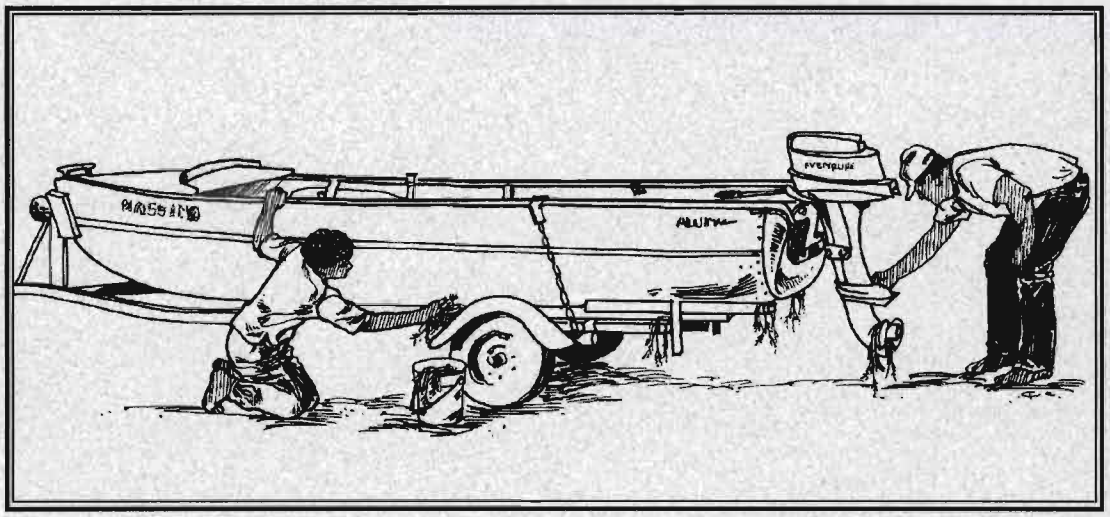
North and South Twin Lakes Riparian Association
Lake Planning Grant:

Water Chemistry Monitoring and Exotic Species Prevention

FINAL REPORT

Project Number LPL - 481



Prepared for the North and South Twin Lakes Riparian Association

May 2000

Introduction

North and South Twin Lakes are high quality water resources. The Department of Natural Resources identifies the lakes as outstanding resource waters. The high quality resources of the lakes include excellent water quality, lake aesthetics, a cold water cisco fishery, trophy walleye and muskellunge fisheries, and high quality recreational opportunities. The lakes are important to local residents and the general public.

Because of the high quality of these lakes, they are very desirable sites for residences and recreational activities. Increased use of the lakes and development in their watershed has the potential to diminish many of the high quality characteristics. NSTLRA recognized this and began work on a comprehensive lake management plan. Part of the management plan involved an investigation of past and current water quality conditions. However, existing water quality data on the lakes were limited.

The quality of North and South Twin Lakes are also threatened by the potential for invasion by harmful exotic species. Invasion by Eurasian Water Milfoil has caused many lake management organizations to spend large amounts of money on control projects. Nearby Big Sand Lake is infested by Eurasian Water Milfoil and could serve as a source for introduction if the plant is carried by a boater into North or South Twin. North and South Twin Lakes have three public boat landings. Since it is well known that preventing introduction of exotic species is the best starategy to use when dealing with these invaders, NSTLRA wanted to prevent introduction at the most likely avenues, the three public boat landings.

Project Goals

1) Water Chemistry Testing - Water chemistry samples will be collected from North and South Twin Lake during spring and fall turnover, at the point of maximum depth. Since both lakes are thermally stratified during the summer, sampling during spring and fall turnover is done to ensure that the true water chemistry conditions are represented. Sampling will be conducted for two years and analyzed for total phosphorus, total Kjeldahl nitrogen, ntirate-nitrite nitrogen, conductivity, pH, alkalinity, chloride, hardness, calcium, and magnesium.

2) Exotic Species Signs - An exotic species sign will be installed at each of the three developed boat landings. The signs will include information about the most significant harmful exotic species and will try to educate people that use the boat landings about the dangers of exotic species. They will be large and visible, with pictures of several different exotic organisms.

Project Accomplishments

Water Chemistry Testing

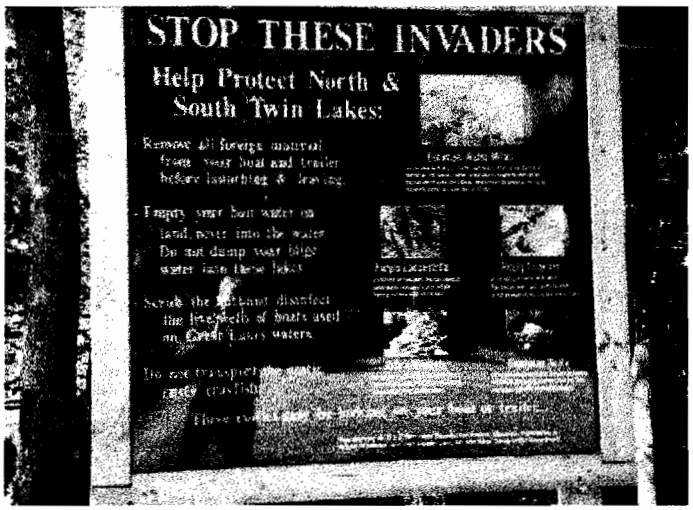
Water samples were collected by NSTLRA volunteer, John Callewaert, in 1997 and 1998 during spring and fall turnover. Samples were sent to the State Lab of Hygiene in Madison for analysis. The results were included in the NSTLRA lake management plan and are also included on the attached water chemistry information summary.

Exotic Species Signs

Three large free-standing 4' x 4' exotic species signs were designed for North and South Twin Lakes. The signs were constructed by Scenic Signs, Inc. in Wausau. One 8"x10" color photo of Eurasian Water Milfoil and 5" x 7" color photos of Zebra Mussels, Rusty Crayfish, Purple Loosestrife, and the European Ruffe were developed and attached to each of the signs. The signs are 4 feet by 4 feet in size with brown wood frame, yellow copy, aluminum extrusions for mounting and a clear polycarbonate sign face cover.

NSTLRA volunteers constructed 4" x 4" posts and frames for the signs and installed them at the boat landings in spring 1998. Each fall the signs are removed and stored inside for the winter. In spring 2000, NSTRLA volunteer Don Zirbel contructed roofing for each sign to shade the photos from sun and decrease fading.

A photograph of one of the installed signs is shown below:

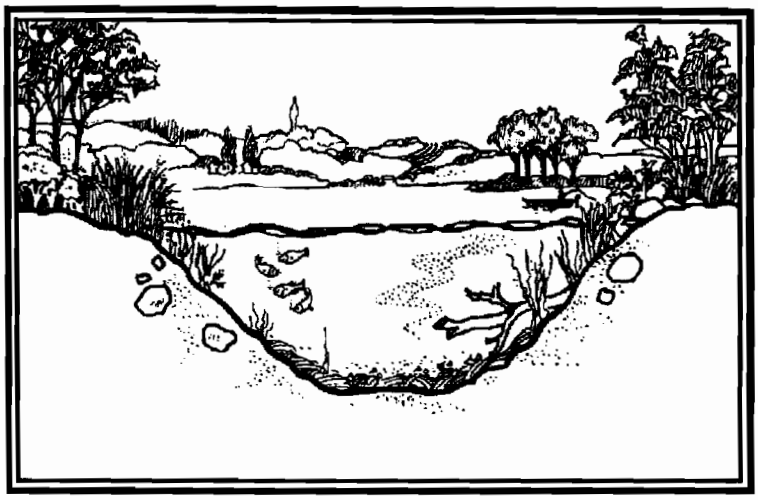


Exotic species sign installed at the South Twin Lake boat landing.

North and South Twin Lakes

Water Chemistry
Information Summary

The following is a summary of water quality data that was collected by the North and South Twin Lakes Riparian Association (NSTLRA) in 1997 and 1998 as part of a DNR Lake Planning Grant. The samples were collected each spring and fall during lake turnover to collect a baseline of water quality data. This information is used to assess the current conditions of North and South Twin Lakes and can be used to compare with future water chemistry information to indicate changes. Other lake information is also included in this report.



This summary is being provided to help interpret the results of the water quality testing. Some of the parameters provide background information on water characteristics related to the soils and geology of the area. Other parameters directly assess the condition and quality of the water from both natural and human-induced factors.

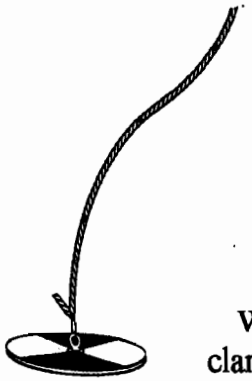
Secchi Depth:

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	10.5	10.0	10.0	11.0	**10.4 ft**
South Twin Lake	9.8	10.0	10.0	12.8	**10.6 ft**

Secchi depth measures the water clarity of the lake. Algae and sediment suspended in the water will decrease water clarity. The natural color of the water will also affect the readings. Water clarity often is a good indicator of a lake's overall water quality, especially the amount of algae present. Many readings over a number of years can provide an excellent way to document long-term changes in water clarity.

Water Clarity Index

Water clarity	Secchi depth (ft)
Very poor	3
Poor	5
Fair	7
Good	10
Very good	20
Excellent	32



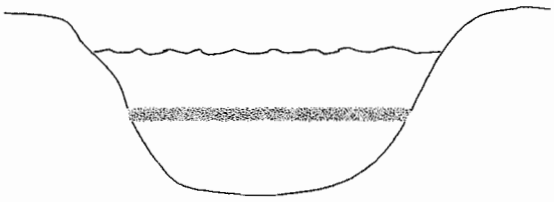
Water clarity is measured using a standard black and white disc.

Lake Type: Drainage

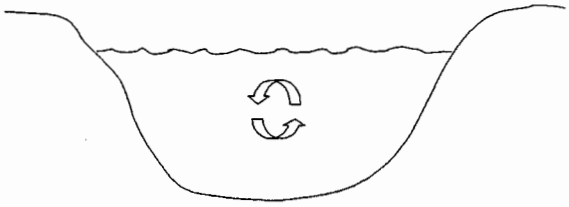
Drainage lakes are fed by streams, groundwater, precipitation and runoff. These lakes have an inlet and an outlet. Water quality in these lakes can be highly variable. These lakes often have large watersheds.

Stratification:

A lake is stratified when the top and bottom of the lake differ in temperature and, as a result, prevent mixing. Stratified lakes have the potential to lose oxygen in the bottom layer from plant and algae decomposition. Stratified lakes can therefore be more sensitive to increased nutrient inputs. Non-stratified lakes are continually mixed and re-oxygenated.



Stratified lake



Non-stratified lake
(continually mixed)

Stratification Factor	
0-11.4	Not stratified
11.5-13.4	Weakly stratified
13.5-29.9	Stratified
> 30	Strongly stratified

North Twin Lake: 18.72
South Twin Lake: 16.92

pH:

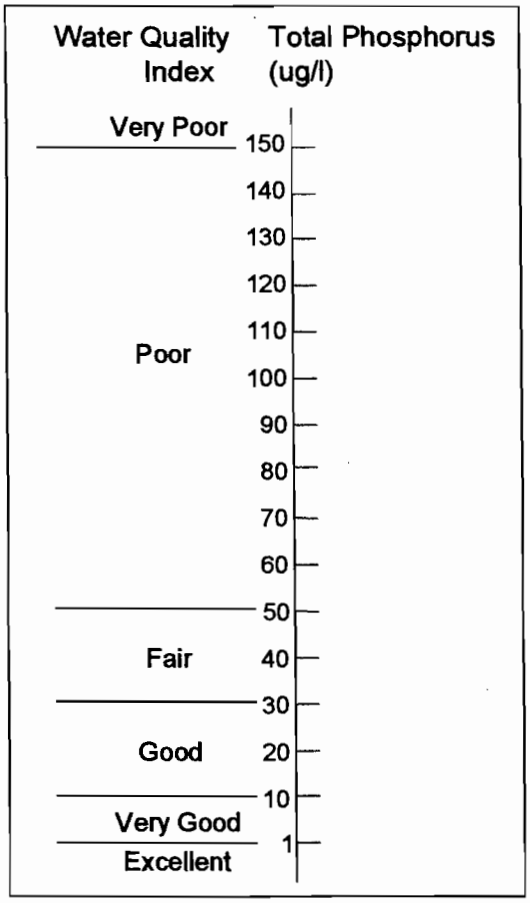
A lake's acid level is indicated by pH. A pH of 7.0 is neutral. Lower pH values indicate that a lake is more acidic, higher values are less acidic. A change of 1 pH unit is a tenfold change in acid level because pH values are on a logarithmic scale. The pH values found in Wisconsin lakes range from 4.5 for the most acidic, to 8.4 for some hard water lakes. Most aquatic life requires a pH value between 6 and 9 to live and reproduce. Lakes with a low pH might see increased concentrations of some toxic metals, like mercury, if the metals are present in the lake bottom or surrounding soils. This is because these metals become more soluble at lower pH values.

Effects of Acidity on Fish (Olszyk, 1980)	
pH	Effect
6.5	walleye spawning inhibited
5.8	lake trout spawning inhibited
5.5	smallmouth disappear
5.2	walleye, lake trout disappear
5.0	spawning inhibited in many fish
4.7	northerns, suckers, sunfish disappear
4.5	perch spawning inhibited
3.5	perch disappear
3.0	toxic to all fish

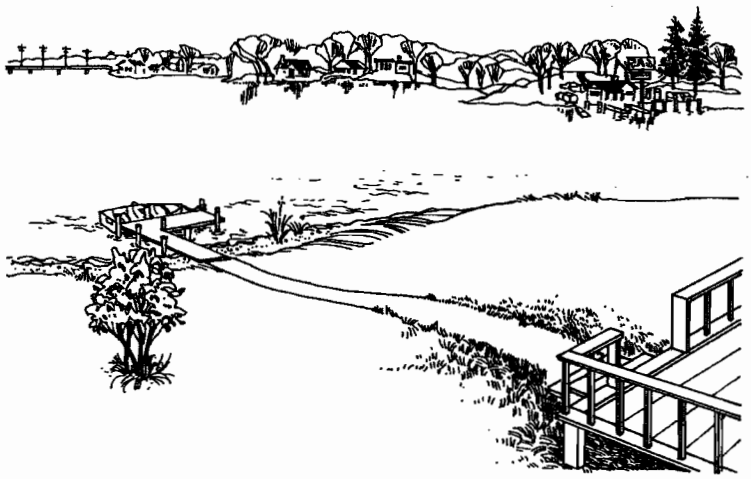
	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	7.81	7.33	7.48	8.38	**7.75**
South Twin Lake	7.83	7.32	7.56	7.85	**7.64**

Total Phosphorus:

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	18	32	31	20	**25 ug/l**
South Twin Lake	22	28	31	16	**24 ug/l**



In most lakes, phosphorus promotes excessive aquatic plant and algae growth. It occurs naturally in soils, but human activities can greatly increased the quantities of phosphorus available to the lake systems. Major sources include soil erosion, septic systems, detergents, runoff from lawns and farms, fertilizers, and human and animal wastes. Concentrations below 20 ug/l for natural lakes and 30 ug/l for impoundments will normally prevent nuisance algal blooms.



Flushing:

North Twin Lake: 0.14 times per year *(or approximately 7 years to flush)*
South Twin Lake: 1.00 times per year *(or approximately 1 year to flush)*

Flushing measures the number of times per year that a lake's total water volume is replaced. Flushing index is the ratio of a lake's watershed area to its volume. It approximates how long pollutants and nutrients that enter a lake will remain in the waterbody. Lakes with high flushing rates allow pollutants and nutrients to be flushed out of the lake quicker than lakes with low flushing rates.

Flushing Index	**Rate**
0-5.9 times per year	Low flushing rate
6-9.9	Medium flushing rate
10-29.9	High flushing rate
over 30	Very high flushing rate

Alkalinity:

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	44	43	44	46	**44 mg/l**
South Twin Lake	42	42	42	46	**43 mg/l**

Alkalinity is a measure of certain dissolved compounds, mostly carbonates, which neutralize acid. The lower the alkalinity level, the greater the effect acid rain may have on the lake. High alkalinity levels buffer the lake because bicarbonate (HCO3-) and carbonate (CO3=) neutralize hydrogen ions from any acid added to the lake. Alkalinity levels are determined by the soils and bedrock of the area. In Northern WI, the alkalinity of seepage lakes average around 25 mg/l, drainage lakes average around 50 mg/l.

Sensitivity of Lakes to Acid Rain

Sensitivity	**Alkalinity (mg/l CaCO3)**
High	0-2 mg/l
Moderate	2-10 mg/l
Low	10-25 mg/l
Nonsensitive	>25 mg/l

(adapted from Taylor, 1984)

Hardness:

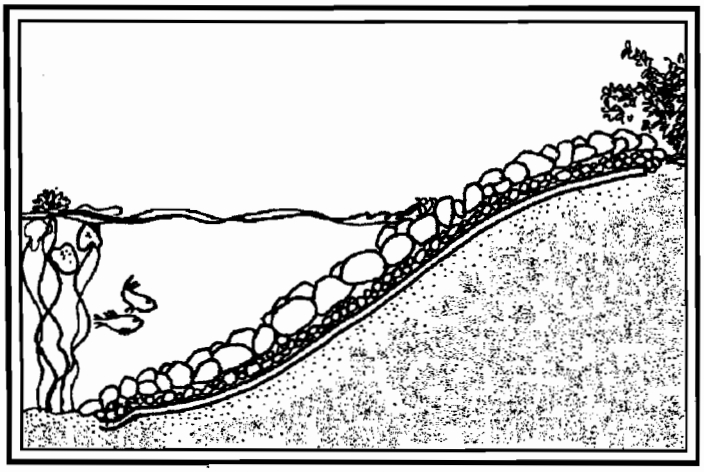
	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	44	43	44	44	**44 mg/l**
South Twin Lake	41	42	42	44	**42 mg/l**

A lake's hardness is affected by the type of minerals in the soil and watershed. If the soils are sandy, or if direct rainfall is a major source of lake water, hardness will be low. Lakes with low levels of hardness are considered soft water lakes and are more susceptible to acidification by acid rain. Soft water lakes are generally less productive than hard water lakes. Hard water lakes with high levels of hardness (greater than 150 mg/l) can cause marl (CaCO3) to precipitate out of the water.

Hardness Level	**Total hardness as mg/l CaCO3**
soft	0-60 mg/l
moderately hard	61-120 mg/l
hard	121-180 mg/l
very hard	>180 mg/l

Conductivity:

Conductivity is related to the amount of dissolved substances in water, but it does not indicate which minerals are present. Normal values are roughly about two times the water hardness. If conductivity is much greater than two times the hardness, the water may be receiving high concentrations of contaminants introduced by humans. Changes in conductivity over time may indicate changing water quality.



	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	102	103	102	110	**104 umhos/cm**
South Twin Lake	99	101	98	109	**102 umhos/cm**

Calcium:

The amount of calcium in a lake is related to the presence of calcium-bearing minerals in the area. Calcium is one of the two major factors that determine water hardness, the other being magnesium. Northern WI lakes typically average around 10 mg/l calcium.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	11	11	11	11	**11 mg/l**
South Twin Lake	10	11	11	11	**11 mg/l**

Magnesium:

Magnesium is closely related to the bedrock geology of the area. Magnesium concentrations are usually lower than calcium concentrations and typically average about 5 mg/l in northern WI.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	4.0	3.9	4.0	4.1	**4.0 mg/l**
South Twin Lake	3.8	3.8	3.8	4.1	**3.9 mg/l**

Chloride:

Chloride does not affect plant and algae growth and is not toxic to aquatic organisms at low levels. However, the presence of chloride where it does not occur naturally indicates possible water pollution. Natural levels for northern WI lakes are usually less than 3 mg/l. Sources of chloride include septic systems, animal waste, fertilizer runoff and drainage from road salt.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	3.4	3.4	3.4	3.4	**3.4 mg/l**
South Twin Lake	3.2	3.6	3.2	3.3	**3.3 mg/l**

Nitrogen:

Nitrogen is a necessary nutrient for plant and algae growth. Sources of nitrogen to lakes include lawn fertilizers, septic systems, precipitation, farm fertilizers and animal wastes. Nitrogen can be measured in different forms. For most forms, there are no 'acceptable ranges'.

Nitrogen to Phosphorus (N:P) Ratio:

The N:P ratio compares total nitrogen levels to total phosphorus. If the total nitrogen levels are more than 15 times the total phosphorus levels, then the lake is considered phosphorus limited, meaning phosphorus levels directly affect plant and algae growth. If the ratio is less than 15, plant and algae growth are controlled by nitrogen levels. Both North and South Twin lakes are most likely phosphorus limited.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	--	--	--	--	**--**
South Twin Lake	--	--	4*	31*	**18***

Total Nitrogen:

Total nitrogen is the sum of total kjeldahl nitrogen and nitrate + nitrite. This is used to calculate the N:P ratio.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	--	--	--	--	**--**
South Twin Lake	--	--	133*	499*	**316 ug/l***

Total Kjeldahl Nitrogen (TKN):

Total kjeldahl nitrogen is the measure of the organic nitrogen and ammonia levels in a lake.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	--	--	150*	500	**325 ug/l***
South Twin Lake	--	--	120*	480	**300 ug/l***

Nitrate + Nitrite (NO3 + NO2):

Nitrate and nitrite are forms of nitrogen that can be used by aquatic plants and algae as nutrients.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	--	--	--	--	--
South Twin Lake	--	--	13*	19*	**16 ug/l***

Ammonia (NH4):

Ammonia is a product of decomposing organic matter that can be used as a nutrient by plants and algae. Levels can often fluctuate seasonally.

	Spring 97	Fall 97	Spring 98	Fall 98	**Average**
North Twin Lake	--	--	14*	--	**14 ug/l***
South Twin Lake	--	--	--	--	--

-- no data are available

* results are approximate due to detection limits or exceedances of holding times.

Summary provided by: Vilas County Land and Water Conservation Department.

Sources: Understanding Lake Data, Shaw et al, 1994.
Limnological Characteristics of WI Lakes, Lillie and Mason, 1983.
Thermal Stratification of Wisconsin Lakes, Richard C. Lathrop and Richard A. Lillie. Trans. Wis. Acad. Sci., Arts, and Letters. 68:90-96.