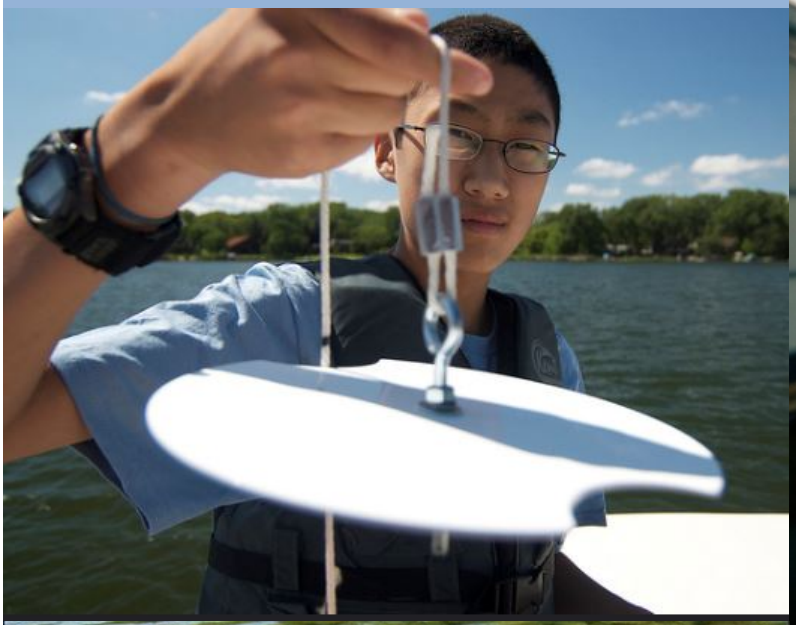
Citizen Lake Monitoring Program Instruction Manual



Minnesota Pollution Control Agency

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Minnesota Pollution Control Agency

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This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: wq-s1-13

Foreward

This manual has been prepared to help answer any questions that new or veteran volunteer monitors may have about the Citizen Lake Monitoring Program and/or lake monitoring in general. It is our hope that you will find this booklet useful as well as informative.

Did you know that participants in the Citizen Lake Monitoring Program belong to one of the longest-running volunteer lake monitoring program in the nation? Volunteer lake monitors are critical to tracking the long term quality of Minnesota's lakes. The Minnesota Pollution Control Agency thanks volunteer monitors for all their hard work and dedication toward protecting and improving the surface waters of Minnesota.

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Introduction

Thank you for joining the Citizen Lake Monitoring Program (CLMP)! You have joined over 1,000 volunteers monitoring over 900 Minnesota lakes. Because lakes are central to Minnesota's economy and our way of life, it is imperative that we maintain or improve their water quality. Data collected by CLMP volunteers is vitally important to that effort.

The CLMP was started in 1973 at the University of Minnesota by Dr. Joe Shapiro. During its first year, volunteers monitored 74 lakes. Administration of the CLMP was transferred to the Minnesota Pollution Control Agency (MPCA) in 1978. The CLMP is a cooperative program that combines the technical resources of the MPCA and the efforts of citizen volunteers statewide that collect water quality data on their lakes. The participation of citizen volunteer monitors in the CLMP effectively increases the monitoring capabilities of the MPCA. The CLMP is a cost-effective way to obtain good, basic, water quality data on many of Minnesota's lakes. For many of them, CLMP data is the only water quality information available.

The CLMP involves voluntary participation of citizens residing on or near lakes or those who are frequent lake users. CLMP participants are asked to take weekly transparency measurements on their lake during the summer using a Secchi disk. A minimum of eight readings per season are required in order to adequately define each summer's water quality. Data collected by CLMP volunteers are entered into the U.S. Environmental Protection Agency's (EPA) water quality database along with all other water quality data collected by the MPCA. These data are used to analyze water quality trends, characterize trophic status, and provide a basis for water quality goal setting.

CLMP volunteers provide the state and others with valuable information on the water quality of Minnesota's lakes. By participating in CLMP, volunteers learn about the water quality of lakes in their area and gain a greater awareness of the causes and effects of lake degradation.

What is a Secchi disk?

A Secchi (pronounced “Seh-kee”) disk is a circular metal plate attached to a measuring rope. It is probably the least expensive and easiest to use tool in water quality monitoring.

Information provided by the Secchi disk is easily interpreted by volunteers and can be used to detect water quality trends in lakes.

The Secchi disk is named after Fr. Pietro Angelo Secchi (Figure 1), astrophysicist and scientific advisor to the Pope. Secchi was asked by Commander Cialdi, head of the Papal Navy, to measure the transparency of the Mediterranean Sea. The first disk was lowered from the papal yacht, I’immacolata Concezion (Immaculate Conception), on April 20, 1865 (Carlson and Simpson, 1996). There have been many revisions to the disks used by Secchi in terms of size and color. The two most common color variations in use today are the all-white disk and the black and white quadrant version disk (Figure 2). In Minnesota, we use an all-white, eight inch diameter metal disk with notched sides for line storage when the disk is not in use.

Figure 1. Pietro Angelo Secchi (1818-1878).

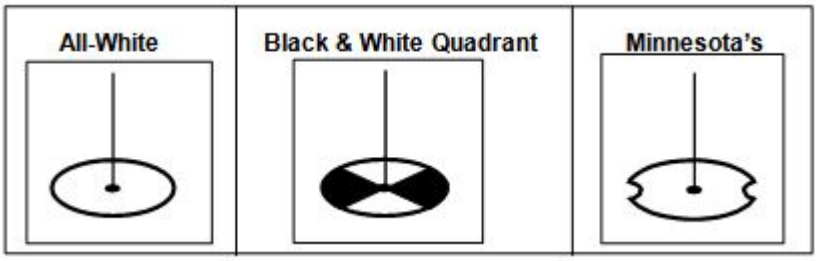


Figure 2. Secchi disk color and style varieties.

What does a Secchi disk measure?

A Secchi disk measures water transparency or clarity. It is a quick and easy measurement that tells scientists a lot about a lake's water quality. First, it indicates the amount of light penetration into a lake (Figure 3). Second, Secchi transparency provides an indirect measure of the amount of suspended material in the water, which in many cases is an indication of the amount of algae in the water. Long-term transparency monitoring by CLMP volunteers provides a valuable basis for detecting trends in water quality. Generally, the sooner water-quality problems are detected, the easier and less expensive it is to restore the lake to its previous state.

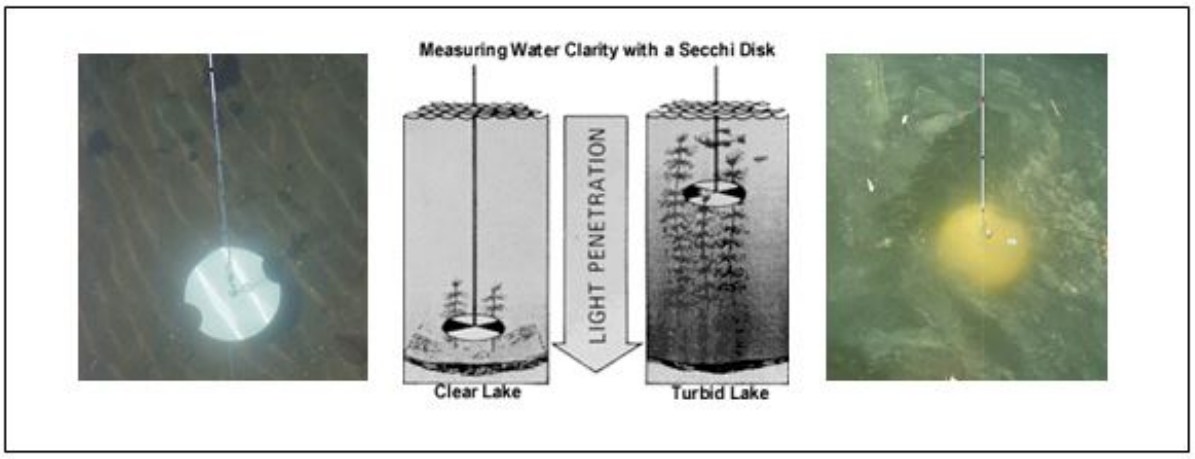


Figure 3. Measuring water clarity with a Secchi disk.

How to take and record Secchi readings

Readings should be taken at least three days apart, primarily during the months of May through September. **A minimum of two readings per month is needed to provide meaningful information about your lake**. It is ideal to take the readings between dawn and dusk on calm days. All readings should be taken from the same monitoring location throughout the summer (See page 5 on selecting a monitoring location). **Note: If you monitor more than one site on a lake, each site must have a separate datasheet.**

1. Travel to your designated monitoring location and anchor your boat.
2. Remove sunglasses while making a reading, as this affects the accuracy of your reading. If you wear photo gradient prescription eyeglasses, prevent them from darkening by wearing a hat with a wide brim.
3. Lower the Secchi disk into the lake on the shaded side of the boat, until the disk *just disappears* completely from view. When it does, stop lowering the disk.
4. While continuing to look down into the water, slowly raise the disk until it reappears. Lower and raise the disk until you have found the midpoint between disappearance and reappearance of the disk - then note this depth.
5. Round the reading to the nearest ½ foot to get the transparency reading. Record this reading in the "Secchi" column on the CLMP datasheet. Also record the date and time of this reading.
6. If you can see the disk while it is resting on the lake bottom, write a capital "B" in the column on your datasheet after the "Secchi" column.

Additional lake monitoring information

Following the "Secchi" column on your datasheet are columns for recording additional information that will help to accurately denote the condition of your lake. For each of these columns, please select only one number. We cannot record ranges or fractions.

Physical condition ("PC" on your datasheet)

Each time you sample, please select the one number that best describes the physical condition of the lake water *at your sampling site* (not whole-lake conditions).

1 = Crystal clear water

2 = Not quite crystal clear—a little algae present/visible

3 = Definite algae—green, yellow, or brown color apparent

4 = High algal levels with limited clarity and/or mild odor apparent

5 = Severely high algae levels with one or more of the following: massive floating scums on the lake or washed up on shore; strong, foul odor; or fish kill

Recreational suitability ("RS" on your datasheet)

Each time you sample, please select the one number that best describes your opinion of how suitable the lake is for recreation and/or aesthetic enjoyment.

1 = Beautiful, could NOT be better

2 = Very minor aesthetic problems; excellent for swimming, boating

3 = Swimming and aesthetic enjoyment are slightly impaired due to algae levels

4 = Desire to swim and level of enjoyment of the lake substantially reduced due to algae levels (i.e., would not swim, but boating is okay)

5 = Swimming and aesthetic enjoyment of the lake nearly impossible due to algae levels

Water color

The "Water Color" column should be used to record the color of the lake water *at your sampling site*. Each time you sample, please choose **one** of the following color options:

Clear: Clear, blue water with a low amount of particles or dissolved, colored materials that reflect light. The deeper the water, the darker blue it may appear.

Green: Green water caused by suspended particles of living material such as suspended algae.

Stained: Brown or red stained clear water that may look like iced tea which results from dissolved organic matter.

Sediment: Muddy or cloudy brown water due to high sediment levels; often resembles chocolate milk.

* We understand these four options may be limiting, so if you feel you need to further clarify water color, please do so in the "Other Notes" section of the datasheet after making your color selection from the choices above.

Other notes

The last column is for you to record information about that sampling day for your own use, for example: "saw three loons today," "slightly cloudy with wind from NE," or "lake treated with copper sulfate last week".

Secchi disk tips

- Your disk will last longer and give better service if it is kept clean and protected from scratches and direct sunlight which can damage the paint.
- You may find that your lake is exceptionally clear and that the rope is not long enough. If so, feel free to request a 50 foot measuring rope from the CLMP by calling 651-296-6300 (Twin Cities) or 1-800-657-3864 (Greater Minnesota) or email us at clmp.pca@state.mn.us.

Selecting a monitoring location

When you enroll, the CLMP coordinator will send a map identifying one, or several, potential monitoring location(s) on the lake. The deepest part of the lake will always be the preferred monitoring location, but alternative locations may be suggested if the lake has distinct bays or if it is large in size. **Once you begin monitoring at a location, it is important to continue at that same location.** When traveling to your site, use equipment such as a depth finder or GPS on your initial trips until you become familiar with shoreline landmarks. This will make it easier to accurately find your site(s) the next time you monitor. If you need to change your monitoring location at any time, please contact the CLMP staff (see page 12).

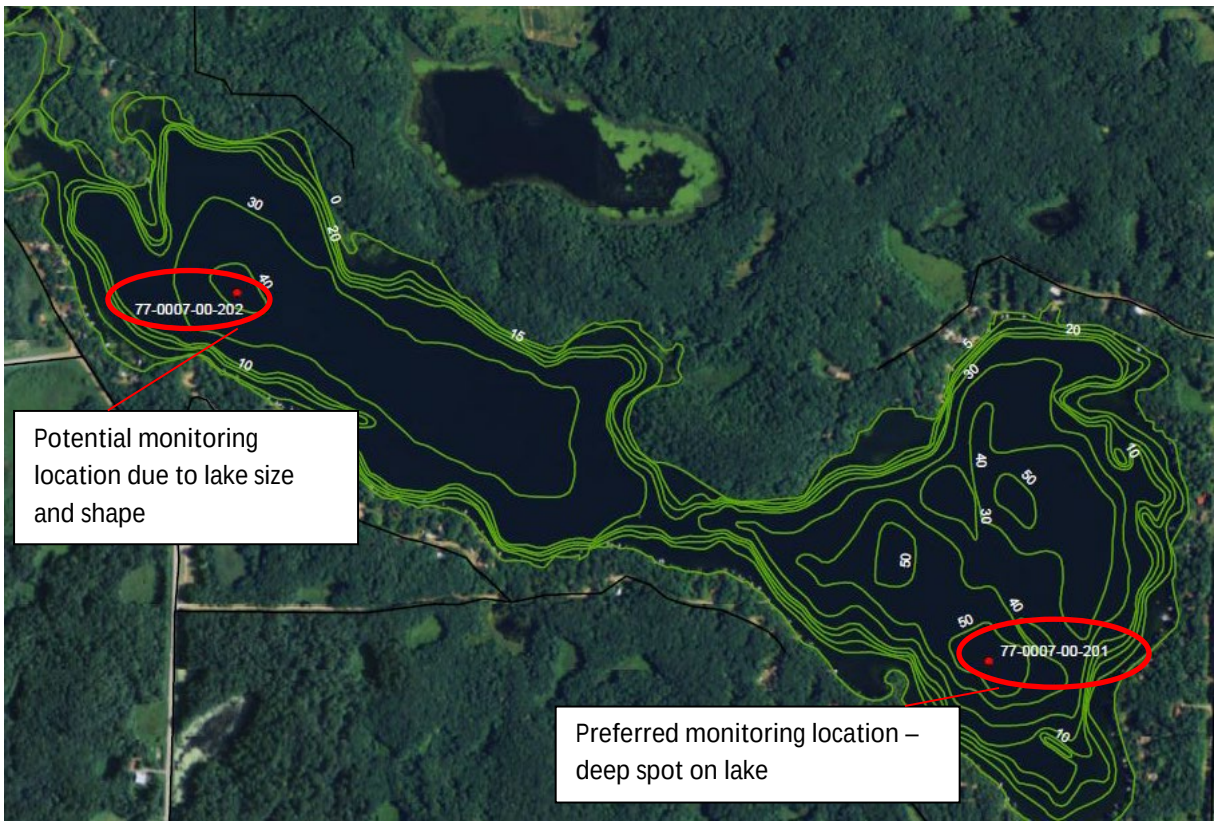


Figure 4. Example monitoring site locations.

Submitting data

Each spring, CLMP staff mails customized paper datasheets to all volunteers. CLMP volunteers should use this datasheet to record data collected throughout the monitoring season. Volunteers should submit their data to CLMP staff once annually, at the end of each monitoring season. Volunteers can do this by:

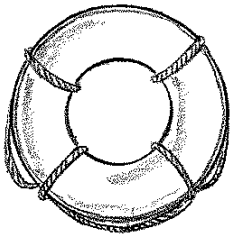
- Mailing in their hard copy datasheet using the postage paid envelope included in each spring mailing.
- Emailing their data using the CLMP Electronic Datasheet, available for download on the CLMP webpage (www.pca.state.mn.us/cmp). Instructions are contained within the file, but don't hesitate to contact CLMP staff with questions.

The off-season

The monitoring season is over and you've submitted your data. Now what? Each fall/winter CMP staff review, proof, and upload data collected by volunteers into the state water quality database. CLMP staff then creates individual, online monitoring site reports summarizing Secchi transparency data submitted by each volunteer. These annual reports are available to volunteers by late winter and volunteers are notified by email when they are ready for download. CMP staff also compiles annual statewide results on program participation and Secchi transparency. This *Annual Statewide Summary Report* is available on the CMP website each spring: www.pca.state.mn.us/cmp.

Safety issues

Always take the appropriate safety precautions when conducting your monitoring activities. What may seem like simple, routine monitoring can turn dangerous very quickly. Using the "buddy system" when conducting monitoring activities is not only more fun, it can also reduce danger in case of an emergency. The following are some tips to ensure your safety while conducting your monitoring activities:



Boating tips

1. Know and follow all boating rules.
2. Learn how to swim.
3. Make sure you and all occupants of your boat, especially children, wear their Personal Flotation Device (PFD or life jacket) at all times.
4. If your boat should tip over and it still floats, stay with it. If it capsizes, try to right it and re-board. If you cannot right your boat, climb on top and hang on. Immersion in cold water can quickly cause hypothermia.
5. Always obey signs and keep away from lock and dam structures on river systems.
6. Never consume alcohol while boating – this can potentially be a deadly combination.
7. Watch out for other boaters to avoid collisions – for your safety as well as theirs.
8. Minnesota weather can change quickly, so be alert to current weather conditions. Watch for wind shifts or distant lightening. **Never monitor when lightning is present**.

9. Tell someone where you are going and when you expect to return. If there is an emergency, this will help authorities looking for you find you faster.
10. If you get caught in rough waters, head to shore, making sure to head into heavy waves at an angle.

Taking appropriate safety precautions refers not only to following boating tips, but also to having safety equipment along that can help you in times of emergency. The Minnesota Department of Natural Resources (MDNR) offers boating safety information. Some of the free publications you can get include: *Minnesota Boating Guide*; *Hypothermia: The Cold Facts*; and *Danger-Thin Ice*. Call the Boat and Water Safety Section of the MDNR at 651-259-5400 or toll-free at 1-888-MINNDNR for more information. Information is also available online at: www.dnr.state.mn.us/safety/boatwater/index.html.

How Secchi data is used

Volunteer- collected water transparency data is extremely valuable to the MPCA. CLMP data is used to:

- Convey information about the general quality of lakes and their productivity level (also known as trophic state)
- Calculate trends to detect changes in lake transparency over time
- Determine if a lake is meeting state water quality standards during a formal assessment process (when used alongside phosphorus and algae (chlorophyll-a) data)
- To calibrate satellite imagery for statewide remote sensed Secchi transparency

Trophic State Index

Carlson's Trophic State Index (TSI, Carlson 1977) is a common way to characterize a lake's overall health or productivity and does so by examining the relationship between total phosphorus, chlorophyll-*a*, and Secchi disk readings in a lake. To calculate the TSI number, individual equations are used for each of the three parameters. Total phosphorus and chlorophyll-*a* are measured in micrograms per liter (μg/L) and Secchi disk transparency is measured in meters (1 meter = 3.281 feet). The individual TSI's are then averaged to get the final TSI.

The TSI scale ranges from "ultra-oligotrophic" or nutrient poor to "hypereutrophic" or nutrient rich. Low trophic values (oligotrophic) are often associated with very clean and clear lakes such as those found in the Boundary Waters Canoe Area. High and/or increasing trophic status values indicate more eutrophic (greener, less healthy) conditions. **Although total phosphorus and chlorophyll-*a* concentrations are not measured in the CLMP, the average summer Secchi transparency generally provides a good indication of trophic status for Minnesota's lakes and can be used to estimate likely ranges of total phosphorus and chlorophyll-*a* for your lake** (Figure 5).

TSI < 30 Classical Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion, salmonid fisheries in deep lakes.

TSI 30 - 40 Deeper lakes still exhibit classical oligotrophy, but some shallower lakes will become anoxic in the hypolimnion during the summer.

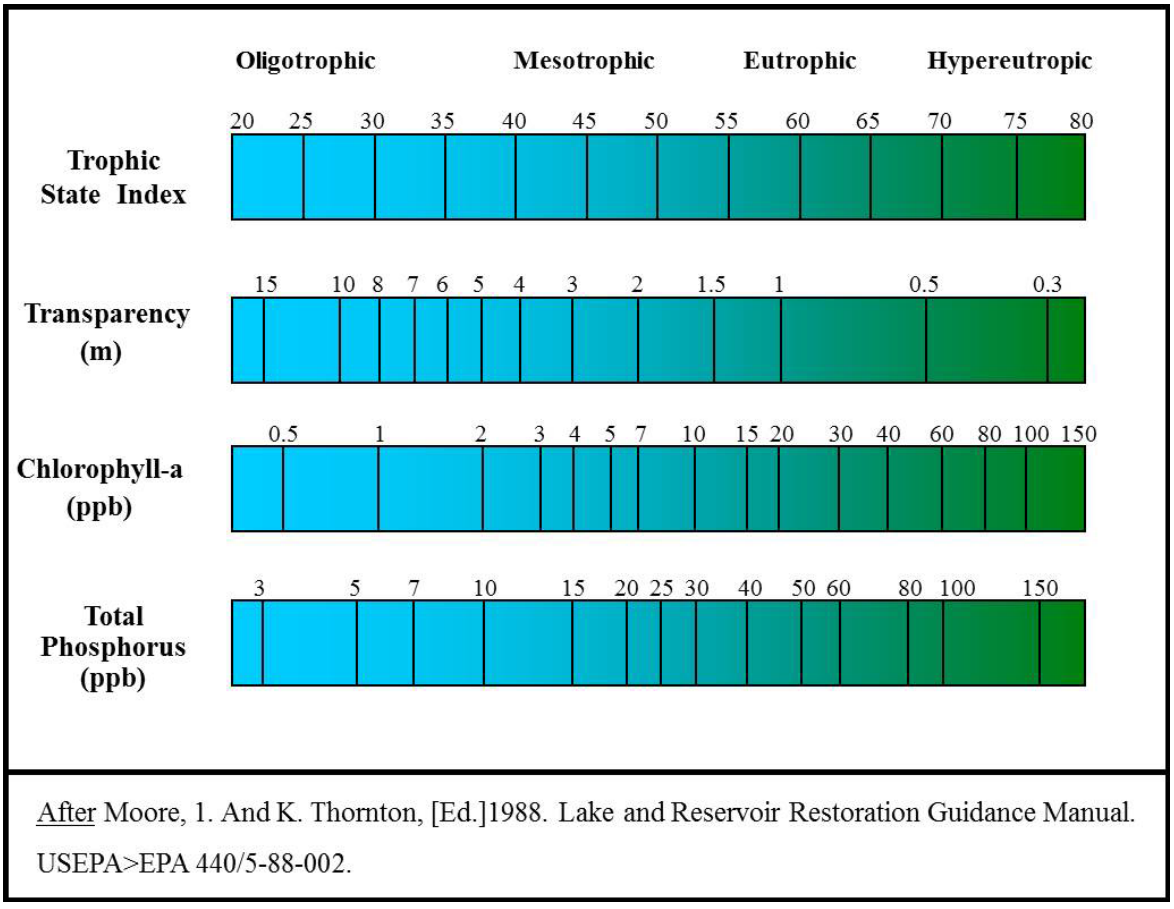
TSI 40 - 50 Water moderately clear, but increasing probability of anoxia in hypolimnion during summer.

TSI 50 - 60 Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnia during the summer, macrophyte problems evident, warm-water fisheries only.

TSI 60 - 70 Dominance of blue-green algae, algal scums probable, extensive macrophyte problems.

TSI 70 - 80 Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic.

TSI > 80 Algal scums, summer fish kills, few macrophytes, dominance of rough fish.



After Moore, 1. And K. Thornton, [Ed.]1988. Lake and Reservoir Restoration Guidance Manual. USEPA>EPA 440/5-88-002.

Figure 5. Carlson's Trophic State Index R.E. Carlson.

Trends

Detecting trends in lake water quality over time is a primary goal for many lake managers and is a concern for local units of government and citizens. For lakes, a minimum of eight years of data (with four or more readings per season) are typically required to detect trends in trophic status. Secchi transparency is one of the best parameters for characterizing lake trophic status and is an economical method for assessing water quality and documenting trends over time.

Plotting average summer transparency readings of a lake over time is one way to identify patterns or trends (Figure 6). The average summer transparency is the average of all readings taken from June – September. Lakes' average summer transparencies vary from year to year, often in response to changes in weather patterns such as an increase in precipitation or temperature. It is important to consider these factors when trying to determine if significant long-term changes have occurred or if changes are merely natural variation in a living system. Based on an analysis of several lakes with long-term Secchi transparency data, yearly average transparencies tend to vary within one to two feet (or about 20%) of the long-term average (Heiskary and Lindbloom, 1993). Consistent variation of more than 20% of the long-term average (or consistent increasing or decreasing summer averages) may be indicative of a trend.

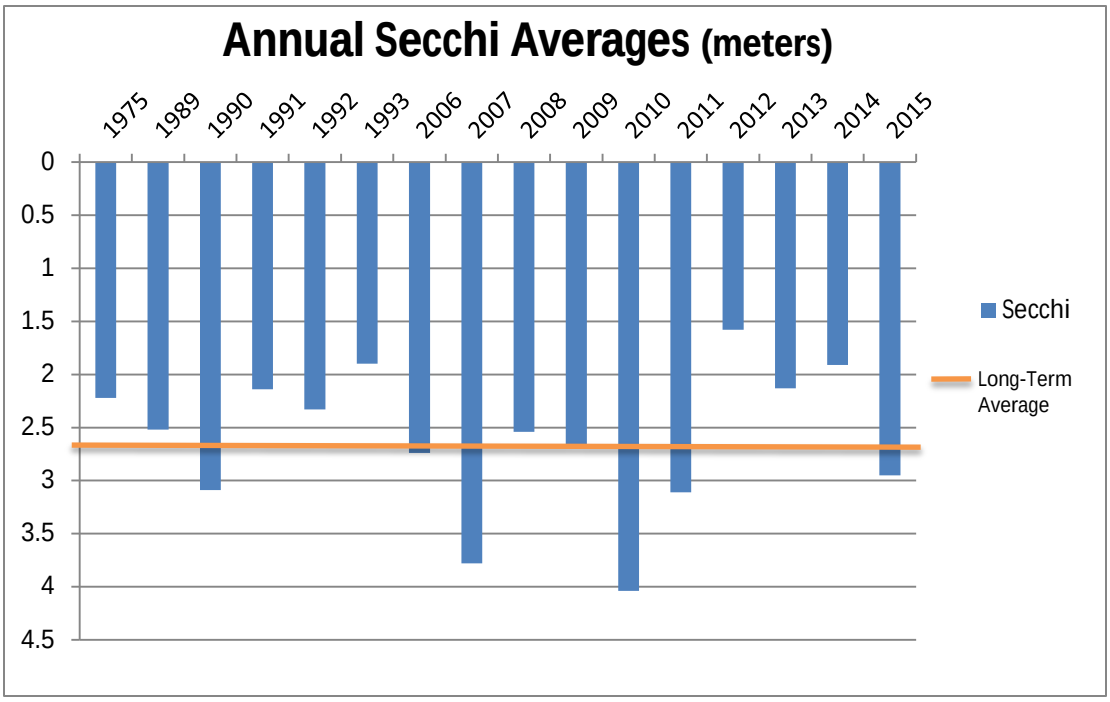


Figure 6. Summer average Secchi transparency Aerie Lake (69-0701), St. Louis County.

In addition to plotting average summer transparency readings, it is helpful to statistically analyze the data. The MPCA uses the Seasonal Kendall Statistical Test to identify trends in a lake's transparency data. Only lakes with four or more transparency readings per summer (June – September) and eight or more years of data are analyzed (Figure 7). When performing trend analysis, it is important to consider the strength of the correlation and number of years of data before determining if the trend is "significant"; and if further investigation, including additional monitoring, is warranted.

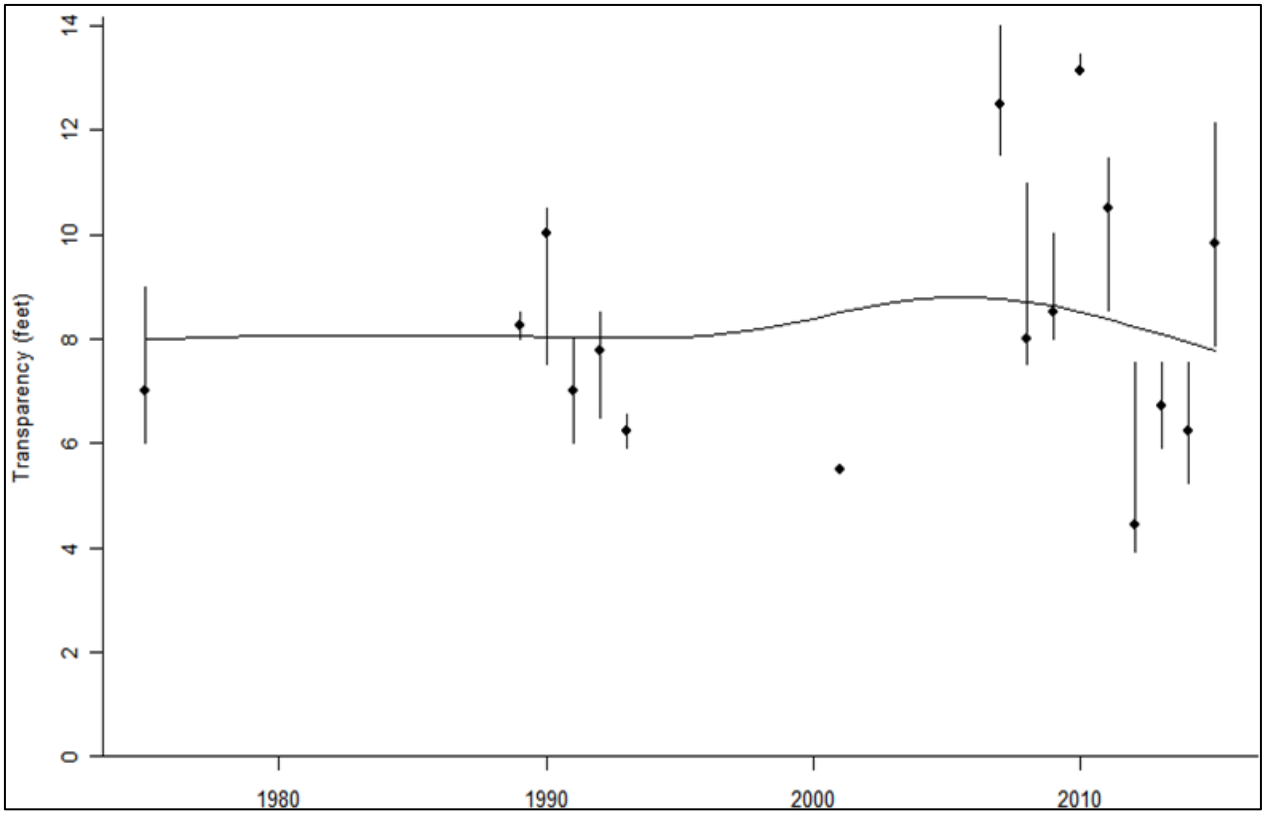


Figure 7. Secchi transparency trend analysis Aerie Lake (69-0701), St. Louis County, indicating no detectable trend.

To view trends determined with CLMP data, visit our website at: http://cf.pca.state.mn.us/water/cmp/index.cfm.

Water quality assessments

Watersheds serve as the basis for how the MPCA monitors and assesses lakes and streams in the state. In a watershed, all water drains to the same place, be it a river, stream, or lake. Watersheds exist on major and minor scales and the MPCA organizes its monitoring efforts based on the 80 major watersheds. The MPCA and partners monitor select lakes and streams within each major watershed for a 2-year period every 10 years. Following the 2-year monitoring period the MPCA formally evaluates water quality conditions and establishes priorities and goals for restoration and protection activities. Data collected by CLMP volunteers are used extensively during the water quality evaluation process. They are combined with data collected by the MPCA and local partners to determine water quality conditions during the two-year monitoring window. They also can provide insights into historical conditions and potential trends, provided enough data exists. CLMP volunteers also collect valuable transparency data in the years when intensive MPCA monitoring is not occurring in the watershed.

Beyond the CLMP

Water quality data can be a valuable tool on many scales – from large state government agencies down to the smallest township – and some volunteers find that once they start gathering data through the CLMP they want to be more involved in protecting their favorite lakes. Here are just a few things you can do to protect your lake outside of the CLMP.

Start a lake association or join an existing association

Residents living on or near a lake have a vested interest in protecting and maintaining the ecological integrity of the lake and its surrounding landscape. This, in addition to tackling growing issues such as aquatic invasive species, is the purview of lake associations across Minnesota. Lake associations are organized groups of lakeshore or near lakeshore residents concerned about lake management and committed to initiating lake protection activities.

Many well-populated lakes have lake associations and are always looking for new members and board appointees. The nonprofit, Minnesota Waters, lists many active lake associations on their website and also provides a helpful search tool: http://minnesotawaters.org/. Many small lakes across the state, however, are in need of a lake association. If you are interested in starting a lake association, *The Minnesota Shoreland Management Guide* is an excellent resource: http://www.shorelandmanagement.org.

Connect with your local watershed organization

Local units of government exist across the state to facilitate regional natural resource management. They support other government entities as well as private citizens and land owners in implementing restoration, protection and management activities across their districts.

- All 87 counties in the state have a local **Soil and Water Conservation District (SWCD)** office. SWCDs provide technical assistance, funding, and leadership on local projects and regularly seek support from volunteers in implementing or commenting on projects.
- **Watershed Districts** focus specifically on solving and preventing water-related problems. The boundaries of each district follow those of a natural watershed. Forty six of them exist across the state and are formed through a local petition process. Watershed districts are governed by a board appointed by the county boards of commissioners with land in the watershed district.
- **Watershed Management Organizations (WMO)** are found only in the seven-county Metro Area and are the result of the Metropolitan Area Surface Water Management Act of 1982. WMOs are similar to watershed districts, but they only focus on surface water, do not have taxing authority and are governed by a board appointed by member municipalities and townships.

Get involved in shoreland management

Proper management of both public and privately held shoreland is critical to the long-term health of any lake. Native vegetation and buffers prevent nutrients and sediment from reaching lake waters in addition to providing quality habitat for wildlife. Several resources exist to help landowners maintain their own personal shoreland habitat and educate their fellow residents:

- MDNR shoreland management programs http://www.dnr.state.mn.us/shorelandmgmt/index.html
- Minnesota Sea Grant's Minnesota's Shoreland Management Resource Guide http://www.shorelandmanagement.org

Join other water-focused citizen science programs

Several volunteer-based citizen science programs exist in Minnesota for collecting data related to water quality and abundance:

- MPCA's Advanced Citizen Lake Monitoring Program (CLMP+)
  https://www.pca.state.mn.us/water/advanced-citizen-lake-monitoring-program-clmp
- MPCA's Lake Ice Reporter Program
  https://www.pca.state.mn.us/water/lake-ice-reporting-program
- MPCA's Citizen Stream Monitoring Program
  https://www.pca.state.mn.us/water/citizen-stream-monitoring-program
- MDNR's Lake Level Monitoring Program
  http://www.dnr.state.mn.us/climate/waterlevels/lakes/volunteering.html
- Community Collaborative Rain, Hail & Snow Network (CoCoRaHS)
  http://www.cocorahs.org/state.aspx?state=mn

Citizen Lake Monitoring Program staff

For information or assistance with CLMP please call 651-296-6300 (Twin Cities) or 1-800-657-3864 (Greater Minnesota) and ask to speak with the Citizen Lake Monitoring Program coordinator or email clmp.pca@state.mn.us.

Glossary of lake-related terms

Acid rain: Rain with a higher than normal acid range (low pH), caused when polluted air mixes with cloud moisture; can damage fish populations.

Algal bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Bioaccumulation: Build-up of toxic substances in fish flesh. Toxic effects may be passed on to humans eating the fish.

Biomanipulation: Adjusting the fish species composition in a lake as a restoration technique.

Dimictic: Lakes which thermally stratify and mix (turnover) once in spring and fall.

Ecoregion: Areas of relative homogeneity. EPA ecoregions have been defined for Minnesota based on land use, soils, landform, and potential natural vegetation.

Ecosystem: A community of interaction among animals, plants, and microorganisms, and the physical and chemical environment in which they live.

Epilimnion: Most lakes form three distinct layers of water during summertime weather. The epilimnion is the upper layer and is characterized by warmer and lighter water.

Eutrophication: The aging process by which lakes are fertilized with nutrients. *Natural eutrophication* will very gradually change the character of a lake over time. *Cultural eutrophication* is the accelerated aging of a lake as a result of human activities.

Eutrophic lake: A nutrient-rich lake – usually shallow, "green" and with limited oxygen in the bottom layer of water.

Fall turnover: Cooling surface waters, activated by wind action, sink to mix with lower levels of water. As in spring turnover, all water is now at the same temperature.

Hypolimnion: The bottom layer of lake water during the summer months. The water in the hypolimnion is denser and much colder than the water in the upper two layers.

Lake management: A process that involves study, assessment of problems, and decisions on how to maintain a lake as a thriving ecosystem.

Lake restoration: Actions directed toward improving the quality of a lake.

Lake stewardship: An attitude that recognizes the vulnerability of lakes and the need for citizens, both individually and collectively, to assume responsibility for their care.

Limnetic community: The area of open water in a lake providing the habitat for phytoplankton, zooplankton and fish.

Littoral community: The shallow areas around a lake's shoreline, dominated by aquatic plants. The plants produce oxygen and provide food and shelter for animal life.

Mesotrophic lake: Midway in nutrient levels between the eutrophic and oligotrophic lakes.

Nonpoint source pollution: Polluted runoff – nutrients and pollution sources not discharged from a single point: e.g. runoff from agricultural fields or feedlots.

Oligotrophic lake: A relatively nutrient- poor lake, it is clear and deep with bottom waters high in dissolved oxygen.

pH scale: A measure of acidity.

Photosynthesis: The process by which green plants produce oxygen from sunlight, water and carbon dioxide.

Phytoplankton: Algae – the base of the lake's food chain, it also produces oxygen.

Point source pollution: Specific sources of nutrient or polluted discharge to a lake: e.g. stormwater outlets.

Polymictic: A lake which does not thermally stratify in the summer. Tends to mix periodically throughout summer via wind and wave action.

Profundal community: The area below the limnetic zone where light does not penetrate. This area roughly corresponds to the hypolimnion layer of water and is home to organisms that break down or consume organic matter.

Respiration: Oxygen consumption.

Secchi disk: A device measuring the depth of light penetration in water.

Sedimentation: The addition of soils to lakes, a part of the natural aging process, makes lakes shallower. The process can be greatly accelerated by human activities.

Spring turnover: After ice melts in spring, warming surface water sinks to mix with deeper water. At this time of year, all water is the same temperature.

Thermocline: During summertime, the middle layer of lake water. Lying below the epilimnion, this water rapidly loses warmth.

Trophic status: The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration.

Turbidity: Particles in solution (e.g. soil or algae) which scatter light and reduce transparency.

Water density: Water is most dense at 39 degrees F (4 degrees C) and expands (becomes less dense) at both higher and lower temperatures.

Watershed: The surrounding land area that drains into a lake, river or river system.

Zooplankton: Microscopic animals suspended or drifting in the water column.

References

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Carlson, R.E. and Simpson, J. 1996. *A Coordinators Guide to Volunteer Lake Monitoring Methods.* North American Lake Management Society, Madison, Wisconsin.

Heiskary, S.A. and Lindbloom, J.L. 1993. Lake Water Quality Trends in Minnesota. MPCA. St. Paul, Minnesota.

Related websites

www.pca.state.mn.us/	MPCA website
www.pca.state.mn.us/wfhyac7	CLMP website
www.pca.state.mn.us/veizac4	Advanced CLMP website
www.pca.state.mn.us/cmp	Citizen Monitoring Program website
www.dnr.state.mn.us	Minnesota Department of Natural Resources website
www.minnesotawaters.org	Minnesota Waters website

Related publications

You can find additional information on lakes from these publications. They cover information for both the beginner and advanced lake enthusiast from identifying lake and watershed characteristics to advanced monitoring practices.

1. *Guide to Lake Protection and Management*. This publication is available for download from the MPCA at website at http://www.pca.state.mn.us/hqzq141b.
2. *Volunteer Surface Water Monitoring Guide*. This publication is available from the MPCA. For a copy, call 651-296-6300 (Twin Cities) or 1-800-657-3864 (Greater Minnesota) or download a copy from https://www.pca.state.mn.us/water/volunteer-surface-water-monitoring-guide.