(July 7, 2011)

Lake Management Plan
for
North Lake

Albany, Minnesota
Stearns County, Minnesota

Healthy Lakes & Rivers Partnership

City of Albany

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Management Plan for North Lake

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I. Introduction

In February 2010 the City of Albany was invited to participate in the Initiative Foundation's Healthy Lakes and Rivers Partnership program along with seven other Lake Associations in Stearns County. Under the coordination of the Greg Berg (Stearns County Soil & Water Conservation District) and Susan McGuire (Stearns County Environmental Services), representatives attended two days of training on strategic planning, communication, and nonprofit group leadership.

Representatives of many state and local agencies, as well as nonprofit organizations also attended the training sessions in order to offer their assistance to each group in developing a strategic Lake Management Plan. The City of Albany was represented at the Healthy Lakes & Rivers training sessions by: Tom Schneider, Tom Kasner, Joe Mergen, Scott Daninger, Robert St. Marie, Mike Stenlund, Bryan Schiffler, and Ross Voit.

Following the training sessions, each Lake Association or City held an ***inclusive community planning/visioning session*** designed to identify key community concerns, assets, opportunities, and priorities. The City of Albany held this planning session on March 31, 2010, facilitated by Marian Bender. Approximately 39 people were in attendance, with about 95 percent of the participants describing themselves as year round residents. North Lake has no seasonal properties. Details of the public input received at this session are provided within this plan.

This document is intended to create a record of historic and existing conditions and influences on North Lake, and to identify the goals of the City of Albany. Ultimately it is meant to also help prioritize goals, and guide citizen action and engagement in the priority action areas. Clearly state agencies and local units of government have a vital role and responsibility in managing surface waters and other natural resources, but above all else this Lake Management Plan is intended to be an assessment of what we as citizens can influence, what our desired outcomes are, and how we will participate in shaping our own destiny.

This Lake Management Plan is also intended to be a "living document;" as new or better information becomes available, as we accomplish our goals or discover that alternative strategies are needed, it is our intent to update this plan so that it continues to serve as a useful guide to future leaders.

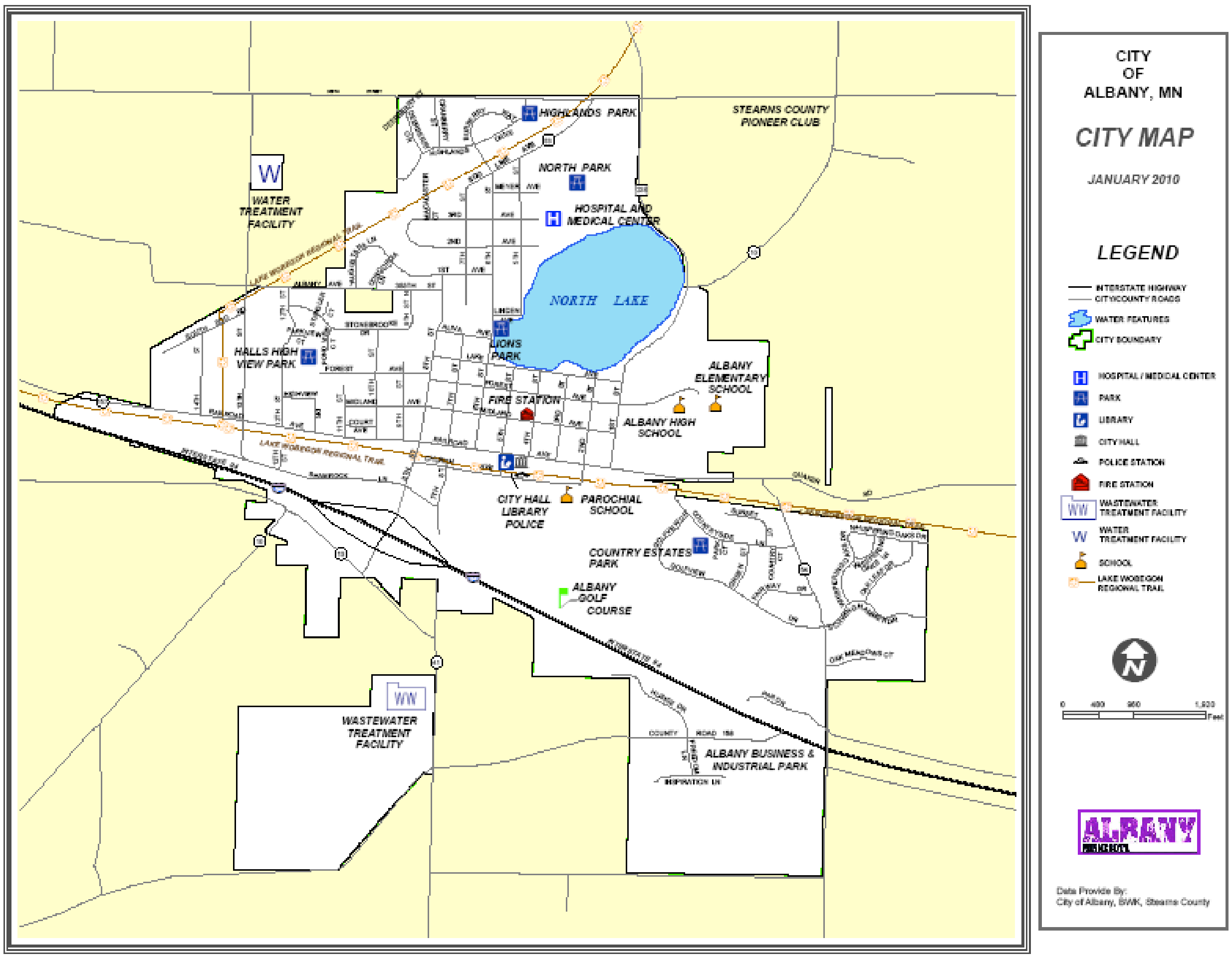
In discussing lake management issues, it is impossible to avoid all scientific or technical terms. We have tried to express our goals, measures of success, and other themes as simply and clearly as possible, but have included a glossary of common limnological terms at the end of the plan to assist the reader. Limnology is the state of lake conditions and behavior.

Finally, we would like to thank the funders of the Healthy Lakes & Rivers Partnership program for Stearns County, including the McKnight Foundation, Minnesota Power, Xcel Energy, U.S. Environmental Protection Agency, McDowall Company, the Cass County Water Plan, Lake Hubert Conservation Association, Portage-Crooked Lakes Association, and the Sibley Lake Association of Stearns County, the Ann Lake Sportsmen's Club of Kennebec County, various staff from the Initiative Foundation, and over thirty generous individuals.

Physical Characteristics and location of North Lake

North Lake (#73-0177) is located in Stearns County, literally within the northeast portion of the City of Albany. Albany is located off Interstate 94 and State Highway 238 in Central Minnesota, 20 miles west of St. Cloud. The northeastern quadrant of the immediate shoreline is surrounded by wetlands, and is likely largely undevelopable. The higher areas of the shoreline are essentially developed in urban densities, with water main and sanitary sewer mains (wastewater) provided by the City.

Figure 1 – Location Map of North Lake



Water Level:
The Minnesota Department of Natural Resources, Division of Waters has monitored North Lake levels in cooperation with volunteer readers on only two occasions; September 24, 1986 (elevation = 1,190.3 ft) and again on May 20, 1996 (1,189.93 ft.). A regulatory Ordinary High Water (OHW) level has been established at 1,190.5 feet. The outlet for North Lake was recently reconstructed as part of the City's 2006 6th Street Improvement Project. The outlet pipe was replaced with an overflow structure with an outlet elevation set at 1189.5 msl in 2004. The outlet elevation was set according to the permit authorized by the MnDNR.

Precipitation
In 2002 the Minnesota Pollution Control Agency conducted a Lake Assessment Program (LAP) study of nearby Two Rivers Lake and noted that in this part of the state average annual precipitation ranges around 28 inches and evaporation averages around 36 inches. Summer (May to September) precipitation averages about 18 inches.

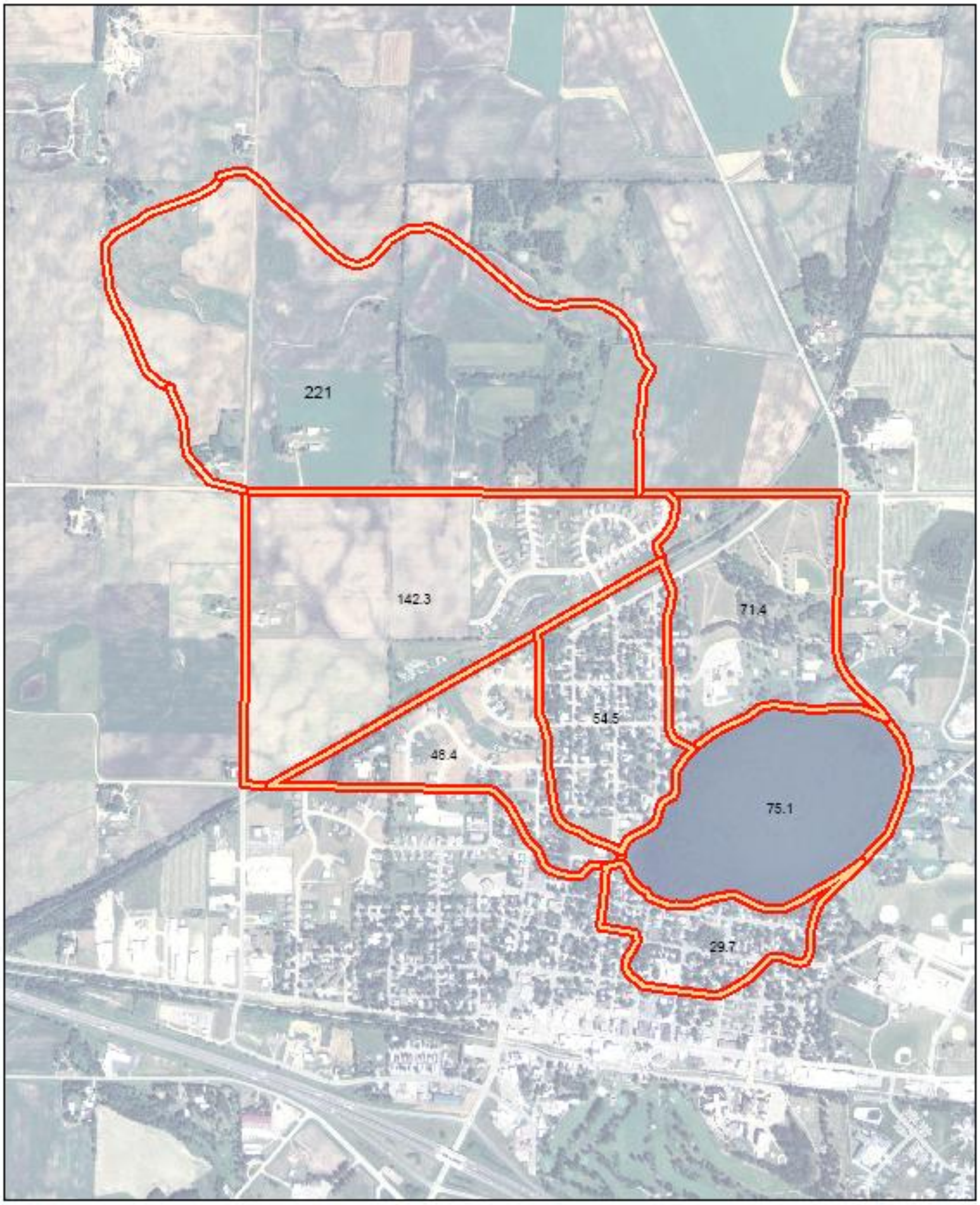
Soils
Nearly all of the lakes within the Two Rivers watershed are ice-block basins formed in the pitted to hilly moraine deposits of the Des Moines Lobe and the Grantsbury sub-lobe, the most recent glacial lobe during the Wisconsin Glaciation.

Watershed
The City of Albany lies within the Platte Spunk Watershed, which includes the North Lake and many others, and eventually discharges into the Mississippi River as shown below.

Hydrologic Unit Code: 07010201
Mayor Basin: Mississippi Basin

Drainage Area: 652,677 acres

The North Lake Watershed basin map is shown on page 7.



Albany Lake

Watershed Basins

February 2010

BASINS w/Acreage

Bonestroo

Introduction/History of North Lake

The North Lake is a natural body of water, within the limits of the City of Albany, Minnesota. Prior to 1904 North Lake overflowed into a natural watercourse running in a southwesterly direction through the City of Albany, across several streets. The elevation of the natural water course at the point where it left the lake was 1190 feet above sea level.

Around 1904, adjacent landowners constructed title drainage ditch partly within said natural watercourse, and inpart laid in the streets which had been dedicated to the public in the original Townsite of Albany and in the Theisen's First and Second Addition to the City of Albany. On Sixth Street, near the outlet of said North Lake, the tile drainage ditch was laid forty-eight paces southerly of the natural watercourse; that the tile drainage ditch was laid deeper than the elevation of the natural watercourse, in an attempt to drain said lake.

The plat of the Original Townsite of Albany was filed for record on November 20, 1872 and that Theisen's First Addition plat for the City of Albany was filed for record on July 5, 1895 and Theisen's Second Addition plat for the City of Albany was filed for record on January 18, 1901. There is no evidence of any agreement to the adjacent landowners a right to construct a tile drainage ditch across the streets to the plat Original Townsite of Albany.

That from the time the tile was laid, about 1904, to the time the City broke it in 1949, the original owners of the tile nor their predecessors in title did anything to maintain the drain tile; that this failure of the maintenance for almost fifty years, plus the natural disintegrations of the tile line, resulted in said tile becoming almost completely obstructed; and, as practical matter, worthless, prior to 1949.

That the failure of the owners to maintain said tile drain produced an artificially high underground water table which created a hazard to the citizens in that water escaped from said tile drain, soaking up the street surfaces and running into the basements of certain property owners in said City near said tile drain; that said hazard resulted in numerous citizen complaints to the City and threats of lawsuits if the City allowed the conditions to continue.

That is an effort to correct the hazard so created, the City of Albany in 1949 constructed a system of storm sewers in said City, and in the process of the construction of said storm-sewer system, broke said drain tile at various places; that the City's braking of the tile did not affect the level of North Lake, Because the City made a connection between said tile drain and the storm-sewer system at the point where said tile drain crossed Lake Avenue, in an attempt to salvage the upper end of the tile drain.

The fall of 1951, certain farmers owning about 1000 acres of land which normally drained into North Lake, deepened their ditches, causing an increased and accelerated flow of water into North Lake. That the total precipitation for the year 1951 was the greatest in the history of the United States Weather Bureau over a period of fifty-four years.

The level of the outlet from the lake installed by the City and attached to its storm sewer in 1952 was 1187.5 feet above sea level, or 5.5 feet height that the old outlet installed in approximately 1904. This did not result in the level of the lake being raised. The level of the lake had remained fairly constant over a long period for years before and after 1953, subject onto to change due to the Natural weather variations and rainfall. The natural overflow of the lake was 1190 feet above sea level and that its actual level was 1188.29 feet above sea level on July 15, 1947. Within the 640 acre stormwater basin that includes the North Lake, approximately 70 acres of past agricultural land has been converted to residential development. However, great steps have been taken by the City of Albany to require stormwater retention ponds in these subdivisions and to control the rate and volume of stormwater flowing into North Lake. Other areas within the stormwater basin are identified as future residential development in the City's Comprehensive Plan. Approximately 50% of land use surrounding the lake is residential and the remaining property is North Park, Lions Park, and State Highway #238. There are 28 residential homes that either abut or are across a street from North Lake. Albany Area Hospital and Medical Clinic also abut North Lake on the northern shoreline. All homes are serviced by the City's sanitary sewer system, but six (6) remain as private septic systems along State HWY #238 due to topography preventing connection to the existing gravity sanitary sewer system. Past street reconstruction projects have yielded great results in reducing the infiltration of sediment from streets with the construction of sedimentation structures on 6th Street, but Lake Avenue continues to be a source of infiltration with three stormsewer inlet pipes dumping directly into the lake. In the summer of 2010, there will be shoreline improvements constructed consisting of two rain gardens and planting of native plants with monies coming from the Stearns County Soil and Water Conservation District and City of Albany. The North Lake does not qualify to be included in a shoreland ordinance, but the City does have a Zoning Ordinance which requires specific set back requirements and maximum building coverage in a residential district. There are no issues with ice berms on the lake affecting private and public shoreline.

ORGANIZATION HISTORY

At the October 21, 2009 Council meeting, Mayor Dennis Sand with the consensus of the Council, directed the City Engineer to complete, prepare, and submit an application to the 2010 Healthy Lakes and Rivers Partnership (HLRP) program to improve the water quality and to identify the assets of North Lake. North Lake Committee members are Bryan Schiffler, Ross Voit, Tom Kasner, Joseph Mergen, Tom Schneider, Robert St. Marie, Scott Daninger, and Michael Stenlund. HLRP held training sessions in Waite Park on February 22nd, and March 8th.

II. REVIEW OF HISTORICAL AND EXISTING CONDITIONS

WATER RESOURCE ANALYSIS

INTRODUCTION

This section provides a basic primer on lake ecology and characterization that will provide a background to better understand to lake management. It important to understand the different types of lakes and the characteristics of North Lake to establish an effective lake management plan.

LAKE MANAGEMENT PRIMER

TYPES OF LAKES

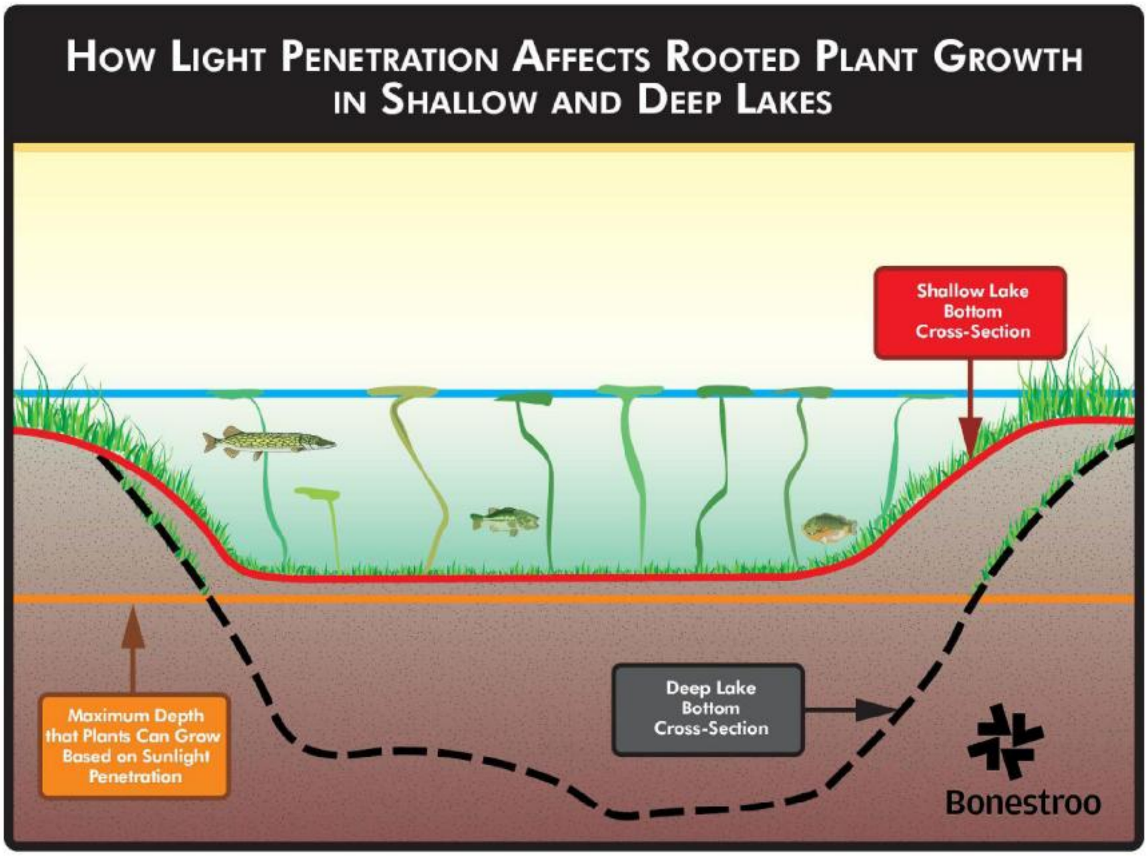
There are two types of lakes that are distinguished for lake management purposes: shallow lakes and deep lakes. This distinction is made on the basis of certain physical characteristics. Differences in the physical characteristics of lakes affect how lakes respond to seasonal changes and watershed inputs, and different management strategies are employed depending on lake type. Pickerel Lake is a shallow lake, but a comparison of deep and shallow lakes is presented in the following sections to provide an understanding of what makes shallow lakes like Pickerel Lake unique.

DEEP LAKES

By definition, a deep lake is a water body with at least 20% of the lake having a depth of 15 feet or greater (Minnesota Pollution Control Agency 2005). Because of their depth, deep lakes exhibit a seasonal phenomenon known as "thermal stratification." Stratification occurs in the summer and winter seasons due to meteorological influences.

During stratification a deep lake becomes separated into three zones. The epilimnion is the top portion of a stratified lake and is enriched with oxygen while the hypolimnion is the bottom portion and is often devoid of oxygen (anoxic) in all but the least polluted lakes. A thermocline is an area in the middle portion (metalimnion) of a stratified lake. The thermocline is characterized by rapid temperature change separating the upper and lower layers. In part because of their stratification, deep lakes are better able to withstand the impacts of pollutant loading because they can store at least some of the pollutants in those deeper, isolated waters for much of the year. This can keep the pollutants from mixing into the upper layers of the lake where most of the biological activity takes place. Every year, there is a time during the spring and fall, however, where the temperature differences between the shallow and deep water diminish and the whole lake mixes or "turns over". Thus, deep lakes are often referred to as dimictic, meaning they mix twice a year.

Another important characteristic of deep lakes is that a significant portion of the bottom of the lake is too deep for adequate light penetration to support rooted aquatic vegetation growth. The figure on the following page shows how light limitation and depth characteristics can affect rooted plant growth in deep and shallow lakes. This is why deep lakes are predominantly open water, no matter what their water quality.



Light Limited Compensation Depth in Lakes

SHALLOW LAKES

Shallow lakes are defined as those with 80% or more of their surface area having a depth of 15 feet or less (MPCA 2005). Shallow lakes are distinct from wetlands, which are defined by specific language and criteria.

Shallow lakes can be strongly affected by wind and wave action. It is not uncommon to see a shallow lake that is intermittently weakly stratified, then mixed periodically during the open water season. Because they can mix many times throughout the open water period, they are referred to as “polymictic”. The constant mixing during open water conditions facilitates a high degree of interaction between the water and underlying sediment. This dynamic makes shallow lakes more prone to nutrient enrichment compared to deep lakes of similar surface area and watershed size. During winter, the limited volume of shallow lakes can result in low oxygen condition which can result in fish kills. These low oxygen conditions often have a greater negative impact on game fish species like bass, northern, and walleye than on rough fish like carp and bullhead because the former require higher levels of oxygen in the water to survive.

In a natural, pristine state, shallow lakes typically have clear water and a rich aquatic vegetation community almost everywhere in the lake that is dominated by rooted aquatic plants (Scheffer 1998). The figure on the following page shows a picture of a relatively pristine shallow lake in northeastern Minnesota compared to a highly turbid shallow lake in the Twin Cities area. Note the abundance of emergent and submergent vegetation in the relatively pristine system.

Shallow lakes with a low nutrient content usually have vegetation dominated by relatively small rooted aquatic plants. Shallow lakes that receive large stormwater inputs from urban areas (like Pickerel Lake) often have significantly higher concentrations of plant nutrients like phosphorus than pristine lakes. In these lakes, the total mass of aquatic plants increases as more nutrients are available to support plant growth. Plants that fill the entire water column or concentrate much of their growth near the lake surface dominate the vegetative community in these lakes. If something is done to eradicate the rooted aquatic plants, algal blooms often result which can lead to a highly turbid condition in the lake. Ultimately, shading by the algal blooms leads to a collapse of the rooted aquatic vegetation due to light limitation. Invertebrates associated with the vegetation disappear and with these the birds and fish that rely on plants and invertebrates for food. Once a lake has turned to a turbid condition without rooted aquatic plants, it is difficult to restore it to a clear water vegetated state (Scheffer 1998).

minimally impacted shallow lake

turbid shallow lake

City of St. Paul

Comparison of Turbid Shallow Lake with Minimally Impacted Shallow Lake

NATURAL RESOURCE MANAGEMENT PLAN

Bonestroo

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In short, there is no such thing as a shallow lake without abundant vegetation (whether algae or rooted aquatic plants or some combination thereof); it is more a question of what types of plants will dominate in the system. A native rooted aquatic plant–dominated system with clear water is generally considered the most desirable condition of shallow lakes because of the diversity and perceived value of the plants and animals it supports. Further, state water quality standards also support achieving this type of condition. The management goal for Pickerel Lake should be to achieve a clear water condition with a diverse emergent and submergent native-dominated plant community.

Water Quality

No citizen volunteers from North Lake have participated in the Minnesota Pollution Control Agency's (MPCA) Citizen Lake Monitoring Program (CLMP), recording secchi disc transparency – a measure of water clarity. The following information was taken by Joe Mergen and Rolland Hanson on April 23, 2010:

			ALBANY NORTH LAKE							
			Joe Mergen, Rolland Hanson							
			(measurements taken 4-23-10)							
No.	**Depth (feet)**	**GPS**	**Mud Level (inches)**	**Secchi Disk (feet)**		**No.**	**Depth (feet)**	**GPS**	**Mud Level (inches)**	**Secchi Disk (feet)**
1	2.8	97	12	2		32	3.5	455	16	
2	2.4	1013	12			33	3.4	576	16	
3	3.3	1074	12			34	2.6	738	16	
4	3.9	1172	12			35	3.4	816	16	2
5	4.1	1209	12			36	3.6	1099	12	
6	4.6	1245	12	2		37	4.8	1143	12	
7	5	1280	16			38	5.1	1072	12	
8	4.8	1252	16			39	5.2	1037	12	
9	4.6	1222	16			40	5.1	800	12	
10	4.6	1226	16			41	5.7	602	12	
11	4.4	1263	16	2		42	5.8	442	12	
12	3.9	1232	16			43	5.2	247	12	
13	4.1	1160	16			44	4.8	203	12	
14	4.1	1043	16			45	4.8	223	12	
15	4.6	963	12	2		46	4.9	304	12	
16	4.5	845	12			47	4.8	419	12	
17	4.2	768	12			48	4.7	540	12	
18	3.8	649	12			49	4.4	704	12	
19	4.2	488	12			50	4.4	860	12	
20	4.5	367	12			51	4.4	906	15	
21	4.6	252	12			52	5.5	717	15	
22	4.8	180	12			53	5.6	557	12	
23	4.5	117	12	2		54	6	357	12	
24	4.1	87	12			55	5.4	274	12	
25	3.4	83	12			56	5	349	12	
26	3.5	79	12			57	5	425	12	2
27	3.4	101	12			58	5.3	585	12	
28	3.1	158	12			59	4.8	750		
29	3.4	224	12			60	5.6	631		
30	3.1	297	12			61	5.6	552		
31	3.3	375	15			62	5.8	475		
	3.9871						4.845			
		AVERAGE DEPTH:		4.42	feet					

On the MPCA's web-site link, "Lake Water Quality Database," additional water chemistry data is typically reported. The MPCA's "Environmental Database Access" system also provides additional water chemistry data which includes total phosphorus concentrations, as well as other data. No data for North Lake are recorded within this database either.

One application of secchi disc transparency data is to convert the clarity measurements into a Carlson Trophic Status Index (TSI) score. The Carlson Trophic Status Index (TSI) is a tool used to summarize several measurements of water quality into one index value, which can be used to compare a lake to other lakes, or to historic/future data as a measure of degradation or improvement. In many ways, the index can be viewed as a measure of the potential for algae productivity. Since most people value lakes with low algae productivity, the lower the TSI value, the healthier the lake. Specifically:

TSI Range	**Trophic Status**	**Characteristics**
0-40	Oligotrophic	Clean Lake
41-50	Mesotrophic	Temporary algae & aquatic plant problems
50-70	Eutrophic	Persistent algae & aquatic plant problems
Greater than 70	Hyper-eutrophic	Extreme algae & aquatic plant problems

A second method of assessing water quality and determining whether your water body is the "best that it can be" is to compare it to other lakes of similar morphology, geology, and land uses. The table below is adapted from the MN Pollution Control Agency "Environmental Data Access" database, and compares observed surface water results in Albany Lake to common water quality ranges for lakes within the North Central Hardwood Forest Eco-region.

Average Summer Water Quality and Trophic Status Indicators

Parameter	Typical Range: North Central Hardwood Forest Eco-region (25^{th}-75^{th} Percentile)	North Lake (#73-0177)
Total Phosphorus (µg/L)	23 – 50	JUNE 2010 TBD
Chlorophyll a (µg/L) mean	5 – 22	
Chlorophyll a (µg/L) maximum	7 – 37	
Secchi disc (feet)	4.9 – 10.5	
Total Kjeldahl Nitrogen (mg/L)	< 0.60 – 1.2	
Nitrite + Nitrate Nitrogen (mg/L)	<0.01	
Alkalinity (mg/L)	75-150	
Color (Pt-Color units)	10 – 20	
pH	8.6 – 8.8	
Chloride (mg/L)	4 – 10	
Total Suspended Solids (mg/L)	2 – 6	
Conductivity (µmhos/cm)	300 – 400	

A third application of these data is to compare phosphorus concentrations to the Minnesota Pollution Control Agency water quality criterion for swimming and other recreational contact. For the North Central Hardwood Forest Ecoregion phosphorus criteria level of 40 micrograms per liter (µg/L) serves as the upper threshold for full-support for swimmable use.

Phosphorus concentration (µg/L)	Trophic Status Index range	Regulatory Status	Common conditions
40	57 or lower	Full support for swimmable use	
40-45	57-59	Partial-support	Increased frequency of nuisance algal blooms results in high percentage of summer (26-50 percent) perceived as impaired swimming.
45	59 or higher	Non-support	Mild algal blooms occur over 80

			percent of the summer, nuisance blooms about 40 percent of the summer, and severe nuisance blooms about 15 percent of the summer.

The MPCA uses a summary based on available summer (June through September) data in STORET (STORET is the national water quality data repository developed by the United States Environmental Protection Agency) to calculate achievement in this area. All water quality data collected by MPCA or received from external groups is placed in STORET) collected between 1974 and 2009. The following summary is presented on the MPCA website:

Name	Mean Total Phosphorus (µg/l)	Carlson's Trophic Stratus Index (phosphorus)	MPCA Swimming Criterion[1]
North Lake			

At the end of the day, many of these water quality measurements and metrics may be inappropriate for what is in many respects a deep wetland. In the City of Minneapolis, the Minneapolis Park and Recreation Board uses for the Wetland Health Evaluation Project (WHEP) process to train citizen volunteers to sample for vegetation and invertebrates. This information is then used to evaluate the wetland's biological health based on metrics developed by the Minnesota Pollution Control Agency. For quality assurance purposes, spot checks and quality control checks are conducted by other citizen teams and by a technical expert. The program is administered by Hennepin County – Environmental Services. For additional information on this tool visit: http://www.mnwhep.org.

The MN Pollution Control Agency web-site provides additional guidance on how to chart and interpret Lake Water Quality, including providing a spreadsheet which can be used to generate interpretive graphs: http://www.pca.state.mn.us/water/charting.html, as well as a simple model which allows you to compare what your water quality "should be" based on local influences. At this point, no data has been recorded that would show this lake as a sustainable fishery, but certainly recreational uses are an option without risk to public health. The water are aesthetically attractive to the public other than maybe two months during the summer months when the algae is in full bloom as evidence by large mats of weed protruding to the top of the water. Water quality data will begin in June 2010; whereby samples will be taken by volunteers and given to RMB, a certified laboratory, to determine water chemistry of the materials to provide base line data to be used in the future to improve the water clarity.

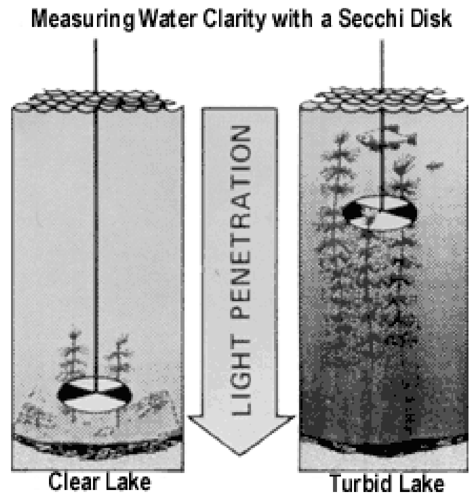
WATER QUALITY VARIABLES

Water quality data typically collected for lakes to assess their condition focus on parameters like total phosphorus, dissolved oxygen concentrations, chlorophyll-a, and secchi disk transparency.

Total Phosphorus (TP) is a measure of all of the different forms of phosphorus in water. TP includes phosphorus dissolved in water, suspended in water, attached to sediments, or incorporated in algae and other organisms. Because of the importance of phosphorus in controlling lake quality, the next report section provides a more detailed explanation of its role in lake ecology.

Dissolved Oxygen (DO) refers to the uncombined molecular oxygen that is in solution in water. Aquatic plants and algae produce DO as a result of photosynthesis while fish, zooplankton, and bacteria consume DO. Generally, DO concentrations provide insight on:

- Habitat suitability for fish and other vertebrate populations;
- Stratification of a lake system; and
- Potential for internal nutrient cycling.



A secchi disk provides a visual estimate of water clarity and the depth of light penetration in a lake. Water clarity is a key physical parameter affecting user perceptions of the suitability of a lake for recreation. As water clarity decreases, human perceptions of the suitability of a lake for recreational use also decrease.

A secchi disk is a circular disk with alternating white and black quadrants. It is lowered through the water column and the depth at which it disappears from view is recorded as the water clarity.

The chlorophyll-a concentration is a measure of algae (phytoplankton) in the water. The amount of algal growth strongly influences the clarity of the water. In general, higher phosphorus concentrations cause more algal growth which decrease water clarity. High chlorophyll-a concentrations indicate a nutrient-rich environment with large amounts of algae in the lake water.

ROLE OF PHOSPHORUS IN LAKE QUALITY

Phosphorus is an essential nutrient for plant growth. It is the nutrient most commonly limiting plant and algae growth in lakes in the upper Midwest. This is because when compared with other plant nutrients such as nitrogen, phosphorus supply in a lake is generally lowest relative to demand by algae.

> *If phosphorus concentrations are low, algal growth will often be low. Conversely, high phosphorus concentrations often foster high algal productivity.*

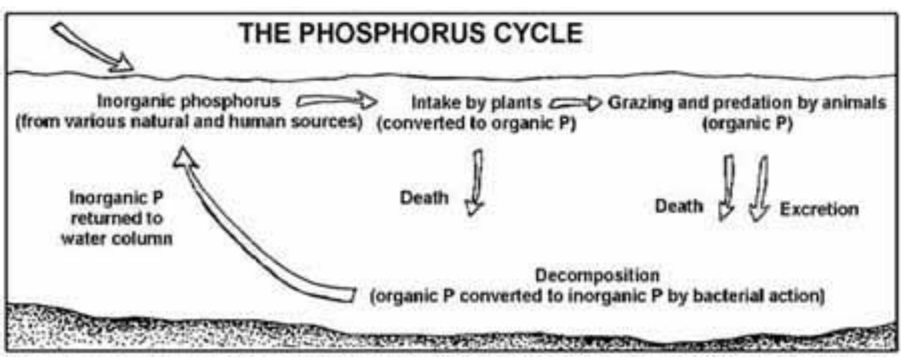
Algae obtain almost all of their nutrients from the water column in a dissolved form. A balanced population of algae is an important part of the biological system within a lake. However, too great an abundance of algae adversely affects both the ecology of the lake as well as the suitability of the lake for use by people. Under nutrient enriched conditions (i.e., high phosphorus concentrations in the water column), populations of certain types of algae can explode during the summer growing season causing what is commonly referred to as a "bloom".

Phosphorus concentration is the most critical factor in the quality of any lake. Controlling and reducing the amount of phosphorus that reaches a lake is essential in managing lake quality. Phosphorus can be delivered to a lake from a watershed in many ways. Elevated phosphorus loadings from developed areas are in part a consequence of more runoff volume as a result of increased impervious surfaces such as roads, rooftops, and driveways. They are also a consequence of higher concentrations of pollutants in runoff from urbanized areas. For example, major sources of phosphorus in urban runoff include improperly applied fertilizers containing phosphorus, vegetative material left on hard surfaces, soil and dust particles, and animal waste. Municipal storm drainage systems installed to prevent flooding provide an efficient vehicle for delivery of these pollutants from their places of origin to the receiving water.

INTERNAL NUTRIENT CYCLING

Elevated nutrient loading (phosphorus) to lake systems can greatly affect lake management strategies. As a result of long-term elevated phosphorus loads, a lake can accumulate a large reserve of phosphorus in its sediments. Phosphorus accumulation promotes a perpetual condition of internal nutrient cycling within a lake system.

Internal nutrient cycling can exist in both shallow and deep lakes. The cycling process is triggered by periods of low Dissolved Oxygen (DO) at the sediment/water interface as a result of thermal stratification. Low DO causes the nutrient enriched bottom sediments to release the accumulated phosphorus content into the overlying water. The phosphorus released from the sediments is made available to algae at the lake surface during periods of mixing. In shallow lakes, intermittent calm summer conditions promote a temporary lake stratification which is frequently broken by the mixing effect of wind and wave actions. The mixing transfers sediment-released phosphorus from lower to upper layers of the lake. The re-introduction of phosphorus to the water column from bottom sediments is known as "internal loading." The loading contributes to algae blooms that negatively affect the ecology of the lake as well as the suitability of the lake to support desirable uses such as swimming, fishing, or boating. Eventually the algae die, sink to the bottom of the lake and decompose, ultimately returning the organic material (including phosphorus) back to the sediment and completing the internal nutrient cycle.



Most rooted aquatic plants obtain their nutrients from lake sediments. Nutrient enriched sediments can foster an overabundance of aquatic plants causing nuisance conditions. The proliferation of the aquatic plant curly leaf pondweed can also contribute to internal nutrient loads. This plant grows during early spring before water temperatures are favorable for other aquatic plants. Curly leaf pondweed completes its growing cycle and begins to die off by mid-summer. As with algal blooms, curly leaf pondweed sinks to the lake bottom and decomposes, further contributing to TP reserves and internal release of phosphorus by oxygen depletion during decomposition.

Effective lake management strategies must account for internal nutrient cycling dynamics. In-lake conditions favoring internal phosphorus recycling can cause poor water quality conditions to persist even with aggressive watershed management efforts. Even if watershed inputs are brought to near-zero conditions, water quality can remain poor until the reserves of phosphorus in the sediment are exhausted, a process which could possibly take decades.

Fisheries:

For Stearns County the DNR Area Fisheries Manager is Paul Diedrich, MN DNR Fisheries, 7372 SW State Hwy 25, Montrose, MN 55363, and phone: 763-675-3301, e-mail: paul.diedrich@state.mn.us. Mr. Diedrich does not have a fisheries management plan for North Lake since it does not have a public access and is not managed or stocked by the DNR.

Aquatic Vegetation

In all your discussions, distinguish between beneficial vegetation (wildlife or fish habitat, vegetative buffer zones, native species) and nuisance (impediments to recreation) or exotic/invasive (biological "threats" such as Eurasian milfoil, purple loosestrife, and curlyleaf pondweed). It is also important to remember that control of the nuisance kind of vegetation may have adverse impacts on the fishery/wildlife end of things; it is very hard to please everyone. By Minnesota Rule, aesthetics ***are not*** part of the definition of nuisances. Recreational impairment is the standard used to define nuisance conditions related to aquatic plants.

No surveys, maps, or other assessments have been completed which identify or quantify the location and vitality of remaining aquatic vegetation communities. GPS coordinates have been identified for the entire lake and volunteers will venture on the lake in spring/summer of 2010 to identify specific location of aquatic vegetation. A rain garden was constructed at the edge of a parking lot in 2009 at the Albany Area Hospital by members of the Albany Girls Scouts. Students at the Albany Area Schools will be utilized with the assistance of teachers in formulating educational materials regarding environmental aspects of North Lake. The City of Albany has sponsored the Sauk River Watershed District annual Water Festival which is an educational event for students to participate in water quality activities in helping them understand the importance of water quality and groundwater.

Wildlife

The "Blue Book," *Developing a Lake Management Plan* notes that:

> "Minnesota's lakes are home to many species of wildlife. From our famous loons and bald eagles to muskrats, otters, and frogs, wildlife is an important part of our relationship with lakes. In fact, Minnesota's abundant wildlife can be attributed largely to our wealth of surface water. From small marshes to large lakes, these waters are essential to the survival of wildlife.

The most important wildlife habitat begins at the shoreline. The more natural the shoreline, with trees, shrubs and herbaceous vegetation, the more likely that wildlife will be there. Just as important is the shallow water zone close to shore. Cattail, bulrush, and wild rice along the shoreline provide both feeding and nesting areas for wildlife. Loons, black terns and red-necked grebes are important Minnesota birds that are particularly affected by destruction of this vegetation. Underwater vegetation is also important to wildlife for many portions of their life cycle, including breeding and rearing of their young.

The primary agency charged with the management of Minnesota's wildlife is the Department of Natural Resources, Division of Fish and Wildlife, Wildlife Section. For North Lake, the DNR Area Wildlife Manager is Fred Bengtson, Assistant Wildlife Manager, St. Cloud, Phone: 320-255-4279, e-mail: fred.bengtson@state.mn.us

There are several species of ducks nesting on the lake. Several Woodduck houses have been erected on the lake and volunteers have seen many pairs of ducks consistently using the houses each spring. A local eagle has also been seen circling North Lake as a source of food. A loon or two has been seen on the lake but due to the shallow depth and it being undesirable no nest has been verified. Muskrats and mink are very visible on the lake and have been for many years. The majority of the waterfowl present on the lake is Canada Geese. They can be a nuisance to property owners and contribute to the poor water quality of the lake. It' has been estimated that nearly 500 geese call North Lake their home, but they do disappear during the winter months being the lake completely freezes over and no open water exists in the winter. Other ducks include but not limited to mallard, teal, buffalo head, and coot. The Minnesota County Biological Survey has completed the survey for Stearns County. No specific areas of high value ecological resources were noted in the immediate watershed of North Lake.

Exotic Species

No surveys have been previously conducted relating to exotic species. There are no neighboring lakes that would that have had a positive confirmation of the presence of exotic species and we have never received a vegetation management plan from the DNR. Volunteers will speak with DNR and Stearns County Soil and Water Conservation officials in an attempt to create an inventory using GIS coordinates to determine what if any exotic species are present in North Lake and their specific location. Chemical treatment would be an option to control this problem.

Nathan Olson is now the DNR's Invasive Species Specialist, 1509 1st Avenue North Fergus Falls, MN 56537, 218-739-7576 x259 phone, nathan.olson@state.mn.us.

Paul Diedrich is the DNR's Area Fisheries Supervisor, 7372 State Hwy 25 SW, Montrose, MN 55363, and telephone: (763) 675-3301, e-mail: paul.diedrich@state.mn.us.

Background

"Exotic" species -- organisms introduced into habitats where they are not native -- are severe world-wide agents of habitat alternation and degradation. A major cause of biological diversity loss throughout the world, they are considered "biological pollutants."

Introducing species accidentally or intentionally, from one habitat into another, is risky business. Freed from the predators, parasites, pathogens, and competitors that have kept their numbers in check, species introduced into new habitats often overrun their new home and crowd out native species. In the presence of enough food and favorable environment, their numbers will explode. Once established, exotics rarely can be eliminated.

Most species introductions are the work of humans. Some introductions, such as carp and purple loosestrife, are intentional and do unexpected damage. But many exotic introductions are accidental. The species are carried in on animals, vehicles, ships, commercial goods, produce, and even clothing. Some exotic introductions are ecologically harmless and some are beneficial. But other exotic introductions are harmful to recreation and ecosystems. They have caused the extinction of native species -- especially those of confined habitats such as islands and aquatic ecosystems.

The recent development of fast ocean freighters has greatly increased the risk of new exotics in the Great Lakes region. Ships take on ballast water in Europe for stability during the ocean crossing. This water is pumped out when the ships pick up their loads in Great Lakes ports. Because the ships make the crossing so much faster now, and harbors are often less polluted, more exotic species are likely to survive the journey and thrive in the new waters.

Many of the plants and animals described in this guide arrived in the Great Lakes this way. But they are now being spread throughout the continent's interior in and on boats and other recreational watercraft and equipment. This guide is designed to help water recreationalists recognize these exotics and help stop their further spread.

Eurasian watermilfoil (*Myriophyllum spicatum*) was accidentally introduced to North America from Europe. Spread westward into inland lakes primarily by boats and also by waterbirds, it reached Midwestern states between the 1950s and 1980s.

In nutrient-rich lakes it can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. In shallow areas the plant can interfere with water recreation such as boating, fishing, and swimming. The plant's floating canopy can also crowd out important native water plants.

A key factor in the plant's success is its ability to reproduce through stem fragmentation and runners. A single segment of stem and leaves can take root and form a new colony. Fragments clinging to boats and trailers can spread the plant from lake to lake. The mechanical clearing of aquatic plants for beaches, docks, and landings creates thousands of new stem fragments. Removing native vegetation crates perfect habitat for invading Eurasian watermilfoil.

Eurasian watermilfoil has difficulty becoming established in lakes with well established populations of native plants. In some lakes the plant appears to coexist with native flora and has little impact on fish and other aquatic animals.

Likely means of spread: Milfoil may become entangled in boat propellers, or may attach to keels and rudders of sailboats. Stems can become lodged among any watercraft apparatus or sports equipment that moves through the water, especially boat trailers.

Purple loosestrife (*Lythrum salicaria*) is a wetland plant from Europe and Asia. It was introduced into the East Coast of North America in the 1800s. First spreading along roads, canals, and drainage ditches, then later distributed as an ornamental, this exotic plant is in 40 states and all Canadian border provinces.

Purple loosestrife invades marshes and lakeshores, replacing cattails and other wetland plants. The plant can form dense, impenetrable stands which are unsuitable as cover, food, or nesting sites for a wide range of native wetland animals including ducks, geese, rails, bitterns, muskrats, frogs, toads, and turtles. Many are rare and endangered wetland plants and animals and are also at risk.

Purple loosestrife thrives on disturbed, moist soils, often invading after some type of construction activity. Eradicating an established stand is difficult because of an enormous number of seeds in the soil. One adult plant can disperse 2 million seeds annually. The plant is able to re-sprout from roots and broken stems that fall to the ground or into the water.

A major reason for purple loosestrife's expansion is a lack of effective predators in North America. Several European insects that only attack purple loosestrife are being tested as a possible long-term biological control of purple loosestrife in North America.

Likely means of spread: Seeds escape from gardens and nurseries into wetlands, lakes, and rivers. Once in aquatic system, moving water and wetland animals easily spreads the seeds.

Other Midwestern Aquatic Exotics

Curly-leaf pondweed (*Potamogeton crispus*) is an exotic plant that forms surface mats that interfere with aquatic recreation. The plant usually drops to the lake bottom by early July. Curly-leaf pondweed was the most severe nuisance aquatic plant in the Midwest until Eurasian watermilfoil appeared. It was accidentally introduced along with the common carp.

Flowering rush (*Botumus umbellatus*) is a perennial plant form Europe and Asia that was introduced in the Midwest as an ornamental plant. It grows in shallow areas of lakes as an emergent, and as a submersed form in water up to 10 feet deep. Its dense stands crowd out native species like bulrush. The emergent form has pink, umbellate-shaped flowers, and is 3 feet tall with triangular-shaped stems.

Round goby (*Neogobius melanostomus*) is a bottom-dwelling fish, native to Eastern Europe that entered the eastern Great Lakes in ballast water. They can spawn several times per year, grow to about 10 inches, are aggressive, and compete with native bottom-dwellers like sculpins and log perch. They are expected to be harmful to Great Lakes and inland fisheries.

Rusty crayfish (*Orconectes rusticus*) are native to streams in the Ohio, Kentucky, and Tennessee region. Spread by anglers who use them as bait, rusty crayfish are prolific and can severely reduce lake and stream vegetation, depriving native fish and their prey of cover and food. They also reduce native crayfish populations.

White perch (*Morone americana*) are native to Atlantic coastal regions and invaded the Great Lakes through the Erie and Welland canals. Prolific competitors of native fish species, white perch have the potential to cause declines of Great Lakes walleye populations.

Land Use and Zoning

The water quality of a lake or river is ultimately a reflection of the land uses within its watershed. While the specific impacts to a lake from various land uses vary as a function of local soils, topography, vegetation, precipitation, and other factors, it is ultimately the land uses which citizens have the most control over through prudent zoning

Many zoning regulations are based upon the Shoreland Management Act and/or the Minnesota Department of Natural Resources (DNR) classification of a given lake. The DNR has classified all lakes within Minnesota as General Development (GD), Recreational Development (RD), or Natural Environmental (NE) lakes, and assigned a unique identification number to the lake for ease of reference. Counties in turn have used these classifications as a tool to establish minimum lot area (width and setbacks) that is intended to protect and preserve the character reflected in the classification. Clearly any local municipal jurisdiction may have additional (and usually more restrictive) standards as well.

On any shoreland the permissible density and setbacks for virtually all new uses are determined by the lake or river classification standards established by the Department of Natural Resources. Albany Lake (DNR Lake ID #73-0177) is a Recreational Development (RD) Lake.

Natural Environment lakes are generally small, often shallow lakes with limited capacities for assimilating the impacts of development and recreational use. They often have adjacent lands with substantial constraints for development such as high water tables, exposed bedrock, and unsuitable soils. These lakes, particularly in rural areas, usually do not have much existing development or recreational use. In Stearns County, an NE management district is "established to preserve and enhance high quality waters by protecting them from pollution and to protect shorelands of waters which are unsuitable for development; to maintain a low density of development; and to maintain high standards of quality for permitted development."

Recreational Development lakes are generally medium-sized lakes of varying depths and shapes with a variety of landform, soil, and ground water situations on the lands around them. They often are characterized by moderate levels of recreational use and existing development. Development consists mainly of seasonal and year-round residences and recreationally-oriented commercial uses. Many of these lakes have capacities for accommodating additional development and use. In Stearns County the RD management district is established to "manage proposed development reasonably consistent with existing development and use; to provide for the beneficial use of public waters by the general public, as well as the riparian owners; to provide for multiplicity of lake uses; and to protect areas unsuitable for residential and commercial uses from development."

General Development lakes are generally large, deep lakes or lakes of varying sizes and depths with high levels and mixes of existing development. These lakes often are extensively used for recreation and, except for the very large lakes, are heavily developed around the shore. Second and third tiers of development are fairly common. The larger examples in this class can accommodate additional development and use. Stearns County's Shoreland Ordinance notes that "the GD management district is established to provide minimum regulations in areas presently developed as high density, multiple use areas; and to provide guidance for future growth of commercial and industrial establishments which require locations on protected waters."

Details on the Zoning Ordinance, restrictions and additional assistance are provided through the City's Zoning Department (320-845-4244), P.O. Box 370, Albany, MN 56307 or by email at albanycity@albanytel.com.

The North Lake is regulated by City Ordinance. No motorized boats including the operation of any other motorized water craft is strictly prohibited due to the lack of depth and potential hazards that lurk beneath the water's surface.

Public water access

According to the Minnesota Department of Natural Resources website, there is no note of any public accesses on North Lake. In 2010, a public canoe and/or kayak access was constructed by the City of Albany on the northwest shoreline. The public may park in the parking lot adjacent to State Hwy 238 or east entrance to North Park to utilize the canoe and/or kayak access to the lake.

Organizational Development and Communication

A second meeting was held after the vision session meeting on April 29, 2010 and 15 individuals attended with six being committee members. Several lake improvement ideas were tossed around and we thought we'd select the least expensive objectives at the moment and once we gather this information, an informative decision can be made for more expense improvements in the future.

III. Summary of Visioning/Planning Session (Held on March 31, 2010 at Albany City Hall)

The North Lake committee held this planning session on March 31, 2010, facilitated by Marian Bender. Approximately 39 people were in attendance, with about 95 percent of the participants describing themselves as year round residents. There are no cabins on the lake. The individuals were divided into small groups of five or six to identify key community concerns, assets, opportunities, and priorities. The four focus areas selected by those present were as follows:

1) Water Quality/Vegetation
2) Recreation
3) Wildlife/Habitat
4) Education

The majority of the individuals were concerned with the algae bloom and abundance of weed growth floating on the surface of the water and how this could be reduced in the future to improve the appearance of the lake. Many thought that a survey of the existing aquatic plants would be very beneficial. Mr. Schneider informed the group that much of the storm runoff north of the City empties into the North Lake and the level of the lake is controlled by a device on the southwest corner of the lake. Mr. Schneider also noted that properties south and north of the lake that contribute to the stormwater runoff must take personal responsibility for runoff into the lake form their property eliminating any contaminates that contribute to the water quality issues of the lake. Mr. Schneider also noted that their remains nearly six properties on the east side of the lake that is not served by municipal sewer and thus their septic system needs to remain in compliance with MPCA and Stearns County regulations.

The following are the goals listed for the aforementioned four focus areas:

1) Water Quality/Vegetation: Reduce Algae or fewer algae blooms, set up monitoring program to acquire base line data (phosphorus, plants, and fish), street sweeping program to prioritize street adjacent to lake, and maintain sedimentation structures. Create an aquatic vegetation maintenance program.

2) Recreation: create swimming, non-motorized boating, walking paths, fishing, public access area for canoe's, kayak, and/or paddle boats.

3) Wildlife/Habitat: improve and add woodduck nesting areas, plant wild flowers.

4) Education: educate youth and community to help save what we already have on the lake and work with the media. Define shallow lake and the function of a shallow lake. Discuss the use of rain barrels, rain gardens, shoreline restoration; restore wetland areas in upper basin storage areas, native plants, etc. Involve students relating to environmental projects.

Assets discussed were as follows: wildlife habitat, acts as storm water retention pond, winter and summer activities, abuts City's North Park, local bald eagle feeding lake.

The following individuals are responsible for proving more research and information to the group at the next meeting on April 29th:

1) Water Quality/Vegetation - Joseph Mergen
2) Recreation - Kristin Alderink
3) Wildlife/Habitat - Pat Nathe
4) Education - Nick Brandner

Joseph Mergen, Robert St. Marie, and Rolland Hanson will obtain depth information on the lake via GPS coordinates and present this information at the next group meeting.

I.V. Prioritized Goals and Action Plan

We narrowed down our objectives to the following four:

1) Canoe/kayak Access installation - City approval in June 2010, no DNR permit required. (Kristen Alderink)

2) Water Quality - RMB to conduct in June, July, August, and September of 2010. Also a sample will be taken after a run-off event. (Joe Mergen)

3) Aquatic Vegetation - Species present in the lake will be sampled by Rolland Hanson, Bob St. Marie, and Grant Pearson during the year 2010.

4) Education - information regarding the Healthy Lakes and Rivers Partnership and North Lake Committee in newsletter and newspaper (Tom Schneider)

Future objectives to be considered for the lake include, but not limited to the following:

- Construction of walk/bike path either a boardwalk or widen the existing bituminous on State Highway #238 on west side of right of way and connection to North Park.

- Construct fishing or lookout pier south of Jaycee Picnic Shelter in North Park.
- Construction of sedimentation structures for the storm sewer outlets along Lake Avenue.
- Dredge the lake to a greater depth for fish survival.
- Construct shoreline buffer improvements along Lake Avenue between 4^{th} and 5^{th} St.
- Create partnership with school to obtain on-going lake information.
-

Our next meeting will be held at the end of September. In the interim, Tom Schneider will be preparing a proposed Lake Management Plan for Don Hickman to look review and comment, but this will only be submitted in October or November. The shoreline improvements on the northwest shoreline will begin in June 2010 which includes one rain garden and the planting of native plants by Prairie Restorations, the contractor at a project cost of nearly $26,000 with 75% of the funding coming from the Stearns County Soil and Water Conservation District and the remaining 25% from the City of Albany.

Grantee Action Plan and Evaluation Form

Objective #1	Water Quality Review and identify stormwater discharge points		
Action Plan- What steps need to be done to achieve this objective:	**Action**	**By When**	**Person Responsible**
	1. Review any available water quality data collected by the City. Identify stormwater discharge points and potential additional water sample collections areas, sample parameters, and frequency.	**Summer 2011**	**Consultant**
	2.		
	3.		
	4.		
Expected Result:			
Objective #1 Mid-point Result (fill out at mid-point ONLY if grant exceeds $5,000)			
Objective #1 Actual Result (to be completed at end of grant period for final report)			Initiative Foundation Use Only

Objective #2	Aquatic Plant Survey

Action Plan- What steps need to be done to achieve this objective:

Action	By When	Person Responsible
1. Under this task the consultant will complete a full Point Intercept (PI) Aquatic Macrophyte Survey of all native and invasive plant communities within the littoral zone. At each sample point the abundance of each plant would be documented on a 1 – 3 scale, along with depth, which would allow for the creation of a bathymetric map of the lake if so desired. The point intercept grid would be established by consultant, based on the size of the lake it is anticipated a grid with 30 – 40 meter spacing would be established in the form of GPS points. All data and data points would be provided to the City in electronic and hard copy format.	**Between mid June and mid July, 2011**	**Consultant**
2.		

Expected Result:	Reduce nuisance vegetation "mats".

Objective #2 Mid-point Result (fill out at mid-point ONLY if grant exceeds $5,000)		
		Initiative Foundation Use Only

Objective #3	Water Quality Testing
Action Plan- What steps need to be done to achieve this objective:	

Action	By When	Person Responsible
1. Coordinate phosphorus and chlorophyll a water sampling in North Lake.	**Summer 2010**	**Joe M.**
2.Coordinate phosphorus and chlorophyll a water sampling in storm water holding ponds north of the lake.	**Summer 2010**	**Joe M**

Expected Result:	Identify contaminant levels.
Objective #3 Mid-point Result (fill out at mid-point ONLY if grant exceeds $5,000)	

Objective #3 Actual Result (to be completed at end of grant period for final report)		Initiative Foundation Use Only

*** Objective #4**

Complete Lake Management Plan

Action Plan- What steps need to be done to achieve this objective:

Action	By When	Person Responsible
1. The consultant will compile all of the aquatic plant survey data and water quality data and update the Lake Management Plan as started by City staff. The Plan will be written with specific goals and objectives with the purpose of being used to apply for future grant funding opportunities to support the actions within the plan.	**Completed within 60 days of the aquatic plant survey completion**	**Consultant**
2.		

Expected Result:

Reduce aquatic vegetation growth and phosphorus use.

Results: *Please note: the remaining questions are to be filled out at mid term (if grant exceeds $5,000) and at end of grant period for evaluation purposes.

Objective #4 Mid-point Result (fill out at mid-point <u>ONLY</u> if grant exceeds $5,000)

Objective #4 Actual Result (to be completed at end of grant period for final report)

Initiative Foundation Use Only

Grantee Action Plan and Evaluation Form

Objective #5	Education

Action Plan- What steps need to be done to achieve this objective:

Action	By When	Person Responsible
1. Inform public of dangers to North Lake water quality when using lawn fertilizers that contain phosphorus via newsletter and email.	**Summer 2010**	**Tom S**
2.		
3.		
4.		

Expected Result:	Reduce aquatic vegetation growth and phosphorus use.

Objective #5 Mid-point Result (fill out at mid-point ONLY if grant exceeds $5,000)		
Objective #5 Actual Result (to be completed at end of grant period for final report)		Initiative Foundation Use Only

Grantee Action Plan and Evaluation Form

Objective #6

Construct Canoe Access in North Park

Action Plan- What steps need to be done to achieve this objective:

Action	By When	Person Responsible
1. Install appropriate signage and prepare area south of Jaycee Shelter in North Park for canoe access to North Lake.	**Fall 2010**	**Joe M.**
2.		
3.		
4.		

Expected Result:

Provide recreation opportunity for residents or lake enthusiast.

Objective #6 Mid-point Result (fill out at mid-point <u>ONLY</u> if grant exceeds $5,000)

Objective #6 Actual Result (to be completed at end of grant period for final report)

Initiative Foundation Use Only

Glossary

Aerobic: Aquatic life or chemical processes that require the presence of oxygen.

Algal bloom: An unusual or excessive abundance of algae.

Alkalinity: Capacity of a lake to neutralize acid.

Anoxic: The absence of oxygen in a water column or lake; can occur near the bottom of eutrophic lakes in the summer or under the ice in the winter.

Benthic: The bottom zone of a lake, or bottom-dwelling life forms.

Best Management Practices: A practice determined by a state agency or other authority as the most effective, practicable means of preventing or reducing pollution.

Bioaccumulation: Build-up of toxic substances in fish (or other living organism) flesh. Toxic effects may be passed on to humans eating the fish.

Biological Oxygen Demand: The amount of oxygen required by aerobic microorganisms to decompose the organic matter in sample of water. Used as a measure of the degree of water pollution.

Buffer Zone: Undisturbed vegetation that can serve as to slow down and/or retain surface water runoff, and assimilate nutrients.

Chlorophyll *a*: The green pigment in plants that is essential to photosynthesis.

Clean Water Partnership (CWP) Program: A program created by the legislature in 1990 to protect and improve ground water and surface water in Minnesota by providing financial and technical assistance to local units of government interested in controlling nonpoint source pollution.

Conservation Easement: A perpetual conservation easement is a legally binding condition placed on a deed to restrict the types of development that can occur on the subject property.

Cultural eutrophication: Accelerated "aging" of a lake as a result of human activities.

Epilimnion: Deeper 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.

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

Exotic Species: Any non-native species that can cause displacement of or otherwise threaten native communities.

Fall Turnover: In the autumn as surface water loses temperature they are "turned under" (sink to lower depths) by winds and changes in water density until the lake has a relatively uniform distribution of temperature.

Feedlot: A lot or building or a group of lots or buildings used for the confined feeding, breeding or holding of animals. This definition includes areas specifically designed for confinement in which manure may accumulate or any area where the concentration of animals is such that a vegetative cover cannot be maintained. Lots used to feed and raise poultry are considered to be feedlots. Pastures are not animal feedlots.

Groundwater: water found beneath the soil surface (literally between the soil particles); groundwater is often a primary source of recharge to lakes.

Hardwater: Describes a lake with relatively high levels of dissolved minerals such as calcium and magnesium.

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.

Impervious Surface: Pavement, asphalt, roofing materials or other surfaces through which water cannot drain. The presence of impervious surfaces can increase the rates and speed of runoff from an area, and prevents groundwater recharge.

Internal Loading: Nutrients or pollutants entering a body of water from its sediments.

Lake Management: The process of study, assessment of problems, and decisions affecting the maintenance of lakes as thriving ecosystems.

Littoral zone: The shallow areas (less than 15 feet in depth) around a lake's shoreline, usually dominated by aquatic plants. These plants produce oxygen and provide food, shelter and reproduction areas for fish & animal life.

Local Unit of Government: A unit of government at the township, city or county level.

Mesotrophic Lake: A lake that is midway in nutrient concentrations (between a eutrophic and oligotrophic lake). Characterized by periodic problems with algae blooms or problem aquatic vegetation.

Native Species: An animal or plant species that is naturally present and reproducing.

Nonpoint source: Polluted runoff – nutrients or pollution sources not discharged from a single point. Common examples include runoff from feedlots, fertilized lawns, and agricultural fields.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and nonpoint source pollution.

Oligotrophic Lake: A relatively nutrient-poor lake, characterized by outstanding water clarity and high levels of oxygen in the deeper waters.

Nutrient: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Fertilizers, particularly phosphorus and nitrogen, are the most common nutrients that contribute to lake eutrophication and non-point source pollution.

pH: The scale by which the relative acidity or basic nature of waters are accessed,

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 Sources: Specific sources of nutrient or pollution discharge to a water body, i.e., a stormwater discharge pipe.

Riparian: The natural ecosystem or community associated with river or lake shoreline.

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

Sedimentation: The addition of soils to lakes, which can accelerate the "aging" process by destroying fisheries habitat, introducing soil-bound nutrients, and filling in the lake.

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

Thermocline: During summertime deeper lakes stratify by temperature to form three discrete layers; the middle layer of lake water in known as the thermocline.

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

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

Zooplankton: Microscopic animals.

Common Biological or Chemical Abbreviations

BOD	Biological Oxygen Demand
°C	degree(s) Celsius
cfs	cubic feet per second (a common measure of rate of flow)
cfu	colony forming units (a common measure of bacterial concentrations)
chl *a*	Chlorophyll *a*
cm	centimeter
COD	Chemical Oxygen Demand
Cond	conductivity
DO	dissolved oxygen
FC	fecal coliform (bacteria)
ft	feet
IR	infrared
l	liter
m	meter
mg	milligram
ml	milliliter
NH_3-N	nitrogen as ammonia
NO_2-NO_3	nitrate-nitrogen
NTU	Nephelometric Turbidity Units, standard measure of turbidity
OP	Ortho-phosphorus
ppb	parts per billion
ppm	parts per million
SD	Standard Deviation (statistical variance)
TDS	total dissolved solids
TN	total nitrogen
TP	total phosphorus
TSI	trophic status index
TSI (C)	trophic status index (based on chlorophyll *a*)
TSI (P)	trophic status index (based on total phosphorus)
TSI (S)	trophic status index (based on secchi disc transparency)
TSS	total suspended solids
μg/l	micrograms per liter
μmhos/cm	micromhos per centimeter, the standard measure of conductivity
UV	Ultraviolet

Guide to common acronyms

State and Federal Agencies

BWSR	Board of Soil & Water
COE	U.S. Army Corps of Engineers
CRP	Conservation Reserve Program - A federal government conservation program
DNR	Department of Natural Resources
DOJ	United States Department of Justice
DOT	Department of Transportation
DTED	Department of Trade and Economic Development
EPA	U.S. Environmental Protection Agency
EQB	MN Environmental Quality Board
LCCMR	Legislative-Citizen Commission on Minnesota Resources
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
OEA	MN Office of Environmental Assistance
OSHA	Occupational Safety and Health Administration
RIM	Reinvest In Minnesota - a State of Minnesota Conservation Program
SCS	Soil Conservation Service
SWCD	Soil & Water Conservation District
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish & Wildlife Service

Regional, watershed, community development, trade and advocacy groups

AMC	Association of Minnesota Counties
APA	American Planning Association
COLA	Coalition of Lake Associations
IF	Initiative Foundation
LMC	League of Minnesota Cities
MAT	Minnesota Association of Townships
MCIT	Minnesota Counties Insurance Trust
MSBA	Minnesota School Board Association
Mid-MnMA	Mid-Minnesota Association of Builders
MnSCU	Minnesota State Colleges and Universities
MW	Minnesota Waters
TIF	Tax Increment Financing

Codes and Regulations

110B	The Minnesota law that regulates non-metro county water plans
ADA	American Disabilities Act
B & B	Bed and Breakfast
BOA	Board of Adjustment
Chapter 70/80	Individual Sewage Treatment Standards
CIC Plat	Common Interest Community Plat
Class V	Class Five “Injection” well; any well which receives discharge
CSAH	County State Aid Highway
CUP	Conditional Use Permit
CWA	Clean Water Act
EAW	Environmental Assessment Worksheet
EIS	Environmental Impact Statement
EOA	Equal Opportunity Act
FOIA	Freedom of Information Act
GD	General Development (lake)
GLAR	Greater Lakes Area Association of Realtors
IAQ	Indoor Air Quality
ISTS	Individual Sewage Treatment System
LMP	Lake Management Plan
LQG	Large Quantity Generator (of hazardous waste)
MAP	Minnesota Assistance Program
OHW	Ordinary High Water
PUD	Planned Unit Development
RD	Recreational Development (lake)
ROD	Record of Decision
ROW	Right-of-Way
SBC	State Building Code
SDWA	Safe Drinking Water Act
SF	Square feet
SIZ	Shoreland Impact Zone
SQG	Small Quantity Generator (of hazardous waste)
SWMP	Stormwater Management Plan
UBC	Universal Building Code