fork Crow Rive Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

Middle Fork Pour Point
Manannah

Middle Fork Crow River
WATERSHED DISTRICT

Just down stream of the town of Manannah all of the water from the Middle Fork Watershed enters the North Fork.



Upstream Image

Downstream Image

<u>High Water</u>
3/29/19

see point on hydrograph above

Downstream Image

Upstream Image

<u>Low Water</u>
8/30/19

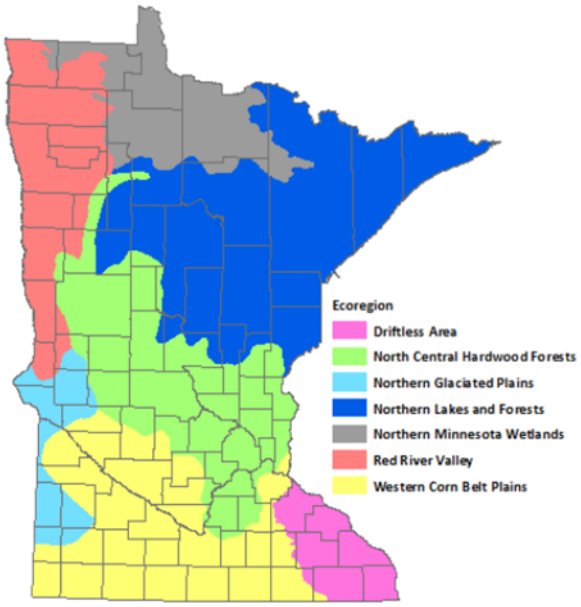
see point on hydrograph above

Water Quality Data

Hubbard, Schultz, Wheeler Shallow Chain of Lakes

Middle Fork Crow River
WATERSHED DISTRICT

Lakes and streams around Minnesota have different physical and chemical properties based on where they are located. Water quality reflects the variety of geographic and environmental conditions in the state. This diversity makes it difficult to explain what constitutes "good" water quality for an individual body of water in Min-



To make it easier, Minnesota Pollution Control Agency offers a guide to typical water quality conditions in these seven "ecoregions," large expanses of land containing a geographically distinct collection of plants, animals, natural communities and environmental conditions. A numeric and narrative water quality standard is prescribed in Minnesota Statute which provides the qualities and properties of the water that are necessary for the aquatic life

There is a specific water quality standard for shallow lakes in the North Central Hardwood Forest ecoregion. If the standards in this ecoregion are exceed the shallow lake basin is considered indicative of a polluted condition which is actually or potentially harmful for public uses and benefits to aquatic and terrestrial

The Hubbard, Schultz, Wheeler Shallow Chain of Lakes project lies in the North Central Hardwood Forest eco region.

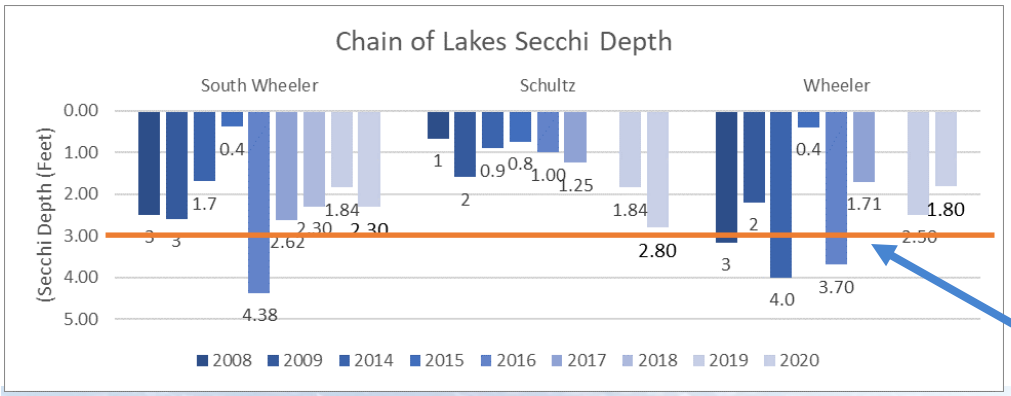
This ecoregion is an area of transition between the forested areas to the north and east and the agricultural areas to the south and west. The terrain varies from rolling hills to smaller plains. Upland areas are forested by hardwoods and conifers. Plains include livestock pastures, hay fields and row crops such as potatoes, beans, peas and corn.

Water Quality Data

Hubbard, Schultz, Wheeler Shallow Chain of Lakes

Middle Fork Crow River
WATERSHED DISTRICT

Secchi disk measurements over time can give a general indication of issues in a lake by assessing the water clarity, or turbidity. Turbidity is suspended materials such as algae, silt, and organic matter in the water.

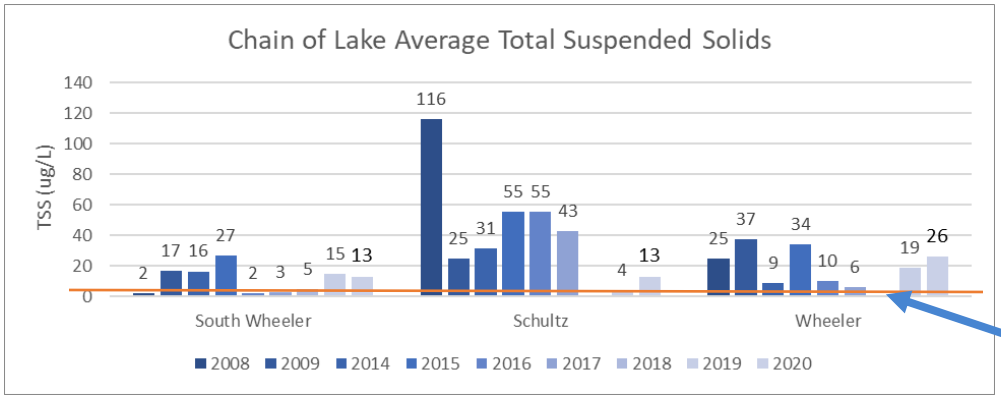


- The 0.00 is the surface of the water body.
- Deeper secchi disk readings (larger numbers) indicate clearer water.

3.28 ft (1 m) = MPCA Shallow Lake Ecoregion Average for North Central Hardwood Forest

Schultz Lake

North Wheeler Lake



A measure of the material suspended in wastewater. Total suspended solids (TSS) cause: a) interference with light penetration, b) buildup of sediment and c) potential reduction in aquatic habitat. Solids also carry nutrients that cause algal blooms and other toxic pollutants that are harmful to fish.

2-6 mg/L TSS =MPCA Shallow Lake Ecoregion Average for North Central Hardwood Forest

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888

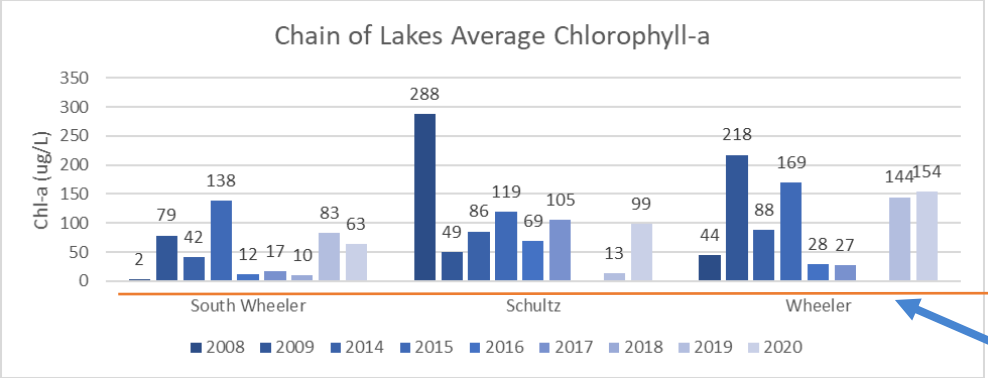
WWW.MFCROW.ORG

Water Quality Data

Hubbard, Schultz, Wheeler Shallow Chain of Lakes

Middle Fork Crow River
WATERSHED DISTRICT

Grab samples provide insight into the chemical condition of the water body and determine its suitability for fisheries, recreational activities, and groundwater recharge. They also become an important indicator of potential land use problems in the watershed. Lake samples are collected monthly or bimonthly from May through September and tested for TP, TSS, and Chlorophyll-a (Chl-a).

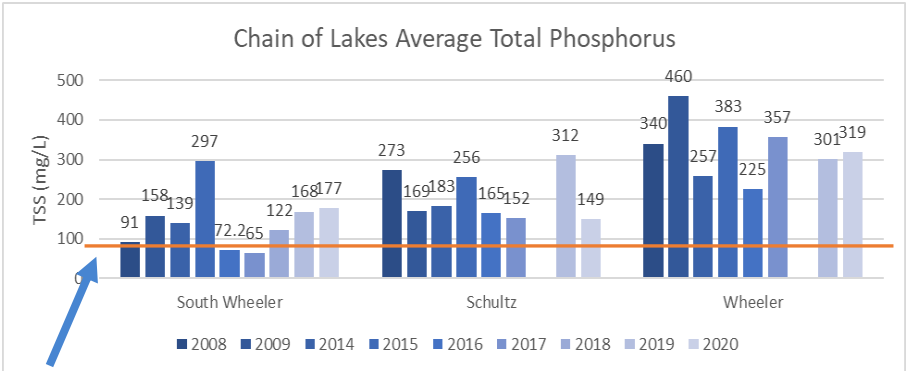


Chlorophyll-a – Chlorophyll-a is the pigment in plants that make them look green. Measuring chlorophyll-a indicates the amount of algae in the water column.

20 ug/L = MPCA Shallow Lake Ecoregion Average for North Central Hardwood Forest

In 2011, the Middle Fork Crow River Watershed District partnered with Ducks Unlimited to actively manage the Hubbard, Schultz, Wheeler Chain of Lakes. A project unlike any other in the state of Minnesota with four separate basins ranging in size from 57 acres to 238 acres. This chain of lakes contributes 45% of the surface water to the impaired waterbody of Diamond Lake but provided 78% of the Total Phosphorus. During 2017 and 2018, four water control structures and a 2,100-foot underground pipeline were installed to empty the lake chain to create a "winterkill" condition, eradicating the invasive carp, returning once turbid lakes to a clean, health condition. The four-basin uniqueness of this project provided an unprecedented and exciting challenge for conservation minded organizations and solidified the success of partnerships with Ducks Unlimited, DNR, along with local support of the Middle Fork Crow River Watershed District.

A lake drawdown is the temporary lowering of a lake water level via removal of outlet



60 ug/L = MPCA Shallow Lake Ecoregion Average for North Central Hardwood Forest

Phosphorus – Phosphorus is one of the key elements necessary for growth of plants and animals. If too much phosphorus enters the waterway, algae and aquatic plants will grow excessively and choke up the waterway. As the algae and plants die, their decomposition depletes the water body's oxygen supply, leading to the loss of aquatic life. Some sources of phosphorus include cropland (fertilizer and soil), human and animal waste, and stormwater runoff from urban areas.

Diamond Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

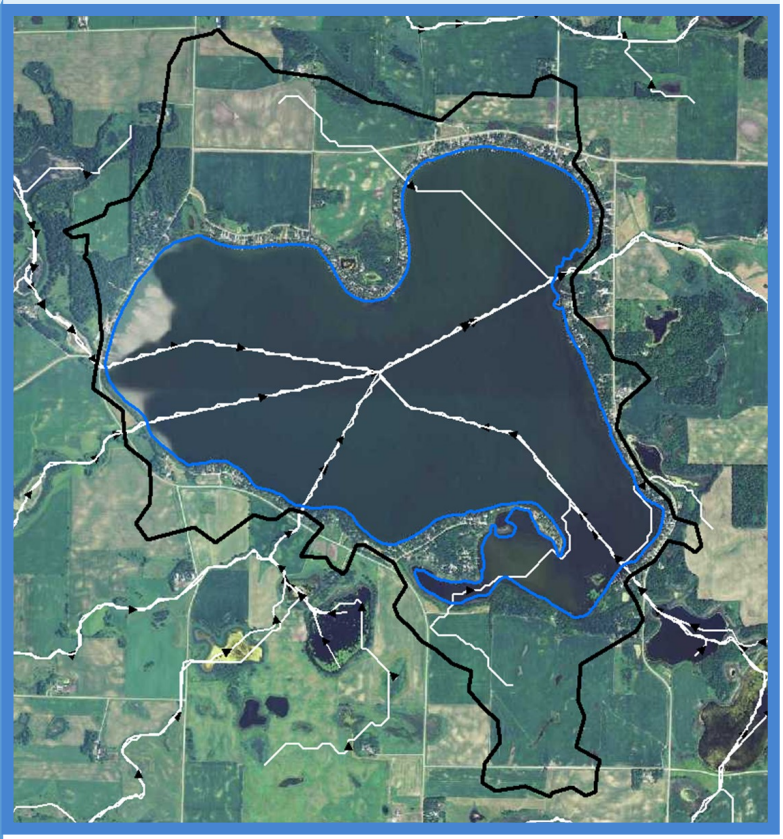
Littoral Area: 635 acres

Surface Area: 1,609.52

Subwatershed Area: 15,280

Upstream Waters: Middle Fork crow River

Maximum Depth: 27 feet



Common Fish

Bluegill, Northern Pike, Largemouth bass

Dominant Vegetation

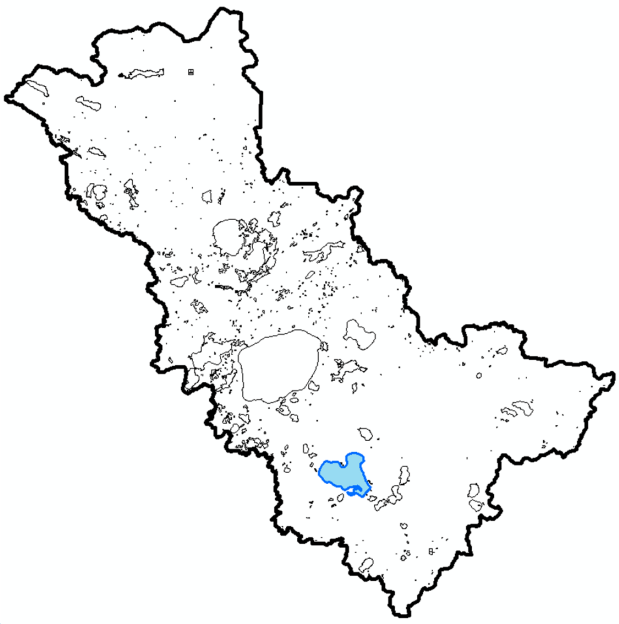
Sago Pondweed, Muskgrass, Narrowleaf Pondweed, WaterMoss

Invasive Species

Curly-leaf Pondweed, Zebra Muscle

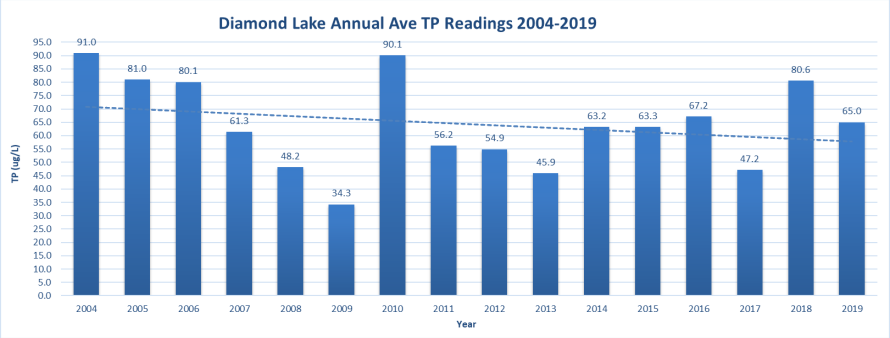
Impairment Status

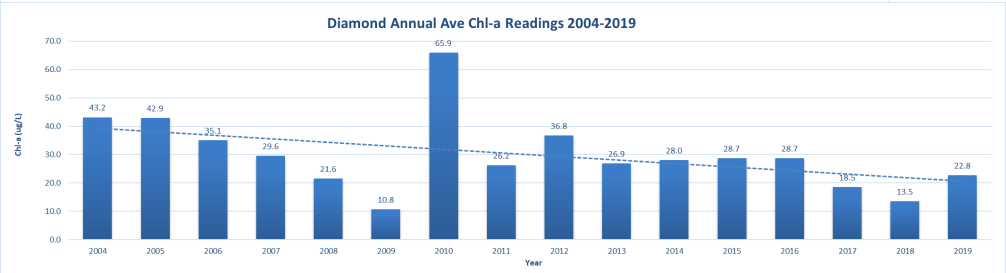
Mercury in fish tissue, Nutrients phosphorus

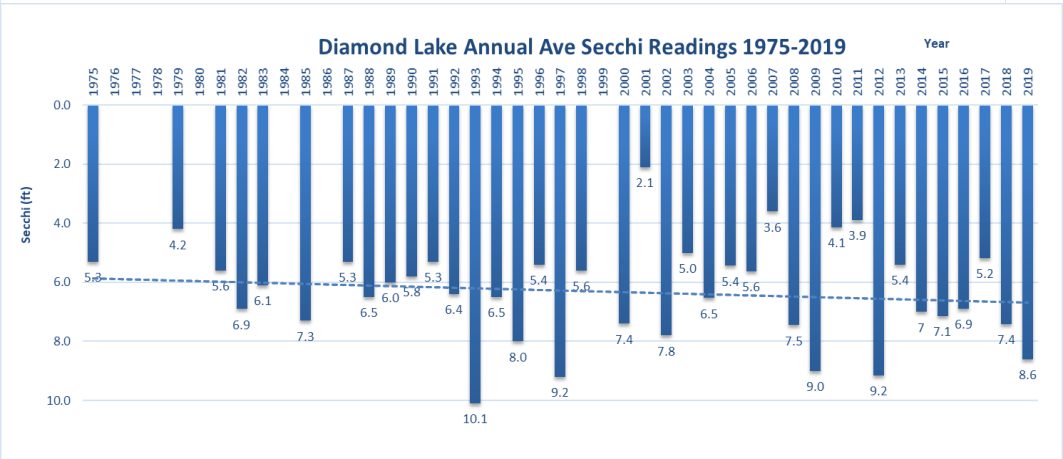


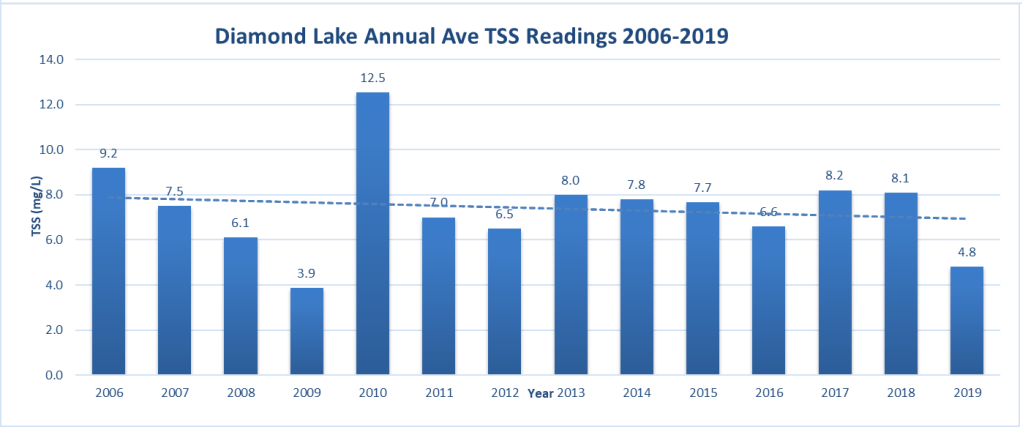
Diamond Lake

Middle Fork Crow River
WATERSHED DISTRICT









Diamond Lake trends for total phosphorus (TP), Chlorophyll-a (Chl-a), Secchi, and total suspended solids (TSS) have all been showing consistent improvement when looking at the trend lines. In 2019 the first successful drawdown of the Hubbard, Schultz, Wheeler chain of lakes was completed. This will hopefully have a further positive effect on Diamond lake. This along with many other projects completed around Diamond Lake and its surround watershed should continue to help improve water quality.

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

Calhoun

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Shoreline Length: 4.81 miles

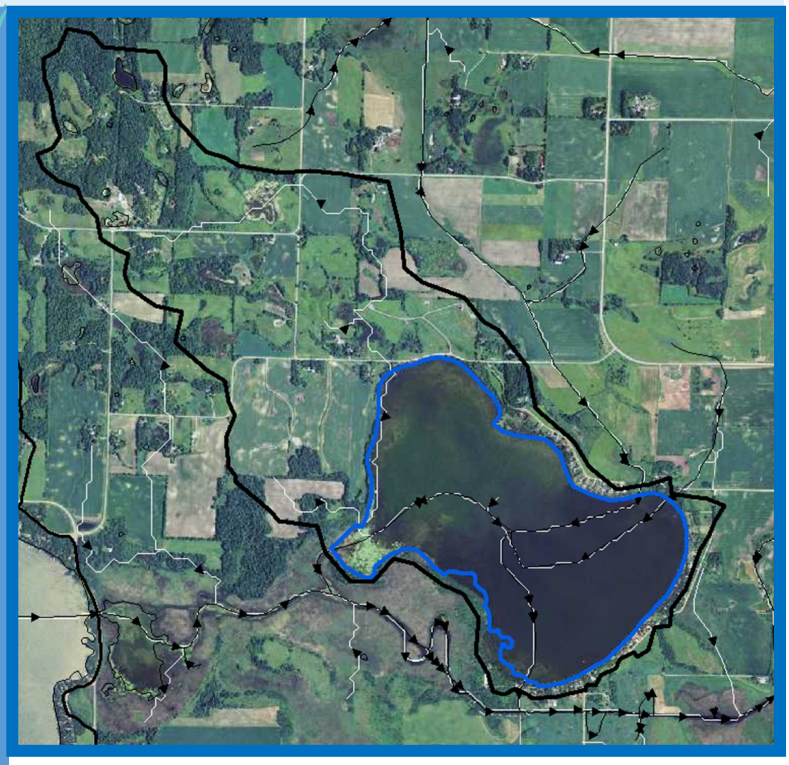
Surface Area: 647.12 acres

Subwatershed Area: 7,578 acres

Upstream Waters: Green Lake

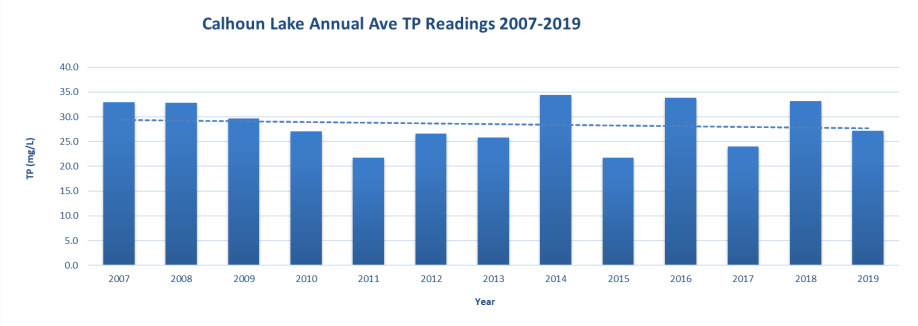
Maximum Depth: 13 feet

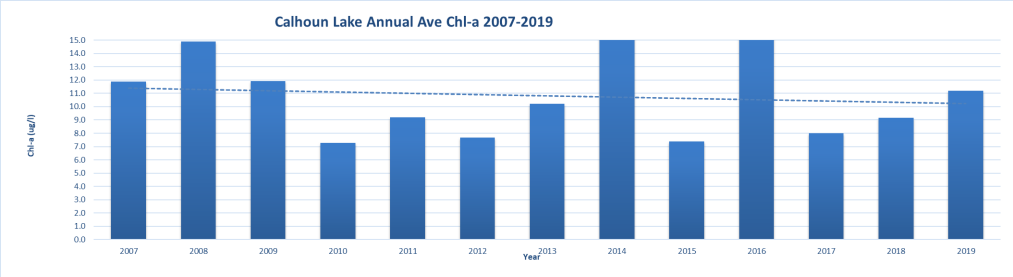
Common Fish	Bluegill, Northern Pike, Black Crappie, Yellow Bullhead
Dominant Vegetation	Filamentous algae, Muskgrass, Northern Milfoil, Sago Pondweed
Invasive Species	Eurasian Watermilfoil, Zebra mussel
Impairment Status	Impaired for Mercury in fish tissue

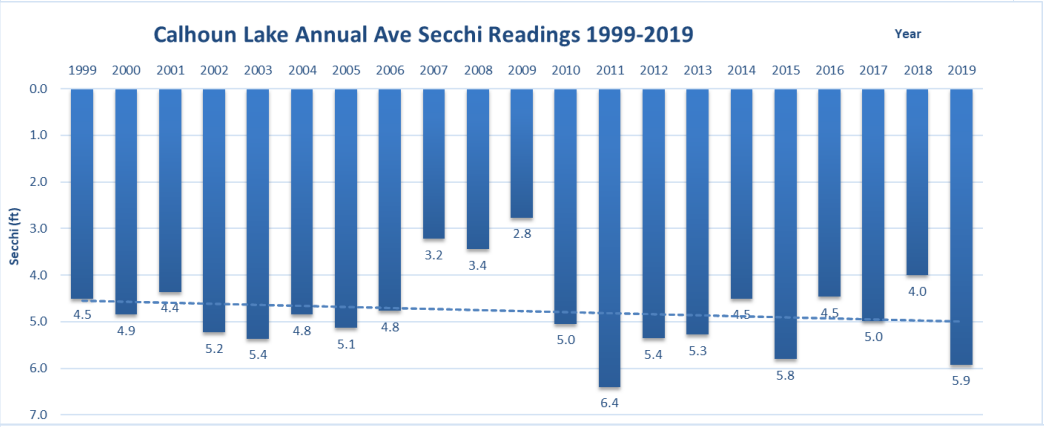


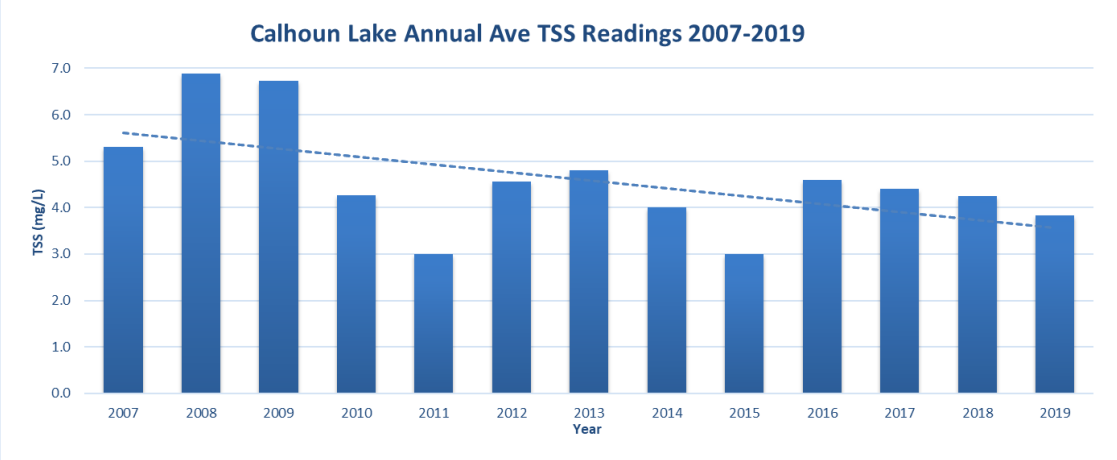
Calhoun

Middle Fork Crow River
WATERSHED DISTRICT









Calhoun has shown very consistent water quality values over the last 12 years. There has been some improvement when looking at trends for clarity (secchi) and total suspended solids (TSS). Calhoun is suitable for swimming and wading with good clarity and low algae levels throughout the open water season. Being in the North Central Hardwood Forest Ecoregion Calhoun has been predominately located within the eutrophic zone but is trending towards more of a mesotrophic state. Overall Calhoun looks like it is showing improving water quality tends.

Elkhorn Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 30 acres

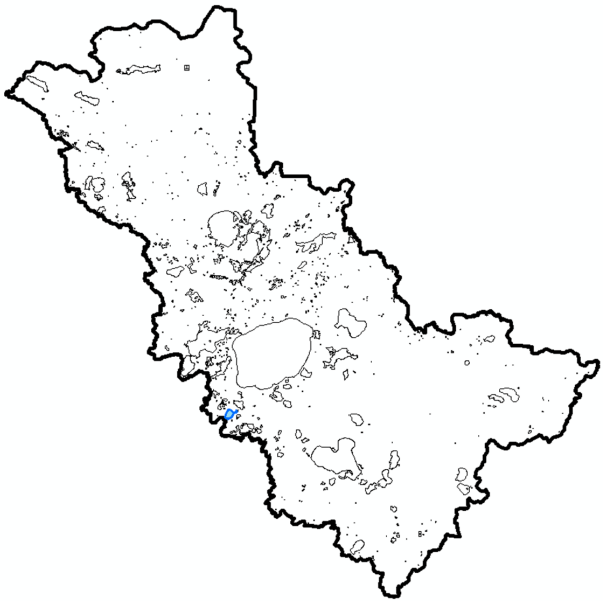
Surface Area: 79 acres

Subwatershed Area: 16,515 acres

Upstream Waters: Gina and Thompson lake

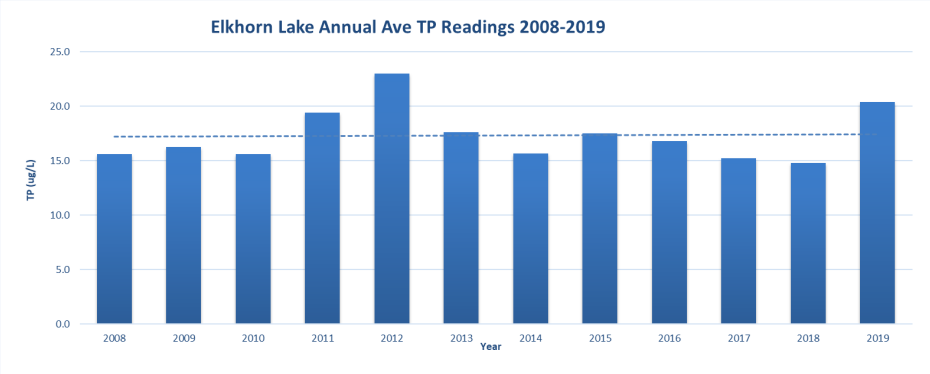
Maximum Depth: 41 feet

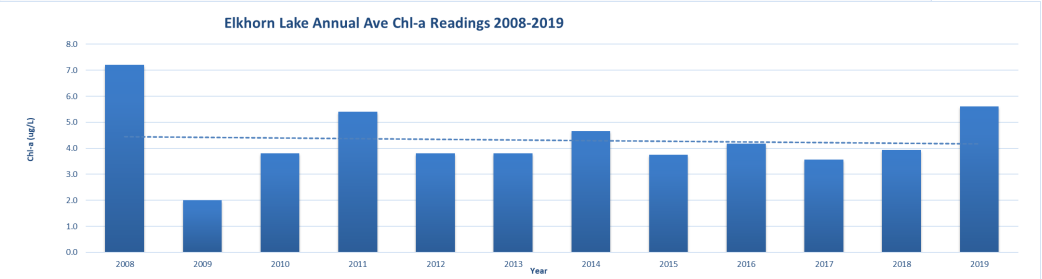
Common Fish	Bluegill, Northern Pike, Largemouth bass
Dominant Vegetation	Clasping-leaf Pondweed, Coontail, Flat-stemmed pondweed, Sago
Invasive Species	Eurasian Watermilfoil, Curly-leaf pondweed , Zebra mussel
Impairment Status	Non-impaired

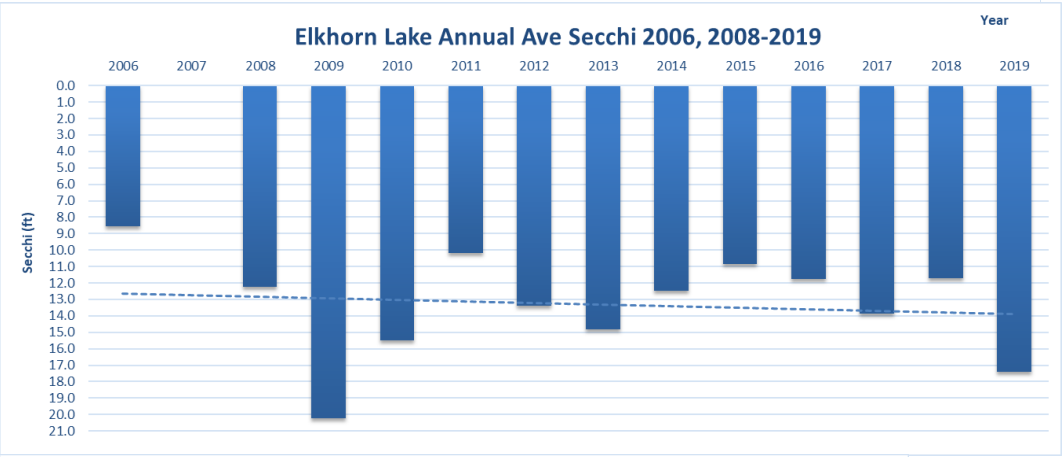


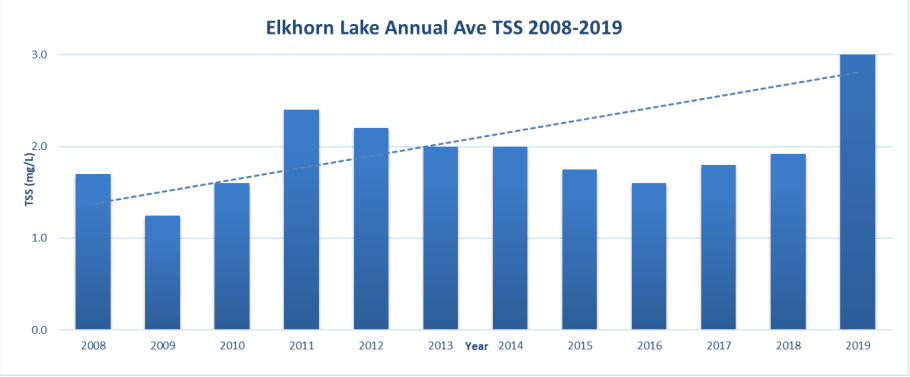
Elkhorn Lake

Middle Fork Crow River
WATERSHED DISTRICT









Elkhorn has had consistent water quality for the last 12 years. 2019 did show increases in total phosphorus (TP), Chlorophyll-a (Chl-a), and total suspended solids (TSS). Secchi readings still remained good though. The poorer water quality measurements in 2019 are something that we will looking at for 2020. To see if we see a confirming trend or if 2019 will be seen as an outlier. A lake association has now been established on the lake and hopefully will result in a collective effort across the lake to improve lake stewardship and water quality. Elkhorn has been situated predominately in the Mesotrophic zone for water quality. We will be watching for any confirming data that shows a trend towards more of a eutrophic state.

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

George Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 112 acres

Surface Area: 231 acres

Subwatershed Area: 5,348

Upstream Waters: 3 small inlets

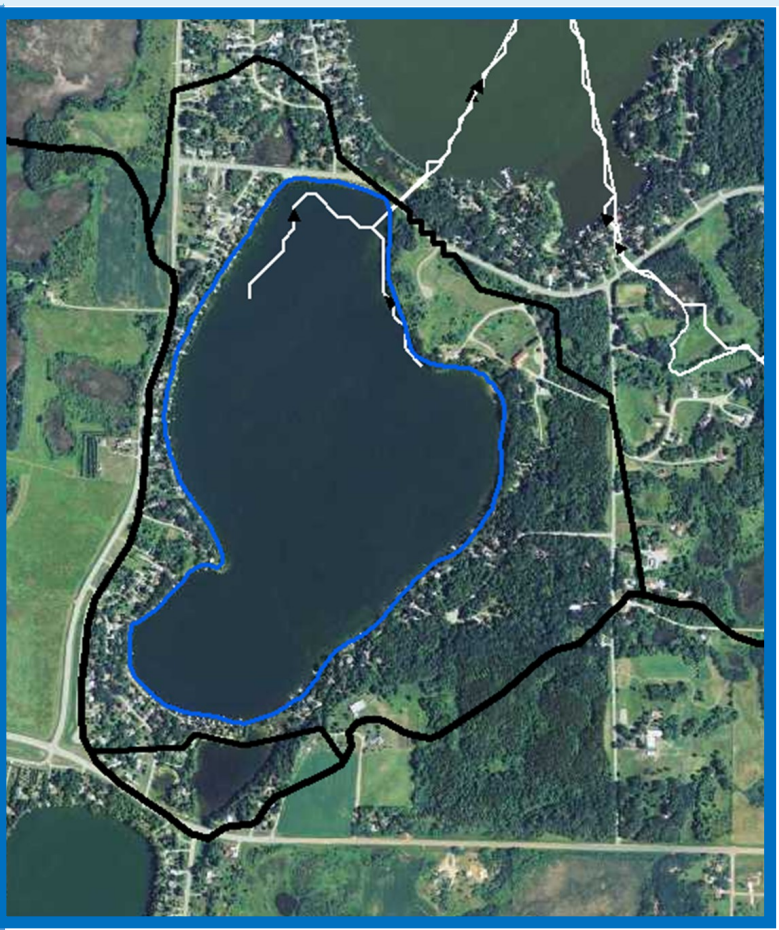
Maximum Depth: 34 feet

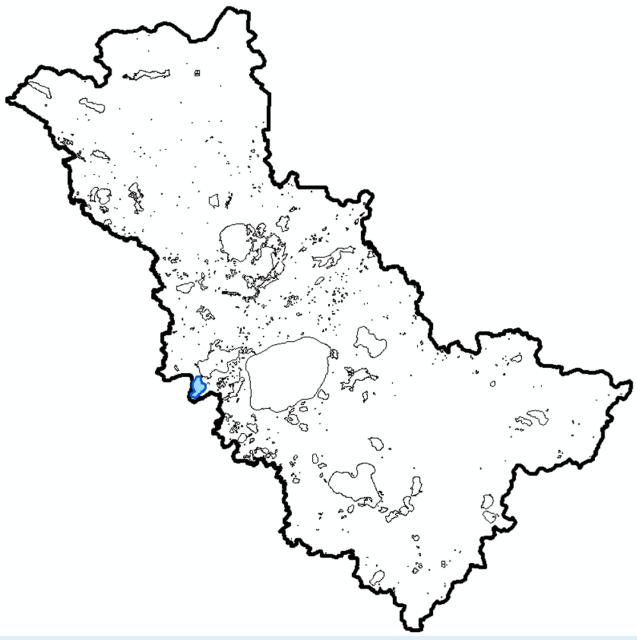
Common Fish
Bluegill, Northern Pike, Walleye

Dominant Vegetation
Flat-stemmed pondweed, Muskgrass, Bushy Pondweed, Sago

Invasive Species
Zebra Mussel

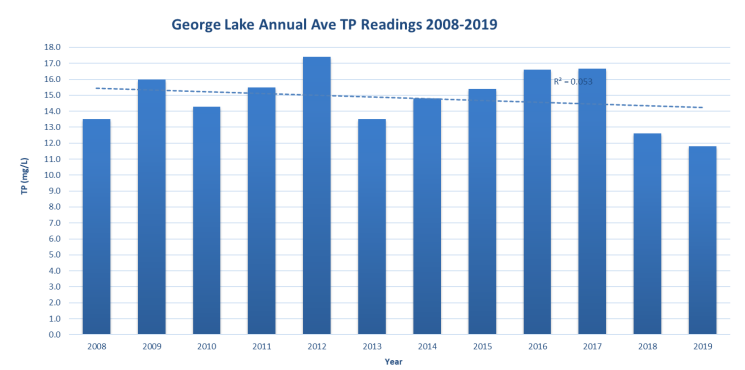
Impairment Status
Mercury in fish tissue

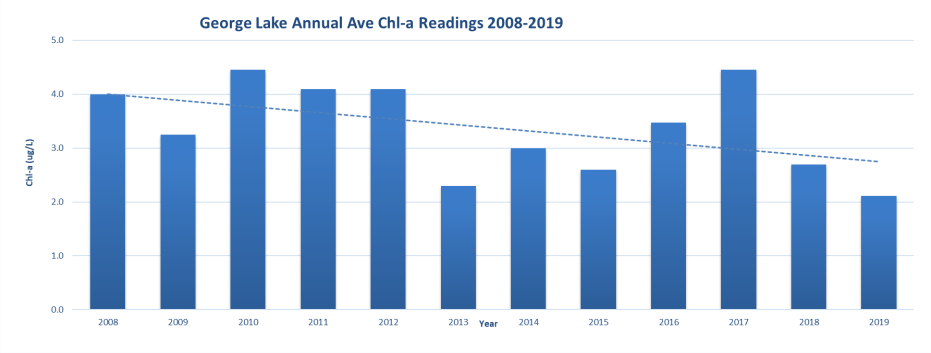


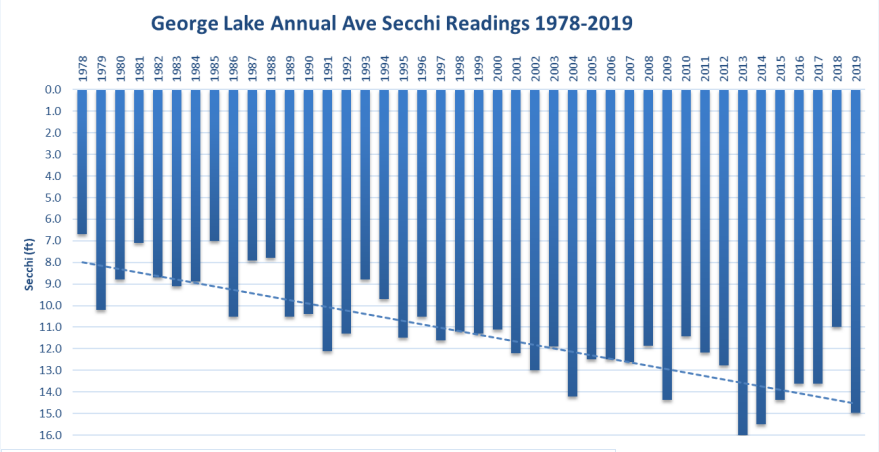


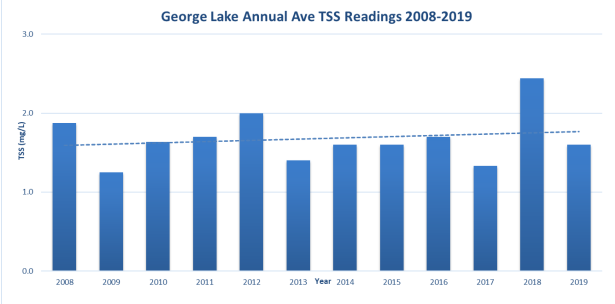
George Lake

Middle Fork Crow River
WATERSHED DISTRICT









George lake has shown improvement in most water quality parameters. Although, Total Suspended Solids (TSS) have a slight trend up. This is primarily due to very high readings in 2018. 2019 TSS was still a bit high but withing in the historical norm. Secchi readings have continually improved since 1978 which is quite impressive. But again, there you can see 2018 as an outlier since it was a very wet summer with multiple big rain events.

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

Nest Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 525 acres

Surface Area: 969 acres

Subwatershed Area: 5,348 acres

Upstream Waters: Middle Fork crow River

Maximum Depth: 40

Common Fish
Bluegill, Northern Pike, Largemouth bass

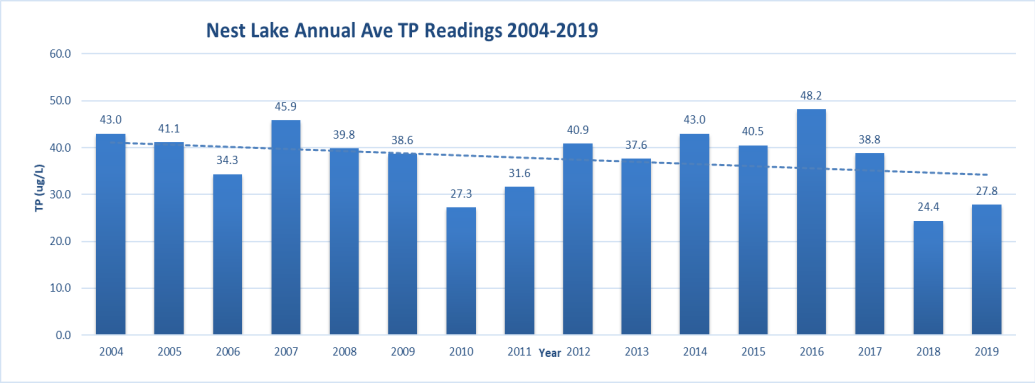
Dominant Vegetation
Coontail, Water moss, Filamentous algae, Star duckweed

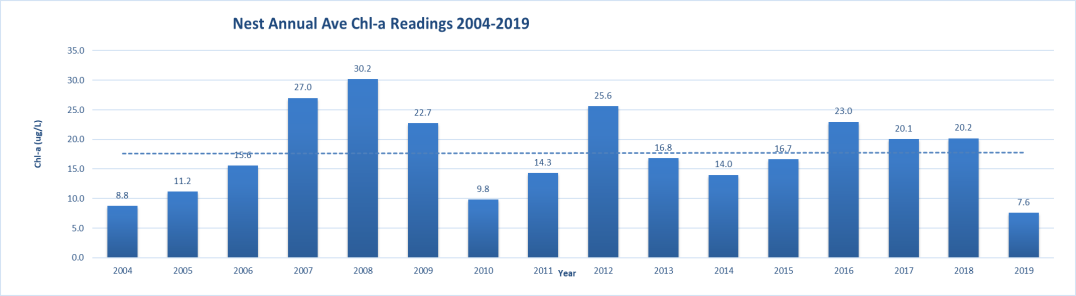
Invasive Species
Zebra mussel, Curly –leaf pondweed

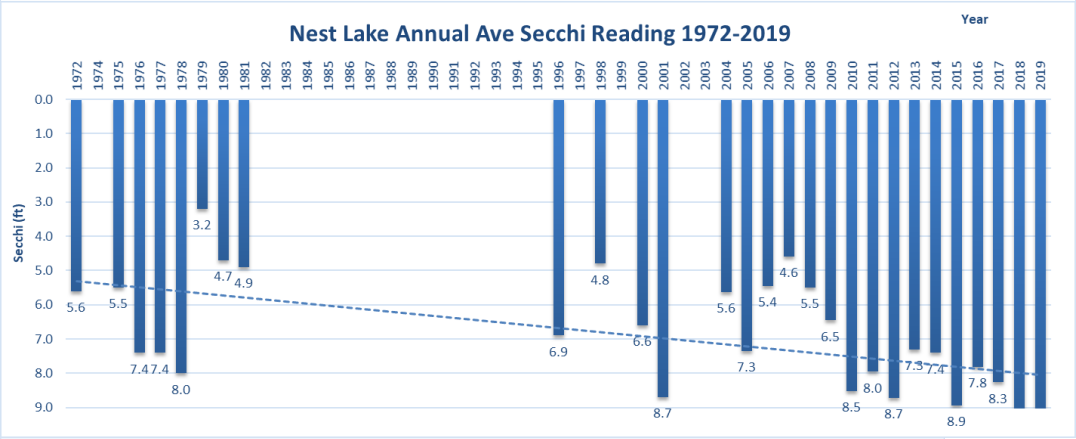
Impairment Status
Impaired for: Mercury in fish tissue, Phosphorus,

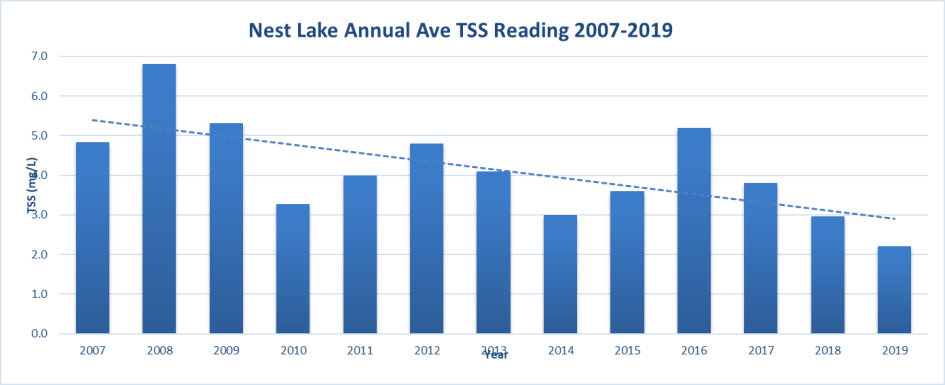
Nest Lake

Middle Fork Crow River
WATERSHED DISTRICT









Nest Lake water quality parameters have shown improvement since 2004. Especially total phosphorus (TP) and total suspended solids (TSS). Chlorophyll-a has remained fairly consistent over the years. The District is currently working on a study that looks at legacy phosphorus with in the Nest lake sediments. One component of this is taking dissolved oxygen profiles for two year every two weeks. We will be wrapping up year on of this work in October leaving one more year of readings. This data will help us determine next steps to address legacy phosphorus.

Green Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 2,035 acres

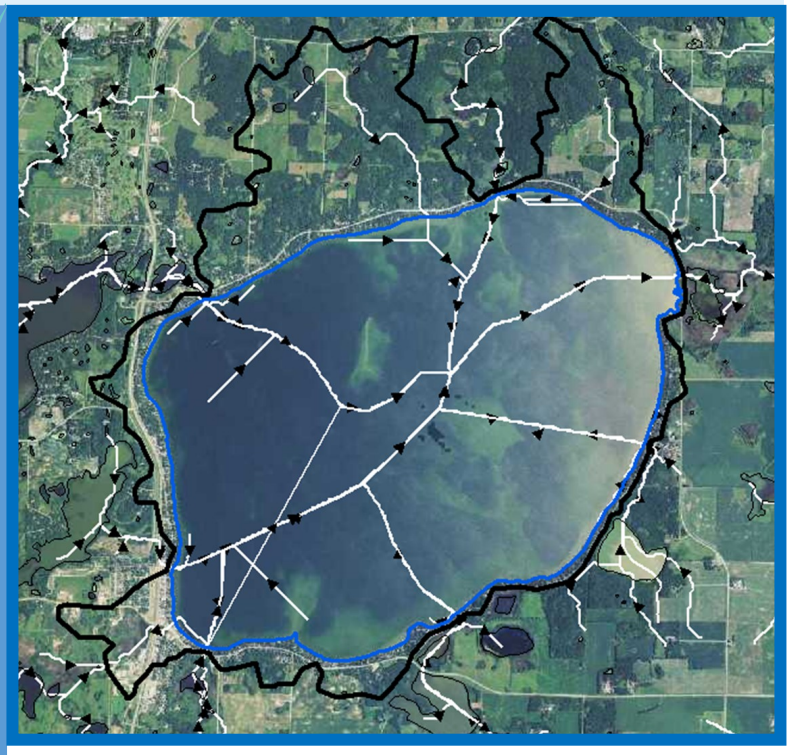
Surface Area: 5,569 acres

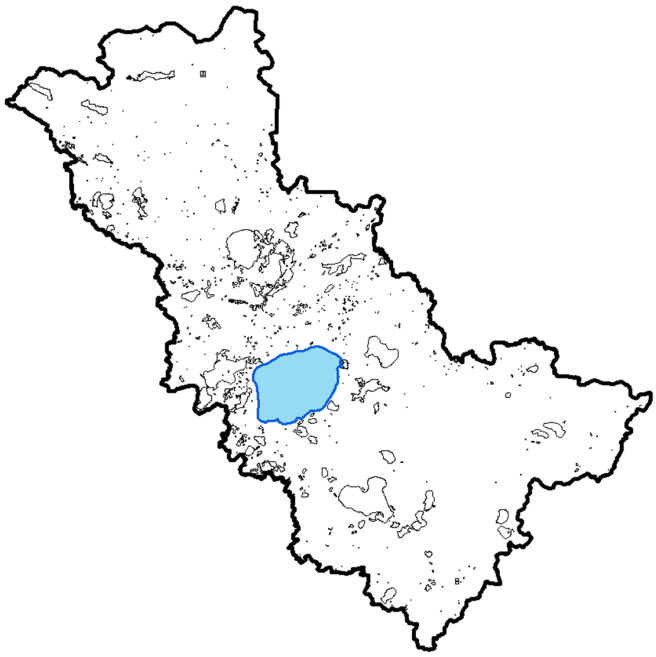
Subwatershed Area: 16,515 acres

Upstream Waters: Nest Lake

Maximum Depth: 110 feet

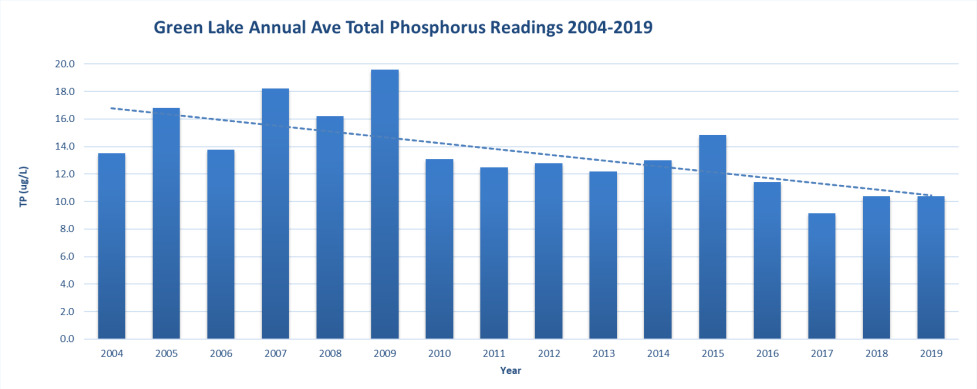
Common Fish	Rock Bass, Northern Pike, Walleye
Dominant Vegetation	Muskgrass, Clasping–leaf pondweed, Eurasian water milfoil
Invasive Species	Zebra mussel, Eurasian water-milfoil
Impairment Status	Mercury in fish tissue

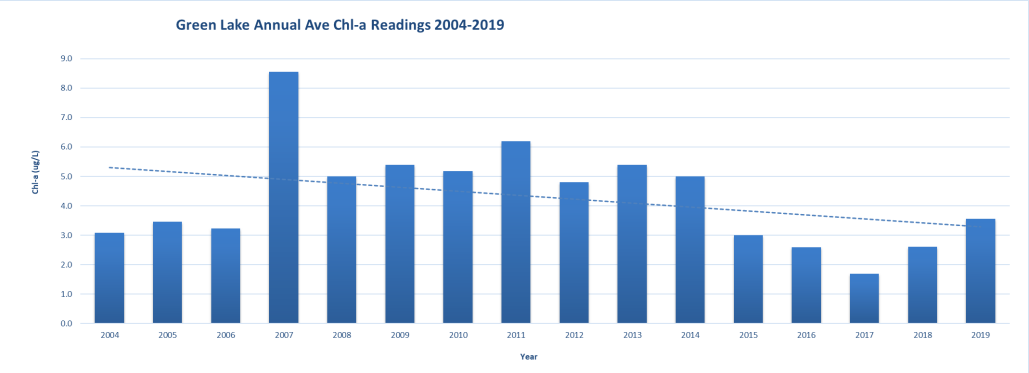


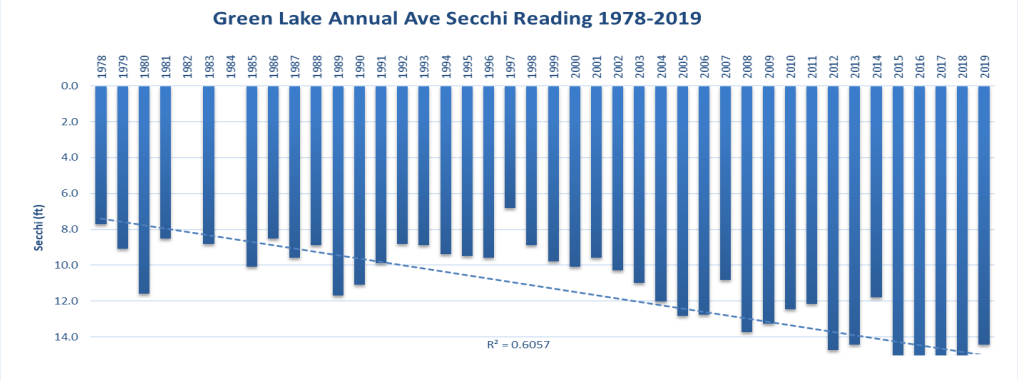


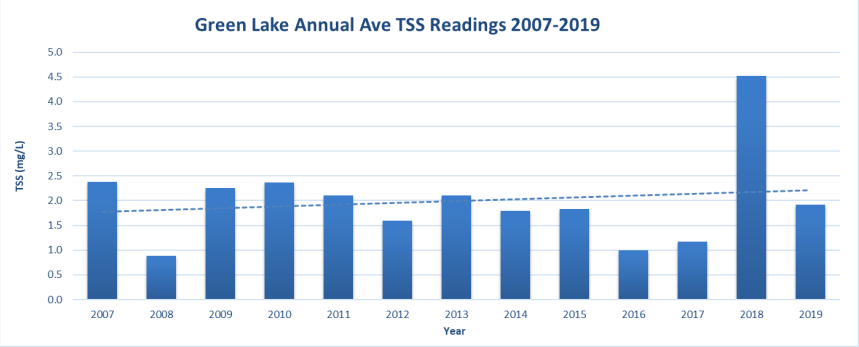
Green Lake

Middle Fork Crow River
WATERSHED DISTRICT









Green Lake, has seen a nice over trend towards better water quality since 2004. The introduction of Zebra muscles to the lake does make it harder to interpret the data but we will continue to monitor the waters to see what the long term trend is and what are the impacts of zebra muscles. We have also begun taking profile measurements but it will take a few years of data do draw any conclusions.

Long Lake

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 127 acres

Surface Area: 324.4 acres

Subwatershed Area: 5,801 acres

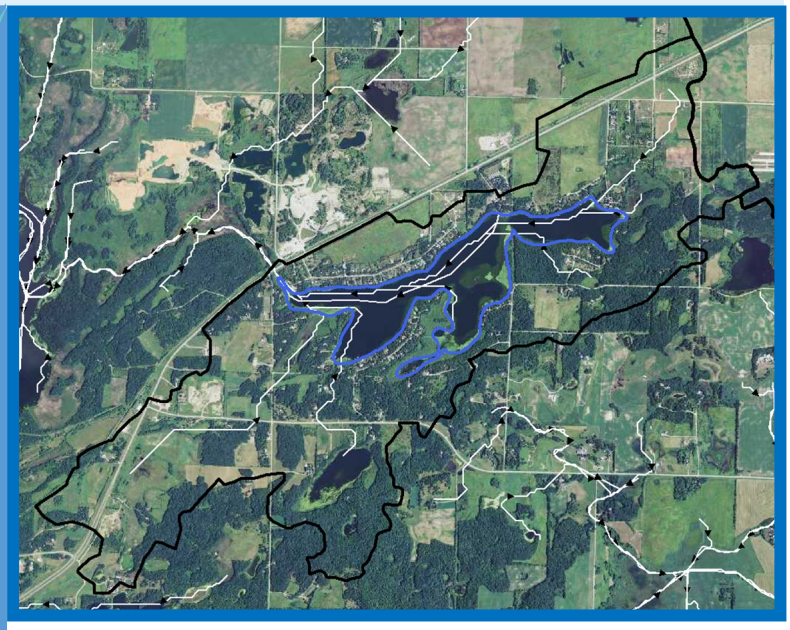
Upstream Waters: Shoemaker Lake

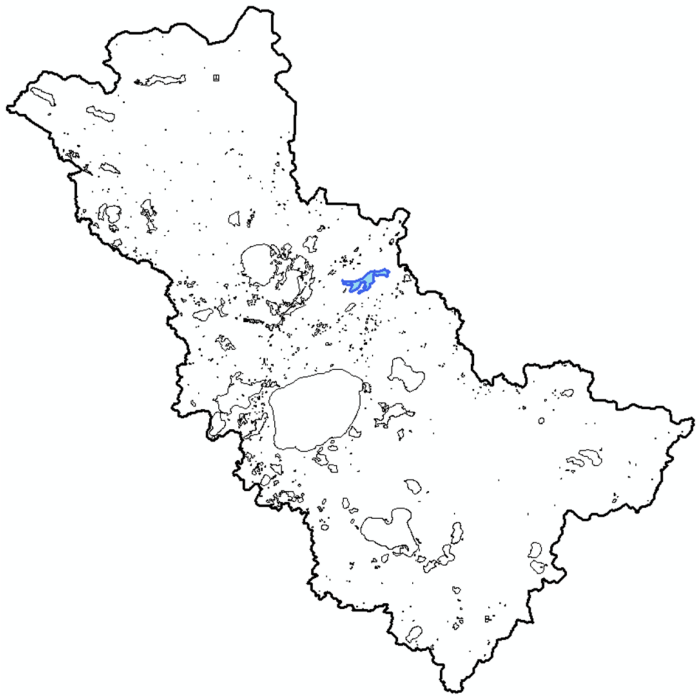
Maximum Depth: 46 Feet

Common Fish
Bluegill, Northern Pike, Largemouth bass

Dominant Vegetation
Fries' pondweed, Muskgrass, Coontail, Sago

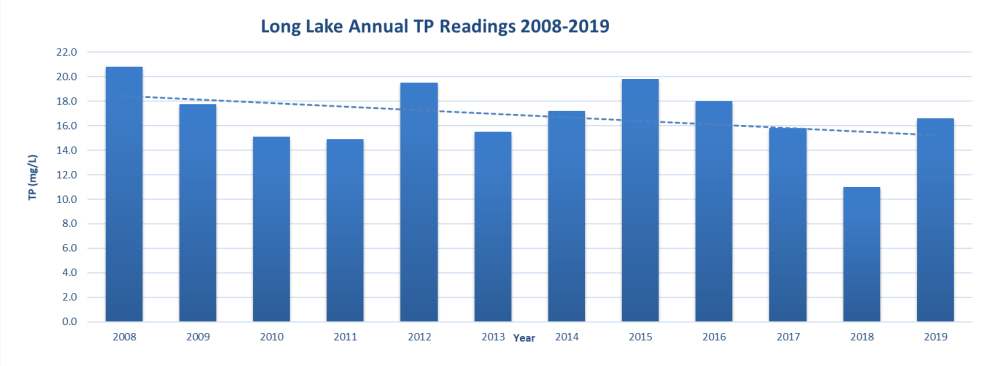
Impairment Status
Mercury in Fish Tissue

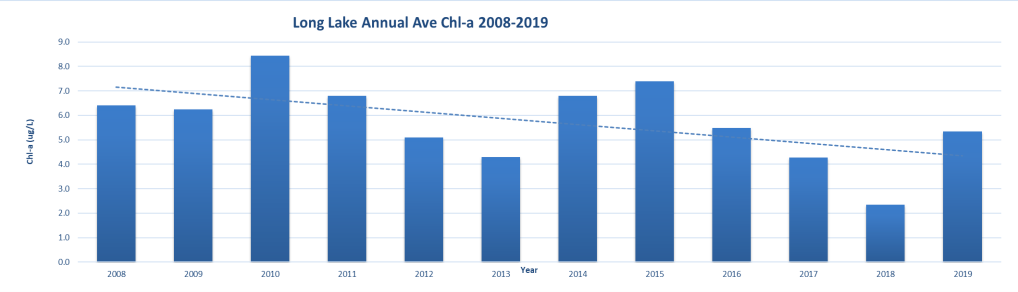


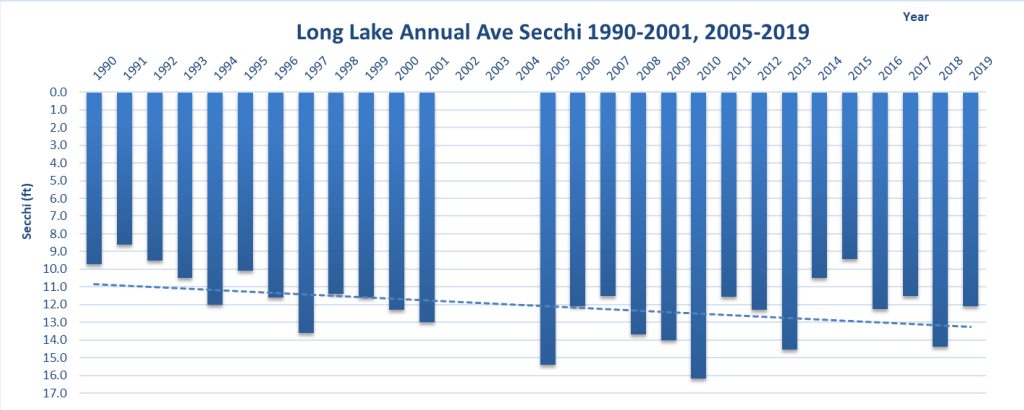


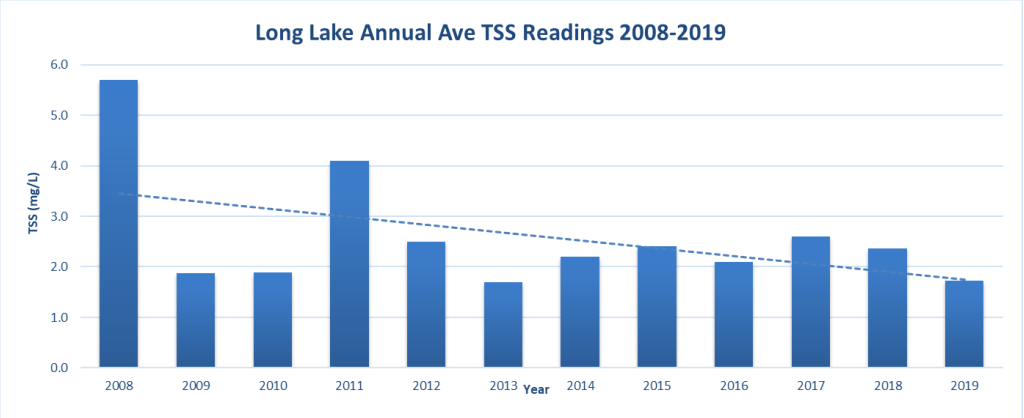
Long Lake

Middle Fork Crow River
WATERSHED DISTRICT









Long Lake, has seen a nice overall trend with improving water quality parameters. total phosphrous, chloro-phyll –a, Secchi, and total suspended solids have all shown improvement since 2008. This is a relatively small data set but we will continue to monitor Long and watch for any changes that might point to changing water quality.

Middle Fork Crow River Watershed District - 189 County Road 8 NE - PO BOX 8 Spicer, MN 56288 - T 320.796.0888
WWW.MFCROW.ORG

Monongalia

Middle Fork Crow River
WATERSHED DISTRICT

Quick Facts

Littoral Area: 2,270 acres

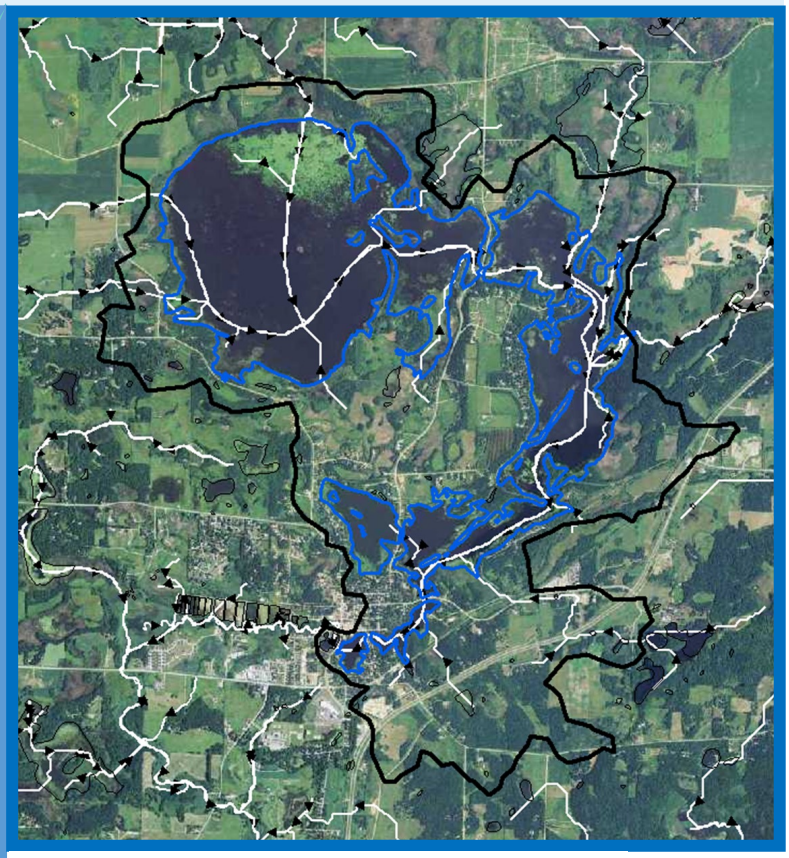
Surface Area: 2,290 acres

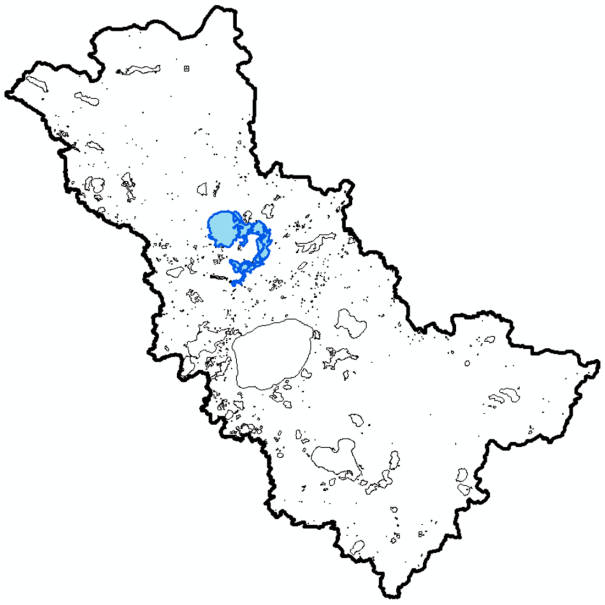
Subwatershed Area: 11,527 acres

Upstream Waters: Middle Fork crow River

Maximum Depth: 14 feet

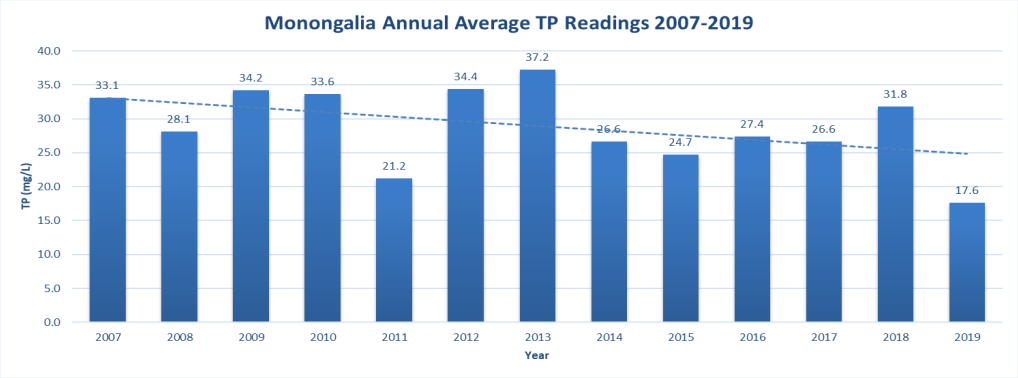
Common Fish	Bluegill, Northern Pike, Largemouth bass
Dominant Vegetation	Sago Pondweed, Muskgrass, Rice Group, Water Celery
Invasive Species	Curly leaf pond weed
Impairment Status	Mercury in fish tissue

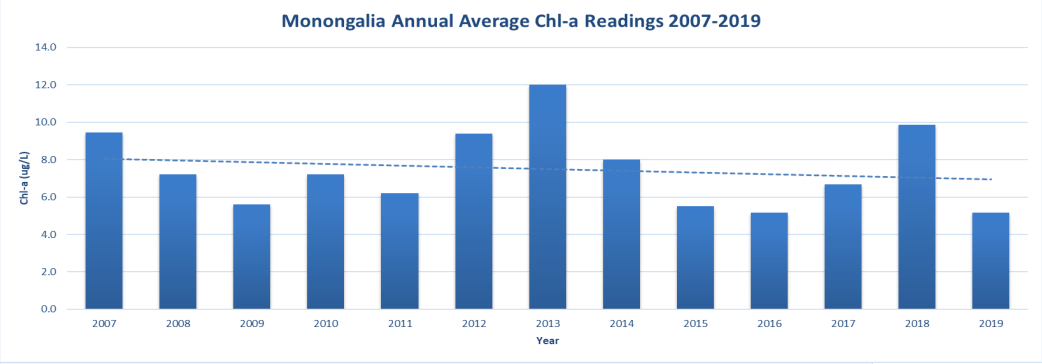


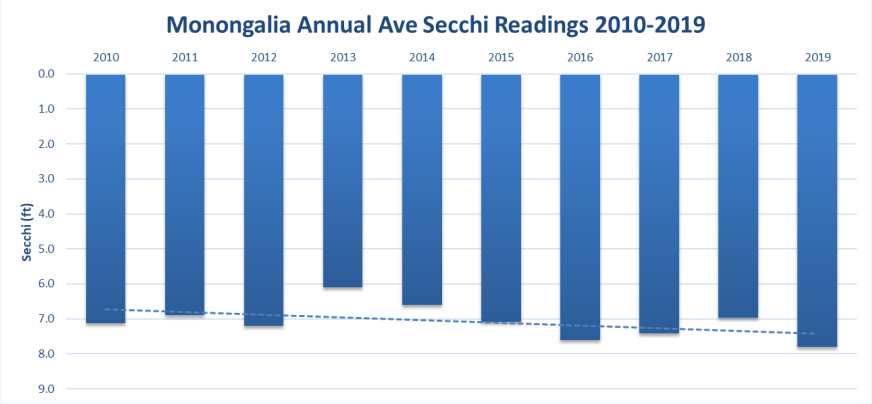


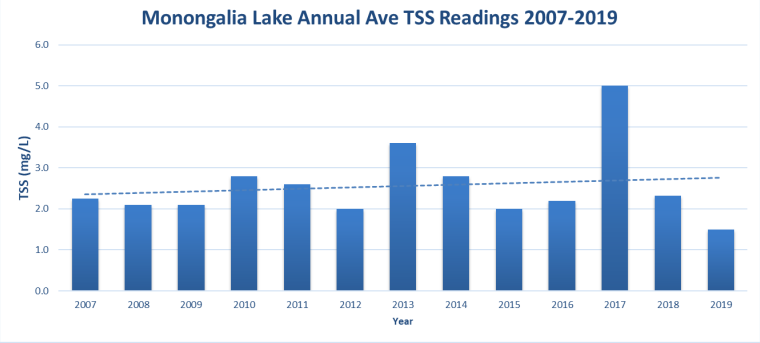
Monongalia

Middle Fork Crow River
WATERSHED DISTRICT







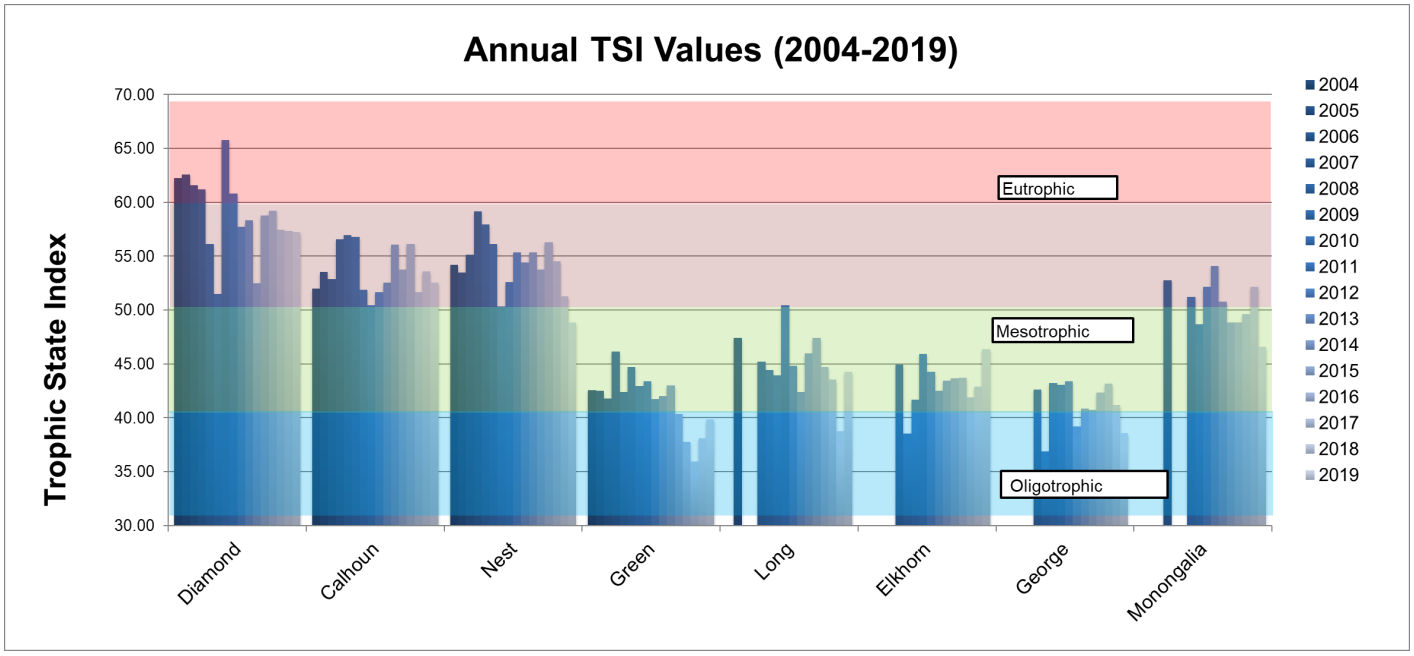


Monongalia, has shown improving water quality when looking at total phosphorus, Chloro-phyll-a and Secchi read-ings. Total suspended solids have shown a slight uptrend but part of that increase is largely due to the very wet year in 2007 which drove run off and resulted in higher than normal sediment entering waters. We will continue to monitor Mo-nongalia for any changes in water quality.

Trophic State

Middle Fork Crow River
WATERSHED DISTRICT

To determine the overall health of a lake one can look at Carlson's Trophic State Index (TSI). Trophic state indicates the overall productivity, or plant and algae growth, occurring in a lake. The TSI uses algal biomass as its basis and is determined by using three productivity parameters: total phosphorus, chlorophyll-a, and secchi disk.



When looking at the above data one can see that the lakes have been fairly consistent since 2004 with a slight improvement in TSI values. We are making lower lows and lower highs as you look at each individual lake.

TSI 30-40 Oligotrophic – clear water, hypolimnion oxygenated throughout the year (except in shallow lakes)

TSI 40-50 Mesotrophic – Water moderately clear, but anoxia becoming more likely in hypolimnion during the summer

TSI 50-60 Lower Boundary of classical eutrophy: Decreased transparency, anoxic hypolimnia during the summer, aquatic plant problems evident, warm water fisheries only.

TSI 60-70 Eutrophic: Dominance of blue-green algae, algal scums probable, extensive aquatic plant problems

TSI 70-80 Hypereutrophic: Heavy algal blooms possible throughout the summer, dense aquatic plant beds, but extent limited by light penetration.