
Water Quality Management Plan for Golden Lake

Prepared for the City of Circle Pines

January 2003

Prepared By:

**WSB & Associates, Inc.
4150 Olson Memorial Highway, Suite 300
Minneapolis, MN 55422
(763) 541-4800
(763) 541-1700 (Fax)**

CERTIFICATION

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Pete Willenbring, P.E.

Date: January 20, 2003

Lic.No.15998

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I. INTRODUCTION/PURPOSE

This Water Quality Management Plan for Golden Lake was prepared by the Golden Lake Water Quality Task Force, a group of citizens, and City Representatives on behalf of the City of Circle Pines in their goal of improving the lake's water quality, reducing the rooted aquatic plant infestation, and enhancing the lake as a fishery.

The Task Force believes the plan outlined herein, describes the most cost-effective feasible improvements available to meet the goals set forth by the Golden Lake Water Quality Task Force in their recent meetings. These improvement goals were developed by the Task Force over the past year as they met monthly with residents and agency officials to discuss the condition of and improvement options for Golden Lake. As part of these meetings, input was received from representatives from the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, and others who have undertaken previous studies or implemented improvement projects in and around Golden Lake for the purpose of protecting or improving its water quality.

II. BACKGROUND INFORMATION/DESCRIPTION OF PROBLEM

Golden Lake is a 57 acre lake located within the City of Circle Pines (**see Figure 1**). The lake has a maximum depth of 25 feet, an average depth of 8 feet, and receives runoff water from a 4,400 acre watershed. Approximately ninety percent (90%) of this area is located in the City of Blaine, and the remaining ten percent (10%) is within the City of Circle Pines. The land use within most of the area draining to the lake from the City of Blaine consists of sod farms, wetlands, and commercially developed property. Runoff from these areas is conveyed to Golden Lake via Anoka County Ditch 53-62.

Over the past 20+ years, water quality studies and resident surveys have been completed for Golden Lake. As a result of these studies, a number of findings have generally been made relative to the condition of this lake and its associated eco-system. Outlined below is a summary of these studies and their findings:

1. Minnesota Department of Natural Resources Assessment

Minnesota Department of Natural Resources has categorized this lake as “non-supporting” for swimming activities due to frequent algal blooms and poor transparencies in the summer months. Based on total phosphorus, chlorophyll-a, and transparency measurements, the lake is currently classified as hypereutrophic and experiences frequent algal blooms.

2. Minnesota Pollution Control Agency Assessment

The Minnesota Pollution Control Agency has categorized Golden Lake as “threatened” in their recent statewide lake assessment. This “threatened” classification was given to the lake based on recent sechi depth transparency and phosphorus concentration information, as well as a review of past water quality

data available for the lake that is stored in the MPCA's water quality data base "STORET".

3. **1982 Diagnostic Feasibility Study**

The University of Minnesota Limnological Research Center, in conjunction with the consulting engineering firms of Orr, Schelen, Mayeron & Associates, and the Environmental Research Group Inc., completed a Diagnostic Feasibility Study as part of the EPA Clean Lakes Grant Program in 1982. This Feasibility Study indicated that the inflow of nutrients from its upstream watershed along with hypolimnetic oxygen depletion and subsequent sediment phosphorus release (internal loading) caused extensive algal blooms and hypolimnetic oxygen depletion. This study recommended diversion of inflows, hypolimnetic aeration, and biomanipulation. Hypolimnetic aeration and biomanipulation were both implemented as a result of this Feasibility Study, but the diversion of inflows was not undertaken.

4. **Review of Other Water Quality Monitoring Data, Studies and Analyses**

As part of the development of this water quality management plan, WSB & Associates, Inc., along with the Golden Lake Water Quality Task Force also reviewed and analyzed other available monitoring data and studies completed for Golden Lake for which no interpretation of the data was provided. The WSB and Task Force analysis of this data supported the following findings:

- A. The inflow of water from County Ditch 53-62 into Golden Lake produces excessively high hydraulic and nutrient loadings that significantly impact the water quality within Golden Lake.
- B. The deposition of sediment in the bottom of Golden Lake over the years has resulted in a nutrient rich substrate that results in increased internal nutrient recycling within the lake, and also contributes to the expansion of rooted aquatic plants within the littoral (shallow) areas of the lake.
- C. The use of the hypolimnetic aeration system within the lake is reducing the internal nutrient recycling, has prevented further reductions in the quality of water within the lake, and has aided in maintaining the lake as a fishery. However, these studies have also shown that this aeration system as currently sized is only able to meet the lake's oxygen demand for a small area.
- D. The previous construction of the upstream treatment basis has reduced the sediment transport into the basin and reduced the loading of particulate nutrients into the lake basin. However, the soluble nutrient loading is still high enough to cause extensive algal blooms during the summer growing season.

III. DESCRIPTION OF MAJOR PROBLEMS IMPACTING PUBLIC USE OF THE LAKE

Based on input from residents and the general public utilizing Golden Lake over the past years, there are three recurring problems that are routinely impacting the public use of Golden Lake. They include:

1. **Excessive Algal Blooms and Corresponding Reductions in Transparency**
Golden Lake experiences frequent heavy algal blooms during the summer months. These algal blooms significantly impact the clarity of the water, at times result in floating mats of algae being present in the lake, and reduce the appeal of swimming, fishing, and boating on the lake. The Minnesota Department of Natural Resources has classified the lake as “non-supportive” for swimming activities based on similar observations.
2. **Excessive Rooted and Floating Aquatic Plant Growth**
Residents indicate that rooted aquatic plants are significantly impacting the public’s use of the lake both for fishing and in swimming areas. Rooted aquatic plant surveys indicate that over 60% of the area of the lake is impacted by rooted aquatic plants at the height of the growing season. These rooted aquatic plants were also identified to be “pumping” phosphorus from the bottom sediments into the water column during certain times of the year further increasing the in-lake phosphorus concentrations present in the water column, which result in increased algae growth.
3. **Winter Fish Kills/Fishery Management**
Residents have indicated that over the years, Golden Lake has been subject to winter fish kills that have resulted in odor and aesthetic problems along with a greater proliferation of bullheads and carp. These winter fish kills have also reduced populations of bluegills and large mouth bass. The installation of the currently operating hypolimnetic aeration system has reduced the frequency and/or severity of winter fish kills and has been somewhat beneficial in increasing the median size of the fish in the lake.

IV. IMPROVEMENT GOALS FOR GOLDEN LAKE

The Golden Lake Task Force has identified three specific measurable improvement goals for Golden Lake, and believes that it is feasible to meet these goals with a reasonable expenditure of funds. The Task Force also believes if these goals are met, the public use of the lake will not be impacted for swimming, boating, fishing, and other aesthetic uses.

A description of the measurable goals in each of these areas is outlined below:

A. Improve Water Quality

The water quality goals that have been set require that transparency, phosphorus concentrations, and chlorophyll a concentrations be maintained so as to meet an average Carlson Trophic State Index (TSI) of 50 and a maximum Carlson Trophic State Index of 55. These values will be based on taking and analyzing a surface water sample from the lake once per month from April through September, analyzing this sample for section depth transparency, phosphorus, and chlorophyll a concentration, and determining the corresponding TSI from these analysis results.

B. Manage Excessive Growth Of Rooted Aquatic Plants

As part of this management objective, rooted aquatic plants will be controlled to the extent necessary so as not to hinder the use of the lake in designated swimming, boating, or fishing areas. It is recognized and acknowledged that this aquatic plant management program will be implemented only over selected areas as some rooted aquatic plant growth is beneficial to the lake for other purposes. A map will be prepared showing areas in the lake that will remain free of aquatic plant infestation.

C. Manage Lake for Fishing Purposes

The goal of this plan is for Golden Lake to maintain healthy populations of desirable fish species. Residents of all ages within the City currently utilize this lake for recreational fishing and this use is anticipated to increase in the future.

The City will work with the Minnesota Department of Natural Resources to implement the fish stocking and lake management plan they have on file.

V. DISCUSSION OF OPTIONS AVAILABLE TO MEET LAKE IMPROVEMENT GOALS

As part of the development of this Golden Lake Water Quality Management Plan, the results of previously completed water quality studies were reviewed and updated, the problems identified by the task force were analyzed and options available for addressing these problems and the improvement goals for Golden Lake were investigated. Based on this investigation, a number of improvement options were identified that singly and/or collectively could meet the improvement goals identified for Golden Lake. A description of these options is outlined below and further information on the costs and associated benefits for each option are shown in **Table 1**.

1. Install and Operate Alum or Ferric Chloride Injection System Upstream of Golden Lake Wetland Treatment System

This option consists of constructing a chemical storage and metering facility at a location upstream of the Golden Lake Wetland Treatment System. This facility would measure the flow and meter at the proper dose, alum or ferric chloride into the water flowing by the facility. The chemical addition would remove phosphorus through a chemical reaction and precipitate it out of the water prior to reaching Golden Lake. The phosphorus that is precipitated by this chemical reaction would settle out in the wetland treatment basin upstream of Golden Lake.

2. **Implement In-Lake Alum Treatment for Golden Lake**

This treatment has similar benefits as the treatment describe above but the phosphorus removed by the chemical treatment is deposited in the bed of the lake and not in the treatment basin upstream. This alternative is not as expensive as the option associated with pretreating the inflow and may have some benefits associated with reducing the internal nutrient release from the bottom sediments of Golden Lake, but also results in the build-up of phosphorus laden bottom sediments in the lake.

3. **Lake Level Drawdown in Winter**

This option consists of drawing the water levels within the lake down four to six feet in the winter, and allowing the sediments in the shallower areas to freeze, consolidate, and decompose under significantly different conditions than those present in the lake when they are under water. Water levels would be allowed to rebound to previous levels in the spring following this treatment. This process has been shown to be effective in reducing the growth of rooted aquatic plants, enhancing the consolidation of lake bottom sediments, and expanding the oxidation of organic bottom sediments in these shallow areas.

4. **Lake Level Drawdown, Dredging, Scraping, and Sediment Delta Removal**

This alternative is similar to that of Option 3, however, in addition to the drawdown activity, dredging, scraping, and removal of sediments that are present in these areas would be undertaken. This activity would reduce the presence of aquatic seed beds; remove organic sediments and deepen the lake in the areas.

5. **Biomanipulation**

Biomanipulation is a method of physically manipulating the biology of the lake (fish species, plant species, etc.) in an effort to address public use problems.

One method involves eliminating a population of small, minnow-sized fish that feed on smaller insects known as daphnia (water fleas). These daphnia feed on algae, and if enough of the daphnia are present these organisms, have the ability to reduce algal populations which are a source of concern to the residents. Although biomanipulation can be successful, it has proven to be difficult to maintain these limited populations of minnow-size fish and expanded populations of daphnia in the lake for an extended period of time without constant management.

6. **Diversion**

This alternative consists of diverting the current inflow of water and associated nutrients to the downstream outlet of the lake. Bypassing the lake through this process reduces the corresponding nutrient loading that has resulted in many of the water quality problems being experienced within the lake in its recent past. This alternative would have the potential for significantly improving the long-term “health” of the lake in the future.

7. **Enhanced Storm Water Treatment in Areas Upstream of I-35W**

This alternative consists of constructing additional storm water treatment systems upstream in the City of Blaine to treat the water generated in this area prior to its discharge downstream into Golden Lake. This alternative has the potential to provide some limited reduction in hydraulic and nutrient loading to Golden Lake. The magnitude of this improvement would be limited and it is unlikely such enhancements would be able to fully address the problems identified by the task force.

8. **Weed Harvesting**

This option consists of utilizing an aquatic weed harvesting program to manage the rooted aquatic macrophyte infestation problem present in Golden Lake. This treatment would be required periodically throughout the summer months, and is generally more costly than utilization of an herbicide treatment to control rooted aquatic plant growth. This harvesting alternative does have the potential to fully address rooted aquatic plant growth problems for residents using the lake to the extent allowed by the Minnesota Department of Natural Resources.

9. **Herbicide Treatment to Control Rooted Aquatic Plants**

This alternative is similar to Option 8 except herbicide is used to kill rooted aquatic plants in areas that are designated to be free of these plants. Treatment is required annually and is generally less costly than weed harvesting. This option has potential similar benefits as weed harvesting but due to the use of chemicals, has some limited potential environmental side effects.

10. **Phosphorus Control Ordinance in Upstream Watershed**

This option consists of passing an ordinance to prohibit the use of phosphorus in the upstream watershed. This approach would be similar to the State of Minnesota recently passing legislation banning the use of phosphorus containing fertilizers by homeowners in the metropolitan area effective January 1, 2004. However, this legislation does not apply to farmers, and one of the most significant sources of nutrients in the upstream watershed is from the application of fertilizers to sod fields that are present in this upstream area. It should also be noted that phosphorus is a nutrient that is necessary to stimulate root growth in newly seeded areas. If this alternative is selected, it would likely be necessary for the City of Blaine and Circle Pines to pass an ordinance prohibiting phosphorus to be utilized for farming practices in these areas.

11. Expansion of Upstream Wetland Treatment System

This alternative consists of expanding the size of the current upstream wetland treatment system so as to improve its ability to remove pollutants directed to it from County Ditch 53-62 prior to its discharge into Golden Lake. An expansion of this treatment system was recently undertaken as part of a townhouse development that is under construction in this area. An analysis of the benefits of this expansion indicates that a reduction of nutrient loading from this area will occur as a result of the expanded system but the extent of this reduction is not adequate to have a measurable benefit on the quality of water in Golden Lake.

12. Hypolimnetic Withdrawal

This alternative consists of installing a new outlet for the lake in such a manner to direct water that currently overflows from the lake surface to be withdrawn from the bottom of the lake instead. Because the quality of the water in the bottom of the lake is generally of poorer quality than that of surface waters, this would result in more nutrients being carried out of the lake when water is discharged than it has in the past. This alternative has the potential to provide long-term benefits to the water quality of the lake; however, the watershed district has expressed concerns that this alternative will degrade the quality of water of water bodies downstream from Golden Lake if this option is exercised. For this reason, there is some concern that this alternative is not feasible from a regulatory standpoint.

13. Expanded Aeration System

This alternative consists of expanding the existing, or installing a new aeration system to supplement the existing hypolimnetic aeration system that is present in the lake. The current hypolimnetic aeration system takes water from the bottom of the lake, aerates it, and returns it to the hypolimnion of the lake so as not to destroy the stratification of the lake in the summer or winter months. This system has been shown to be effective in managing the fish population, as well as maintaining oxygen near the sediments in the vicinity of the aerator discharge point. This oxygenated environment reduces the amount of nutrients that are released into the water column from the bottom sediments of the lake in this area. Expanding this aeration system would expand the area over which these benefits are received.

14. Expand Non-Point Source Runoff Controls in Direct Watershed

This alternative consists of expanding measures to treat storm water runoff directed to Golden Lake from its immediate watershed. As identified in the background information, the lake has a watershed of approximately 4,400 acres, of which approximately 400 acres (10%) is within the direct watershed. This option anticipates undertaking additional measures to attempt to further improve the quality of water discharged from this direct watershed into the lake. Due to its limited area (10%), and the fact that much of this water is already treated

before discharge, these measures are not anticipated to significantly improve the water quality of Golden Lake.

15. Fish Stocking

This alternative consists of working with the Minnesota Department of Natural Resources in the implementation of their fish stocking program so as to maintain a robust and healthy population of desirable fish species in the lake. In order for the fisheries management component of this plan to be realized, this fish stocking component will need to be undertaken annually in the future.

TABLE 1

COSTS AND POTENTIAL BENEFITS ASSOCIATED WITH OPTIONS

Option No.	Description of Proposed Improvement	Estimate of Cost	Potential Benefit		
			Water Quality	Aquatic Plant Control	Fisheries Management
1	Alum or Ferric Chloride Treatment Upstream	\$200,00-400,000	High	Low/Possible Negative Impact	Low
2	Alum or Ferric Chloride Treatment In-lake	\$30,000 per treatment	High	Low/Possible Negative Impact	Low
3	Lake Level Draw-down in Winter	\$50,000-100,000, less in future yrs.	High	High	High/Medium /Low
4	Lake Level Draw-down, Dredging, Scraping, and Sediment Delta Removal	\$300,000-900,000	High	High	High/Medium /Low
5	Bio-manipulation	\$50,000-200,000	Medium	Medium	High
6	Diversion	\$250,000-350,000	High	Low	Low
7	Treatment Enhancements Upstream of I 35W	\$150,000-250,000	Low	Low	Low
8	Weed Harvesting	\$40,000 annually	Low	High	Low
9	Herbicide Treatment of Rooted Aquatics	\$2,000-5,000 annually	Low	High	Low
10	Phosphorus Control Ordinance in Upstream Watershed	\$0	Low	Low	Low
11	Expansion of Upstream Wetland Treatment System	\$200,000-400,000	Low	Low	Low
12	Hypolimnetic Withdrawal	\$100,000	Low/Medium	Low	Low
13	Expanded Aeration System	\$100,000-200,000	Low	Low	Medium
14	Expanded NPS Watershed Management Measures in Direct Watershed	\$25,000-100,000	Low	Low	Low
15	Fish Stocking	DNR Funded	Low	Low	High

VI. PROPOSED MANAGEMENT PLAN

Based on a review of the various improvement alternatives that are available to meet the goals identified, a review of their preliminary estimate of cost, and their associated potential benefits, the task force has determined that the Golden Lake Management Plan should consist of implementing the following improvement projects if the City wishes to meet the lake improvement goals outlined in this plan:

1. Complete a lake level drawdown, dredging, scraping, and sediment delta removal project (**Option 4**).
2. Divert flows around Golden Lake from County Ditch 53-62 (**Option 6**).
3. Undertake annual herbicide treatment of rooted aquatic plants in selected areas (**Option 9**).
4. Implement phosphorus control ordinance in upstream watersheds to the extent possible (**Option 10**).
5. Expand aeration system (**Option 13**).
6. Expand non-point source watershed management measures in the direct watershed (**Option 14**).
7. Work with the Minnesota Department of Natural Resources to implement aggressive fish stocking program (**Option 15**).

Table 2 provides a summary of these selected options, and an estimate of cost estimate to implement these improvement alternatives.

Table 2
Activities to be Implemented as Part of the Golden Lake Water Quality Management Plan

Option No.	Description of Proposed Improvement	Estimate of Cost	Potential Benefit		
			Water Quality Improvement	Aquatic Plant Control	Fisheries Management
4	Lake Level Draw Down in Winter	\$300,000-900,000	High	High	High/Medium/Low
6	Diversion	\$250,000-350,000	High	Low	Low
9	Herbicide Treatment of Rooted Aquatic Plants	\$2,000-5,000 annually*	Low	High	Low
10	Phosphorus Control Ordinance in Upstream Wetland	\$0	Low	Low	Low
13	Expanded Aeration System	\$100,000-200,000	Low	Low	Medium
14	Expanded NPS Watershed Management Measures in Direct Watershed	\$25,000-100,000	Low	Low	Low
15	Fish Stocking	Paid for by the DNR	Low	Low	High
TOTAL*		\$675,000-1,550,000			

*Annual costs not included in this total

VII. IMPLEMENTATION PLAN

It is the intention of the Golden Lake Task Force and the Circle Pine City Council to work toward the implementation of the options outlined within this management plan.

However, it is recognized that in order to implement these improvement projects, a significant source of funds from outside the City will need to be secured. Toward that end, the City of Circle Pines intends to fund the improvements needed by securing financial support from a wide range of stakeholders and interest groups, including state, federal, and local agencies. The City also anticipates it will be necessary to submit grant applications and funding requests to these various agencies and interest groups in order to achieve these goals. The City, The Golden Lake Task Force, and city residents intend to undertake activities to secure such support in the coming year.

**ATTACHMENT
PROPOSED IMPLEMENTATION PLAN**

Proposed Implementation Plan

In order for the City to implement the Golden Lake Management Plan, it will be necessary to secure funding for the project from a number of sources. Toward that end, it is anticipated that a formal and rigorous effort to secure funding over an extended period of time will need to be undertaken by the Task Force Members, City Council and Staff, and interested residents in order for this project to go forward.

Outlined below is a list of potential sources of funding that may be able to contribute financial support towards implementation of the Management Plan as outlined in **Table 2**. Other funding sources and/or activities may also be available that are not listed below.

It is recommended that the Task Force, City Council, City Staff, and other interested residents review these funding sources and develop a formal process to solicit funds from these agencies or entities

Agency or Entity Name	Contact	Grant Name/Description	Level of Assistance	Application Deadline
City of Circle Pines	City of Circle Pines~200 Civic Heights Circle~Circle Pines, MN 55014~763-784-5898	Various	Varies	NA
Rice Creek Watershed District	Steve Hobbs, District Administrator 4325 Pheasant Ridge Drive, Suite 611 Blaine MN 55449-4541 Phone: (763) 398-3070 Fax: (763) 398-3088	Various	Varies	NA
DNR	Grants Manager Local Grants Program Department of Natural Resources 500 Lafayette Road, Box 10 St. Paul, MN 55155-4010 Fax: (651)296-6047	Environmental Partnerships Grants. Funds available for community environmental service projects to clean up areas such as lakes, streams, and wetlands	Up to a maximum of 50% of the total eligible costs not to exceed \$20,000, minimum project cost is \$1,000.	Submit by June 1, 2003 for project review and evaluation. Grants awarded in 2004.
DNR Fish and Wildlife	Gerald Johnson Regional Fisheries Manager/DNR Fish & Wildlife 500 Lafayette Road, Box 12 St. Paul, MN 551155 Phone: (651) 772-7955 Fax: (651) 297-4916 E-Mail: gerald.johnson@dnr.state.mn.us	CORE (Cooperative Opportunities for Resource Enhancement). Funds available for aeration, fishing piers, fishery management.	Varies depending on funds available for fiscal year. Pays for initial costs of project installation	Submit in 2003 for consideration, ranking and review. Grants awarded in 2004.

Agency or Entity Name	Contact	Grant Name/Description	Level of Assistance	Application Deadline
MPCA	Glen Skuta 520 Lafayette Road St. Paul, MN 55155-4194 (651)296-7359	Clean Water Partnership/Federal 319 Program.	Up to 50% of eligible costs.	To be announced
MPCA	Jennifer Klang 651-282-2618 jennifer.klang@pca.state.mn.us	Citizens' Lake Monitoring Program	Volunteer/Lake Homeowners	NA
BWSR	Marybeth Block BWSR One West Water Street, Suite 200 St. Paul, MN 55107 (651)297-7965	Local Water Planning Challenge Program 2004/5 Land and water quality treatment, monitoring and maintenance.	Matching Funds	To be announced (usually must be submitted by the end of February annually)
House Representative	Philip Krinkie 365 State Office Building Saint Paul, Minnesota 55155 (651) 296-2907 E-mail: rep.phil.krinkie@house.mn	Direct Legislative Appropriation	Varies	NA
Senate Representative	Mady Rieter 132D State Office Building St. Paul, MN 55155 Capitol phone: (651) 296-1253 E-mail: sen.mady.reiter@senate.mn	Direct Legislative Appropriation	Varies	NA
City of Blaine	Blaine City Hall 10801 Town Square Drive Blaine, MN 55449 763-785-6161	Various	Varies	NA
Circle Pines Lexington Lion's Club	Jan Kreminski (651)784-7231 P.O. Box 13 Circle Pines, MN 55014	Charitable Donations for Non-Profit Organizations. Community service projects.	Varies	NA
Anoka Soil and Water Conservation District	Chris Lord - Manager Anoka SWCD 16015 Central Avenue NE #103 Ham Lake, MN 55304 (763)434-2030	Various	Varies	NA
Anoka County	Anoka County Government Center 2100 3rd Avenue Anoka, Minnesota 55303 763-421-476	Various	Varies	NA
Mn/DOT	Patti Loken Metro State Aid Office Waters Edge Building, 1550 W. County Road B2, Roseville, Minnesota 55113 (651)582-1373	Cooperative Agreements and State Assistance with Road related projects (Diversion of Ditch 53-62)	Varies	NA
Other Civil Groups	To be established	To be established	To be established	NA

