

Hanging Horn Lake

09-0038-00

Carlton County



Hanging Horn Lake is located 4.5 miles north of Moose Lake, MN in Carlton County. It is a round lake covering 409 acres (Table 1).

Hanging Horn Lake has four inlets and one outlet, which classify it as a drainage lake. Water enters Hanging Horn Lake from ground-fed streams in the south, from Little Hanging horn in the east, and from Moose Horn River in the north. Moose Horn River exits the lake on the west side of Hanging Horn Lake and carries water southwest to the Kettle River.




Water quality data have been collected on Hanging Horn Lake from 1983-2016 (Tables 2 & 3). These data show that the lake is mesotrophic (TSI = 49) which is characteristic of mostly clear water throughout the summer and good fisheries.

Hanging Horn Lake has an organized association that is involved in activities such as water quality monitoring, golf tournaments, and education.

Table 1. Hanging Horn Lake location and key physical characteristics.

Location Data		Physical Characteristics	
MN Lake ID:	09-0038-00	Surface area (acres):	408.7
County:	Carlton	Littoral area (acres):	65.4
Ecoregion:	Northern Lakes and Forests	% Littoral area:	16%
Major Watershed:	Kettle River	Max depth (ft), (m):	84, 25.6
Latitude/Longitude:	46.477886, -92.694706	Inlets:	4
Invasive Species:	None	Outlets:	1
		Public Accesses:	1

Table 2. Availability of primary data types for Hanging Horn Lake.

Data Availability	
Transparency data	 Excellent CLMP data from 2002-2016.
Chemical data	 Data from 1993, 1997, and 2016.
Inlet/Outlet data	 Moose Horn River was monitored in Barnum from 2016-2017.
Recommendations	For recommendations refer to page 15.

Lake Map

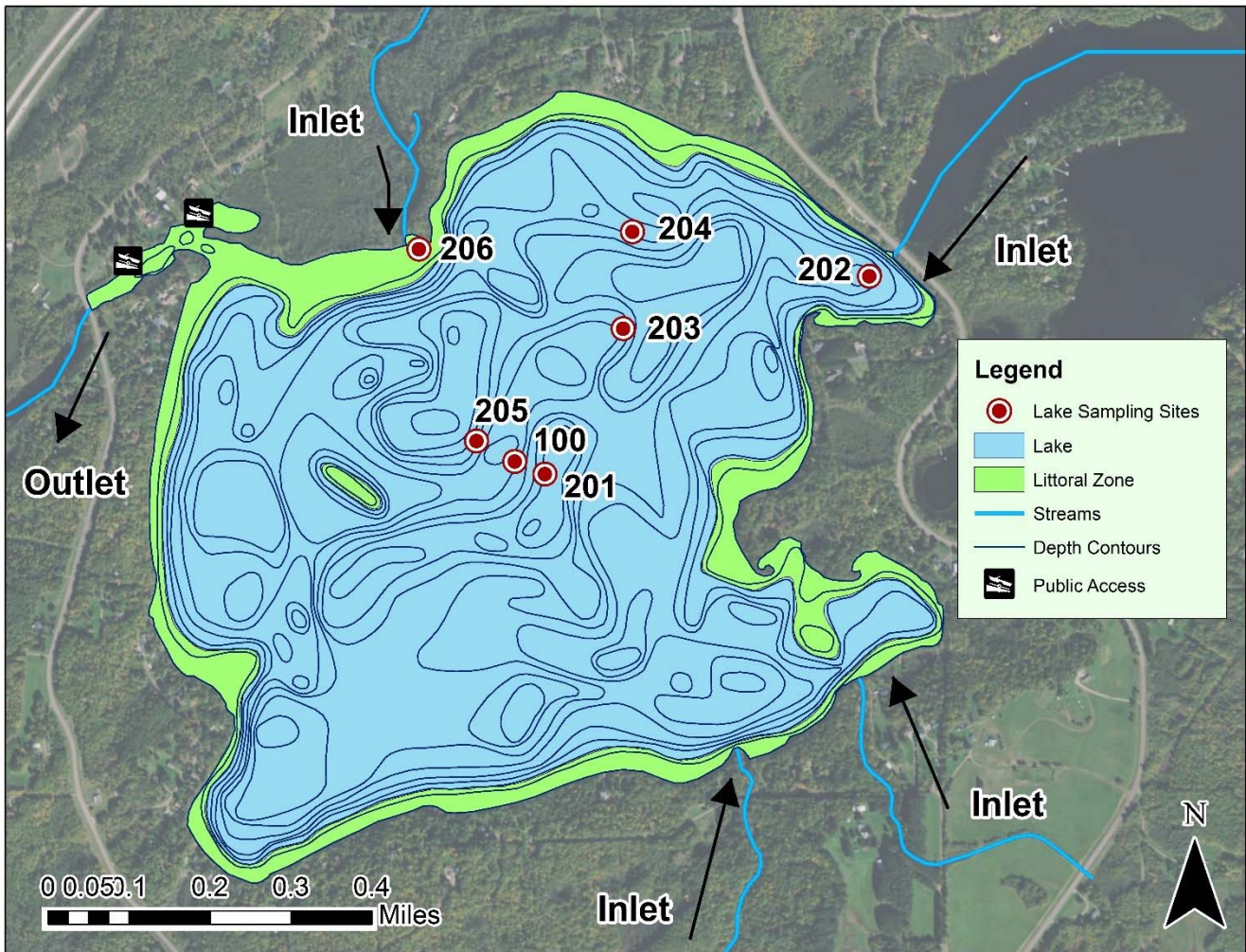


Figure 1. Map of Hanging Horn Lake with 2010 aerial imagery and illustrations of lake depth contour lines, sample site locations, inlets and outlets, and public access points. The light green areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom, allowing aquatic plants to grow.

Table 3. Monitoring programs and associated monitoring sites. Monitoring programs include the Citizen Lake Monitoring Program (CLMP), MPCA Lake Monitoring Program Project (MPCA), Mississippi River-Grand Rapids Carlton SWCD (SWCD), and Citizens Monitoring Bacteria (CMB).

Lake Site	Depth (ft)	Monitoring Programs
100	35	MPCA: 1993-1994
201	70	CLMP: 1983-1997, 2011
202	40	CLMP: 1991; MPCA: 1984, 1997
203	50	CLMP: 1999
204	40	CLMP: 2000-2001, 2005-2016
205	50	CLMP: 2002-2016; SWCD: 2016
206	5	CMB: 2007

Average Water Quality Statistics & Comparisons

The information below describes available chemical data for Hanging Horn Lake through 2017 (Table 4). Data for total phosphorus, chlorophyll *a*, and Secchi depth are from the primary site 205.

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 ecoregion¹ (Table 4). Hanging Horn 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 List².

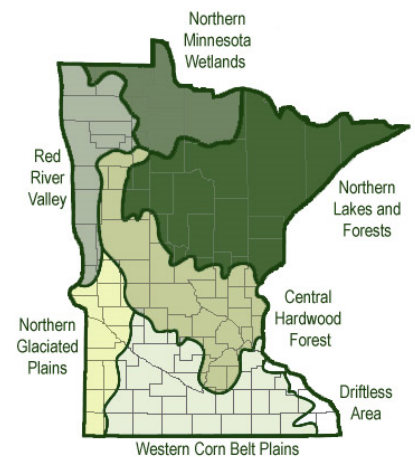


Figure 2. Minnesota ecoregions.

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 (ug/L)	27.1	14 – 27	> 30	
³ Chlorophyll <i>a</i> (ug/L)	9.1	4 – 10	> 9	Results are within the expected range for the Northern Lakes and Forests Ecoregion and the lake is not impaired for excess phosphorus.
Chlorophyll <i>a</i> max (ug/L)	14.2	< 15		
Secchi depth (ft)	7.5	8 – 15	< 6.5	
Dissolved oxygen	<i>See page 8</i>			Dissolved oxygen depth profiles show that the lake mixes in spring and fall (dimictic).
Total Kjeldahl Nitrogen (mg/L)	0.8	<0.4 – 0.75		Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	45.6	40 – 140		Within the expected range for the ecoregion.
Color (Pt-Co Units)	60	10 – 35		Indicates tannins (brown stain) in the water.
pH	7.2	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)	2.9	0.6 – 1.2		Slightly over the expected range for the ecoregion, but still considered low level.
Total Suspended Solids (mg/L)	1.8	<1 – 2		Within the expected range for the ecoregion.
Specific Conductance (umhos/cm)	70.8	50 – 250		Within the expected range for the ecoregion.
TN:TP Ratio	33:1	25:1 - 35:1		Within the expected range for the ecoregion, and shows the lake is phosphorus limited.

¹The 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>

²For further information regarding the Impaired Waters Assessment program, refer to <http://www.pca.state.mn.us/water/tmdl/index.html>

³Chlorophyll *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	Primary Site 205	Site 204
Total Phosphorus Mean (ug/L):	27.1	NA
Total Phosphorus Min:	18	
Total Phosphorus Max:	39	
Number of Observations:	7	
Chlorophyll a Mean (ug/L):	9.1	NA
Chlorophyll-a Min:	4	
Chlorophyll-a Max:	14.2	
Number of Observations:	7	
Secchi Depth Mean (ft):	7.5	7.3
Secchi Depth Min:	3.6	3.9
Secchi Depth Max:	10.5	10
Number of Observations:	107	102

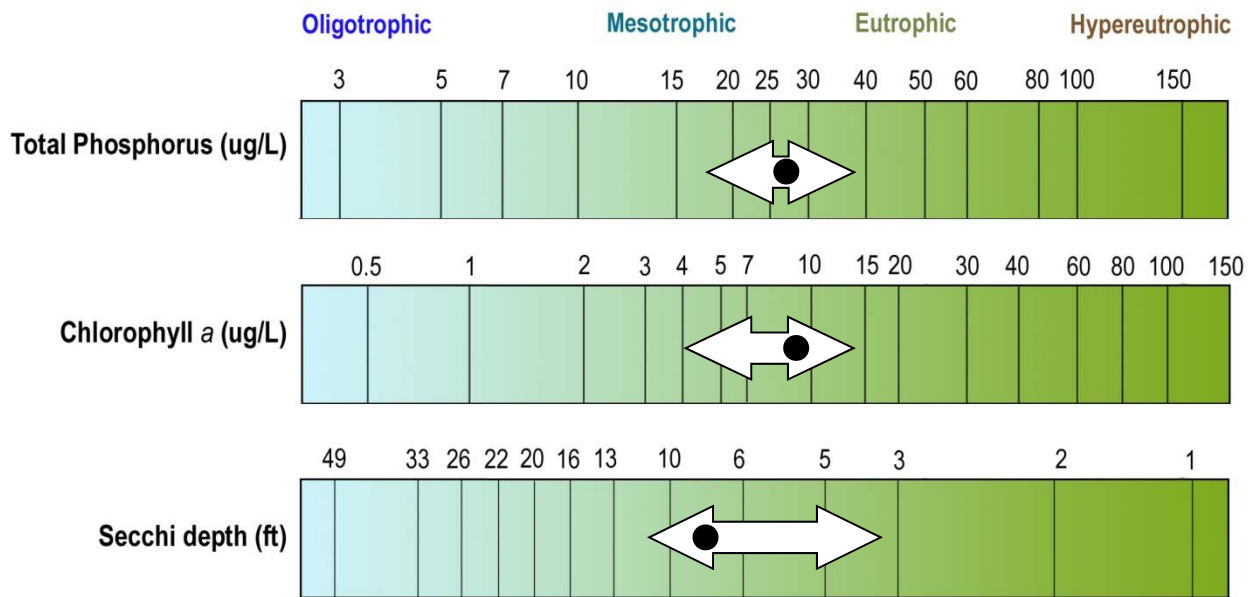


Figure 3. Hanging Horn Lake total phosphorus, chlorophyll a and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 205). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. No. EPA 440/5-88-002)

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 Hanging Horn Lake ranges from 5.2 to 13.9 feet (Figure 4). The annual means hover fairly close to the long-term mean except for 2016, which was lower. For trend analysis, see page 10. Transparency monitoring should be continued annually at site 205 in order to track water quality changes.

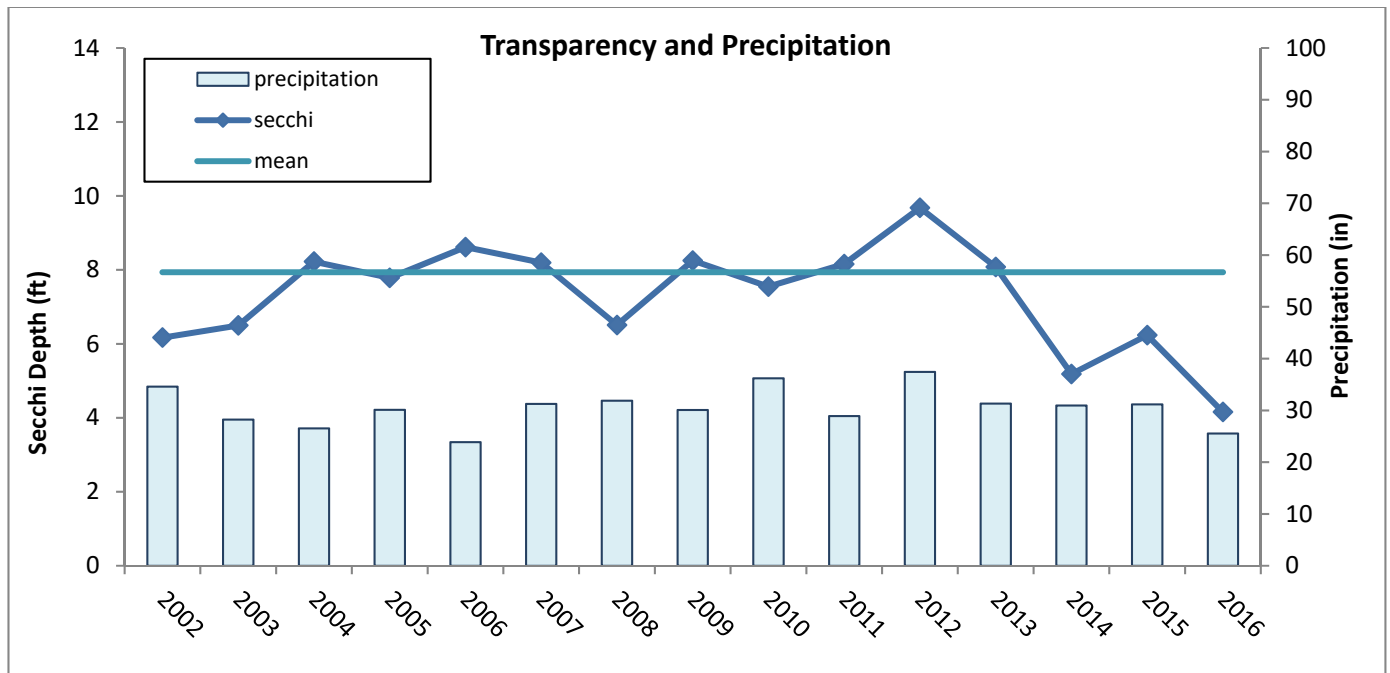


Figure 4. Annual mean transparency compared to long-term mean transparency

Hanging Horn Lake transparency ranges from 3.6 to 10.5 ft at the primary site (Table 5). Figure 5 shows the seasonal transparency dynamics. Hanging Horn Lake transparency is relatively consistent throughout the summer and varies a lot year to year (Figure 5). This pattern could be due to the brown stain from tannins. 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 at certain times of the year. It is typical for a lake to vary in transparency throughout the summer.

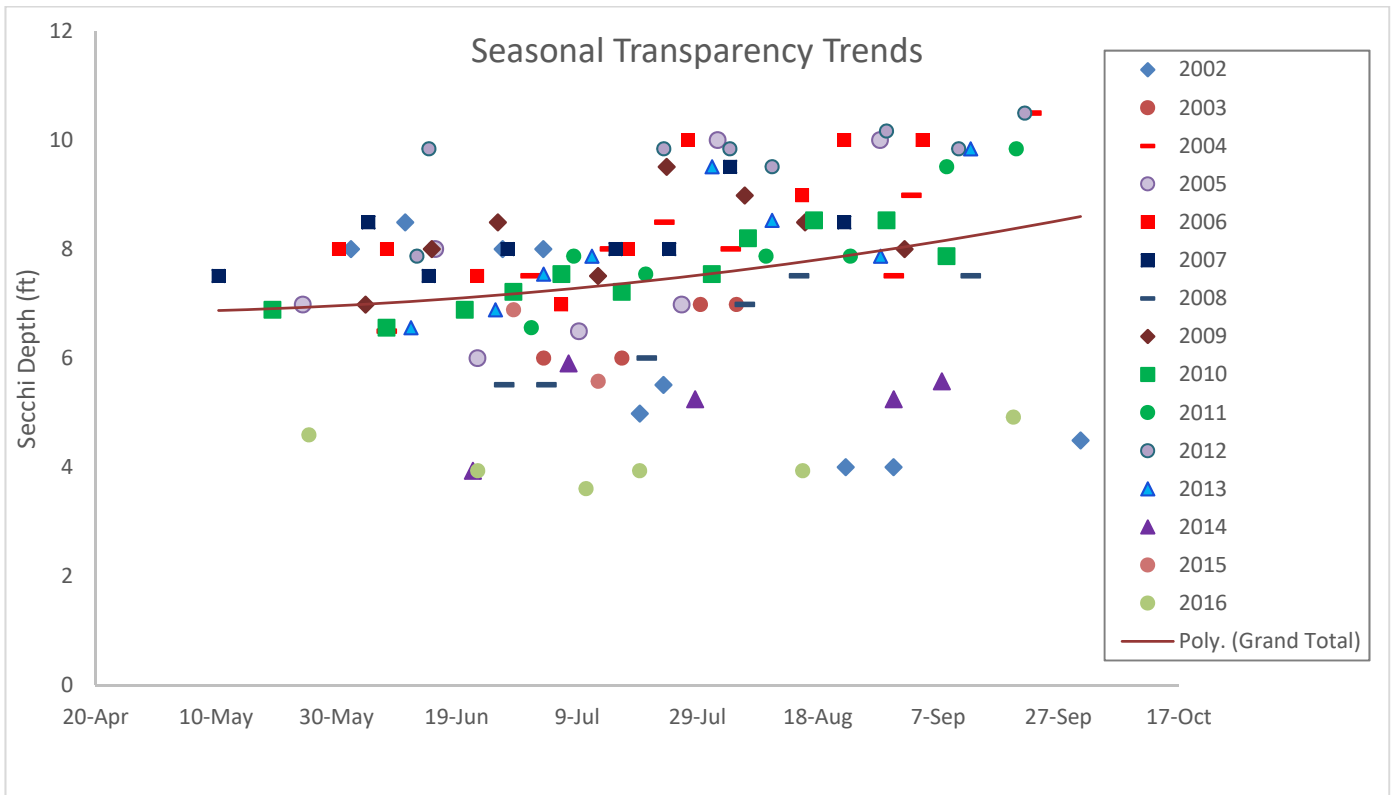


Figure 5. Seasonal transparency dynamics and year to year comparison (Primary Site 205). The black line represents the pattern in the data.

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).

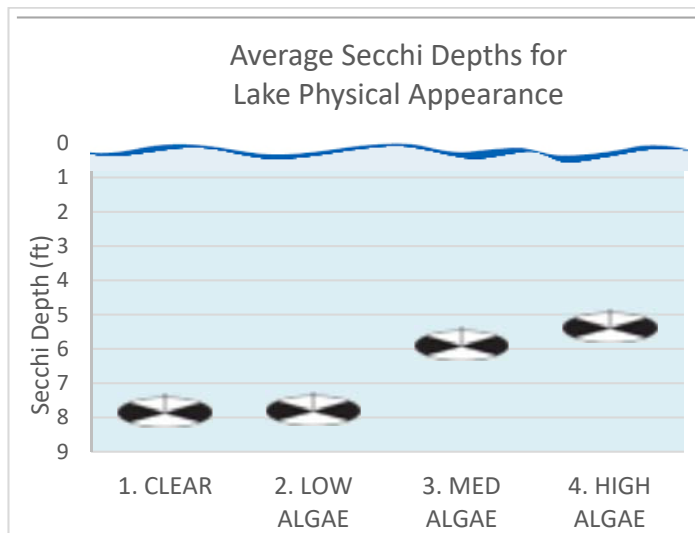


Figure 7. Average Secchi depth for each lake physical appearance rating.

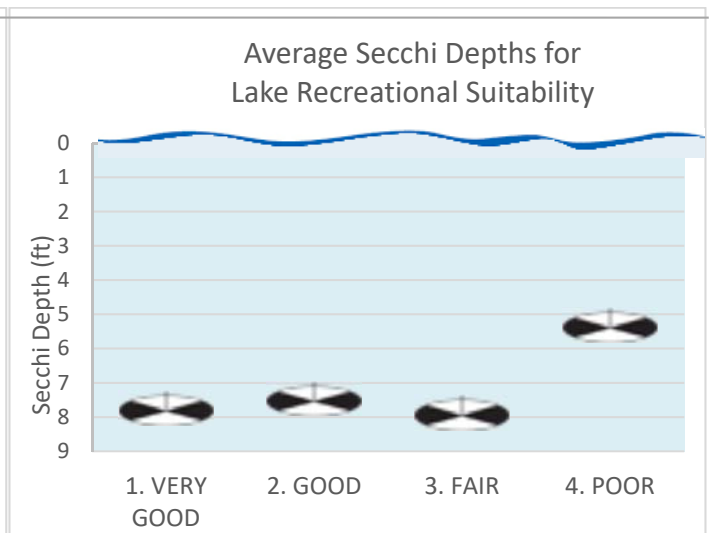


Figure 6. Average Secchi depth (ft) for each lake recreational suitability rating.

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.

Chlorophyll *a* was evaluated in Hanging Horn Lake 1993, 1997, and 2016 (Figure 8). Chlorophyll *a* concentrations went above 10 ug/L from July to September of 2016, indicating minor algae blooms.

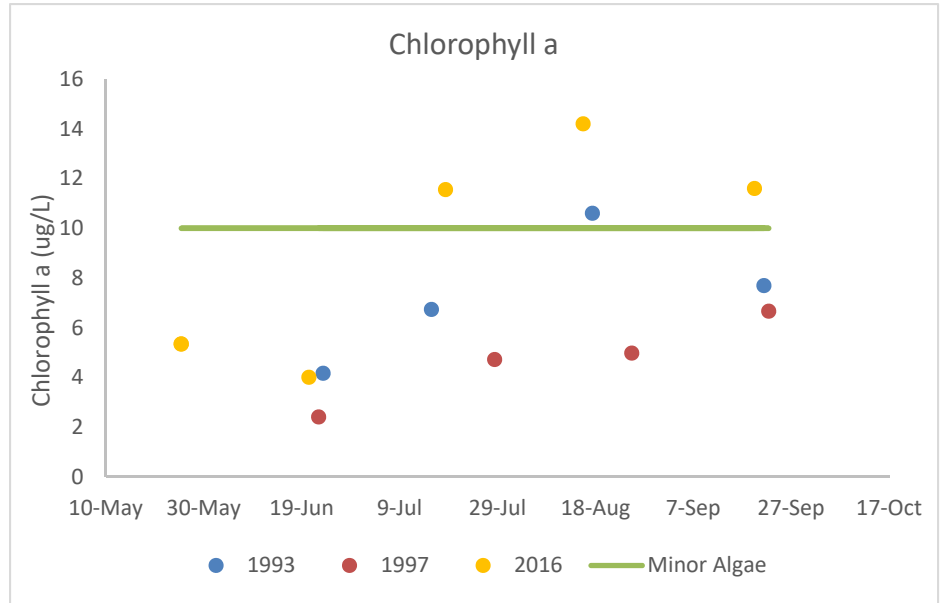


Figure 8. Chlorophyll *a* concentrations (ug/L) for Hanging Horn Lake at site 205.

Phosphorus

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

Total phosphorus was evaluated in Hanging Horn Lake in 1993, 1997, 2005, and 2016. The data do not indicate much seasonal variability. The majority of the data points fall into the mesotrophic range (Figure 9).

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

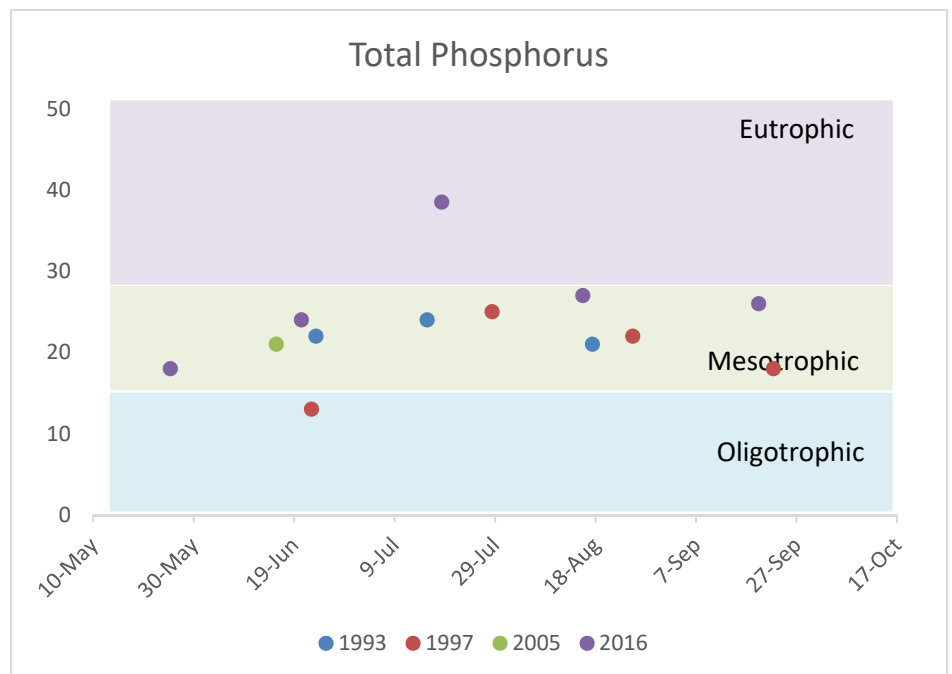
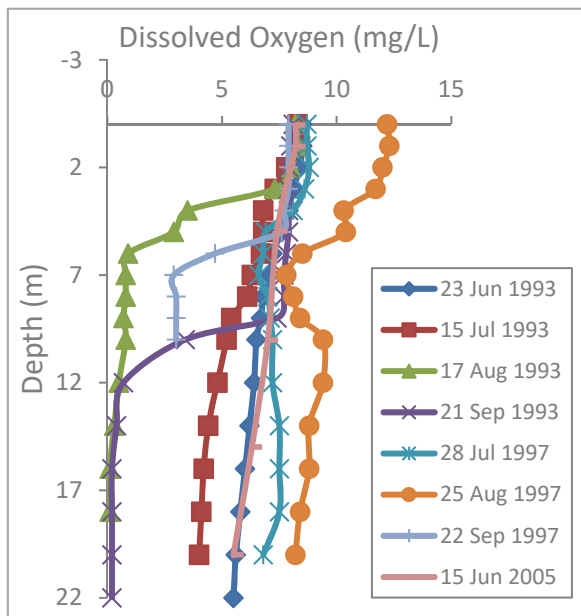


Figure 9. Historical total phosphorus concentrations (ug/L) for Hanging Horn Lake site 205.

Oxygen



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.

Hanging Horn Lake is a deep lake, with a maximum depth of 84 feet. Dissolved oxygen profiles from data collected in 1993, 1997 and 2005 at site 205 show stratification developing mid-summer (Figure 10). The thermocline was around 5 meters (16.4 feet), and much of the summer dissolved oxygen levels are higher than 5 mg/L, which supports ciscoes. DNR Fisheries lists Hanging Horn Lake as a cisco refuge lake. Lake Trout are also stocked in Hanging Horn Lake.

Figure 10. Representative dissolved oxygen profiles from 1993, 1997, and 2005 in Hanging Horn Lake.

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. Hanging Horn Lake falls into the mesotrophic range (Tables 6, 7).

Table 6. Trophic State Index for Hanging Horn Lake.

Trophic State Index	
TSI Phosphorus	49
TSI Chlorophyll-a	50
TSI Secchi	48
TSI Mean	49
Trophic State:	Mesotrophic
<i>Numbers represent the mean TSI for each parameter.</i>	

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

Hanging Horn 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.

Hanging Horn Lake 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 Hanging Horn Lake.

Lake Site	Parameter	Date Range	Trend
205	Total Phosphorus	2016	Insufficient Data
205	Chlorophyll <i>a</i>	2016	Insufficient Data
205	Transparency	2006-2016	No trend

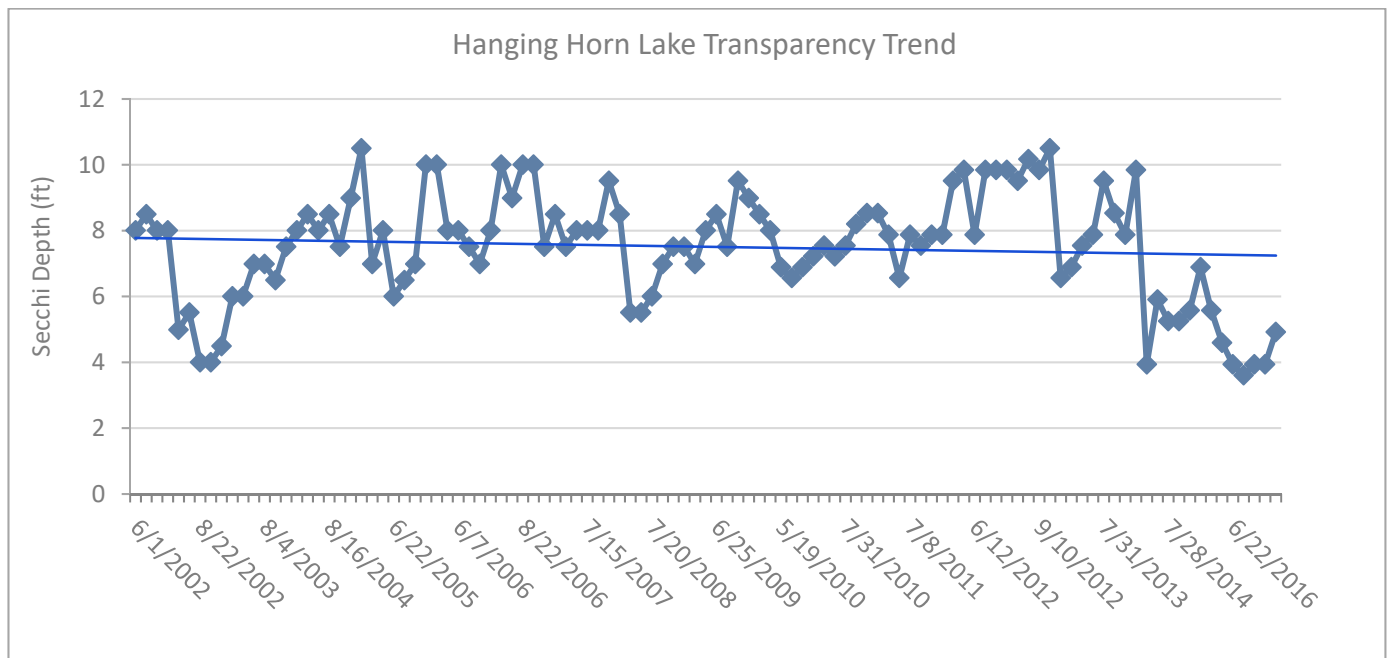


Figure 11. Transparency (feet) trend for site 205 from 2002-2016.

Hanging Horn Lake shows insufficient evidence for a transparency trend (Figure 11); however, since 2013 the transparency is lower than before 2013. 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 Major 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. Hanging Horn Lake falls within lakeshed 3502302 (Figure 16). 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 9). Watershed disturbance was defined as having urban, agricultural and mining land uses. Watershed protection is defined as publicly owned land, public water, wetlands, 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 artedii*) 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. Hanging Horn Lake is a cisco refuge lake.

Hanging Horn Lake’s lakeshed is classified with having 50% of the watershed protected and 6% of the watershed disturbed (Figure 13). Therefore, this lakeshed should have a protection focus. Goals for the lake should be to limit any increase in disturbed land use and maintain protected land. Hanging Horn Lake is a drainage lakeshed, which means that other lakesheds flow into it (Figure 12). It has a large watershed because the Moose Horn River flows through it.

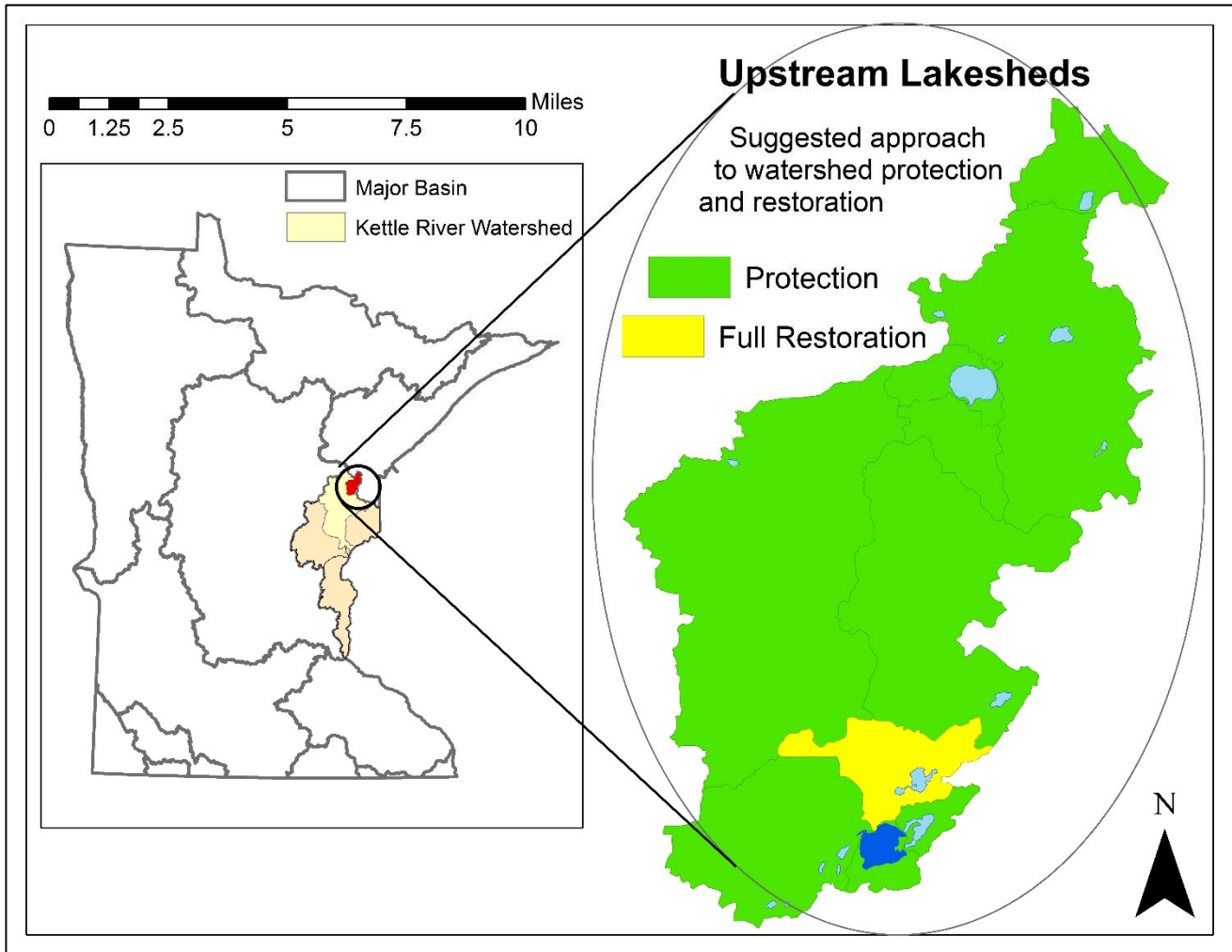


Figure 12. Kettle River major watershed and MN basins (left), and Hanging Horn Lake lakeshed and upstream catchments with protection suggestions (right).

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.

Half of the Hanging Horn Lake lakeshed is protected. This total includes water, wetlands, and publicly owned land. There are two parcels along the lakeshore which have specific conservation potential. They are both private land over 20 acres which are less than 50% developed or agriculture. There are no animal feedlots in the lakeshed (Table 10).

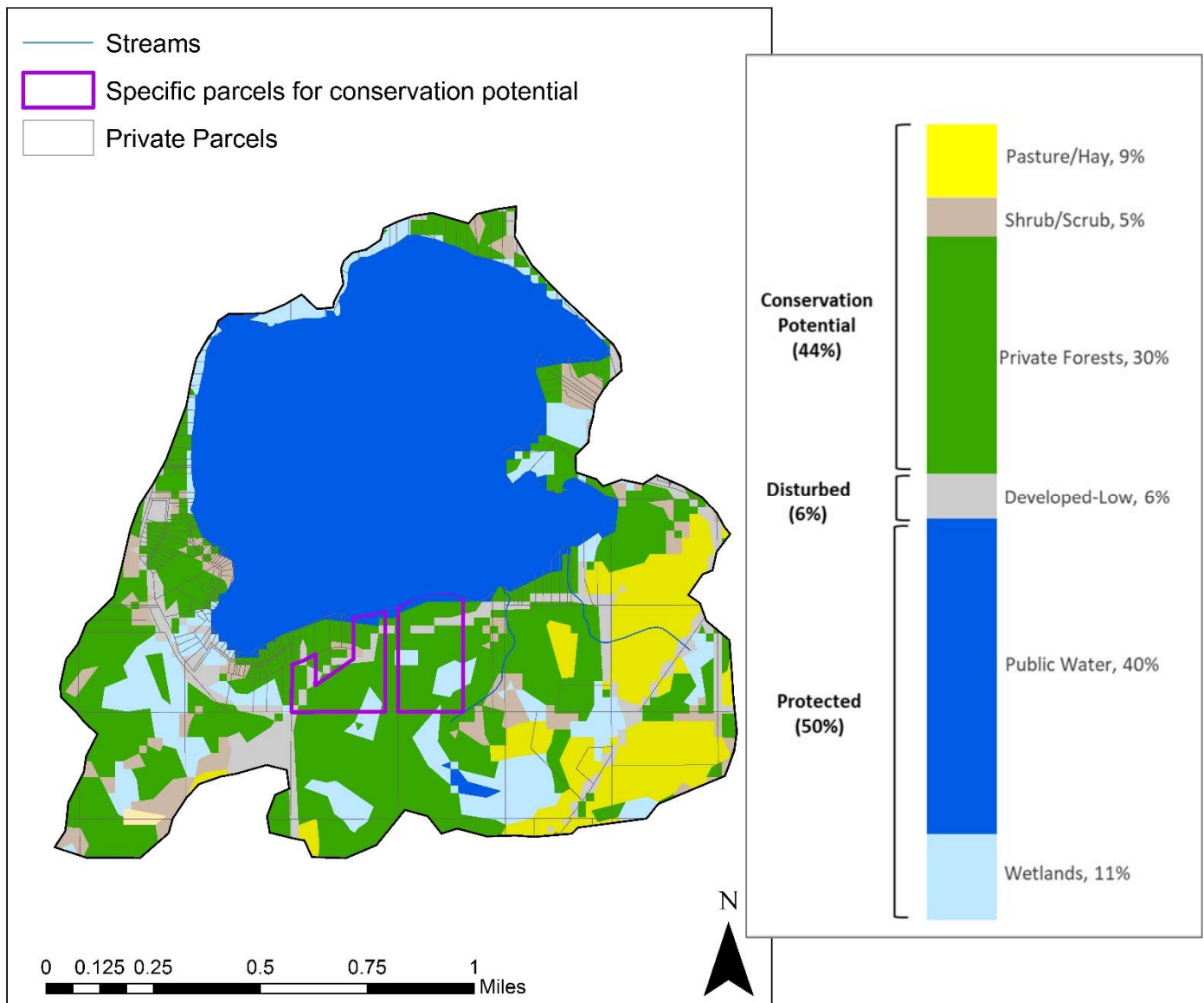


Figure 13. Land use and ownership in the Hanging Horn Lake lakeshed.

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. Hanging Horn Lake lakeshed vitals table.

Lakeshed Vitals		Rating
Lake Area	408.7 acres	descriptive
Littoral Zone Area	65.4 acres	descriptive
Lake Max Depth	84 ft.	descriptive
Lake Mean Depth	32 ft.	
Water Residence Time	NA	Not available
Miles of Stream	0.9	descriptive
Inlets	4	
Outlets	1	
Major Watershed	35 – Kettle River	descriptive
Minor Watershed	35023	descriptive
Lakeshed	3502302	descriptive
Ecoregion	Northern Lakes and Forest	descriptive
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	3:1	
Standard Watershed to Lake Basin Ratio (standard watershed includes lake areas)	134:1	
Wetland Coverage	6.5%	
Aquatic Invasive Species	None	
Public Drainage Ditches	None	
Public Lake Accesses	1	
Miles of Shoreline	4.6	descriptive
Shoreline Development Index	1.62	
Public Land to Private Land Ratio	0:1	
Development Classification	Recreational Development	
Miles of Road	4.1	descriptive
Municipalities in lakeshed	None	
Forestry Practices	None	
Feedlots	None	
Sewage Management	Compliance inspections are required for subsurface sewage treatment systems at point-of-sale or permit application in shoreland areas.	
Lake Management Plan	None	
Lake Vegetation Survey/Plan	DNR, 1997	

Hangings Horn Lake, Status of the Fishery (DNR, 7/20/2015)

A standard survey was conducted on Hanging Horn Lake during the summer of 2015 to evaluate and update information about fish populations and to evaluate the effectiveness of the Lake Trout stocking program.

Lake Trout is the primary management species for Hanging Horn Lake. Over 25,000 yearling Lake Trout have been stocked into the lake since 2007. Zero Lake Trout were captured in 2015 for a gillnet abundance of 0.0 per lift. Six special deep water gillnets were also set targeting Lake Trout. No Lake Trout were captured in the deep gillnets either. The 2010 assessment captured two Lake Trout for a deep gillnet abundance of 0.3 per lift, but both specimens were age-1 and had been recently stocked. The lack of Lake Trout captured suggests that Hanging Horn is unsuitable for Lake Trout management. Lake Trout likely are not surviving the warm summer months due to low dissolved oxygen levels and thermal stress in the deeper areas of the lake.

Walleye abundance of 1.1 per gillnet lift was average compared to other Minnesota lakes. Walleye average length was 12.5 inches and 1.7 pounds. Several year-classes of young walleye were evident in the sample suggesting angling for Walleye may improve in the next few years as these year-classes mature.

Tullibee/Cisco abundance of 36.1 per gillnet lift was well above average compared to other Minnesota lakes. Tullibee gillnet average length was 10.6 inches. Angling and/or sport netting opportunities for Cisco are exceptional in Hanging Horn Lake. Hanging Horn consistently has the highest abundance of Cisco in the Duluth Area.

Northern Pike abundance of 0.9 per gillnet lift was below average compared to other Minnesota Lakes. However, average size was good at 26.4 inches with fish up to 38.7 inches present. Although Northern Pike are present in low abundance, quality size fish are available in Hanging Horn Lake.

Black Crappie abundance of 3.7 per trapnet lift was above average compared to other Minnesota lakes. Average length was 8.1 inches with fish up to 10 inches sampled. Bluegill abundance was average at 11.8 per trapnet lift. Average length was 6.7 inches but only 12% exceeded 8 inches.

One Brook Trout was captured for a gillnet abundance of 0.1 per lift. The fish was 13.7 inches in length and was from the 2011 year-class. The origin of this fish is unknown but it likely emigrated from a cold water stream connected to the Moosehorn River which flows through Hanging Horn Lake. Historically, one other Brook Trout was captured in Hanging Horn during an assessment in 1993.

See the link below for specific information on gillnet surveys, stocking information, and fish consumption guidelines. <http://www.dnr.state.mn.us/lakefind/showreport.html?downum=09003800>

Key Findings and Recommendations

Monitoring Recommendations

Transparency monitoring at site 205 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 205, as the budget allows, to track future water quality trends.

Overall Conclusions

Hanging Horn Lake is a mesotrophic lake (TSI = 48) with insufficient evidence of a long-term trend in water clarity. The clarity in 2016 was lower than other years, so it should continue to be monitored in the future to document any changes. The total phosphorus, chlorophyll *a* and transparency ranges are within the ecoregion ranges (Table 4).

A third of Hanging Horn Lake's lakeshed is forested, none of the lakeshed is in public ownership, and 50% of the lakeshed is protected, while only 6% of the lakeshed is disturbed (Figure 13).

Hanging Horn Lake is one of several connected lakes joined via the Moose Horn River. The total watershed area for Hanging Horn Lake is very large (Table 11), therefore disturbances beyond the immediate lakeshed can adversely impact Hanging Horn's water quality.

Hanging Horn Lake is managed by DNR Fisheries for a cold water fishery, including ciscoes and lake trout. Dissolved oxygen profiles show hospitable oxygen levels for ciscoes in the summer (Figure 10). The DNR Fisheries summary on page 14 reports that cisco populations are above average for the area, but lake trout may not be surviving in the lake.

Phosphorus Loading and Priority Impacts

Hanging Horn Lake is at a disadvantage because it has a very large watershed (Table 11). Upstream land use in the watershed is likely the main impact to the lake's water quality.

With the Moose Horn River flowing through the lake, it likely has a short residence time, which means that many of the nutrients flowing into the lake also flush out.

Table 11. Watershed characteristics.

Lakeshed to Lake Area Ratio (lakeshed includes lake area)	3:1
Watershed to Lake Area Ratio (watershed includes lake areas)	134:1
Number of Upstream Lakes	9
Headwaters Lake?	No
Inlets / Outlets	4 / 1
Water Residence Time	NA

Hanging Horn Lake's trophic state (TSI=48) is a bit higher than expected for a deep lake that supports cold water fisheries, but that is likely due to its large watershed. Working to protect the land upstream and around the shoreline will help maintain Hanging Horn Lake's water quality.

Best Management Practices Recommendations

The management focus for Hanging Horn 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.

Hanging Horn Lake Goals

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

Table 12. Best Management Practices Table specific to Hanging Horn Lake (refer to Figure 13)

Category	Land use type	Conservation project ideas	Results	Who	Contact for help
Conservation Potential Land	private forests (30%, 313 acres)	Forest stewardship planning, 3 rd party certification, SFIA, local woodland cooperatives	Conserve and protect current forest cover	<ul style="list-style-type: none"> • Individual Property Owners 	Carlton SWCD (218) 384-3891 https://carltonswcd.org
	pasture/hay (9%, 95.8 acres)	Conservation Reserve Program (CRP), maintain vegetative cover, plant trees, conservation easements, grassed waterways, ditch buffers, maintain/restore wetlands.	Reduce water runoff and soil erosion, better water storage.	<ul style="list-style-type: none"> • Individual Property Owners 	Natural Resources Conservation Service 218-720-5209
	shrub/scrub (5%, 50.7 acres)	Maintain vegetative cover, plant trees, conservation easements, grassed waterways, buffers.	Reduce water runoff and soil erosion, better water storage.	<ul style="list-style-type: none"> • Individual Property Owners 	Natural Resources Conservation Service 218-720-5209
Disturbed Land	developed, low intensity (6%, 60.5 acres)	Shoreline buffers, rain gardens.	Reduce water runoff and shoreline erosion in lakes and streams.	<ul style="list-style-type: none"> • Individual Property Owners • Lake Associations 	Carlton SWCD (218) 384-3891 https://carltonswcd.org

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 12).

A third of the lakeshed is privately owned forested uplands (Table 12). 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.

The lakeshed still has a couple of large undeveloped shoreline parcels (Figure 13). Because a lot 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

Hanging Horn Lakeshore Management Association	P.O. Box 192 Barnum, MN 55707
DNR Fisheries Office	5351 North Shore Drive, Duluth, MN 55804 218-302-3264, duluth.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	808 3rd St, Carlton, MN 55718 (218) 384-3891, https://carltonswcd.org/
Carlton County	301 Walnut Ave, Carlton, MN 55718 http://carltoncountymn.govoffice3.com/