(Draft) Lake Management Plan
for
Lake Koronis and Rice Lake

Stearns County, Minnesota

Revised: April 2011

Healthy Lakes & Rivers Partnership Committee

Koronis Lake Association
Rice Lake Association

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INTRODUCTION

In February 2010 the Rice Lake Association (RLA) and Koronis Lakes Association (KLA) were 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 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 RLA and KLA were represented at the Healthy Lakes & Rivers training sessions by: three members from RLA and five members from KLA.

Following the training sessions, the two lake associations held an inclusive community planning/visioning session designed to identify key community concerns, assets, opportunities, and priorities. The KLA and RLA held this planning session July 17, 2010, facilitated by John Sumption. Approximately 80 people were in attendance. 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 Lake Koronis and Rice Lake, and to identify the goals of the lake community served by Koronis and Rice. Ultimately it is meant to 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 and 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.

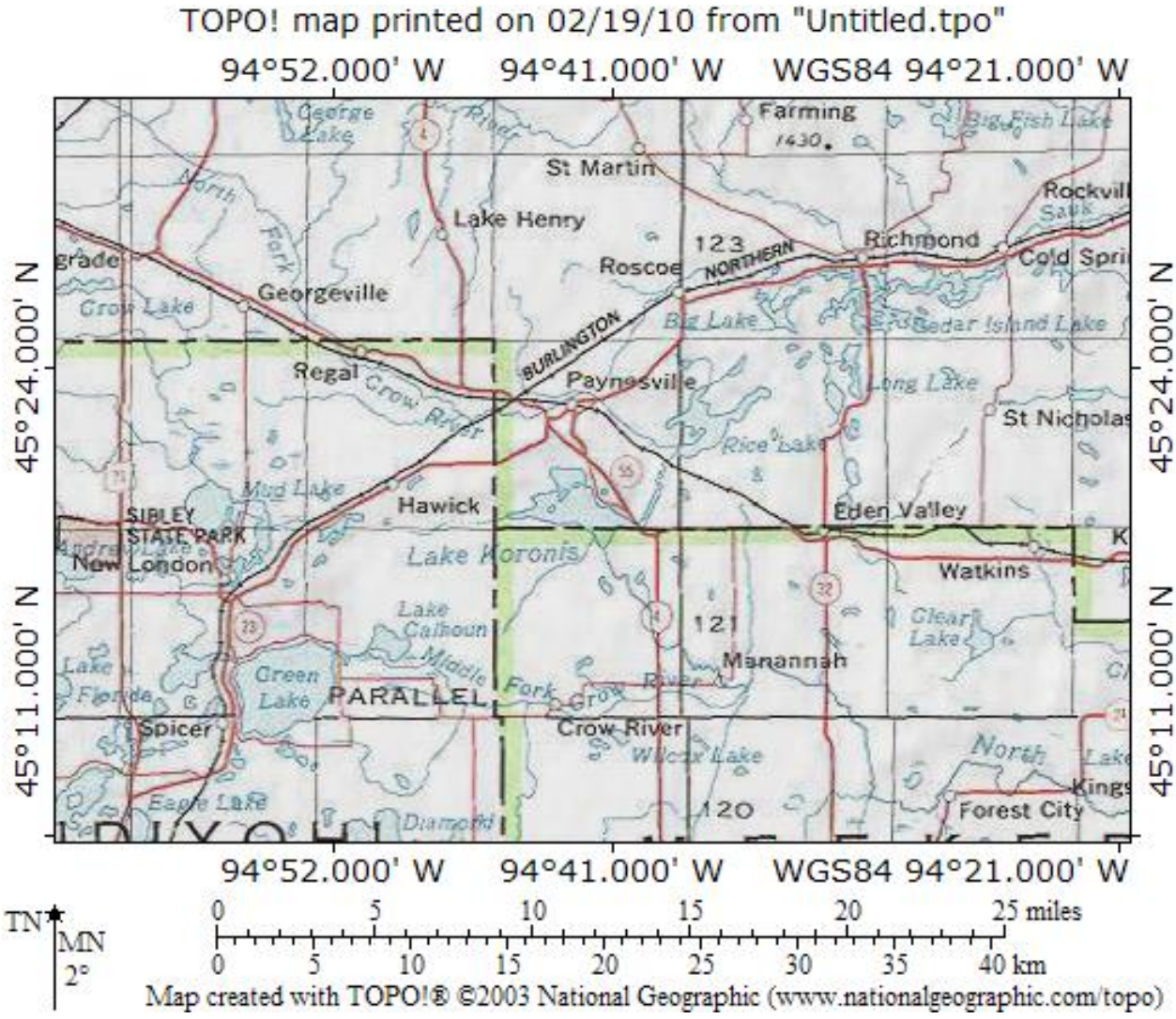
In discussing lake management issues, it is impossible to avoid all scientific or technical terms. We have tried to express our goals, measures of success and other themes as simply and clearly as possible but have included a glossary of common limnological terms at the end of the plan to assist the 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, Sibley Lake Association of Stearns County, Ann Lake Sportsmen's Club of Kanabec County, various staff from the Initiative Foundation and over thirty generous individuals.

PHYSICAL CHARACTERISTICS AND LOCATION OF LAKE KORONIS AND RICE LAKE

Lake Koronis (#74-0200) and Rice Lake (#73-0196) are located south southeast of the city of Paynesville. Lake Koronis has a surface area of 3,014 acres and maximum depth of 132 feet. Rice Lake has a surface area of 1,509.35 acres, and a maximum depth of 41 feet. Approximately 1,176 acres (39 percent) of Lake Koronis is within the littoral zone (having a depth of less than 15 feet); at Rice Lake 958 acres (63 percent) is littoral. Water clarity at Koronis averages 5.2 feet; Rice Lake the average clarity is about 3.5 feet.

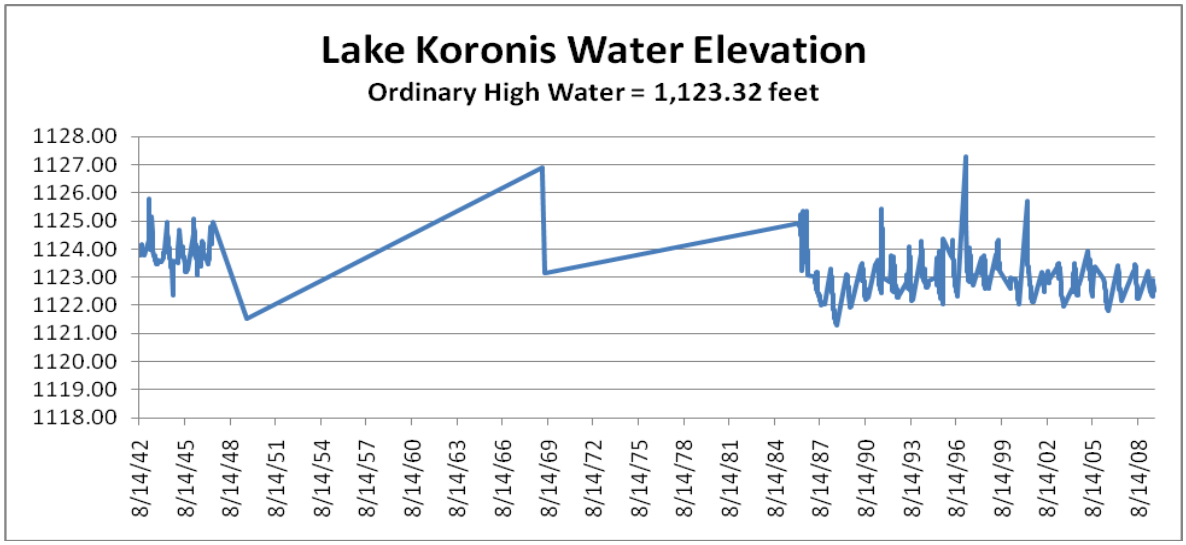
The largest inlet is the North Fork of the Crow River, which enters Lake Koronis along the east shore and outlets near the southeast corner.

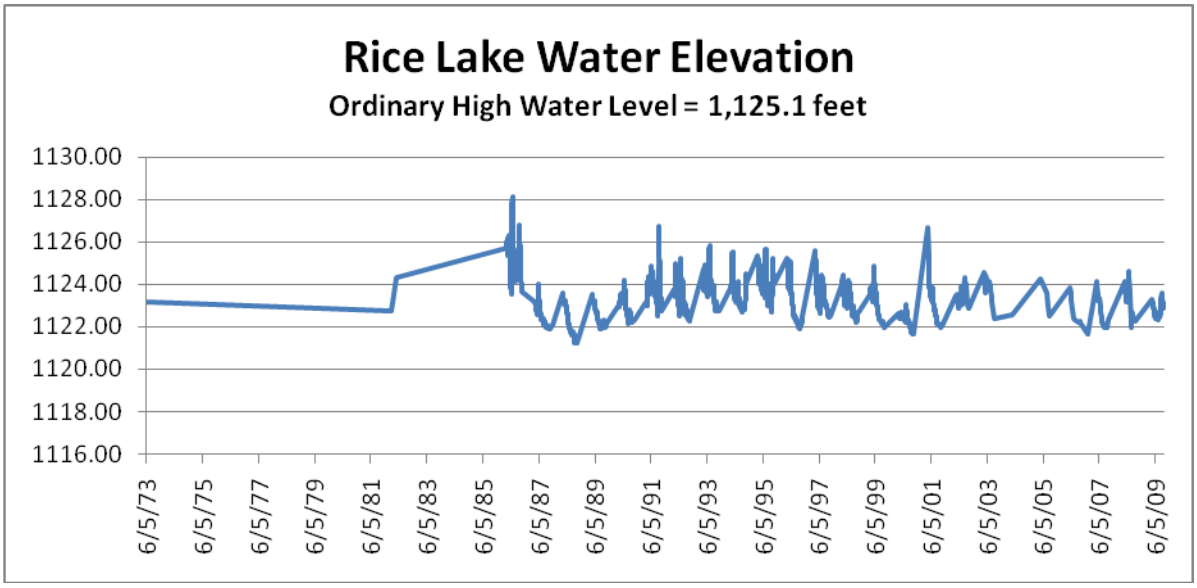


WATER LEVEL

The Minnesota Department of Natural Resources, Division of Waters has monitored Koronis Lake levels in cooperation with volunteer readers since 1942. During the period of record the lake level has varied 6.0 feet based on 2,777 readings (through September 2009). In general, water levels decline from May through September, with the exception of a slight increase in mid-July in response to several storms.

	Highest Recorded (feet/date)	Lowest Recorded (feet/date)	Ordinary High Water (feet)
Koronis	1,127.28 ft (April 9, 1997)	1,121.28 ft (October 8, 1988)	1,123.32 ft.
Rice	1128.16 ft (June 24, 1986)	1,121.22 ft (September 9, 1988)	1,125.1 ft.





PRECIPITATION

The Minnesota Pollution Control Agency conducted many Lake Assessment Program (LAP) studies in Stearns County and reports 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.

WATERSHED

The 2010 Lake Management Plan presented estimates of existing land cover within the watershed (prepared by Minnesota Planning). The table below compares these to typical ranges for the entire ecoregion (presented in the Two Rivers Lake – MPCA Lake Assessment Program report, 2003) showing that 21 years ago the watershed was less urbanized (residential), more agricultural, less forested, and with fewer surviving wetlands that most of the rest of the region.

Land Use Type	**Rice-Koronis Watershed Land Cover 1989**			**Typical Range for North Central Hardwoods Eco-region**	
	Acres	Percentage		Percentage	
Residential	5,051	2.5%		2-9%	
Agricultural	133,889	67.2%		22-50%	
Prairie – Pasture/grasslands	32,709	16.4%		11-25%	
Forest	15,444	7.8%		6-25%	
Lake	6,726	3.4%		Water & Marsh: 14-30%	
Wetland	5,247	2.6%			
Total	199,178 acres			122,228 acres	

INTRODUCTION AND HISTORY OF YOUR LAKE/RIVER ASSOCIATIONS

In 2002, the Rice Lake Association and the Koronis Lake Association both sent teams of citizen leaders to the Initiative Foundation's Healthy Lakes & Rivers Partnership program to develop a Lake Management Plan. This effort was supplemented by assistance from the Stearns County Soil & Water Conservation District (SWCD) which also provided funding through the MN Board of Water & Soil Resources (BWSR) to coordinate planning and support projects which lead to tangible, measureable outcomes. The resulting 2003 Lake Management Plan (for both lakes) is a primary source of the history presented below, and is also still available online at the SWCD website: http://www.stearnscountyswcd.net/Rice-Koronis%20Lakeshed%20Management%20Plan/ricekoronis_lake_management_plan.htm

LAKE HISTORY FROM 2003 LAKE MANAGEMENT PLAN

The Rice and Koronis Lakes area is rich with cultural and natural history accounts and events. Over the past 100 or so years, there have been numerous events in and around the lakes that have affected their character and use. The following table summarizes some of the more important events:

Year	Event
1856	First attempt by settlers to form a community in the Paynesville area.
1857	The town site that would eventually become the City of Paynesville was established. Settlers began moving into the area that year.
1960	A total of 14 resorts were operating on Lake Koronis. By1987, only four resorts remained operating on Koronis, and three on Rice Lake.
1967	There were 180 seasonal and 96 permanent dwellings (276 total) on Lake Koronis and 116 seasonal and 30 permanent dwellings (146 total) on Rice Lake.
1971	The Koronis Lake Association (KLA) was formed.
1975	The Rice Lake Association (RLA) was formed.
1979	A spillway project and a walleye-rearing pond were constructed with support from RLA. The pond was used for three years.
1979	RLA had 183 members that paid $5/annual membership dues.
1982	Since 1967, the number of dwellings on Lake Koronis increased by 79 percent to 293 seasonal and 202 permanent homes (495 total). The number of dwellings on Rice Lake increased by 86 percent to 201 seasonal and 87 permanent homes (288 total) over the same 15 year period.
1983	RLA and KLA work together to pursue efforts to address issues on a watershed basis.
1984	Petition filed with the Minnesota Water Resources Board to create a watershed district.
1985	The MWRB established the North Fork Crow River Watershed District (NFCRWD).
1987	The first overall Watershed Plan was completed and adopted for the NFCRWD.
1989	RLA contributes $700 for the construction of an earthen dam project on the east end of the lake and $575 towards a retention pond project constructed by the Paynesville Sportsman's Club.
2001	The two lake association jointly received grants from the Initiative Foundation for the HRLP program and from BWSR through the Challenge Grant program.

The 2010 Lake Management Plan also includes a summary of completed Lake Association Projects:

Year	Project/Description
1979	Water quality study – John Barten completed a nutrient and hydrologic budget study of Lake Koronis for this at St. Cloud State University. He presented the study to the Koronis Lake Association in1979.
1982	Water diversion study – A report on ways to restore Lake Koronis was prepared by Hickok & Associates for the KLA. One of the recommendations from the study proposed the diversion of water from the North Fork Crow River around Lake Koronis.
1995	Diagnostic Feasibility Study – a diagnostic feasibility study for the two lakes was completed as part of the Clean Water Partnership grant (Phase I). The Phase II or implementation portion of the CWP grant began the following year and continued for several years.
1997	Several water quality projects were completed in 1997 including: • Septic system upgrades – 47 systems were upgraded with loans from the Revolving Loan Fund project on the two lakes ($290,000) • One livestock exclusion project ($1,000) • Four sediment control projects ($88,000) • Six stabilization projects installed, including two on the North Fork Crow River and four on the two lakes ($48,500) • Three manure management projects ($159,000).
1998	Crestridge Road project completed.
1998	Aldon Heights project.
1998	Paynesville Township drainage system repairs completed.
2005	Roberg Diversion: A diversion structure was installed near the Roberg Farm on Co Rd 20 one quarter mile northeast of the outlet bridge in the east ditch right-of-way. This structure diverts surface water runoff in the east road ditch from going into Lake Koronis. All surface water is diverted except the heaviest of rains away from the lake and into the North Fork Crow River downstream from the lake.
2006	Doug Larson Project: Located south of Co Rd 20 and east of Co Rd 25 in Meeker County. This project re-established wetlands on land owned by Doug Larson and Tom Burr. The natural surface waterway was repaired. Once the surface water enters the wooded creek area, it is held back and slowed down by a 25 foot high, 150 foot long earthen dam. Water is released slowly back into the creek and into Lake Koronis.
2007	Randall Feedlot: Located south of Co Rd 20 in Section 6, Union Grove Township, and Meeker County. The pole building that was being used for shelter for livestock and storage for hay was removed and the manure pack was cleaned up. This facility was adjacent to a significant drainage creek flowing into Lake Koronis.
2008	Recreational Trail Bridge: A 60 foot bridge was used to span an environmentally sensitive area, including fish spawning every spring. The bridge runs parallel to Baywater Road and also has a fishing bump-out for public use.
2002-2010	Paynesville Water Festival: This one day festival in the spring of each year educates Paynesville Area Middle School fifth graders about ground water, surface water, erosion, contamination and other areas related to water quality. KLA has been a contributor each year to the program.

2006-2009	Crow River Clean-up: The Koronis Lake Association has been actively involved in the clean-up of the North Fork Crow River during September each year. We have helped the Paynesville Trail Guards haul junk and debris out of the river as it passes through the city of Paynesville.
2007-2009	Pheasants Forever/CRP: KLA has contributed over $6500 to the Stearns County Soil and Water Conservation District to help pay for one staff salary. This staffer has enlisted several farmers with land near ditches and streams in the North Fork Crow River Watershed District into CRP. A strip of land 50 feet wide adjacent to the ditch or stream on the farmers land has been enrolled into the CRP program. This reduces nutrient loading into the river and also compensates the landowner for the loss of cropland.

Two Individual Septic Treatment System (ISTS) studies have been initiated: one completed and the second in progress on these two lakes. In 1996, the study largely involved the educational component. About 25% of the ISTS around both lakes were found to be out of compliance. The worst systems were required to upgrade. The latest study, started in 2007, is being completed through the NFCRWD with the cooperation of Kandiyohi, Meeker, Pope and Stearns counties. The involvement of the counties ensures that all ISTS out of compliance will be brought up to code. This study is being conducted throughout the entire watershed district and will be completed in 2012-13.

Lake Koronis and Rice Lake have been invited to participate in the Healthy Lakes and Rivers Program offered through the Initiative Foundation first in 2002, and now again in 2010. This program helps all of us focus on positive ways to improve the quality of our lakes.

Efforts to clean up our lakes has been supported by the cooperation of the four counties previously mentioned Paynesville Township, City of Paynesville, Union Grove Township and the Paynesville Sportsmen's Club.

KLA has helped with water monitoring every two weeks during 2010. Previously we have helped with this project but not as often.

KLA placed curb markers on storm sewers in Paynesville to raise awareness. What goes down our sewers ends up in our rivers and lakes.

KLA helps to fund life guards at the public beach on Lake Koronis.

Additional history is available on the *Natural Resource Inventory* webpage maintained by the SWCD:
http://www.stearnscountyswcd.net/Rice-Koronis%20Lakeshed%20Management%20Plan/ricekoronis_lake_management_resource_inventory.htm

North Fork Crow River Watershed District (NFCRWD) is conducting a project to inspect all of the individual subsurface sewage treatment systems in the watershed. Stearns County hired an

inspector to complete the inspections. Her salary is paid by NFCRWD. The systems around Rice were inspected in 2007 and around Koronis in 2008. Both now have 100% of the inspections completed and are up to code.

ASSOCIATION HISTORY

The Koronis Lake Association was formed into a group of lake residents in 1971. This group noticed other lakes were forming associations, and this seemed like a good opportunity to do something about water quality and their enjoyment of Lake Koronis. It is believed the first board members were Mary Ann Erdmann, Bill Henderson, Bob Monson, Dwight Putzke, Harold Putzke, and Virgel Vagle. Vagle became the first president of the association. Other's who have served as presidents are Paul Bugbee, Peter Jacobson, and the current president Diane Rittenhouse.

The association's motto, written in 1971, "An association formed to promote the protection and improvement of Lake Koronis" is just as true today as it was 39 years ago.

In the 1970's and the early 1980's, two major studies were done: first, a study of the sources of nutrient loading into Lake Koronis, and second, a feasibility study which assessed whether a diversion of much of the water in the North Fork Crow River around Lake Koronis would result in a reduction of nutrient loading in the lake.

In the mid 1980's, the Koronis Lake Association and the Rice Lake Association were instrumental in the establishment of the North Fork Crow River Watershed District (NFCRWD). This district included all of the sub-watersheds that flow into the North Fork Crow River through Rice Lake and Lake Koronis, as well as all of the sub-watersheds flowing into both lakes.

Several small water quality projects have been completed from the mid 1980's to the present. (See pages 7-9 for a listing of completed projects.)

WATER QUALITY

Since 1974, citizen volunteers from Rice and Koronis Lakes have participated in the Minnesota Pollution Control Agency's (MPCA) Citizen Lake Monitoring Program (CLMP), recording secchi disc transparency – a measure of water clarity. For Koronis Lake, Roland Ebent, William H. Moyer, Jim Paster, Greg Berg, Harry Thielen, Garry Swenson, Mark Schmisek, and the North Fork Crow River Watershed District have been responsible for these efforts in recent years. On Rice Lake the volunteers Elaine Peterson, Pamela Bosshart, Roger and Karen Reede, Gary Skartvedt, Bob Vadner, Vince Miller, Mark Schmisek, Dallas Karl, and the watershed district submitted transparency data.

On the MPCA's web-site link, *Lake Water Quality Database*, additional water chemistry data is reported. The MPCA's *Environmental Database Access* system also provides additional water chemistry data which includes total phosphorus concentrations as well as other data.

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 algal productivity. Since most people value lakes with low algae productivity, the lower the TSI value, the healthier the lake. The table below explains TSI and trophic status.

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

Based on the limited data provided on the MPCA website, an average concentration (or depth) for the key TSI parameters can be determined, and the associated TSI score calculated.

Average TSI Measurements for Koronis Lake, 1973-2009.

Year	Chlorophyll *a* (µg/L)	Total Phosphorus (µg/L)	Secchi Depth (feet)	Average TSI
1973	---	---	6.6	50.1
1974	---	---	8.8	46.3
1975	---	---	5.3	53.2
1976	---	---	6.6	49.9
1977	---	---	5.8	51.8
1978	---	---	7.4	49.1
1980	4.0	50.0	17.4	46.9
1985	---	---	5.2	53.9
1986	---	---	6.1	52.3
1987	---	---	5.2	54.6
1988	---	---	7.3	48.9
1989	---	---	9.4	45.2
1990	---	---	8.6	47.0
1991	8.6	39.9	8.0	49.5
1992	37.0	59.8	10.3	49.9
1993	---	---	6.8	51.3
1994	---	---	8.0	48.4
1995	---	---	4.3	56.5
1999	---	---	11.7	42.8
2001	23.0	42.3	5.6	54.9
2002	29.6	60.1	10.1	46.9
2003	5.0	52.5	10.5	46.9
2004	22.3	56.5	11.1	45.4
2005	17.0	72.8	10.0	46.8
2006	8.3	28.0	8.0	49.1
2007	17.5	42.8	6.7	51.5
2008	19.0	45.3	6.8	50.8
2009	12.3	57.2	8.6	54.0

These data suggest that water quality in Lake Koronis routinely exhibits conditions in the mesotrophic range (a score above 40 but below 50) or lower eutrophic range (above 50 but below 70).

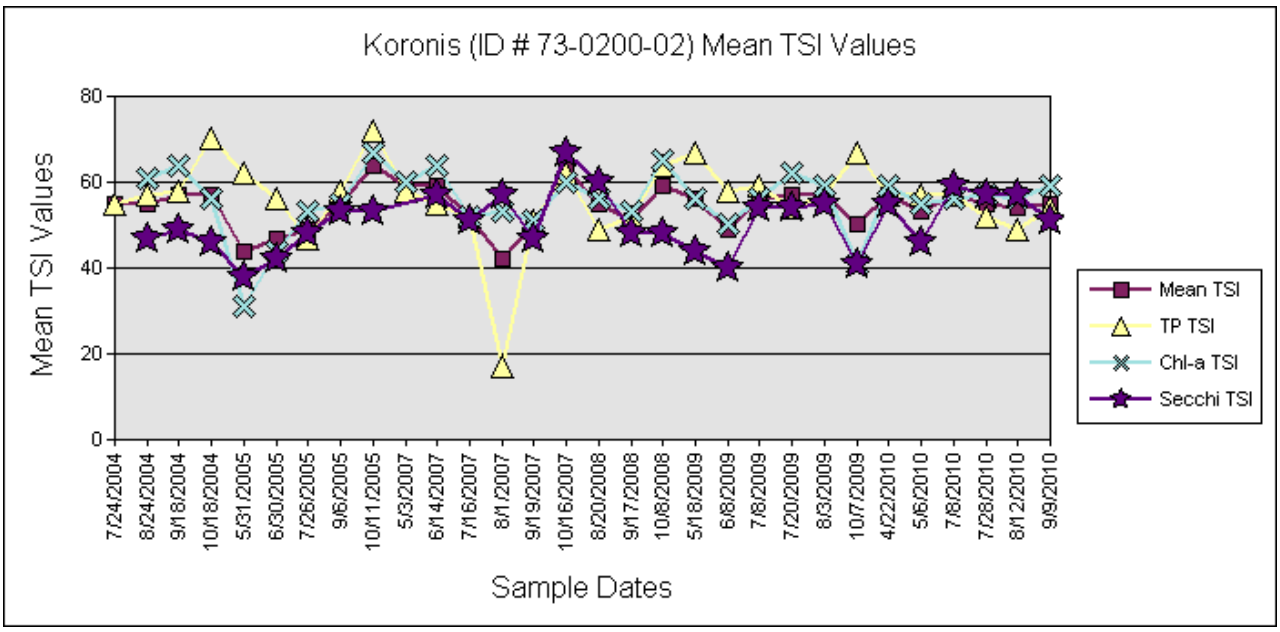
In the MPCA's *Report on the Transparency of Minnesota Lakes* (2006 edition), these data were statistically analyzed. Lake Koronis was classified as demonstrating *no trend* with respect to water clarity.

Average TSI Measurements for Rice Lake, 1947-2009.

Year	Chlorophyll *a* (µg/L)	Total Phosphorus (µg/L)	Secchi Depth (feet)	Average TSI
1947	---	34.0	---	55.0
1958	---	---	2.0	67.1
1976	---	---	5.0	54.9
1977	---	---	5.2	56.2
1979	---	85.3	5.6	56.6
1980	4.0	77.0	4.0	61.5
1981	---	69.5	4.6	57.7
1982	---	---	5.4	56.5
1983	---	---	5.9	53.8
1989	---	---	2.4	65.2
1990	---	---	5.0	57.8
1991	9.7	57.4	6.2	54.4
1992	57.7	77.9	6.0	58.3
1993	---	---	6.5	52.3
1994	---	---	6.4	54.1
1995	---	---	4.6	57.7
1996	---	---	5.1	57.7
1997	---	---	5.9	54.5
1998	---	---	5.4	54.8
1999	---	---	5.5	55.2
2000	---	---	5.9	54.3
2001	28.0	76.4	6.2	53.4
2002	29.0	78.9	6.9	52.9
2003	34.0	72.3	7.3	54.0
2004	44.3	63.8	7.4	51.4
2005	32.6	86.4	8.2	50.6
2006	14.8	37.7	5.0	57.2
2007	42.1	64.4	3.8	61.0
2008	39.3	67.0	4.2	58.9
2009	35.3	84.3	7.5	59.3

This data suggests that water quality in Rice Lake routinely exhibits conditions in the upper eutrophic range (a score above 50 but below 70).

In the MPCA's *Report on the Transparency of Minnesota Lakes* (2006 edition), these data were statistically analyzed Rice Lake was classified as demonstrating *improving trend* with respect to water clarity.



The graph above shows the long-term trend in Trophic Status Index values the years for which data are available for **Koronis Lake**. The variation observed within a single year reflects naturally occurring impacts of temperature, precipitation and water level; the important *take home message* of this graph is that the data suggests range in mesotrophic or lower eutrophic conditions since data were first collected in 1973.

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 Minnesota Pollution Control Agency (MPCA) *Environmental Data Access* database. It compares observed surface water results in Lake Koronis and Rice Lake to common water quality ranges for lakes within the Central Hardwood Forest Eco-region.

Average Summer Water Quality and Trophic Status Indicators

Parameter	Typical Range: Central Hardwood Forest Eco-region (25^{th}-75^{th} Percentile)	Koronis Lake (#73-0200)	Rice Lake (#73-0196)
Total Phosphorus (µg/L)	23 – 50	59.2 + 51.2	112.9 + 203.4
Chlorophyll a (µg/L) mean	5-22	18.2 + 20.95	32.7+ 24.3
Chlorophyll a (µg/L) maximum	7 – 37	147	129
Secchi disc (feet)	4.9 – 10.5	8.01 + 4.10	5.6 + 3.9
Total Kjeldahl Nitrogen (mg/L)	< 0.60 – 1.2	1.24 + 0.25	1.4 + 0.3
Nitrite + Nitrate Nitrogen (mg/L)	<0.01	0.43 + 0.34	0.42 + 0.50
Alkalinity (mg/L)	75-150	202.9 + 23.9	195.2 + 39.8
Color (Pt-Color units)	10 – 20	15 + 0	19.3 + 7.0
pH	8.6 – 8.8	8.2 + 0.3	8.3 + 0.5
Chloride (mg/L)	4 – 10	12.5 + 2.0	11.2 + 6.0
Total Suspended Solids (mg/L)	2 – 6	4.7 + 2.8	7.3 + 4.1
Conductivity (µmhos/cm)	300 – 400	292.3 + 56.2	417.2 + 82.4

A third application of these data is to compare phosphorus concentrations to the MPCA water quality criterion for swimming and other recreational contact. For the 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 the 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 also 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 between 1987 and 2009 is placed in STORET. The following summary is presented on the MPCA website:

Name	Mean Total Phosphorus (µg/l)	Carlson's Trophic Stratus Index (phosphorus)	MPCA Swimming Criterion
Lake Koronis	42.0	58	Partial-Support
Rice Lake	60.0	63	Non-Support

Based on the phosphorus data presented above, Rice Lake does not support "fishable/swimmable" standards, and Koronis Lake only provides partial support for recreational use and contact.

The North Fork-Crow River Watershed District (NFCRWD) is also a primary partner in protecting and restoring water quality in the Rice-Koronis Basin. Created on May 10, 1985 by citizen petition, the district administered a budget of $663,000 in 2007 for monitoring, permitting, projects, ditch maintenance and repair, and education. The District's address is: 100 Prairie Avenue North, PO Box 40, Brooten, MN 56314, (320) 346-2869, nfcrwsd@tds.net. The MPCA will complete a total maximum daily load (TMDL) study of Rice Lake in June, 2011. The study is administered through the NFCRWD.

FISHERIES

The Minnesota Department of Natural Resources (DNR) provides the following report of fishery on Lake Koronis (current to July 27, 2003).

A fish population assessment of Lake Koronis was conducted in late July of 2003. Koronis is a large, deep, and productive lake located primarily in Stearns County. Koronis is a popular fishery for walleye, northern pike, smallmouth bass, and bluegill. Koronis receives moderate recreational use during the summer months. The lake is highly developed with 507 homes and cabins (400 in Stearns Cty and 107 in Meeker Cty). In addition, the City of Paynesville is within two miles of the lake. Nutrient runoff enters Koronis from agricultural, city storm sewer, and lake residential sources. There are five public access sites on Koronis. Aquatic vegetation densities are variable yearly in the lake. Hardstem bulrush stands are limited within the lake. There are three large islands located on Koronis. Shoalwater substrates are varied with boulder, rubble, gravel, sand, and silt. Water clarity was moderate to low during the 2003 population assessment (secchi=5.2 feet). Water levels were normal during the spring and early summer, but low by fall due to drought conditions in 2003. The largest inlet is the North Fork of the Crow River, which enters Koronis along the east shore and outlets near the southeast corner.

Black crappie numbers were low in 2003 (0.5 fish/trapnet) and near the low end of the normal range for similar lakes. The Koronis black crappie historical average catch rate is 0.7 fish/trapnet. The 2003 black crappie average size was small (0.16 pounds and 5.9 inches) from trapnets. The Koronis black crappie historical average length is 8.5 inches. Black crappie growth rates were within or above the normal ranges for ages 1-4 compared to area lakes. The 2002 black crappie year class comprised 86% of the 2003 total black crappie catch in Koronis.

Bluegill numbers were low to moderate in 2003 (12.1 fish/trapnet) and within the normal range for similar lakes. The Koronis bluegill historical average catch rate is 8.5 fish/trapnet. The 2003 bluegill average size was small (0.04 lbs. and 3.7 inches) from trapnets. The Koronis bluegill historical average length is 4.9 inches from trapnets.

Northern pike numbers were moderate to high in 2003 (5.6 fish/gillnet) and within the normal range for similar lakes. The Koronis northern pike historical average catch rate is 2.2 fish/gillnet. The 2003 northern pike average size was moderate (3.7 lbs. and 24.9 inches) from gillnets. The Koronis northern pike historical average length is 23.5 inches from gillnets. Northern pike growth rates in Koronis were generally above the normal ranges compared to area lakes. The 2001 Northern pike year class comprised 51% of the 2003 total northern pike assessment catch in Koronis. The largest northern pike captured was 36.5 inches in the 2003 assessment.

Smallmouth bass numbers were moderate in 2003 (1.0 fish/gillnet), but above the normal range for similar lakes. The smallmouth bass historical average catch rate is 0.6 fish/gillnet from Koronis. The 2003 smallmouth bass average size was moderate (1.3 lbs. and 11.3

inches) from gillnets. The smallmouth bass historical average length is 12.7 inches from gillnets. The 2002 smallmouth bass year class comprised 36% of the total 2003 smallmouth bass summer assessment catch in Koronis. Smallmouth bass growth rates in Koronis were generally above the normal ranges compared to similar area lakes. The largest smallmouth bass captured in the 2003 summer assessment was 20.0 inches.

Largemouth bass numbers were low in the Koronis 2003 spring electrofishing survey (15.3 fish/hour). The Spicer area historical average largemouth bass catch rate is 46.1 fish/hour from spring electrofishing. Previous spring electrofishing largemouth bass catch rates for Koronis were moderate in 1990 (36.7 fish/hour, 9.2 inches average size) and 1991 (26.4 fish/hour, 10.0 inches average size). The 2003 largemouth bass average size was moderate (1.21 pounds and 12.2 inches) from spring electrofishing. The 2000 year class comprised 43% of the Koronis 2003 total spring electrofishing largemouth bass catch. Koronis largemouth bass growth rates were generally above the normal ranges compared to area lakes. The largest largemouth bass captured during the Koronis 2003 spring electrofishing survey was 16.1 inches.

Tullibee "cisco" numbers were low in 2003 (0.9 fish/gillnet) and near the low end of the normal range for similar lakes. The tullibee historical average catch rate is 1.2 fish/gillnet for Koronis. The 2003 tullibee average size was large (1.57 lbs. and 13.9 inches) from gillnets. The tullibee historical average length is 12.6 inches from gillnets. Tullibee are an important forage species for both large northern pike and large walleye.

Yellow perch numbers were high in 2003 (68.8 fish/gillnet) compared to the normal range for similar lakes. The yellow perch historical average catch rate is 65.3 fish/gillnet for Koronis. The 2003 yellow perch average size was small (0.11 lbs. and 6.2 inches) from gillnets. The yellow perch historical average length is 6.9 inches from gillnets.

Walleye abundance in 2003 (7.3 fish/gillnet) was within the normal range for similar lakes, but slightly below the Koronis historical average catch rate (8.9 fish/gillnet). The 2003 walleye average weight and length were 1.44 lbs. and 14.9 inches respectively from gillnets. The walleye historical average length is 13.7 inches from gillnets. The catch rate of quality size (15.0 inches) and larger walleye in 2003 (1.5 fish/gillnet) was lower than the historical average (2.7 fish/gillnet) for Koronis. The 2001 year class (stocked and natural reproduction) comprised 34% of the Koronis total 2003 walleye assessment catch. Walleye growth rates calculated from the 2003 Koronis assessment were generally below the normal ranges for ages 1-8 compared to area lakes, but slightly above average compared to historical growth rates for Koronis.

Walleye natural reproduction in Koronis was generally both frequent and adequate to sustain walleye numbers based on previous fall and summer surveys from 1993-2003. Walleye fingerlings (2,830 fish, 215 pounds) were last stocked in Koronis during 1996. Walleye fry were stocked during 1996, and 2001-2003 as a 10% return of walleye eggs taken for the DNR statewide walleye hatching program. Low young of year "YOY" walleye numbers (10.9 YOY walleye/hour, 6.7 inches average size) were captured in the 2003 fall night electrofishing survey. A large 2001 year class from natural reproduction (79%) and

stocking of fry (21%) was documented in the Koronis 2001 fall electrofishing survey (84.9 YOY/hour). The fall electrofishing YOY walleye historical average catch rate is 35.4 YOY walleye/hour for Koronis.

Rock bass numbers were high in 2003 (8.0 fish/gillnet) compared to the normal range for similar lakes. The rock bass historical average catch rate is 1.4 fish/gillnet for Koronis. The 2003 rock bass average size was small (0.19 lbs. and 6.1 inches) from gillnets. The Koronis rock bass historical average length is 7.2 inches from gillnets.

Other species of interest captured in 2003 include low numbers of black bullhead (4.8 fish/gillnet, 0.9 fish/trapnet) and carp (0.0 fish/gillnet, 0.1 fish/trapnet) from Koronis. The Koronis historical average catch rates for black bullhead are 21.0 fish/gillnet and 3.1 fish/trapnet. The Koronis historical average catch rates for carp are 0.5 fish/gillnet and 1.7 fish/trapnet.

Current fish management activities on Koronis include protecting the important aquatic vegetation such as bulrush through the permit process, participating in local watershed projects, stocking various species as needed, and stocking walleye fingerlings after two consecutive years of poor natural reproduction as documented by fall night electrofishing surveys. The Koronis fishery will be surveyed again for YOY walleye in the 2004 fall and all fish species during the 2007 summer.

The Rice Lake fishery was surveyed on July 16, 2007.

A resurvey of Rice Lake was conducted in mid July of 2007. Rice is a large, moderately deep, and productive lake located in Stearns County. Rice is a popular fishery for walleye, northern pike, and black crappie. There are two public access sites on Rice. Rice receives moderate recreational use during the summer months. The lake is highly developed with approximately 288 homes and cabins. There is one small resort (East end) and a large RV campground (Northeast end). A church camp is located along the southeast shore. In addition, the city of Paynesville is within four miles of the lake. The immediate shoreline area is a mixture of hardwoods and residential development with lesser amounts of wetlands, grassland, and pasture areas. The surrounding watershed is a mixture of rolling hardwood and row crop areas, feedlots/pastures, wetlands, and residential development. Nutrient runoff enters Rice from agricultural row crops, feedlots/pasture areas, city storm sewer, and lake residential sources.

Water clarity was moderate to low during the June and July of 2007 (secchi=3.5 feet). Nutrient levels (total phosphorus=0.049 ppm, chlorophyll a=36.3 ppm) were moderately high during June of 2007. Aquatic vegetation densities are variable in the lake on a yearly basis. High frequency occurrence and abundance of submergent vegetation species included northern milfoil, water celery, sago pondweed, and clasping-leaf pondweed. Less desirable aquatic vegetation species present in high occurrence and abundance include curly-leaf pondweed, muskgrass, water moss, filamentous algae, and blue-green algae in 2007. Severe blue-green algae blooms are a common occurrence on Rice during mid to late summer.

Emergent vegetation stands (cattails) are limited within the lake (outlet area, north bay). Shoalwater substrates are varied with rubble, marl, muck, clay, gravel, sand, and silt. Water levels were below normal during the 2007 summer. The largest inlet is the North Fork of the Crow River, which enters Rice along the southwest corner and outlets about 100 yards south of where it enters the lake. Rice Lake is upstream and connects to Lake Koronis via the North Fork of the Crow River. Walleye from both Rice and Koronis spawn in the North Fork of the Crow River upstream of Rice Lake. Walleye also spawn adjacent to an east shore point area in Rice. Both Rice and Koronis are periodic walleye egg take sites for the statewide walleye propagation program. A northern pike spawning area is located along the northwest shore of the northeast bay. Commercial harvest of carp, black bullhead, bigmouth/smallmouth buffalo and white sucker has occurred in past years, but none since 2001 (9,150 pounds of carp, 40 pounds of bigmouth/smallmouth buffalo, and 860 pounds of white sucker).

Rice is managed primarily for walleye and black crappie with northern pike, bluegill, and yellow perch as secondary species.

Black crappie numbers were high in 2007 (7.73 fish/trapnet) compared to the normal range for similar lakes and above the Rice historical average catch rate (5.48 fish/trapnet). The 2007 black crappie average size was small (0.25 pounds and 7.53 inches) from trapnets. The black crappie historical average length is 8.51 inches from trapnets. The catch rate of quality size (8.00 inches) and larger black crappie was low (1.87 fish/trapnet) in the 2007 resurvey. Black crappie growth rates were within the Spicer Area normal ranges for ages 1-4, and above the normal range for age 5. The 2005 black crappie year class comprised 81% of the 2007 black crappie gillnet and trapnet catch in Rice.

Bluegill numbers were moderate in 2007 (23.73 fish/trapnet) compared to the normal range for similar lakes, but above the Rice historical average catch rate (13.91 fish/trapnet). The 2007 bluegill average size was small (0.09 pounds and 4.78 inches) from trapnets. The bluegill historical average length is 5.32 inches from trapnets. The catch rate of quality size (6.00 inches) and larger bluegill was moderate to low (3.61 fish/trapnet) in the 2007 resurvey. There were abundant young of year "YOY" bluegill (50.43 fish/haul, 1.28 inches average length) captured in the 2007 shoreline seine hauls. Bluegill growth rates were within the Spicer Area normal ranges for ages 1-2, and above the normal ranges for ages 3-5. The 2005 year class comprised 61% of the 2007 bluegill gillnet and trapnet catch.

Northern pike numbers were abundant in 2007 (13.14 fish/gillnet) compared to the normal range for similar lakes and above the Rice historical average catch rate (3.50 fish/gillnet). The 2007 northern pike average size was small to moderate (2.77 pounds and 23.14 inches) from gillnets. The northern pike historical average length is 22.41 inches from gillnets. The 2007 catch rate of preferred size (28.00 inches) and larger northern pike was moderate (1.14 fish/gillnet). Northern pike growth rates in Rice were within the Spicer Area normal ranges for ages 1-7. The 2005 and 2004 year classes comprised 52% and 26% respectively of the 2007 gillnet and trapnet catch. The largest northern pike captured in the 2007 resurvey was 37.80 inches.

Smallmouth bass numbers were moderate in 2007 (0.43 fish/gillnet) compared to the normal range for similar lakes, but above the Rice historical average catch rate (0.11 fish/gillnet). The 2007 spring electrofishing catch rate was low (2.22 fish/hour). The 2007 smallmouth bass average size was large (2.50 pounds and 16.09 inches) from gillnets. The 2007 smallmouth bass average size was moderate (1.79 pounds and 14.20 inches) from spring electrofishing. The smallmouth bass historical average length is 15.23 inches from gillnets. There were low numbers of YOY smallmouth bass (1.29 fish/haul, 2.97 inches average length) captured in the 2007 shoreline seine hauls. Smallmouth bass growth rates in Rice were above the Spicer Area normal ranges for ages 2-7, and within the normal range for age 1. The 2003 and 2001 smallmouth bass year classes comprised 50% and 38% respectively of the 2007 smallmouth bass spring and summer catch. Anglers often seek both smallmouth bass and largemouth bass in a shallow basin (Mud Lake) located downstream of Rice Lake via the North Fork of the Crow River and upstream of Lake Koronis during the early summer months.

Yellow perch numbers were moderate in 2007 (10.57 fish/gillnet) compared to the normal range for similar lakes, but below the Rice historical average catch rate (26.39 fish/gillnet). The 2007 yellow perch average size was small (0.19 pounds and 6.84 inches) from gillnets. The yellow perch historical average length is 7.06 inches from gillnets. The 2007 catch rate of quality size (8.00 inches) and larger yellow perch was low (2.14 fish/gillnet). There were moderate numbers of YOY yellow perch (15.00 fish/haul, 2.51 inches average length) captured in the 2007 shoreline seine hauls. Yellow perch growth rates were within the Spicer normal ranges for ages 1-5. The 2004 and 2003 year classes comprised 45% and 35% respectively of the 2007 yellow perch gillnet and trapnet catch.

Walleye numbers were high in 2007 (8.29 fish/gillnet) compared to the normal range for similar lakes, but similar to the Rice historical average catch rate (8.94 fish/gillnet). The 2007 walleye average size was moderate to large (2.52 pounds and 18.16 inches) from gillnets. The walleye historical average length is 15.83 inches from gillnets. The 2007 catch rate of quality size (15.00 inches) and larger walleye was high (5.71 fish/gillnet). The 2007 catch rate of preferred size (20 inches) and larger walleye was also high (3.57 fish/gillnet). Walleye growth rates were within the Spicer Area normal ranges for ages 1-8. The 2004 and 2003 year classes comprised 23% and 16% of the 2007 gillnet and trapnet catch.

Walleye natural reproduction in Rice was generally both frequent and adequate to sustain walleye numbers based on previous fall and summer surveys from 1993-2004. Walleye fingerlings (20,069 fish, 814 pounds), yearlings (5,103 fish, 1,566 pounds), and adults (138 fish, 168 pounds) were stocked in Rice during 2007. Walleye fry (1-2 million each year) were stocked during 2001-2007 as a 10% return of walleye eggs taken for the DNR statewide walleye hatching program. Low young of year "YOY" walleye numbers were captured in the 2005 (14.21 YOY/hour, 7.63 inches average), 2006 (5.14 YOY/hour, 6.25 inches average), and 2007 (8.40 YOY walleye/hour, 7.00 inches average) fall night electrofishing surveys. The 2003 (42.00 YOY/hour, 6.46 inches average) and 2004 (55.50 YOY/hour, 6.74 inches average) had moderate/high YOY walleye fall catch rates, which corresponded to the dominant year classes present in the 2007 gillnet and trapnet catch in Rice. The fall electrofishing YOY walleye historical average catch rate is 53.11 YOY

walleye/hour for Rice.

Black bullhead numbers were high in 2007 (44.00 fish/gillnet) compared to the normal range for similar lakes. The black bullhead historical average catch rate is 29.65 fish/gillnet for Rice. The 2007 black bullhead average weight (0.51 pounds) was slightly below the Rice historical average (0.60 pounds).

Yellow bullhead numbers were high in 2007 (10.14 fish/gillnet) compared to the normal range for similar lakes. The yellow bullhead historical average catch rate is 1.83 fish/gillnet for Rice. The 2007 yellow bullhead average weight (0.73 pounds) was similar to the Rice historical average (0.67 pounds).

Other species of interest captured in 2007 included high numbers of shorthead redhorse (8.29 fish/gillnet) and white sucker (4.43 fish/gillnet), and moderate numbers of carp (0.40 fish/trapnet) from Rice. The Rice historical average catch rates for shorthead redhorse, white sucker, and carp were 5.48 fish/gillnet, 5.21 fish/gillnet and 2.97 fish/trapnet respectively. The 2007 average size was 2.47 pounds for shorthead redhorse, 2.16 pounds for white sucker, and 8.23 pounds for carp.

Current fish management activities on Rice include protecting important aquatic vegetation through the permit process, participating in local watershed projects, stocking various species as needed, and stocking walleye fry or fingerlings as required or needed. The Rice Lake fishery will be surveyed during the 2008 fall for YOY walleye numbers.

For southern Stearns County the DNR contact is Bruce Gilbertson, Spicer Area Fisheries Supervisor, 10590 Co Rd 8 NE, Spicer, MN 56288, (320) 796-2161, e-mail: www.bruce.gilbertson@state.mn.us. Gilbertson and his colleagues have prepared a fisheries management plan for Rice and Koronis Lakes.

The fisheries management goal of the DNR plan for Koronis Lake is to manage, "…primarily for walleye and secondarily for a variety of other gamefish species. Although walleye natural reproduction occurs during most years as measured by annual fall electrofishing, supplemental fingerling stocking has periodically been needed after consecutive years of poor natural reproduction to sustain survey catches to meet long-range goals.

The DNR plan also notes the following limiting factors for Lake Koronis:

- Continual loss of emergent vegetation due to shoreline development has progressively occurred and has undoubtedly limited spawning/rearing habitat, particularly for Centrarchids. Water quality benefits from emergent vegetation have been reduced.
- Lake Koronis receives consistently moderate-heavy angling pressure which can limit certain species, particularly walleye, quality-sized panfish and large northern pike. There is a lack of quality creel information for Koronis and Rice Lake. Periodic creel surveys

are needed to better monitor the fishery (at least once per decade), evaluate the fishery (develop creel based long-range goals) and will be useful if changes in management occur (e.g., experimental regulations).
- Water levels tend to fluctuate relatively rapidly given the large watershed that drains into Lake Koronis which exacerbates shoreline erosion and variable habitat conditions.
- Summerkill, particularly of tullibee, periodically occur. Under periods of stable summer thermoclines, anoxic conditions persist in the hypolimnion.
- Population abundances of yellow perch, bluegill, and black bullhead fluctuate widely.
- The popularity of automatic untended aquatic plant control devices is increasing.

The DNR management goal for Rice Lake notes that the lake, "…supports a primary walleye fishery and a secondary fishery for a variety of other gamefish species, most notably northern pike and black crappie. Although walleye natural reproduction occurs during most years as measure by annual fall electrofishing, supplemental fingerling stocking may periodically be needed to maintain survey catches within long-range goals."

The limiting factors for fisheries in Rice Lake are similar to those of Koronis:

- Continual loss of emergent vegetation due to shoreline development has progressively occurred and has undoubtedly limited pawning/rearing habitat, particularly for Centrarchids. Water quality benefits from emergent vegetation have been reduced.
- Rice Lake periodically receives heavy angling pressure which can limit certain species, particularly walleye and black crappie, quality-sized panfish and large northern pike. There is a lack of quality creel information for Koronis and Rice Lakes. Periodic creel surveys are needed to better monitor the fishery (at least once per decade), evaluate the fishery (develop creel based long-range goals) and will be useful if changes in management occur (e.g., experimental regulations).
- Water levels tend to fluctuate relatively rapidly given the large watershed that drains into Rice Lake which exacerbates shoreline erosion and variable habitat conditions.
- Population abundances of most species tend to fluctuate widely. This is related to the variable habitat/water quality conditions that exist in Rice Lake
- The popularity of automatic untended aquatic plant control devices is increasing. The recent increase in submerged vegetation densities on Rice Lake has also increased interest in aquatic plant control efforts.
- Partial Summerkill, primarily white sucker, occurs periodically.
- Curled Pondweed (an invasive exotic) is periodically abundant. Mid-summer die-offs exacerbate algal booms.
- Poor water clarity periodically limits winter spearing success for northern pike.

The entire DNR Fisheries Management Plan Koronis Lake (Appendix I) and Rice Lake (Appendix II) are presented at the end of this Lake Management Plan.

AQUATIC VEGETATION

In all discussions we 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, curlyleaf pondweed). It is important to remember that control of the nuisance kind of vegetation may have adverse impacts on fishery and wildlife. 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.

Both lake associations have access to Garden Clubs as site-specific assets, such as Lake Demonstration sites on the lake.

WILDLIFE

Developing a Lake Management Plan by the Interagency Lake Coordinating Committee, (p. 18) notes, "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 Lake Koronis and Rice 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

Of special interest is the nesting of eagles on Third Island on Lake Koronis. Loon nesting is also confirmed.

The Minnesota County Biological Survey has completed the survey for Stearns County. At the north end of Rice Lake is shown with the symbol indicating that a federally or state listed animal has been identified in a Dry Prairie – Hill subtype area and in the Koronis Lakeshed on the western shores a similar designation has been attributed to an Oak Forest, Mesic subtype area.

Dry Prairie - hill subtype - Dry to dry-mesic prairies on well-drained soils on slopes and hilltops in glacial till. Dominant grasses are little bluestem, side-oats grama (*Bouteloua curtipendula*), and prairie dropseed (*Sporobolus heterolepis*); associated graminoids include plains muhly (*Muhlenbergia cuspidata*), porcupine grass, big bluestem, and Mead's sedge (Carex meadii). Typical forbs include standing milk-vetch (*Astragalus adsurgens*), buffalo-bean (*Astragalus crassicarpus*), purple prairie clover (*Petalostemon purpureum*), silky aster (*Aster sericeus*), heath aster (*Aster ericoides*), dotted blazing star (*Liatris punctata*), and pasque-flower (*Anemone patens*). Lead-plant (*Amorpha canescens*) and wolfberry (*Symphoricarpos occidentalis*) are common low shrubs.

Oak Forest - mesic subtype - Mesic forests primarily on well-drained glacial till on level to strongly rolling topography in northern and eastern Stearns County. Canopy typically dominated by red oak (*Quercus rubra*); common associated or codominant canopy trees in-clude basswood (*Tilia americana*) , northern pin oak (*Quercus ellipsoidalis*), white oak (*Quercus alba*), bur oak (*Quercus macrocarpa*), paper birch (*Betula papyrifera*) , and redmaple (*Acer rubrum*). Sugarmaple (*Acer saccharum*) and big-toothed aspen (*Populus grandidentata*) are

occasional in the canopy of some stands. Subcanopy consists mostly of shade-tolerant species including sugar maple and ironwood (*Ostrya virginiana*). Shrub-layer species include American hazelnut (*Corylus americana*), prickly gooseberry (*Ribes cynosbati*), downy arrowwood (*Viburnum rafinesquianum*), and frequently, dense patches of sugar maple. Ground layer dominated by summer-blooming species such as wild sarsaparilla (*Aralia nudicaulis*), common false Solomon's-seal (*Smilacina racemosa*), wild geranium (*Geranium maculatum*), sweet cicely (*Osmorhiza claytonii*), pointed-leaved tick-trefoil (*Desmodium glutinosum*), and black-fruited rice-grass (*Oryzopsis racemosa*).

EXOTIC SPECIES

No specific surveys for sampling invasive species have been done on Lake Koronis or Rice Lake. However, DNR watercraft inspectors monitor accesses across the state as well as Lake Koronis and Rice Lake. Enforcement does checks as well. When Fisheries crews work on area lakes, they detect invasive species. They also respond to reports from the public about unusual plants with concern that they may be invasive species. Lake Koronis does not have a Lake Vegetation Management Plan (LVMP). That is a plan our invasive species specialist would work with the lake association to develop if KLA establishes that as a goal.

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.

Bruce Gilbertson, previously listed, is also knowledgeable in this area.

BACKGROUND

Exotic species -- organisms introduced into habitats where they are not native -- are severe worldwide agents of habitat alteration 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. 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 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 attached to boats and other recreational watercraft and equipment. This guide is designed to help water recreationists recognize these exotics and help stop their further spread.

Eurasian watermilfoil (*Myriophyllum spicatum*)
Eurasian watermilfoil was accidentally introduced to North America from Europe. Spread westward into inland lakes primarily by boats and also by water birds, 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 creates 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*)
Purple loosestrife 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 rare and endangered wetland plants and animals 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 resprout 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 an aquatic system, moving water and wetland animals easily spread 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 from 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 submerged 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.

Zebra Mussel (***Dreissena polymorpha***) is a freshwater mussel – small fingernail sized – native to the Caspian Sea region of Asia. They are believed to have been transported to the Great lakes via ballast water, taken on in a freshwater European port and discharged into Lake St. Clair where the mussel was discovered in 1988. They have spread rapidly to all the Great Lakes and lakes in many Minnesota.

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 to which citizens have the most control that impact water quality.

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. Lake Koronis (DNR Lake ID #73-0200) is a General Development (GD) lake, and Rice Lake (#73-0196) is classified as Recreational Development (RD).

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, a 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."

The Stearns County zoning standards for lakes for each of the respective classifications are:

Standards:	General Development	Recreational Development	Natural Environment	River – Agriculture
Structure setback from OHWL[1]	75 feet	100 feet	200 feet	100 feet
Structure setback from Bluff Height	30 feet	30 feet	30 feet	30 feet
Lot Size	20,000 sq ft	40,000 sq ft	80,000 sq ft	40,000 sq ft
Lot Width	100 ft	150 ft	200 ft	150 feet
Height (other than water oriented accessory structure)	30 ft	30 ft	30 ft	30 ft
Elevation of lowest floor above highest known water level	3 feet	3 feet	3 feet	3 feet
Water Oriented Accessory Structure setback from OHWL	10 feet	10 feet	25 feet	10 feet

[1] OHWL = Ordinary High Water Level

Paynesville Township has an ordinance requiring a 75 foot setback for any new out buildings or placements of fish houses after removing from the ice.

Most lakes have numerous properties that are "grandfathered," or developed prior to the establishment of these restrictions. In general, these pre-existing uses are allowed to remain unless they are identified as a threat to human health or environment or are destroyed by natural, accidental causes or in association with significant renovation.

The Stearns County web-site provides a link to the Planning and Zoning ordinances for the county: http://www.co.stearns.mn.us/Government/CountyOrdinances/PlanningandZoningOrdinances. On any shoreland the permissible density and setbacks for virtually all new use are determined by the lake or river classification standards established by the Department of Natural Resources. Stearns County has a web site which offers helpful contact information regarding planning and zoning matters: http://www.co.stearns.mn.us/index.html.

Details on shoreland standards and restrictions and answers to *frequently asked questions* regarding best management practices, resources of education or information and additional assistance are provided through the Environmental Services Department, Stearns County Environmental Services, 705 Courthouse Square, Administration Center Room 343, St. Cloud, MN 56303, Phone: 320/656-3613, E-mail: dave.nett@co.stearns.mn.us

There have been some trends from seasonal to year round occupancy on Lake Koronis. Rice Lake has had new construction occurring on empty lots over the years.

Veterans Park has a new shelter for picnic use with a kitchen. This facility may be rented. Community Park has a newly developed camping area for everyone's enjoyment with several camp sites and a few small cabins for rent. A newly constructed storm shelter and new play ground were also added. There is a tornado warning siren now in place to warn campers and residents of any impending storm.

MANAGING WATER SURFACE USE CONFLICTS

The goal of lake management is to ensure that the lake can continue to provide the benefits that attract homeowners and users. However, conflicts among uses invariably arise. Successful resolution of conflicts lies in the ability of the users to work collaboratively to arrive at acceptable compromises.

The primary agency responsible for managing surface water use conflicts is the Minnesota Department of Natural Resources, Bureau of Information and Education. The Boat and Water Safety Section within the Bureau oversees surface water use and is in charge of administering the Water Surface Use Management (WSUM) program. The goal of this program is to enhance the recreation use, safety and enjoyment of the water surfaces in Minnesota and to preserve these water resources in a way that reflects the state's concern for the protection of its natural resources.

Within this context, any governmental unit may formulate, amend or delete controls for water surface use by adopting an ordinance. Submit the ordinance for approval by the MDNR Boat and Water Safety Coordinator by calling 1 (800) 766-6000 or (651) 296-3336. To gain approval the ordinance must:

- Accommodate all compatible recreational uses, where practical and feasible
- Minimize adverse impacts on natural resources
- Minimize conflicts between users in a way that provides for maximum use, safety and enjoyment
- Conform to the standards set in WSUM Rules

PUBLIC WATER ACCESS

Research has shown that Minnesotans rely heavily upon public access sites to enter lakes and rivers. A 1988 boater survey conducted by the University of Minnesota showed that three-fourths of the state's boat owners launch a boat at a public water access site at least once a year. In addition, over 80 percent of boat owners report using public water access sites for recreation activities other than boating.
The primary agency responsible for pubic water accesses in Minnesota is the Minnesota Department of Natural Resources, Trails and Waterways Unit. They are responsible for the acquisition, development and management of public water access sites. The DNR either manages them as individual units or enters into cooperative agreements with county, state and federal agencies as well as local units of government such as townships and municipalities. The DNR's efforts to establish and manage public water access sites are guided by Minnesota statutes and established written DNR policy. The goal of the public water access program is free and adequate public access to all of Minnesota's lake and river resources consistent with recreational demand and resource capabilities to provide recreation opportunities.

According to the 2003 Minnesota Department of Natural Resources Fisheries Survey, there are five public access on Koronis Lake, and four more on Rice, as shown below:

Koronis Lake Public Access

Ownership	Type	Description
Minnesota DNR	Concrete	Norman Dahlman Access is a large access located in the inlet bay (east side of lake) southwest of Highway 55.
Minnesota DNR	Gravel	Putzke Access is a small access on north side of the north bay off County Road #181.
Township	Concrete	Tim Adams Access is a small access on the west side of the lake east of the Tri-County Road (County Roads #20 & #39).
DNR	Concrete	Community Park Access is on the south side of the lake in the Tri-County Regional Park.
City	Concrete	Veteran's Park Access on the east side of the north bay, across the road from the park. Cooperative access with the DNR and Paynesville.

Rice Lake Public Access

Ownership	Type	Description
Private Property	Other	Access is located at Morning Star Campground on the northeast side of lake.
Private Property	Concrete	Fishers Resort
DNR	Concrete	Access is located along the southwest corner of Rice (south of the Crow River Inlet/Outlet).
DNR	Concrete	Access is located in Schaumann's Bay (northwest portion of lake).

SUMMARY OF VISIONING/PLANNING SESSION

We are investigating educational opportunities on invasive species at high volume times of the year: fishing opener, Memorial Day, 4th of July, and Labor Day weekends. This will include inspections and educational hand outs. We are interested in fishing contests held throughout the year. We need more information on where and when contests are held as well as where boaters have recently been with their boat and trailer.

KLA was established in 1971, approximately 40 years ago. Our mission statement was and still reads: An association formed to promote the protection and improvement of Lake Koronis. We all wish to improve the water quality of our lake for the enjoyment of everyone for years to come.

Concerns impacting our water quality are the North Fork Crow River, local watershed drainage and water runoff from lake property and surrounding farms. Our goal is to limit nutrient loading from these sources in the next 5 years.

Our communication tools are:

- KLA newsletter (published 3 times per year) sent to all lake association members and interested persons in our area
- articles published in our local newspaper
- KLA website (work in progress)

We will communicate progress on our goals to our residents and community constituents. Keeping informed is a high priority for us. We hope to increase more participation toward our future goals.

Our visioning session was held at Ron and Judy's Restaurant in Paynesville on July 17th, 2010. We had a good turnout with over 80 in attendance. We had goals listed in several areas:

- Water quality
- Land use
- Zoning
- Aquatic Species

Group discussions were held in order to list priorities for lake improvement in the years to come. Our visioning facilitator was John Sumption.

WATER QUALITY IMPROVEMENTS – Lake Koronis

GOAL 1 – Reduce subwatershed nutrient loading around Lake Koronis			
Objectives	**Supporting Agencies**	**Year**	**Estimated Cost**
Lakeshore Improvement Project: Assist in establishing 50 new lakeshore improvements over the next 2 years	KLA, NFCRWD, Meeker and Stearns SWCD's	2011 and 2012	$250,000
Herfendahl/Kalkbrenner Project: establish retention basins and buffer strips on land south of Cty Rd 20, repair settling pond and the waterway to Lake Koronis on Herfendahl property	KLA, NFCRWD, Stearns and Meeker SWCD's	2011	$40,000
Koronis Ministries: control waterway erosion on the hill behind the southern portion of the camp with retention ponds, waterway stabilization	KLA, NFCRWD, Stearns SWCD	2010	$15,000
Randall Project: repair the cattle watering retention pond, establish new water retention where possible, develop cattle exclusion from the creek that runs through property, establish vegetative buffers on steep creek slopes	KLA, NFCRWD, Meeker and Stearns SWCD's	2011	$40,000
Larson II Project: establish water retention buffer strips and sediment basins to reduce nutrient loading on northwest quarter of Section 4, Union Grove Township, Meeker County. This is another subwatershed that has a lot of nutrient loading into Lake Koronis.	KLA, NFCRWD, Meeker and Stearns SWCD's	2011	$35,000
Birch Beach Subwatershed: located in the NE quarter of section 4, Union Grove Township, Meeker County. Nutrient loading will be reduced using water retention basins, streambank buffers, and sediment basins.	KLA, NFCRWD, Meeker SWCD	2012	$25,000

GOAL 2 – Water Testing Awareness			
Objectives	**Supporting Agencies**	**Year**	**Estimated Cost**
Obtain more information from the NFCRWD on water testing -place information in newsletter and local newspaper	KLA, NFCRWD	2011	-

LAND USE AND ZONING - Lake Koronis

GOAL 3 – Awareness and Action

Objectives	Supporting Agencies	Year	Estimated Cost
Become more involved in land use, on-going planning and decision making	KLA	On-going	$0
Install storm shelters and sirens at strategic points around the lake	KLA, Paynesville, Union Grove Townships	2015	TBD
Education on Lake Living – update the living with Lake Koronis book, submitting articles to educate homeowners on proper land use	KLA NFCRWD	On-going	TBD
Web site development	KLA	2011	TBD

AQUATIC VEGETATION - Lake Koronis

GOAL 4 – To keep Lake Koronis free of invasive species and to promote education/awareness of healthy weeds

Objectives	Supporting Agencies	Year	Estimated Cost
To decrease or eliminate chemical use to control weeds	KLA NFCRWD	On-going	?
To keep exotic species from entering Lake Koronis –posting signs at landings -volunteers at landings on high traffic holidays -channel 8 publicity	KLA NFCRWD	2011	$1500
To educate all on being environmentally friendly -Lake Koronis booklet and newsletter -channel 8 -live with the weeds by the docks (promote public beaches for swimming)	KLA NFCRWD	2011	$200

SUMMARY OF RICE LAKE ASSOCIATION VISIONING AND PLANNING GOALS

Rice Lake Association (RLA) is nearing the end of a Total Maximum Daily Load (TMDL) study through the Minnesota Pollution Control Agency (MPCA). With that as a context, our visioning and planning goals will focus on water quality measures we think will be validated in this study. The consensus of those attending our visioning meeting centered on the following goals.

1. Water quality: Decrease runoff from both lakeshore and agricultural areas near and adjacent to Rice Lake.
2. Aquatic vegetation: Promote a healthy balance of weeds including a decrease in curly leaf pondweed and algae growth.

WATER QUALITY IMPROVEMENT – Rice Lake

GOAL 1: Decrease runoff from lakeshore and agricultural land near and adjacent to Rice Lake			
Objective	Supporting agency	Year	Estimated cost
Meet with farmers whose property is above Rice Lake	Stearns County Environmental Services; Soil and Water Conservation District (SWCD)	2011- Begin discussion with farmers to define problem and potential solutions	TBD based on scope of solution; estimate of $75,000
Develop education plan targeted to lakeshore property owners on effects of runoff and benefits of shore land restoration	University of Minnesota Extension Service; SWCD	2011- Mail survey to shoreline residents to determine barriers to shoreline restoration; meet with SWCD to develop long-range plan	$400 for survey mailing and update of data parcel information
Determine City of Paynesville storm water effect on Rice Lake and potential beneficial interventions	City of Paynesville; North Fork Crow River Watershed District (NFCRWD)	2011- Request review of 2010 storm water study with RLA Board of Directors	TBD dependent on results affecting North Fork Crow River and Rice Lake

AQUATIC VEGETATION IMPROVEMENT – Rice Lake

GOAL 2: Promote a healthy balance of weeds including a decrease in curly leaf pondweed and algae growth			
Objective	Supporting agency	Year	Estimated cost
Complete aquatic plant inventory	Department of Natural Resources (DNR)	2012 (Contact DNR 2011 to determine process and plan to complete in 2013)	TBD; estimate $5,000
Develop aquatic plant plan/ projects targeted to lakeshore property owners on benefits of shoreland restoration and scientifically recommended treatment of unwanted weeds	DNR; SWCD	2013	$2,000

Appendix I
DNR Fisheries Management Plan
Koronis Lake

DNR Fisheries, Spicer, is preparing new fishing reports for Lake Koronis that will be based on 2010 survey information. These reports will be available soon and will be added to this Lake Management Plan at that time.

Appendix II
DNR Fisheries Management Plan
Rice Lake

DNR Fisheries, Spicer, is preparing new fishing reports for Rice Lake that will be based on 2010 survey information. These reports will be available soon and will be added to this Lake Management Plan at that time.

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 a sample of water. Used as a measure of the degree of water pollution.

Buffer Zone: Undisturbed vegetation that can serve 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, 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
KLA	Koronis Lake Association
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
RLA	Rice Lake Association
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