Lake Alexander 49-0079-00 MORRISON COUNTY

Summary

Lake Alexander is located eight miles north of the City of Randall in Morrison County, Minnesota. It covers 2,990 acres, which places it in the upper 5% of lakes in Minnesota in terms of size.

Lake Alexander has one inlet and one outlet, which classifies it as a drainage lake. It lies in the northeastern end of the Long Prairie River Watershed. Flow leaves the west side of Lake Alexander through Thoroughfare Creek into Fishtrap Lake, then northwest through Fishtrap Creek and into the Long Prairie River which drains the watershed to the northeast. Lake Alexander has very good water quality, which could be due to the fact that it lies at the top of its watershed.

Water quality data have been collected in Lake Alexander since 1993. These data show that the lake is mesotrophic (page 9). Mesotrophic lakes are commonly found in north central Minnesota and have clear water with occasional algal blooms in late summer. They are also usually good walleye lakes.

The Lake Alexander Property Owners Association has been involved in numerous activities including water quality monitoring, education, Healthy Lakes Initiative. The invasive Eurasian watermilfoil plant was found in Lake Alexander in 2003. Since then, the Association has been chemically treating the plant to manage its density and spread.

Vitals

MN Lake ID:	49-0079-00
County:	Morrison
Ecoregion:	Northern Lakes and Forests
Major Drainage Basin:	Upper Mississippi River
Latitude/Longitude:	46.20833333 / -94.54194444
Water Body Type:	Public
Monitored Sites (Primary):	202
Monitored Sites (Secondary):	101, 202, 203, 204, 205

Physical Characteristics

Surface area (acres):	2,990	
Littoral area (acres):	842	
% Littoral area:	28%	
Max depth	(ft): 65	(m): 19.8
Lakeshed size (acres):	12,249	
Lakeshed : lake area ratio	4:1	
Inlets	1	
Outlets	1	
Accesses	3	

Invasive species present: Eurasian watermilfoil, confirmed in 2003; Curly-leaf pondweed

Data Availability

Transparency data	👍	Numerous yearly secchi readings from 1993-2009 through the MPCA CLMP program.
Chemical data	👍	Total Phosphorus and Chlorophyll *a* data have been collected in 1990 and 2007-2009.
Inlet/Outlet data	👎	No inlet or outlet monitoring has been conducted.
Recommendations		For recommendations refer to page 12.

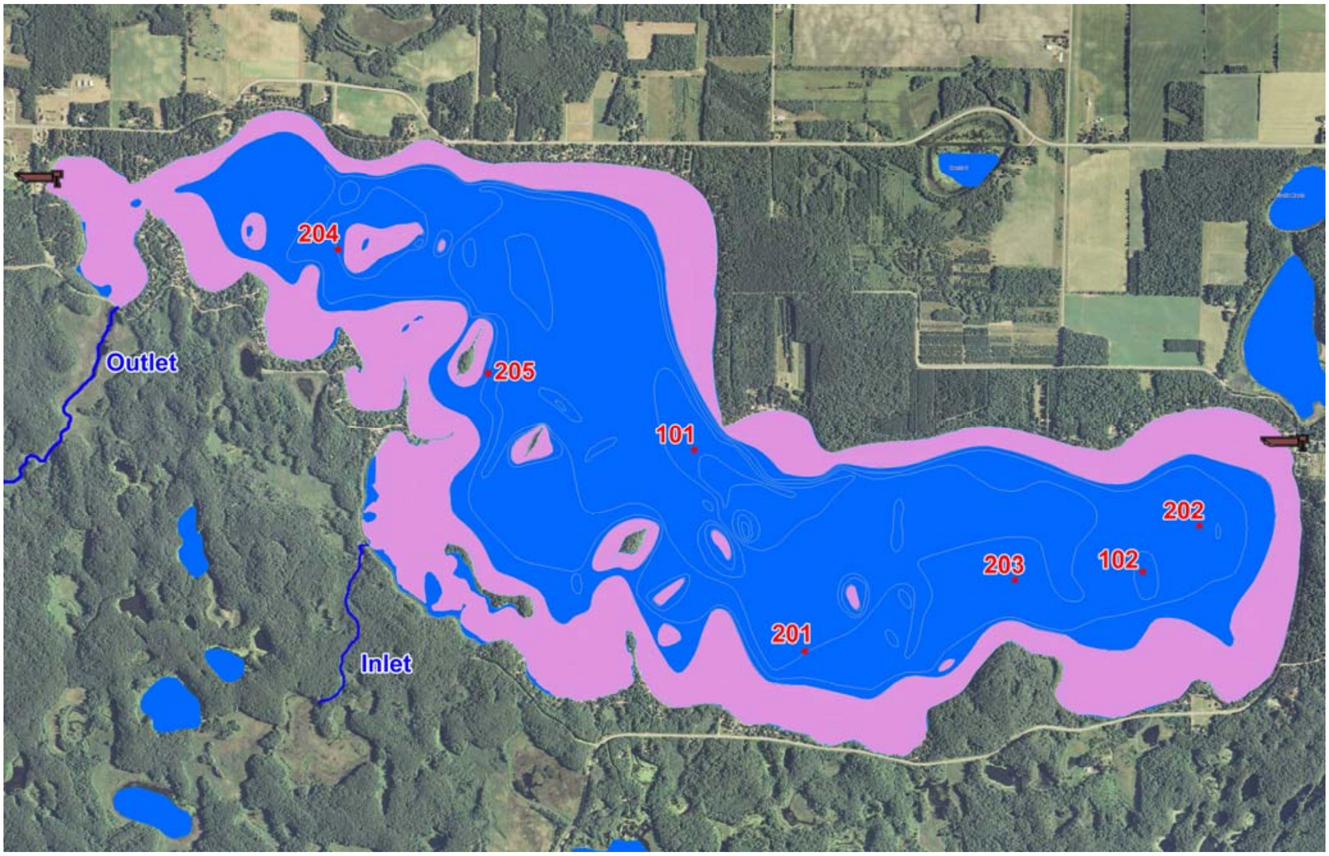


Figure 1. Map of Lake Alexander illustrating bathymetry, lake sample site locations, stream inlets and outlets and aerial land use. The pink shaded areas in the lake illustrate the littoral zone, where the sunlight can usually reach the lake bottom allowing aquatic plants to grow.

Lake Site	Depth (ft)	Monitoring Programs
101	60	MPCA: 1980, 1990
102	40	MPCA: 1990;
201	36	CLMP: 1993-2008
202	30	CLMP: 1997-1999, 2003-2009; RMB Lab: 2007-2009
203	25	CLMP: 2002
204	34	CLMP: 2004-2008
205	30	CLMP: 2008

KEY:
MPCA: Minnesota Pollution Control Agency
CLMP: Citizens Lake Monitoring Program
RMB Lab: RMB Environmental Laboratories Lakes Monitoring Program

The information below describes available chemical data for Lake Alexander through 2009. The data set is limited, and all parameters with the exception of total phosphorus, chlorophyll *a* and secchi depth, are means for just 1990 data.

Minnesota is divided into seven ecoregions based on land use, vegetation, precipitation and geology. The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion. For more information on ecoregions and expected water quality ranges, see page 11.

Parameter	**Mean**	**Ecoregion Range[1]**	**Impaired Waters Standard[2]**	**Interpretation**
Total phosphorus (ug/L)	19	14 - 27	> 35	Results within the expected range for the ecoregion. For more information about Impaired Waters Assessment, see page 12.
Chlorophyll *a* (ug/L) [3]	7	4 - 10	> 12	
Chlorophyll *a* max (ug/L)	22	<15		
Secchi depth (ft)	16	7.5 - 15	< 4.5	
Dissolved oxygen	*see page 8*			Dissolved oxygen depth profiles show that the deep areas of the lake are anoxic in late summer.
Total Kieldahl Nitrogen (mg/L)	0.70	0.4 - 0.75		Indicates insufficient nitrogen to support summer nitrogen-induced algae blooms.
Alkalinity (mg/L)	114	40 - 140		Indicates a low sensitivity to acid rain and a good buffering capacity.
Color (Pt-Co Units)	8.6	10 - 35		Indicates clear water with little to no tannins (brown stain).
pH	8.4	7.2 - 8.3		Characteristic of a hard water lake. Lake water with pH less than 6.5 can affect fish spawning and the solubility of metals in the water.
Chloride (mg/L)	1.6	0.6 - 1.2		Slightly over the ecoregion average, but still considered low level.
Total Suspended Solids (mg/L)	2	<1 - 2		Indicates low suspended solids and clear water.
Conductivity (umhos/cm)	210	50 - 250		Within the ecoregion average range.
Total Nitrogen :Total Phosphorus	36:1	25:1 – 35:1		Indicates the lake is phosphorus limited, which means that algae growth is limited by the amount of phosphorus in the lake.

Data Source: 1990 Minnesota Pollution Control Agency, 2007-2009 RMB Labs

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

Water Quality Characteristics - Historical Means

Years monitored: 1980, 1990, 1993-2009

Parameters	Primary Site 202	Site 101	Site 102	Site 201	Site 204
Total Phosphorus Mean (ug/L):	**19**	**21**	**14**		
Total Phosphorus Min:	10	10	10		
Total Phosphorus Max:	32	50	22		
Number of Observations:	15	7	4		
Chlorophyll *a* Mean (ug/L):	**6.9**	**9.0**	**6.5**		
Chlorophyll-a Min:	2.0	2.2	2.2		
Chlorophyll-a Max:	22.0	22.0	13.8		
Number of Observations:	15	7	4		
Secchi Depth Mean (ft):	**16.0**	**9.3**	**10.9**	**14.5**	**16.6**
Secchi Depth Min:	5.2	6.2	6.6	7.0	10.5
Secchi Depth Max:	30.0	14.8	15.4	26.5	23.0
Number of Observations:	121	7	4	147	31

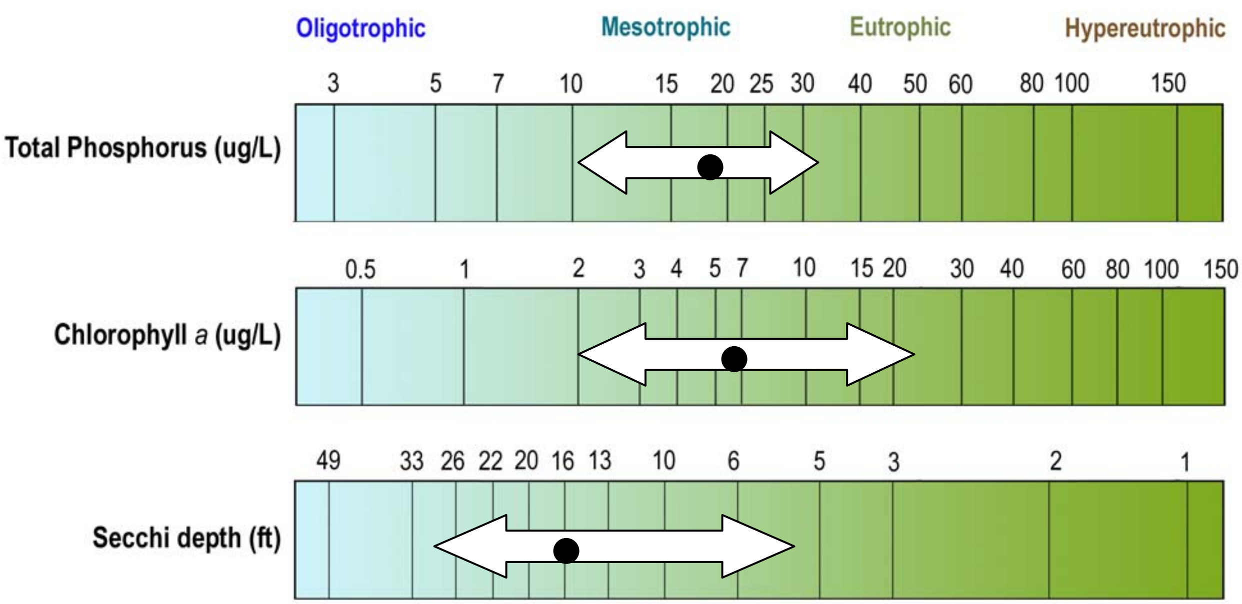


Figure 2. Alexander Lake total phosphorus, chlorophyll *a* and transparency historical ranges. The arrow represents the range and the black dot represents the historical mean (Primary Site 202). Figure adapted after Moore and Thornton, [Ed.]. 1988. Lake and Reservoir Restoration Guidance Manual. (Doc. 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 amount 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.

For sites 201 and 202, which had the most transparency data, the mean transparency ranges from 11 to 21 feet (Figure 3). Site 201 had continuous annual data from 1993-2008, while site 202 data was more disjointed. Overall, site 202 at the east end of the lake appears to have better transparency than site 201. Most years, the transparency hovered around the historical means, but in 2005 it was much higher (annual mean = 21 ft).

Transparency monitoring should be continued annually at sites 201 and 202 in order to track water quality changes.

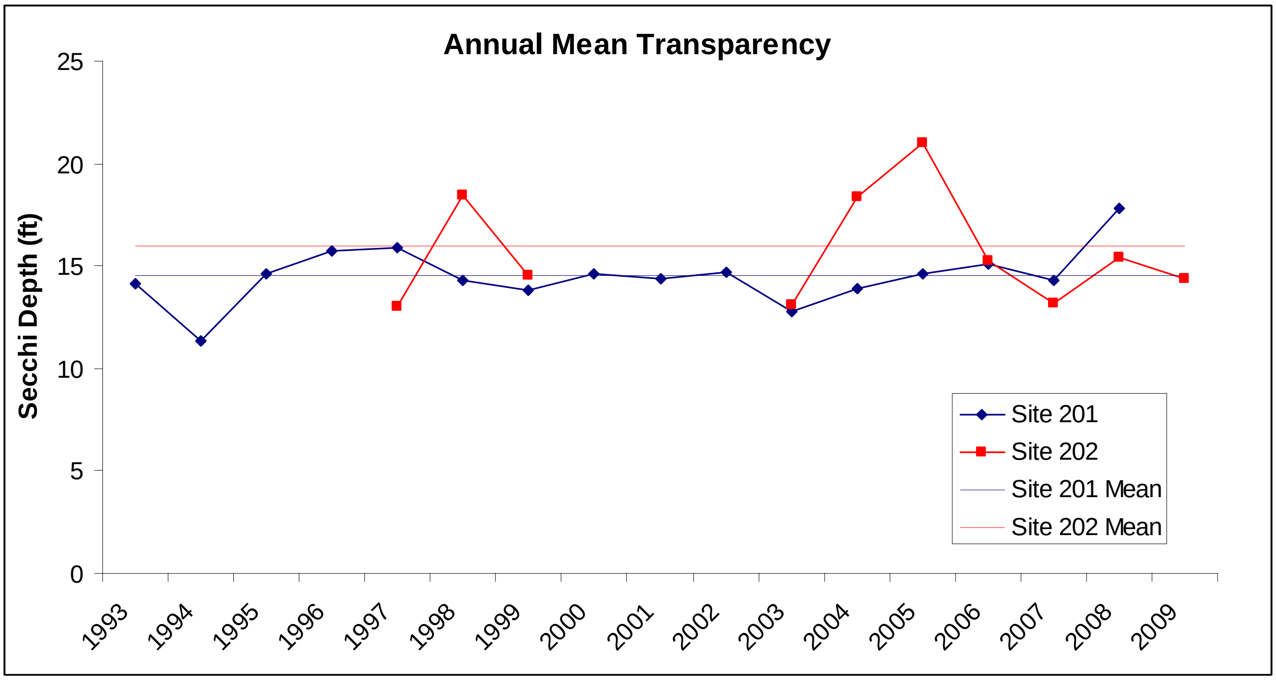


Figure 3. Annual mean transparency for sites 201 and 202.

Lake Alexander transparency ranges from 5 to 30 ft at the primary site (202). Figure 4 shows the seasonal transparency dynamics. Lake Alexander transparency is highest in early June, decreases steadily throughout the summer, and then rebounds in October. This pattern is typical for a Minnesota lake of this depth. Transparency dynamics are related to algae population dynamics and lake turnover.

It is helpful for lake association members to understand the seasonal transparency dynamics so they don't worry when the transparency declines in late August. Figure 4 can show them that it is typical for the lake to decline in late August when the algae are most abundant, and that the transparency then rebounds in October after fall turnover.

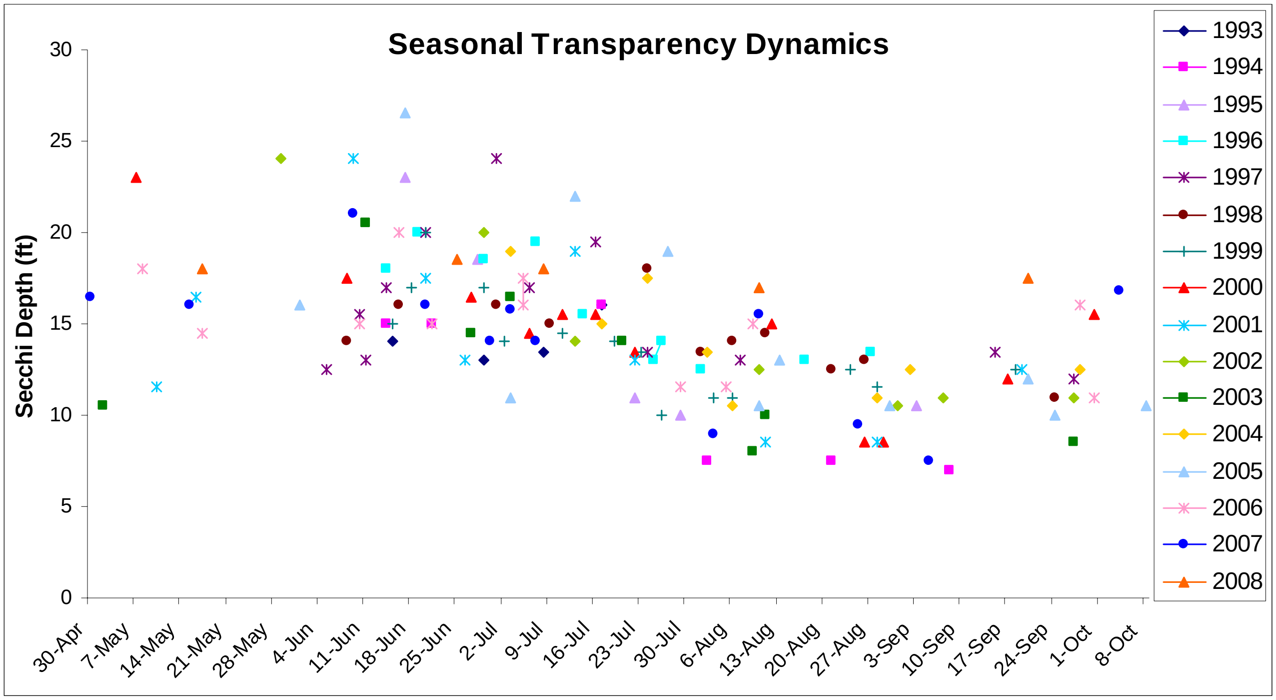


Figure 4. Seasonal transparency dynamics and year-to-year comparison (Site 201).

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 rating decreases. Lake Alexander was rated as being "not quite crystal clear" 62% of the time between 1993-2009 (Figure 5).

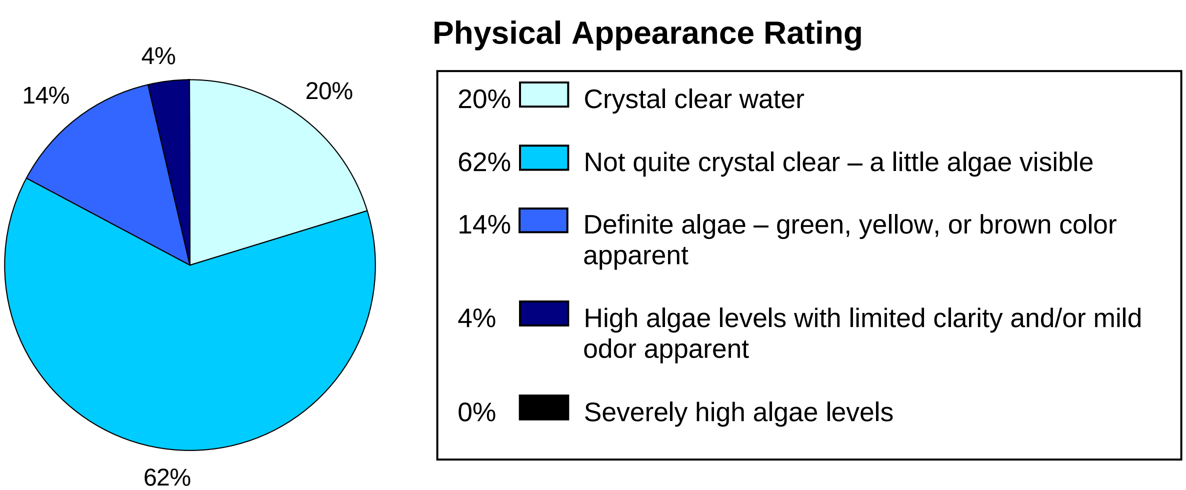


Figure 5. Physical appearance rating, as rated by the volunteer monitor (1993-2009).

As the secchi depth decreases, the perception of recreational suitability of the lake decreases. Lake Alexander was rated as being "swimmable" 100% of the time from 1993-2009 (Figure 6).

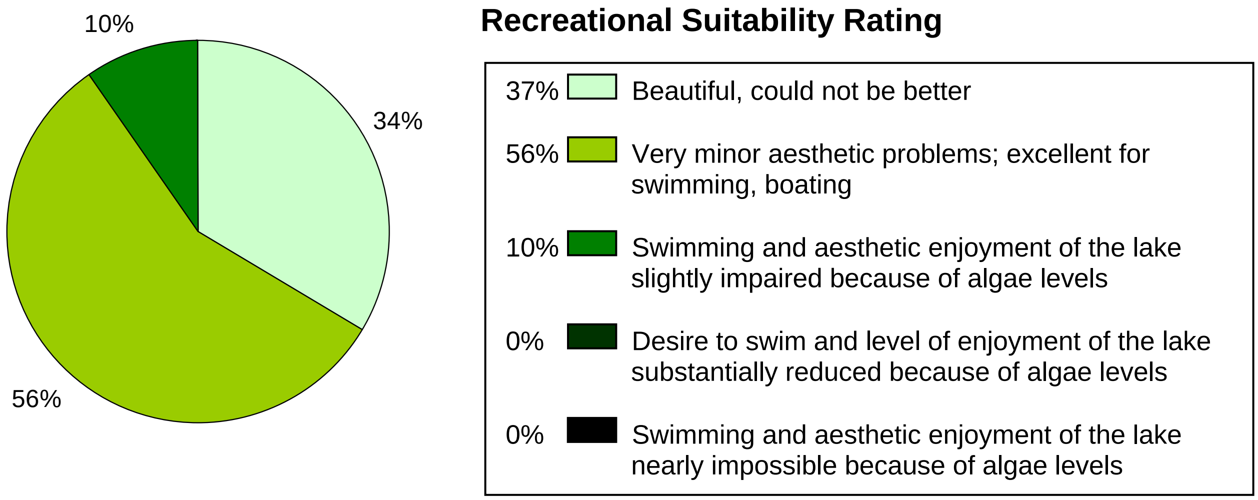


Figure 6. Recreational suitability rating, as rated by the volunteer monitor (1993-2009).

Total Phosphorus

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

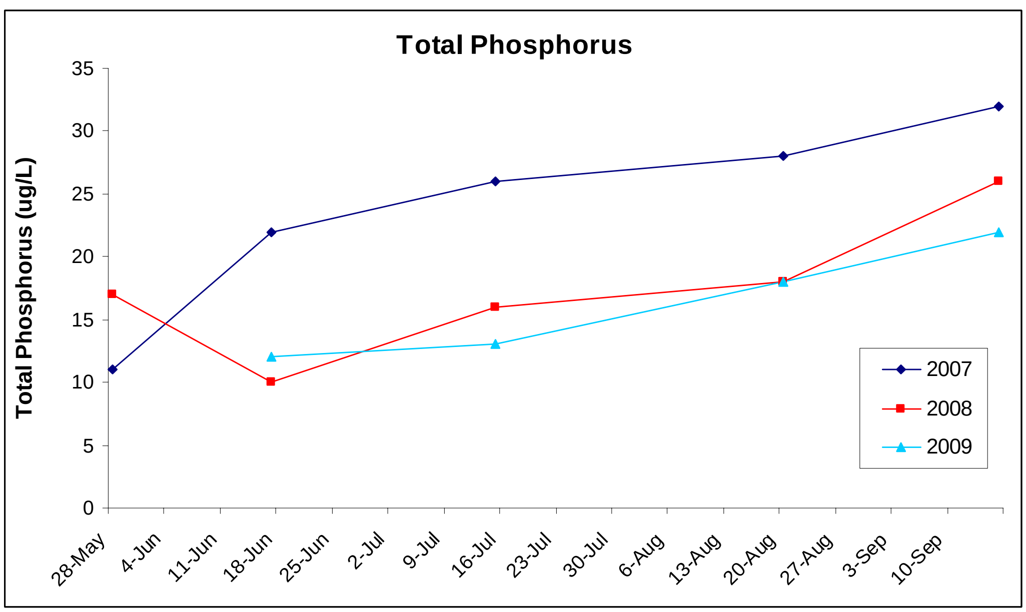


Figure 7. Historical total phosphorus concentrations (ug/L) for Lake Alexander (data set from 2007-2009).

Total phosphorus was evaluated in Lake Alexander by their Lake Association in 2007-2009 (Figure 7). The data indicate a slight increase in phosphorus from the beginning of the summer to the end. This pattern is typical for Minnesota lakes. Phosphorus concentrations were higher in 2007 than 2008-2009. Phosphorus levels can vary year-to-year due to natural variations including precipitation, lake use, and weather. Phosphorus should continue to be monitored to track any future changes in water quality.

Chlorophyll *a*

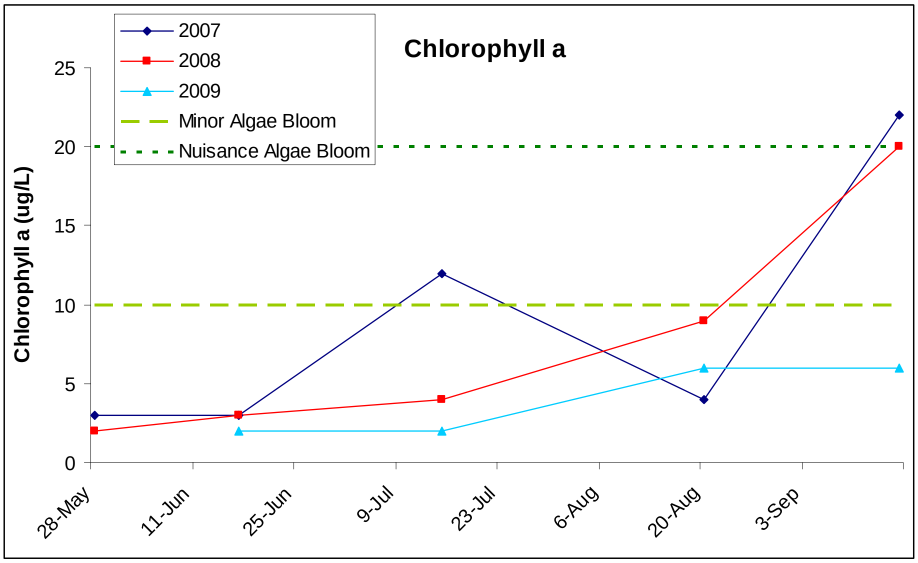


Figure 8. Chlorophyll *a* concentrations (ug/L) for Lake Alexander (data sets from 2007-2009).

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 Lake Alexander by their Lake Association in 2007-2009 (Figure 8). Chlorophyll *a* concentrations reached 20 ug/L in mid-September of 2007 and 2008, indicating nuisance algae blooms. Chlorophyll *a* concentrations increased steadily toward the end of the summer. This pattern is typical for Minnesota lakes and matches the phosphorus pattern since phosphorus is an important nutrient for algae growth.

Dissolved 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 fish.

Dissolved oxygen profiles from 1990 indicate that Lake Alexander stratifies throughout the summer. The thermocline exists at 7 meters (23 feet), which means that game fish are most likely absent deeper than 23 feet in July and August. Benthic phosphorus samples taken in 1990 indicate internal loading occurs in Lake Alexander when the hypolimnion is anoxic (154-283 ug/L). This means that a chemical reaction occurs that releases phosphorus from the sediments back into the water column.

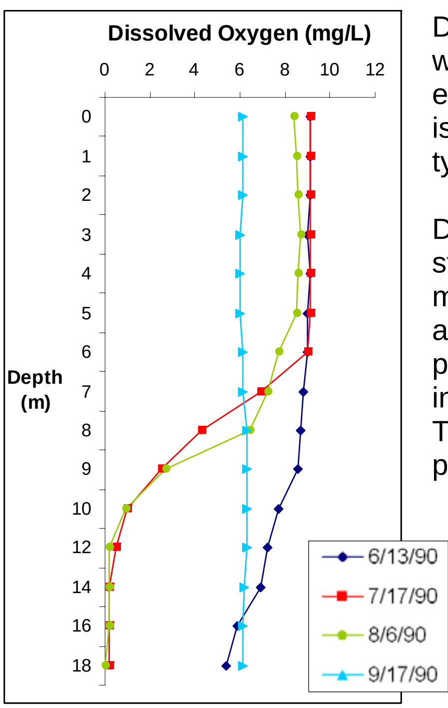


Figure 9. Dissolved oxygen and temperature profile for Lake Alexander in 1990.

Trophic State Index

Trophic State Index (TSI) is a standard measure or means for calculating the trophic status or productivity of a lake. Phosphorus (nutrients), chlorophyll *a* (algae concentration) and Secchi depth (transparency) are related. As phosphorus increases, there is more food available for algae, resulting in increased algal concentrations. When algal concentrations increase, the water becomes less transparent and the Secchi depth decreases.

Trophic State Index	Site 202
TSI Total Phosphorus	46
TSI Chlorophyll-a	46
TSI Transparency	40
TSI Mean	44
Trophic State:	Mesotrophic

Numbers represent the mean TSI for each parameter.

The mean TSI for Lake Alexander indicates that it is mesotrophic (Figure 10). There is good agreement between the TSI for phosphorus, and chlorophyll *a*, indicating that these variables are strongly related. As the phosphorus increases, the chlorophyll a increases. The TSI for transparency is better than for total phosphorus and chlorophyll a.

Mesotrophic lakes (TSI 40-50) are characterized by moderately clear water most of the summer. "Meso" means middle or mid; therefore, mesotrophic means a medium amount of productivity. Mesotrophic lakes are commonly found in central Minnesota and have clear water with some algal blooms in late summer. They are also usually good walleye lakes.

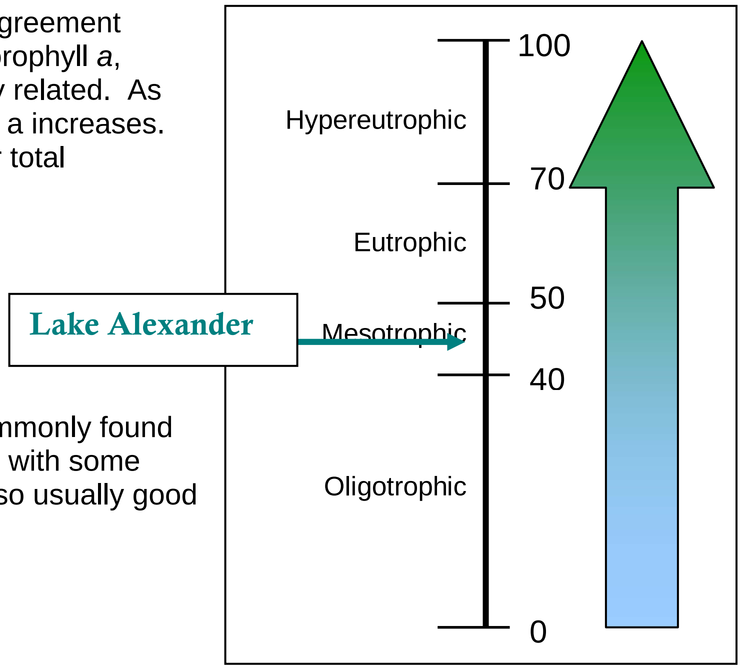


Figure 10. Trophic state index chart with corresponding trophic status.

TSI	Attributes	Fisheries & Recreation
<30	**Oligotrophy:** Clear water, oxygen throughout the year at the bottom of the lake, very 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.
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.

There is not enough historical data to perform trend analysis for total phosphorus or chlorophyll *a* on Lake Alexander. Sites 201 and 202 had at least 8 years of transparency data, which was enough data to perform a long-term trend analysis. The data was analyzed using the Mann Kendall Trend Analysis.

Lake Site	Parameter	Date Range	Trend	Probability
201	Transparency	1993-2008	No Trend	--
202	Transparency	1997-1999, 2003-2009	Declining	90%
202	Transparency	2003-2009	Declining	95%

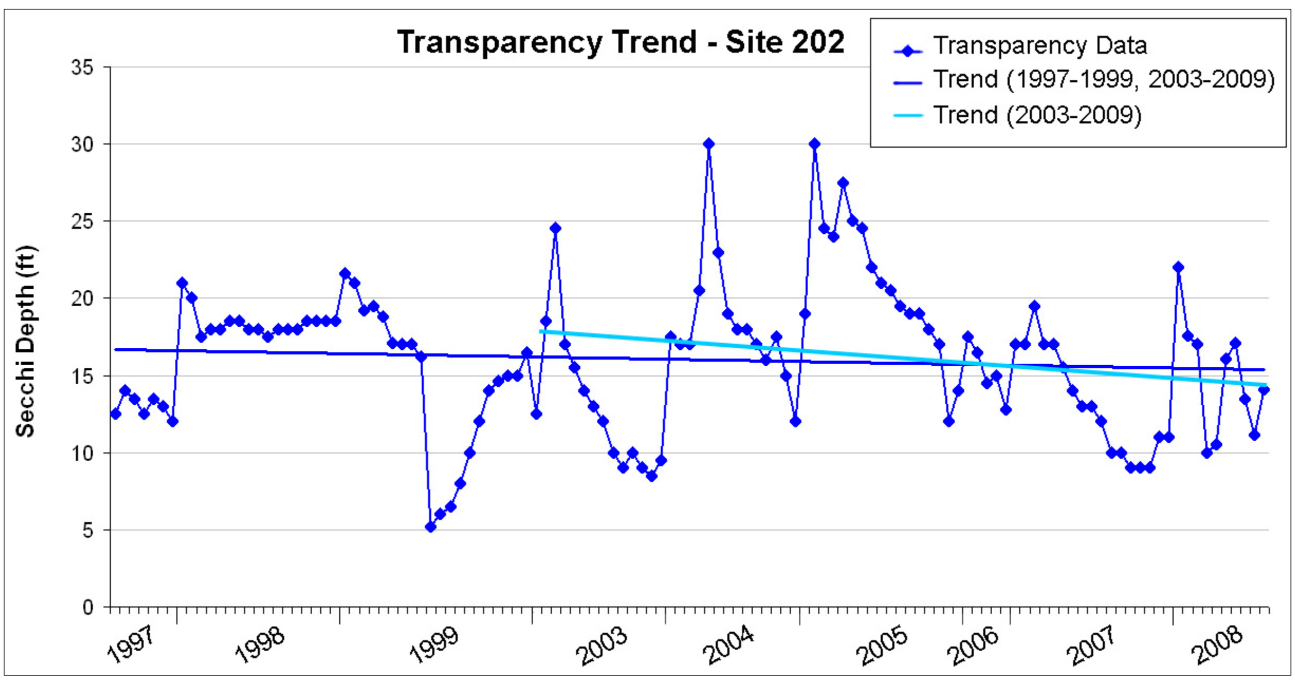
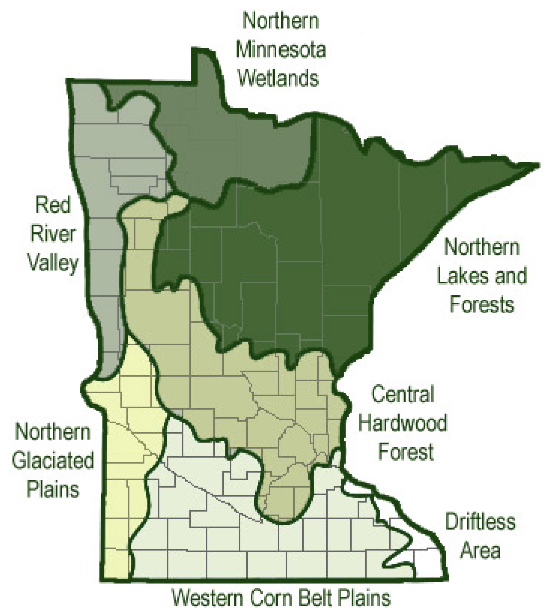


Figure 11. Transparency trend for site 202.

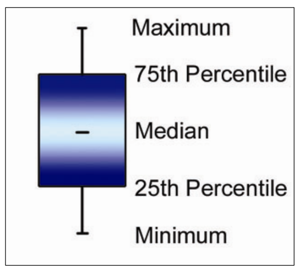
Site 201 in Lake Alexander had no trend occurring. At site 202, there is a slight decline in transparency. Transparency has declined an average of approximately 0.5 feet over 1997-1999 2003-2009 (Figure 11). A short-term trend from 2003-2009 indicates an average transparency decline of approximately 2 feet. Land use practices around Lake Alexander should be investigated for improvement opportunities. Protection projects could include shoreline restoration, investigation upstream of the inlet, and lake resident education (see page 13). Transparency monitoring should continue at both sites so that this trend can be tracked in future years.

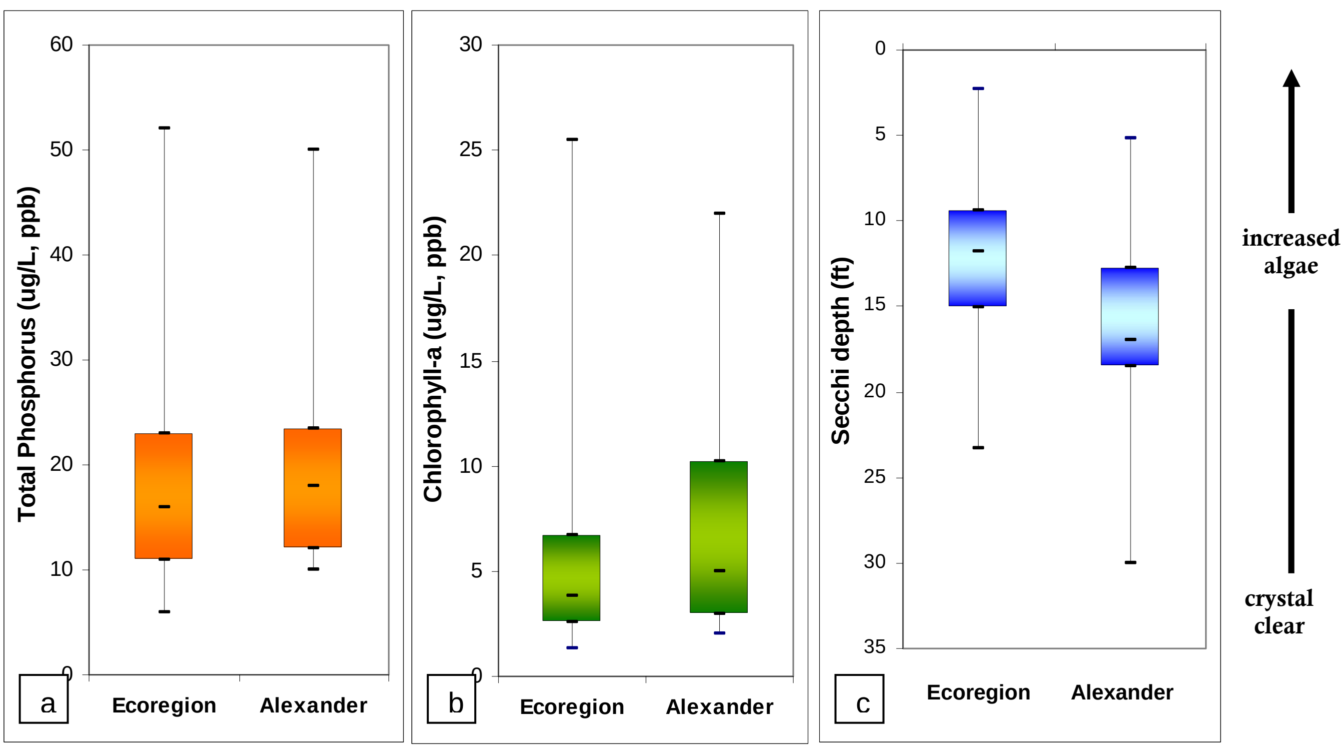
Ecoregion Comparisons

Minnesota is divided into seven ecoregions based on land use, vegetation, precipitation and geology. The MPCA has developed a way to determine the "average range" of water quality expected for lakes in each ecoregion. From 1985-1988, the MPCA evaluated the lake water quality for reference lakes. These reference lakes are not considered pristine, but are considered to have little human impact and therefore are representative of the typical lakes within the ecoregion. The "average range" refers to the 25th - 75th percentile range for data within each ecoregion. For the purpose of this graphical representation, the means of the reference lake data sets were used.



Lake Alexander is in the Northern Lakes and Forests Ecoregion. The mean total phosphorus, chlorophyll a and transparency (secchi depth) for Alexander are all within the expected ecoregion ranges (Figures 12a-c).





Figures 12a-c. Lake Alexander ranges compared to Northern Lakes and Forest Ecoregion ranges. The Lake Alexander total phosphorus and chlorophyll *a* ranges are from 16 data points collected in May-September of 2007-2009. The Lake Alexander secchi depth range is from 121 data points collected in May-September from 1997-1999, 2003-2009.

Inlet/Outlet Data Assessment

No inlet or outlet data have been collected for Lake Alexander.

Assessment/Findings Recommendations

Transparency

Transparency monitoring at sites 201 and 202 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. Site 202 shows a declining trend in transparency. Land use practices around Lake Alexander should be investigated for improvement opportunities. Protection projects could include shoreline restoration, investigation upstream of the inlet, and lake resident education (see page 13)

Impaired Waters Assessment 303(d) List

There are two main types of Impaired Waters Assessment for lakes: eutrophication (excess phosphorus) for aquatic recreation and mercury in fish tissue for aquatic consumption. Lake Alexander is not listed as impaired for eutrophication or mercury in fish tissue.

Aquatic Recreational Use Assessment 305(b)

In the 2008 MPCA Aquatic Use Assessment (305(b)), Lake Alexander had insufficient information to complete the assessment. In the next assessment round (2010), there should be sufficient data for this assessment.

Inlet/Outlet Monitoring

If problems are suspected upstream from the lake inlet, a monitoring program could be designed to test the inlet with the goal of finding possible impacts to the lake.

Organizational contacts and reference sites

Lake Alexander Property Owners Association	upnorth@lakealexander.com http://lakealexander.com/index.html
Morrison County Soil and Water Conservation District	Helen McLennan, District Manager 16776 Heron Rd., Little Falls, MN 56345 (320) 616-2479 helen.mclennan@mn.nacdnet.net http://www.morrisonswcd.org/
Regional DNR Fisheries Office	16543 Haven Road, Little Falls, MN 56345 (320) 616-2450 eric.altena@dnr.state.mn.us http://www.dnr.state.mn.us/lakefind/index.html
Regional Minnesota Pollution Control Agency Office	7678 College Road, Suite 105, Baxter, MN 56425 (218) 828-2492 http://www.pca.state.mn.us
Regional Board of Soil and Water Resources Office	1601 Minnesota Drive, Brainerd, MN 56401 (218) 828-2383 http://www.bwsr.state.mn.us

Checklist of Stewardship Practices for Lake Protection

Use this checklist to test how you are doing as a lake steward. Check the practices you use. Review those that you don't use and think about adding them. Periodically review this list to see if you have improved as a lake steward.

Boating and other Recreation

___ Use a 4-cycle boat engine or a non-motorized boat.
___ Use lead-free weights and tackle.
___ Limit clearing of shoreline plants to only area needed for access and recreation.
___ Adjust boat speed to reduce wake and minimize wave damage to shore.
___ Stop washing dishes, laundry, and self in lake while camping.
___ Properly dispose of wastewater when boating and ice fishing.

Runoff Reduction

___ Reduce paved areas (e.g. use paving stones rather than concrete).
___ Sweep driveways and walks instead of washing them with water.
___ Redirect downspouts away from paved areas.
___ Drain your sump pump through the lawn rather than directly to the street.
___ Re-establish or preserve a vegetative buffer along the shore.
___ Do not remove ice ridges that form along the shoreline.

Yard Care

___ Use 0 phosphorus fertilizer unless soil test results show phosphorus is needed.
___ Don not use fertilizers within 10 feet of a lake, wetland, stream, or storm drain.
___ Sweep fertilizer, grass clippings and soil off of your driveway and the street.
___ Replace lawn with native trees, shrubs, grasses, sedges, and wildflowers.
___ Pick up pet waste.
___ Minimize use of salt and sand on walkways and driveways during the winter.

Exotic Species

___ Learn how to identify and control exotic species.
___ Inspect boats and equipment for exotics before taking them to other waters.
___ Never dump bait buckets or live fish from one water body into another.

Septic Systems

___ Eliminate use of garbage disposal when using an on-site septic system.
___ Pump septic tank annually, through the manhole, not through inspection port.
___ Don't use septic tank additives.

This page is a Checklist of Stewardship Practices from the Guide to Lake Protection and Management published by the Freshwater Society in cooperation with the Minnesota Pollution Control Agency. http://www.pca.state.mn.us/water/lakeprotection.html

References and Additional Sources of Information

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Lake Alexander Lakeshed Assessment

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

Lakeshed Vitals		Rating
Major Basin	Upper Mississippi River	descriptive
Major Watershed	Long Prairie River	descriptive
Minor Watershed	14063	descriptive
Lakeshed	Fish Trap Lake (1406301)	descriptive
Ecoregion	Northern Lakes and Forests	descriptive
Lake Area	2,990 acres	descriptive
Miles of Shoreline	16.5	descriptive
Miles of Stream	3.5	descriptive
Miles of Road	23.5	descriptive
Lake Max Depth	64 ft. (19.5 m)	descriptive
Lake Mean Depth	NA	NA
Water Residence Time	NA	NA
Municipalities	None	+
Sewage Management	Individual waste treatment systems (septic systems and holding tanks – inspections only for property sales and building permit requests)	-
Public Drainage Ditches	None	+
Lake Management Plan	Healthy Lakes & Rivers Partnership program, 2003	+
Lake Vegetation Survey/Plan	Survey Completed June/July 2004	+
Forestry Practices	None	+
Development Classification	General Development	-
Shoreline Development Index	2.2	-
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	4:1	x
Public Lake Accesses	3	x
Inlets	1	x
Outlets	1	x
Feedlots	None	+
Agriculture Zoning	233 acres within 200 ft. of lake; 4,440 acres > 200 ft. from lake	-
Public Land : Private Land	0.4:1	-
Wetland Coverage	5%	+
Lake Transparency Trend	Site 201 – no trend; Site 202 – declining trend (90% Probability)	+/-
Exotic Species	Eurasian watermilfoil & curly-leaf pondweed	-

Rating Key:
+ *beneficial to the lake*
- *possibly detrimental to the lake*
x *warrants attention*

Lakeshed

Understanding a lakeshed requires the understanding of basic hydrology. A watershed is the area of land that drains into a surface water body such as a stream, river, or lake and contributes to the recharge of groundwater. There are three categories of watersheds: 1) basins, 2) major watersheds, and 3) minor watersheds.

Lake Alexander is found within the **Upper Mississippi River Basin**, which includes the **Long Prairie River Major Watershed** as one of its sixteen major watersheds (Figure 1). The basin covers 20,000 square miles, while the Long Prairie River covers 893 square miles (approximately 571,451acres). Lake Alexander falls within **minor watershed 14063**, one of the 63 minor watersheds that comprise the Long Prairie River Major Watershed (Figure 2).

Within this watershed hierarchy, lakesheds also exist. A lakeshed is defined simply as the land area that drains to a lake. While some lakes may have only one or two minor watersheds draining into them, others may be connected to a large number of minor watersheds, reflecting a larger drainage area via stream or river networks. Lake Alexander falls within the **Fish Trap Lake (1406301) lakeshed**, covering 12,249 acres (includes lake area) (Figure 3).

Lake Alexander Lakeshed Water Quality Protection Strategy

Each lakeshed has a different makeup of public and private lands. Looking in more detail at the makeup of these lands can give insight on where to focus protection efforts. The protected lands (easements, wetlands, public land) are the future water quality infrastructure for the lake. Developed land and agriculture have the highest phosphorus runoff coefficients, so this land should be minimized for water quality protection.

A large percentage of Lake Alexander's lakeshed is private forested uplands. This land can be the focus of development and protection efforts in the lakeshed.

	Private (53%)					26%	Public (21%)		
	Developed	Agriculture	Forested Uplands	Other	Wetlands	Open Water	County	State	Federal
Land Use (%)	5%	6%	32%	5%	5%	26%	0%	21%	0%
Runoff Coefficient Lbs of phosphorus/acre/ year	0.45 - 1.5	0.26 - 0.9	0.09		0.09		0.09	0.09	0.09
Description	Focused on Shoreland	Cropland	Focus of develop-ment and protection efforts	Open, pasture, grass-land, shrub-land	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3rd party certification, SFIA, local woodland cooperatives		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

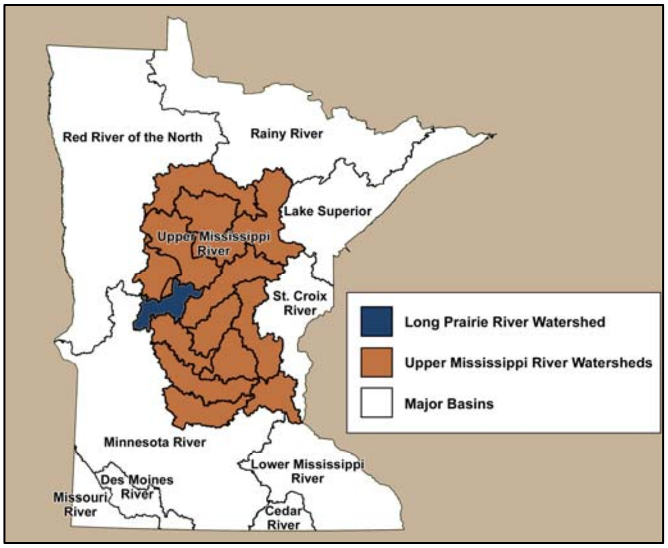


Figure 1. Upper Mississippi Basin and the Long Prairie River Watershed.

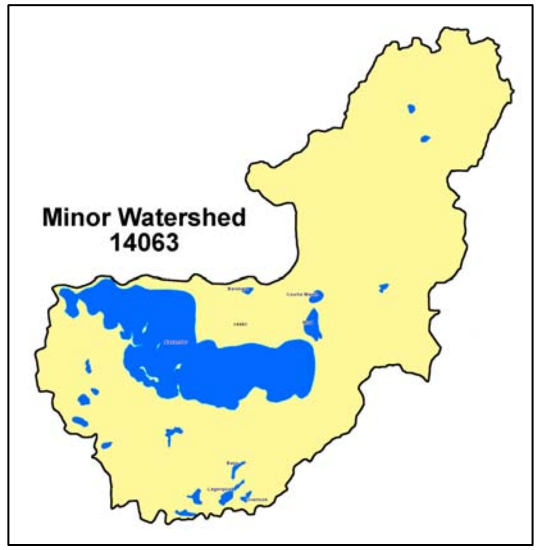


Figure 2. Minor Watershed 14063 contributes water to Lake Alexander.

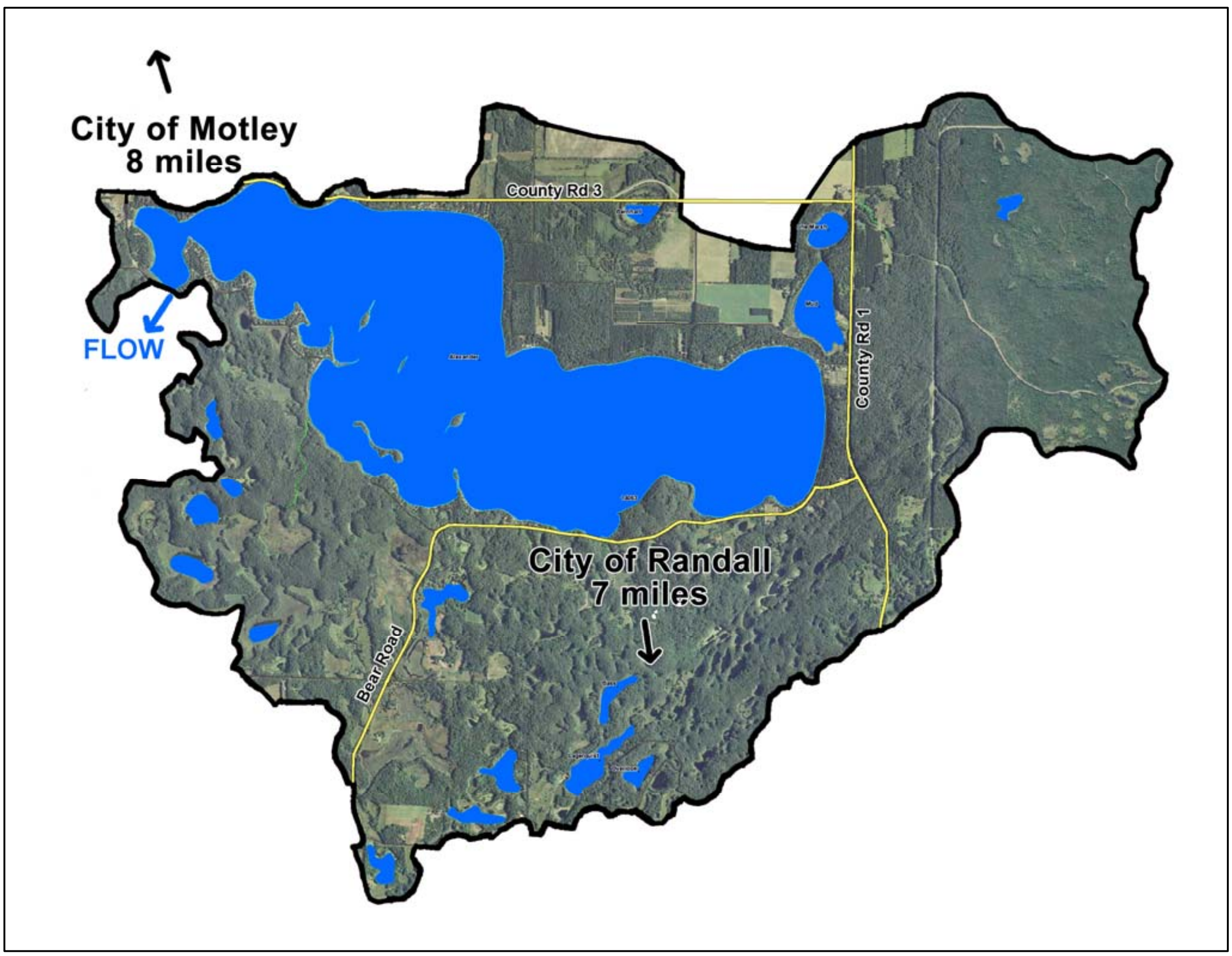


Figure 3. The Fish Trap Lake (1406301) lakeshed (Aerial imagery 2008).

Land Cover / Land Use

The 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. The basic purpose of land use planning is to ensure that each area of land will be used in a manner that provides maximum social benefits without degradation of the land resource.

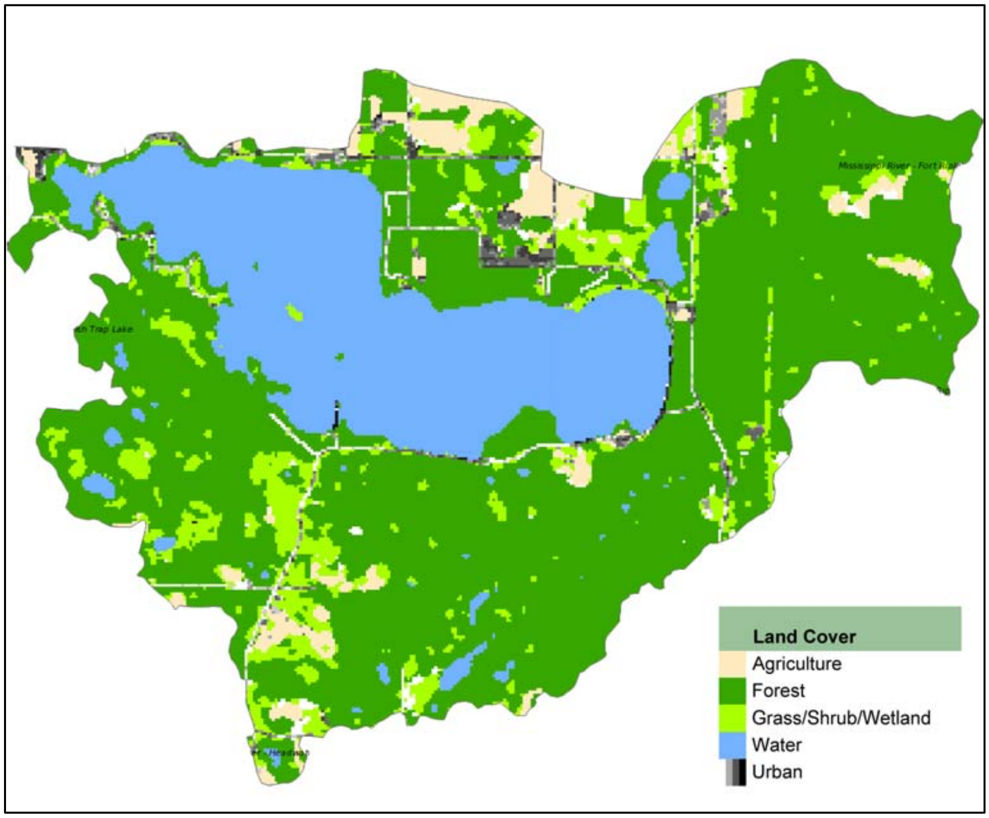


Figure 5. The Fish Trap Lake (1406301) lakeshed land cover (http://land.umn.edu).

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the land's ability to absorb and store water rather than cause it to flow overland (gathering nutrients and sediment as it moves) towards the lowest point, typically the lake. Impervious intensity decribes the land's inability to absorb water; the higher the % impervious intensity the more area that water cannot penetrate in to the soils. Monitoring the changes in land use can assist in future planning procedures to address the needs of future generations.

Phosphorus export, which is the main cause of lake eutrophication, depends on the type of land cover occurring in the lakeshed. Figure 5 depicts Lake Alexander's lakeshed land cover.

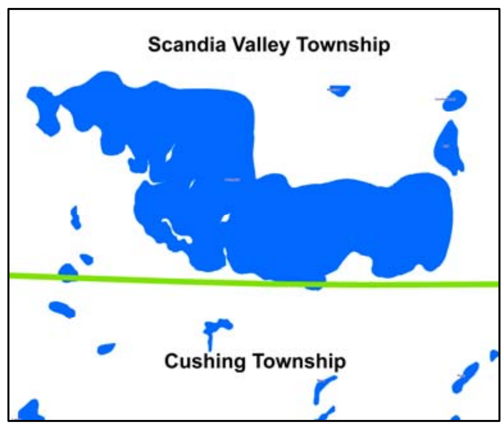
The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (http://land.umn.edu). Table 1 describes Lake Alexander's lakeshed land cover statistics and percent change from 1990 to 2000. Due to the many factors that influence demographics, one cannot determine with certainty the projected statistics over the next 10, 20, 30+ years, but one can see the transition within the lakeshed from agricultural, grass/shrub/wetland, and water acreages to forest and urban acreages. The largest change in percentage is the increase in urban land cover (50.8%); however, in acreage, forest cover has increased the most (1,015 acres). In addition, the impervious intensity has increased, which has implications for storm water runoff into the lake. The increase in impervious intensity is consistent with the increase in urban acreage.

Table 1. Lake Alexander's lakeshed land cover statistics and % change from 1990 to 2000 (http://land.umn.edu).

	1990		2000		% Change
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**	**1990 to 2000**
Agriculture	674	5.5	466	3.8	30.9% Decrease
Forest	6,324	51.63	7,339	59.92	16.0% Increase
Grass/Shrub/Wetland	1,779	14.52	1,154	9.42	35.1% Decrease
Water	3,158	25.78	2,818	23.01	10.8% Decrease
Urban	311	2.54	469	3.83	50.8% Increase
Impervious Intensity %					
0	12,046	98.37	11,882	97.03	1.4% Decrease
1-10	49	0.4	69	0.56	40.8% Increase
11-25	52	0.42	112	0.91	115.4% Increase
26-40	39	0.32	115	0.94	194.9% Increase
41-60	36	0.29	57	0.47	58.3% Increase
61-80	16	0.13	10	0.08	37.5% Decrease
81-100	8	0.07	1	0.01	87.5% Decrease
Total Area	12,249		12,249		
Total Impervious Area **(Percent Impervious Area Excludes Water Area)**	60	0.66	95	1.01	58.3% Increase

Demographics

Lake Alexander is classified as a general development lake. 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.



The Minnesota Department of Administration Geographic and Demographic Analysis Division extrapolated future population in 5-year increments out to 2035. These projections are shown in Figure 6 below. Compared to Morrison County as a whole, both Scandia Valley and Cushing Townships have higher extrapolated growth projections.

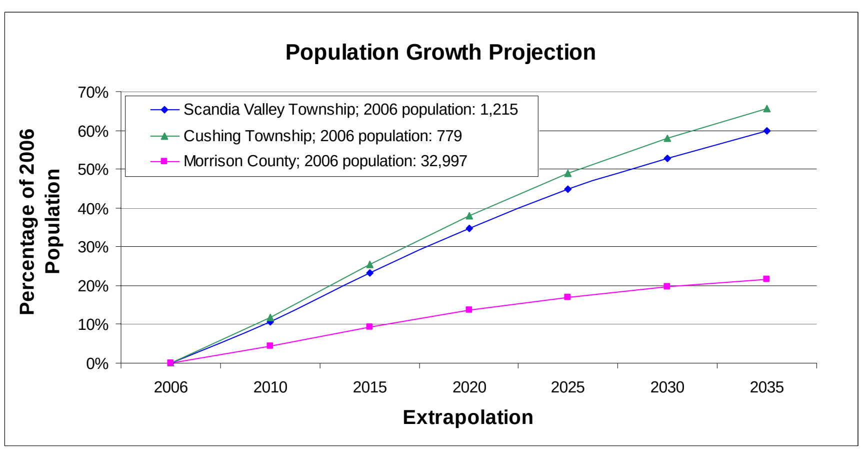


Figure 6. Population growth projection for Morrison County and the townships around Lake Alexander (source: http://www.demography.state.mn.us/resource.html?Id=19332).

Status of the Fishery (DNR, as of 08/14/2006)

Lake Alexander is one of the most popular lakes in Morrison County. Besides being a scenic, clear-water lake, it supports a diverse fish community that offers a variety of angling opportunities. Alexander has abundant offshore structure and a reputation for better angling success at night or on overcast days. Submergent vegetation grows to a depth of 19 feet with canada waterweed, coontail, eurasian milfoil, flat stem pondweed, and northern milfoil being the most common species. Curly leaf pondweed is common before July 1. Sand is the most common shallow water substrate around the lake. Several resorts as well as three public accesses can be found on the lake. The Lake Alexander Preserve which is owned by the Nature Conservancy is located on the south shore of the lake and is open to hiking. The fish management focus for the lake is walleye, northern pike, largemouth bass, smallmouth bass, and muskellunge. Walleye are a much sought after species on Alexander and the 2006 did show a decrease in numbers since the 2002 survey. A variety of sizes was seen in the survey from 8 inches up to 29 inches. Walleye fry stocking has proven to be an inexpensive and viable method of sustaining the walleye population and meeting fishing pressure demands on the lake. Northern pike numbers continue to be low but the size structure of the population was much improved when compared to the 2002 survey. In 2002, none of the pike were over 24 inches compared to 50% of the pike exceeding 24 inches with 4 of the fish being over 30 inches in 2006. A northern pike regulation was implemented in 2003 which required the release of all pike between 24 and 36 inches. The goal of the regulation was to increase the opportunity of catching a trophy size fish and improve overal size structure. Muskellunge were introduced in Alexander in 1988 and have since become increasingly popular as a species targetted by anglers. Some of the fish have now reached over 50 inches in length with fish over 45 inches being common. Good numbers of both largemouth and smallmouth bass can be found in Lake Alexander and quality fish of both species have been documented. Panfish species present include black crappie, bluegills, hybrid sunfish, and pumpkinseeds. Most of the panfish tend to be small by angler's standards, but bluegills over 7 inches and black crappies over 10 inches can be found. Crappies provide a popular winter and spring fishery on the lake with fish over 13 inches being possible. Other fish species sampled in the survey include rock bass, tullibee or cisco, white sucker, yellow bullhead, and yellow perch. Tullibee were stocked in 2003 to supplement what appears to be a low population. The lake once supported a good tullibee population that provided a popular late winter fishery but anglers and netting efforts indicated the population had declined. Yellow perch abundance appears to be good with many of the fish seen in the survey between 6 and 8 inches which should be a good prey size for the larger gamefish in the lake. White sucker and yellow bullhead abundance appears to be low which was the same as in the 2002 survey. Lake Alexander provides the potential for anglers to catch a trophy size fish of several different species which draws many fishermen to the lake. Fishermen do need to be diligent about checking and draining their boats to prevent the spread of exotics, several of which grow in Alexander. While a large portion of the watershed is forested, good land use practices along the many inlets and lakeshore are encouraged to protect and improve the water quality of the lake. Two websites which provide information for shoreline property owners are:

MPCA - "Guide to Lake Protection & Management www.pca.state.mn.us/water/lakeprotection.html

Minnesota Shoreland Management Resource Guide www.shorelandmanagement.org/index.html ?

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=49007900