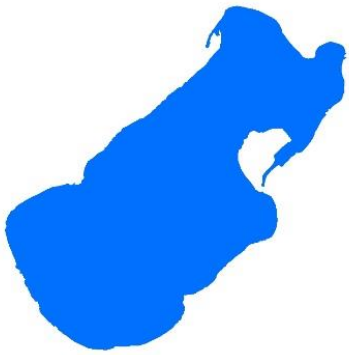
Sturgeon Lake 58-0067-00 Pine County



Sturgeon Lake is located 5 miles east of Sturgeon Lake, MN in Pine County. It is a medium sized lake, covering approximately 1,706 acres with a shoreline length of 9.56 miles (Table 1). Sturgeon Lake has no major inlets or major outlets.

Water quality data have been collected on Sturgeon Lake in 1980 and then continually from 1987-2018 (Tables 2 & 3). These data show that the lake is mesotrphic (TSI = 41) with moderately clear water conditions most of the summer and excellent recreational opportunities.

Table 1. Sturgeon Lake location and key physical characteristics.

Location Data

MN Lake ID: **58-0067-00**
County: **Pine**
Ecoregion: **Northern Lakes & Forests**
Major Watershed: **Kettle River**
Latitude/Longitude: **46.376959/-92.757109**
Invasive Species: **Eurasian water milfoil**

Physical Characteristics

Surface area (acres): **1,705.91**
Littoral area (acres): **495.2**
% Littoral area: **29%**
Max depth (ft), (m): **40, 12.2**
Inlets: **0**
Outlets: **0**
Public Accesses: **1**

Table 2. Availability of primary data types for Sturgeon Lake.

Data Availability

Transparency data		**Limited Available**
Chemical data		**Limited Data Available**
Inlet/Outlet data		**No Data Available**
Recommendations		**For recommendations refer to page 14.**

Lake Map

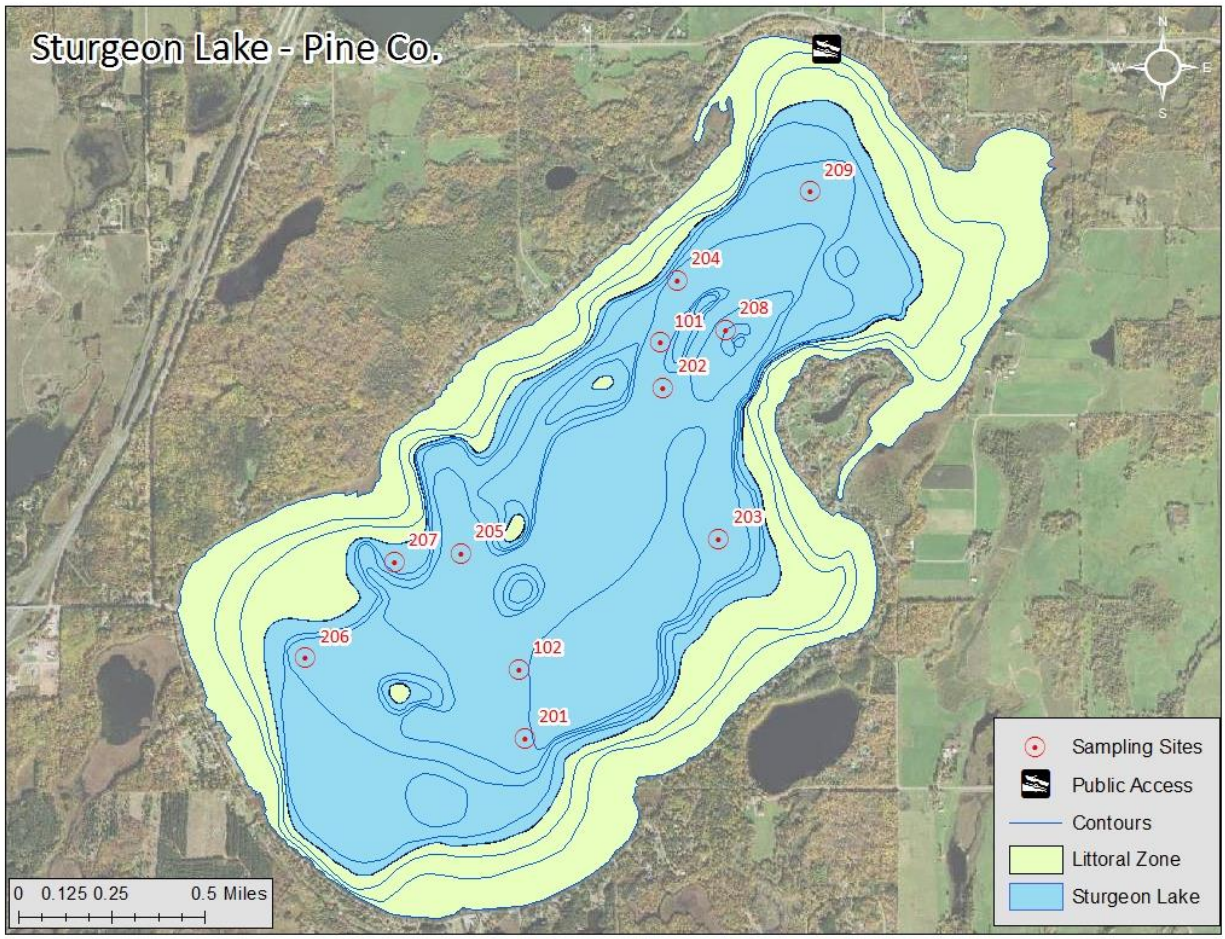


Figure 1. Map of Sturgeon Lake with 2018 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can reach the bottom of the lake.

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the MPCA Lake Monitoring Program Project (MPCA), Clean Water Legacy Surface Water Monitoring (CWLSWM), Lake Assessment Projects (LAP), Citizen Lake Monitoring Program (CLMP), Pine County Surface Water Assessment Grant (SWAG), RMB Environmental Labs (RMB).

Lake Site	Depth (ft)	Monitoring Programs
58-0067-00-101	30	MPCA 1980, 1988, 1992; LAP 2003
58-0067-00-102	35	MPCA 1988, 1992; LAP 2003, CLMP 2017-2018
58-0067-00-201	35	CLMP 1987-2000
58-0067-00-202	30	CLMP 1992; SWAG 2008
58-0067-00-203	35	CLMP 1996-1999
58-0067-00-204	35	CLMP 2005-2006, 2008-2016
58-0067-00-205	35	CLMP 2005-2006, 2008-2016
58-0067-00-206	25	CLMP 2005-2012, 2014-2015
58-0067-00-207	20	CLMP 2005-2012, 2014-2015
58-0067-00-208	40	CWLSWM 2015-2017
58-0067-00-209	25	RMB 2018

Average Water Quality Statistics & Comparisons

The information below describes available chemical data for Sturgeon Lake through 2018 (Table 4). Data for total phosphorus, chlorophyll *a*, and Secchi depth are from various sites.

Minnesota is divided into 7 ecoregions based on land use, vegetation, precipitation and geology. The Minnesota Pollution Control Agency (MPCA) has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion[1] (Table 4). Sturgeon Lake is in the Northern Lakes and Forests Ecoregion (Figure 2).

The MPCA has developed Impaired Waters Standards for lakes in each ecoregion to determine if a lake is impaired for excess phosphorus/eutrophication (Table 4). Lakes that are over the impaired waters standards are placed on the state's Impaired Waters List[2].

Figure 2. Minnesota ecoregions.

Table 4. Water quality means compared to ecoregion ranges and impaired waters standard.

Parameter	Mean	Ecoregion Range[1]	Impaired Waters Standard[2]	Interpretation
Total phosphorus (µg/L)	17.9	14 – 27	> 30	Results are within the expected range for the Northern Lakes and Forests Ecoregion and the lake is not near impaired for any parameters.
[3]Chlorophyll *a* (µg/L)	4.84	4 – 10	> 9	
Chlorophyll *a* max (µg/L)	13.5	< 15		
Secchi depth (ft)	14.4	8 – 15	< 6.5	
Dissolved oxygen	*See page 8*			Dissolved oxygen depth profiles show that the lake stratifies during summer months
Total Kjeldahl Nitrogen (mg/L)	0.56	<0.4 – 0.75		Indicates limited nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	36.8	40 – 140		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	NA	10 – 35		NA
pH	7.7	7.2 – 8.3		Within the expected range for the ecoregion. Lake water pH less than 6.5 can affect fish spawning and the solubility of metals in the water.
Chloride (mg/L)	1.65	0.6 – 1.2		Outside the expected range for the ecoregion. Indicates high amount of dissolved salts in lake.
Total Suspended Solids (mg/L)	2.16	<1 – 2		Indicates turbid water.
Specific Conductance (umhos/cm)	73.08	50 – 250		Within the expected range for the ecoregion.
TN:TP Ratio	31:1	25:1 - 35:1		Outside the expected range for the ecoregion, and shows the lake is not phosphorus limited.

[1]The ecoregion range is the 25th-75th percentile of summer means from ecoregion reference lakes: https://www.pca.state.mn.us/quick-links/eda-guide-typical-minnesota-water-quality-conditions
[2]For further information regarding the Impaired Waters Assessment program, refer to http://www.pca.state.mn.us/water/tmdl/index.html
[3]Chlorophyll *a* measurements have been corrected for pheophytin
Units: 1 mg/L (ppm) = 1,000 ug/L (ppb)

Water Quality Characteristics - Historical Means and Ranges

Table 5. Water quality means and ranges for sites 208 and 204.

Parameters	Site 208	Site 204
Total Phosphorus Mean (µg/L):	13.8	NA
Total Phosphorus Min:	4.0	NA
Total Phosphorus Max:	62.0	NA
Number of Observations:	24	NA
Chlorophyll *a* Mean (ug/L):	4.48	NA
Chlorophyll-a Min:	1.46	NA
Chlorophyll-a Max:	11.6	NA
Number of Observations:	10	NA
Secchi Depth Mean (ft):	15.1	14.8
Secchi Depth Min:	10.2	7.9
Secchi Depth Max:	21.3	24.9
Number of Observations:	10	74

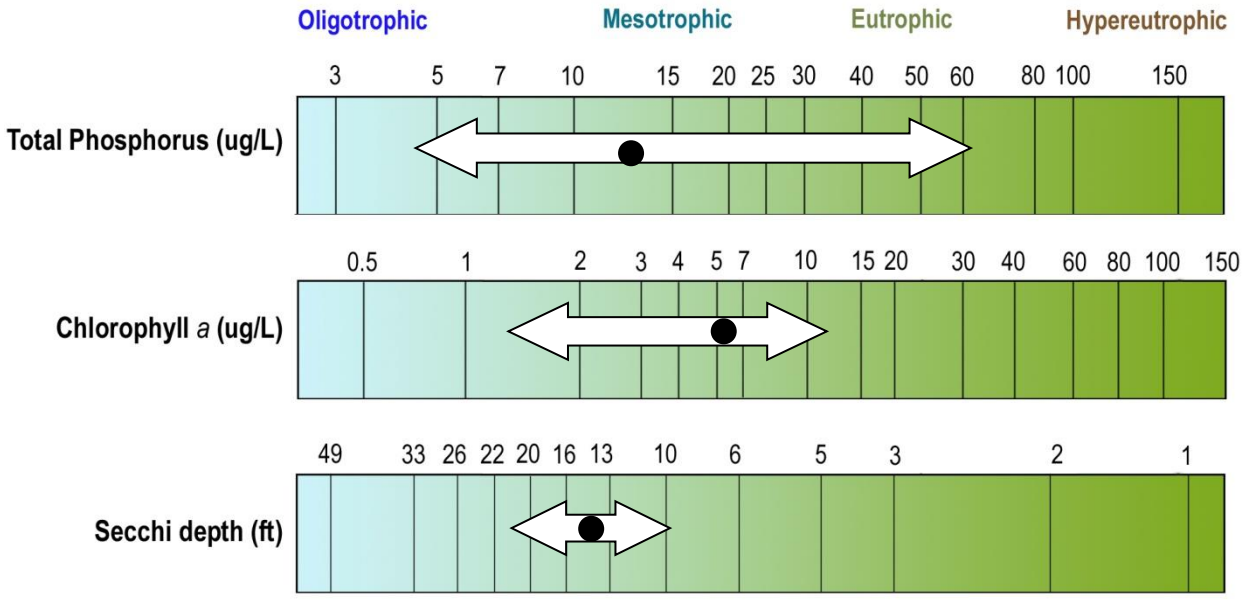


Figure 3. Sturgeon Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Site 208). Figure adapted after Moore and Thornton, [Ed.]. 1988.

Transparency (Secchi Depth)

Transparency is how easily light can pass through a substance. In lakes it is how deep sunlight penetrates through the water. Plants and algae need sunlight to grow, so they are only able to grow in areas of lakes where the sun penetrates. Water transparency depends on the number of particles in the water. An increase in particulates results in a decrease in transparency. The transparency varies year to year due to changes in weather, precipitation, lake use, flooding, temperature, lake levels, etc.

The annual mean transparency in Sturgeon Lake ranges from 11.6 to 17.3 feet (Figure 4). The annual means hover fairly close to the long-term mean of 14.8. For trend analysis, see page 10. Transparency monitoring should be continued annually at site 208 in order to track water quality changes.

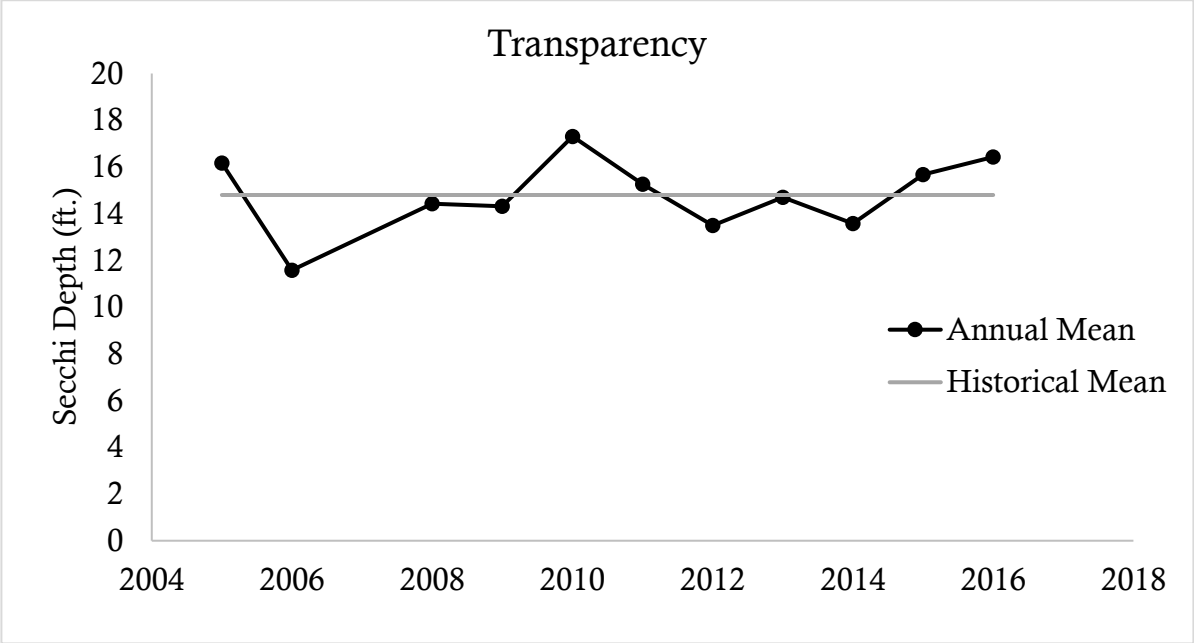


Figure 4. Annual mean transparency compared to long-term mean transparency

It is important for lake residents to understand the seasonal transparency dynamics in their lake so that they are not worried about why their transparency is lower in August than it is in June. It is typical for a lake to vary in transparency throughout the summer (Figure 5).

The maximum Secchi reading is usually obtained in early summer. Sturgeon Lake transparency is high in May and June, and then declines through August. The transparency then rebounds in October after fall turnover. This transparency dynamic is typical of a Minnesota lake. The dynamics have to do with algae and zooplankton population dynamics, and lake turnover.

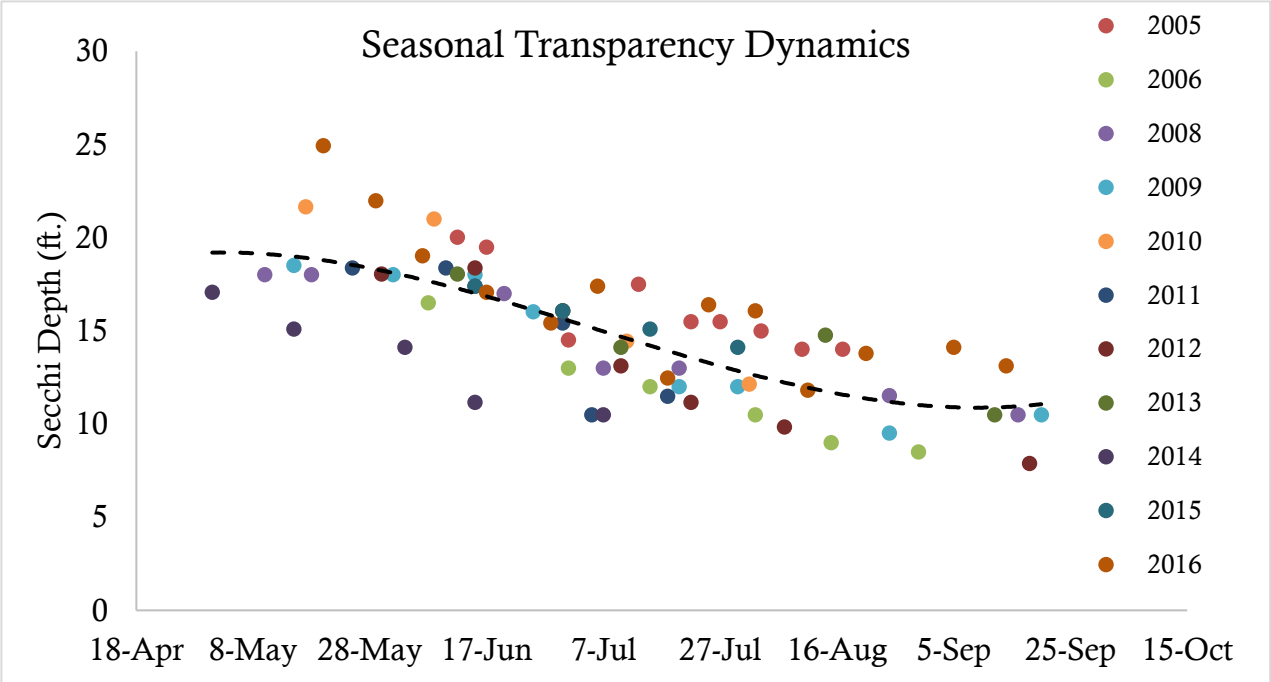


Figure 5. Seasonal transparency dynamics and year to year comparison (Site 204). The black line represents the pattern in the data.

User Perceptions

When volunteers collect Secchi depth readings, they record their perceptions of the water based on the physical appearance and the recreational suitability. These perceptions can be compared to water quality parameters to see how the lake "user" would experience the lake at that time. Looking at transparency data, as the Secchi depth decreases the perception of the lake's physical appearance and recreational suitability decreases (Figures 6-7).

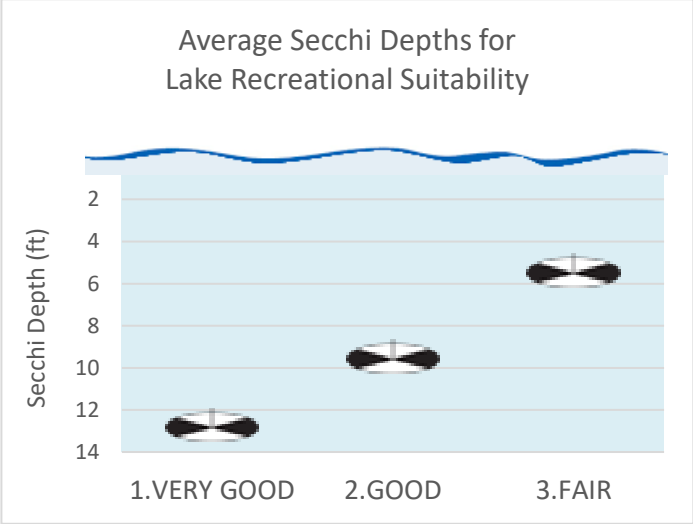


Figure 6. Average Secchi depth (ft) for each lake recreational suitability rating.

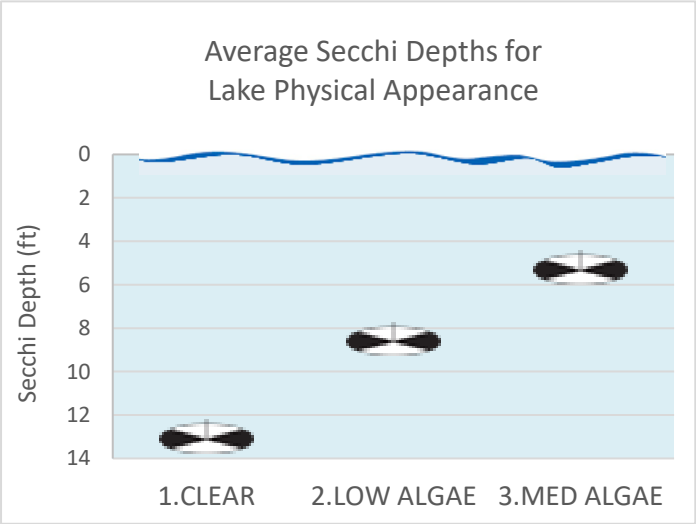


Figure 7. Average Secchi depth for each lake physical appearance rating.

Algae

Chlorophyll *a* is the pigment that makes plants and algae green. Chlorophyll *a* is tested in lakes to determine the algae concentration or how "green" the water is.

Chlorophyll *a* concentrations greater than 10 ug/L are perceived as a mild algae bloom, while concentrations greater than 20 ug/L are perceived as a nuisance.

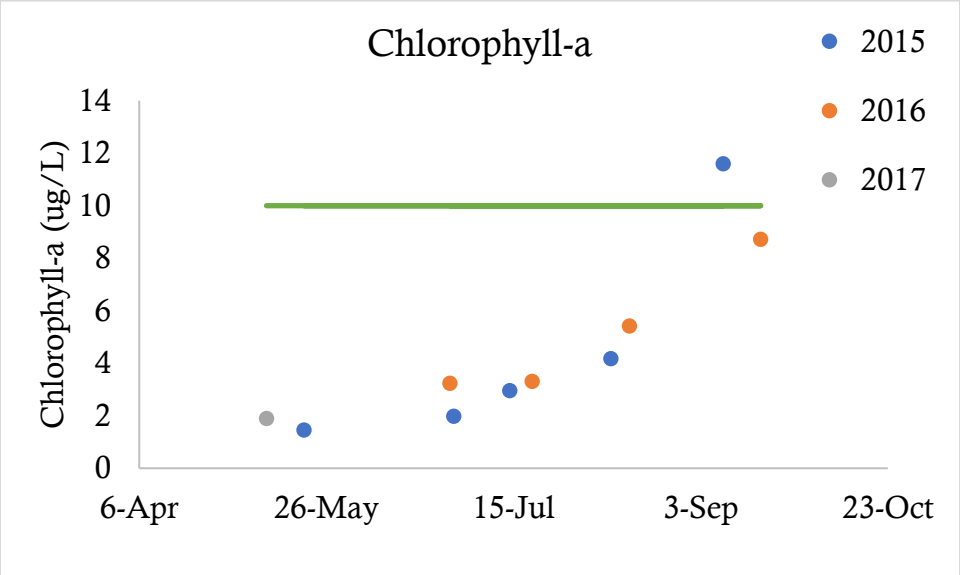


Figure 6. Chlorophyll a concentrations (ug/L) for Sturgeon Lake at site 208.

Chlorophyll *a* was evaluated in Sturgeon Lake at site 208 from 2015-2017 (Figure 8). Chlorophyll *a* concentrations did go above 10 ug/L in 2015, indicating a minor algae bloom. There was not much variation over the years monitored and chlorophyll-*a* concentrations remained relatively steady over the summer.

Phosphorus

Sturgeon Lake is phosphorus limited, which means that algae and aquatic plant growth is dependent upon available phosphorus.

Total phosphorus was evaluated in Sturgeon Lake from 2015-2017 at site 208. The data do not indicate much seasonal variability. Majority of the data points fall into the mesotrophic classification (Figure 9).

Phosphorus should continue to be monitored to track any future changes in water quality.

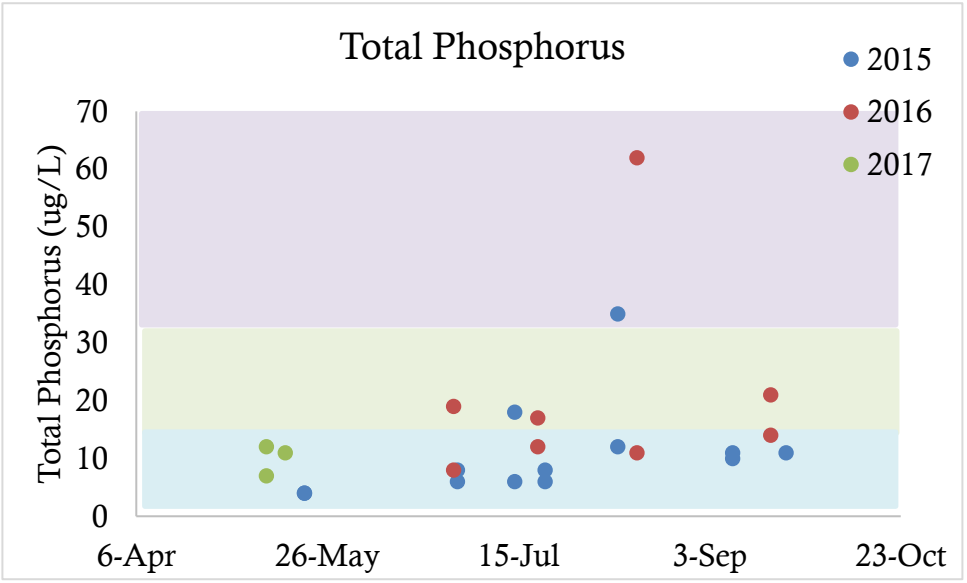


Figure 7. Historical total phosphorus concentrations (ug/L) for Sturgeon Lake site 208.

Oxygen

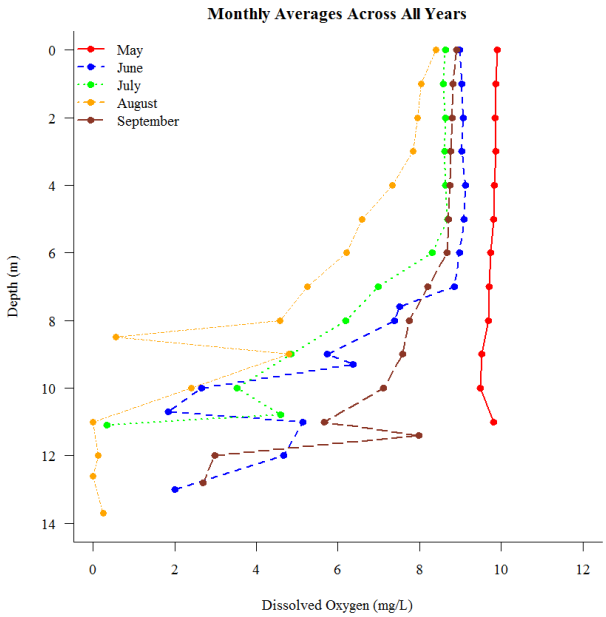


Figure 8. Representative dissolved oxygen profiles from site 208 year in Sturgeon Lake.

Dissolved Oxygen (DO) is the amount of oxygen dissolved in lake water. Oxygen is necessary for all living organisms to survive except for some bacteria. Living organisms breathe in oxygen that is dissolved in the water. Dissolved oxygen levels of <5 mg/L are typically avoided by game fisheries.

Sturgeon Lake is a relatively deep lake, with a maximum depth of 40 feet. Dissolved oxygen profiles from data collected in 2016 and 2017 at site 208 show periods of stratification and periods of mixing throughout the lakes (Figure 10). Some factors that could influence the mixing regime for Sturgeon Lake include wind intensity and chlorophyll-α concentrations.

Trophic State Index (TSI)

TSI is a standard measure or means for calculating the trophic status or productivity of a lake. More specifically, it is the total weight of living algae (algae biomass) in a waterbody at a specific location and time. Three variables, chlorophyll a, Secchi depth, and total phosphorus, independently estimate algal biomass.

If all three TSI numbers are within a few points of each other, they are strongly related. If they are different, there are other dynamics influencing the lake's productivity, and TSI mean should not be reported for the lake. Sturgeon Lake falls into the Eutrophic range (Tables 6, 7).

Table 6. Trophic State Index for Sturgeon Lake.

Trophic State Index	
TSI Phosphorus:	**46**
TSI Chlorophyll-a	**46**
TSI Secchi	**39**
TSI Mean	**43**
Trophic State:	**Mesotrophic**

Numbers represent the mean TSI for each parameter.

Table 7. Trophic state index attributes and their corresponding fisheries and recreation characteristics.

Sturgeon Lake

TSI	Attributes	Fisheries & Recreation
<30	**Oligotrophy:** Clear water, oxygen throughout the year at the bottom of the lake, deep cold water.	Trout fisheries dominate.
30-40	Bottom may become anoxic (no oxygen).	Trout fisheries in deep lakes only. Walleye, Cisco present.
40-50	**Mesotrophy:** Water moderately clear most of the summer. May be "greener" in late summer.	No oxygen at the bottom of the lake results in loss of trout. Walleye may predominate.
50-60	**Eutrophy:** Algae and aquatic plant problems possible. "Green" water most of the year.	Warm-water fisheries only. Sturgeonmay dominate.
60-70	Blue-green algae dominate, algal scums and aquatic plant problems.	Dense algae and aquatic plants. Low water clarity may discourage swimming and boating.
70-80	**Hypereutrophy:** Dense algae and aquatic plants.	Water is not suitable for recreation.
>80	Algal scums, few aquatic plants.	Rough fish (carp) dominate; summer fish kills possible.

Source: Carlson, R.E. 1997. A trophic state index for lakes. *Limnology and Oceanography*. 22:361-369.

Trend Analysis

For detecting trends, a minimum of 8-10 years of data with 4 or more readings per season are recommended. Minimum confidence accepted by the MPCA is 90%. This means that there is a 90% chance that the data are showing a true trend and a 10% chance that the trend is a random result of the data. Only short-term trends can be determined with just a few years of data, because there can be different wet years and dry years, water levels, weather, etc, that affect the water quality naturally.

Sturgeon Lake did not have enough data to perform a trend analysis on transparency at any site but should be continued to be monitored in future years to detect trends in water quality.

Lakeshed

Understanding a lakeshed requires an understanding of basic hydrology. A watershed is defined as all land and water surface area that contribute excess water to a defined point. The MN DNR has delineated three basic scales of watersheds (from large to small): 1) basins, 2) major watersheds, and 3) minor watersheds.

The Kettle River Watershed is one of the watersheds that make up the St. Croix River Basin, which drains south to the Gulf of Mexico (Figure 11).

The MN DNR also has evaluated catchments for each individual lake with greater than 100 acres surface area. These lakesheds (catchments) are the "building blocks" for the larger scale watersheds. Sturgeon Lake falls within lakeshed 3403400 (Figure 11). Though very useful for displaying the land and water that contribute directly to a lake, lakesheds are not always true watersheds because they may not show the water flowing into a lake from upstream streams or rivers. While some lakes may have only one or two upstream lakesheds draining into them, others may be connected to a large number of lakesheds, reflecting a larger drainage area via stream or river networks.

In an effort to prioritize protection and restoration efforts of fishery lakes, the MN DNR has developed a ranking system by separating lakes into two categories based on their lakeshed, those needing protection and those needing restoration. Modeling by the DNR Fisheries Research Unit suggests that total phosphorus concentrations increase significantly over natural concentrations in lakes that have watershed with disturbance greater than 25%. Therefore, lakes with watersheds that have less than 25% disturbance need protection and lakes with more than 25% disturbance need restoration (Table 8). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land or conservation easement.

Table 8. Suggested approaches for watershed protection and restoration of DNR-managed fish lakes in Minnesota.

Watershed Disturbance (%)	Watershed Protected (%)	Management Type	Comments
< 25%	> 75%	Vigilance	Sufficiently protected -- Water quality supports healthy and diverse native fish communities. Keep public lands protected.
	< 75%	Protection	Excellent candidates for protection -- Water quality can be maintained in a range that supports healthy and diverse native fish communities. Disturbed lands should be limited to less than 25%.
25-60%	n/a	Full Restoration	Realistic chance for full restoration of water quality and improve quality of fish communities. Disturbed land percentage should be reduced and BMPs implemented.
> 60%	n/a	Partial Restoration	Restoration will be very expensive and probably will not achieve water quality conditions necessary to sustain healthy fish communities. Restoration opportunities must be critically evaluated to assure feasible positive outcomes.

The next step was to prioritize lakes within each of these management categories. DNR Fisheries identified high value fishery lakes, such as cisco refuge lakes. Ciscos (*Coregonus artedi)* can be an early indicator of eutrophication in a lake because they require cold hypolimnetic temperatures and high dissolved oxygen levels. These watersheds with low disturbance and high value fishery lakes are excellent candidates for priority protection measures, especially those that are related to forestry and minimizing the effects of landscape disturbance. Forest stewardship planning, harvest coordination to reduce hydrology impacts and forest conservation easements are some potential tools that can protect these high value resources for the long term.

Sturgeon Lake's lakeshed is classified with having 64% of the watershed protected and 8% of the watershed disturbed (Figure 12). This shows a large portion of the lakeshed is protected, and the goal should be to limit any increase in disturbed land use. Sturgeon Lake's lakeshed, has one other catchments flow into it (Figure 11).

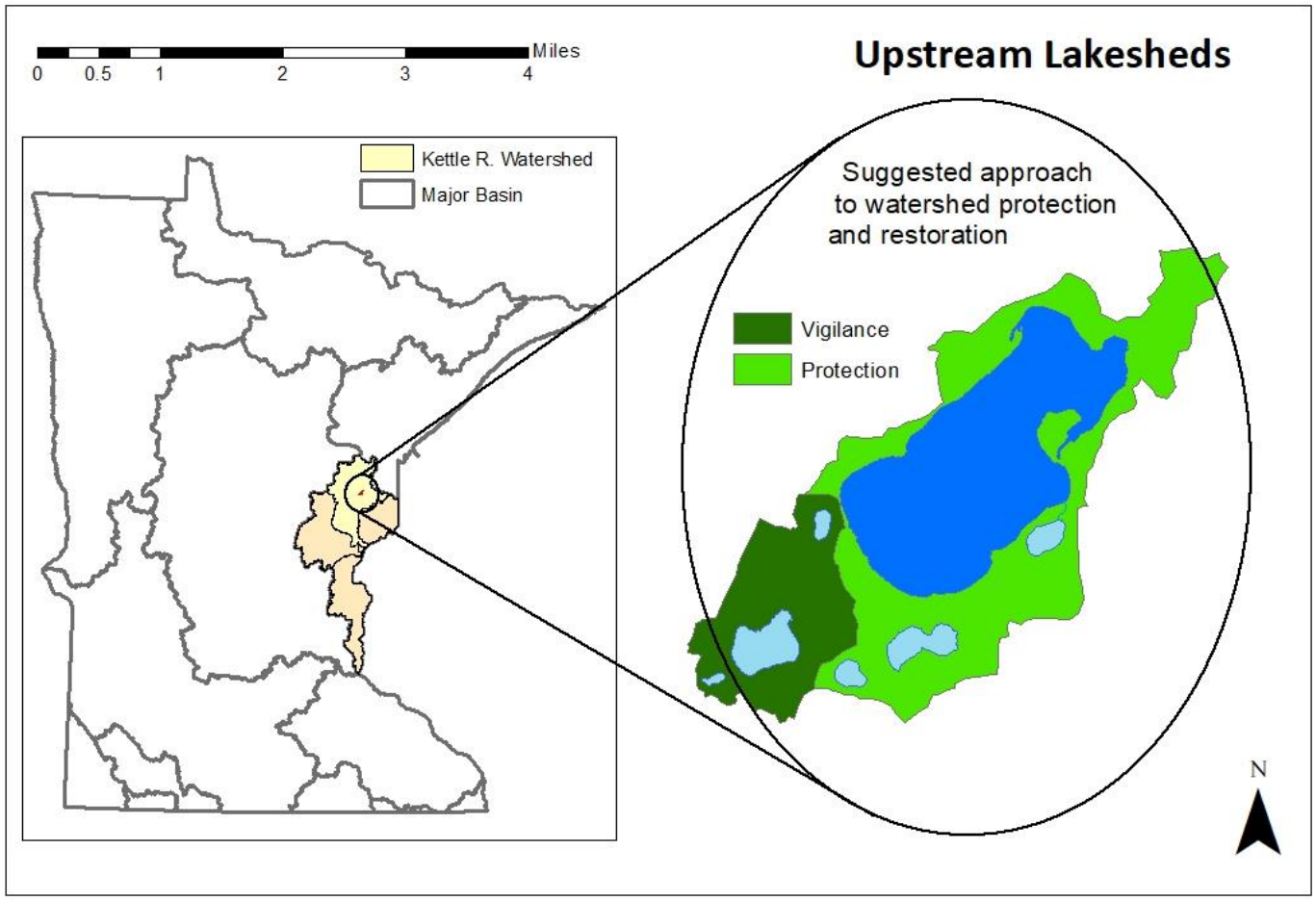
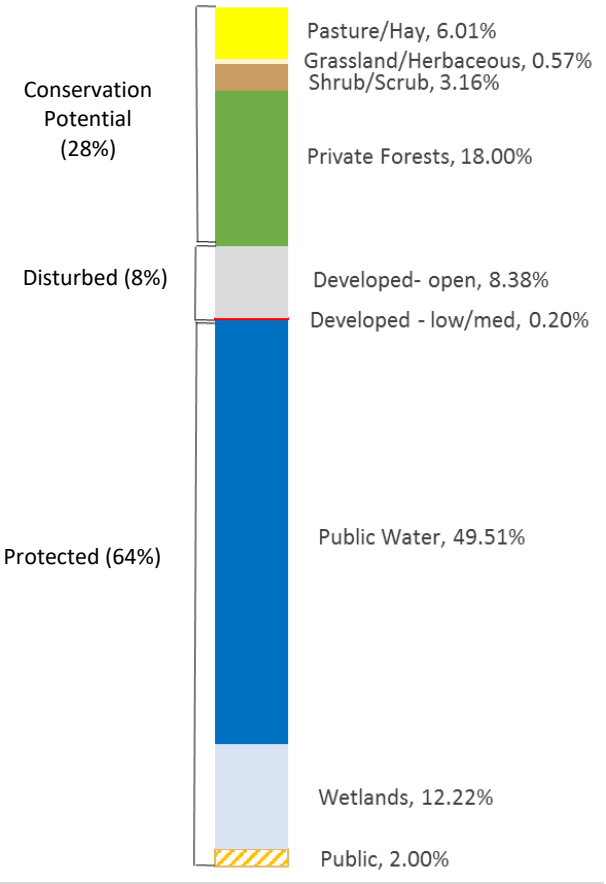


Figure 91. St. Croix major watershed and MN basins (left), and Sturgeon Lake lakeshed and upstream catchments with protection suggestions (right).

Land use and Ownership

Activities that occur on the land within the lakeshed can greatly impact a lake. Land use planning helps ensure the use of land resources in an organized fashion so that the needs of the present and future generations can be best addressed.

64% of the Sturgeon Lake lakeshed is protected. This total includes water, wetlands, and publicly owned land. Parcels were identified along the lakeshore which would be good candidates for conservation potential and were highlighted in purple (Figure 12).



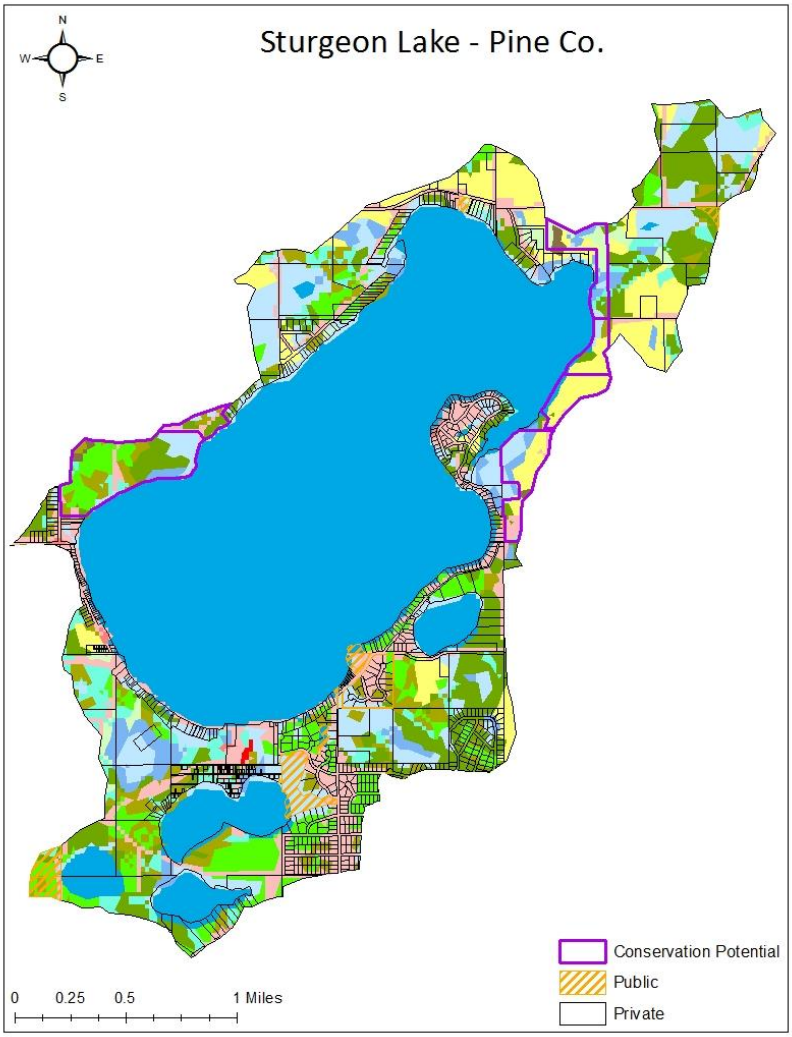


Figure 102. Land use and ownership in the Sturgeon Lake lakeshed.

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake (Table 9). Criteria were developed using limnological concepts to determine the effect to lake water quality.

KEY

Possibly detrimental to the lake
Warrants attention
Beneficial to the lake

Table 9. Sturgeon Lake lakeshed vitals table

Lakeshed Vitals		Rating
Lake Area	1,705.91 acres	descriptive
Littoral Zone Area	495.2 acres	descriptive
Lake Max Depth	40 ft.	descriptive
Lake Mean Depth	22 ft.	○
Miles of Stream	0.2	descriptive
Inlets	1	●
Outlets	1	●
Major Watershed	35 – Kettle River	descriptive
Minor Watershed	35049	descriptive
Lakeshed	3504902	descriptive
Ecoregion	Northern Lakes and Forest	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	2:1	●
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	394:1	●
Wetland Coverage	12%	○
Aquatic Invasive Species	Eurasian water milfoil	○
Public Drainage Ditches	None	○
Public Lake Accesses	1	●
Miles of Shoreline	9.56	descriptive
Shoreline Development Index	NA	○
Public Land to Private Land Ratio	1:18	●
Development Classification	Recreational Development	●
Miles of Road	79	descriptive
Municipalities in lakeshed	None	○
Forestry Practices	NA	○
Feedlots	None	○
Sewage Management	Individual Sewage Treatment Systems, county inspections required upon building permits and property transfers	●
Lake Management Plan	NA	○
Lake Vegetation Survey/Plan	DNR, 1998	●

Sturgeon Lake, Status of the Fishery (DNR, 7/21/2008)

Located in northern Pine County, 1405-acre Sturgeon Lake has an average depth of 22 feet and a maximum depth of 40 feet. Its shoreline length is estimated at 9.56 miles with a maximum fetch of 1.12 miles. Water clarity is good with visibility of 9-10 feet. There is a public access on the north end of the lake, two resorts, and one YMCA campground located on the south and west shores of Sturgeon Lake. Shoreline development is high with cabins and homes along most of the shoreline.

Long-range management goals for Sturgeon Lake include establishing a Walleye gill net catch of 5 per net with a 2 pound average, a Yellow Perch catch of 10 per net, and a Northern Pike population of less than 5 per net with 40% of the population longer than 24 inches. The management plan calls for stocking 600 pounds of Walleye fingerlings annually.

A 20 inch maximum regulation for Northern Pike was implemented in 1997 with the intent of reducing the percentage of Northern Pike less than 20 inches. This regulation was changed to a 24 to 36 inch protected slot in 2008 and is still in place today. The goal of the regulation is to allow anglers to harvest slightly larger fish but still protect the pike 24 inches and larger.

To compare the present fish community to similar lakes and to evaluate management goals, night electrofishing for Largemouth Bass was conducted in June and a standard survey using gill nets and trap nets was conducted in August of 2015.

The Northern Pike size structure has declined since the regulation change in 2008. The percentage of northerns exceeding 20 and 24 inches accounted for 21% and 7% of the catch respectively in 2015, compared to 38% and 21% in 2006. Pike were smaller and more abundant than normal when compared to similar lakes. Nearly half the Northern Pike sampled were 3-year-old fish averaging 16.5 inches long.

Competition with and/or predation by Northern Pike is likely impacting the Yellow Perch and Walleye populations of Sturgeon Lake. Regarding abundance, both species were present below their respective management goals and norms for similar lakes. The Walleye catch of 1.8 per net was one of the lowest catches on record. On a positive note, Walleye averaged 2 pounds, achieving the management goal and exceeding similar lakes. Sampled Walleye ranged from 13.3 to 23.4 inches with a 17.7-inch average. Despite stockings in 2008 and 2013, the Yellow Perch population has shown an overall decline in abundance since 1979. Only 11 perch were netted during the 2015 assessment, yielding a catch rate below both the management goal and the 25th percentile when compared to similar lakes.

The 2015 Black Crappie trap net catch was very similar to the previous assessment in 2011. The Bluegill catch rebounded to near record levels. Both were within their respective lake class normal range. Sampled crappies ranged from 6.2 to 10.3 inches with a 7.9-inch average length, and Bluegill ranged from 2.9 to 8.5 inches with a 6 inch average.

Sturgeon's Largemouth Bass were sampled by night electrofishing on June 11. One hour and eighteen minutes of electrofishing sampled 104 bass yielding a catch rate of 79.98 per hour, very similar to the previous two samples. Bass averaged a respectable 12.2 inches and 1.1 pounds and ranged in length from 7.2 to 19.8 inches with half the catch exceeding 12 inches. Age analysis indicated good growth with most bass reaching 12 inches in their fifth summer.

Anglers visiting Sturgeon Lake can expect fast action from small Northern Pike, good numbers of quality sized Largemouth Bass, Bluegill and Black Crappie in acceptable sizes and abundance, and the occasional decent-sized Walleye.

Key Findings and Recommendations

Monitoring Recommendations
Transparency monitoring at sites 208 should be continued annually. It is important to continue transparency monitoring weekly or at least bimonthly every year to enable year-to-year comparisons and trend analyses. Phosphorus and chlorophyll a monitoring should continue at site 208, as the budget allows, to track future water quality trends.

Overall Conclusions
Sturgeon Lake is a mesotrophic lake (TSI = 43) with the start of a baseline dataset to track long-term trends in water clarity. The total phosphorus, chlorophyll *a* and transparency ranges are within the ecoregion ranges (Table 4).

Sturgeon Lake's lakeshed is 64% protected, mainly with open water and wetlands as the main kinds of land cover. Sixty-one (61%) of the lakeshed is in public ownership, while only 8% of the lakeshed is disturbed (Figure 11).

Sturgeon Lake has one significant inlet and one outlet. Water levels in this system are affected by these inlets/outlets along with precipitation (i.e. rain, snowmelt) or potential springs in the lake. The total watershed area for Sturgeon Lake is not large, however disturbances beyond the immediate lakeshed can adversely impact Sturgeon Lake's water quality.

Phosphorus Loading and Priority Impacts
Sturgeon Lake is at an advantage because the lakeshed is a headwaters catchment, which means no additional water flows into this lakeshed from upstream areas. This means that the land practices around the lake are the main impact to the lake's water quality.

Table 10. Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	2:1
Watershed to Lake Area Ratio (watershed includes lake areas)	7:1
Number of Upstream Lakes	0
Headwaters Lake?	Yes
Inlets / Outlets	1 / 1

Best Management Practices Recommendations

The management focus for Sturgeon Lake should be to protect the current water quality and the lakeshed. Efforts should be focused on managing and/or decreasing the impact caused by current and additional development, including second tier development, and impervious surface area. Project ideas include protecting land with conservation easements, enforcing county shoreline ordinances, shoreline restoration, rain gardens, and septic system maintenance.

Sturgeon Lake Goals

1. Protection Focus: minimize disturbed land uses and maintain protected lands
2. Manage phosphorus loading from nearshore, Table 11
3. Focused BMPs per land type: Table 11

Table 11. Best Management Practices Table specific to Sturgeon Lake (refer to Figure 12)

Category	Land use type	Conservation project ideas	Results	Who	Contact for help
Conservation Potential Land	private forests (21%, 77 acres)	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperatives	Conserve and protect current forest cover	• Individual Property Owners	Pine County SWCD 320-216-4240 Jill.carlier@co.pine.mn.us
	cultivated crops (4%, 19 acres)	Restore wetlands; CRP; Cover Crops,	Reduce water runoff and soil erosion, better water storage	• Individual Property Owners	Natural Resources Conservation Service 320-384-7432, http://www.nrcs.usda.gov.
	pasture/hay (4%, 23 acres)	Maintain vegetative cover, plant trees, Conservation Easements	Reduce water runoff and soil erosion, better water storage	• Individual Property Owners	Natural Resources Conservation Service 320-384-7432, http://www.nrcs.usda.gov.
Disturbed Land	developed, Open Space (6%, 31 acres)	Shoreline buffers, rain gardens		• Individual Property Owners	Pine County SWCD 320-216-4240 Jill.carlier@co.pine.mn.us
	Developed, high intensity (0%, 0 acres)	Sediment basins, rain gardens, shoreline buffers, stormwater retention		• Individual Property Owners • Cities • Lake Associations	Pine County SWCD 320-216-4240 Jill.carlier@co.pine.mn.us

The current lakeshore homeowners can lessen their negative impact on water quality by installing or maintaining the existing trees on their properties. Forested uplands contribute significantly less phosphorus (lbs/acre/year) than developed land cover (Table 11).

Approximately a quarter of the lakeshed is privately owned forested uplands (Table 11). Forested uplands can be managed with Forest Stewardship Planning, 3rd party certification, SFIA, and local woodland cooperatives. Contact the Pine Soil and Watershed Conservation District for options for managing private forests.

Native aquatic plants stabilize the lake's sediments and tie up phosphorus in their tissues. When aquatic plants are uprooted from a shallow lake, the lake bottom is disturbed, and the phosphorus in the water column gets used by algae instead of plants. This contributes to "greener" water and more algae blooms. Protecting native aquatic plant beds will ensure a healthy lake and healthy fishery. If a swimming area is necessary in front of people's docks, clear only a small area of plants. Clearing a whole 100 foot frontage is not necessary and can contribute to additional algae blooms.

Table 13. Organizational contacts and reference sites

Organizational contacts and reference sites

Sturgeon Lake Association

DNR Fisheries Office	PO Box 389, 306 Power Ave N, Hinkley, MN 55037 320-384-7721, hinkley.fisheries@state.mn.us
Regional Minnesota Pollution Control Agency Office	525 Lake Avenue South, Suite 400, Duluth, MN 55802 218-723-4660 https://www.pca.state.mn.us/about-mpca/duluth-office
Pine County Soil and Water Conservation District	130 Oriole St. E Sandstone, MN 55072 (320) 216-4240, https://pineswcd.com/
Pine County	635 Northridge Dr NW Pine City, MN 55063 https://www.co.pine.mn.us