Lake Water Quality Monitoring Report

BECKER COUNTY COLA

Coalition of Lake Associations

Purpose: An organization to facilitate cooperation among member lake associations and assist in fostering wise and legal use of the area lakes.

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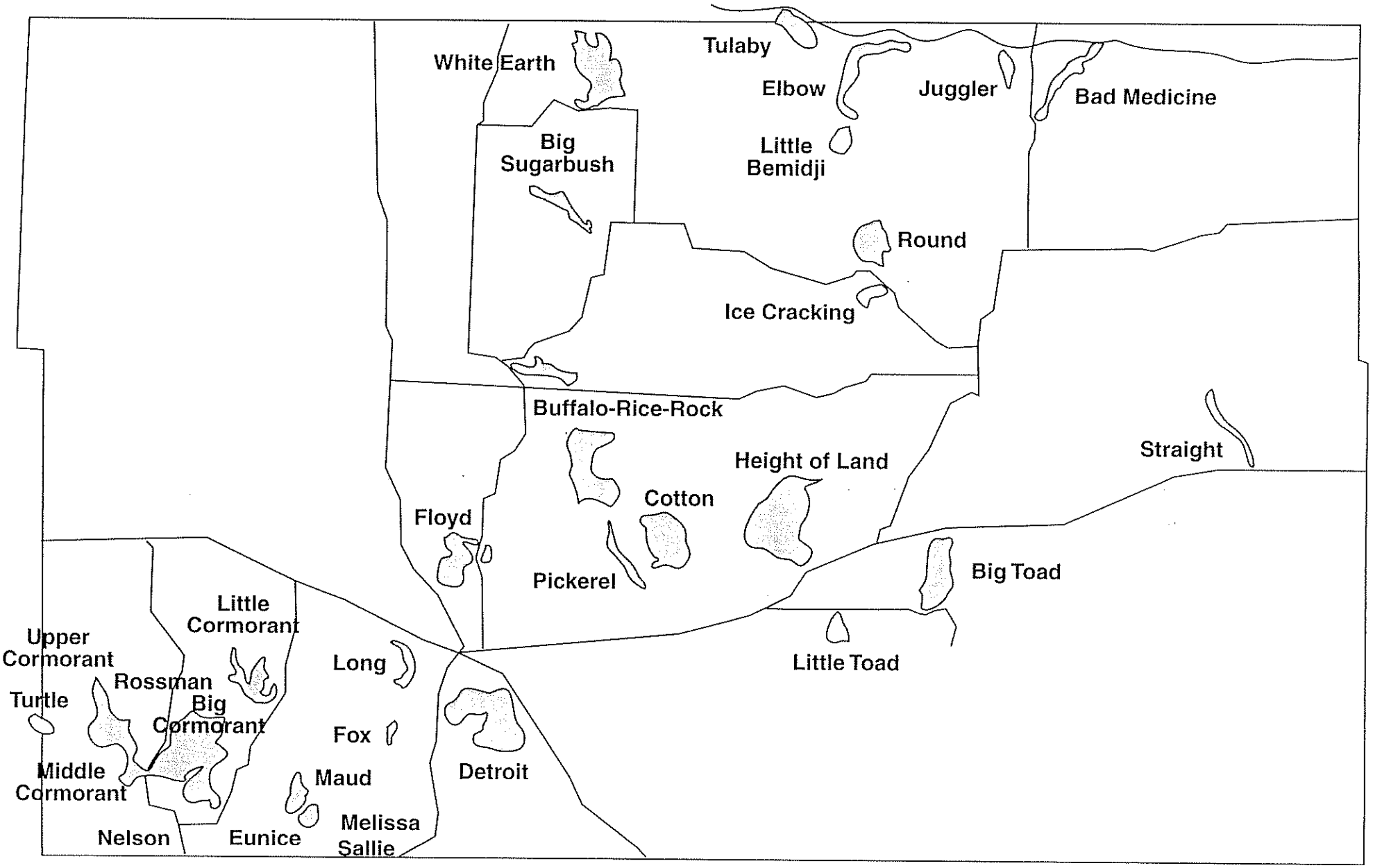


BECKER COUNTY COLA
MEMBER ASSOCIATIONS

BECKER COUNTY COLA
COALITION OF LAKE ASSOCIATIONS

VOLUME 1, ISSUE 2

May 2002

Monitoring Program Changes Adopted by Becker County COLA

Lake monitoring has been a major emphasis throughout the history of the Becker County COLA; for much of that time COLA has received some financial support form the Becker County Water Plan Grant. In 2000, the COLA Monitoring committee concluded that it was important for lake monitoring to continue, and that involvement in the transparency monitoring program should be a central feature of that program. Last year, the **Long Range Planning Committee** also recommended that data collection should continue to receive a major emphasis by COLA, and that all member lakes be encouraged to fully participate in the program. In addition, it was urged that all lakes should participate fully in the Citizen Lake Monitoring Program (CLMP) which involves weekly Secchi readings throughout each summer. The committee also proposed that COLA should encourage lake-specific monitoring programs with costs to be paid by the individual lake associations.

Given those recommendations, for several months the COLA Monitoring Committee has been studying the COLA sampling program. Acknowledging that the sampling program has been successful in the past, the committee believes that the program can be improved. The following are objectives and recommendations adopted by the Board of Directors at the April 11th COLA Meeting:

1. All COLA lakes should be able to estimate their current trophic status and be able to identify trends in trophic status.
2. All COLA lakes should obtain sufficient water samples to comply with the PCA standard (12 Chl-a and TP samples per 10 year period, preferably 12 separate observations over 2 summers).
3. All COLA lakes should be encouraged to develop a lake-specific diagnostic program to determine the source of water quality problems.

Transparency Measurements:

1. All COLA lakes should participate fully in the Citizens Lake Monitoring Program by obtaining and reporting weekly Secchi observations from June through September.

Water Chemistry:

1. All COLA lakes will collect eight TP and Chl-a samples (two samples per month from June to September) for one summer every five years.
2. New COLA lakes will be encouraged to participate in this program as soon as they join.

Monitoring Costs:

1. COLA will pay for basic water chemistry sampling costs for one site per lake association.
2. Costs of testing samples for additional sites, or other lake-specific sampling will be billed to the lake association.

CONCLUSIONS

COLA has done an outstanding job in promoting lake monitoring among its members; it is a leader in the state and continues to serve as a model for other lake associations. The program has a high level of active participants.

A number of lakes that have participated in the COLA water testing program do not participate in CLMP.

Several COLA lakes have not taken advantage of the COLA water testing program; others are not full participants.

MONITORING STATUS OF COLA LAKES

- As many as 21 lakes are not fully participating in CLMP monitoring program; many of these do participate in the COLA water testing program
- As many as 19 lakes do not meet PCA standards for PCA lake impairment determinations—(12 or more TP and Chl-a measurements collected June through September over the course of 2 summers)

RESULTS OF 2003 BECKER COLA WATER QUALITY MONITORING

John Peterka (jpeterka@lakesnet.net)

Introduction

This is the second annual report that provides a summary of lake data collected by eight lake associations under sampling protocols adopted by the Becker County COLA in 2002. The first report provided background information that may be useful in interpreting results of the water quality-monitoring program. Sampling protocols are based on programs sponsored by the Minnesota Pollution Control Agency (MPCA). The intent of this annual summary is to provide guidelines for those who wish to undertake some effort on their own to understand lake data. I've provided a few examples from data collected in 2003.

Results

Annual mean TP and CHL concentrations and SD measurements for each of the eight lakes sampled in 2003 are presented in Table 1.

Table 1. Water quality data for Becker County COLA lakes, 2003. Numbers in parentheses are values predicted from Carlson's TSI equations for a given TP concentration. Little Cormorant Lake data for 2002 is also included.

N=number of observations. Mean=arithmetic mean from June through September.								
	Total Phosphorus (µg/l)		Chlorophyll-a (µg/l)			Secchi disk (ft)		
Lake	N	**Mean**	N	**Mean**	**Predicted**	N	**Mean**	**Predicted**
Bad Medicine	8	**10**	8	**2**	(2)	8	**21**	(16)
Strawberry [a]	5	**12**	5	**1**		4	**23**	
Big Sugar Bush	7	**15**	7	**3**	(3)	7	**19**	(10)
Fox	8	**15**	8	**6**	(3)	8	**8**	(10)
Long [a]	4	**16**	4	**4**			**11** [b]	
Little Detroit	8	**21**	8	**3**	(6)	8	**11**	(8)
Big Detroit	8	**24**	8	**9**	(7)	8	**10**	(7)
L. Cormorant (2002)	8	**35**	8	**9**	(12)	8	**6**	(5)
L. Cormorant (2003)	8	**29**	8	**9**	(9)	8	**7**	(5)

[a] Incomplete sampling (should have eight samples)

[b] from CLMP data (weekly Secchi disk readings were not available for the other lakes when this report was prepared)

Interpretation of Results

What are some of the ways of using the data in Table 1?

1. The most obvious and useful data for detecting trends in algal growth are Secchi disk measurements recorded over a period of years. Secchi disk information is best obtained from the CLMP program (weekly Secchi disk readings) sponsored by the MPCA, and is not part of this report. The annual summaries are usually completed by the MPCA in April-May. The MPCA web site for obtaining lake data is http://www.pca.state.mn.us.

2. TP concentrations can be used to approximate suitability for swimming (see Table 2). Bad Medicine is located in the Northern Lakes and Forests (NLF) ecoregion; the other lakes are in the North Central Hardwood Forests (NCHF) ecoregion. Except for Little Cormorant Lake, all lakes sampled in 2003 are in the "full support" range for swimming. Little Cormorant is on the borderline for "impaired" swimming, as annual TP concentrations were about 35 µg/l in 2002. The MPCA is charged with responsibility for final assignment of swimming status. That assignment is not totally dependent on TP concentrations, but also relies on CHL and SD information as well as the MPCA's professional judgment.

Table 2. Relationships of Carlson's Trophic State Index (TSI) with Secchi disk (SD) measurements in feet, and concentrations of chlorophyll-a (CHL) and total phosphorus (TP) in µg/l; and the relationships of TP concentrations and swimmable-use categories of the Minnesota Pollution Control Agency (MPCA) for the Northern Lakes and Forests (NLF) and the North Central Hardwood Forests (NCHF) ecoregions.

Ecoregion	Swimmable-Use Categories															
NLF	Full Support						Impaired	Non-Support								
NCHF	Full Support							Impaired	Non-Support							
TSI	27	37	43	47	51	53	55	57	59	61	62	63	64	65	66	67
SD	31	16	10	8	6	5	4.5	4	3.5	3.1	2.9	2.6	2.4	2.2	2.1	2.0
CHL	1	2	3	5	7	10	12	15	17	20	23	26	30	33	36	40
TP	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

3. By plotting CHL data for the summer values (not done here), one can determine the percent of the summer with mild blooms of >10µg/l CHL and nuisance blooms of >20µg/l CHL. The MPCA "Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment" (MPCA, 2002) provides useful information on seasonal extent of algae blooms and TP concentrations. This document is available on the MPCA website.

4. Determining if the data fit predicted relationships of TP, CHL and SD as developed by Carlson may be a more difficult task, and it requires review of past data, but it will pay off in a better understanding of how lakes work. The MPCA web site was recently updated so data collected in past years for each lake can be retrieved for analysis.

Carlson developed equations (Carlson's TSIs or trophic state indexes) that relate TP, CHL and SD measurements, and the expected relationships are given in the last four lines in Table 2. For example, in Table 2, a mean annual TP concentration of 10 µg/l (or ppb) would be associated with a mean annual CHL concentration of 2 µg/l, a mean SD of 16 feet and a TSI of 37. Carlson developed these relationships for "typical" lakes: clear-water lakes that are large and deep enough to thermally stratify during open water periods. Lakes that are shallow, or have stained waters, have excessive rooted aquatic vegetation, or are unique in other ways from the lake types used by Carlson would not be expected to follow these relationships. *It should also be realized that these relationships are not as precise as listed by Carlson and are averages of data that are highly variable.*

Based on Carlson's TP, CHL. SD relationships, I used the observed mean TP concentrations measured in 2003 to predict the expected mean CHL concentration and SD measurements (see Table 1). For example, in 2003, Bad Medicine had a mean TP concentration of 10 µg/l and a predicted and observed CHL concentration of 2 µg/l CHL. However the predicted SD of 16 ft was less than the observed SD of 21 ft. While the CHL data indicate Bad Medicine falls within the lake types used by Carlson, the SD data indicate some deviation. Without more information (I did not look at all data from past years) is there a reason for the differences in the observed and predicted SD values, or is this simply an indication of how Bad Medicine deviates from the Carlson typical lake-type? More information is needed that may be available by analyzing past data to determine if the higher-than-expected SD readings in Bad Medicine are the norm.

Fox Lake results appear to deviate markedly from the Carlson TP, CHL, SD relationships. The mean TP concentration in 2003 was 12 µg/l. According to Carlson's relationships the expected CHL concentration for a value of 12 µg/l TP should have been only 3 µg/l instead of the 6 µg/l that was measured, and the expected SD should have been 11ft instead of the 8 ft that was measured. It would appear that the TP concentration should have been higher to agree better with the Carlson relationships. I did check the MPCA database and the mean TP concentration for Fox Lake was reported as 22 µg/l, considerably higher than the 12 µg/l measured in 2003. Fox Lake is small and shallow, and this would also suggest reason for deviation from the Carlson relationships. The person who sampled the lake last year needs to

be aware of possible problems with sampling or of any unusual circumstances that may help account for this departure from expected results.

Another application of Carlson's TP, CHL, SD relationships is as follows: At the time water samples are taken to be submitted to a laboratory for determination of TP and CHL concentrations, use the Secchi disk reading to predict what the TP and CHL values will likely be. For example, if the Secchi disk is 6 ft when the water samples are taken, Table 2 indicates the TP and CHL concentrations should be 25 and 7 µg/l. This is a quick way of identifying a problem when sampling is occurring instead of waiting until the year-end results.

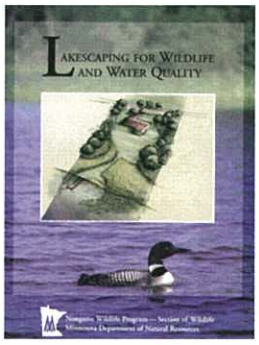
It is likely that many lakes in Becker County do not fit the "typical" lakes used by Carlson to predict relationships of TP, CHL and SD. These lakes 1) may have stained or "sediment" colored waters, or 2) are shallow and do not thermally stratify (lakes with maximum depths of 30 ft probably fall into this category), or in which thermal stratification may be easily upset during open water periods, permitting circulation of lake waters to bottom sediments, or 3) are occupied by much rooted aquatic vegetation that affects development of open-water algae (phytoplankton). Winterkill lakes are another problem-lake category that would not fit Carlson relationships.

Volunteers conducting sampling will gain better appreciation and understanding of their lakes if they prepare written summaries of the year's results and of their observations. An important part of this task would incorporate data from past years. The MPCA provides a site that archives lake data. The "Volunteer Surface Monitoring Guide" provides useful tips and is available from the MPCA: Jennifer.Klang@pca.state.mn.us.

Shoreline Alterations: Natural Buffers and Lakescaping

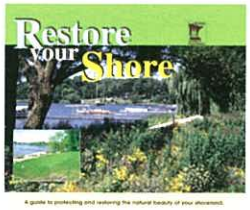
Where can I find additional information?

Book



Lakescaping for Wildlife and Water Quality (C.L. Henderson, C.J. Dindorf, F.J. Rozumalski, 1999, Department of Natural Resources*) is a book showing techniques to prevent shoreline erosion and restore wildlife habitat, wildflowers, and clean water.

CD-ROM



Restore Your Shore (2002, Department of Natural Resources*) is a sequel to the lakescaping book. This instructional CD-ROM presents ideas to use in protecting and restoring natural shorelands. Visit the *Restore Your Shore* website at http://www.dnr.state.mn.us/restoreyourshore/index.html

Web Links

Information about native plants and suppliers is available through the DNR, University of Minnesota Extension Service, and Wild Ones:

- http://www.dnr.state.mn.us/gardens/nativeplants/suppliers.html
- http://www.extension.umn.edu/distribution/naturalresources/DD7357.html
- http://www.for-wild.org/landscap.htm

Technical assistance is available from local watershed districts and soil and water conservation districts:

- http://www.mnwatershed.org/alpha.htm
- http://www.bwsr.state.mn.us/directories/SWCDs.pdf

*Available through Minnesota's Bookstore: http://www.minnesotasbookstore.com

What can I do to create a more natural shoreline?

A natural shoreline is a complex ecosystem that sustains fish and wildlife and protects the entire lake. Native vegetation along the shore acts as a buffer zone, intercepting nutrients and reducing runoff, erosion, and sedimentation. Aquatic plants provide food and shelter for ducks, songbirds, and other animals while reducing problems caused by Canada geese and burrowing muskrats. Plants growing in and near the water are critical for wildlife and fish habitat and a healthy lakeshore. Tall plants like bulrush, lake sedge, and cattail can reduce the energy of wave action to minimize erosion and help maintain water quality.

Creation of a buffer zone is the essence of the lakescaping concept. A buffer zone is an unmowed strip of native vegetation that extends both lakeward and landward from the water's edge. A buffer zone that extends 25-50 feet from shore is preferable, but even 10-15 feet provides benefits. Installing a buffer zone can restore many functions critical to the health of the lake that may have been eliminated previously by sod, hard structures, or mowing. Planting native grasses and species of flowering plants will diversify and enhance your shoreline and provide a seasonal show of color.

A buffer zone of vegetation provides a natural appearance to your shoreline and protects wildlife habitat, water quality, and fish.

Creating and maintaining natural buffer zones along the shore does not mean your property has to look unkempt. Buffers and upland islands of trees, shrubs, and flowers can bring natural beauty to your yard. Additionally, tall native plants typically have deep root systems. They will slow erosion, decrease ice damage, increase rain infiltration, and act as a barrier to discourage geese from walking on your shoreline property.

Your shoreline is part of a larger community and ecosystem. Individual choices by many have cumulative impacts on a lake and its ecosystem. Your actions can restore or degrade the quality of the ecosystem. Restoring your lakeshore to a more natural condition is important, even if your neighbors are not restoring theirs, because it can help wildlife habitat, water quality, and fish.

Shoreline Alterations: Natural Buffers and Lakescaping

Lakescaping and Erosion Control

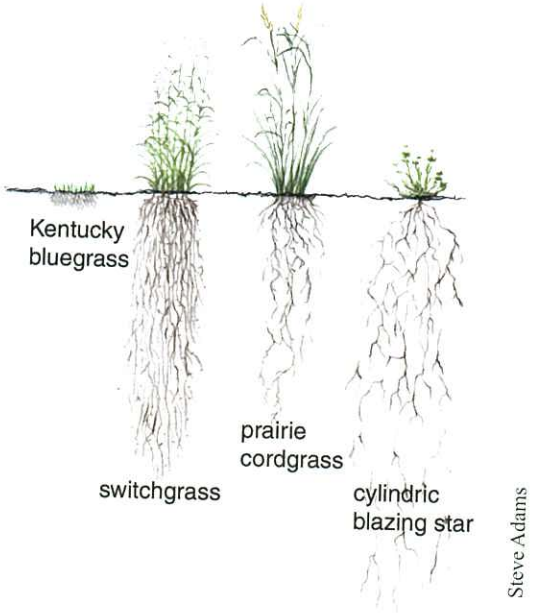
Vegetation is extremely important for controlling erosion. Native trees, shrubs, and grasses dissipate the energy of raindrops, slow the water, and allow it to infiltrate the soil. The DNR and your county soil and water conservation district can help you select the right plants for your project. Listed below are some other erosion-control recommendations.

- Prevent erosion. Preventing erosion by maintaining native vegetation is less costly than fixing an eroded area. Think "root systems." Native plants typically have greater rooting depth and root density. For example, the roots of the little bluestem (*Schyzachyrium scoparium*) are about 2-3 feet long and have a great capacity to hold soil. In contrast, the roots of lawn grass are only 2-3 inches long.

- Identify and address the cause of erosion. Causes may include excessive foot traffic on fragile soils, vegetation clearing (both upland and in the lake), yard waste on the bank that kills vegetation, wave action from boat traffic and prevailing winds (especially when water is high), ice heaves, stairways that channel water, and runoff from hard surfaces.

- Choose erosion-control methods that are "light" on the landscape. If wave action is eroding the bottom (toe) of the bank, consider reinforcing only the toe of the bank and planting native vegetation on the remainder.

- Plant aquatic vegetation. In-lake vegetation can help prevent erosion. Native aquatic vegetation disperses wave energy, anchors soil, limits ice heaves, and provides excellent fish and wildlife habitat.



The picture contrasts the shallow (2-3 inches) roots of Kentucky bluegrass to the deep (3-5 feet) and dense roots of native grasses. The root systems of native grasses may be effective for preventing erosion.

Contrast the eroded shoreline lacking vegetation (foreground) with the well-vegetated, uneroded shoreline in the distance.

Lakescaping Design Factors to Consider

Look around your lake and note how nature works to minimize erosion on healthy, more natural shorelines. What types of wildflowers, grasses, trees, and shrubs do you see i your area? Then determine how much of your lakeshore to naturalize, keeping in mind how much you need for lake access, swimming areas, docks, and dock storage areas. Tall to your neighbors, share ideas, and coordinate efforts to increase habitat and natural shorelines. Natural shorelines are gaining acceptance as people understand the important role shorelines play in protecting their lake and a diverse ecosystem. Many lake associations are developing demonstration projects on area lakes.

Steps for Creating a Buffer Zone

Describe your shoreline area, including the following elements:

- natural features, including existing vegetation and woody debris, fish and wildlife use, and opportunities for links to neighboring habitat;
- removal of structures or construction debris, such as retaining walls or concrete, respectively;
- location of the house, views, trees, pathways or stairways, docks, and swimming areas;
- sun, including amount and number of hours of direct sunlight;
- topography, including ice ridges and slopes (facing directions and steepness);
- soil characteristics, including type, drainage, texture, and fertility; and
- water, such as natural seeps, wet areas during high water, drainage, wave action, and runoff.

Shoreline Alterations: Natural Buffers and Lakescaping

Think about your preferences. How will the site be used (viewing, swimming, boating, fishing)? What kinds of native trees, shrubs, flowers, and grasses do you like? Consider their color, height, and appearances at different times of the year. The type of vegetation you select may affect the shoreline's ability to withstand erosion.

Develop a design and management plan based on your lakeshore and preferences. Consult references and DNR Fisheries lake surveys for information, and visit nearby natural areas or other shorelines to get ideas. Obtain any necessary permits from your local unit of government or the DNR. Be realistic about the size of your shoreline project. Start small, if necessary, and add to it in phases.

Planting

It may be necessary to eradicate non-native, invasive species and turf grass first. *Remember that collecting, transplanting, or removing aquatic vegetation requires a permit from the DNR Fisheries Aquatic Plant Management Program.*

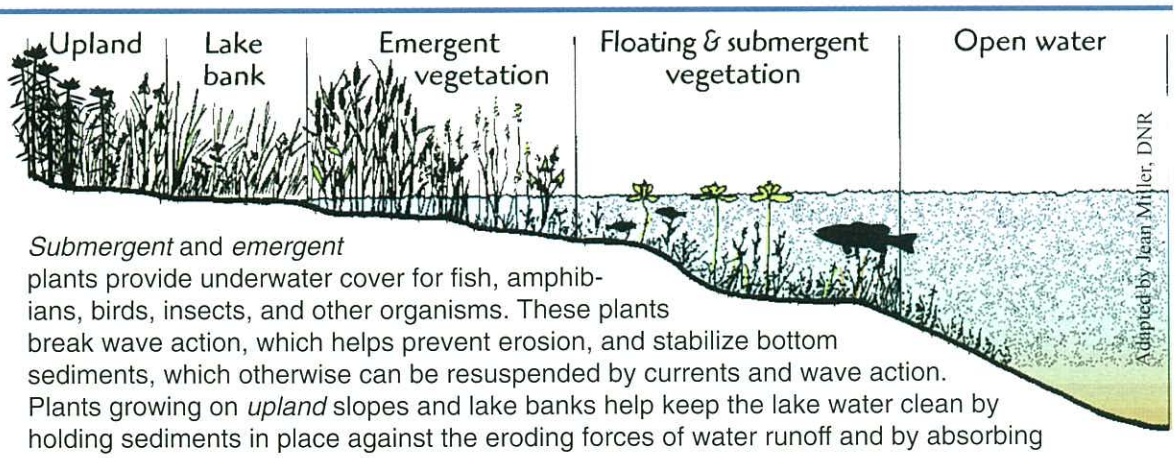
Identify the areas for planting native vegetation and prepare the site for planting. Upland plants should be spaced from 1 foot to 3 feet apart; trees and shrubs should be 6 feet to 14 feet apart. If you decide to use an erosion-control blanket, the supplier can help you determine which type to use. After installing the blanket, simply cut a hole in it for each plant. As an alternative to the blanket, mulch could be used to control erosion, retain moisture, and suppress weeds.

(TOP) Lakefront of home on Lake Marion, Dakota County. (BOTTOM) Closer view of the same lakefront after revegetation.

If you add aquatic plants, a temporary barrier in the water may be needed to protect new plants until they are established. For guidance on aquatic plantings and permit requirements, contact the DNR Shoreland Habitat Coordinator (651-296-2548) or local soil and water conservation district.

Maintenance

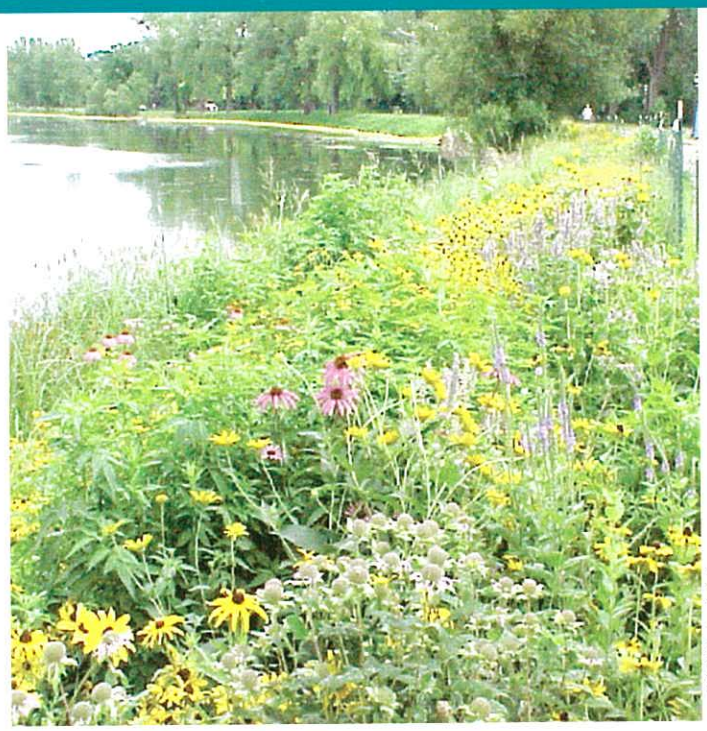
Your new plantings require some maintenance in the first few years as they become established. Provide from 1 inch to 2 inches of water per week the first season and during dry periods in the second season. Weeding during the first few years helps the plants become established and gives them a competitive edge. Replace vegetation that did not survive by replanting species that were most successful at your site. By the third year, watering is no longer necessary, but you should continue to remove weeds.



Submergent and *emergent* plants provide underwater cover for fish, amphibians, birds, insects, and other organisms. These plants break wave action, which helps prevent erosion, and stabilize bottom sediments, which otherwise can be resuspended by currents and wave action. Plants growing on *upland* slopes and lake banks help keep the lake water clean by holding sediments in place against the eroding forces of water runoff and by absorbing excess nutrients like phosphorous and nitrogen.

Shoreline Alterations: Natural Buffers and Lakescaping

Bill Bartodziej



Bill Bartodziej

(ABOVE) In 2000, start of restoration along Lake Phalen in St. Paul. (RIGHT) View of the same site in 2002.

Permit Requirements

For most projects constructed *below* the ordinary high-water level* (OHWL) of public waters as determined by the DNR, an individual Public Waters Work Permit is required, but an individual permit is not required for planting buffer zones. Collecting, transplanting, or removing aquatic vegetation, however, *does require* a permit from the DNR Fisheries Aquatic Plant Management Program.

If you have questions concerning the contents of this information sheet, contact your local DNR Area Hydrologist. Other governmental units (federal, state, city, county, township, and watershed authority) may require a permit for that portion of the project within their jurisdiction, which usually involves work above the OHWL. It is advisable to contact them.

Summary

Maintaining a healthy lake is far less costly than trying to fix a degraded one. If you are fortunate enough to have a natural shoreline, maintain or enhance it as a buffer zone and minimize erosion on the areas used for access or recreation. If your property lacks natural areas, plant native vegetation or let areas grow naturally. You will be surprised at the aesthetic appeal, as well as the energy and time you save, of helping your lake help itself.

Carrol Henderson

*For lakes and wetlands, the OHWL is the highest elevation that has been maintained as to leave evidence on the landscape. It is commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial. For watercourses, the OHWL is the top of the bank of the channel. For reservoirs and flowages, the OHWL is the operating elevation of the normal summer pool.

DNR Contact Information

DNR Waters website lists Area Hydrologists: www.dnr.state.mn.us/waters
DNR Waters in St. Paul: 500 Lafayette Road, St. Paul, MN 55155-4032, (651) 296-4800

DNR Ecological Services website provides information about aquatic plant management permits: www.dnr.state.mn.us/ecological_services
DNR Ecological Services in St. Paul: 500 Lafayette Road, Box 25, St. Paul, MN 55155, (651) 296-2835

DNR Shoreland Habitat Coordinator in St. Paul: 500 Lafayette Road, Box 12, St. Paul, MN 55155, (651) 296-2548

DNR Information Center

Twin Cities: (651) 296-6157
Minnesota toll free: 1-888-646-6367
Telecommunication device for the deaf (TDD): (651) 296-5484
TDD toll free: 1-800-657-3929

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YOUR LAWN AND THE ENVIRONMENT

New phosphorus lawn fertilizer law aims to protect Minnesota lakes and rivers

Minnesota has recently passed a law that restricts the use of lawn fertilizers containing phosphorus, the primary nutrient that turns lakes green with algae.

New Phosphorus Law

Starting January 1, 2004, **fertilizers containing phosphorus cannot be used on lawns in the Twin Cities metro area** (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties). Greater Minnesota is restricted to lawn fertilizers with 3 percent or less phosphate content (with fertilizer, phosphorus is measured as *phosphate*). Look for the middle number on a bag of fertilizer. For the metro area, it should be zero (0) and in Greater Minnesota it should be three (3).

Keep fertilizer off paved surfaces: It's illegal to spread any fertilizer on hard surfaces such as streets, sidewalks, and driveways. Rain can wash the fertilizer into nearby storm drains or road ditches, eventually getting into a lake or river near you. If you accidentally spill or spread fertilizer on a hard surface, clean it up immediately.

Exemptions

Fertilizers containing phosphorus may be used on lawns if a soil test indicates that it is needed or if you are establishing a new lawn.

These restrictions do not apply to fertilizers used for agricultural crops, flower and vegetable gardening, or on golf courses by trained staff.

DO THE GREEN THING: FERTILIZE RESPONSIBLY Many garden centers and hardware stores now carry phosphorus-free lawn fertilizers.

Will phosphorus-free fertilizer keep my lawn healthy?

While phosphorus is necessary to grow healthy lawns, soils in many parts of Minnesota already have an adequate amount. In these instances, adding more phosphorus in fertilizer is not needed and will not benefit your lawn. Healthy lawns can be maintained with phosphorus-free fertilizers.

THE PROBLEM: TOO GREEN

GREEN AND MUCKY Excess algae and weed growth is a major problem in many Minnesota lakes and waterways.

MORE PHOSPHORUS, LESS FISH Too much algae lowers oxygen levels and darkens the water. This can have a devastating effect on fish populations.

What to look for

On any bag or box of fertilizer, there is a string of three numbers. The middle number indicates phosphorus content and should read "0" in the Twin Cities seven-county metropolitan area, and "3" or less in Greater Minnesota.

What can you do to protect water quality?

Fertilizers, leaves, grass clippings, eroded soil, and animal waste are all sources of phosphorus. When they are swept or washed into the nearest street or storm drain, they end up in your local lake or river. You can do your part to protect water quality by doing the following:

- Follow Minnesota's new phosphorus lawn fertilizer law.
- Keep leaves and lawn clippings out of your gutters, streets, and ditches.
- Clean lawn and garden equipment on the grass, not on hard surfaces. Never wash or blow soil or grass clippings into the street.
- Pick up pet waste promptly. Pet waste can contain harmful bacteria as well as nutrients. Never drop pet waste in the street or ditches.

- Control soil erosion around your house. When left bare, soil is easily washed away with rain, carrying phosphorus with it. Soil erosion can be prevented by keeping soil covered with vegetation or mulch.

Sweep it up Grass clippings and leaves left on streets and sidewalks are a major source of phosphorus.

Find out what you need: Test your soil

A soil test is a good idea, especially if you are concerned that your lawn may need phosphorus.

Instructions on soil testing are available through the University of Minnesota Extension Service's INFO-U by calling 612-624-2200 (metro) or 1-800-525-8636 and requesting message 468.

Soil testing information can also be obtained through the Internet by visiting **www.extension.umn.edu** and searching for "Lawn Soil Testing."

A list of laboratories certified for soil testing by the Minnesota Department of Agriculture can be found at **www.mda.state.mn.us/appd/soilabs.htm**.

Visit **www.reduce.org** for lots of ideas about reducing waste and toxic chemicals in your day-to-day life.

reduce.org

For more information on lawn care

- The **Yard & Garden Line** is the University of Minnesota Extension Service's one-stop telephone link to information about plants and insects in the home landscape. Call 612-624-4771, or (toll free) 1-888-624-4771 in Greater Minnesota.
- University of Minnesota **Extension Service's web site**: www.extension.umn.edu. From the home page click on "Garden" then on "Lawns."
- University of Minnesota Extension Service - **Sustainable Urban Landscape Information Series** (SULIS): www.sustland.umn.edu. From the home page, click on "Maintenance" then on "Lawn care."
- **Minnesota Department of Agriculture**: www.mda.state.mn.us. From the home page, click on "Water & Land," then on "Lawn Care & Water Quality."

To obtain additional copies of this fact sheet

contact Office of Environmental Assistance's **Education Clearinghouse** at 1-800-877-6300, 651-215-0232 or e-mail: clearinghouse@moea.state.mn.us.

Minnesota Department of Agriculture — From the farm to your family

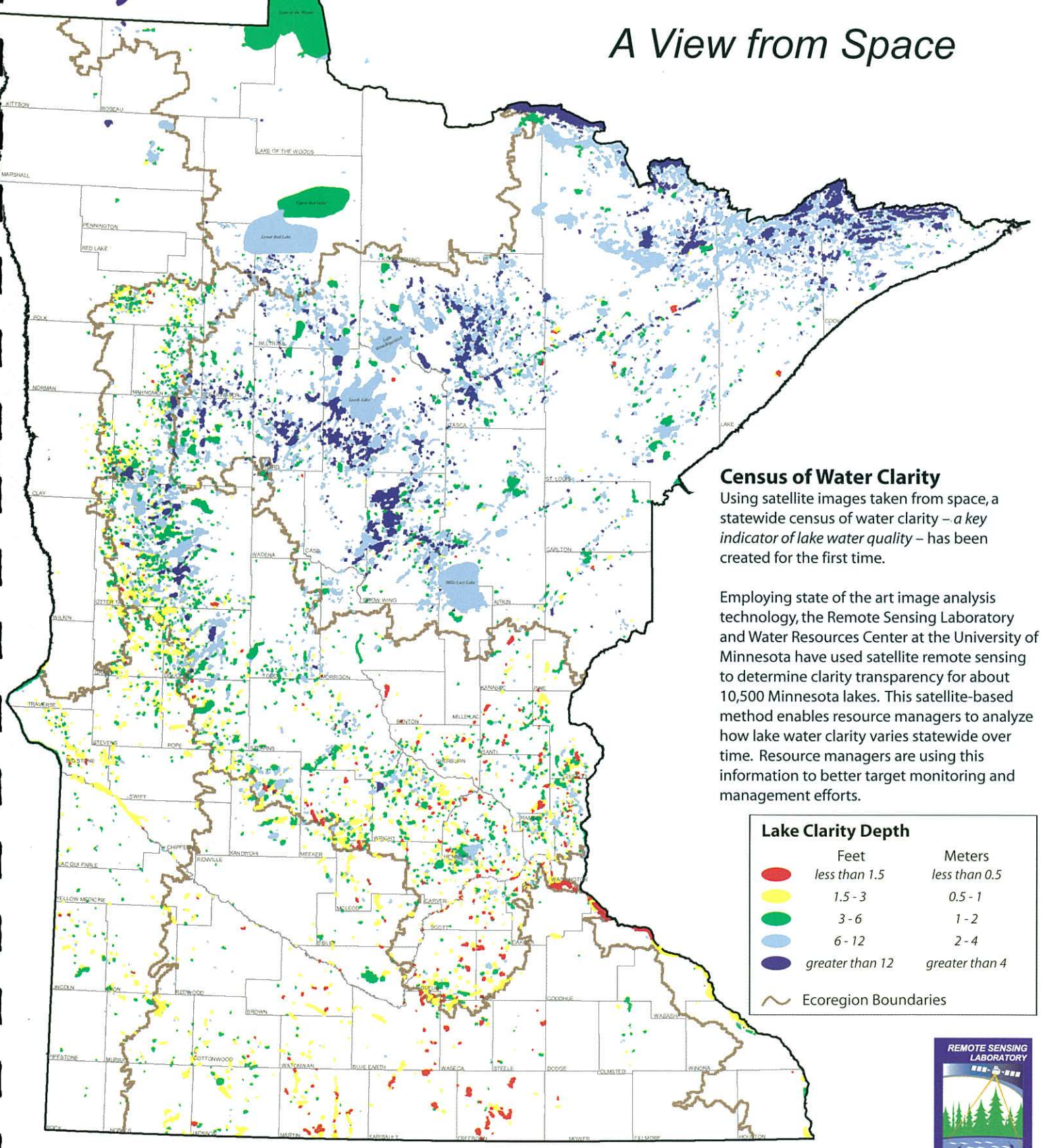
Metro WaterShed Partners

University of Minnesota Extension Service

Minnesota Office of Environmental Assistance

Minnesota Lakes

A View from Space



Census of Water Clarity

Using satellite images taken from space, a statewide census of water clarity – *a key indicator of lake water quality* – has been created for the first time.

Employing state of the art image analysis technology, the Remote Sensing Laboratory and Water Resources Center at the University of Minnesota have used satellite remote sensing to determine clarity transparency for about 10,500 Minnesota lakes. This satellite-based method enables resource managers to analyze how lake water clarity varies statewide over time. Resource managers are using this information to better target monitoring and management efforts.

Lake Clarity Depth

	Feet	Meters
	less than 1.5	*less than 0.5*
	1.5 - 3	*0.5 - 1*
	3 - 6	*1 - 2*
	6 - 12	*2 - 4*
	greater than 12	*greater than 4*

Ecoregion Boundaries

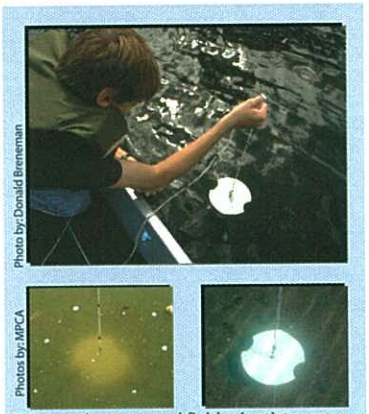
For more information visit:
water.umn.edu

REMOTE SENSING LABORATORY
WATER RESOURCES CENTER

Measuring Lake Clarity

The clarity of lakes usually is measured in terms of the depth to which one can see an object below the water surface. The standard device used to do this is a Secchi disk, a white disk, eight inches (20 centimeters) in diameter attached to a rope that is lowered through the water column until the disk disappears from sight. That depth is called the Secchi disk transparency. The clearer the lake is, the deeper the measurement.

The Minnesota Pollution Control Agency (MPCA) coordinates the collection of Secchi disk readings by staff and citizen volunteers on about 850 lakes annually. These measurements are essential to the satellite data analysis, but they include only a small percentage of the state's lakes. Satellite data enable monitoring of nearly all the 10,000+ lakes in the state.

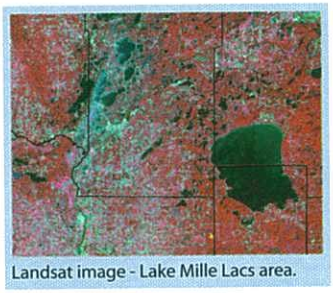


Citizen volunteers and field scientists use Secchi disks to determine lake water clarity.

Monitoring Lakes from Space

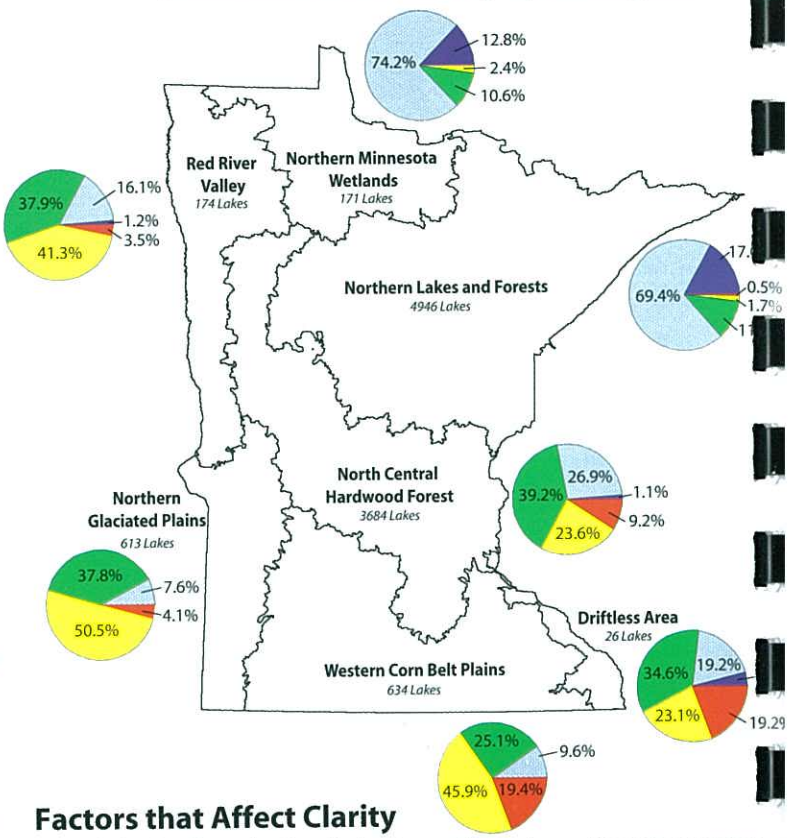
The Landsat satellite orbits 438 miles above the Earth's surface. Its sensor, called a multispectral scanner, records images of the same 115-mile wide path every 16 days. Nineteen images from five orbits are needed to cover Minnesota. The smallest area recorded is 30 x 30 meters (about 1/4 acre). The scanner records digital images of the surface reflectance in visible and infrared wavelengths of the electromagnetic spectrum. The infrared spectral bands are especially useful for mapping vegetation, and the visible blue and red bands are sensitive to physical properties of water, including clarity or transparency.

The first step in mapping lake clarity is to separate water from land features. Next, the analyst determines the relationship between the intensity of reflected blue and red wavelengths and the Secchi disk transparency for a set of 25-50 "calibration" lakes. The relationship then is applied to all the lakes in the image, providing a census of lake clarity.


Landsat image - Lake Mille Lacs area.

Satellite remote sensing provides a cost-effective way to gather the information for water quality assessments in lake-rich areas like Minnesota. This has been done statewide for ~1990 and ~2000 time periods and is available at our website; http://water.umn.edu. New dates, as well as earlier dates (~1975, ~1985 and ~1995), will be added as completed and will enable analysis of changes in lake clarity over time. This map was created using ~2000 satellite data and Secchi disk readings.

Minnesota Lake Clarity by Ecoregion



Factors that Affect Clarity

Lake clarity is affected primarily by three different constituents in water:

(1) Microscopic plants called algae suspended in the water
(2) Suspended sediment – clay and silt – primarily from soil erosion
(3) Dissolved natural organic matter, called humic material, that is derived from the partial decay of terrestrial plants

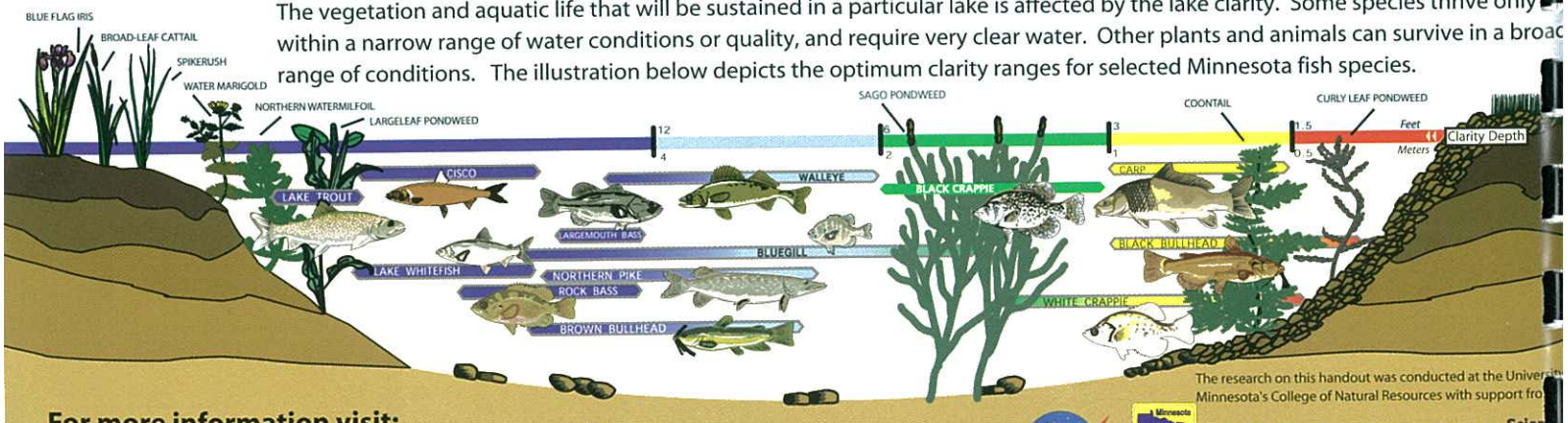
Algae and decomposition products of algae are the primary factors controlling light penetration in most Minnesota lakes. For such lakes, water clarity is closely related to nutrient status.

Lakes with high clarity have low levels of algae and nutrients. Most lakes with low water clarity have high concentrations of algae (measured in terms of chlorophyll) and high concentrations of the nutrients, phosphorus and nitrogen. Sediment tends to be important in some lakes of southern Minnesota where soil erosion is a problem. Humic color affects some lakes in northern Minnesota, especially in forested watersheds with wetlands.

Satellite imagery provides an accurate measure of water clarity across a spectrum of lakes, but additional monitoring may be required to interp which factor (algae, sediment, or humic matter) is limiting water clarity.

Water Clarity Affects Plants and Animals

The vegetation and aquatic life that will be sustained in a particular lake is affected by the lake clarity. Some species thrive only within a narrow range of water conditions or quality, and require very clear water. Other plants and animals can survive in a broad range of conditions. The illustration below depicts the optimum clarity ranges for selected Minnesota fish species.



For more information visit:
water.umn.edu

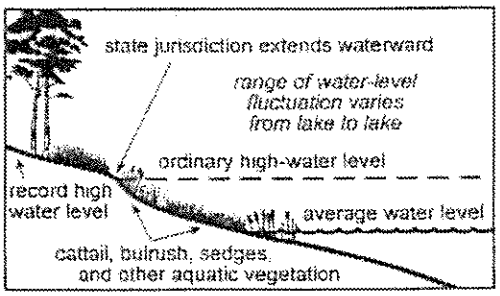
The research on this handout was conducted at the Univer Minnesota's College of Natural Resources with support fro

Minnesota Pollution Control Agency

Is an Individual Permit Required?

For most projects constructed *below* the ordinary high-water level* (OHWL) of public waters, an individual Public Waters Work Permit is required from the Minnesota Department of Natural Resources (DNR).

Ice ridges exception: An individual permit from the DNR is not required for the grading or removal of an ice ridge if the conditions outlined on this information sheet are followed.



Shoreline cross section.

If you have questions concerning the contents of this information sheet, contact your local DNR Area Hydrologist. See contact information on reverse side.

Please note that local units of government and other agencies may require a permit for this project.

*For lakes and wetlands, the OHWL is the highest elevation that has been maintained as to leave evidence on the landscape. It is commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial. For watercourses, the OHWL is the top of the bank of the channel. For reservoirs and flowages, the OHWL is the operating elevation of the normal summer pool.

What causes ice ridges and what can I do about them?

Property owners occasionally return to their cabins in the spring only to discover they are dealing with property damage caused by a phenomenon called "ice heaving" or "ice jacking". This powerful natural force forms a feature along the shoreline known as an "ice ridge". The result may include significant damage to retaining walls, docks and boat lifts, and sometimes even to the cabin itself.

Ice ridge formed along the shore of Shamineau Lake in Morrison County, February 2003.

How do ice ridges form? Ice ridges are caused by the pushing action of a lake's ice sheet against the shore. Cracks form in the ice because of different contraction rates at the top and bottom of the ice sheet. This is especially true in years that the ice sheet lacks an insulating snow cover. Ice cracks also develop because the edges of the ice sheet are sometimes firmly attached to the shore. When water rises in the cracks and freezes, the ice sheet expands slightly. Rising air temperatures warm the ice, leading to additional expansion, which exerts a tremendous thrust against the shore. Alternate warming and cooling of the ice sheet leads to additional pushing action, causing the ice to creep shoreward and scrape, gouge, and push soil and rock into mounds (called "ice ridges", "ice pushes", or "ramparts").

What can be done about ice ridges *after* they form? Because ice ridges do provide ecological benefits (described below), the ideal reaction to the formation of an ice ridge would be to do nothing other than remove personal property from its zone of influence. However, this is often impractical. Ice ridges can impede use of the lake by a property owner or the users of public lakeshore facilities. Therefore, action may be taken to remedy the results of ice activity.

Lake access can be obtained by ramping over or cutting through the ice ridge. There are circumstances, however, when it may be necessary to remove or grade an ice ridge. An individual Public Waters Work Permit is *not* required from the DNR to remove or grade an ice ridge if the work meets the following conditions:

- The ice ridge resulted from ice action within the last year.
- The project is either exempt from local permits or is authorized by issuance of a local government permit.
- Not more than 200 feet of shoreline is affected.
- All ice ridge material that is composed of muck, clay, or organic sediment is deposited and stabilized at an upland site above the ordinary high-water level (OHWL; see sidebar on page 1).
- All ice ridge material that is composed of sand or gravel is removed as provided above or graded to conform to the original cross section and alignment of the lakebed, with a finished surface at or below the OHWL.
- No additional excavation or replacement fill material occurs on the site.
- All exposed areas are immediately stabilized as needed to prevent erosion and sedimentation (see Lakescaping information sheet).
- Local zoning officials, the watershed district (if applicable) and the soil and water conservation district are given at least 7 days' notice before beginning the project.

Removal or grading of an ice ridge must not disturb emergent aquatic vegetation, unless authorized by an aquatic plant management permit from the DNR's Division of Fisheries.

What can be done about ice ridges *before* they form? The simplest means of avoiding ice-related damage to shoreline property is to ensure that personal property is out of wrath's path. State and local shoreland regulations requiring setback limits not only lead to improved aesthetics but also help to minimize personal property damage from ice action and wave-induced erosion. Engineering solutions are sometimes pursued to remedy ice ridge problems, but they can be expensive and ineffective. If an engineering solution is pursued, property owners should seek the advice of a professional.

What are the benefits of ice ridges? Ice ridges are natural berms that have formed around Minnesota's lakes over thousands of years. These mounds of material provide the lake with ecological benefits by creating a barrier to nutrient loading. Nutrients collect on the landward side of the mound, producing fertile soil where plants and trees thrive. The root systems of this near-shore plant community help to protect the shore from erosion and soak up additional nutrients. Shade and habitat offered by near-shore plants benefit organisms along the shore and in the lake, thus supporting nesting and spawning fish.

Ice ridges also work to protect the shore from the lake itself. For example, a small ice ridge formed one year is followed by additional pushes in ensuing years. The ridge is fortified by jamming rocks into it. The roots of the near-shore plant community bind together the soil and rock to form natural shoreline protection.

DNR Contact Information

DNR Waters website lists Area Hydrologists: www.dnr.state.mn.us/waters
DNR Waters in St. Paul: 500 Lafayette Road, St. Paul, MN 55155-4032, (651) 296-4800

DNR Ecological Services website provides information about aquatic plant management permits: www.dnr.state.mn.us/ecological_services
DNR Ecological Services in St. Paul: 500 Lafayette Road, Box 25, St. Paul, MN 55155, (651) 296-2835

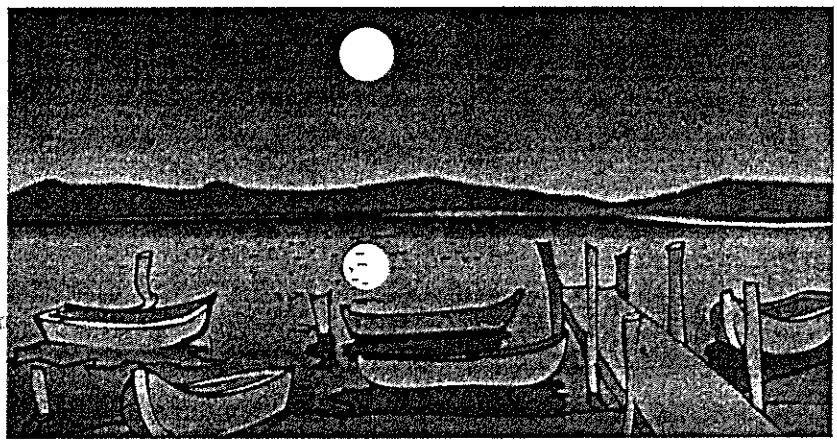
DNR Information Center

Twin Cities: (651) 296-6157
Minnesota toll free: 1-888-646-6367
Telecommunication device for the deaf (TDD): (651) 296-5484
TDD toll free: 1-800-657-3929

This information is available in an alternative format on request. Equal opportunity to participate in and benefit from programs of the Minnesota Department of Natural Resources is available regardless of race, color, national origin, sex, sexual orientation, marital status, status with regard to public assistance, age, or disability. Discrimination inquiries should be sent to Minnesota DNR, 500 Lafayette Road, St. Paul, MN 55155-4031; or the Equal Opportunity Office, Department of the Interior, Washington, DC 20240.

From "Friends of Mississippi River" newsletter

New Study Links Water Quality to Property Value:



A recently completed study by researchers at Bemidji State University has found a direct correlation between lakeshore property values and water quality. The study, which looked at more than 1200 residential property sales on lakes in the Upper Mississippi River Basin, calculated how much property values would rise or fall on 37 lakes if water clarity improved or worsened.

For example, if one could see down an extra 3 feet (down to 13 feet) on Leech Lake, a 40-foot lake property's value would increase by nearly $17,000. If the lake's clarity is reduced by more than 3 feet, that would reduce values by $23,760. Read the study on-line at: **info.bemidjistate.edu/news/currentnews/lakestudy/lakestudy.pdf**.

FUN MINNESOTA FACTS

Minnesota leads the nation in boat ownership ... one boat for every six residents.

Over 3,000 public lake accesses.

Most caught fish — panfish.

Only four counties lack natural lakes — Mower, Olmsted, Pipestone, and Rock.

Minnesota has 11,842 lakes (10+ acres).

The Walleye is the state fish.

Minnesota is home to the nation's largest — Jack Pine, Red (Norway) Pine and White Spruce.

Source: MNDNR Minnesota Facts and figures Web page, www.dnr.state.mn.us/faq/mnfacts/index.html

More information is available on these websites:

1. www.mnlakes.org/beckercola
2. http://www.data.pca.state.mn.us/pca/clmp.html
3. http://www.pca.state.mn.us/water/clmpfactsheets.html
4. http://www.dnr.state.mn.us/lakefind/index.html
5. www.extension.umn.edu/water