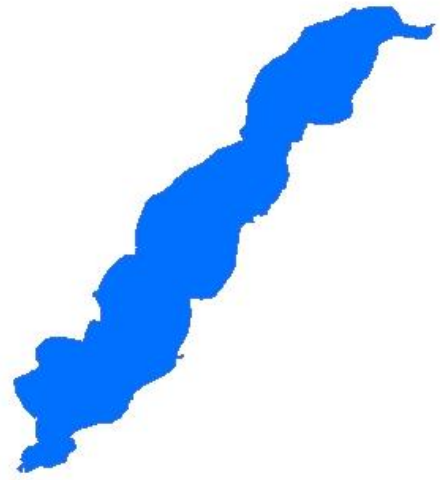
Big Pine Lake

58-0138-00 Pine County



Big Pine Lake is located 6 miles west of Finlayson, MN, in Pine County. It is a long, narrow lake covering approximately 400 acres with a shoreline length of 5.78 miles (Table 1).

Big Pine Lake has two inlets and one outlet as the Pine River flows through Big Pine Lake to Pine Lake.

Water quality data have been collected on Big Pine Lake from 1981-2018 (Tables 2 & 3). These data show that the lake is eutrophic (TSI = 47) with moderately clear water conditions most of the summer and excellent recreational opportunities.

Table 1. Big Pine Lake location and key physical characteristics

Location Data

MN Lake ID: **58-0138-00**
County: **Aitkin/Pine**
Ecoregion: **Northern Lakes & Forests**
Major Watershed: **Kettle River**
Latitude/Longitude: **46.209917/-95.3046118**
Invasive Species: **None listed**

Physical Characteristics

Surface area (acres): **398.95**
Littoral area (acres): **135**
% Littoral area: **34%**
Max depth (ft), (m): **25, 7.6**
Inlets: **1**
Outlets: **1**
Public Accesses: **1**

Table 2. Availability of primary data types for Big Pine Lake

Data Availability

Transparency data		**Data Available**
Chemical data		**Limited Data Available**
Inlet/Outlet data		**Limited Data Available**
Recommendations		**For recommendations refer to page 15.**

Lake Map

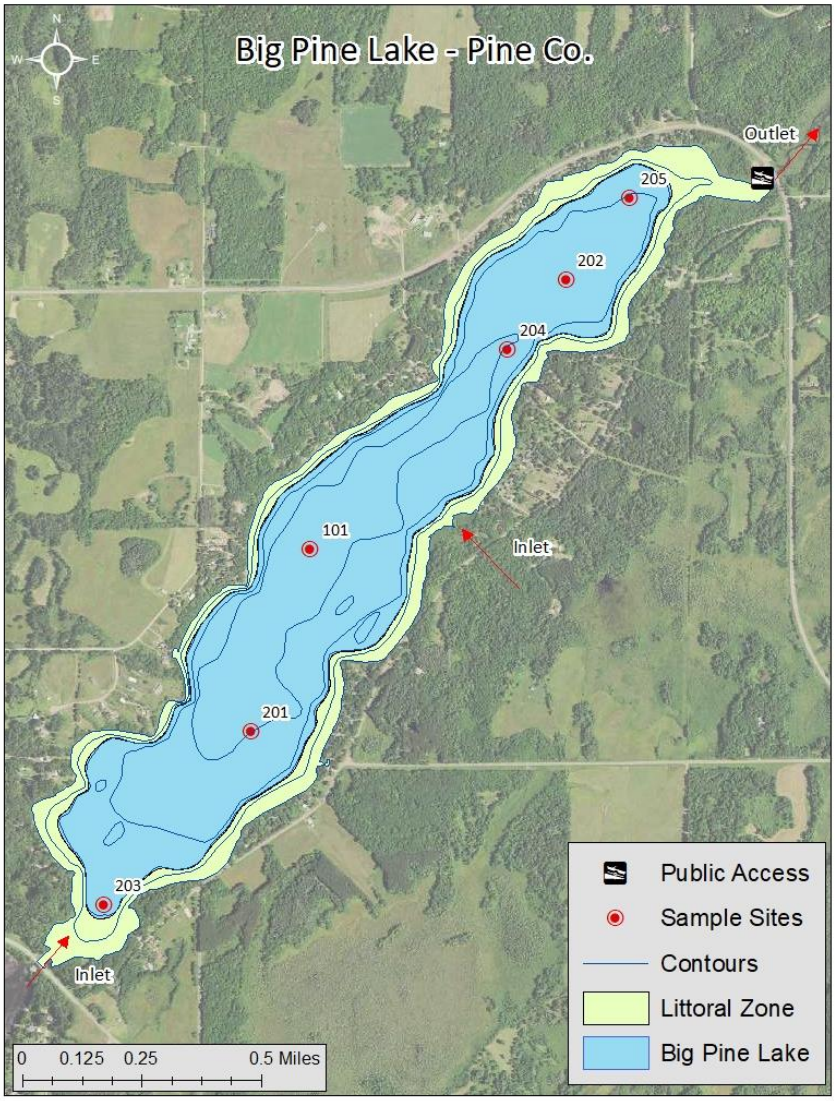


Figure 1. Map of Big Pine Lake with 2018 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can reach the bottom of the lake.

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the Citizen Lake Monitoring Program (CLMP), Clean Water Legacy Surface Water Monitoring (CWLSWM), Pine County SWAG, Citizens Monitoring Bacteria (CMB), Big Pine Lake Association (BPLA), RMB Environmental Lab (RMBEL)

Lake Site	Depth (ft)	Monitoring Programs
58-0138-00-101	22	CMB: 2006, CWLSWM: 2016-2017, CLMP: 1981-1996, SWAG: 2008-2009
58-0138-00-201	20	CLMP: 1987-2018
58-0138-00-202	20	CLMP:1998-2002
58-0138-00-203	15	BPLA: 2013-2018
58-0138-00-204	20	BPLA: 2013-2018
58-0138-00-205	15	RMBEL: 2018

Average Water Quality Statistics & Comparisons

The information below describes available chemical data for Big Pine 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). Big Pine 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)	29.5	14 – 27	> 30	Results are within the expected range for the Northern Lakes and Forests Ecoregion and the lake is near impaired for excess phosphorus and secchi depth.
[3]Chlorophyll *a* (µg/L)	7.1	4 – 10	> 9	
Chlorophyll *a* max (µg/L)	32.0	< 15		
Secchi depth (ft)	4.6	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)	0.9	<0.4 – 0.75		Indicates sufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	80.6	40 – 140		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	NA	10 – 35		NA
pH	7.9	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)	2.7	0.6 – 1.2		Within the expected range for the ecoregion.
Total Suspended Solids (mg/L)	5.1	<1 – 2		Indicates turbid water.
Specific Conductance (umhos/cm)	155.7	50 – 250		Within the expected range for the ecoregion.
TN:TP Ratio	29:1	25:1 - 35:1		Within the expected range for the ecoregion, and shows the lake is phosphorus limited. Results from site 101

[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 primary sites.

Parameters	Site 203	Site 201
Total Phosphorus Mean (µg/L):	29.5	NA
Total Phosphorus Min:	12	NA
Total Phosphorus Max:	49	NA
Number of Observations:	21	0
Chlorophyll *a* Mean (ug/L):	7.1	NA
Chlorophyll-a Min:	1	NA
Chlorophyll-a Max:	43	NA
Number of Observations:	18	0
Secchi Depth Mean (ft):	4.6	5.6
Secchi Depth Min:	2.6	2.0
Secchi Depth Max:	8.2	13.6
Number of Observations:	18	436

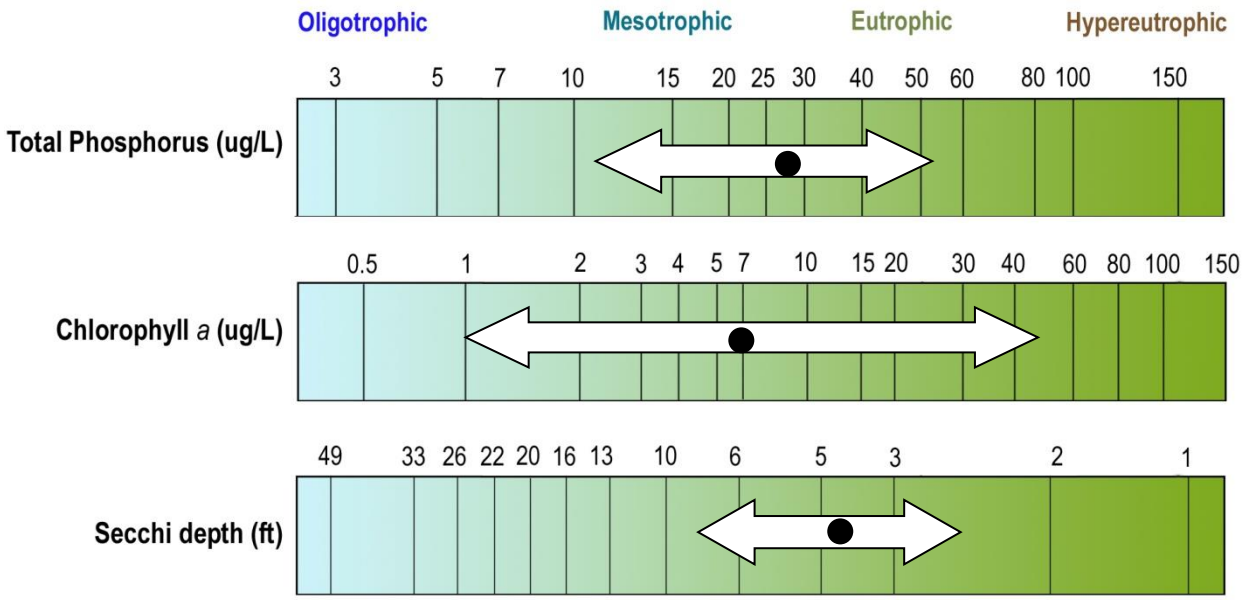


Figure 3. Big Pine Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Site 203). Figure adapted after Moore and Thornton, [Ed.]. 1988.

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 Big Pine Lake ranges from 3.8 to 6.1 feet (Figure 4). The annual means hover fairly close to the long-term mean of 4.6. For trend analysis, see page 9. Transparency monitoring should be continued annually at site 203 in order to track water quality changes.

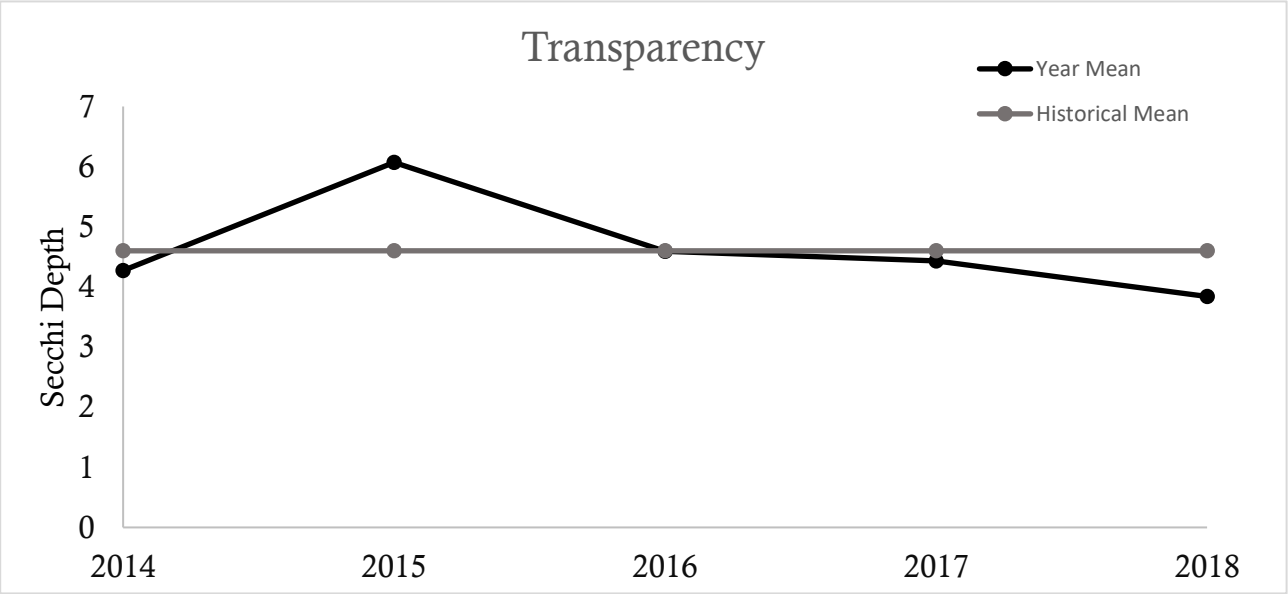


Figure 4. Annual mean transparency compared to long-term mean transparency

Big Pine Lake transparency ranges from 2.6 to 8.2 ft. at the primary site (203). Figure 5 shows the seasonal transparency dynamics. The maximum Secchi reading is usually obtained in early summer. Big Pine 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.

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.

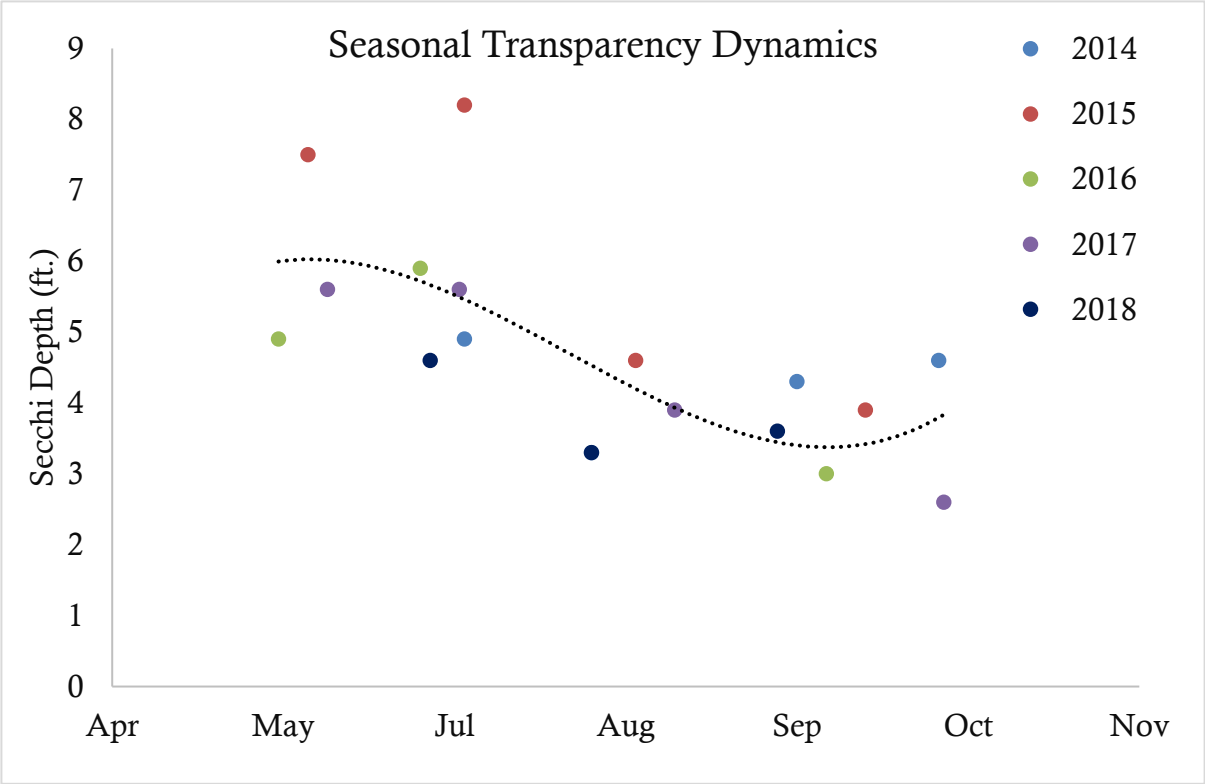


Figure 5. Seasonal transparency dynamics and year to year comparison (Site 203). The black line represents the pattern in the data

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 5-6).

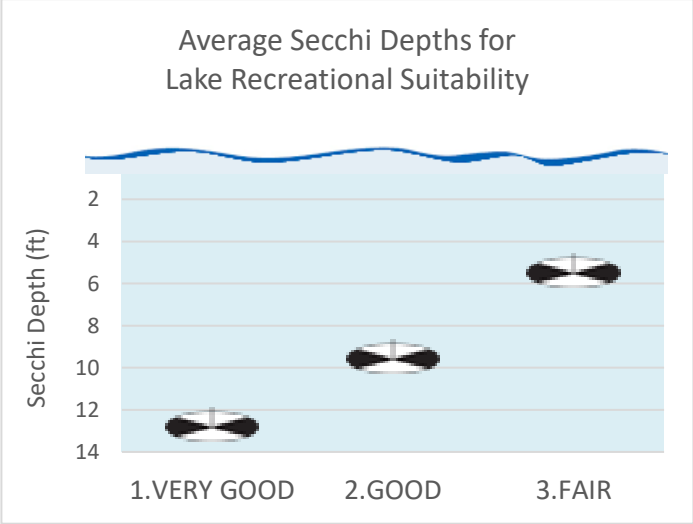


Figure 6. Average Secchi depth (ft) for each lake recreational suitability rating

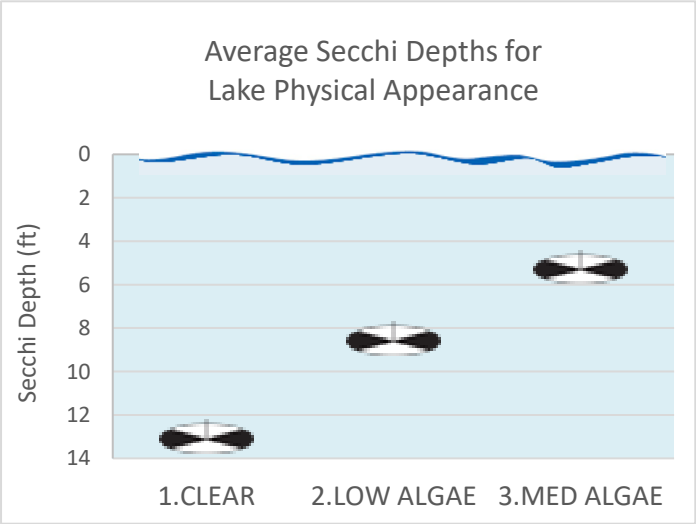


Figure 7. Average Secchi depth for each lake physical appearance rating

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.

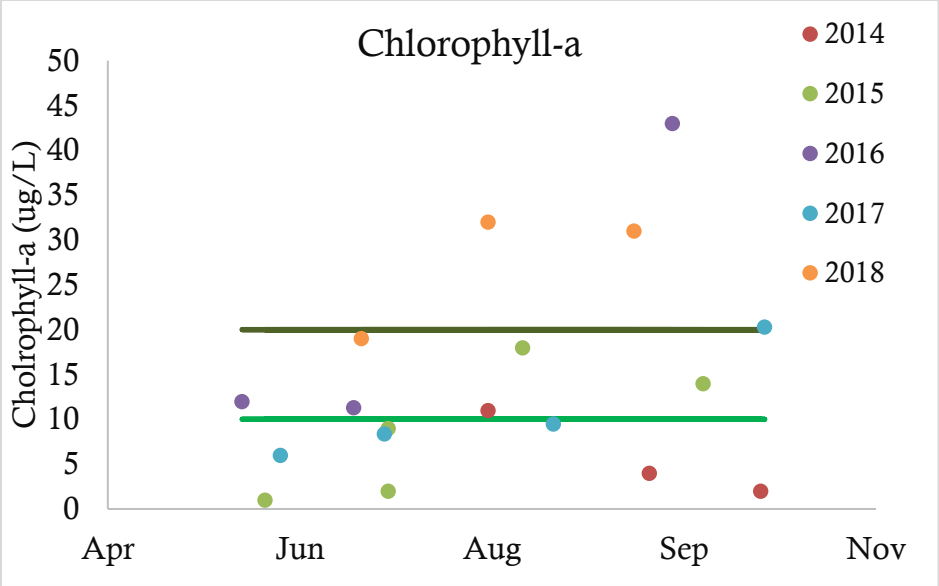


Figure 6. Chlorophyll a concentrations (ug/L) for Big Pine Lake at site 203

Chlorophyll *a* was evaluated in Big Pine Lake at site 203 from 2014-2018 (Figure 8). Chlorophyll *a* concentrations went above 10 ug/L in all 5 years, indicating minor algae blooms. Samples taken in 2016 and 2018 exceeded 20 ug/L in late summer, indicating moderate to severe algae blooms. There was not much variation over the years monitored and chlorophyll *a* concentrations remained relatively steady over the summer.

Phosphorus

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

Total phosphorus was evaluated in Big Pine Lake from 2013-2018 at site 203. The data do not indicate much seasonal variability. All of the data points fall into the mesotrophic and eutrophic range (Figure 9).

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

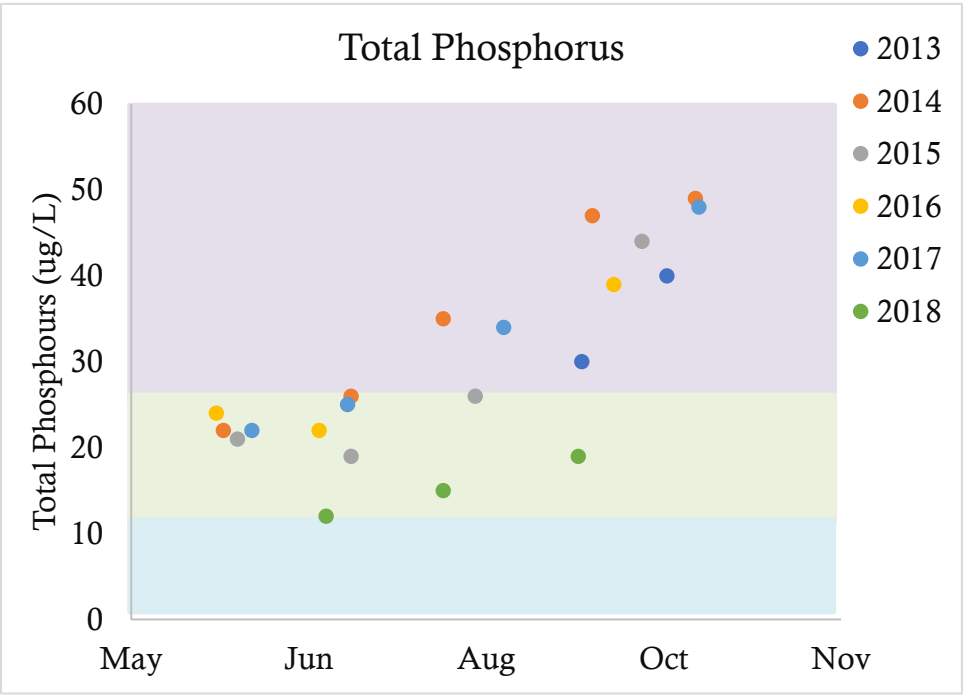


Figure 7. Historical total phosphorus concentrations (ug/L) for Big Pine Lake at site 203

Oxygen

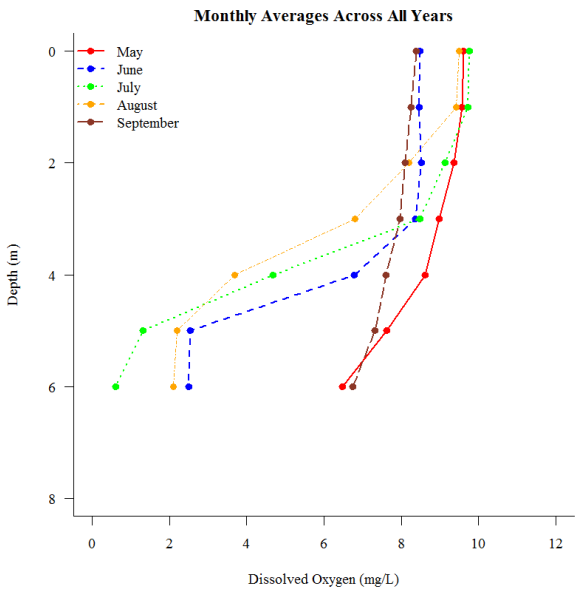


Figure 8. Representative dissolved oxygen profiles from site 101 year in Big Pine Lake

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.

Big Pine Lake is a shallow lake, with a maximum depth of 25 feet. Dissolved oxygen profiles from data collected in 1988, 1996, and 2016 at site 101 show periodic stratification developing mid-summer (Figure 10).

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. Big Pine Lake falls into the mesotrophic range (Tables 6, 7).

Table 6. Trophic State Index for Big Pine Lake.

Trophic State Index	
TSI Phosphorus:	53
TSI Chlorophyll-a	50
TSI Secchi	38
TSI Mean	47
Trophic State:	Mesotrophic

Numbers represent the mean TSI for each parameter.

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

Big Pine Lake

Eutrophication

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. Bass may 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.

Big Pine Lake only had enough data to perform a trend analysis on transparency (Table 8). The data was analyzed using the Mann Kendall Trend Analysis.

Table 8. Trend analysis for Big Pine Lake

Lake Site	Parameter	Date Range	Trend	Probability
NA	Total Phosphorus	NA	NA	NA
NA	Chlorophyll *a*	NA	NA	NA
201	Transparency	1993-2018	Declining	95%

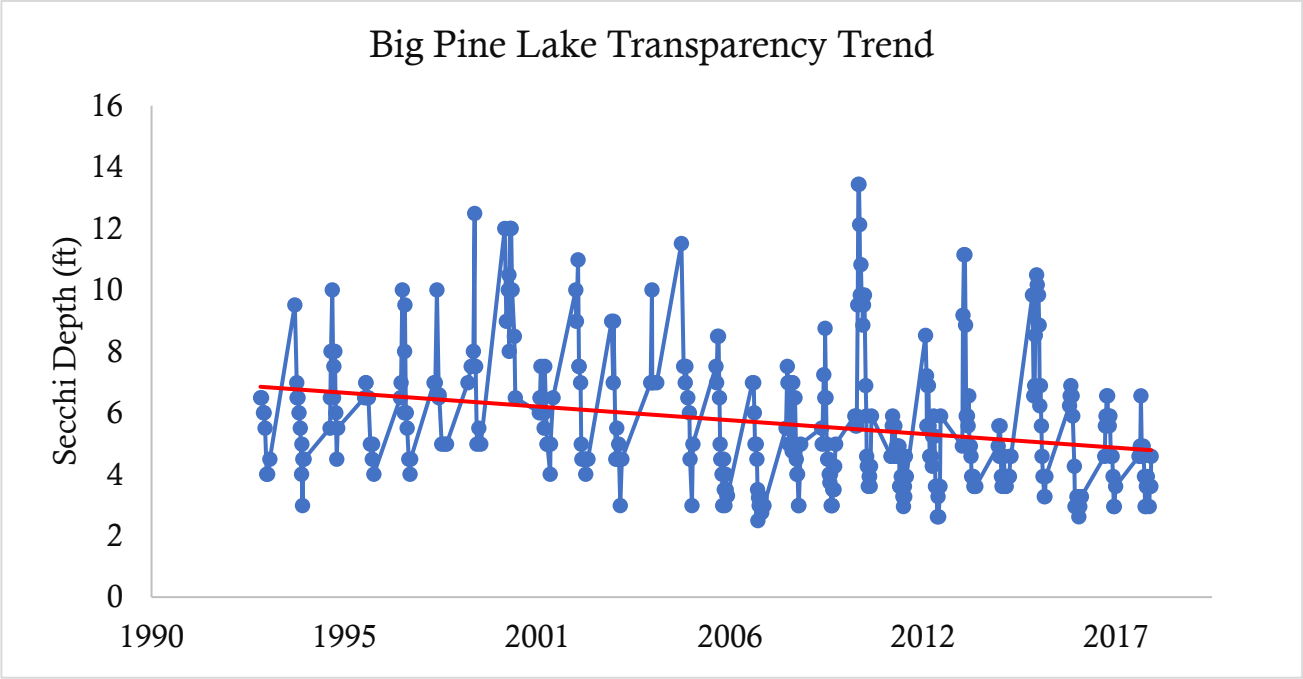


Figure 9. Transparency (feet) trend for site 201 from 1993-2018

Big Pine Lake shows evidence of a declining transparency trend (Figure 11). Since 2006, the clarity minimums are lower than before 2006, showing more algae blooms. Transparency monitoring should continue so that this trend can be tracked in future years.

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 12).

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. Big Pine Lake falls within lakeshed 3503500 (Figure 12). 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 many 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 9). Watershed disturbance was defined as having urban, agricultural, and mining land uses. Watershed protection is defined as publicly owned land or conservation easement.

Table 9. 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.

Big Pine Lake's lakeshed is classified with having 53% of the watershed protected and 8% of the watershed disturbed (Figure 13). This lakeshed is has a good amount of protection, but still has potential for conservation. Goals for the lake should be to limit any increase in disturbed land use.

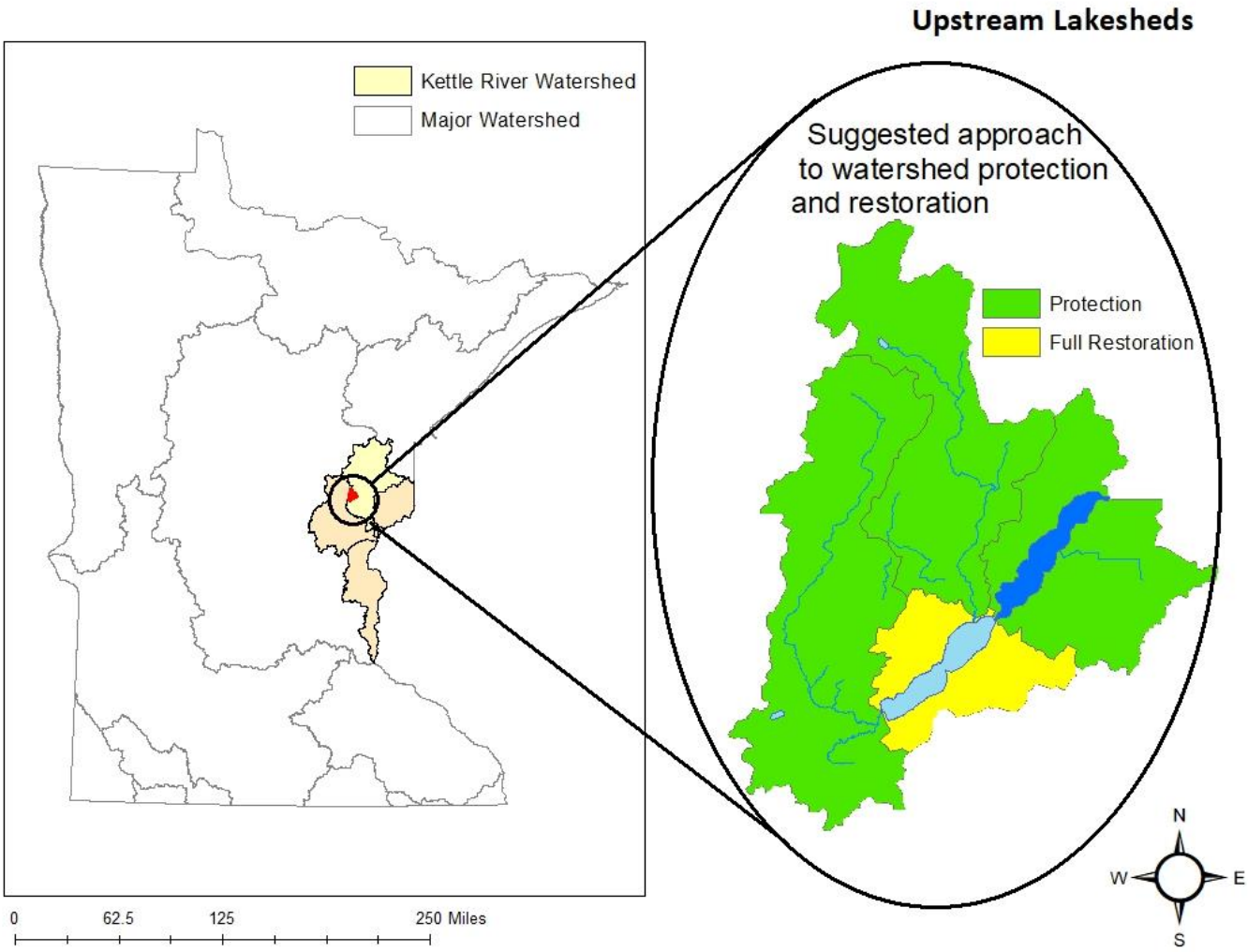
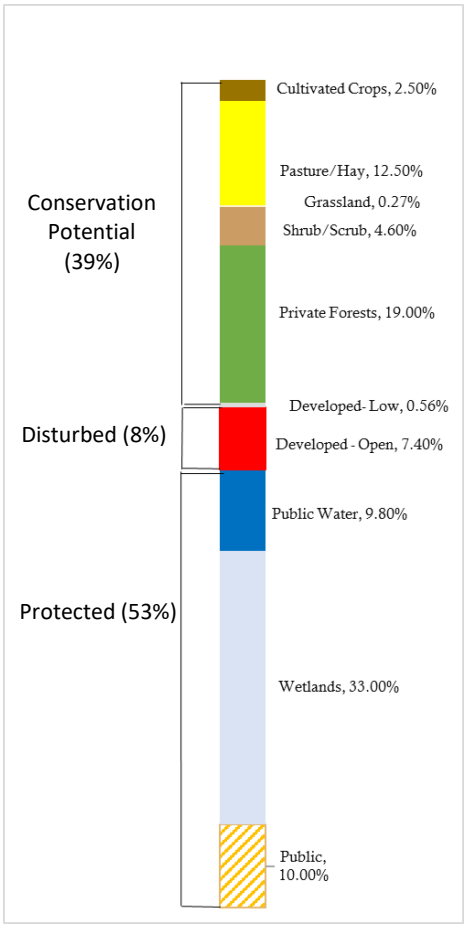


Figure 10. St. Croix major watershed and MN basins (left), and Big Pine Lake lakeshed and upstream catchments with protection suggestions (right)

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.

53% of the Big Pine Lake lakeshed is protected. This total includes water, wetlands, and publicly owned land and the Big Pine Aquatic Management Area (AMA) located at the north end.



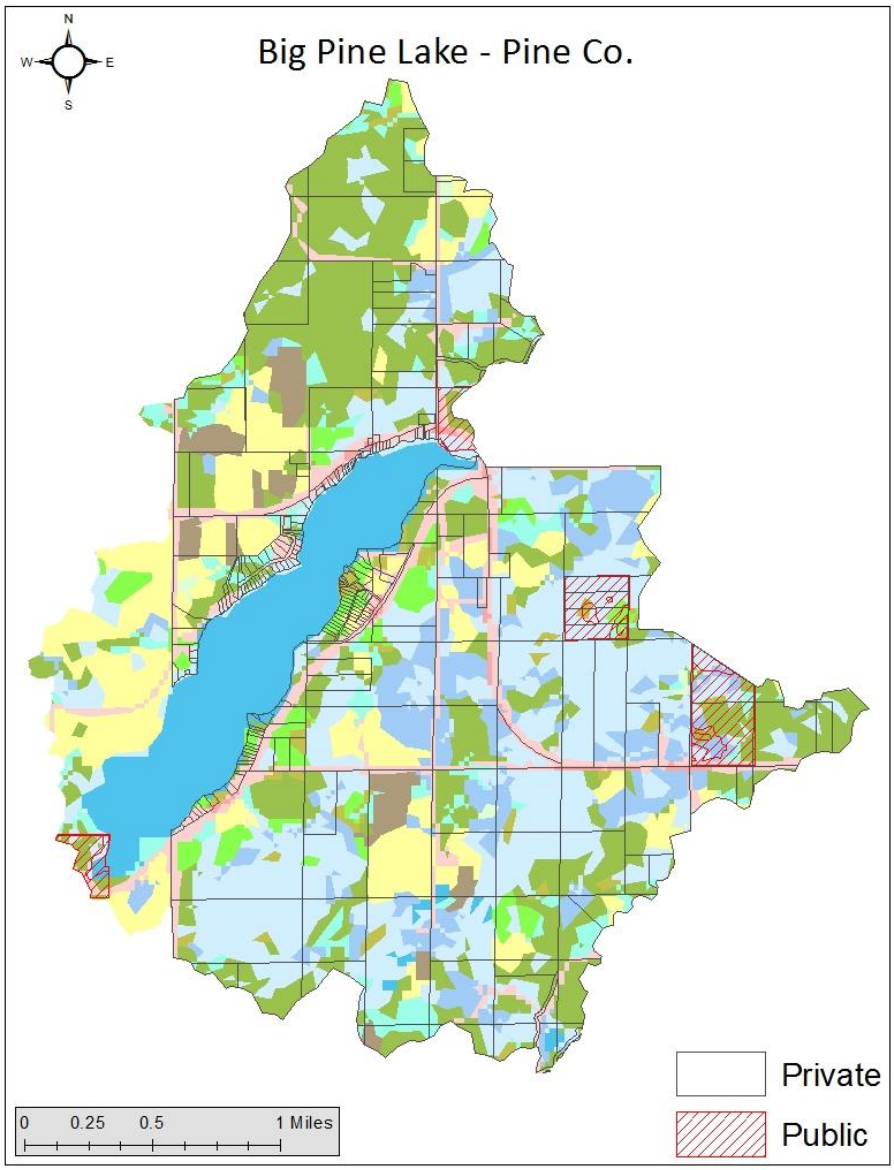


Figure 11. Land use and ownership in the Big Pine Lake lakeshed

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake (Table 10). 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 10. Big Pine Lake lakeshed vitals table

Lakeshed Vitals		Rating
Lake Area	398 acres	descriptive
Littoral Zone Area	135 acres	descriptive
Lake Max Depth	25 ft.	descriptive
Lake Mean Depth	15 ft.	
Miles of Stream	1.74	descriptive
Inlets	2	
Outlets	1	
Major Watershed	35 – Kettle River	descriptive
Minor Watershed	35035	descriptive
Lakeshed	3503500	descriptive
Ecoregion	Northern Lakes and Forest	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	10:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	42:1	
Wetland Coverage	33%	
Aquatic Invasive Species	None	
Public Drainage Ditches	1	
Public Lake Accesses	1	
Miles of Shoreline	5.78	descriptive
Shoreline Development Index	NA	
Public Land to Private Land Ratio	<1:1	
Development Classification	Recreational Development	
Miles of Road	13.6	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	

Big Pine Lake, Status of the Fishery (DNR, 8/11/2014)

Big Pine Lake is a fertile, 387-acre lake located in Pine and Aitkin counties. The lake averages 14 feet with a 22-foot maximum. Water clarity is generally good with a light bog stain, though algae blooms are not uncommon. Lake users can access Big Pine through the public access on the north end of the lake or from the north end of Pine Lake. While natural reproduction of Walleye has occurred, due to limited spawning habitat, Walleye fingerlings are stocked annually.

Anglers on North Big Pine can expect moderate fishing pressure. Walleye abundance has decreased since peaking in the 1994 assessment. Northern Pike are slightly more numerous. Abundance of both species is below the normal range for the lake class while their average size exceeds the norm. Northerns averaged 25.4 inches and 3.3 pounds. Walleyes ranged from 11.9 to 27.6 inches and averaged 3.3 pounds. Largemouth Bass are in good quantity and of quality size. Bass averaged 15 inches and 1.9 pounds. Yellow Perch are slightly more abundant than five years ago with a catch rate exceeding the lake class norm for the first time since 1999. Perch continue to function primarily as a forage species due to their small sizes. The Bluegill and Black Crappie numbers are more than adequate to warrant angling, with more harvestable sized individuals sampled than in the previous assessment.

See the link below for specific information on gillnet surveys, stocking information, and fish consumption guidelines. https://www.dnr.state.mn.us/lakefind/showreport.html?downum=58013800

Key Findings and Recommendations

Monitoring Recommendations
Transparency monitoring at sites 201 and 203 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 201 and 203, as the budget allows, to track future water quality trends.

Overall Conclusions
Big Pine Lake is a mesotrophic lake (TSI = 47) with evidence of a declining long-term trend in water clarity. The total phosphorus is at the high end of ecoregion range near the impaired level which can cause algae blooms in the summer. Chlorophyll *a* levels were within the ecoregion range, however there has been some minor algae blooms with concentrations over 10 ug/L. Transparency is the only parameter not in the ecoregion range as it is below the range indicating low transparency and high algae concentrations (Table 4).

Big Pine Lake's lakeshed is 53% protected, mainly with open water and wetlands as the main kinds of land cover. About ten percent (10%) of the lakeshed is in public ownership, while 39% remains for conservation potential. Only 6% of the land is disturbed. (Figure 11).

Big Pine Lake is connected via the Big Pine River which may cause water levels to fluctuate. Water levels in this system are affected by inputs to the surround watershed and annual precipitation. The total watershed area for Lake Big Pine is very large, therefore disturbances beyond the immediate lakeshed can adversely impact Lake Big Pine's water quality.

Phosphorus Loading and Priority Impacts
Big Pine Lake is at a disadvantage because the lakeshed is not headwaters catchment, which means additional water flows into this lakeshed from upstream areas. This means that the land practices around the lake, and upstream lakes can main impact to the lake's water quality.

A third of the lakeshed is covered with wetlands, which is good for water storage and filtration (Figure 13). Protecting wetlands will help maintain water levels and water storage, reduce flooding, and filter runoff during large storm events.

Table 11. Watershed characteristics

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	10:1
Watershed to Lake Area Ratio (watershed includes lake areas)	43:1
Number of Upstream Lakes	1
Headwaters Lake?	No
Inlets / Outlets	2/ 1
Water Residence Time	NA

Best Management Practices Recommendations

The management focus for Big Pine 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.

Big Pine Lake Goals

1. Protection Focus: minimize disturbed land uses and maintain protected lands
2. Manage phosphorus loading from nearshore, Table 12
3. Focused BMPs per land type: Table 12

Table 12. Best Management Practices Table specific to Big Pine Lake (refer to Figure 13)

Category	Land use type	Conservation project ideas	Results	Who	Contact for help
Conservation Potential Land	private forests (19%, 752 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 (3%, 100 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 (13%, 495 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, low intensity (7%, 277 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).

A fifth 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 Soil and Watershed Conservation District for options for managing private forests.

Because some of undeveloped private land still exists, there is a great potential for protecting this land with conservation easements and aquatic management areas (AMAs). Conservation easements can be set up easily and with little cost with help from organizations such as the Board of Soil and Water Resources and the Minnesota Land Trust. AMAs can be set up through the local DNR fisheries office.

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

Big Pine Lakes Association	PO Box 190, Finlayson, MN 55735 https://minnesotawaters.org/bigpinelakes/
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
Carlton County Soil and Water Conservation District	130 Oriole St. E Sandstone, MN 55072 (320) 216-4240, https://pineswcd.com/
Carlton County	635 Northridge Dr NW Pine City, MN 55063 https://www.co.pine.mn.us