

Thirty Lakes Watershed District LAKE MONITORING REPORT 2024

Analysis and preparation by:



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Introduction

For forty-five years, from its formation in 1971, the Thirty Lakes Watershed District (TLWD) monitored and managed the water quality of lakes within the district boundaries. When the district was disbanded in 2016, their funds were turned over to Crow Wing County to be used exclusively for water quality monitoring within the district's former boundary (Figure 1). The former District is located in west central Crow Wing County and covers approximately 70 square miles; approximately 60% is covered by surface water. The major lakes included in the District's boundary are: Clark, Edward, Gladstone, Horseshoe, Hubert, North Long and Pelican Lakes. The following communities and townships lie partially or wholly in the former District: the cities of Breezy Point and Nisswa, Lake Edward, Center, Pelican and Mission Townships.

Beginning in the summer of 2000, TLWD began monitoring all lakes according to the Trophic State Index (TSI) monitoring protocol. TSI is a standard means for calculating the trophic state 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 are used to independently estimate algal biomass.

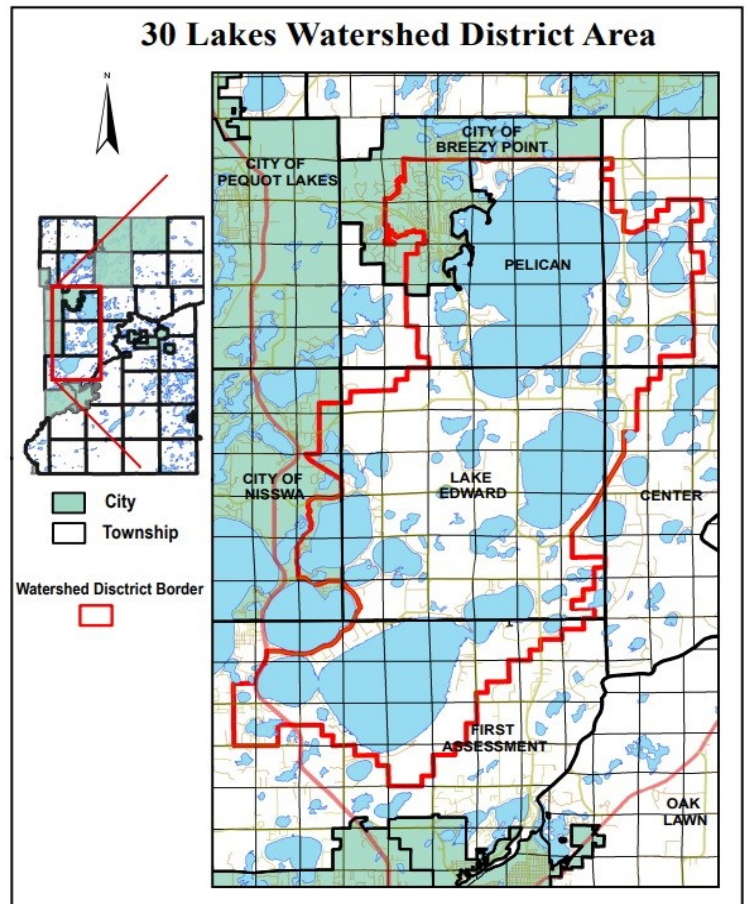
Phosphorus is a requirement for plant growth. When phosphorus concentrations are high, large amounts of plant (including algae) growth can be supported. Phosphorus is most often the limiting nutrient, and therefore the most important nutrient to control in order to prevent overgrowth of plant and algae biomass. All green plants contain chlorophyll *a*; therefore chlorophyll *a* concentrations are used as an estimate of overall plant/algae biomass. A Secchi Disk is a white metal disk used to measure the clarity or transparency of the water. The depth at which the disk is no longer visible is the Secchi Disk Reading.

The TSI computed from any of the above parameters can be used to determine a general trophic state for the lake. TSI values range in most lakes from 20 to 80. Lower values correspond to lower productivity (lower phosphorus and chlorophyll *a* measurements and deeper Secchi readings). Higher values correspond to high productivity (higher phosphorus and chlorophyll-a measurements and shallower Secchi readings). Table 1 presents the TSI scale and corresponding lake attributes.

When the TSI in a lake increases over time, it indicates an increase in the lake's productivity, also known as eutrophication. This is generally seen by lake users as greener water and more aquatic plant and algae growth.

Eutrophication is the process by which lakes receive nutrients (phosphorus and nitrogen) and sediment from the sur-

Figure 1. Map of TLWD Boundary



Introduction

Table 1. Trophic State Index Values and Corresponding Attributes

Trophic State	TSI Value	Attributes	Fisheries & Recreation
Oligotrophic	< 30	Clear water, oxygen throughout the year at the bottom of the lake, deep cold water.	Trout fisheries dominate.
	30-40	Bottom of shallower lakes may become anoxic (no oxygen).	Trout fisheries in deep lakes only. Walleye, Tullibee present.
Mesotrophic	40-50	Water moderately clear most of the summer. May become greener in late summer.	Anoxic conditions at the bottom of the lake limit trout and cold water fish. Walleye may predominate.
Eutrophic	50-60	Algae and aquatic plant problems possible. "Green" water most of the year.	Warm-water fisheries only. Bass may dominate.
	60-70	Blue-green algae possible, algal scums and aquatic plant problems.	Low water clarity may discourage swimming and boating.
Hypereutrophic	70-80	Dense algae and aquatic plants.	Water is not suitable for recreation.
	>80	Algal scums dominate, few aquatic plants.	Rough fish (carp) dominate. Summer fish kills possible.

rounding watershed and become more fertile and shallow. The added nutrients provide food for plants and fish, so the more eutrophic a lake becomes, the more living organisms it can sustain. When a lake becomes shallower from added sediment, more plants can grow because the littoral area (the area of the lake that is shallow enough for light to penetrate to the bottom) increases in overall percentage. Eutrophication is a natural process that all lakes go through over the course of hundreds to thousands of years (Figure 2). This natural eutrophication process is sometimes referred to as "lake aging."

Humans can speed up this natural aging process by contributing nutrients and sediments more quickly. Human-induced eutrophication or "cultural eutrophication" is generally caused by changes in land use practices and can occur over the course of decades (Figure 2). Land practices such as agriculture, animal feedlots, urban development, and the use of subsurface sewage treatment (septic systems) can contribute excess phosphorus to lakes causing an increase in algae and plant growth and diminishing water clarity. It's important for all lakeshore owners to understand the impact that their land use decisions have on their lake and the greater watershed.

Figure 2. Natural vs. Cultural Eutrophication

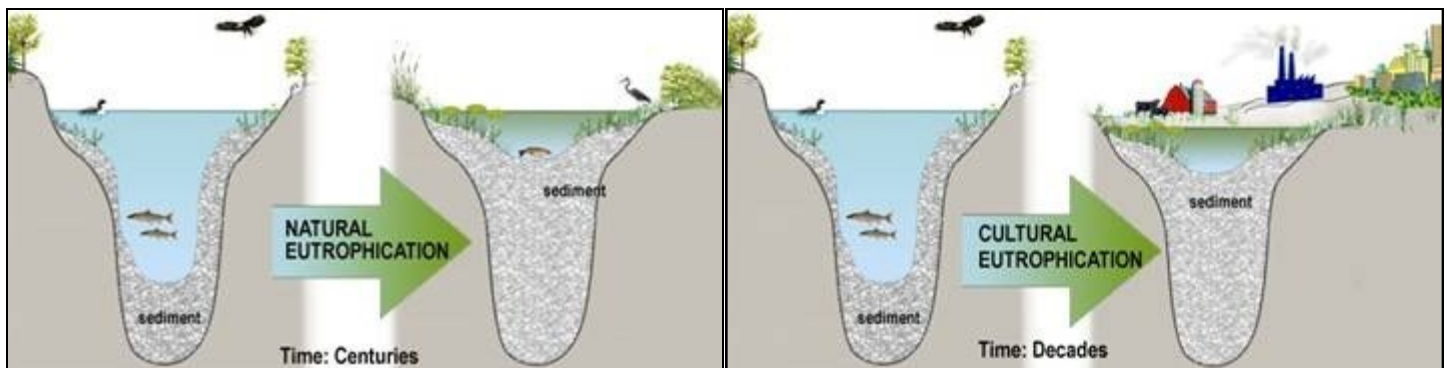


Image Source: <https://www.lakescientist.com/eutrophication/>

Introduction

The following report presents the results of Trophic State Index monitoring that was completed for lakes within the former Thirty Lakes Watershed District in 2024. The majority of samples were collected by volunteers from each corresponding lake with the exception of Little Pelican, Pelican, and North Long Lake, which were collected by staff from A.W. Research Laboratories, Inc. under contract for the Pelican Lakes Association and North Long Lake Association respectively. All samples were analyzed by A.W. Research Laboratories in Brainerd, Minnesota (MN accredited #027-035-135).

The Executive Summary provides a table with the overall Trophic State and TSI value for each lake along with trends for each parameter and the Lakeshed Risk Classification according to the Crow Wing County 2013 Water Plan. More detailed information for each lake can be found on the following pages where you will find a two-page summary for each lake containing the historical data statistics compared to the 2024 data, as well as graphs and charts displaying the data ranges and trends for each parameter measured.

Executive Summary

All lakes monitored were within or better than the expected ranges for lakes in the Northern Lakes and Forests Ecoregion. All lakes are also currently meeting the eutrophication standard for class 2B use waters. The majority of lakes monitored are Mesotrophic and have improving water quality trends for at least 2 of the 3 water quality parameters measured. Two lakes in the monitoring program are classified as Oligotrophic. Bass and Gladstone Lakes are the only lakes that show declining water quality trends. In general, lakes within the Thirty Lakes Watershed District continue to have exceptional water quality with stable and/or improving trends.

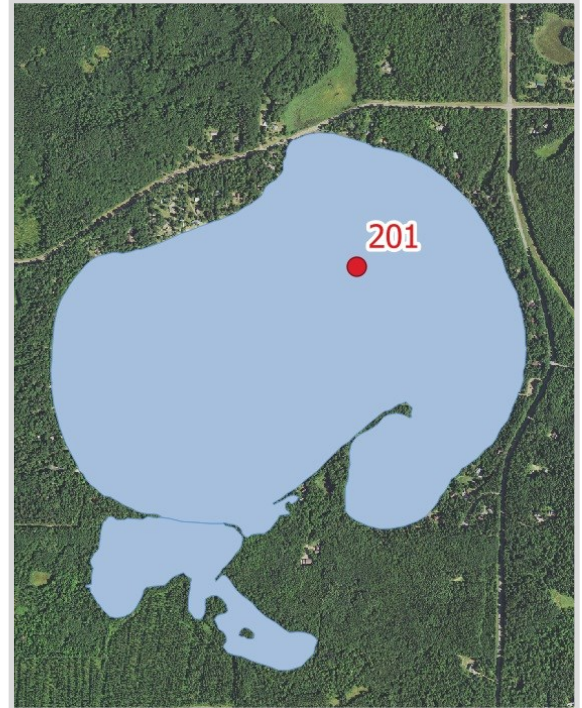
Lake	Mean TSI	Trophic State	Phosphorus Trend	Chlorophyll-a Trend	Secchi Depth Trend	Lakeshed Risk Classification
Bass Lake 18-0256-00	45	Mesotrophic	No Trend	Declining	Declining	Enhance-Protection
Clark Lake 18-0374-00	45	Mesotrophic	Improving	Improving	Improving	Enhance-Protection
Gladstone Lake 18-0256-00	44	Mesotrophic	<i>Insufficient Data</i>	<i>Insufficient Data</i>	Declining	Protection
Horseshoe Lake (East Bay) 18-0251-01	41	Mesotrophic	Improving	Improving	Improving	Vigilance
Horseshoe Lake (West Bay) 18-0251-02	40	Mesotrophic	Improving	Improving	No Trend	Vigilance
Lake Edward 18-0305-00	43	Mesotrophic	Improving	Improving	Improving	Protection
Lake Hubert 18-0375-00	40	Mesotrophic	No Trend	Improving	Improving	Protection
Little Lake Hubert 18-0340-00	41	Mesotrophic	No Trend	Improving	Improving	Protection
Little Pelican Lake 18-0351-00	40	Mesotrophic	No Trend	Improving	Improving	Protection
Lougee Lake 18-0342-00	42	Mesotrophic	No Trend	Improving	Improving	Protection
North Long Lake 18-0372-00	41	Mesotrophic	Improving (Sites 210 & 101) No Trend (Sites 204)	Improving	Improving (Site 210) No Trend (Sites 204 & 101)	Enhance-Protection
Pelican Lake 18-0308-00	37	Oligotrophic	No Trend	No Trend	No Trend	Protection
Sorenson Lake 18-0323-00	38	Oligotrophic	<i>Insufficient Data</i>	<i>Insufficient Data</i>	<i>Insufficient Data</i>	Protection
Young Lake 18-0252-00	42	Mesotrophic	<i>Insufficient Data</i>	<i>Insufficient Data</i>	<i>Insufficient Data</i>	Protection

Bass Lake 18-0256-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Mississippi River Brainerd (07010104)
Surface Area (acres):	294
Littoral Area (acres):	185
% Littoral area:	63%
Max Depth (ft):	21
Inlets/Outlets:	0/0
Public Accesses:	1
Development/Use Class:	Recreational Development / 2B
Impairments:	None listed
Lake Association:	Bass Lake Association
Website:	https://basslakeassociation.weebly.com/
Aquatic Invasive Species:	None listed

Fish Species: black crappie, bluegill, brown bullhead, hybrid sunfish, large-mouth bass, northern pike, pumpkinseed, sunfish, walleye, yellow bullhead, yellow perch, white sucker, banded killifish, blacknose shiner, bluntnose minnow, brook stickleback, golden shiner, Iowa darter, sand shiner, spottail shiner



Summary

Bass Lake saw an increase in the average algae levels (as measured by Chlorophyll-a) in 2024. Water quality has declined from 2013 to 2024. Bass Lake is shallow with no inlets or outlets; therefore, land use practices in the shoreland zone and in the larger lakeshed have the greatest potential impact on water quality.

Water Quality Characteristics

Site 201

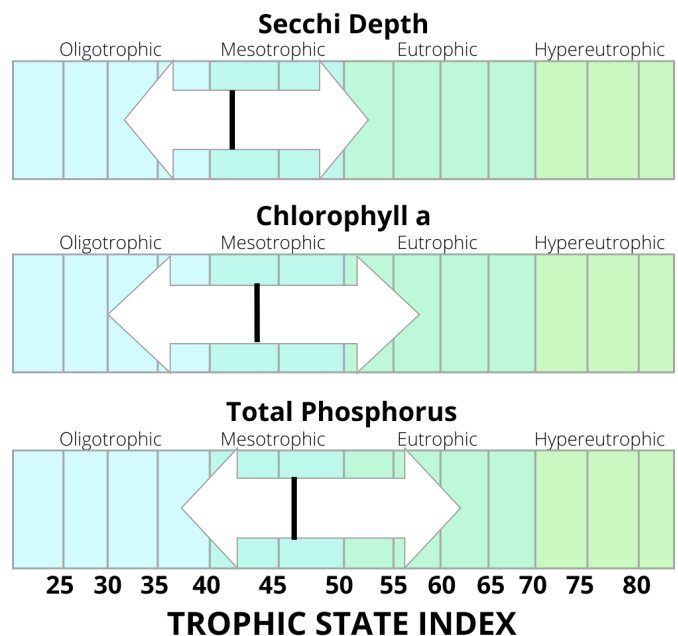
Years Monitored: 2000-2024 (Gap: 2003-2006)

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.019	0.018
Phosphorus (mg/L) Min	0.010	0.012
Phosphorus (mg/L) Max	0.055	0.025
Number of Observations	65	5

Chlorophyll-a (µg/L) Mean	5.3	8.0
Chlorophyll-a (µg/L) Min	1.0	2.3
Chlorophyll-a (µg/L) Max	15.0	11.0
Number of Observations	65	5

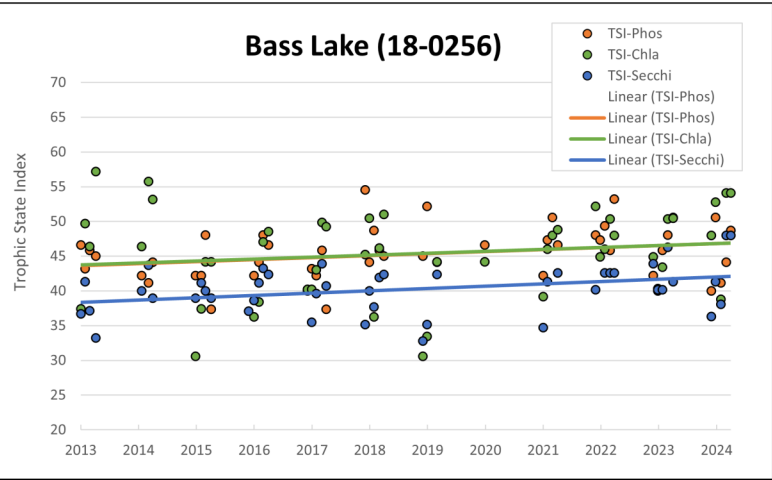
Secchi Depth (ft) Mean	11.4	11.8
Secchi Depth (ft) Min	5.5	7.5
Secchi Depth (ft) Max	21.6	17.0
Number of Observations	89	5

Trophic State: Mesotrophic (45)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Bass Lake 18-0256-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Good
Data Used:	2013, 2015-2018, 2021-2024
Total Phosphorus:	No Trend (95% confidence)
Chlorophyll-a:	Declining (95% confidence)
Secchi Depth:	Declining (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference	Eutrophication	Bass Lake	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.018	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	8.0	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	11.8	Within range and meets standard

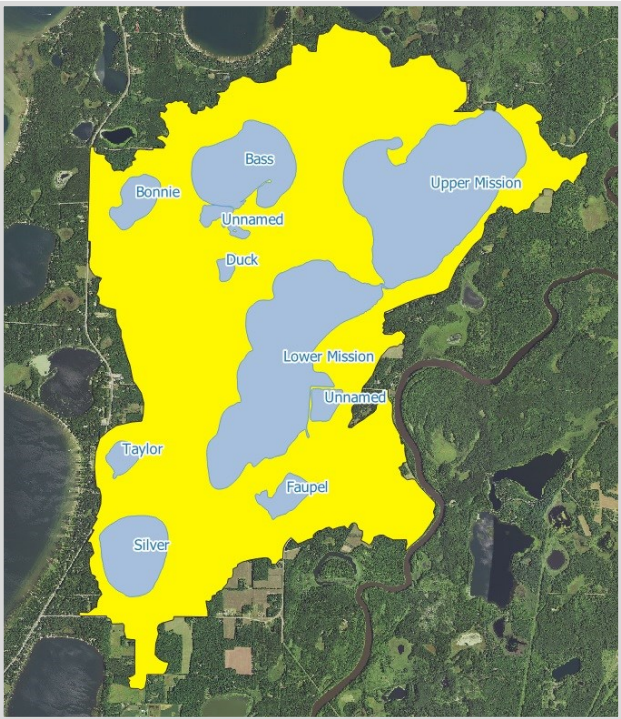
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Mission Creek
Area (acres):	8,149
Public Lands (% Protected):	40-60%
Land Use Disturbance:	8-15% disturbed
Water Quality Trends:	Improving and Declining
Risk Classification:	Enhance-Protection

Enhance-Protection Risk Classification:

Watershed has a percentage of protected lands that is generally less than 40% but also has many potential risk factors that could negatively impact the surface water (and/or groundwater) systems of the watershed. Moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover classes, animal units, extractive uses, and/ or drainage systems are likely within the watershed. In addition, lakes or streams that are impaired or have declining trends in water quality may also be present. The watershed is in fair condition but has great opportunities for project implementation and further protection efforts.



Clark Lake 18-0374-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Crow Wing River
Surface Area (acres):	305
Littoral Area (acres):	264
% Littoral area:	87%
Max Depth (ft):	31
Inlets/Outlets:	1/1
Public Accesses:	1
Development/Use Class:	General Development / 2B
Impairments:	None listed
Lake Association:	Clark Lake Conservation Association
Website:	None
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, smallmouth bass, walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, white sucker, banded killifish, blacknose shiner, bluntnose minnow, emerald shiner, golden shiner



Summary

Water quality on Clark Lake is variable but over the past 20 years Clark Lake shows an improvement in overall water quality. Clark Lake has a large set of data which shows a wide historic range for both phosphorus and chlorophyll-a readings. The water quality of the lake is highly influenced by its inlet and outlet.

Water Quality Characteristics

Site: 201

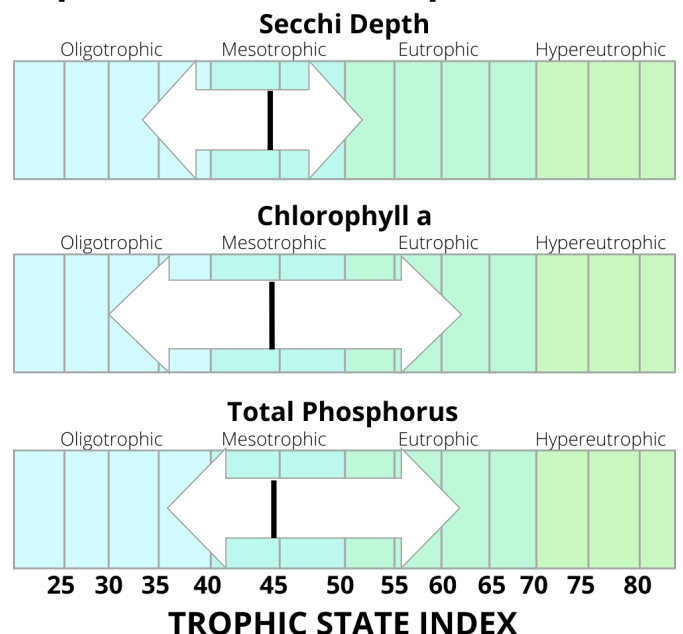
Years Monitored: 1973-1976, 1991-1992, 1994, 1996-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.018	0.015
Phosphorus (mg/L) Min	0.009	0.010
Phosphorus (mg/L) Max	0.055	0.020
Number of Observations	80	5

Chlorophyll-a (µg/L) Mean	5.2	4.2
Chlorophyll-a (µg/L) Min	1.0	1.6
Chlorophyll-a (µg/L) Max	24.0	6.9
Number of Observations	80	5

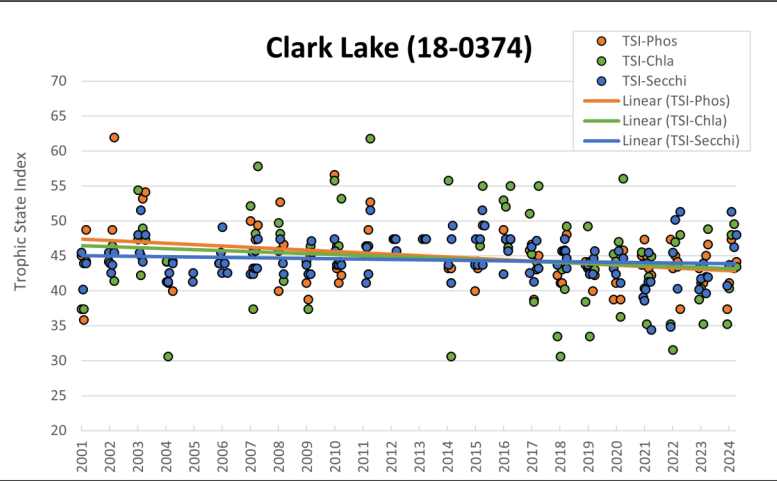
Secchi Depth (ft) Mean	9.73	8.9
Secchi Depth (ft) Min	5.00	6.0
Secchi Depth (ft) Max	19.40	12.5
Number of Observations	167	5

Trophic State: Mesotrophic (45)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Clark Lake 18-0341-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Good
Data Used:	2001-2004, 2006-2010, 2015-2024
Total Phosphorus:	Improving (95% confidence)
Chlorophyll-a:	Improving (95% confidence)
Secchi Depth:	Improving (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference	Eutrophication	Clark Lake	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.015	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	4.2	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	8.9	Within range and meets standard

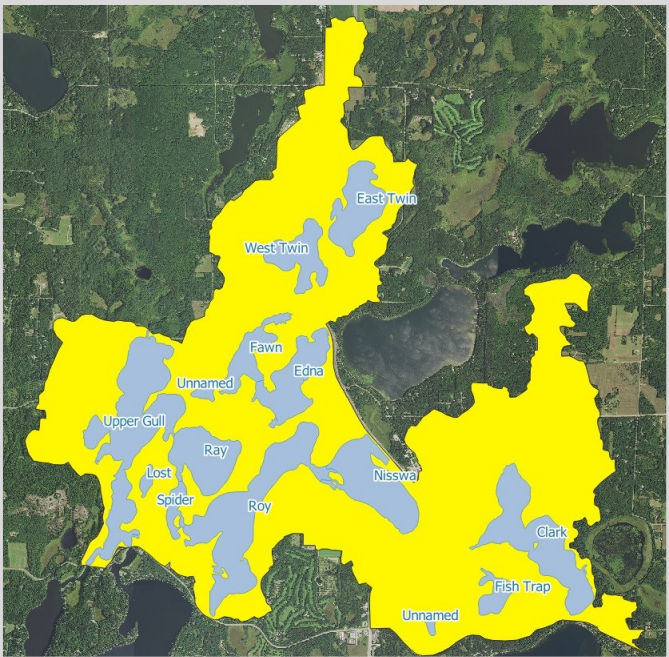
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Upper Gull Lake
Area (acres):	9,203
Public Lands (% Protected):	20-40%
Land Use Disturbance:	8-15% disturbed
Water Quality Trends:	Not Assessed
Risk Classification:	Enhance-Protection

Enhance-Protection Risk Classification:

Watershed has a percentage of protected lands that is generally less than 40% but also has many potential risk factors that could negatively impact the surface water (and/or groundwater) systems of the watershed. Moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover classes, animal units, extractive uses, and/ or drainage systems are likely within the watershed. In addition, lakes or streams that are impaired or have declining trends in water quality may also be present. The watershed is in fair condition but has great opportunities for project implementation and further protection efforts.

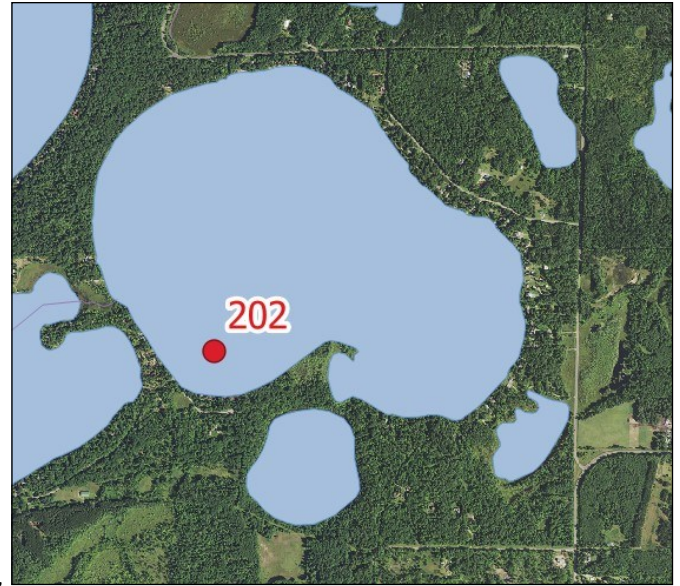


Gladstone Lake 18-0374-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Mississippi River Brainerd
Surface Area (acres):	432
Littoral Area (acres):	244
% Littoral area:	56%
Max Depth (ft):	36
Inlets/Outlets:	0/1
Public Accesses:	1
Development/Use Class:	General Development / 2B
Impairments:	None listed
Lake Association:	Gladstone Lake Association
Website:	http://www.gladstonelake.org/
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, white sucker, banded killifish, blackchin shiner, blacknose shiner, bluntnose minnow, central mudminnow, golden shiner, Iowa darter, Johnny darter, pugnose shiner, spottail shiner, tadpole madtom



Summary

Gladstone Lake is a shallow mesotrophic lake with generally good water quality. The dataset shows a declining trend for water clarity with Gladstone losing approximately 4.5 feet of clarity on average over the past 24 years. More monitoring is needed to assess trends for Chlorophyll-a and Total Phosphorus. It is notable that the average phosphorus measured in 2024 was higher than the historical average by 42%.

Water Quality Characteristics

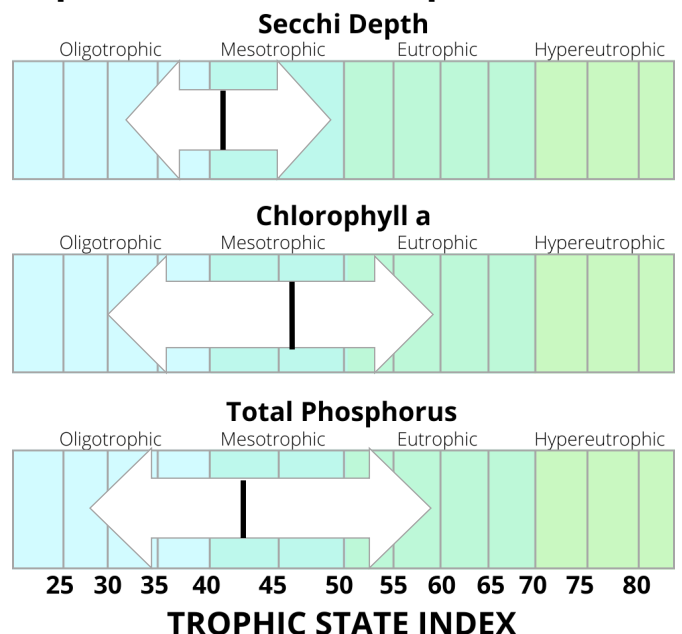
Site: 202, Years Monitored: 1970-72, 1974, 1988-91, 1993-2004, 2007-08, 2013-15, 2020, 2023-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.017	0.026
Phosphorus (mg/L) Min	0.005	0.011
Phosphorus (mg/L) Max	0.046	0.046
Number of Observations	34	4

Chlorophyll-a (µg/L) Mean	5.6	6.1
Chlorophyll-a (µg/L) Min	1.0	3.7
Chlorophyll-a (µg/L) Max	19.0	9.1
Number of Observations	34	4

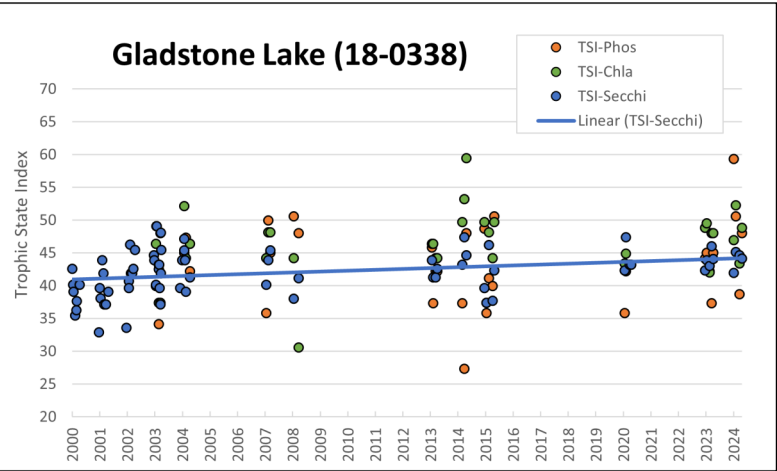
Secchi Depth (ft) Mean	11.8	10.0
Secchi Depth (ft) Min	7.0	9.2
Secchi Depth (ft) Max	21.5	11.5
Number of Observations	151	4

Trophic State: Mesotrophic (44)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Gladstone Lake 18-0341-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality: Insufficient

Total Phosphorus: Insufficient Data

Chlorophyll-a: Insufficient Data

Secchi Depth: Declining (90% confidence)

2000-2004, 2013, 2015, 2020, 2023-2024

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference	Eutrophication	Gladstone Lake	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.026	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	6.1	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	10.0	Within range and meets standard

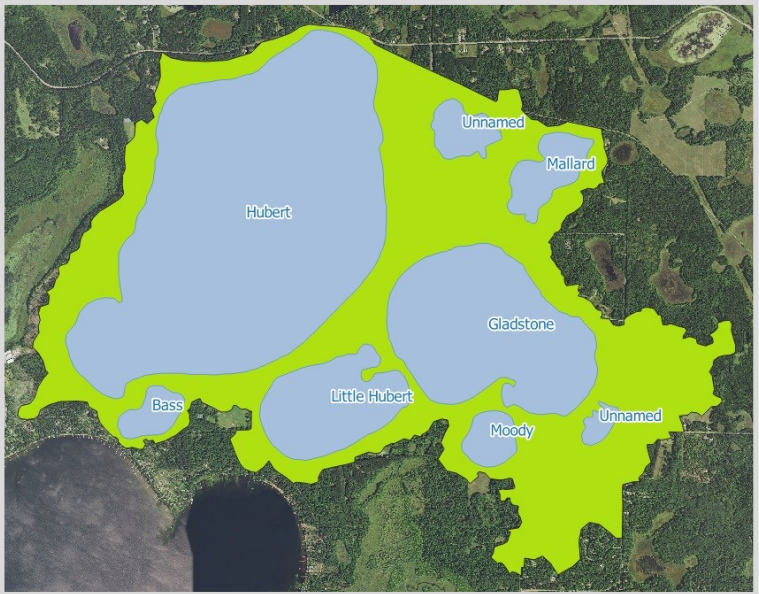
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Unknown
Area (acres):	3,825
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.



Horseshoe Lake (East Bay)18-0251-01

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	591
Littoral Area (acres):	535
% Littoral area:	91%
Max Depth (ft):	43
Inlets/Outlets:	0 / 0
Public Accesses:	1
Development/Use Class:	Recreational Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Horseshoe Lake Property Owners
Website:	www.horseshoelakemn.com
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, walleye, yellow bullhead, yellow perch, golden redhorse, white sucker, banded killifish, bigmouth shiner, blackchin shiner, blacknose shiner, blunt-nose minnow, central mudminnow, golden shiner, iowa darter, Johnny darter, mimic shiner, spotfin shiner, spottail shiner



Summary

The East Bay of Horseshoe Lake shows improving trends for all three water quality parameters. The high level of protection of the lakeshed in which Horseshoe Lake is located has had positive impacts on the water quality of the lake over time. Residents of Horseshoe Lake should maintain a “vigilance” mindset and monitor their land use practices to limit any potential nutrient sources that could hinder the improving water quality trends.

Water Quality Characteristics

Site: 207

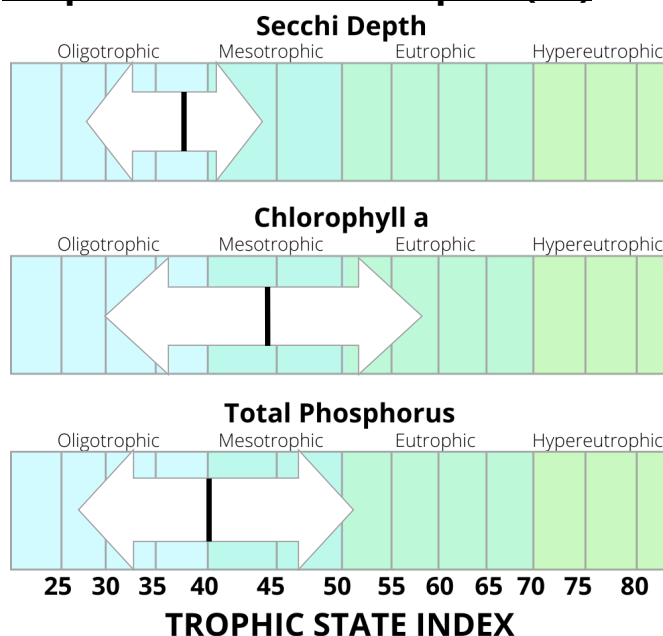
Years Monitored: 2003-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.013	0.009
Phosphorus (mg/L) Min	0.005	0.006
Phosphorus (mg/L) Max	0.026	0.013
Number of Observations	110	5

Chlorophyll-a (µg/L) Mean	4.8	3.1
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	18.0	5.3
Number of Observations	110	5

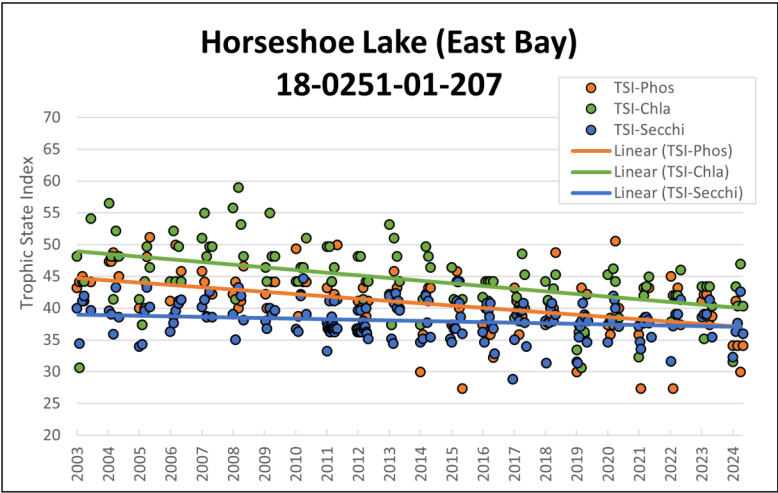
Secchi Depth (ft) Mean	15.4	16.7
Secchi Depth (ft) Min	9.5	11.0
Secchi Depth (ft) Max	28.5	22.5
Number of Observations	169	5

Trophic State: Mesotrophic (41)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Horseshoe Lake (East Bay) 18-0251-01



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Data Used:	2003-2024
Total Phosphorus:	Improving (95% confidence)
Chlorophyll-a:	Improving (95% confidence)
Secchi Depth:	Improving (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Horseshoe East (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.009	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	3.1	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	16.7	Better than range and meets standard

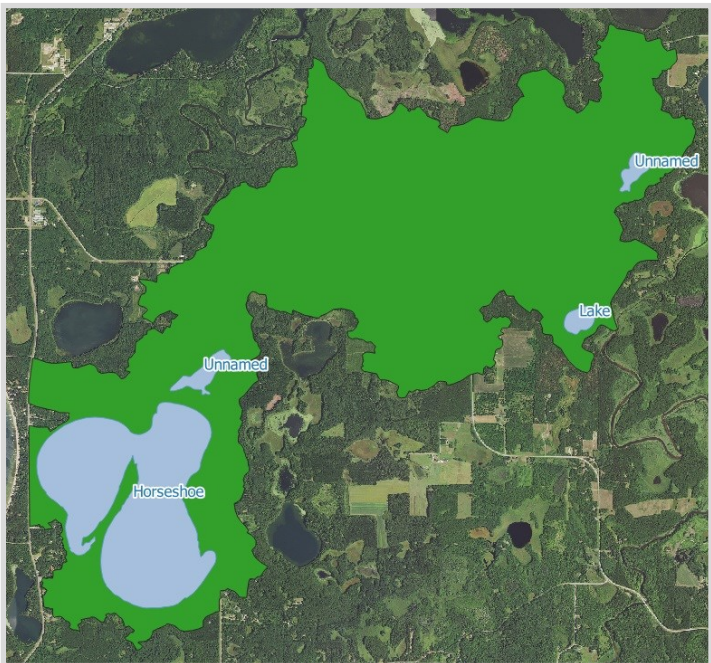
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pine River
Area (acres):	6,562
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Vigilance

Vigilance Risk Classification:

Watershed has a high percentage of protected lands (>50%), low amount of disturbed land cover (<8%) and have no other potential threats to water quality, such as development, agriculture, drainage, or extractive uses. While all watersheds have some risk for negative impacts, “vigilance” watersheds have the least amount of risk and thus warrant the least amount of implementation focus.



Horseshoe Lake (West Bay)18-0251-02

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	319
Littoral Area (acres):	265
% Littoral area:	83%
Max Depth (ft):	56
Inlets/Outlets:	0 / 0
Public Accesses:	None
Development/Use Class:	Recreational Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Horseshoe Lake Property Owners
Website:	www.horseshoelakemn.com
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, walleye, yellow bullhead, yellow perch, golden redhorse, white sucker, banded killifish, bigmouth shiner, blackchin shiner, blacknose shiner, bluntnose minnow, central mudminnow, golden shiner, Iowa darter, Johnny darter, mimic shiner, spotfin shiner, spottail shiner



Summary

The West Bay of Horseshoe Lake shows improving trends for total phosphorus and chlorophyll-a. The high level of protection of the lakeshed in which Horseshoe Lake is located has had positive impacts on the water quality of the lake over time. Residents of Horseshoe Lake should maintain a “vigilance” mindset and monitor their land use practices to limit any potential nutrient sources that could hinder the improving water quality trends.

Water Quality Characteristics

Site: 205

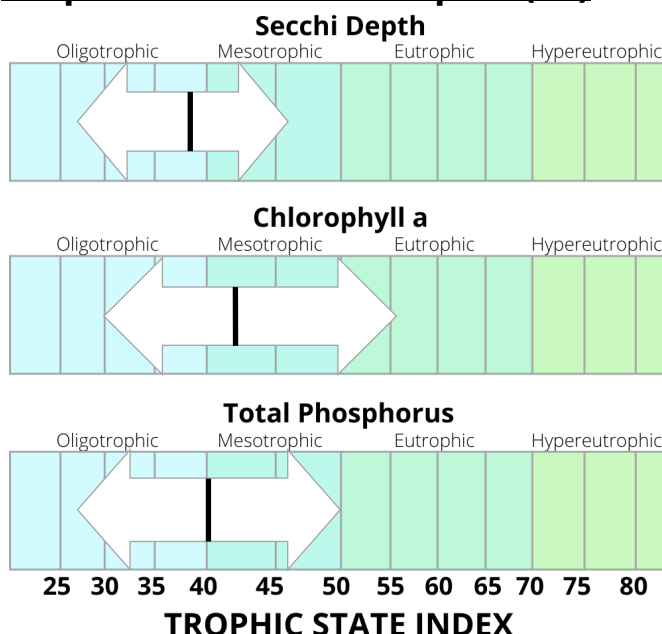
Years Monitored: 1974-1976, 1991-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.013	0.010
Phosphorus (mg/L) Min	0.005	0.007
Phosphorus (mg/L) Max	0.025	0.014
Number of Observations	108	5

Chlorophyll-a (µg/L) Mean	4.4	2.7
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	13.0	3.7
Number of Observations	108	5

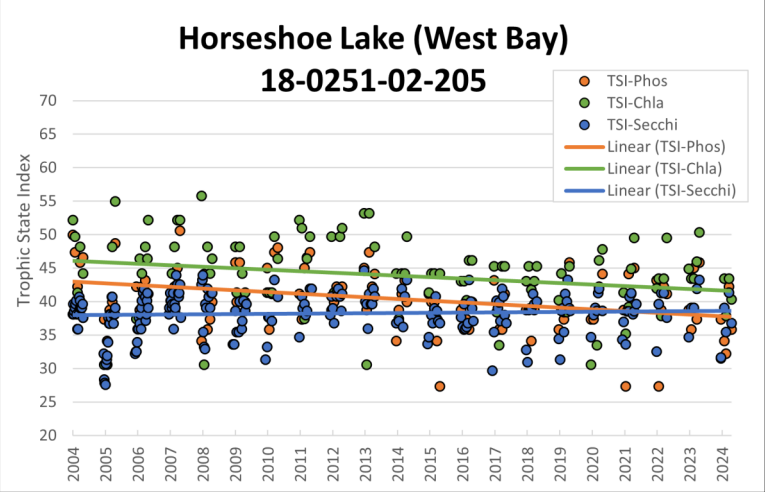
Secchi Depth (ft) Mean	15.3	16.8
Secchi Depth (ft) Min	8.5	12.0
Secchi Depth (ft) Max	31.0	23.5
Number of Observations	439	5

Trophic State: Mesotrophic (40)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Horseshoe Lake (West Bay) 18-0251-02



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Data Used:	2004-2024
Total Phosphorus:	Improving (95% confidence)
Chlorophyll-a:	Improving (95% confidence)
Secchi Depth:	No Trend (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference	Eutrophication	Horseshoe West	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.010	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.7	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	16.8	Better than range and meets standard

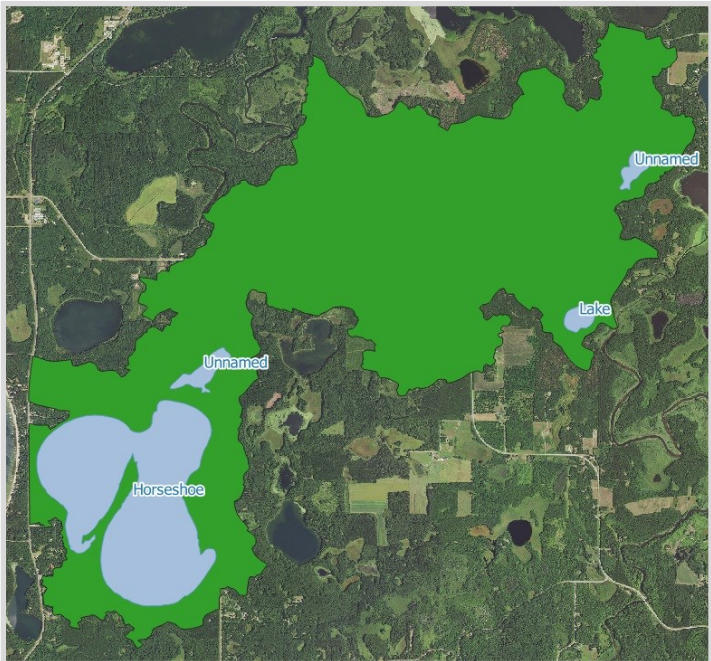
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pine River
Area (acres):	6,562
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Vigilance

Vigilance Risk Classification:

Watershed has a high percentage of protected lands (>50%), low amount of disturbed land cover (<8%) and have no other potential threats to water quality, such as development, agriculture, drainage, or extractive uses. While all watersheds have some risk for negative impacts, “vigilance” watersheds have the least amount of risk and thus warrant the least amount of implementation focus.

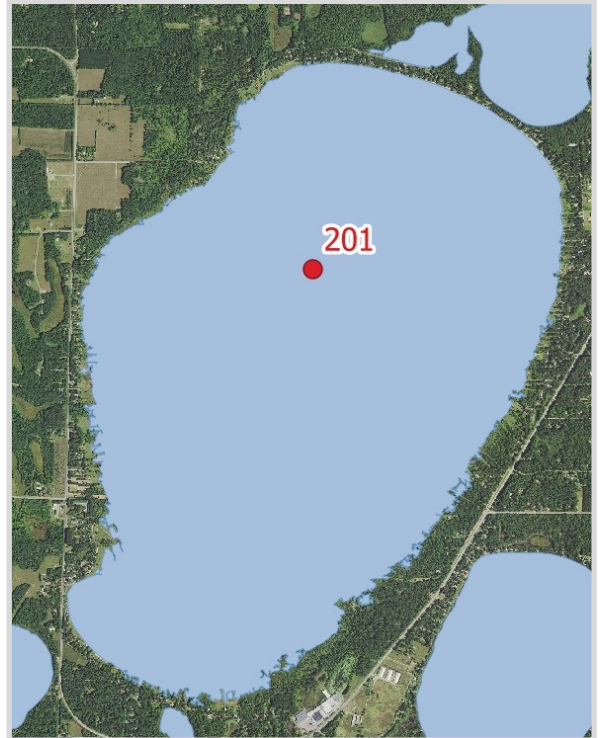


Lake Edward 18-0305-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Crow Wing River (07010106)
Surface Area (acres):	2,575
Littoral Area (acres):	1,198
% Littoral area:	47%
Max Depth (ft):	75
Inlets/Outlets:	1/1
Public Accesses:	1
Development/Use Class:	General Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Lake Edward Conservation Club
Website:	https://edwardlake.wordpress.com/
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, tullibee (cisco), walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, white sucker, banded killifish, blacknose shiner, common shiner, emerald shiner, Johnny darter, shiners, spottail shiner



Summary

Lake Edward is a deep, mesotrophic lake with good water quality. Lake Edward has improving long-term water quality trends which are likely related to introduction of zebra mussels to the lake. Historically water quality has been stable and has begun to improve more noticeably since 2019.

Water Quality Characteristics

Site 201

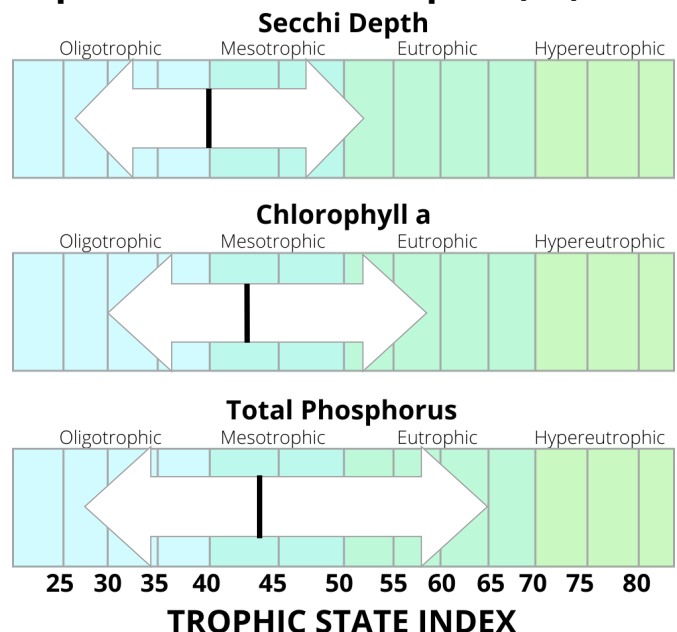
Years Monitored: 1973-1976, 2000-2024 (Gap: 2005, 2007)

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.018	0.014
Phosphorus (mg/L) Min	0.005	0.008
Phosphorus (mg/L) Max	0.070	0.018
Number of Observations	94	4

Chlorophyll-a (µg/L) Mean	4.4	2.4
Chlorophyll-a (µg/L) Min	1.0	1.6
Chlorophyll-a (µg/L) Max	17.8	3.2
Number of Observations	88	4

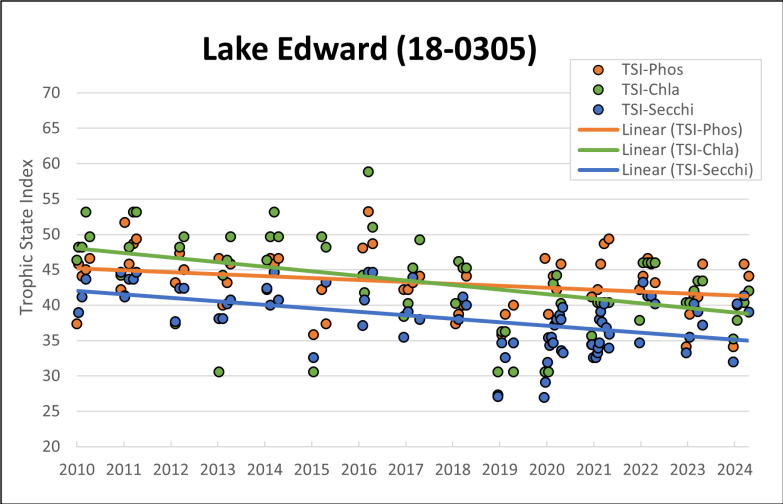
Secchi Depth (ft) Mean	13.5	15.5
Secchi Depth (ft) Min	5.5	12.0
Secchi Depth (ft) Max	32.5	23.0
Number of Observations	153	4

Trophic State: Mesotrophic (43)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Lake Edward 18-0305-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality: Good

Total Phosphorus: Improving (90% confidence)
2010-2011, 2013-2014, 2017-2024

Chlorophyll-a: Improving (95% confidence)
2010-2011, 2013-2014, 2017-2024

Secchi Depth: Improving (95% confidence)
2011, 2013-2014, 2016-2017, 2020-2024

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference	Eutrophication	Lake Edward	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.014	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.4	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	15.5	Better than range and meets standard

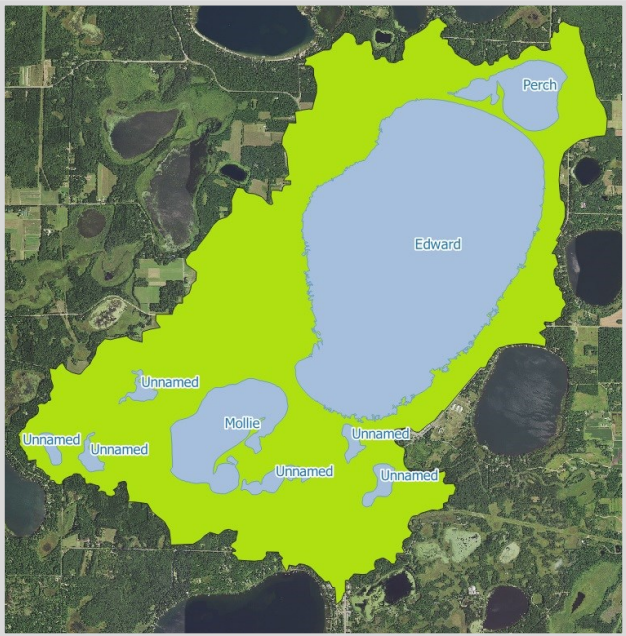
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Unknown
Area (acres):	8,686
Public Lands (% Protected):	40-60%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.

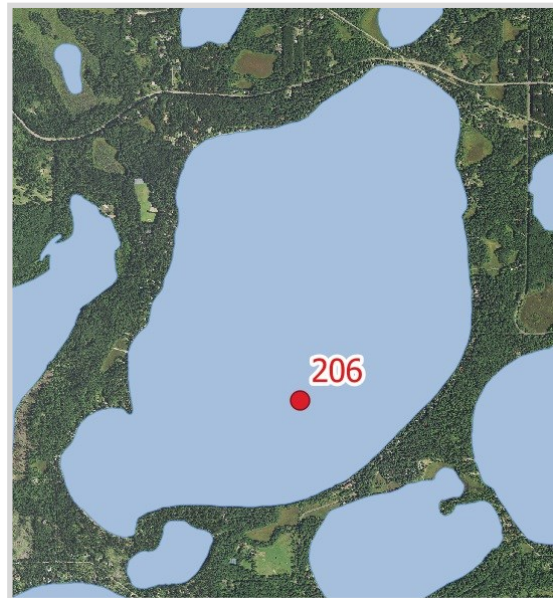


Lake Hubert 18-0375-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Crow Wing River (07010106)
Surface Area (acres):	1,288
Littoral Area (acres):	465
% Littoral area:	36%
Max Depth (ft):	83
Inlets/Outlets:	1/1
Public Accesses:	1
Development/Use Class:	General Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Lake Hubert Conservation Association
Website:	https://www.lake-hubert.com/
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, tullibee (cisco), walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, white sucker, banded killifish, bigmouth shiner, blacknose shiner, bluntnose minnow, brook silver-side, common shiner, fathead minnow, Iowa darter, Johnny darter, least darter, mimic shiner, spottail shiner, tadpole madtom



Summary

Lake Hubert shows improving trends in both chlorophyll-a and Secchi depth. No significant trend was observed in total phosphorus, however Lake Hubert has seen a wide range of total phosphorus readings over the past 40 years. The relative small-size of Hubert's lakeshed means that any land use changes within that area can have a more direct impact on the lake. This may explain the historic variability in the phosphorus data and indicates that managing the land use around Lake Hubert is critical to maintaining its high water quality.

Water Quality Characteristics

Site 206

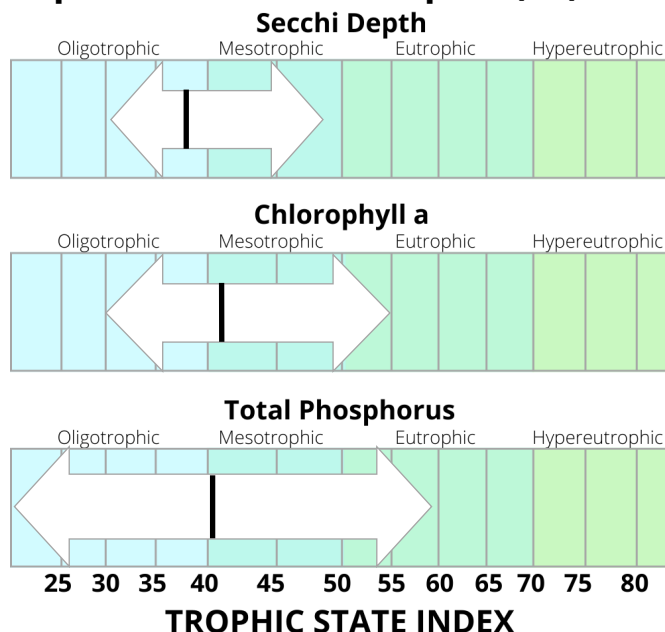
Years Monitored: 1974-1976, 2000-2024 (Gap: 2005, 2013)

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.014	0.012
Phosphorus (mg/L) Min	0.003	0.005
Phosphorus (mg/L) Max	0.046	0.018
Number of Observations	103	4

Chlorophyll-a (µg/L) Mean	3.7	2.1
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	12.5	3.2
Number of Observations	99	5

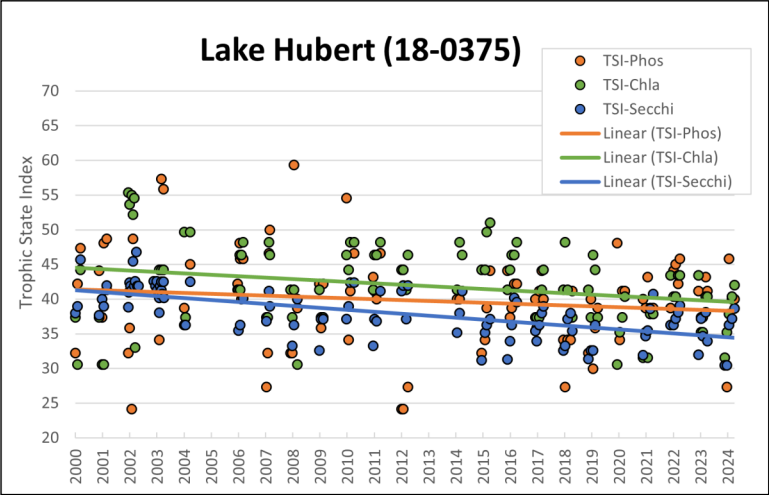
Secchi Depth (ft) Mean	15.2	19.7
Secchi Depth (ft) Min	8.0	14.4
Secchi Depth (ft) Max	25.5	25.5
Number of Observations	113	5

Trophic State: Mesotrophic (40)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Lake Hubert 18-0375-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Total Phosphorus:	No Trend (95% confidence) 2001-2002, 2008, 2010, 2012, 2015-2024
Chlorophyll-a:	Improving (95% confidence) 2001-2002, 2008, 2010, 2012, 2015-2024
Secchi Depth:	Improving (95% confidence) 2001-2003, 2010, 2012, 2015-2019, 2021-2024

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Lake Hubert (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.012	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.1	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	19.7	Better than range and meets standard

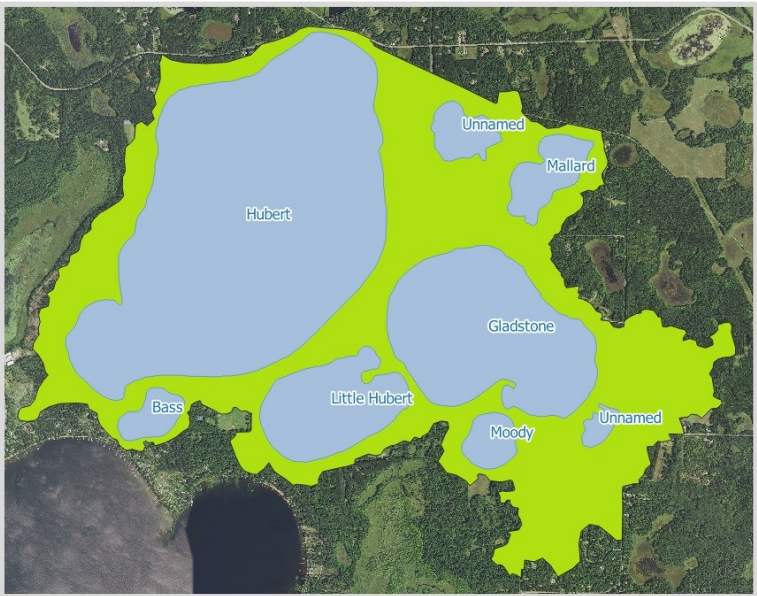
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Unknown
Area (acres):	3,825
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.



Little Lake Hubert 18-0340-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Crow Wing River (07010106)
Surface Area (acres):	194
Littoral Area (acres):	161
% Littoral area:	83%
Max Depth (ft):	41
Inlets/Outlets:	1/1
Public Accesses:	0
Development/Use Class:	Recreational Development / 2B
Impairments:	None listed
Lake Association:	Little Lake Hubert Lake Association
Website:	https://littlelakehubert.wordpress.com/
Aquatic Invasive Species:	None listed
Fish Species:	black bullhead, black crappie, bluegill, brown bullhead, large-mouth bass, northern pike, pumpkinseed, rock bass, walleye, yellow bullhead, yellow perch, bowfin (dogfish)



Summary

Little Lake Hubert has good water quality and significant improving trends for both chlorophyll-a and Secchi depth. The inlet from Gladstone Lake and land use practices have the largest impact on the water quality of Little Hubert. The relative small-size of Little Hubert's lakeshed means that any land use changes within that area can have a more direct impact on the lake. This can explain why phosphorus concentrations have been variable historically in Little Hubert.

Water Quality Characteristics

Site 202

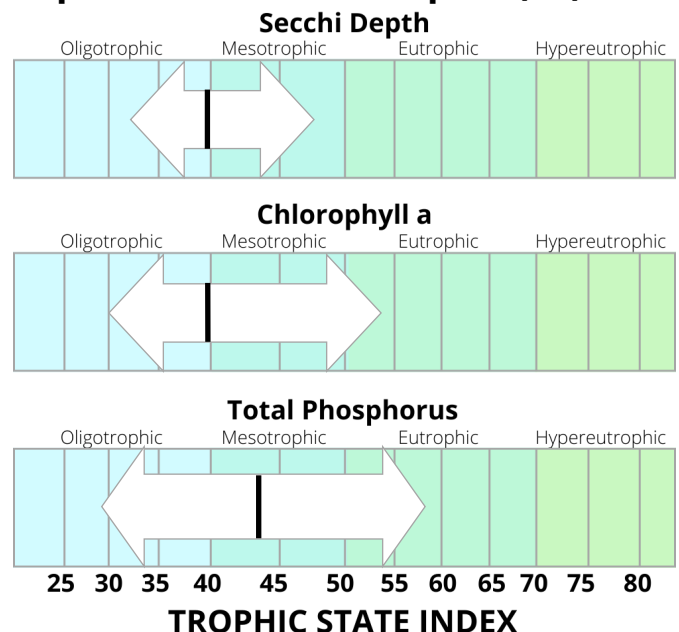
Years Monitored: 1992-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.017	0.019
Phosphorus (mg/L) Min	0.006	0.013
Phosphorus (mg/L) Max	0.041	0.031
Number of Observations	73	4

Chlorophyll-a (µg/L) Mean	3.3	1.6
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	10.7	2.1
Number of Observations	72	4

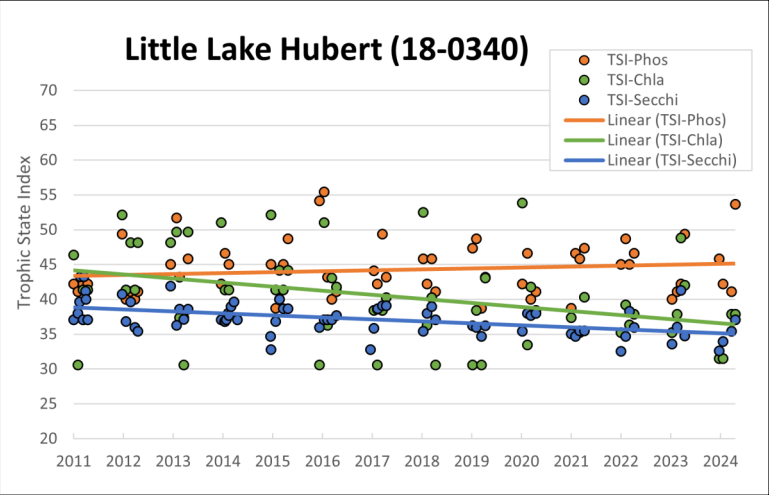
Secchi Depth (ft) Mean	13.6	19.0
Secchi Depth (ft) Min	8.0	16.1
Secchi Depth (ft) Max	22.0	22.0
Number of Observations	276	4

Trophic State: Mesotrophic (41)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Little Lake Hubert 18-0340-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Good
Total Phosphorus:	No Trend (95% confidence) 2011-2013, 2015-2024
Chlorophyll-a:	Improving (95% confidence) 2011-2013, 2015-2024
Secchi Depth:	Improving (95% confidence) 1992-2009, 2011-2024

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Little Hubert (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.019	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	1.6	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	19.0	Better than range and meets standard

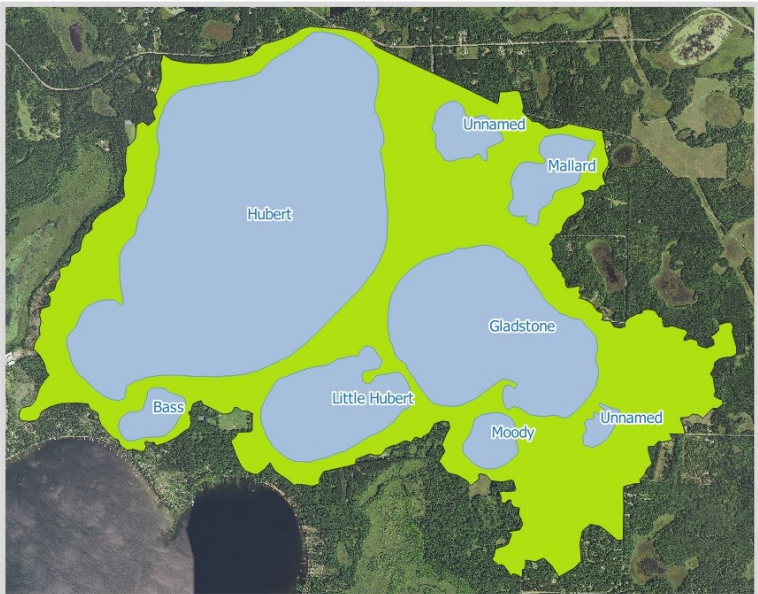
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Unknown
Area (acres):	3,825
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.

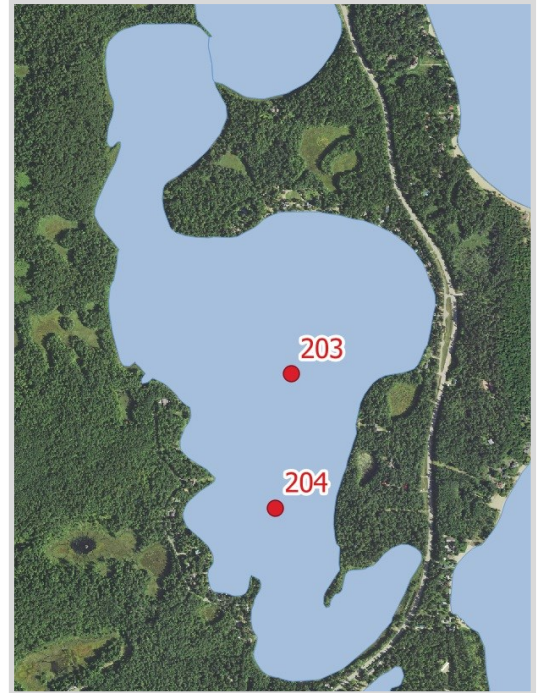


Little Pelican Lake 18-0351-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	271
Littoral Area (acres):	206
% Littoral area:	76%
Max Depth (ft):	34
Inlets/Outlets:	0/0
Public Accesses:	1
Development/Use Class:	General Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Pelican Lakes Association
Website:	http://pelicanlakesassociation.org/
Aquatic Invasive Species:	None listed

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, sunfish, walleye, yellow bullhead, yellow perch, bowfin (dogfish), white sucker, band-ed killifish, blackchin shiner, blacknose shiner, bluntnose minnow, central mudminnow, golden shiner, Iowa darter, Johnny darter, spottail shiner, tad-pole madtom



Summary

Little Pelican Lake is a shallow, Mesotrophic lake with high water quality. Because of its small size and the relatively small size of its lakeshed, the water quality of Little Pelican is highly influenced by the land use practices around it. Little Pelican shows improving trends for both chlorophyll-a and Secchi depth over the long term. There is no significant trend in total phosphorus.

Water Quality Characteristics

Sites 203 & 204

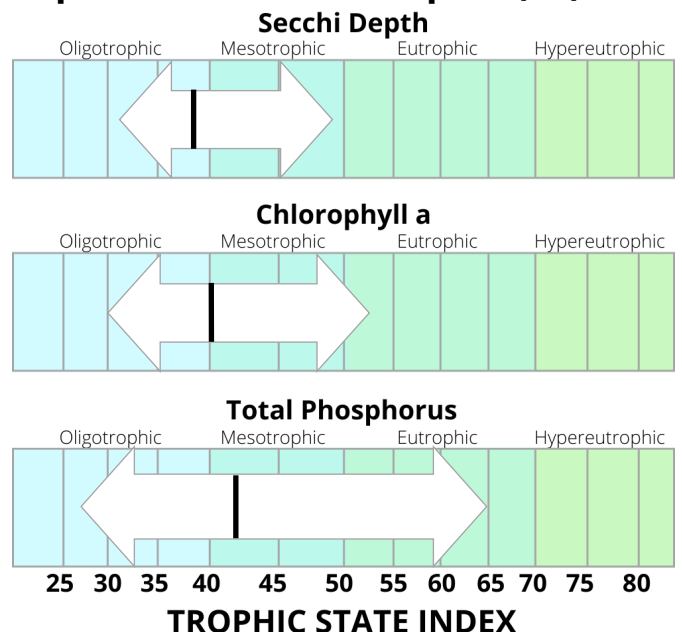
Years Monitored: 1974-1976, 2000-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.016	0.010
Phosphorus (mg/L) Min	0.005	0.005
Phosphorus (mg/L) Max	0.070	0.012
Number of Observations	114	5

Chlorophyll-a (µg/L) Mean	3.3	2.0
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	10.0	3.5
Number of Observations	107	5

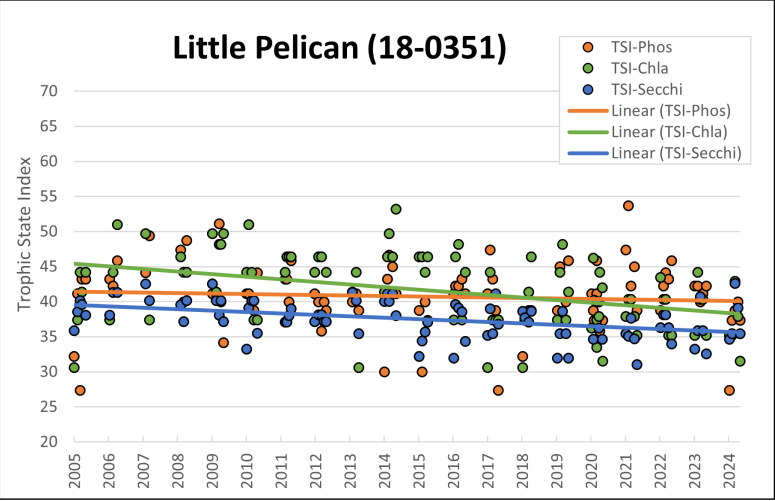
Secchi Depth (ft) Mean	15.4	16.0
Secchi Depth (ft) Min	7.0	11.0
Secchi Depth (ft) Max	24.5	19.0
Number of Observations	109	5

Trophic State: Mesotrophic (40)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Little Pelican Lake 18-0351-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Data Used:	2005, 2009-2010, 2012, 2014-2024
Total Phosphorus:	No Trend (95% confidence)
Chlorophyll-a:	Improving (95% confidence)
Secchi Depth:	Improving (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Little Pelican (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.010	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.0	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	16.0	Better than range and meets standard

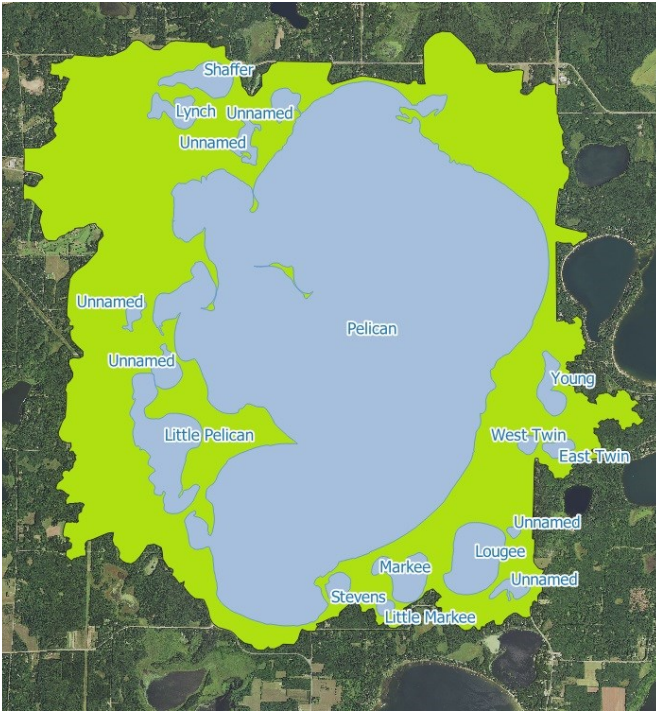
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pelican Lake
Area (acres):	17,816
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.

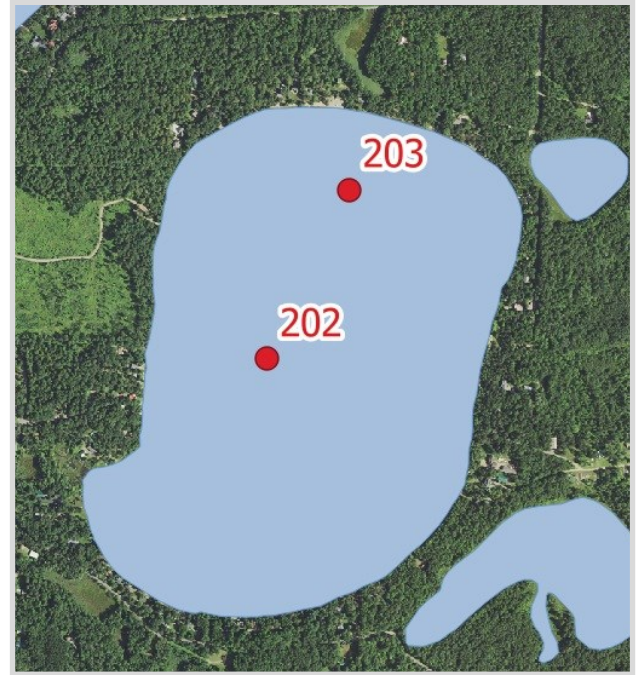


Lougee Lake 18-0342-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	212
Littoral Area (acres):	156
% Littoral area:	74%
Max Depth (ft):	53
Inlets/Outlets:	0/1
Public Accesses:	1
Development/Use Class:	Recreational Development / 2B
Impairments:	None listed
Lake Association:	Lougee Lake Association
Website:	None
Aquatic Invasive Species:	None listed

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, walleye, yellow bullhead, yellow perch, white sucker, blacknose shiner, golden shiner, spottail shiner



Summary

Lougee Lake is a small, moderately deep Mesotrophic lake with good water quality. Lougee Lake has an excellent history of water quality data and shows improving trends for both chlorophyll-a and Secchi depth. There is no significant trend in the phosphorus concentration. The lake has no major inlets making the land use practices around the lake the most important factor in its water quality.

Water Quality Characteristics

Sites 202 & 203

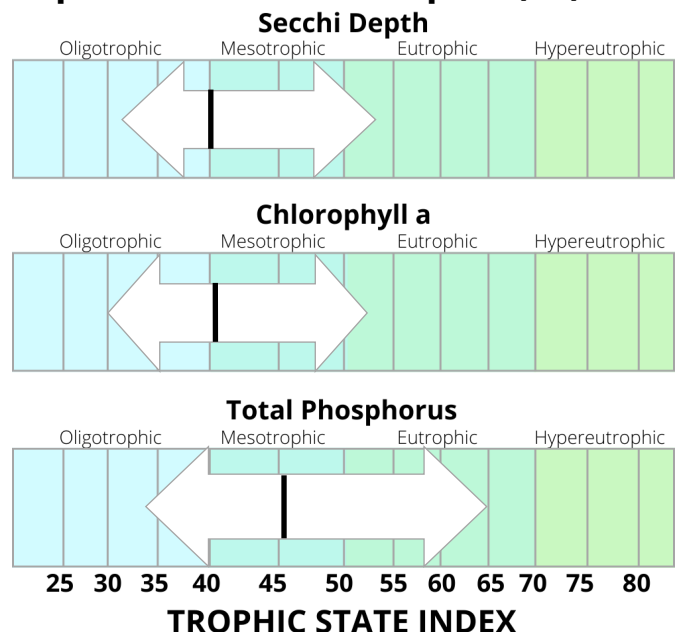
Years Monitored: 1974-1976, 1996-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.020	0.019
Phosphorus (mg/L) Min	0.008	0.011
Phosphorus (mg/L) Max	0.070	0.032
Number of Observations	81	5

Chlorophyll-a (µg/L) Mean	3.2	1.6
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	9.0	2.1
Number of Observations	81	5

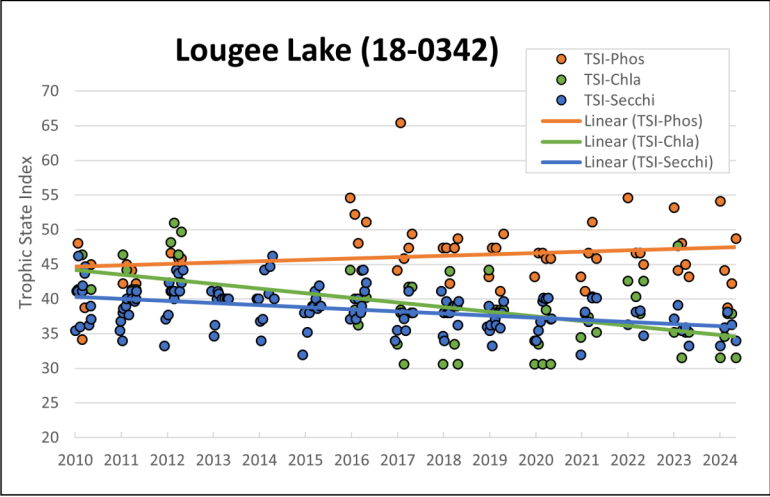
Secchi Depth (ft) Mean	12.9	18.1
Secchi Depth (ft) Min	5.0	15.0
Secchi Depth (ft) Max	23.0	21.0
Number of Observations	273	5

Trophic State: Mesotrophic (42)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Lougee Lake 18-0342-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Total Phosphorus:	No Trend (95% confidence)
Chlorophyll-a:	Improving (95% confidence)
Secchi Depth:	Improving (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Lougee Lake (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.019	Within range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	1.6	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	18.1	Better than range and meets standard

Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pelican Lake
Area (acres):	17,816
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

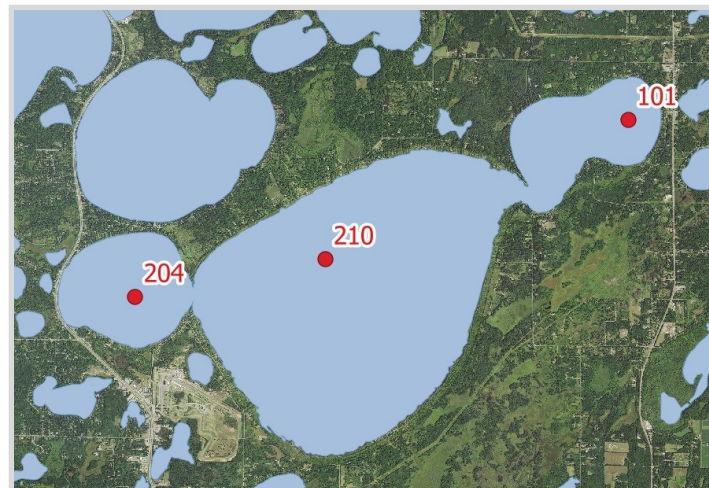
Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.



North Long Lake 18-0372-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Crow Wing River (07010106)
Surface Area (acres):	6,190
Littoral Area (acres):	3,905
% Littoral area:	63%
Max Depth (ft):	97
Inlets/Outlets:	3/1
Public Accesses:	3
Development/Use Class:	General Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	North Long Lake Association
Website:	https://northlong.org/
Aquatic Invasive Species:	Zebra mussel, Eurasian water milfoil



Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, sunfish, tullibee (cisco), walleye, yellow bullhead, yellow perch, bowfin (dogfish), common carp, shorthead redhorse, white sucker, banded killifish, bigmouth shiner, blackchin shiner, blacknose shiner, bluntnose minnow, brook stickleback, central mudminnow, common shiner, emerald shiner, fathead minnow, golden shiner, hornyhead chub, iowa darter, Johnny darter, mimic shiner, northern redbelly dace, sand shiner, spottail shiner, tadpole madtom, trout-perch

Summary

North Long Lake is a large Mesotrophic lake with good water quality. TLWD has historically sampled three sites on the lake, one in each of the main sections of the lake. Site 210 on the main lake shows improving water quality over the past 17 years. Sites 101 & 204 both show improvements in algae concentrations as measured by chlorophyll-a. The water quality improvements are likely related to the presence of zebra mussels in the lake.

Water Quality Characteristics

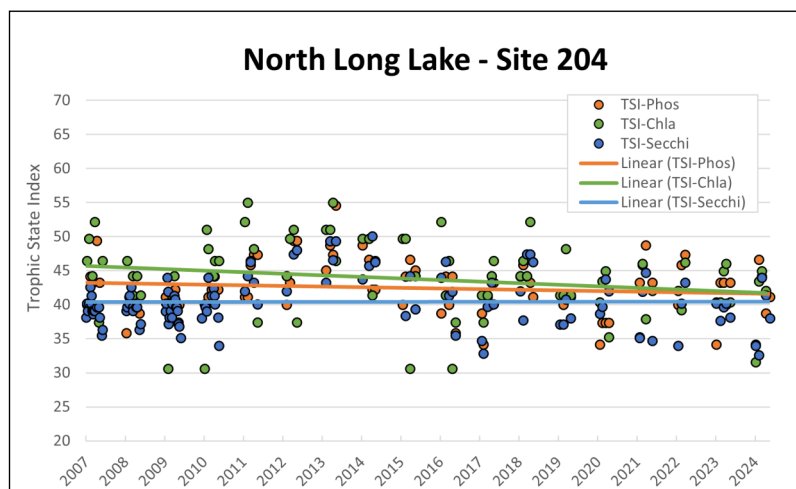
Site 204—West Bay

Years Monitored: 1975, 1981, 1991, 1994, 1998-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.015	0.013
Phosphorus (mg/L) Min	0.006	0.008
Phosphorus (mg/L) Max	0.033	0.019
Number of Observations	86	5

Chlorophyll-a (µg/L) Mean	4.5	3.0
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	12.0	4.3
Number of Observations	86	5

Secchi Depth (ft) Mean	13.3	15.8
Secchi Depth (ft) Min	6.6	10.0
Secchi Depth (ft) Max	22.0	22.0
Number of Observations	323	5



North Long Lake 18-0372-00

Water Quality Characteristics

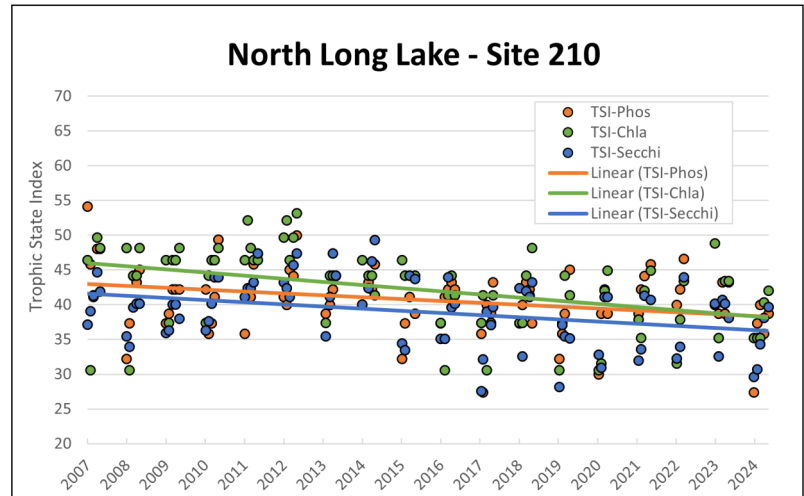
Site 210—Main Lake

Years Monitored: 1974-1976, 2000-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.016	0.009
Phosphorus (mg/L) Min	0.005	0.005
Phosphorus (mg/L) Max	0.107	0.012
Number of Observations	95	5

Chlorophyll-a (µg/L) Mean	3.8	2.1
Chlorophyll-a (µg/L) Min	1.0	1.6
Chlorophyll-a (µg/L) Max	10.0	3.2
Number of Observations	88	5

Secchi Depth (ft) Mean	14.6	20.0
Secchi Depth (ft) Min	5.0	13.5
Secchi Depth (ft) Max	31.2	27.0
Number of Observations	140	5



Water Quality Characteristics

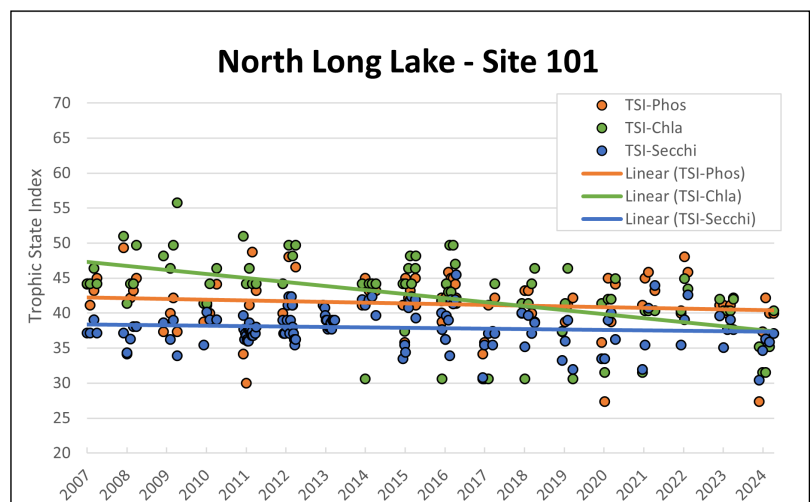
Site 101—East Bay

Years Monitored: 1974-1976, 1981, 1998, 2007-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.014	0.011
Phosphorus (mg/L) Min	0.005	0.005
Phosphorus (mg/L) Max	0.040	0.014
Number of Observations	98	5

Chlorophyll-a (µg/L) Mean	3.8	1.6
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	13.0	2.7
Number of Observations	91	5

Secchi Depth (ft) Mean	15.0	19.0
Secchi Depth (ft) Min	7.0	16.1
Secchi Depth (ft) Max	25.5	25.5
Number of Observations	141	5



North Long Lake 18-0372-00

Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality: Excellent
Data Used: 2007-2020, 2023-2024

Parameter	Site 204	Site 210	Site 101
Total Phosphorus	No Trend (95% confidence)	Improving (95% confidence)	Improving (95% confidence)
Chlorophyll-a	Improving (95% confidence)	Improving (95% confidence)	Improving (95% confidence)
Secchi Depth	No Trend (95% confidence)	Improving (95% confidence)	No Trend (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	North Long Lake (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.011	Below range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.2	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	18.3	Below range and meets standard

Lakeshed Information

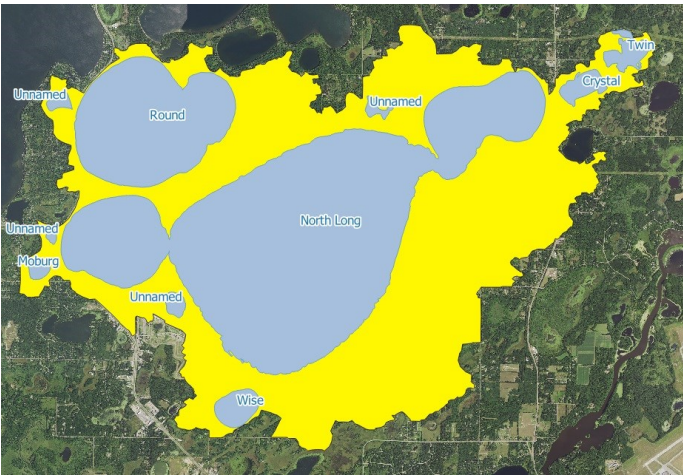
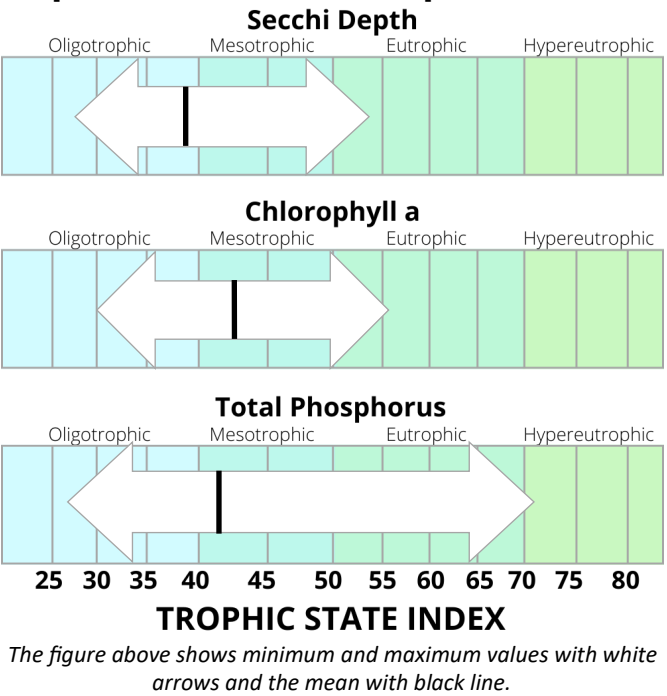
Analysis from the Crow Wing County Water Plan (2013 revision).

Name: From Round Lake
Area (acres): 17,492
Public Lands (% Protected): 60-80%
Land Use Disturbance: 0-8%
Water Quality Trends: Improving & Declining
Risk Classification: Enhance/Protection

Enhance-Protection Risk Classification:

Watershed has a percentage of protected lands that is generally less than 40% but also has many potential risk factors that could negatively impact the surface water (and/or groundwater) systems of the watershed. Moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover classes, animal units, extractive uses, and/ or drainage systems are likely within the watershed. In addition, lakes or streams that are impaired or have declining trends in water quality may also be present. The watershed is in fair condition but has great opportunities for project implementation and further protection efforts.

Trophic State: Mesotrophic (41)

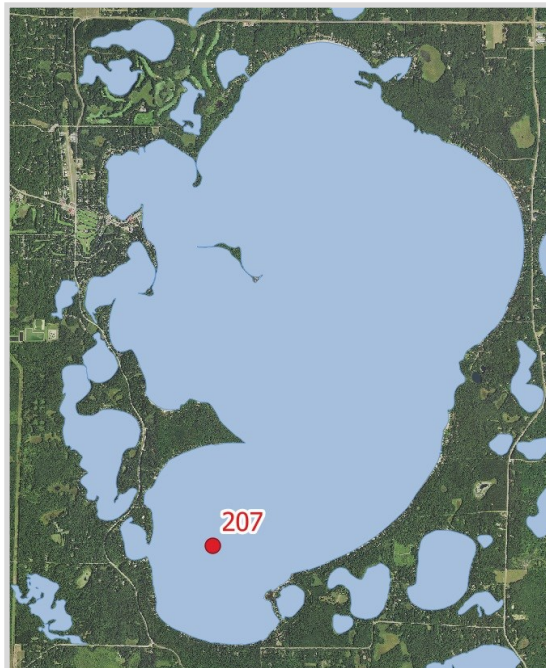


Pelican Lake 18-0308-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	8,367
Littoral Area (acres):	3,910
% Littoral area:	47%
Max Depth (ft):	104
Inlets/Outlets:	1/1
Public Accesses:	4
Development/Use Class:	General Development / 2B
Impairments:	Mercury in fish tissue
Lake Association:	Pelican Lakes Association
Website:	http://pelicanlakesassociation.org/
Aquatic Invasive Species:	Zebra mussel

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, green sunfish, hybrid sunfish, lake whitefish, largemouth bass, northern pike, pumpkinseed, rock bass, smallmouth bass, tullibee (cisco), walleye, yellow bullhead, yellow perch, bowfin (dogfish), silver redhorse, white sucker, banded killifish, bigmouth shiner, blackchin shiner, blacknose shiner, blunt-nose minnow, brook silverside, common shiner, emerald shiner, fathead minnow, golden shiner, Iowa darter, Johnny darter, logperch, mimic shiner, mottled sculpin, sand shiner, spottail shiner, tadpole madtom, trout-perch



Summary

Pelican Lake is a deep oligotrophic lake with stable water quality. There is no significant trend for any of the water quality parameters measured. Pelican Lake has a small lakeshed relative to its size and therefore the land use practices within the lakeshed have the largest impact on water quality.

Water Quality Characteristics

Sites 207

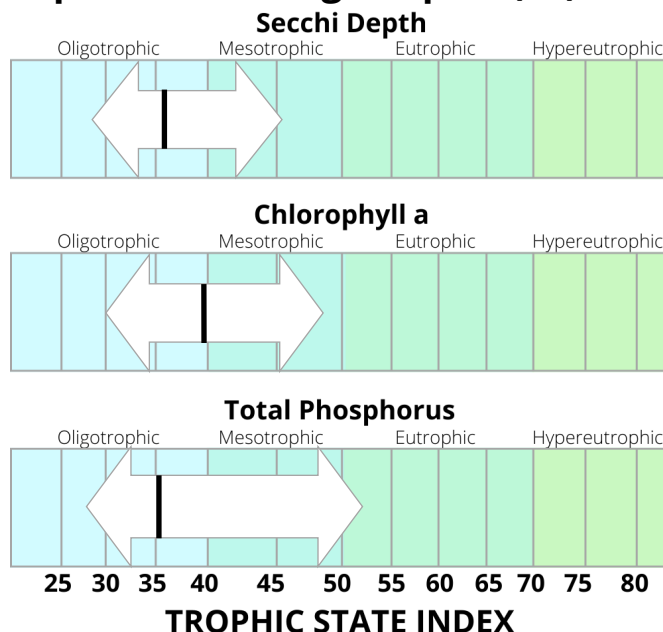
Years Monitored: 2000-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.009	0.008
Phosphorus (mg/L) Min	0.005	0.005
Phosphorus (mg/L) Max	0.027	0.011
Number of Observations	107	5

Chlorophyll-a (µg/L) Mean	2.8	2.0
Chlorophyll-a (µg/L) Min	1.0	1.4
Chlorophyll-a (µg/L) Max	7.0	3.2
Number of Observations	107	5

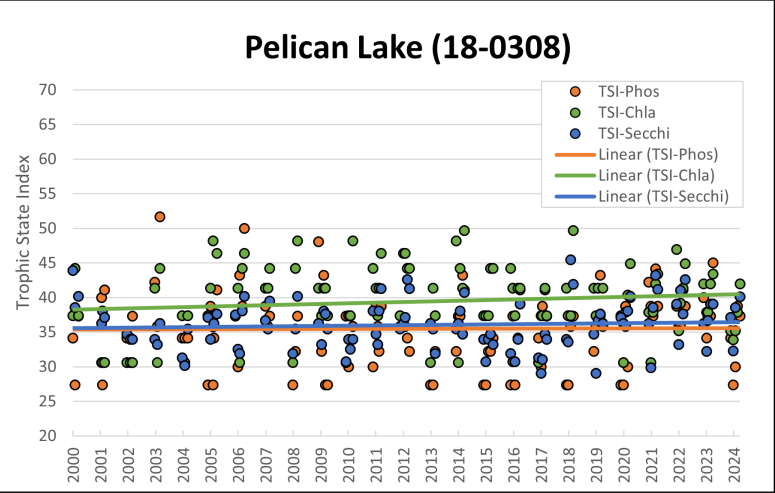
Secchi Depth (ft) Mean	17.8	16.5
Secchi Depth (ft) Min	9.0	13.0
Secchi Depth (ft) Max	28.0	22.5
Number of Observations	106	4

Trophic State: Oligotrophic (37)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Pelican Lake 18-0308-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Excellent
Data Used:	2005-2006, 2009-2012, 2014-2024
Total Phosphorus:	No Trend (95% confidence)
Chlorophyll-a:	No Trend (95% confidence)
Secchi Depth:	No Trend (95% confidence)

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Pelican Lake (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.008	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	2.0	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	16.5	Better than range and meets standard

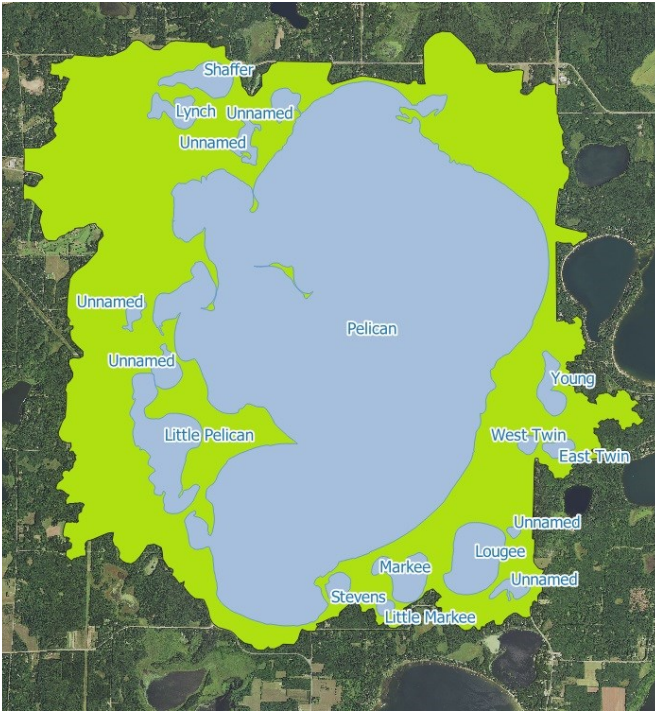
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pelican Lake
Area (acres):	17,816
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.

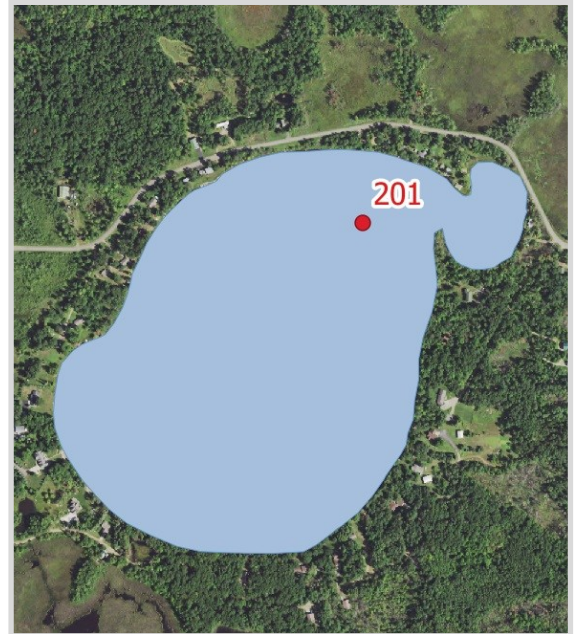


Sorenson Lake 18-0323-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Mississippi River Brainerd (07010104)
Surface Area (acres):	92
Littoral Area (acres):	47
% Littoral area:	51%
Max Depth (ft):	46
Inlets/Outlets:	0/0
Public Accesses:	0
Development/Use Class:	Recreational Development / 2B
Impairments:	None listed
Lake Association:	Sorenson Lake Association
Website:	None
Aquatic Invasive Species:	None listed

Fish Species: black bullhead, black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, walleye, yellow bullhead, yellow perch



Summary

Sorenson Lake is a small, shallow oligotrophic lake with high water quality, no public access, and no inlets or outlets. There is not enough data on Sorenson Lake to complete a trend analysis; however it appears that Sorenson Lake has fairly stable water quality overall.

Water Quality Characteristics

Sites 201

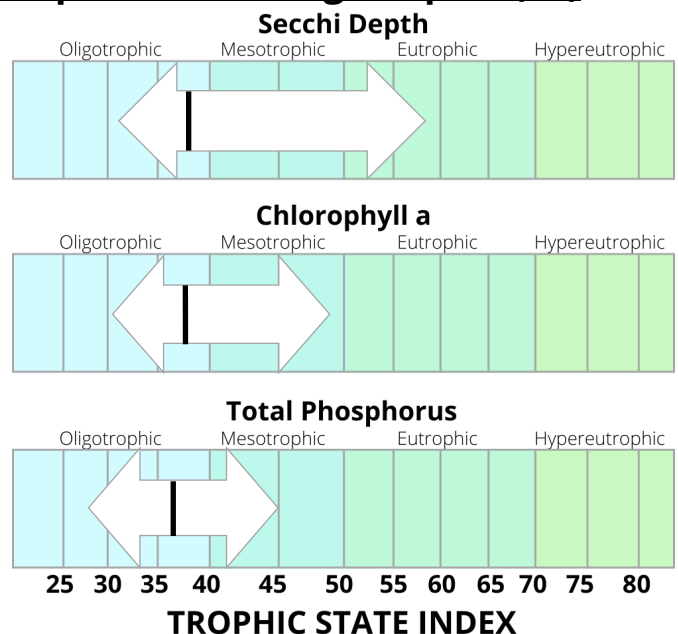
Years Monitored: 2000-2004, 2009-2011, 2022-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.010	0.011
Phosphorus (mg/L) Min	0.005	0.005
Phosphorus (mg/L) Max	0.017	0.017
Number of Observations	41	5

Chlorophyll-a (µg/L) Mean	2.4	1.9
Chlorophyll-a (µg/L) Min	1.0	1.1
Chlorophyll-a (µg/L) Max	6.0	2.7
Number of Observations	41	5

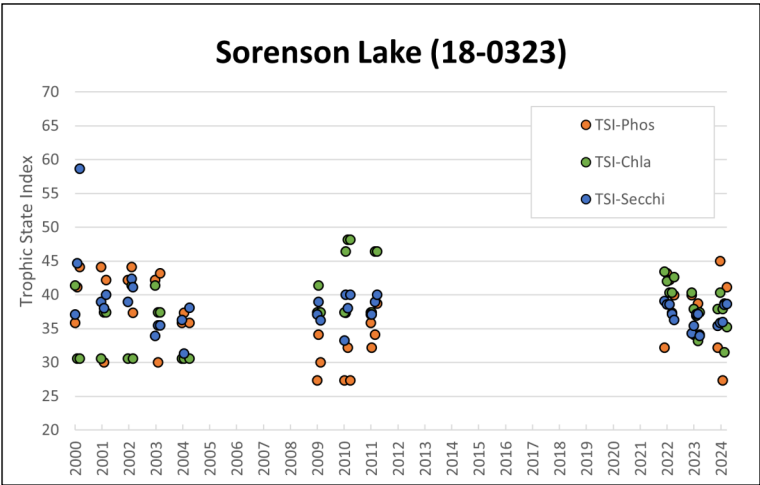
Secchi Depth (ft) Mean	15.5	16.4
Secchi Depth (ft) Min	3.6	14.5
Secchi Depth (ft) Max	24.0	18.0
Number of Observations	41	5

Trophic State: Oligotrophic (38)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Sorenson Lake 18-0323-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Insufficient
Total Phosphorus:	Insufficient Data
Chlorophyll-a:	Insufficient Data
Secchi Depth:	Insufficient Data

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Sorenson Lake (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.011	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	1.9	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	16.4	Better than range and meets standard

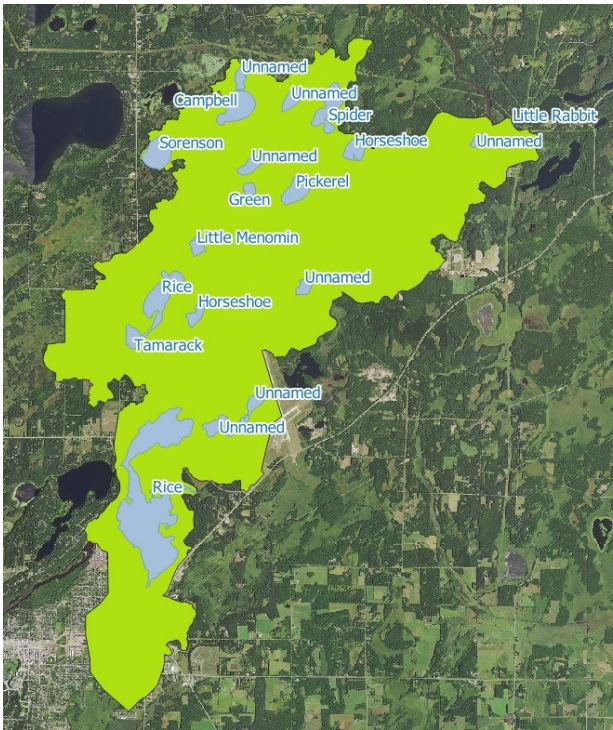
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Mississippi River
Area (acres):	14,272
Public Lands (% Protected):	40-60%
Land Use Disturbance:	15-20%
Water Quality Trends:	Unknown
Risk Classification:	Protection

Protection Risk Classification:

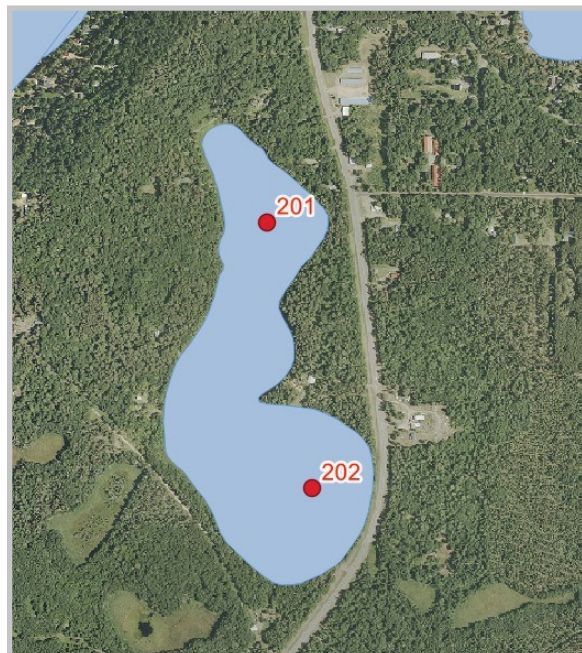
Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.



Young Lake 18-0252-00

Lake Stats

Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Pine River (07010105)
Surface Area (acres):	67
Littoral Area (acres):	60
% Littoral area:	90%
Max Depth (ft):	21
Inlets/Outlets:	0/0
Public Accesses:	0
Development/Use Class:	Recreational Development / 2B
Impairments:	None listed
Lake Association:	None
Website:	None
Aquatic Invasive Species:	None listed
Fish Species:	black crappie, bluegill, brown bullhead, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, yellow perch, golden shiner



Summary

Young Lake is a shallow mesotrophic lake in the Pelican Lake lakeshed. There is not enough data on Young Lake to complete a trend analysis; however, it appears that water quality has been variable in the past but has been more stable in recent years. Young Lake has a high percentage of littoral zone (depth less than 15 feet) and therefore can support a large community of aquatic plants if nutrients are high.

Water Quality Characteristics

Sites 201 & 202

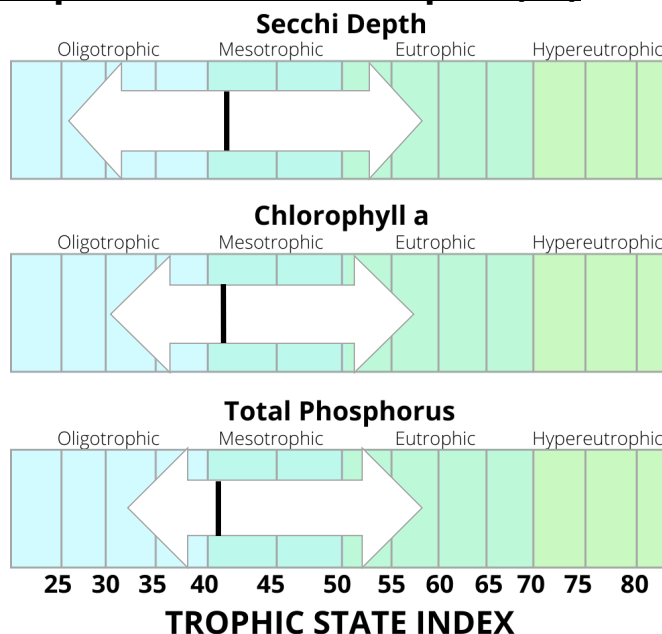
Years Monitored: 2000-2006, 2009-2011, 2021-2024

Parameters	Historical	2024
Phosphorus (mg/L) Mean	0.015	0.012
Phosphorus (mg/L) Min	0.007	0.007
Phosphorus (mg/L) Max	0.043	0.014
Number of Observations	34	5

Chlorophyll-a (µg/L) Mean	4.0	3.1
Chlorophyll-a (µg/L) Min	1.0	2.1
Chlorophyll-a (µg/L) Max	15.0	4.8
Number of Observations	34	5

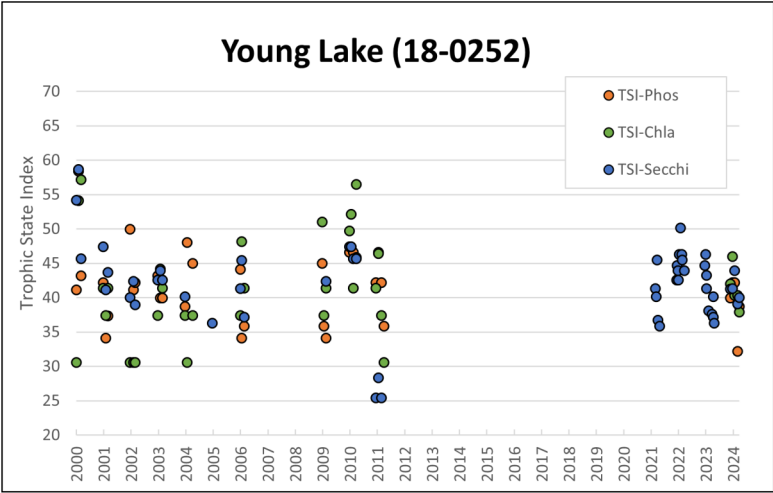
Secchi Depth (ft) Mean	12.3	12.2
Secchi Depth (ft) Min	0.0	10.0
Secchi Depth (ft) Max	52.5	14.0
Number of Observations	58	5

Trophic State: Mesotrophic (42)



The figure above shows minimum and maximum values with white arrows and the mean with black line.

Young Lake 18-0252-00



Long-term Trends

Recommended minimum of 8-10 years of data with 4+ readings per season. Minimum confidence accepted by MPCA is 90%.

Data Quality:	Insufficient
Total Phosphorus:	Insufficient Data
Chlorophyll-a:	Insufficient Data
Secchi Depth:	Insufficient Data

Data Comparison

ECOREGION: Northern Lakes and Forests

Reference Range based on interquartile range (25th-75th percentile) for ecoregion reference lakes. Eutrophication (Impairment) Standard from MN Rule 7050.0222 for Class 2B waters by ecoregion.

Parameter	Reference Range	Eutrophication Standard	Young Lake (2024 Mean)	Conclusion
Total Phosphorus (mg/L)	0.014 - 0.027	< 0.030	0.012	Better than range and meets standard
Chlorophyll-a (µg/L)	< 10	< 9	3.1	Within range and meets standard
Secchi Depth (ft)	7.8 - 15	> 6.5	12.2	Within range and meets standard

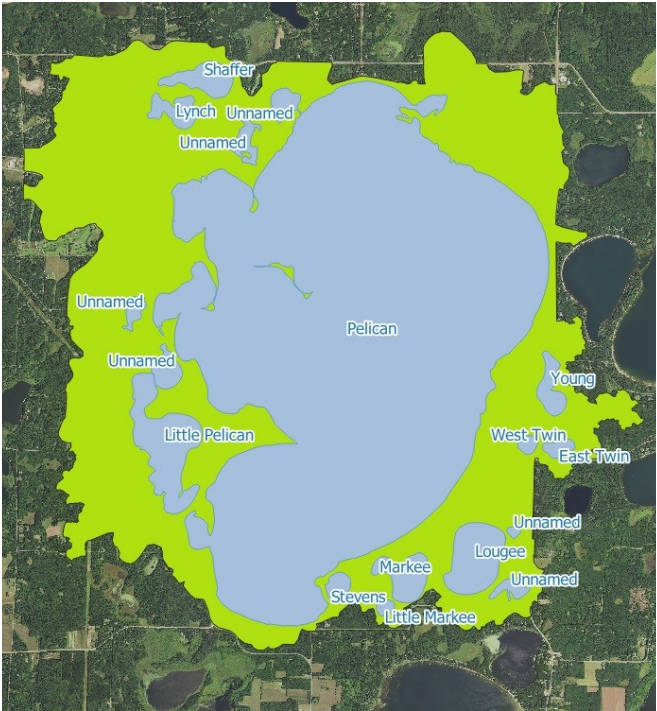
Lakeshed Information

Analysis from the Crow Wing County Water Plan (2013 revision).

Name:	Pelican Lake
Area (acres):	17,816
Public Lands (% Protected):	60-80%
Land Use Disturbance:	8-15%
Water Quality Trends:	No Trend
Risk Classification:	Protection

Protection Risk Classification:

Watershed has a percentage of protected lands >40% but also has some potential risk factors that could negatively impact surface water. Low to moderate amounts of impervious surfaces, development pressures (existing or potential), disturbed land cover (8-30%), animal units, extractive uses, and/or drainage systems are likely within the watershed. Watershed is generally in good condition with no lakes with a declining water quality trend. Watershed has the potential to be better protected with strategies such as private forest stewardship, stormwater management, shoreline buffers, and conservation easements in ecologically sensitive areas.



APPENDIX

Definitions

Development Class: The DNR shoreland management classification of the lake which is used in local shoreland zoning ordinances to regulate the following development standards, which vary based on classification: lot area and width, structure and septic system setbacks from the water, size of the shore impact zone wherein vegetation and land alteration activity is limited.

- **General Development Lakes** usually have more than 225 acres of water per mile of shoreline and 25 dwellings per mile of shoreline, and are more than 15 feet deep.
- **Recreational Development Lakes** usually have between 60 and 225 acres of water per mile of shoreline, between 3 and 25 dwellings per mile of shoreline, and are more than 15 feet deep.
- **Natural Environment Lakes** usually have less than 150 total acres, less than 60 acres per mile of shoreline, and less than three dwellings per mile of shoreline. They may have some winter kill of fish; may have shallow, swampy shoreline; and are less than 15 feet deep.

Reference: https://www.dnr.state.mn.us/waters/watermgmt_section/shoreland/lake_shoreland_classifications.html

Use Class: Seven use classes are outlined in Minnesota's water quality standards rules. These use classes reflect the multiple beneficial uses that Minnesota's surface waters provide, and accordingly all surface waters are assigned multiple use classes. All groundwater is assigned the Class 1 beneficial use of domestic consumption (drinking water).

Surface waters that cannot meet Class 2 aquatic life and recreational uses are Class 7 waters, otherwise known as limited resource value waters. Class 7 waters are still expected to meet standards that are protective for downstream waters and other beneficial uses.

- Class 1: Domestic consumption
- Class 2: Aquatic life and recreation (2A denotes cold water, 2B denotes warm water)
- Class 3: Industrial consumption
- Class 4: Agricultural and wildlife
- Class 5: Aesthetics and navigation
- Class 6: Other uses
- Class 7: Limited Resource Value Water (LRVW)

Reference: <https://www.pca.state.mn.us/water/water-quality-standards>

Ecoregion: Ecoregions are areas of relative homogeneity based on landuse, soils, land and surface form, and potential natural vegetation. Minnesota is divided into seven ecoregions, but most of its lakes are found in four of these. Minnesota Pollution Control Agency (MPCA) researchers found regional patterns in numbers of lakes, lake water quality, morphometry, and watershed characteristics among these ecoregions. For example, lakes of the Northern Lakes and Forests ecoregion have significantly lower total phosphorus and chlorophyll than lakes in the Western Corn Belt Plains ecoregion. Furthermore, the MPCA discovered through lake-user surveys that user perception of water quality varied by ecoregions. This has led to ecoregion-specific criteria for phosphorus and, in general, helped to clarify expectations and goals for protecting lakes in Minnesota.

Reference: http://waterontheweb.org/under/lakeecology/18_ecoregions.html

Figure 3. Minnesota's Ecoregions

