The Como Lake Strategic Management Plan

2002

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Capitol Region Watershed District
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EXECUTIVE SUMMARY

The purpose of the Como Lake Strategic Plan (CLSP) is to identify important Como Lake management issues through input from key stakeholder groups, prioritize the issues and associated goals, and identify implementation activities, including institutional and public roles, time frame and funding. Consulting services were provided by Emmons & Olivier Resources, Inc. and Lynch Associates to ensure a broad-based, participatory process for the development of this plan for future Como Lake management activities. Agency and public participation is documented in the Public Participation Section of this report. A listing of individuals, agencies and consultants who contributed to the development of the Como Lake Strategic Plan is also included in that section. The planning process consisted of identifying stakeholder concerns and issues with the lake, developing goals and expectations for the future of the lake and then developing strategies and implementation activities to meet the desired goals.

The project was funded through a Board of Water and Soil Resources (BWSR) Challenge Grant to the Capitol Region Watershed District (CRWD). The grant period extended over two years ending June 2001. A local match consisting largely of in-kind services provided by District managers, staff, agencies and citizens was provided. The total project budget was $80,000.

Citizen Involvement in Como Lake

Regional-wide interest in Como Lake is very strong. Como Regional Park has the second-highest number of annual visitors among Metropolitan Region parks.

The District 10 Community Council identified Como Lake management issues in their petition to the Board of Water and Soil Resources (BWSR) to form a new watershed district. The Capitol Region Watershed District (District) was formed in September 1998, in part due to this group's suggestion that the management of Como Lake be more focused as well as better coordinated between participating groups. At the District's Kickoff Meeting held in February 1999, Como Lake management was the highest priority among interested citizens.

Citizens are very concerned about the shoreline of the lake, as evidenced by a petition to the City of St. Paul signed by dozens of residents in 1999. In addition, a high percentage of residents feel that Como is polluted or very polluted, as indicated in a survey conducted by the District in 1999.

The community continues to sponsor neighborhood events, such as the Healthy Lawns for a Healthy Lake Community Fair and Cleanup held in March 2001. The St. Paul Neighborhood Energy Consortium (NEC), the Capitol Region Watershed District, District 10 Community Council and other partners sponsored the event which included a volunteer cleanup along the lakeshore, exhibits and information displays along with a picnic lunch provided by a local business.

District 10 Environment Committee has undertaken several projects, such as assembling historic photographs and information related to Como Lake, creating a slide presentation and promoting neighborhood involvement through such activities as Como Days.

Scope of the Como Lake Strategic Management Plan

The strategic plan development process included several major work activities that were completed cooperatively by project participants, District staff and consultants.

Review and evaluate available watershed and water quality information. A variety of data and information sources were available to the project. Water and phosphorus budgets were prepared as part of a Clean Lakes (Environmental Protection Agency and Minnesota Pollution Control Agency) project for Como Lake in the mid-1980's (Runke et.al. 1982). A technical paper summarizing Como Lake water quality trends, macrophyte and zooplankton abundance, and fisheries information over the period 1981-1997 has also been prepared by the County (Noonan 1998). The District recently completed a project to measure impervious surfaces (SEH 2000) including roads, alleys, structures, and parking lots for the entire District and used this information to model (P8, Barr Engineering 2000) the hydrology and selected pollutant loading for selected subwatersheds, including Como Lake. Sediment coring was also completed during the project and compared to data from 1982 (Bauer 2001). The sediment depth corresponding to the time of European settlement was also evaluated for a single core sample.

Prioritize management concerns. Management concerns were identified from a variety of sources prior to beginning the project, including: lake water quality, management responsibility for Como Lake, sand deltas at inlets, macrophyte abundance, internal nutrient loading, aesthetics, Canada geese impacts, shoreline maintenance practices, housekeeping Best Management Practices (BMP's) in the watershed, impacts of road reconstruction, Gottfried's Pit, possible stormsewer system modifications, and reductions in nutrient loading by chemical treatment. Once the planning process began, this list was expanded and modified into four priority areas of concern (in descending priority order): water quality, aesthetics, recreation / lake use, and natural resources.

Identify management goals and objectives. Management goals and objectives were identified for the high priority management concerns. A quantitative water quality goal of a 60% reduction in external total phosphorus loading to Como Lake was identified by the Data Collection Group and adopted by the Advisory Group. Target total phosphorus reductions were quantified by subwatershed based on current nutrient loading. Qualitative goals and objectives were identified for aesthetic, recreational and natural resource concerns.

Enumerate implementation activities. Prior to consideration of structural BMPs or capital improvement projects (defined as one-time projects) to meet the water quality goal, the Data Collection group assigned expected phosphorus reductions over a 20-year period from good housekeeping activities, including street sweeping, public education and outreach, and erosion control (10% reduction), and implementing redevelopment design criteria through District rules that reduce impervious surface area and provide on-site treatment (10% reduction). Several structural BMPs were applied to subwatersheds in combination to reach water quality goals: water quality ponds, rain gardens, infiltration trenches, alum treatment for stormwater, catch basin sump manholes, mechanical separators / filter systems, and catch basin inserts. Management activities were also identified for each area of concern. The Public Outreach group developed an education and outreach plan, including both short-term and long-term activities, during this project. Costs for all implementation activities were estimated over a 20-year period and a 5-year implementation table was developed to correspond to the format used in the approved District Watershed Management Plan.

Evaluate citizen and agency roles. Successful implementation of the CLSP management activities will require a partnership between the CRWD and the cities of St. Paul, Roseville and Falcon Heights, Ramsey County, state and regional agencies, nonprofit groups and community councils, businesses and citizens. The implementation table identifies potential cooperating groups.

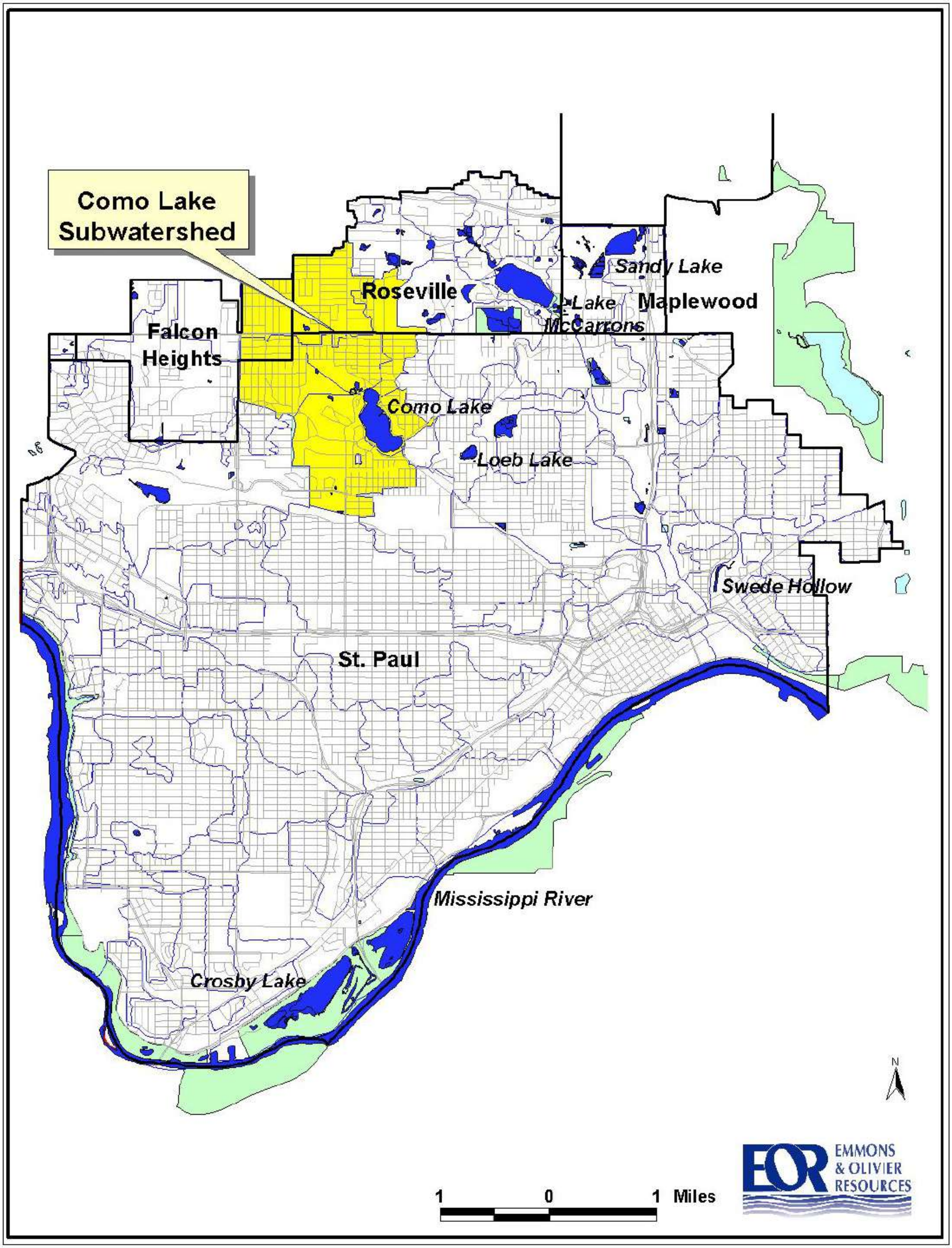
Implementation of the Como Lake Strategic Management Plan

The CRWD Board of Managers and staff identified the appropriate lead agency for each implementation activity based on agency responsibilities and current work programs. The implementation activities identified for the CRWD were further categorized based on whether they were specific to Como Lake or District-wide activities.

The implementation activities specific to Como Lake were prioritized based on cost effectiveness, impact on Como Lake and coordination with existing management activities. Priority activities are identified in the Implementation Tables within the plan and estimated capital costs are provided. The initial 5-year implementation program of priority activities is $2.5 million consisting of about $1.9 million in capital improvements and $600,000 in management activities. In addition to the priority activities, the Watershed District has identified additional activities for Como Lake that they may implement dependent upon availability of outside funding and compatibility with over priorities of the District.

Management activities more appropriately implemented by agencies other then the CRWD are identified in the Implementation Activities - District Cooperators section.

The intent of the Como Lake Strategic Management Plan is to provide added detail to the resources goals and management activities outlined for Como Lake in the Watershed Management Plan.


Como Lake Subwatershed
Roseville
Falcon Heights
Sandy Lake
Lake McCarrons
Maplewood
Como Lake
Loeb Lake
Swede Hollow
St. Paul
Mississippi River
Crosby Lake
N
1 0 1 Miles
EMMONS & OLIVIER RESOURCES

SECTION I INTRODUCTION TO THE STRATEGIC PLANNING PROCESS

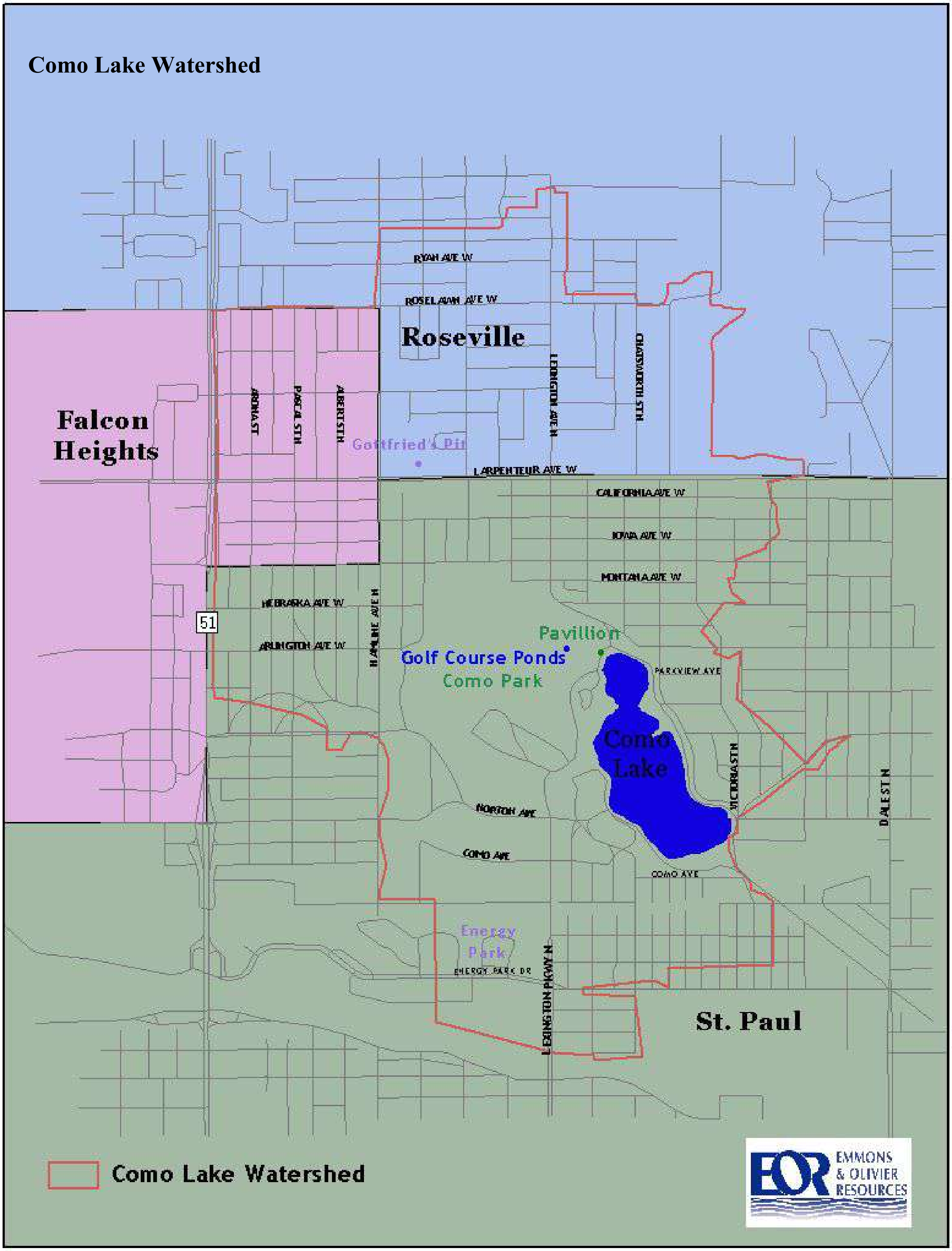
In 2000, the Capitol Region Watershed District adopted a Watershed Management Plan. The Plan identifies several key issues relating to water resource management in the area. The development of a Strategic Lake Management Plan for Como Lake was identified as a critical first step in the protection of this key regional resource. The purpose of the Como Lake Strategic Management Plan is to identify important Como Lake management issues through input from key groups of stakeholders, prioritize the issues and associated goals, and identify implementation activities, including institutional and public roles, time frame and funding. Participants were selected for membership on one of three work groups: Advisory, Data Collection and Management and Public Outreach. Consultant services were provided by Emmons & Olivier Resources, Inc. and Lynch Associates to ensure a broad-based, participatory process for the development of this plan for future Como Lake management activities. Agency and public participation is documented in the Public Participation section of this report. A listing of individuals, agencies and consultants who contributed to development of the Como Lake Strategic Plan is also included in that section.

The project was funded through a BWSR Challenge Grant to the District. The grant period extended over two years ending June 2001. A local match consisting largely of in-kind services provided by District managers, staff, agencies and citizens was provided. The total project budget was $80,000.

The strategic plan development process included several major work activities that were completed cooperatively by project participants, District staff and consultants.

- Complete a work plan and timeline for strategic plan development
- Review and evaluate available watershed and water quality information
- Prioritize management concerns
- Identify management goals and objectives
- Enumerate implementation activities
- Evaluate citizen and agency roles
- Complete a final report

Although there was broad stakeholder membership and participation during the strategic planning process, the District wants those who were not involved in the process to have an opportunity to review and comment on the Strategic Plan prior to adoption of the plan in final form. At least one public hearing will be held on the proposed plan and there will be a time period for written comments to be received from local governments, state and regional agencies, and the public during this process. The final Como Lake Strategic Management Plan will be incorporated into the District Watershed Management Plan by an amendment process as specified by the Board of Water and Soil Resources (BWSR).


Como Lake Watershed
Roseville
Falcon Heights
St. Paul
RYAN AVE W
ROSELAWN AVE W
LEXINGTON AVE N
LARPENTEUR AVE W
Gottfried's Pit
CALIFORNIA AVE W
IOWA AVE W
MONTANA AVE W
NEBRASKA AVE W
ARLINGTON AVE W
HAMLINE AVE N
51
Pavillion
Golf Course Ponds
Como Park
PARKVIEW AVE
Como Lake
VICTORIA ST N
DALE ST N
NORTON AVE
COMO AVE
Energy Park
ENERGY PARK DR
LEXINGTON PKWY N
Como Lake Watershed
EOR
EMMONS & OLIVIER RESOURCES

SECTION II PUBLIC PARTICIPATION PROCESS

The public participation process for the CLSP was carefully designed to balance technical needs with those of the Como watershed communities. This was the first subwatershed public participation process initiated by the Capitol Region Watershed District. It was determined that three committees were needed: a technical committee to analyze the data and make recommendations, a public relations/communications committee that could provide the "neighborhood" perspective and be the "eyes" and "ears" of the Como communities and a steering committee that managed the entire process. All three of the committees were designed to work independently but continually feed information to each other so both their individual and project goals could be realized.

Three work groups were formed: Advisory Group, Data Collection and Management and Public Outreach. Participants for each of the groups were recruited from government, organizations, businesses and citizens active in the Como watershed communities including St. Paul, Roseville, Falcon Heights and Ramsey County. Some of the members were participating as staff members for their respective organizations and some of the members were volunteers.

There were 12 Advisory Group members, 13 Data Collection and Management Work Group members and nine Public Outreach Work Group members (See CLSP Membership List at the end of this section). Sixteen meetings were held from July 2000 through June 2001. The general format for the meetings was to meet together at the beginning of the meetings and then to break out into the work groups afterwards. Towards the end of the CLSP, the committees met independently in order to meet deadlines and to enhance the flow of work for the entire process.

Advisory Group

The Advisory Group was the steering committee of the entire strategic planning process. Members represented key governmental agencies, the Minnesota State Legislature, business, non-profit organizations and citizen-based groups. The Advisory Group identified key objectives for each of the work groups, coordinated the development of a list of issues to be addressed, prioritized issues, analyzed and selected options for addressing those issues and assisted in creating an implementation and monitoring process. It also reviewed the draft CLSP and recommended changes based upon the committees' feedback and their own careful analysis.

Data Collection and Management Work Group

This committee reviewed and evaluated existing watershed and water quality information and provided educational presentations to the Advisory Group and the Public Outreach Work Group. It provided feedback to the Advisory Group regarding issues, management concerns, options and implementation scenarios. Members had a technical background and represented local and state government and non-profit organizations.

Public Outreach Work Group

This committee assisted the Advisory Group in the development and prioritization of issues, and developed a communications plan that identified short and long-term projects. The short-term projects were designed to build the public's awareness regarding the CLSP, the state of Como Lake and current and future water quality enhancement activities. The long-term projects were designed to create ongoing interest and commitment to improve the water quality of the lake through the media, stewardship activities and outreach to schools and local governments.

Members represented community organizations and citizens. Generally, volunteers facilitated the meetings, determined the work plan and used staff and consultants to assist and generate work products recommended at the meetings.

Volunteers Mary Bakeman and Susan Jane Cheney co-chaired the Public Outreach Work Group meetings.

Meeting Format

At the beginning of each meeting, all the committees met together for updates. After the first half-hour of updates and education, the committees met separately to work on their own agendas. There were a few exceptions to that format, however, when the entire group met to complete the following tasks: identifying issues, reviewing data regarding the issues, setting expectations regarding the Lake's future, participating in a lakes education workshop and reviewing the draft CLSP.

The following is the general work plan followed in the strategic planning process:

Meetings 1-2

- Organize the groups; develop meeting structure & schedule; voting procedure
- Complete membership recruitment
- Begin building an information base on Como Lake

Meetings 3-5

- Develop a list of issues
- Determine the sequence for issues discussion
- Provide issues education/review of watershed and water quality information
- Prioritize issues/management concerns

Meetings 6-8

- Generate options/management goals and objectives
- Provide options education/review of watershed and water quality information

Meetings 9-10

- Assess options for issue resolution
- Develop a list of implementation activities for issue resolution
- Continue options education/review of watershed and water quality information

Meetings 11-12

- Continue developing implementation activities
- Evaluate citizen and agency roles in implementation
- Consider costs and benefits of implementation activities
- Establish an evaluation and monitoring procedure for implementation
- Consider funding sources for implementation activities

Meetings 13 -15

- Draft and review report
- Adopt the final report

CLSP MEMBERSHIP LIST

Advisory Group

City of Saint Paul	*Liz Anderson, Asst. Director, Division of Parks and Recreation*
CRWD Board of Managers	*Marylyn Deneen, Board Chair*
CRWD Board of Managers	*Robert Piram, Board Member*
CRWD Citizens Advisory Committee	*Susan Schmidt*
City of Falcon Heights	*Bill Downing*
Community Council District 6	*Lee Helgen*
Community Council District 10	*Mike Perniel*
Como Northtown Credit Union	*Brian Roegge*
Como Shoreline Interests	*Sandy Barnes*
Minnesota State Legislature	*Senator Ellen Anderson, District 66*
Minnesota State Legislature	*Representative Alice Hausman, District 66B*
Ramsey Soil and Water Conservation District	*Tom Petersen*
Ramsey County	*Commissioner Janice Rettman*
Citizen Alternate	*Chet Morocha*

Data Collection and Management Work Group

CRWD Citizens Advisory Committee	*David Arbeit*
City of Saint Paul, Div. of Parks and Recreation	*Ed Olsen*
City of Saint Paul Public Works	*Anne Weber*
Community Council District 6	*Corey Plath*
Metropolitan Council Environmental Services	*Randy Anhorn*
Minnesota Department of Natural Resources	*Joe Richter*
Minnesota Pollution Control Agency	*Mark Tomasek*
Ramsey County Public Works	*Terry Noonan*

Data Collection and Management Work Group (cont'd)

Ramsey Soil and Water Conservation District	*Dave Bauer*
University of Minnesota Water Resources Center	*Tara Carson*
Community Council District 10	*Suzy Mellem*
Citizen	*Berhane Worku*
Citizen	*Dan Edgerton*
Citizen Alternate	*Betty Iwanski*

Public Outreach Work Group

*Co-chairs

Community Council District 10	*Susan Jane Cheney**
Como Shoreline Interests	*Tom Lux*
Neighborhood Energy Consortium	*Shelley Shreffler*
City of Roseville	*Mary Bakeman**
St. Paul Parks and Recreation Commission	*Terry Huntrods*
Citizen	*Tony Hainault*
Citizen	*Carla Sherman*
St. Paul Parks and Recreation Commission	*Altin Paulson*
Community Council District 10	*Deb Robinson*

Individuals, Agencies, and Consultants who contributed to this effort

Emmons & Olivier Resources
- Brett Emmons
- Pat Conrad
- Marcey Westrick

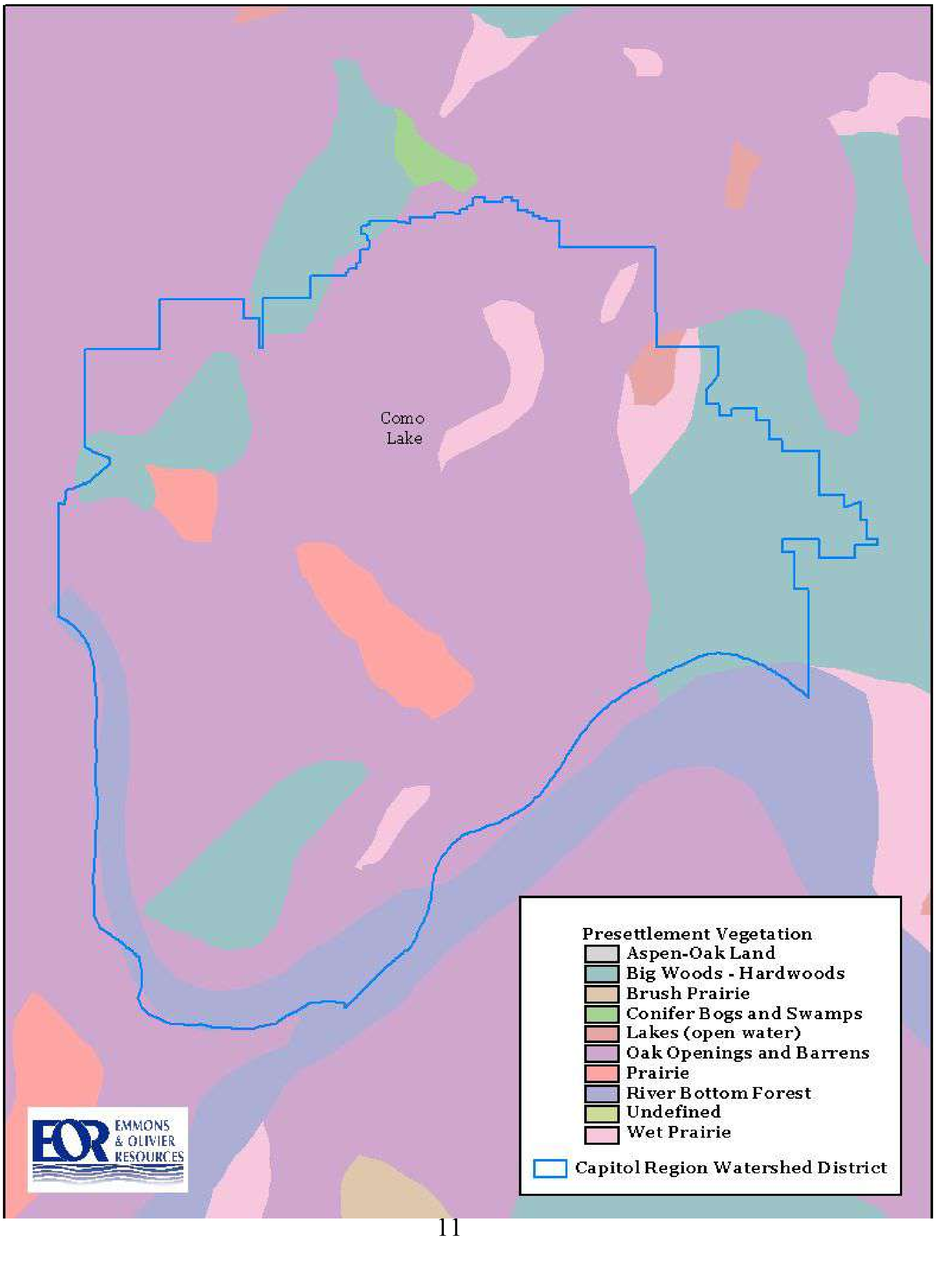
Lynch Associates
- Diane Lynch

Jane Dusek, CRWD Administrative Assistant

David Claypool, Ramsey County Surveyor – Presented information on original land survey of area
JoAnn Peters, Neighborhood Energy Consortium – Presented information on Clean Como Lake Program
Louise Watson, Ramsey Washington Watershed District, Charlotte Shover, Dakota County Environmental Services, and Jeff Lee and Deb Pilger, Minneapolis Parks and Recreation Board - – Provided information on Public Outreach approaches
Dan Wheeler, University of Minnesota – Performed lake sediment core sampling
Lynn Lyng and Craig Erickson, St. Paul Foundation/Minnesota Foundation – Provided information on the establishment of private foundations
Sidne Berg, Tony Barrows, Michelle Willinganz Foley-Sackett Advertising Agency - Developed a proposal for an outreach program
Val Cunningham – Provided list of bird species observed around Como Lake

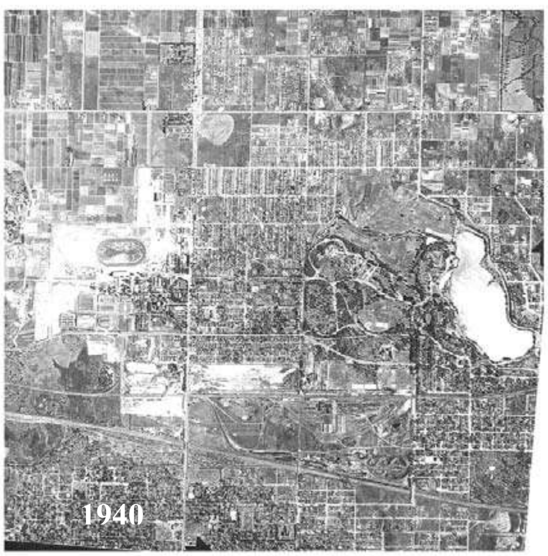
SECTION III DEVELOPMENT OF THE COMO LAKE WATERSHED

The development of the Como Lake watershed plays a critical role in defining the quality and character of this resource. In general terms, the Como Lake watershed has evolved over the past 200 years from an undisturbed natural landscape to a heavily developed urban area. The pre-settlement vegetation of the watershed was predominantly Oak Openings and Barrens with some Big Woods areas and smaller areas of Prairie and Wet Prairie (see figure below). Como Lake does not show up on the pre-settlement vegetation

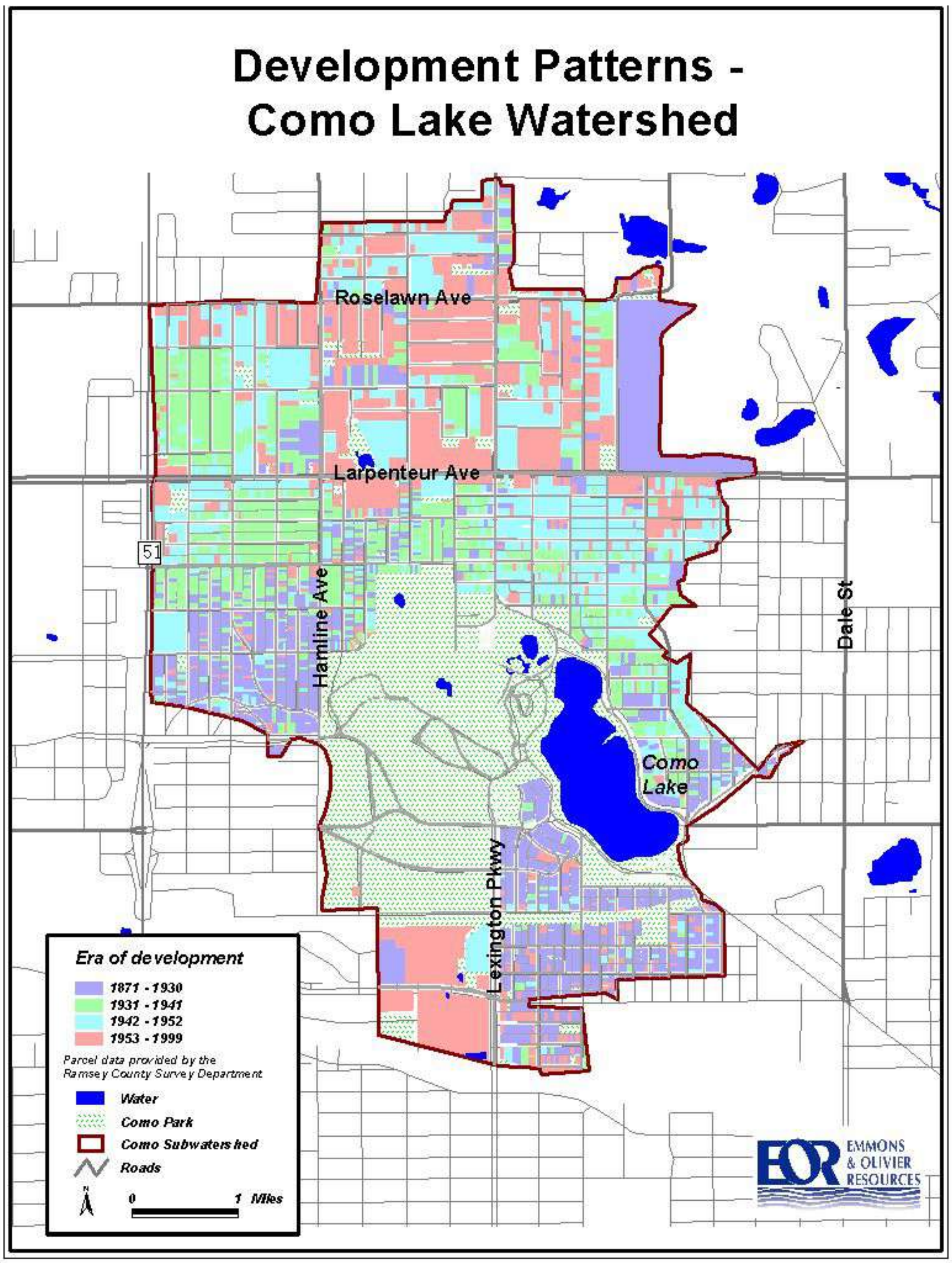


map, its location is noted. The pre-settlement vegetation map is from Marschner, F.J. 1974. The Original Vegetation of Minnesota , United States Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota. These natural landscapes contained numerous small wetlands and depressions that served to gather rainfall runoff. The area of land contributing stormwater to Como Lake during pre-settlement conditions was much smaller than it is today. The pre-settlement watershed also differs from the watershed today in that only very large rainstorms would provide runoff to the lake. The smaller, more common rainstorms would be held in the wetlands and depressions within the watershed or simply infiltrated into the ground.

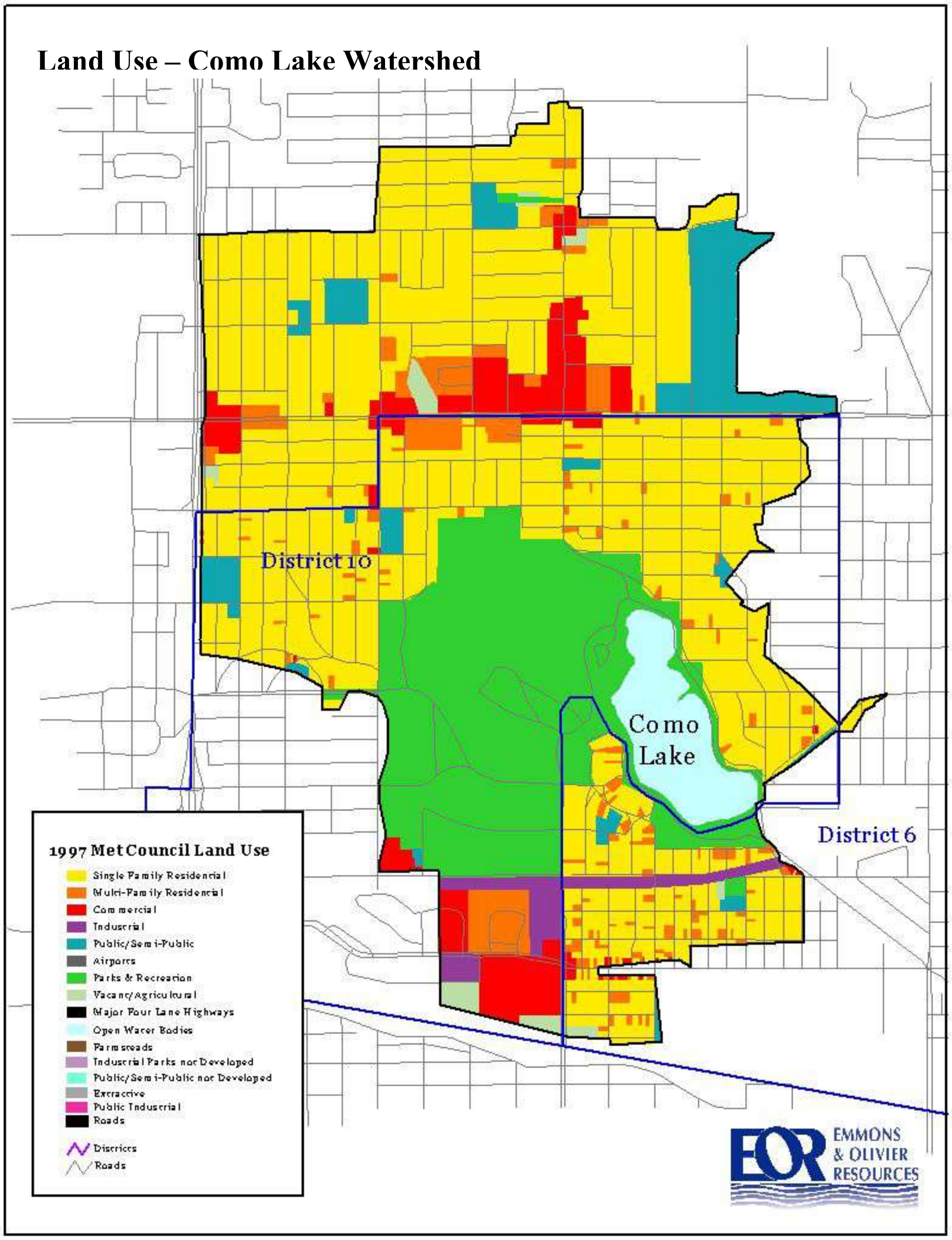
With settlement, the watershed began to change. Early development of the watershed included some homes, businesses and roads but mainly consisted of a considerable amount of agricultural land use. Homes began to appear south of the lake and west of Como Park and businesses were also found along the lake and south along the railroad (see the figure below comparing a 1940 and 1957 aerial photograph). Como Lake during this period likely received sediment and nutrient rich stormwater from the agricultural land use and was directly impacted by livestock wading in the lake, as seen in many of the historic photos. The effective watershed area (area regularly contributing runoff to the lake) would also be increasing with the introduction of ditching and the increase in impervious surfaces, resulting in an increase in the volume of water reaching Como Lake.



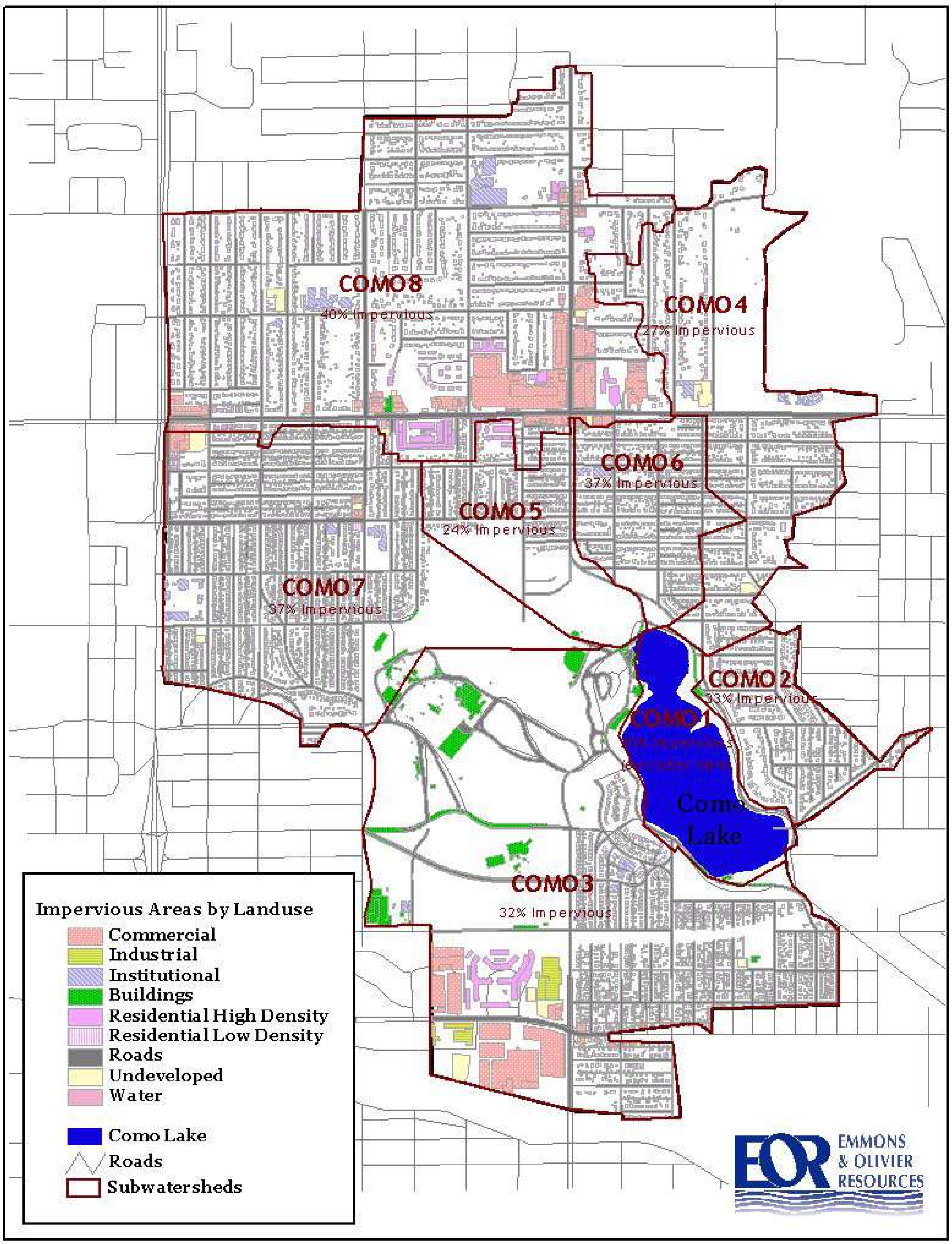
Development of the watershed district continued throughout the mid 1900's, especially during the post-war period, with the conversion of agricultural land to residential land with an intensive network of roads (see the figure - Development Patterns Como Lake Watershed). This development had the result of providing a more direct hydrologic connection between the landscape and Como Lake. This development trend continued throughout the watershed, primarily in a northward direction into the City of Roseville. Recent development has included retail centers and homes north of Larpenteur Ave and redevelopment of the retail and high-density residential areas at Energy Park.



The watershed at this time is nearly fully developed with a variety of land uses (see land use figure).



The single most significant factor relating the level of development and the character of Como Lake is the amount of impervious area within the watershed. Impervious land surfaces are simply those areas where water cannot infiltrate into the ground. The rainfall hitting these land surfaces is immediately converted into stormwater runoff, carrying with it sediment nutrients, and trash. This high level of imperviousness (see figure below) within the watershed has resulted in the character of Como Lake today.



SECTION IV DESCRIPTION OF COMO LAKE ISSUES

Located within Como Park in the city of St. Paul, Como Lake is a relatively shallow (approximately 16 feet deep), 72-acre lake located in a highly urbanized, 1,680-acre watershed. Como Lake is a major regional recreational amenity and a very important community resource for St. Paul, Roseville and Falcon Heights. As with a majority of urban lakes, Como Lake has historically served a stormwater function and therefore faces the challenging issues of increased runoff and pollutant loads associated with developed areas. Non-point source pollution (pollution arising from wash-off of land surfaces as opposed to pollution coming from industrial discharges) poses the most serious threat to the water quality of Como Lake by carrying excessive quantities of nutrients, specifically phosphorus (P), and sediment to the lake. Documented problems include poor water quality, sedimentation, and excessive vegetation during parts of the year. All of these impacts have reduced the recreational value of Como Lake by hindering swimming (not an allowed or expected use), boating, fishing and reducing its overall aesthetics. Poor water quality has also altered the ecological and natural resource values of the lake.

The CRWD Watershed Management Plan cited the challenge of trying to manage Como Lake and its watershed when there are so many jurisdictions involved. The Plan recommended that strong leadership by one governmental agency is needed to ensure management efforts are coordinated, efficient, and effective.

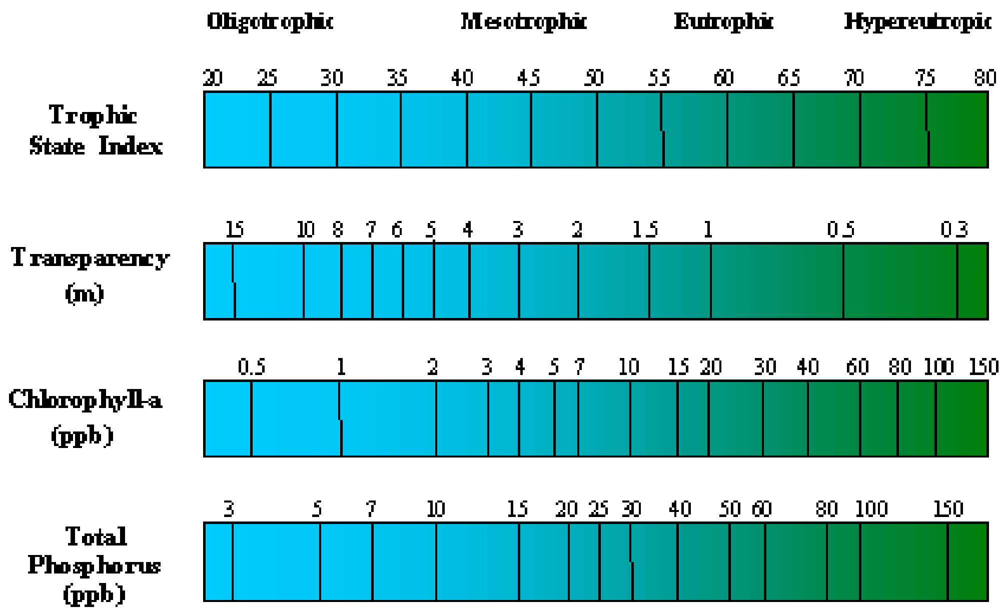
Better understanding and protection of the lake by the public is also an issue. Developing clear public education and information programs to establish realistic expectations for the lake is needed. Implementing citizen-based protection of the lake and better housekeeping Best Management Practices (BMPs) will improve the lake quality. The efforts and desires of all to improve the lake must also strike a balance with the public funds available to implement improvements.

Refer to the glossary found at the end of the report for definitions of technical terms.

Water Quality

Water quality in lakes is typically measured in terms of Secchi disk transparency, abundance of chlorophyll *a* or concentration of total phosphorus. These parameters are typical measures of the fertility or "trophic status" of a lake. The concept of trophic status is based on the fact that changes in nutrient levels (measured by total phosphorus) causes changes in algal biomass (measured by chlorophyll *a*) which in turn cause changes in lake clarity (measured by Secchi disk transparency). The Carlson Trophic State Index (TSI) is a convenient way to quantify the level of fertility of a lake with the use of any one of the parameters.

The graphic on the following page relates the Carlson TSI to quantities of the typical water quality parameters: secchi depth, chlorophyll a concentration and total phosphorus concentration. The terms used across the top of the graphic are those typically used to describe the quality of lakes.



Carlson TSI

The expected lake conditions associated with each of the above trophic states is described in the following table:

Oligotrophic TSI <30 Clear water, oxygen through the year in the hypolimnion, salmonid fisheries in deep lakes.

TSI 30-40 Deeper lakes still exhibit classical oligotraphy, but some shallower lakes will become anoxic in the hypolimnion during the summer.

Mesotrophic TS 40-50 Water moderately clear, but increasing probability of anoxia in hypolimnion during summer.

TS 50-60 Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnion during the summer, macrophyte problems evident, warm-water fisheries only.

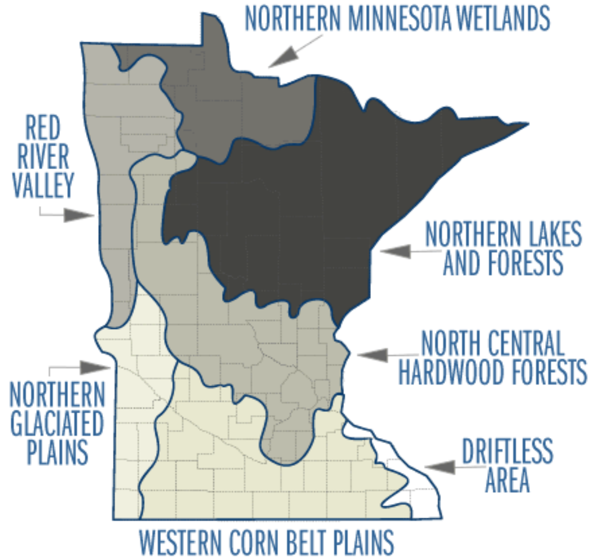
Eutrophic TSI 60-70 Dominance of blue-green algae, algal scums probable, extensive macrophyte problems.

Hypereutrophic TSI 70-80 Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic.

TSI > 80 Algal scums, summer fish kills, few macrophytes, dominance of rough fish.

Currently, Como is a hypereutrophic lake that does not support swimming (not an expected use). The Minnesota Pollution Control Agency (MPCA) has used the phosphorus criteria in conjunction with the Carlson's Trophic State Index (TSI) as a means to classify lakes based on their ability to support swimming. These classifications are defined as follows:

- Full Support - Few algal blooms and adequately high transparency exist to support swimming throughout the summer.
- Full Support (marginal) – Swimmable use is still fully supported, but the lake is near the P limit for its ecoregion and small increases in in-lake P could result in increased algal blooms and perceptible decreases in transparency.
- Partial Support (limited) – Algal blooms and low transparency may limit swimming for a significant portion of the year.
- Non-Support – Severe and frequent algal blooms and low transparency will limit swimming for most of the summer.



In addition, due to the varied nature of lakes across the state, the PCA has developed TSI threshold levels for four of Minnesota's seven ecoregions. The TSI levels for each ecoregion were developed through citizen monitoring and "use perception" surveys. The citizens monitoring each lake were asked to provide user perception and recreational suitability evaluations. For example, in the North Central Hardwood Forest (NCHF) ecoregion, 75% of the citizen observations ranked as "impaired" or "no swimming" correlated to a Secchi transparency 1.5 meters or less. The PCA then set phosphorus criteria for swimming in the NCHF ecoregion as 40 µg/l. At or below this phosphorus concentration "transparency should remain above 1.5 meters over 70% of the summer and nuisance algal blooms should occur less than 20% of the time. Currently, Como Lake has a mean in-lake phosphorus concentration of 215µg/l and a TSI value of 82, which puts it into the non-supporting category in the PCA's classification system. Como Lake has a long-term average secchi disk TSI of 59, a Chlorophyll A TSI of 67 and phosphorus TSI of 82.

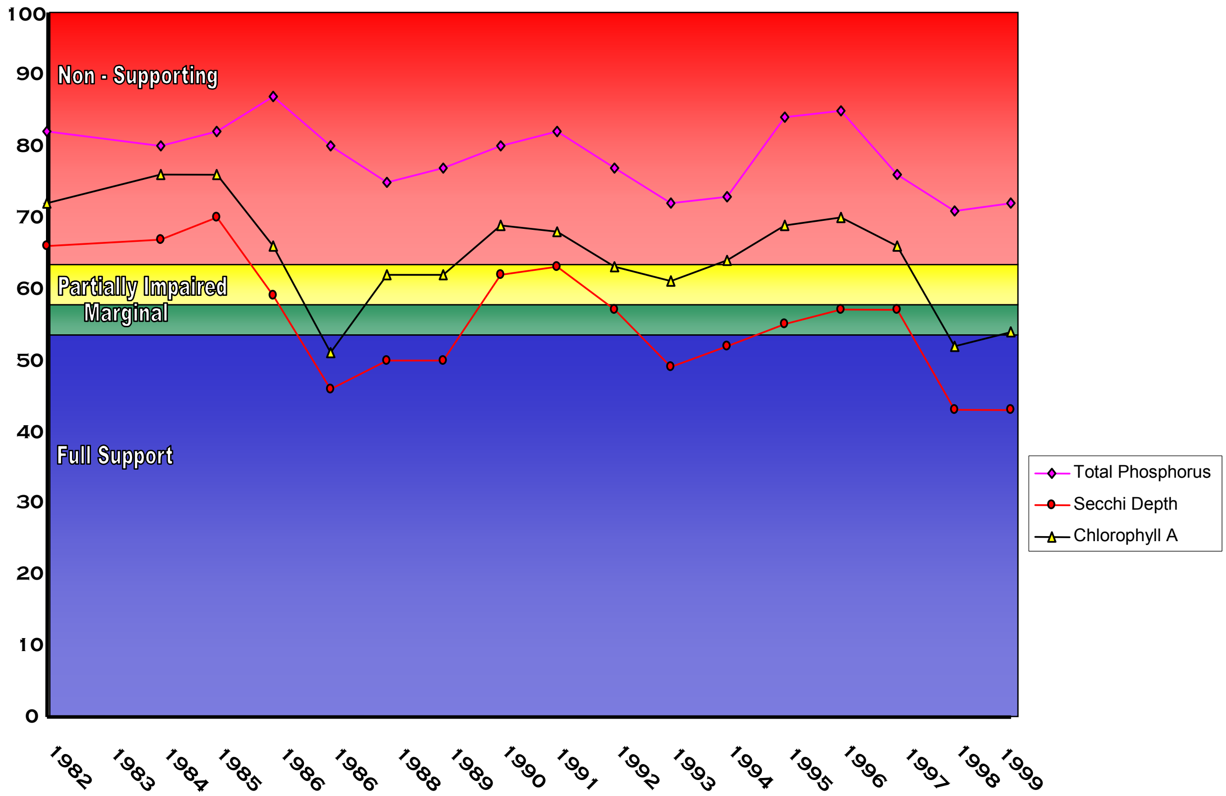
The North Central Hardwood Forest ecoregion has the following thresholds for lake swimmability;

• Full Support	TSI less than 53
• Full Support (marginal)	TSI 53 to 57
• Partial Support (limited)	TSI 57 to 63
• Non-Support	TSI greater than 63

In 1985, rough fish were removed from Como Lake in efforts to improve the water quality and the lake was restocked with largemouth bass, walleye and bluegill sunfish. The graph below shows the trends of the Carlson Trophic Index indicators for the years 1982-1999. After the biomanipulation of Como Lake, both secchi depth and chlorophyll A concentrations decreased but phosphorus levels remained high. While both secchi depth and chlorophyll A concentrations are currently lower than they were prior to 1985, there is not a tight correlation with the in-lake phosphorus concentrations. This is thought to be the result of the top-down biomanipulation that modified in-lake conditions but could not address external phosphorus loadings (Noonan, 1998).

Sources of phosphorus to Como Lake come from a variety of different sources including lawn fertilizer, decomposing vegetation, runoff from hard surfaces (roads, rooftops, etc.)

CARLSON TSI FOR PHOSPHORUS, SECCHI DEPTH, AND CHLOROPHYLL A
COMO LAKE'S ABILITY TO SUPPORT SWIMMING



and waterfowl and pet excrement. In addition to phosphorus entering Como Lake from external sources, there are also concerns with the amount of internal phosphorus loading to the lake water column from bottom sediments. Phosphorus that is bound to in-lake sediments can be released into the water column under anoxic conditions in the hypolimnion (bottom layer). This contributes to the overall in-lake phosphorus concentration of Como Lake. High nutrients levels have caused nuisance algae blooms, decreased water clarity, and increased the amount of rooted aquatic vegetation growing in the shallow near shore waters of the lake.

The decomposition of plants and algae has, at times, lead to the depletion of Como Lake's oxygen supply during winter months. Oxygen levels within the Lake have dipped

low enough in the past to cause partial fish kills. Ramsey County has installed and maintains an aerator in an effort to prevent low oxygen levels in the lake.
In addition to excess nutrient, excessive sediment has created sedimentation deltas, destroyed habitat for fish, and increased the amount of pollutants coming into Como Lake. Sediment enters Como Lake via home construction, road application and general erosion. Sediment deltas at several stormsewer inlets impact habitat and reduce the volume of Como Lake. Increased sediment into the lake also causes the water to become turbid reducing the amount of light penetration needed by aquatic vegetation, affects aquatic life by smothering fish larvae and eggs, clogs fish gills and impairs their sight. Fine sediment also acts as a vehicle to transport other pollutants including nutrients, trace metals and hydrocarbons. Further information on Como Lake's past water quality is provided in Appendix B.

Aesthetics

Como Lake is a centerpiece of one of the region's largest, most visited, and most important parks, Como Park. The primary issue related to the aesthetics of Como Lake is the odor problem that occurs every summer due to the periodic filamentous algae mats in the lake. Odor problems have been recorded since 1945. Decaying filamentous algae are believed to be one of the main sources for the undesirable odor on Como Lake. Decaying plant material and other biomass are also a likely source of odor problems. Generally, Como Lake is a very productive lake, which means it has large inputs of energy (nutrients) and has large outputs (algae and plants). Aquatic plants such as Curlyleaf Pondweed and Elodea reach nuisance populations during the growing seasoning and are also a concern, especially to boaters.

Another aesthetics issue concerning Como Lake is that of trash in and around the lake. Trash enters Como Lake either from people throwing it directly into the lake, by blowing in from the surrounding parkland or by washing in through the storm sewer system. Along with being visually unappealing, trash can be hazardous to the various forms of wildlife that inhabit Como Lake and its surrounding areas.

Recreation

Fishing and boating are two key recreational activities on the lake in addition to the more passive uses such as walking, biking, skating, and running that occur around the lake on the park's extensive trail system and open spaces. In addition, visitors enjoy the wildlife that inhabits the park.

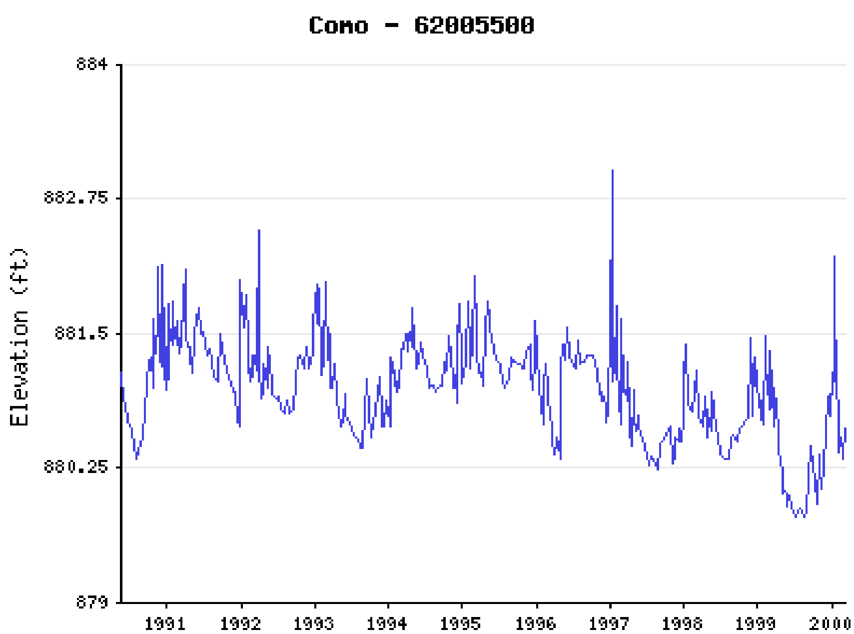
The MDNR fisheries division classifies Como Lake as a bass panfish lake with very heavy fishing pressure. The MDNR has indicated that Como Lake does not support a reproducing population of walleye or northern pike due to the absence of the appropriate spawning substrate. The MDNR also indicated that the bass and panfish spawning areas in Como Lake are threatened due to the sediment loading.

Fish winterkill had been frequent, recorded as far back as 1945. The installation of an aerator to the lake in 1985 has largely addressed the winterkills, although in times of aeration malfunction or harsh winters, partial winterkills occur. Fish surveys conducted by the MDNR (1996) show bluegills to be abundant. Other fish species found in numbers include largemouth bass, black crappie, northern pike, yellow perch (moderate numbers), few walleye and channel catfish. Angling pressure was found to be highest on Como Lake compared to that on eleven other metro lakes surveyed in 1991 and resulted in decreased fish populations.

The fish population in Como Lake exists mainly through stocking efforts by the MDNR. The MDNR has stocked fish since 1986, one year after the aerator was installed on the lake to minimize winter fish kills. Largemouth bass, walleye and bluegill were stocked in 1986. Additional bass and bluegill stocking occurred in the spring of 1987 and channel catfish were stocked in 1996. There are currently fish consumption advisories on walleye, largemouth bass and yellow bullhead. Recent fisheries surveys have shown largemouth bass have not persisted in Como Lake, partially due to aerator failure and limited success of fishing limit restricts. Northern pike, which have not been stocked in Como Lake, have been caught by anglers and measured in fisheries surveys. The MDNR considers Como Lake a high priority lake for fisheries management due to population density and use potential.

There is also concern of fluctuating lake levels, especially below the established outlet elevation and the decreasing trend in the depth of Como Lake. As lake levels decrease, light has less distance to travel and increases the conditions for nuisance macrophyte growth. In addition, as lake levels decrease, the volume of the lake decreases and the potential assimilative capacity for nutrients in the lake is decreased.

Como Lake Water Level s (1991-2000)



Natural Resources

Issues concerning the natural resources of Como Lake revolve around wildlife and vegetation. As mentioned earlier, the large filamentous algae population is a big concern. Not only does the algae cause odor problems, it also blocks out sunlight for other submerged macrophytes. Because of their small size and rapid growth rate, algae are difficult to control. Using various forms of mechanical harvesting (i.e., raking algae mats to shore) can help minimize problems but are limited in how long they can control nuisance blooms. Herbicides are another way to control algae but they are often not species specific and kill off other desirable plants as well.

The quality of habitat in Como Lake can roughly be equated to the complexity of vegetative strata. In general terms, the habitat within Como Lake is fairly one-dimensional. Generally speaking, the more diverse the plant stratum, the better the habitat is. The lake is predominately made up of submergent aquatic vegetation. There is very little floating leaved or emergent vegetation within the lake. The emergent aquatic plants in Como Lake that were once reported have been diminished except for two remaining stands of Narrow Leaf Cattail. Submergent plant species are reported to include Elodea, Coontail and native Water Milfoil. Lack of diverse vegetation communities limits the type and number of wildlife present in and around Como Lake.

The upland zone of the shoreline is much more complex then the in-lake zone. The shoreline is made up of canopy and sub-canopy trees, shrubs, forbs, grasses and vines along with turf areas. Much of the shoreline is protected with riprap. The city of St. Paul does have a plan to modify the shoreline zone that will alter the structure of the system and replace non-native vegetation with native vegetation. This should help provide a more diverse and suitable habitat for wildlife.

Early on in the planning process, a list of issues concerning Como Lake was presented to the Data Collection and Management Group for their review and input. The review included open discussions on each of the issues, multiple presentations providing background and education on various issues, and multiple brainstorming sessions. The following is the list of key issues brought up by this group. The organization of this issues into the larger groups was based on consensus of group members and forms the basis for which the remainder of this plan is organized.

Recreation / Lake Use Issues
Appropriate recreational uses (health of fish, fish advisories)
Lake level/lake depth (maintain a certain level/depth)
Diversity of fish, birds & wildlife

Water Quality Concerns
Sediment loadings (deltas, soil erosion, impacts on shoreline)
Nutrient inputs/chemical treatment (chemicals, phosphorus, nitrogen)
Waterfowl (feces, feeding issues)
Internal nutrient loadings

Stormwater impact
What is coming into lake, when it is coming into lake and how to treat it?
Source of better water than stormwater for lake (balancing H_20 quality with H_20 quantity)
Study sediments to determine history (learn from history)

Aesthetics
Aquatic plant populations
Shoreline vegetation
Smell-especially on SW end of lake
Trash in water

Natural Resource Issues
Fisheries management
Aquatic plant populations
Shoreline vegetation
Lake management (weed harvesting, other "taking out" options, who is responsible for what action?)
Diversity of fish, birds & wildlife

SECTION V COMMUNICATIONS EFFORTS AND OUTREACH PLAN

The Public Outreach Work Group determined that it was important to create a short and long-term work plan in the form of a "communications plan." The short-term work plan (Phase I) identified tasks to be accomplished by this work group during the CLSP process. The long-term work plan (Phase II) identified tasks to be accomplished by the Capitol Region Watershed district and other partners or "cooperators," similar to the strategy outlined for the proposed implementation activities (See Recommended Implementation and Five Year Work Plan). The following is the Communications Plan:

The Advisory Group supports the concepts contained in the Public Outreach Communications Plan for Como Lake. The Communications Plan should be integrated with the CRWD's communications efforts outlined in the Watershed Management Plan as well as the communication plan developed by the watershed district in December 2001.

Purpose:
To create a short-term and long term outreach strategy which results in community awareness and understanding of Como Lake's problems, the Strategic Management Planning process and citizen, government, business and organizational commitment to accept responsibility and to take action to solve the problems.

Goals:
- To create public awareness and support for the Strategic Management Plan process
- To generate public awareness regarding the relationship of Como Lake to the watershed and of the work of the Capitol Region Watershed District (CRWD)
- To communicate the causes of Lake problems and provide information on the current conditions of the Lake, and to call citizens, government, business and organizations to take action to improve and protect Como Lake
- To work with internal (city staff) and external (public) audiences to develop an understanding of the impact of their activities on the watershed in general and Como Lake, specifically, and to adjust their Best Management Practices toward protection and improvement of Como Lake.

Strategies:
- Work with professional services to define specific action steps and materials for use in the plan, and to develop pro bono opportunities to leverage taxpayer dollars
- Utilize various information outlets
- Develop information and communicate it
- Identify organizations that will help to distribute information developed
- Evaluate the communications efforts regularly and revise as needed

Targeted Audiences:
Citizens: adults and children
Community/civic groups
Schools
City staff

Key Messages:

- Citizens, community organizations, local governments, state agencies and business organizations are participating in a yearlong collaborative effort to identify Como Lake's problems and recommend solutions (short-term message--see action steps)
- Everyone is part of the problem and can be part of the solution.
- Como Lake is part of a larger ecosystem. As part of a watershed, damage to Como Lake results in pollution in the Mississippi River.
- Implementation of solutions will require extensive and continuous community commitment, resources and money in order to be successful.
- In order to reach desired results, a comprehensive, not piecemeal, effort is required.
- People will know who to contact regarding questions and concerns about the Lake and the Strategic Management Plan process.

Como Lake Event. The first annual Como Lake Event took place on April 28, 2001. Continue participating in this annul event. A display, including a display of current lake water and examples of "clean water," a video of shoreline vegetation, etc. could be created. A brochure describing the Como Lake Strategic Management Plan process could be included. "Give aways" could be included in the future, such as "stress balls," bottles of water, a sand shovel with a "Don't Feed the Geese" message, etc.

This should become an annual event, and part of the on-going public relations/outreach program. The CRWD will take the lead in the expansion and growth of this event into a major 'happening' for the entire region.

Articles. The CRWD, in cooperation with the other agencies and groups, should develop a series of articles for the community newspapers (Roseville Review, Midway/Como Monitor, North End News), St. Paul Pioneer Press and the Saint Paul edition of the Star Tribune. The series could include:

- History of Como Lake
- Report card/ state of the Lake (good and bad)
- Review the Plan process: process, vision, how and why, benefit, link to CRWD
- Personal responsibility and how it affects the Lake, the watershed and the Mississippi River

In addition to this series, articles should be written for the community newspapers to announce the completion of various activities within the implementation program.

Community information boards. Develop materials from the articles that can be posted strategically, such as at the Como Pavilion, etc. Use the existing structure in front of the Lakeside Pavilion. After this existing kiosk is used sufficiently, explore sites such as the fishing dock and Duck Point Parking lots for additional kiosks.

Website/Electronic Bulletin Board. Use the CRWD website to post the articles mentioned in #2 above and to announce events/activities on or by the Lake. This should become a place where information about Public Works projects, Parks and Recreation projects, MDNR restocking and other issues can be either posted or linked. These groups will need to view this as a valuable resource to expand their outreach through the coordination it offers. The Electronic Bulletin Board should become the first place for residents to turn to get answers to their questions about the lake and the activities surrounding it. Refer users to "list serves," and allow them to request notifications when the website changes.

Speakers' Bureau Develop a Speaker's Bureau to educate citizens, organizations and businesses regarding Como Lake and the watershed. This includes development of materials to be used by speakers, such as a presentation/video on history of Como Lake and current activities.

Signage Develop signage for around the lake, such as: don't feed the ducks–here's why, drop your waste in the trash–not the lake, etc. The Report Card on water quality could be posted as well. Continue to evaluate the usage/response to the community bulletin board mentioned above and work with the St. Paul Parks and Recreation Division to install additional boards or 'talk boxes,' as appropriate. An interpretive sign with the history of the lake should be planned for the overlook wall at the Pavilion. This could also include limnology and the need to protect the resource.

Media Involvement Create an ongoing presence in the media regarding: ways individuals can make a difference, CRWD's activities, public works projects, community projects, etc. Write a regular column for the Como/Midway Monitor, Roseville Review and North End News.

Stewardship Activities Continue to work with Districts 10 and 6, St. Paul Parks and Recreation and the other groups to sponsor events at and for Como Lake. Develop projects for future Clean Como Lake Community Events or as stand-alone, such as: landscaping/lawn care; 'Grate-mates,' public cleanup; stenciling; monitoring (schools, boy and girl scouts, etc.), "Memory Maker." There could be one "kick-off" event that will initiate stewardship projects throughout the year. Peer-to-peer education and outreach could be continued.

Public Outreach on Best Management Practice (BMP) Projects Continue to involve the public in "hands-on" work with BMP projects such as the planting of native vegetation within constructed wetlands or raingardens.

Materials Develop materials for dissemination and adapt existing materials. Create a phone, fax back or e-mail ad campaign. Create a postcard that shows Como as it used to be. Topics for these materials could include: problems facing Como Lake and known causes of problems, history of Como Lake, what individuals can do to help improve the lake, the Como Lake Strategic Management Plan-what it is, who is involved, what is and will be happening.

Continue Phase I Work Continue the Phase I activities indicated above. This features parts of the Como Lake Strategic Management Plan in articles.

Cable Contact cable networks (such as the St. Paul News Network) and determine what opportunities there are to spread our key messages.

Communications Staff CRWD could hire or contract with a communications specialist to help carry out this communications plan. In addition, a professional public relations firm could assist in developing communications to the public through speakers' bureau, radio and television spots, press releases, etc.

School Outreach Develop a presentation regarding Como Lake and present it to curriculum coordinators at the eight elementary schools within walking distance to Como Lake and Como Senior High. Work with curriculum coordinators to include Como Lake and the watershed information in the schools' curriculums. Explore the possibility of contracting this activity because of the different skill sets needed to reach teachers.

Public Employee Outreach Get on the agendas of the Saint Paul City Council, Roseville City Council, Roseville District 623 School Board, St. Paul District 625 School Board and Ramsey County Board of Commissioners to discuss Como Lake's problems and how staff can assist in preventing and solving them. Provide training as needed or requested. Targeted audiences include seasonal and permanent maintenance and public works staffs in schools, park departments, public works departments and St. Paul Water Utility.

Create a Como Lake Community Foundation Establish an endowment and a pass-through fund to allow major contributions by individuals and corporations for new and ongoing lake enhancement activities. This would provide a source of funds for such items as signage as well as provide the donors with a current income tax deduction.

SECTION VI COMMITTEE EXPECTATIONS FOR THE LAKE

The CLSP group as a whole, spent several meetings discussing lake issues in general, as well as issues specific to Como Lake (see Description of Lake Issues section). Trends in lake conditions were analyzed, management efforts were described, and the water quality limitations of Como Lake were discussed. The group then developed ”expectation statements” for the future condition of Como Lake. An example would be, *“In the future, I expect that significant sediment deltas will be gone from the lake.”* The priority issue areas for those expectations, ranked from most to least important for the workplan of the CLSP were: Water Quality, Aesthetics, Recreation/Land Use and Natural Resources. The Data Collection and Management Work Group reviewed the expectation statements for conflicting and unrealistic expectations and made recommendations for consideration by the Advisory Group. The expectation statements continued to evolve through the planning process as additional information was made available by the Data Collection and Management Work Group.

The following list of Expectation Statements is the result of on-going refinement by the Data Collection and Management Work Group and the Advisory Group. The Advisory Group reviewed the expectations and prioritized them as: eliminate, low, medium and high. The rankings were designed to help the Data Collection and Management Work Group prioritize their level of effort.

CLSP Expectation Statements by Major Issue Area

Water Quality

WQ- 01 Significant sediment deltas will be gone
Advisory Group Rank: ***HIGH***

WQ-02 The depth of the lake will be increased
Advisory Group Rank: ***MEDIUM***

WQ-03 Additional sediment and metals loadings will be minimized
Advisory Group Rank: ***HIGH***

WQ-04 Residents, business and governments in the watershed will fully understand the impact of human activity on sediment, nutrients, pollutants and metals loading in the lake
Advisory Group Rank: ***HIGH***

WQ-05 Erosion around the lake will decrease
a. Shoreline
Advisory Group Rank: ***LOW***
b. Watershed
Advisory Group Rank: ***HIGH***

WQ-06 Waterfowl excrement and path compaction on the lake will be reduced
Advisory Group Rank: ***HIGH***

WQ-07 The transparency of the lake will be improved, especially in July and August
Advisory Group Rank: ***MEDIUM***

WQ-08 The internal and external nutrient loading will be reduced
a. Internal
Advisory Group Rank: ***HIGH***
b. External
Advisory Group Rank: ***HIGH***

WQ-09/10 Water quality will not be a risk to health for people or animals and the Lake will be managed to meet health criteria if a beach were to be developed
Advisory Group Rank: ***MEDIUM/HIGH (9 was ranked high and 10 was ranked medium)***

Aesthetics

A-01 The lake's odor will be diminished, especially during the summer months
Advisory Group Rank: ***HIGH***

A-02 There will be fewer algal mats and scums on the lake surface.
Advisory Group Rank: ***HIGH***

A-03 There will be less trash in and around the lake
Advisory Group Rank: ***HIGH***

A-04 Waterfowl excrement around the lake will be reduced
Advisory Group Rank: ***HIGH***

A-05 There will be better quality lake views for aesthetic purposes that will be determined by environmental factors and will be balanced with trees and low growing vegetation
Advisory Group Rank: ***HIGH***

A-06 Shoreline erosion around the lake will decrease
Advisory Group Rank: ***HIGH***

Recreation/Lake Use

R-01 Bird watching and other wildlife watching opportunities will be enhanced by increasing the diversity of birds and wildlife in and around the lake
Advisory Group Rank: ***HIGH***

R-02 Fishing will be a recreational opportunity
Advisory Group Rank: ***HIGH***

R-03 The lake level will be maintained to enhance recreation
Advisory Group Rank: ***MEDIUM***

R-04 Canoeing and kayaking experiences will improve with fewer aquatic weeds
Advisory Group Rank: ***HIGH***

R-05 Walking/jogging/biking surfaces will be cleaned and maintained
Advisory Group Rank: ***HIGH***

R-06 Como Lake will support ice recreation
Advisory Group Rank: ***HIGH***

Natural Resources

NR-01 There will be a diversity of rooted aquatic plants that allow for balanced use in order to enhance wildlife habitat
Advisory Group Rank: ***HIGH***

NR-02 Low-lying shoreland areas will have wetland vegetative cover.
Advisory Group Rank: ***HIGH***

NR-03 & 4 There will be better wildlife habitat that will be determined by environmental factors and will be balanced with trees and low growing vegetation. Diversity of fish, birds (including migratory) and other wildlife in and around the lake will be increased
Advisory Group Rank: ***HIGH***

NR-05 The entire ecosystem will be enhanced
Advisory Group Rank: ***HIGH***

Following the development of expectation statements, the data collection and management work group brainstormed possible solutions intended to meet these expectations. The implementation tables provided later in the plan are crossed referenced, to a large extent, to the expectation statement numbers listed above.

SECTION VII IDENTIFICATION AND SELECTION OF POSSIBLE SOLUTIONS

Following the development of the vision for Como Lake's future, the Data Collection and Management Work Group developed a list of solutions to meet those expectations. The group began by evaluating each of the *Expectation Statements* enumerated in the previous section. A brainstorming session was held to develop a list of potential implementation activities that would address those expectations and resulted in a list of one to six implementation activities for each particular expectation statement. The implementation activities were then presented to the Advisory Group for their review. The Advisory Group recommended which activities warranted further investigation by the Data Collection and Management Work Group and where further education of the Advisory Group was needed.

To assist in the evaluation of the implementation activities, the Data Collection and Management Work Group provided the Advisory Group with a table describing each activity. The table also included the following information:

- The type of option – regulatory, behavioral, structural
- Ability to meet the expectation statement alone – rated from 1=low to 5=high
- Ability to meet the expectation statement in combination with other efforts – rated from 1=low to 5=high
- Existing efforts to be paired with
- Barriers to implementation
- Cooperating partners needed for implementation
- Estimated time needed for implementation
- Whether or not phasing would be required and at what interval
- Level of maintenance required – rated from 1=low to 5=high
- Type of monitoring or evaluation needed to evaluate effectiveness

Upon reviewing the list of implementation activities and the above information, the Advisory Committee developed a decision grid. A decision grid is a facilitation tool to assist in comparing solutions based on agreed upon and objective criteria. The Advisory Group selected the following criteria with the definitions designated below to compare options suggested by the Data Collection and Management Work Group that could satisfy the expectations:

- Effectiveness
    - Permanency of solution
    - Sole source to provide the solution
    - Ability to resolve the problem in conjunction with other resources
- Support by:
    - Public (seen as fair and equitable)
    - Politicians
    - Implementers

- "Do-ability"
    - Time it takes to implement: short, long, ongoing, when it starts
    - Maintenance needed and who's responsible for the maintenance
    - Has the solution been tested
    - Appropriateness of the solution
    - The reasonableness of the solution
    - The fairness of the solution
- Compatibility
    - With other projects
    - With other solutions
- Unintended Consequences
    - (Check-in, not ranked)

The Advisory Group used the above criteria to develop an overall rank for each activity. Each of the criteria had equal weight in determining the overall rank.

The Advisory Group used the following numbering system to rank the options:

0-Not Valid
1-Poor
2-Fair
3-Good
4-Very good
5-Excellent

Activities rated 0 – 2 were eliminated from consideration by the Data Collection and Management Work Group and can be found in Appendix A – Options Considered but Eliminated.

The ranking information was then provided to the Data Collection and Management Work Group to develop further details, including cost estimates for all activities rated 3-5. These implementation activities are included in the **Implementation Plan** section.

SECTION VIII IMPLEMENTATION PLAN

The previous section described the methodology used in identifying and evaluating potential solutions to the issues facing Como Lake. Each of the potential solutions that were rated three or higher are carried forward to the Implementation Plan. The Implementation Plan identifies the specific activities that are proposed for Como Lake. A cost estimate is included for each implementation activity as well as a schedule for when the activity will occur. The costs are divided between "Capital Improvement" costs, which are one time project costs, and "Management Program" costs, which are on-going costs. (An example of a capital improvement cost would be installing grit chambers at the inlets leading to the lake. A management program cost would be the long-term maintenance of the grit chambers.) One point at which the Implementation Plan varies from the standard approach is in the planning of water quality best management practices. The approach used for water quality, in general, was to develop a goal for nutrient loading to the lake, and then to design a system of best management practices to meet that goal. The water quality approach is referred to as the Subwatershed Loading Plan. This plan is described in detail following the Implementation Tables. The costs for implementing the Subwatershed Loading Plan are incorporated into the Implementation Table and the overall implementation cost table.

The following table outlines the five-year work plan for the Como Strategic Lake Management Plan. Following the Implementation Table is a summary of the costs for the five-year plan.

For the first year, there should be noticeable and measurable improvement achieved through more aggressive street sweeping, aquatic vegetation harvesting and possible alum treatment. Within the first five years, there should be less algal scums, reduced smell and improvement of fish and wildlife habitat. The 20-year implementation plan could be funded through a combination of state bonding, grants, tax levies and other programs

The Advisory Group supports reaching a phosphorus TSI number of 60 for Como Lake that would be achieved over 20 years by reducing internal and external phosphorus loading. We believe that continual monitoring and evaluation is essential and that when this information is taken into consideration, the goal may need to be adjusted. The water quality reduction goal of 60% reduction of phosphorus to the lake was established as the goal for the Subwatershed Loading Plan. The 60% reduction goal is based on input and general guidance from the Advisory Committee to reduce to the maximum extent possible the loadings to the Lake. From that general guidance, the Data Collection and Management Group's technical input suggested the greatest practical reduction of phosphorus for the foreseeable future to be 60%. Based on the significant effort required, a planning target of 20 years was established to meet the goal. In the difficult situation of a fully developed watershed like Como Lake's, the goal will need to be evaluated, re-examined, and refined over time as the plan is implemented to reflect the relative success and effectiveness of the practices.

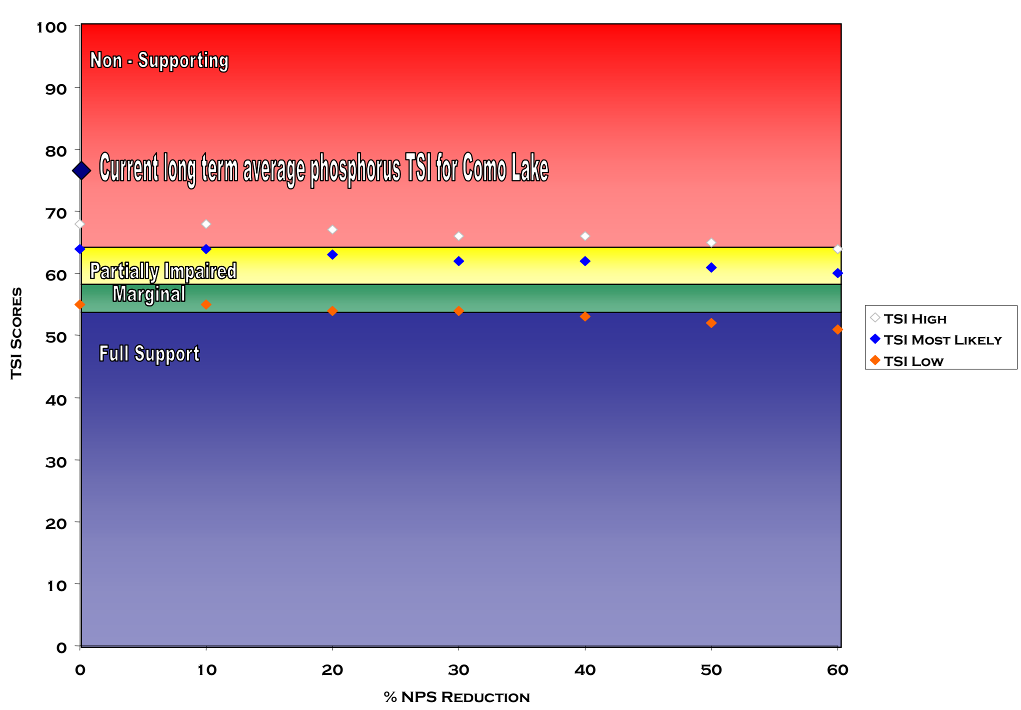
VIII – A Water Quality Goal Development

The various expectations developed during the initial phases of the planning process needed to be translated into actions in able to accomplish the expectations. It was clear that many of the desired changes in the lake, such as improved aesthetics, reduced algal scums and less odor, were largely driven water quality of the lake. Water quality improvement for the lake was also its own objective identified by the committee.

In order to define a specific goal for the lake, the Data Collection and Management Work Group considered what would be the best scenario for water quality improvement in the lake that was still feasible and attainable. The goal should also be significant enough that there would be a perceptible improvement in the lake by the general public. The Data Collection and Management Work Group looked at the lake's Trophic State Index (TSI) as a commonly used, scientifically-based measure of lake quality. The TSI can be calculated and measured using three variables or indicators, phosphorus (a nutrient that drives most lake systems), chlorophyll-a (a measure of algal content in water), and secchi depth (a measure of water transparency or clarity). Como Lake is somewhat unusual in that while the three different measures correlate to each other (which is typical), the chlorophyll-a and secchi depth TSI values have been lower (better quality) than the phosphorus TSI after the bio-manipulation of the mid 1980's. Since phosphorus is the driving force of the lakes biological system and still contributes to significant rooted aquatic plants growth, the management goal would need to targeted at the phosphorus budget of the lake.

Setting a phosphorus-calculated TSI (TSI-P) was determined to be the best method to have a measurable goal for Como Lake water quality. A preliminary goal of 50 for a TSI-P was discussed which would correspond to a mesotrophic lake and would be just low enough to be considered fully supporting for swimming, based on MPCA rating system. This was considered to be potentially unrealistic for a lake with the physical and drainage characteristics of Como Lake and probably unattainable. A goal of 60 TSI-P

TSI FOR PHOSPHORUS FOR VARIOUS NON-POINT SOURCE REDUCTIONS IN THE COMO LAKE WATERSHED: (ASSUMED INTERNAL LOADINGS HAVE BEEN ADDRESSED)



was then suggested and recommended by the Data Collection and Management Work Group as probably the most ambitious goal for the lake that could be attained. The TSI of 60 would correspond to a eutrophic lake, but would be an improvement over the current hypereutrophic condition of the lake. TSI 60 also corresponds to a partially impaired water for swimmability, thus taking out of the non-supporting category.

TSI is calculated from an in-lake water phosphorus concentration and therefore the TSI can also be converted to phosphorus concentration. Therefore the target TSI condition for the lake from the Wisconsin Lake Modeling Suite (WiLMS) Summary Trophic Response corresponds to an in-lake phosphorus concentration of approximately 59 ppb. Through in-lake modeling using the Walker 1987 Reservoir Model and the watershed loadings from the District's water quality modeling project (Barr, 2000) the necessary reduction in watershed loadings of phosphorus to the lake was established to be at least a 60% reduction. It is important to note that the 60% reduction was modeled and established with the internal nutrient loadings to the lake (from sediments) being reduced through other measures. Therefore, based on the modeling, the desired improvement in lake condition and the TSI goal cannot be accomplished by only the 60% reduction of watershed loads (external loads), but is also combined with control of internal loadings from the sediments.

The 60% reduction of annual phosphorus loads to the lake from external sources via surface runoff from the watershed is the basis for the subwatershed loading plan. The subwatershed loading plan describes the BMPs necessary to accomplish the 60% reduction goal through watershed improvements.

The relative merits of the TSI-P goal are improvement in the lake's water quality and decreases in the overall productivity of the lake. However, "improvement" and "lake water quality" are somewhat subjective from the perspective of the general public. The development of the categories for swimmability by the MPCA for different eco-regions is a means to quantify the public perception of lake water quality. Therefore, the change of Como Lake from "non-supporting" to "partially impaired" (and it is close to the next category of "marginal") is one means of gauging the perception of improved quality of the lake by the public.

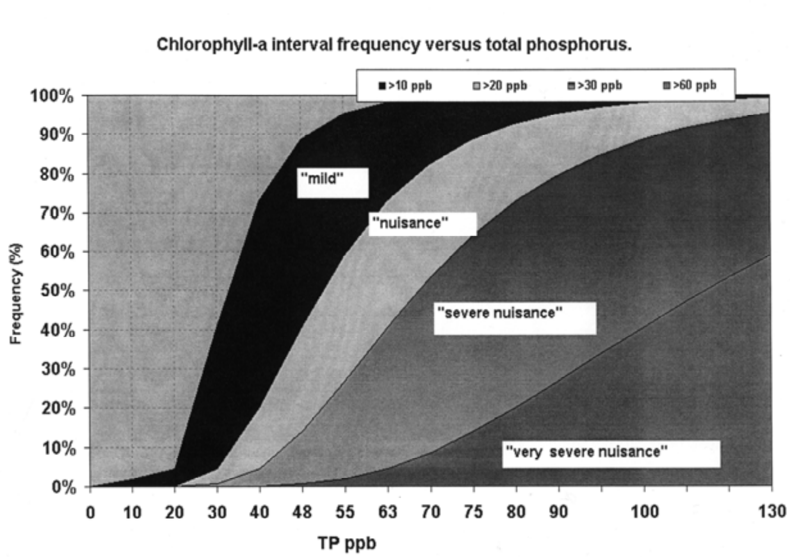
The MPCA has also developed a graphic that relates the perception of nuisance algae blooms, their frequency during the summer months, and the in-lake phosphorus concentration. The graphic, "Chlorophyll-a interval frequency versus total phosphorus." plots the frequency of different levels of nuisance algal blooms in lakes to phosphorus concentration based on lake user perception. The algal blooms are tracked using chlorophyll-a since chlorophyll-a is a measure of algal biomass. Based on this graphic the current condition of the lake is such that over 90% of the time algal blooms are either "very severe nuisance" or "severe nuisance" with about equal frequency of the two.

Based on the proposed condition of 59 ppb phosphorus, the algal blooms would be reduced to the following distribution:

Category	Frequency or Amount of the Time
"very severe nuisance"	< 5%
"severe nuisance"	30 %
"nuisance"	30%
"mild"	30%
none	5%

This should represent a marked improvement in the lake quality as perceived by lake users, even though the lake will still experience some nuisance algal blooms.

The predicted benefits presented are based on the available information and the current tools available to analyze complex systems such as lakes. The predictive tools used to estimate the future conditions of the lake have limitations and still have a significant level of uncertainty associated with them. For these reasons, the District will need to continue to monitor the condition of the lake and response to the improvements it undertakes. Based on this feedback, the District will continually evaluate the most successful practices to use and will need to time many of their improvements when the opportunities arise given the fully developed nature of the watershed.



VIII -B District Priority Activities

The Watershed District has prioritized several activities for implementation within the first five years following adoption of this plan. The District believes that these activities will have the largest positive impact on Como Lake. The activities were selected through a workshop with the CRWD Board of Managers and staff and are based on the following criteria:

- **Positive impact on the quality of Como Lake** – Activities which are expected to have the largest positive impact on water quality (i.e. provide the most sediment or nutrient reduction).
- **Cost effectiveness** – Activities with a relatively high ratio of cost to potential benefit.
- **Coordination with existing efforts** – Activities which are generally an expansion of existing efforts or coordination of redevelopment efforts.

These implementation activities are further defined in the Implementation Table that follows the narrative. These narratives are listed by expectation statement, while the Implementation Table lists actual activities designed to meet that expectation. The number refers to the activity in the Implementation Table.

#1 Storm sewers and streets will be managed to substantially decrease sediment loads to Como Lake. Advisory Group Rank – 4 This would entail sweeping all streets a minimum of four times per year. In addition, the use of a regenerative air sweeper would be explored. This activity will be evaluated by visual inspections of storm sewers in addition to monitoring Como Lake for sediment deltas and Total Suspended Solids.

 # 2 Install grit chambers or sumped manhole structures near the outlet of all stormsewer pipes discharging into the lake. Advisory Group Rank – 4 This would entail retrofitting 22 storm sewer inlets to the lake. For planning purposes, we are assuming that we will construct 12 Grit Chambers and 10 Sump Manholes at a cost of 30K and $2500 respectively. It is quite possible that some inlets may be combined and that the total number of structures could be reduced. This approach however could increase costs due to the need to reroute pipes. The structures would then need to be cleaned three times per year to maintain their intended capacity. This activity will be evaluated by monitoring Como Lake for sediment deltas and Total Suspended Solids. Recent work conducted by the Watershed District indicates that a few lake inlets are far more significant than the rest. The Watershed District will incorporate this information to prioritize the location of potential grit chambers.

 # 3-6 Subwatershed Loading Plan
Several of the water quality implementation activities had the similar goal of reducing external phosphorus loading into Como Lake. These activities are

referred to as the Subwtarshed Loading plan. The activities within the subwatershed loading plan are Best Management Practices for stormwater management. Refer to Appendix B for a detailed description of the Subwatershed Loading Plan.

It is important to note that many of the innovative stormwater management techniques proposed and promoted in this plan have been implemented in the Como watershed by the St. Paul Park and Recreation Department. The Parks department has been incorporating natural stormwater systems such as rain gardens and grassed swales into their parking lot renovation plans. The Parks Department has also installed a mechanical separator in a catch basin within Como Park and is monitoring its effectiveness. The Watershed District applauds this effort aimed at protecting Como Lake.

 # 7 Conduct an investigation to assess Como Lake's response to an in-lake alum treatment. Advisory Group Rank – 4 This activity would include conducting a lake bottom soil analysis and a detailed feasibility study. This activity will be evaluated by monitoring in lake phosphorus levels.

 # 8 Conduct mechanical removal of filamentous algae. Advisory Group Rank – 4 This would entail the corralling of algal mats with nets or wind, and removing the mats with vactor trucks. This activity will be evaluated by visual observation of aquatic vegetation as well as citizen surveys on lake aesthetics.

 # 9 Trash will be picked up around and in the lake in conjunction with an "adopt a lake " program. The frequency of trash removal at receptacles will be increased by picking up trash twice a day instead of once a day. Collect trash on Como Lake by boat. Advisory Group Rank – 5 This would entail the staff coordinating volunteer efforts. This activity will be evaluated through visual surveys in the amount of trash in and around Como Lake.

 # 10 Signs will be installed around the lake emphasizing the importance of not feeding waterfowl.

 # 11 Increase the frequency of mechanical harvesting of aquatic vegetation in Como Lake to twice a summer. Advisory Group Rank – 4 Currently, aquatic vegetation is harvested at least once a summer. This activity will be evaluated by visual observation of aquatic vegetation in addition to citizen surveys on lake aesthetics.

 # 11 Harvest weeds from fishing areas to promote the use of designated fishing areas. **Advisory Group Rank – 4** This would entail harvesting weeds every two weeks during the time from May – October. This activity will be evaluated by conducting vegetation surveys in Como Lake in addition to visual observations.

 # 11 Regular harvesting of nuisance vegetation on parts of Como Lake such as cruising lanes. **Advisory Group Rank – 3** This would entail harvesting the weeds from a particular path through the lake, referred to as a cruising lane. These lanes provide recreation corridors as well as hunting areas for fish. Harvesting would be conducted four times per summer. This activity will be evaluated through citizen surveys in addition to vegetation surveys.

 # 12 Participate in an annual Como Lake event. The first Como Lake event took place in the spring of 2001. This should become an annual event, and part of the on-going public relations and outreach program. The CRWD will take the lead in the expansion and growth of this event into a major 'happening' for the entire region. This would entail coordinating volunteer and staff to organize and participate in the event including creating a display of current lake water and providing examples of "clean water," and a video of shoreline vegetation. A brochure describing the Como Lake Strategic Management Plan process could be included. "Educational Give Aways" could be included in the future, such as "stress balls," bottles of water, a sand shovel with various messages. For example, "Don't Feed the Geese" or "Storm sewers drain directly into Como Lake"

VIII -D Other District Implementation Activities

The following were identified in the Como Lake Strategic Planning process as activities that the Watershed District would take the lead in implementing. These activities, while beneficial to Como Lake, were not identified as priorities by the Watershed District Board of Managers and staff. The Watershed District may choose to implement these activities as funding, potentially from grants, becomes available. The numbers refer to the Implementation Tables.

 # 13 Conduct a pilot project to determine the feasibility of polyacrylamide treatment for sediment removal. Advisory Group Rank – 4 This activity would entail retrofitting an existing storm sewer inlet to allow for the introduction of polyacrylamide and constructing an area sufficient enough to allow sediments to settle out. In addition, there would need to be annual operation and maintenance of the structures such as the sweeping of debris and the application of the chemicals. This activity would be evaluated by taking measurements of Total Suspended Solids before and after treatment in addition to visual observations of Como Lake.

 # 14 Install & Maintain Mechanical Separator/filter systems in catch basins within the watershed. Advisory Group Rank – 4 This activity would entail retrofitting an existing storm sewer inlet s to include mechanical separators. The details for this implementation activity are provided in the subwatershed loading plan.

 # 15 Develop speakers' bureau. A Speaker's Bureau of local and regional experts is a means to educate citizens, organizations and businesses regarding Como Lake and the watershed. This activity would entail the development of materials to be used by speakers, such as a presentation/video on history of Como Lake and current activities.

 # 16 Best Management Practices- Subwatershed Loading Plan elements not implemented as Priorities identified in Implementation Table. The priority work plan identifies specific best management practices at targeted locations. These practices were selected by the District as having the greatest potential to improve Como Lake. The work plan also includes a continued level of effort for constructing BMPs throughout the watershed. The remaining BMP construction and maintenance identified in the subwatershed loading plan is listed in the following section.

VIII – F - Implementation Activities – District Cooperators

The following narrative describes implementation activities developed in the strategic planning process where the lead agency is not the Capitol Region Watershed District. These activities are a priority for reaching the goal of the Strategic Plan but are more appropriately implemented by other agencies involved in the planning process. The Watershed District is committed to working with the agencies listed below to ensure that these activities are implemented.

Saint Paul Park and Recreation

The following activities are either an expansion of current St. Paul Park and Recreation efforts or activities which would be best suited to the mission and role of the organization. In some cases, St. Paul Parks is the lead agency because of their ownership of the lake shoreline.

Install signs to discourage pedestrian use of areas that are sensitive to erosion. Advisory Group Rank – 4 This would entail the design, fabrication, and installation of three signs around Como Lake. This activity will be evaluated by visual erosion inspections around Como Lake in addition to monitoring for Total Suspended Solids.

Add signage at the paddle boat center on the importance of trash removal at the lake. Advisory Group Rank – 5 This would entail the design, fabrication and installation of one sign. This activity will be evaluated through visual surveys in the amount of trash in and around Como Lake.

Increase the number of trash receptacles around Como Lake without detracting from the aesthetics of the park. Advisory Group Rank – 5 This would entail the addition of 8 trash receptacles. This activity will be evaluated through visual surveys in the amount of trash in and around Como Lake.

Increase the frequency of path cleaning where geese congregate. Advisory Group Rank – 5 This would entail daily path cleaning for a time period of 5 months. This activity will be evaluated through visual surveys of the amount of goose droppings around the lake and citizen surveys on lake aesthetics.

Disrupt non-migratory Canada Geese to prevent congregation around Como Lake. Advisory Group Rank – 5 This would entail the installation of swan decoys in the lake in addition to maintaining tall vegetation around the lake. This could also consist of using live swans from the Como Zoo. This activity will be evaluated by visual observation and population counts of Canada Geese around Como Lake.

Remove non-migratory Canada Geese from Como Lake. Advisory Group Rank – 4 This would entail rounding up and relocating the geese during their summer flightless period. This activity will be evaluated by visual observation and population counts of Canada Geese around Como Lake.

Add interpretive signage at three lake view overlooks to emphasize the water quality, ecology, geology, and history of Como Lake. **Advisory Group Rank – 3** This would entail the design, fabrication and installation of three signs. This activity will be evaluated by citizen surveys.

Create specific points on Como Lake for shorefishing in an effort to reduce bank erosion from heavy foot traffic. **Advisory Group Rank – 4** This would entail the installation of reinforced turf and boulders in two areas around the lake. This activity will be evaluated by conducting citizen surveys in addition to visual inspections of erosion around Como Lake.

It is important to note that many of the innovative stormwater management techniques proposed and promoted in this plan have been implemented in the Como watershed by the St. Paul Park and Recreation Department. The Parks department has been incorporating natural stormwater systems such as rain gardens and grassed swales into their parking lot renovation plans. The Parks Department has also installed a mechanical separator in a catch basin within Como Park and is monitoring its effectiveness. The Watershed District applauds this effort aimed at protecting Como Lake.

Ramsey County Public Works

The following activities, relating mainly with operation of the Como Lake aeration system, are most appropriately conducted by Ramsey County Public Works. The aerator is currently maintained and operating by this agency.

Support ice fishing through aeration to prevent winter kill and fish management. **Advisory Group Rank – 3** This would entail maintaining fishing opportunities through on-going aeration and fish management activities. Costs are incorporated within these management activities. This activity will be evaluated by fish surveys and visual observations of Como Lake.

Maintain and improve the current aerator to minimize winter fish kills. **Advisory Group Rank – 4** This would entail the evaluation and implementation of a shore-based pump and baffle system for winter aeration as well as evaluating hypolimnetic aeration and summer aeration. This activity will be evaluated by fish surveys and visual observations of Como Lake.

Minnesota Department of Natural Resources

The Minnesota DNR has been identified as the lead agency for the following implementation activities recommended in the Como SLMP.

Continue the biomanipulation (top-down approach) efforts in Como Lake to reduce phosphorus in-lake concentrations. Advisory Group Rank – 4 This would entail the continuation of annual population assessment and stocking of fish. This activity will be evaluated by on-going water quality monitoring and the Carlson Trophic State Index in addition to conducting fish surveys.

Create nesting boxes (both floating and stabilized) to attract other waterfowl to Como Lake. **Advisory Group Rank – 4** This would entail installing ten tree nest boxes for wood ducks and one floating nest box for swans. These nesting boxes would be designed and built to exclude Canada Geese. This activity will be evaluated by visual observations on the diversity of waterfowl and population counts.

Post multiple language signage indicating health advisories for fish consumption, types of fish that can be caught and their limit, and fisheries management strategy for Como Lake. **Advisory Group Rank – 3** This would entail the design, fabrication and installation of three signs in three different languages: English, Spanish, and Hmong. This activity will be evaluated by conducting citizen surveys to see if the signs provide educational input.

Reduce bullhead populations in Como Lake. **Advisory Group Rank – 3** This would entail maintaining higher trophic levels of predator fish populations and the maintenance of adequate winter oxygen levels through aeration. This activity will be evaluated by conducting a fishery survey every 5 years.

St. Paul Community Council – District 10

The following activity cannot be implemented by a Watershed District. District 10 was identified as the appropriate group to implement this activity due to their involvement with the planning process and their commitment to Como Lake.

Create a Como Lake Community Foundation. Establishing an endowment and a pass-through fund will allow major contributions by individuals and corporations for new and ongoing enhancement activities for Como Lake. This would provide a source of funds for such items as signage as well as provide the donors with a current income tax deduction.

St. Paul Public Works, City of Roseville, City of Falcon Heights, Ramsey County Public Works

The following activity has been identified as a priority of the CLSMP planning process for all road installation/maintenance agencies.

Install & Maintain sump-manholes in catch basins throughout watershed. Sump-manholes to be installed within existing stormsewer system throughout the watershed. As roads are improved/upgraded sumped manholes would be installed. Other manholes could be retrofitted as funds are available.

It is important to note that the City of St. Paul has already begun installing sumped manholes in catch basin within the watershed and plans to continue this practice as roads are being reconstructed. The Watershed District applauds this effort aimed at protecting Como Lake.

VIII- G - Watershed District-Wide Implementation Activities

The following activities identified in the Como Strategic Lake Management Plan have District-Wide benefits or have been previously identified in the CRWD Watershed Management Plan. The Watershed District is committed to implementing these activities throughout the entire district in addition to the Como Lake subwatershed.

Coordinate the permitting & enforcement of stormwater and soil erosion control measures in the watershed. Advisory Group Rank – 4 The Capital Region Watershed District (CRWD) would enter into a Memorandum of Agreement with the various cities within the watershed. This activity would be evaluated by monitoring construction activities for compliance.

Support a no or low phosphorus fertilizer ordinance for the Como Lake Watershed. Advisory Group Rank – 4 This would entail the coordination by the Staff with existing regional and/or city efforts, and would likely include the development of a model ordinance for use by cities. This activity will be evaluated by conducting citizen surveys as well as monitoring Carlson Trophic Index indicators in Como Lake.

Assist the City of St. Paul in developing and implementing a shoreline management plan. Advisory Group Rank – 5 The Como Lake Strategic Management Plan recommends working within the framework of the City of St. Paul's existing Shoreline Management Plan. The City's Shoreline Management Plan outlines the types of alterations planned for various segments of the lakeshore. The plan sets the foundation for future lakeshore restoration projects. At some point in the future, specific plans will be developed for each of the lakeshore segments. The Como Strategic Management Plan recommends that the CRWD work with the City to develop the specific plans for each of the lakeshore segments as well as developing in-lake planting plans and plantings within the upland areas of the park. Specific expectations of the Como Lake Strategic Management Plan include:

- Focusing the plan on erosion control and water quality as well as aesthetics
- Restore and maintain upland forest
- Restore and maintain different prairie types
- Provide in-lake and shoreline microhabitat (rocks for turtles, woody debris, snags, etc)
- Increase in-lake habitat (fish cribs, woody debris, emergent vegetation)
- Establish mesic wetland vegetation in exposed areas around lake
- Emergent vegetation will be part of shore plant communities in appropriate areas

This activity will be evaluated through visual observations, citizen surveys, and vegetation surveys around Como Lake.

Manage invasive exotic vegetation in and around Como Lake. **Advisory Group Rank – 4** Currently, there are some populations of exotic species in the area. The populations are likely to increase as areas are replanted as part of the shoreline management plan. This would entail the control of curlyleaf pondweed, buckthorn, and purple loosestrife through education and management activities. This activity will be evaluated by visual observations and vegetation surveys in Como Lake.

Conduct on-going monitoring and evaluation to determine the effectiveness of the Implementation Activities

Develop a series of monthly articles for the community newspapers (Roseville Review, Midway/Como Monitor, North End News), St. Paul Pioneer Press and the Saint Paul edition of the Star Tribune. The series could initially include:

- History of Como Lake
- Report card/ state of the Lake (good and bad)
- Review the Plan process: process, vision, how and why, benefit, link to CRWD
- Personal responsibility and how it affects the Lake, the watershed and the Mississippi River

Develop community information boards. Developing community information boards around Como Lake will provide the public with education and outreach about Como Lake. This activity would entail writing articles about Como Lake, developing materials from previously written articles on Como Lake and placing these strategically around the lake, such as at the Como Pavilion. After existing kiosks are used sufficiently, additional sites such as the fishing dock and Duck Point Parking lots can be considered for additional kiosks.

Develop and maintain electronic bulletin board. By using the existing CRWD website, articles about Como Lake can be posted electronically and announcements of events and activities on or by the lake can be posted. This electronic bulletin board should become a place where information about Public Works projects, Parks and Recreation projects, DNR restocking and other issues can be either posted or linked. The Electronic Bulletin Board should become the first place for residents to turn for answers to their questions about the lake and the activities surrounding it. This activity will entail weekly or daily updates of the electronic bulletin board by a staff member in addition to maintaining the current CRWD website.

Create an ongoing presence in the media. Create an ongoing presence in the media regarding ways individuals can make a difference, CRWD's activities, public works projects, and community projects. This activity would entail writing a regular column for the Como/Midway Monitor, Roseville Review and North End News.

Develop stewardship activities. Continue to work with Districts 6 and 10, St. Paul Parks and Recreation and the other groups to sponsor events at and for Como Lake. Develop projects for future Clean Como Lake Community Events or as stand-alone, such as: landscaping/lawn care; 'Grate-mates,' public cleanup; stenciling; monitoring (schools, boy and girl scouts, etc.), "Memory Maker." There could be one "kick-off" event that will initiate stewardship projects throughout the year. Peer-to-peer education and outreach could be continued. A project to revegetate Como's shoreline with native plants is described in the Como Lake Shoreline Management Plan.

Conduct on-going education on "rain gardens." Continue developing "rain gardens" throughout communities like the one at Nebraska and Lexington. This will require instructions and education.

Develop education materials. This activity would entail developing materials for dissemination and adapting existing materials for dissemination. In addition, phone, fax back or e-mail ad campaign or postcards showing the history of Como Lake, current problems facing Como Lake, known causes of problems on Como Lake, or how individuals can do to help improve the lake could be created.

Develop education programs for cable television. This activity would entail contacting cable networks (such as the St. Paul News Network) and determine what opportunities there are to spread key messages about Como Lake.

Conduct a school outreach program. This activity would entail developing a presentation regarding Como Lake and presenting it to curriculum coordinators at the eight elementary schools within walking distance to Como Lake and Como Senior High. In addition, work with curriculum coordinators to include Como Lake and the watershed information in the schools' curriculums.

Establish a public employee outreach program. This activity would entail getting on the agendas of the Saint Paul City Council, Roseville City Council, Roseville District 623 School Board, St. Paul District 625 School Board and Ramsey County Board of Commissioners to discuss Como Lake's problems. In addition, work with city staff and elected officials to develop an understanding of the impact their activities have on the watershed in general and Como Lake, specifically, and to adjust BMPs toward protection and improvement of Como Lake.

GLOSSARY

Aeration Any active or passive process by which intimate contact between air and liquid is assured, generally by spraying liquid in the air, bubbling air through water, or mechanical agitation of the liquid to promote surface absorption of air.

Aerobic Processes requiring oxygen.

Algae Microscopic organisms/aquatic plants that use sunlight as an energy source (e.g., diatoms, kelp, seaweed). One- celled (phytoplankton) or multicellular plants either suspended in water (Plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of chlorophyll a (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Numerous species occur. Algae are an essential part of the lake ecosystem and provides the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short.

Algal Bloom Population explosion of algae in surface waters due to an increase in plant nutrients such as nitrates and phosphates.

Alkalinity The ability of water, or other substances, to absorb high concentrations of hydrogen ions. Substances with a pH greater than 7.0 are considered alkaline. A measure of the amount of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity is the main indicator of susceptibility to acid rain. Increasing alkalinity is often related to increased algae productivity. Expressed as milligrams per liter (mg/1) of calcium carbonate (CaCO3), or as microequivalents per liter (ueq/1). 20 ueq/1 = 1 mg/l of CaCO3.

Alum Common name for commercial-grade Aluminum Sulfate. Its chemical formula is generally denoted by $Al_2(SO^4)_3$ X $12H_2O$. Most often used in lakes as a way to precipitate a floc that settles through the water column removing fine particles to the sediment and building up a barrier layer to contain soluble phosphorus in the bottom sediments.

Ammonia A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient. It converts rapidly to nitrate (NO3) if oxygen is present. The conversion rate is related to water temperature. Ammonia is toxic to fish at relatively low concentrations in pH-neutral or alkaline water. Under acid conditions, non-toxic ammonium ions (NH4+) form, but at high pH values the toxic ammonium hydroxide (NH4OH) occurs. The water quality standard for fish and aquatic life is 0.02 mg/l of NH4OH. At a pH of 7 and a temperature of 68 Deg F (20 Deg. C), the ratio of ammonium ions to ammonium hydroxide is 250:1; at pH 8, the ratio is 26:1.

Anaerobic Living or occurring in the absence of air or free oxygen.

Anoxic Without oxygen.

Aquatic Organisms that live in or frequent water.

Aquatic Invertebrates Aquatic animals without an internal skeletal structure such as insects, mollusks, and crayfish.

Aquifer A saturated permeable geologic unit that can transmit significant quantities of water.

Banks and Shorelines Those areas along streams, lakes, ponds, rivers, wetlands, and estuaries where water meets land. The topography of banks and shorelines can range from very steep to very gradual.

Benthic Zone The bottom zone of a lake.

Bioaccumulation Food chain is the sequence of algae being eaten by small aquatic animals (zooplankton) which in turn are eaten by small fish which are then eaten by larger fish and eventually by people or predators. Certain chemicals, such as PCBs mercury, and some pesticides, can be concentrated from very low levels in the water to toxic levels in animals through this process.

Biological Oxygen Demand (BOD) Amount of dissolved oxygen needed to break down (oxidize) organic materials to carbon dioxide, water, and minerals in a given volume of water at a certain temperature over a specified time period.

Biomass The total quantity of plants and animals in a lake. Measured as organisms or dry matter per cubic meter, biomass indicates the degree of a lake system's eutrophication or productivity.

Blue-Green Algae Algae that are often associated with problem blooms in lakes. Some produce chemicals toxic to other organisms, including humans. They often form floating scum as they die. Many can fix nitrogen (N2) from the air to provide their own nutrient.

Carnivore An organism that feeds primarily on other animals.

Chloride (Cl-) Chlorine in the chloride ion (Cl-) form has very different properties from chlorine gas (Cl2), which is used for disinfecting. The chloride ion (Cl-) in lake water is commonly considered an indicator of human activity. Agricultural chemicals, human and animal wastes, and road salt are the major sources of chloride in lake water.

Chlorophyll a Green pigment present in all plant life and necessary for photosynthesis. The amount present in lake water depends on the amount of algae and is therefore used as a common indicator of water quality.

Clarity The transparency of a water column. Measured with a Secchi disc.

Concentration units Express the amount of a chemical dissolved in water. The most common ways chemical data is expressed is in milligrams per liter (mg/1) and micrograms per liter (ug/1). One milligram per liter is equal to one part per million (ppm). To convert micrograms per liter (ug/1) to milligrams per liter (mg/1), divide by 1000 (e.g. 30 ug/l = 0.03 mg/1). To convert milligrams per liter (mg/1) to micrograms per liter (ug/1), multiply by 1000 (e.g. 0.5 mg/l = 500 ug/1). Microequivalents per liter (ueq/1) is also sometimes used, especially for alkalinity; it is calculated by dividing the weight of the compound by 1000 and then dividing that number into the milligrams per liter.

Conductivity (specific conductance) Measures water's ability to conduct an electric current. Conductivity is reported in micromhos per centimeter (umhos/cm) and is directly related to the total dissolved inorganic chemicals in the water. Values are commonly two times the water hardness unless the water is receiving high concentrations of contaminants introduced by humans.

Consumers Organisms that obtain their energy by eating other organisms; generally divided into primary consumers (herbivores), secondary consumers (carnivores), and microconsumers (decomposers).

Cultural Eutrophication Accelerated eutrophication that occurs as a result of human activities in the watershed that increase nutrient loads in runoff water that drains into lakes.

Daphnia Small crustacean (zooplankton) found in lakes. Prey for many fish species.

Decompose Breakdown of organic materials to inorganic materials.

Detritus Partially decomposed (dead) organic matter.

Dissolved Oxygen (DO) The amount of free oxygen absorbed by the water and available to aquatic organisms for respiration; amount of oxygen dissolved in a certain amount of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.

Diversity Number of species in a particular community or habitat.

Ecosystem A system formed by the interaction of a community of organisms with each other and with the chemical and physical factors making up their environment.

Epilimnion The layering of water due to differences in density is stratification. Water's greatest density occurs at 39 Deg.F (4 Deg.C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 feet.

Erosion The wearing away and removal of materials of the earth's crust by natural means.

Eutrophic Pertaining to a lake or other body of water characterized by large nutrient concentrations such as nitrogen and phosphorous and resulting high productivity. Such waters are often shallow, with algal blooms and periods of oxygen deficiency. Slightly or moderately eutrophic water canbe healthful and support a complex web of plant and animal life. However, such waters are generally undesirable for drinking water and other needs.

Eutrophication The process by which lakes and streams are enriched by nutrients, and the resulting increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients--mostly nitrates and phosphates--from natural erosion and runoff from the surrounding land basin. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile), hypereutrophic (extremely productive and fertile).

Exotic A non-native species of plant or animal that has been introduced.

Filamentous Algae Algae that forms filaments or mats attached to sediment, weeds, piers, etc.

Food Chain The transfer of food energy from plants through herbivores to carnivores. An example: insect-fish-bear or the sequence of algae being eaten by small aquatic animals (zooplankton) which in turn are eaten by small fish which are then eaten by larger fish and eventually by people or predators.

Function and Value Wetlands are important because they provide many intrinsic ecological functions (water quality maintenance, fish and wildlife habitat, etc.) and socioeconomic values (flood and erosion control, groundwater recharge and water supply, recreation, education, research, food production, etc.). *Functions* generally refer to the ecological (physical, chemical, and biological) processes or attributes of a wetland without regard for their importance to society. *Values* refer to wetland processes or attributes that are valuable or beneficial to society.

Geomorphology The shape of geologic features.

Glacial Lake Deposits Flat-topped hills composed of silt, sand, and gravel deposited at the bottom of lakes that developed in potholes in glaciers. When the surrounding ice melted, the lakes drained and the lakebed deposits were left as hills on the surrounding landscape.

Groundwater Water contained in or flowing through the ground. Amounts and flows of groundwater depend on the permeability, size, and hydraulic gradient of the aquifer.

Groundwater Discharge Areas Areas where groundwater exits to the surface. Depending on local topography, these may create continuously saturated areas on slopes or in shallow depressions that support unusual plant communities, or may interact with surface water runoff to create ponds and deep-water wetlands.

Groundwater Recharge Areas Areas on the earth's surface where surface water can percolate down to the water table.

Groundwater drainage lake Often referred to a spring-fed lake, has large amounts of groundwater as its source, and a surface outlet. Areas of high groundwater inflow may be visible as springs or sand boils. Groundwater drainage lakes often have intermediate retention times with water quality dependent on groundwater quality.

Habitat The place where an organism lives that provides an organism's needs for water, food, and shelter. It includes all living and non-living components with which the organism interacts.

Herbivorous Feeding on plants.

Hydraulic Head The top elevation of a water body under normal atmospheric pressure.

Hydrologic (water) Cycle The process by which the earth's water is recycled. Atmospheric water vapor condenses into the liquid or solid form and falls as precipitation to the ground surface. This water moves along or into the ground surface and finally returns to the atmosphere through transpiration and evaporation.

Hydrologic Soil Groups The classification of soils by their reference to the intake rate of infiltration of water, which is influenced by texture, organic matter content, stability of the soil aggregates, and soil horizon development.

Hydrology The study of water, especially its natural occurrence, characteristics, control and conservation.

Hypolimnion Stratification is the layering of water due to differences in density. Water's greatest density occurs at 39 Deg.F (4 Deg.C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. The cold bottom water is the hypolimnion.

Hypereutrophic Pertaining to a lake or other body of water characterized by excessive nutrient concentrations such as nitrogen and phosphorous and resulting high productivity. Such waters are often shallow, with algal blooms and periods of oxygen deficiency. Slightly or moderately eutrophic water can be healthful and support a complex web of plant and animal life. However, such waters are generally undesirable for drinking water and other needs.

Impervious A term denoting the resistance to penetration by water or plant roots; incapable of being penetrated by water; non-porous.

Infiltration Rate Rate at which water penetrates into the ground.

Kjeldahl nitrogen The most common analysis run to determine the amount of organic nitrogen in water. The test includes ammonium and organic nitrogen.

Lacustrine Refers to features (such as sediments, landforms, plant communities, or animal communities) that were formed by or are associated with a lake.

Landlocked Basins Basins or depressions which have no surface outlet to a body of water.

Larva The immature form of an insect with complete metamorphosis where the individual must completely change before assuming the adult characteristics.

Limiting factor The nutrient or condition in shortest supply relative to plant growth requirements. Plants will grow until stopped by this limitation; for example, phosphorus in summer, temperature or light in fall or winter.

Limnology The study of inland lakes and waters.

Littoral The near shore shallow water zone of a lake, where aquatic plants grow.

Loam Soil composed of sand, silt, clay, and possibly organic material.

Macrophytes Refers to higher (multi-celled) plants growing in or near water. Macrophytes are beneficial to lakes because they produce oxygen and provide substrate for fish habitat and aquatic insects. Overabundance of such plants, especially problem species, is related to shallow water depth and high nutrient levels.

Mesotrophic Pertaining to a lake or other body of water characterized by moderate nutrient concentrations such as nitrogen and phosphorous and resulting significant productivity. Such waters are often shallow, with algal blooms and periods of oxygen deficiency. Slightly or moderately eutrophic water can be healthful and support a complex web of plant and animal life. However, such waters are generally undesirable for drinking water and other needs.

Metalimnion Stratification is the layering of water due to differences in density. Water's greatest density occurs at 39 Deg.F (4 Deg.C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 feet. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Nitrate (NO3-) An inorganic form of nitrogen important for plant growth. Nitrogen is in this stable form when oxygen is present. Nitrate often contaminates groundwater when water originates from manure pits, fertilized fields, lawns or septic systems. High levels of nitrate-nitrogen (over 10 mg/1) are dangerous to infants and expectant mothers. A concentration of nitrate-nitrogen (NO3-N) plus ammonium-nitrogen (NH4-N) of 0.3 mg/l in spring win support summer algae blooms if enough phosphorus is present.

Nitrite (NO2-) A form of nitrogen that rapidly converts to nitrate (NO3-) and is usually included in the NO3- analysis.

Nitrogen Cycle Cyclic movement of nitrogen in different chemical forms from the environment to organisms and then back to the environment.

Non-Point Source A source of pollution that comes from no single identifiable point of discharge. Example: topsoil erosion into a lake or stream.

Nutrients Elements or substances such as nitrogen and phosphorus that are necessary for plant growth. Large amounts of these substances can become a nuisance by promoting excessive aquatic plant growth.

Omnivorous Feeding on both plants and animals.

Ordinary High Water Level The highest level reached by a body of water under normal conditions.

Organic Matter Elements or material containing carbon, a basic component of all living matter.

Outwash Sandy or gravelly material deposited by glacial meltwater flowing from an ice sheet.

Overturn Fall cooling and spring warming of surface water increases density, and gradually makes temperature and density uniform from top to bottom. This allows wind and wave action to mix the entire lake. Mixing allows bottom waters to contact the atmosphere, raising the water's oxygen content. However, warming may occur too rapidly in the spring for mixing to be effective, especially in small sheltered kettle lakes.

Perennial Persisting for more than one year; for plants, a plant that lives for 3 years or more.

Permeability The ability of a substance, such as rock or soil, to allow a liquid to pass or soak through it.

pH The numerical value used to indicate how acid or alkaline a solution is. The number refers to the number of hydrogen ions in the solution. The pH scale ranges from 1 to 14 with 7.0 being neutral. Acid ranges from 0 to 6. Alkaline ranges from 8 to 14.

Phosphorus Key nutrient influencing plant growth in freshwater lakes. Soluble reactive phosphorus is the amount of phosphorus in solution that is available to plants. Total phosphorus includes the amount of phosphorus in solution (reactive) and in particulate form.

Photosynthesis The process by which green plants convert carbon dioxide (CO2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base, and is an important source of oxygen for many lakes.

Phytoplankton Microscopic floating plants, mainly algae, that live suspended in bodies of water and that drift about because they cannot move by themselves or because they are too small or too weak to swim effectively against a current.

Planktiviorous Refers to organisms that eat plankton.

Plankton Small plant organisms (phytoplankton and nanoplankton) and animal organisms (zooplankton) that float or swim weakly though the water.

Pollution The contamination of water and other natural resources by the release of harmful substances into the environment.

ppm Parts per million; units per equivalent million units; equal to milligrams per liter (mg/l).

Precipitation Rain, snow, hail, or sleet falling to the ground.

Predator An animal that hunts and kills other animals for food.

Prey An animal that is hunted or killed by another for food.

P8 Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds. A model for predicting the generation and transport of stormwater runoff pollutants in urban watersheds.

Retention Time (turnover rate or flushing rate) The average length of time water resides in a lake, ranging from several days in small impoundments to many years in large seepage lakes. Retention time is important in determining the impact of nutrient inputs. Long retention times result in recycling and greater nutrient retention in most lakes. Calculate retention time by dividing the volume of water passing through the lake per year by the lake volume.

Riparian Area Wet soil areas directly influenced by the water of a stream, lake, or wetland.

Rooted Aquatic Plants See *macrophytes*

Runoff Water that flows over the surface of the land because the ground surface is impermeable or unable to absorb the water.

Secchi Disc An 8-inch diameter plate with alternating quadrants painted black and white that is used to measure water clarity (light penetration). The disc is lowered into water until it disappears from view. It is then raised until just visible. An average of the two depths, taken from the shaded side of the boat, is recorded as the Secchi disc reading. For best results, the readings should be taken on sunny, calm days.

Sedimentation The removal, transport, and deposition of detached soil particles by flowing water or wind. Accumulated organic and inorganic matter on the lake bottom. Sediment includes decaying algae and weeds, marl, and soil and organic matter eroded from the lake's watershed.

Soluble Capable of being dissolved.

Species A group of animals or plants that share similar characteristics such as can reproduce.

Specific Conductance Measures water's ability to conduct an electric current. Conductivity is reported in micromhos per centimeter (umhos/cm) and is directly related to the total dissolved inorganic chemicals in the water. Values are commonly two times the water hardness unless the water is receiving high concentrations of contaminants introduced by humans.

Stormwater Runoff Water falling as rain during a storm and entering a surface water body like a stream by flowing over the land. Stormwater runoff picks up heat and pollutants from developed surfaces such as parking lots.

Stratification The layering of water due to differences in density. Water's greatest density occurs at 39 Deg.F (4 Deg.C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 feet. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Subwatershed A smaller geographic section of a larger watershed unit with a drainage area of between 2 and 15 square miles and whose boundaries include all the land area draining to a point where two second order streams combine to form a third order stream.

Sulfate (SO^4--) The most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate (SO4) can be reduced to sulfide (S--) and hydrogen sulfide (H2S) under low or zero oxygen conditions. Hydrogen sulfide smells like rotten eggs and harms fish. Sulfate (SO4--) input from acid rain is a major indicator of sulfur dioxide (SO2) air pollution. Sulfate concentration is used as a chemical fingerprint to distinguish acid lakes acidified by acid rain from those acidified by organic acids from bogs.

Suspended Solids A measure of the particulate matter in a water sample, expressed in milligrams per liter. When measured on inflowing streams, it can be used to estimate the sedimentation rate of lakes or impoundments.

Thermal Pollution Addition of heat energy to the environment. It may be transferred by heated air or water and causes localized temperature increases.

Thermocline Stratification is the layering of water due to differences in density. Water's greatest density occurs at 39 Deg.F (4 Deg.C). As water warms during the summer, it remains near the surface while colder water remains near the bottom. Wind mixing determines the thickness of the warm surface water layer (epilimnion), which usually extends to a depth of about 20 feet. The narrow transition zone between the epilimnion and cold bottom water (hypolimnion) is called the metalimnion or thermocline.

Till Un-stratified and unsorted material deposited directly by a glacier. Till consists of clay, sand, gravel, or boulders mixed in any proportion.

Toxic Lethal Concentration

Trophic Levels A classification of organisms according to what they eat (i.e., energyflows) For example, organisms such as algae and plants that get their food directly from the sun are called primary producers Organisms that eat algae are called secondary producers, etc .

Trophic State Eutrophication is the process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification or state: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile).

Turbidity Degree to which light is blocked because water is muddy or cloudy.

Turnover Fall cooling and spring warming of surface water increases density, and gradually makes temperature and density uniform from top to bottom. This allows wind and wave action to mix the entire lake. Mixing allows bottom waters to contact the atmosphere, raising the water's oxygen content. However, warming may occur too rapidly in the spring for mixing to be effective, especially in small sheltered kettle lakes.

Water Table The top or 'surface' of groundwater. The water table level changes in response to amounts of groundwater recharge flowing in, and amounts of water leaving the ground through seeps, springs, and wells.

Watershed The geographic region within which water drains into a particular river, stream, or body of water.

Wetland Habitats where the soil is saturated or covered with water for part of the year.

Zooplankton Microscopic or barely visible animals that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish, they are the primary source of food.

APPENDIX A Existing Information on Como Lake

Fisheries

The following data is from the DNR fisheries survey done in 1996. Como Lake is scheduled to have a new fishery survey in 2001. We will coordinate with the DNR to incorporate their findings into the strategic lake management plan.

Fish Sampled up to the 1996 Survey Year						
		Number of fish per net				
Species	Gear Used	Caught	Normal Range	Average Fish Weight (lbs)	Normal Range (lbs)	
Black Bullhead	Trap net	0.3	2.5 - 70.2	0.65	0.1 - 0.5	
Black Crappie	Gill net	3.5	2.0 - 19.0	0.17	0.1 - 0.2	
	Trap net	9.6	1.3 - 27.7	0.18	0.1 - 0.4	
Bluegill	Gill net	11.5	N/A - N/A	0.14	N/A - N/A	
	Trap net	23	2.8 - 43.3	0.14	0.1 - 0.3	
Channel Catfish	Trap net	0.2	N/A - N/A	0.12	N/A - N/A	
Golden Shiner	Gill net	2	1.0 - 8.5	0.14	0.1 - 0.1	
	Trap net	3.8	0.4 - 3.9	0.15	0.1 - 0.1	
Hybrid Sunfish	Trap net	0.2	N/A - N/A	0.08	N/A - N/A	
Largemouth Bass	Gill net	0.5	1.0 - 3.8	0.88	0.2 - 0.7	
	Trap net	0.6	0.2 - 1.1	0.41	0.3 - 1.0	
Northern Pike	Gill net	0.5	1.5 - 9.0	6.28	1.8 - 3.7	
	Trap net	0.4	N/A - N/A	4.99	N/A - N/A	
Snapping Turtle	Trap net	0.7	N/A - N/A	ND	N/A - N/A	
Softshell Turtle	Trap net	0.1	N/A - N/A	ND	N/A - N/A	
Walleye	Gill net	0.5	2.3 - 17.8	3.8	0.7 - 2.1	
White Sucker	Gill net	1	1.0 - 6.6	2.72	1.0 - 2.2	
	Trap net	1.2	0.2 - 2.2	2.56	1.0 - 2.0	
Yellow Perch	Gill net	14	2.5 - 25.8	ND	0.1 - 0.2	
	Trap net	0.4	0.4 - 3.5	0.2	0.1 - 0.2	
Normal Ranges represent typical catches for lakes with similar physical and chemical characteristics.						

Status of the Fishery 07/29/96 (Minnesota DNR Web Page)

Como Lake's largemouth bass population is down; 11 bass were sampled by electrofishing in May, 1996. With the exception of 1995, this is below previous levels. These fish ranged from 8 to 16 inches long and averaged 10.5 inches. Only two fish were over 12 inches long and only one over 16 inches. Bluegill were the most abundant fish sampled. Size of bluegill is improved from previous years with over 25% being 6 inches or longer and 5% being at least 7 inches long. 1996 is the first time since 1988 that bluegill over 7 inches long have been sampled, when 1% were at least 7 inches long. Moderate numbers of black crappie are present with most less than 7 inches long, but over 10% 8 inches or longer. Northern pike were sampled for the first time in Como Lake with five fish between 24 and 28 inches long. The yellow perch population is up, but are present in only moderate numbers. Lengths of perch ranged from 6.5 to 9 inches. A few walleye remain from the 1986 stocking. Two were captured - these were both between 22 and 23 inches long. Small channel catfish yearlings were stocked in early July of 1996 - two of these were captured. Other species caught in low numbers were black bullhead, hybrid sunfish, white sucker, and golden shiner.

Fish Stocked by Species for the Last Five Years			
Year	**Species**	**Age**	**Number**
1996	Channel Catfish	Yearling	1,389
1997	Channel Catfish	Adult	6
	Walleye	Fry	70,000
	Channel Catfish	Yearling	771
	Yellow Perch	Adult	2,008
1998	Channel Catfish	Yearling	700
	Yellow Perch	Adult	1,876
1999	Channel Catfish	Fingerling	456

Compared to other lakes of Ramsey County, Como Lake had one of the lowest secchi disk transparencies in 1997. While the TSI for secchi transparence is high (suggesting poor water quality), the TSI for phosphorus is even higher.

1997 Data	DNRID	SECCHI	SITE	SECCHI	TP	CCHL A	TSI-SD	TSI-TP	TSI-CHL	AVG. TSI
WH BEAR	82-0167	1	5402	5.4	0.014	3.8	36	42	44	41
	82-0167	2	5401	5.1	0.018	3.4	37	46	43	42
SNAIL	62-0073	3	5402	3.9	0.021	3.8	40	48	44	44
	62-0073	3	5401	3.9	0.024	3.6	40	50	43	45
WABASSO	62-0082	4	5401	3.8	0.027	5.4	41	52	47	47
SILVER E	62-0001	5	5401	3.7	0.028	3.7	41	52	43	46
PHALEN	**62-0013**	**6**	**5401**	**3.6**	**0.031**	**9.8**	**42**	**54**	**53**	**49**
JOSEPHINE	62-0057	7	5401	2.9	0.03	7.8	45	53	51	50
TURTLE	62-0061	7	5401	2.9	0.022	5.9	45	49	48	47
JOHANNA	62-0078	9	5401	2.7	0.039	11.6	46	57	55	52
OTTER	02-0003	10	5401	2.6	0.032	5.8	46	54	48	49
GERVAIS	62-0007	10	5401	2.6	0.038	14.5	46	57	57	53
OWASSO	62-0056	12	5401	2.5	0.04	13.1	47	57	56	53
MCCARRON	**62-0054**	**13**	**5401**	**2.3**	**0.049**	**12.8**	**48**	**60**	**56**	**55**
ISLAND S.	62-0075	14	5402	2.1	0.053	11.2	49	61	54	55
TWIN	62-0039	15	5401	2	0.045	9	50	59	52	54
ISLAND N.	62-0075	15	5404	2	0.05	8	50	61	51	54
ROUND(PH)	62-0012	17	5401	1.8	0.046	11.8	52	59	55	55
BENNETT	62-0048	17	5401	1.8	0.095	6.5	52	70	49	57
VALENTINE	62-0071	17	5401	1.8	0.089	8.8	52	69	52	57
BALD EAGLE	62-0002	20	5401	1.5	0.075	31.4	54	66	64	62
BEAVER	62-0016	20	5401	1.5	0.109	29.6	54	72	64	63
LONG S.	62-0067	20	5401	1.5	0.058	15.6	54	63	58	58
SILVER W	62-0083	23	5401	1.4	0.049	31.4	55	60	64	60
COMO	**62-0055**	**24**	**5401**	**1.2**	**0.138**	**36**	**57**	**75**	**66**	**66**
KOHLMAN	62-0006	25	5401	1	0.093	18.2	60	70	59	63
KELLER	62-0010	25	5401	1	0.051	17.1	60	61	58	60
WAKEFIELD	62-0011	27	5401	0.7	0.118	46.2	65	73	68	69
LONG N.	62-0067	27	5403	0.7	0.155	53	65	77	70	71

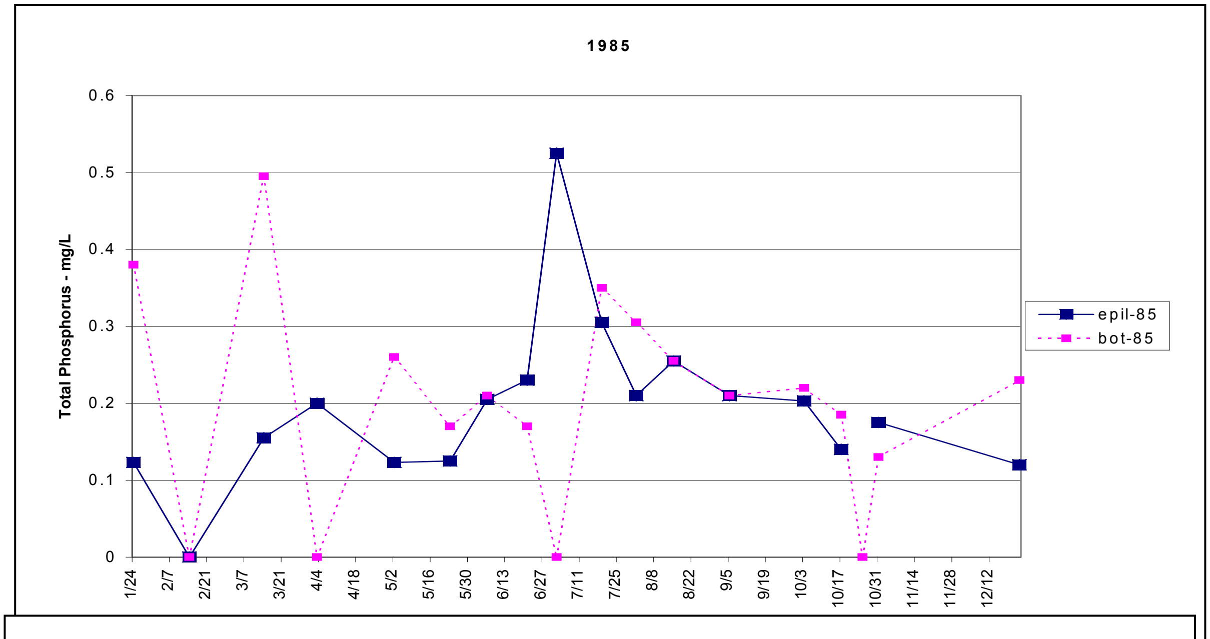
(Ramsey County)

The following figures show seasonal trends in Como Lake for three representative years out of the water quality record. 1985 is the year prior to the biomanipulation with very high algae abundance and limited transparency (mean Secchi = 0.5 m). 1991 is a year with poor transparency (mean Secchi = 0.8 m) in the "cyclic" response post-treatment and 1998 is an example of a high transparency year (mean Secchi = 3.2 m). Water quality and biological characteristics for these years are summarized in the following figures:

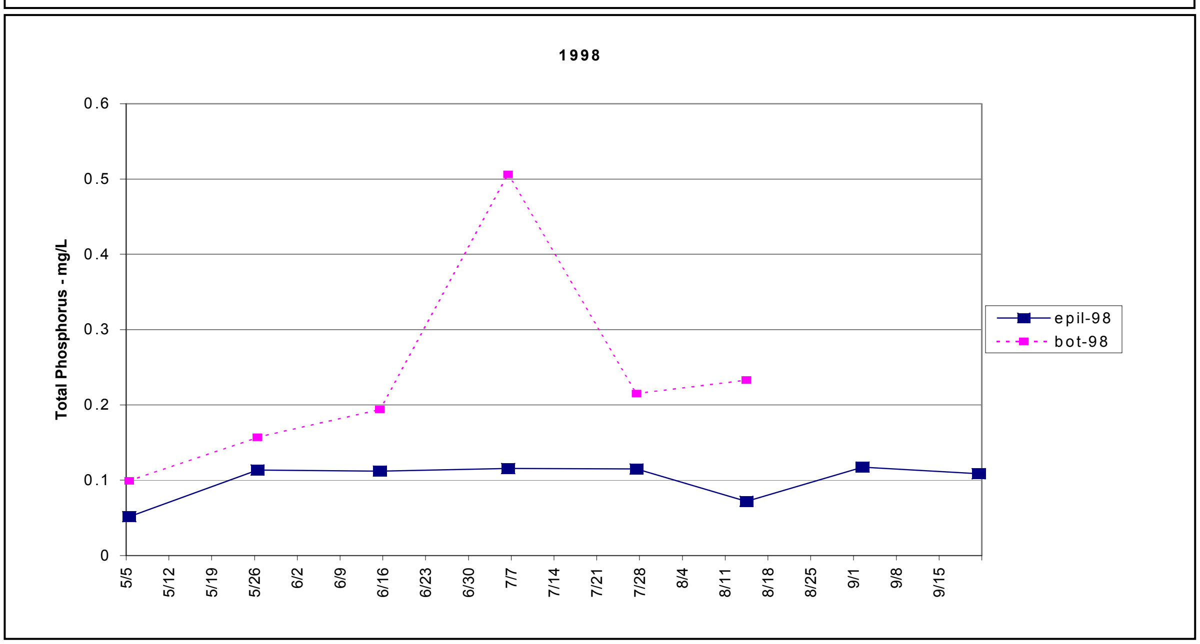
	Upper TP (epil)	Bottom TP (bot)	Water Clarity (Sec=Secchi Depth)	Floating Algae (Chl=chlorophyll)
1985	>.2 mg/L most of summer; large peak >.5 July	Similar to Upper TP	Low (< .8 m) all summer	Very high all summer (max ~ 175 mg/M^3)
1991	~ .4 mg/L much of July & Aug	Elevated (>.4 mg/L) all summer	> 1 m thru June then < .8 m rest of summer	Very high July thru Sept (max ~ 75 mg/M^3)
1998	~ .1 mg/L all summer	>.2 mg/L most of summer; large peak ~.5 July	>= 3 m all summer	Low all summer (max ~ 25 mg/M3)

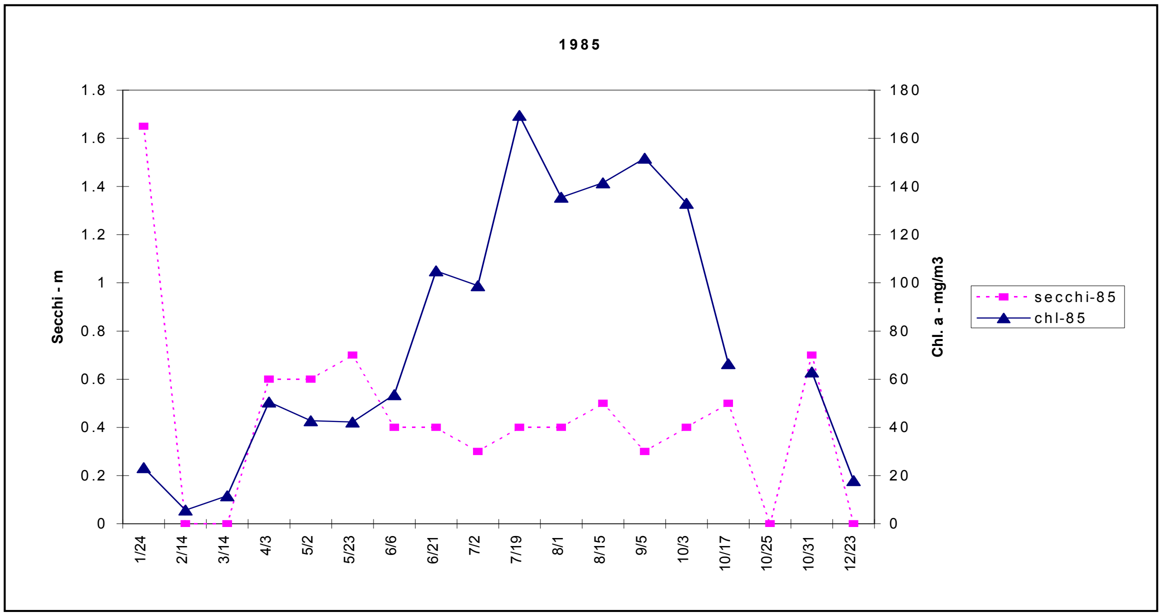
Internal loading of phosphorus from the sediments can be estimated as unchanged between years. Each of these years was above normal in precipitation, with 1991 a particularly wet year (average annual precipitation is 28 inches).

	Precipitation (water year) inches	Macrophytes (filamentous algae + Aquatic Plants)	Planktivorous Fish	Daphnia
1985	32.39	None	Few	Abundance low with short body length (~.6 mm)
1991	37.02	Qualitatively less than 1988-90; harvest once "significantly less material than previous years"	Very abundant (~200 fish/net)	Abundance low with short body length (~.8 mm)
1998	>30.16	Abundant all summer; Aug. 14 "nuisance Elodea w/ attached algae & scums over much of lake surface; harvest late Sept.	Most recent information (1996), reduced abundance & biomass	Moderate abundance & biomass (increasing trend re: 2 previous years); length ~.9 mm


1985
Total Phosphorus - mg/L
0.6
0.5
0.4
0.3
0.2
0.1
0
1/24
2/7
2/21
3/7
3/21
4/4
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
10/17
10/31
11/14
11/28
12/12
epil-85
bot-85


1991
Total Phosphorus - mg/L
1.4
1.2
1
0.8
0.6
0.4
0.2
0
4/10
4/17
4/24
5/1
5/8
5/15
5/22
5/29
6/5
6/12
6/19
6/26
7/3
7/10
7/17
7/24
7/31
8/7
8/14
8/21
8/28
9/4
9/11
9/18
epil-91
bot-91


1998
Total Phosphorus - mg/L
0.6
0.5
0.4
0.3
0.2
0.1
0
5/5
5/12
5/19
5/26
6/2
6/9
6/16
6/23
6/30
7/7
7/14
7/21
7/28
8/4
8/11
8/18
8/25
9/1
9/8
9/15
epil-98
bot-98


1985
Secchi - m
Chl. a - mg/m3
secchi-85
chl-85
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
180
160
140
120
100
80
60
40
20
0
1/24
2/14
3/14
4/3
5/2
5/23
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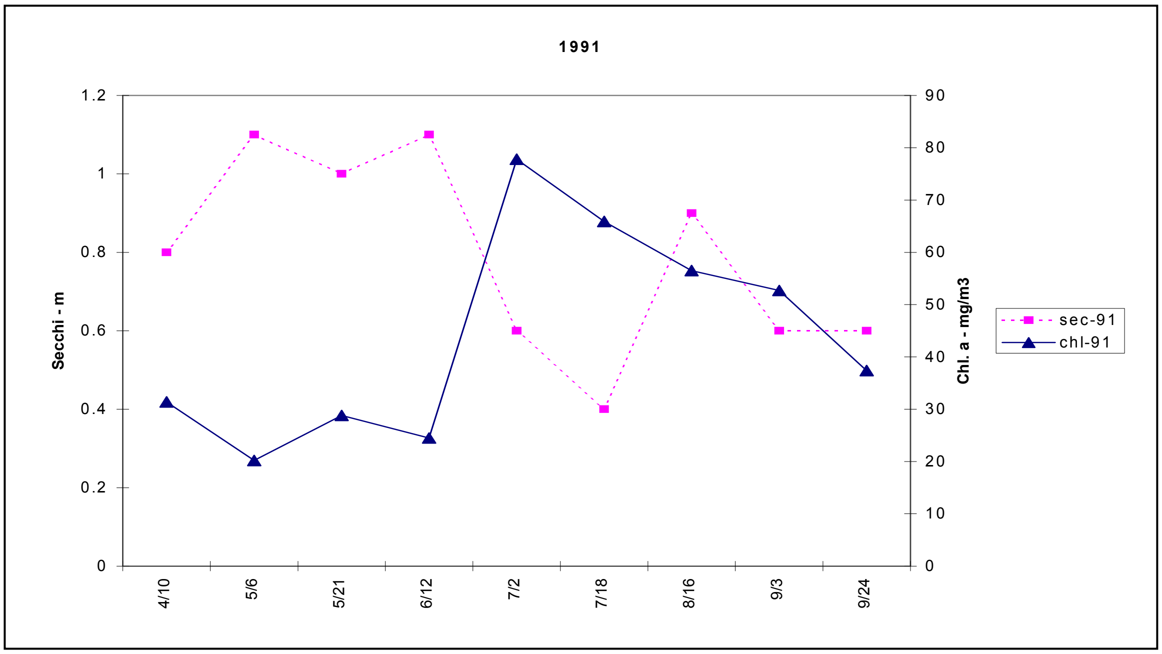
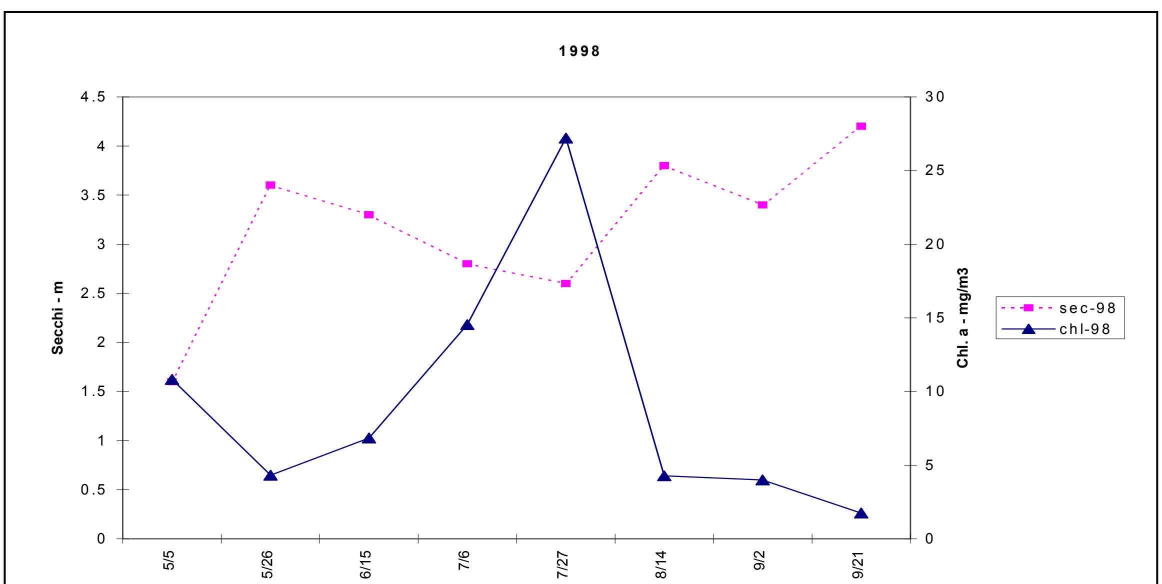
10/17
10/25
10/31
12/23


1991
Secchi - m
Chl. a - mg/m3
sec-91
chl-91
1.2
1
0.8
0.6
0.4
0.2
0
90
80
70
60
50
40
30
20
10
0
4/10
5/6
5/21
6/12
7/2
7/18
8/16
9/3
9/24


1998
Secchi - m
Chl. a - mg/m3
sec-98
chl-98
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
30
25
20
15
10
5
0
5/5
5/26
6/15
7/6
7/27
8/14
9/2
9/21

Bird Species

The following is a list of birds identified within Como Park by local resident Val Cunningham over the last fifteen years.

Common Loon (two or three every spring, just after ice-out)
Horned Grebe (sometimes up to 15 of them, in the spring)
Pied-Billed Grebe (high numbers in spring, some seem to nest at the lake)
Double-Crested Cormorant (used to be high numbers, now just a few)
Black-Crowned Night Heron (haven't seen in five years or more)
Green Heron
Great Egret
Great Blue Heron
Canada Goose (population is increasing dramatically)
Wood Duck (they nest around the lake)
Mallard (large numbers, many more males than females, leading to "forced copulation" behaviors in spring)
American Wigeon (briefly in spring, not seen since 1995)
Northern Shoveler (briefly in spring and fall, not seen for several years)
Blue-Winged Teal (briefly in spring, few to none in last several years)
Redhead Duck (a few stop by during spring migration)
Lesser Scaup (used to arrive in large numbers in spring and fall, now only a few are seen in each season)
Ring-Necked Duck (spring and fall, seem to be fewer in last 5 years)
Bufflehead (spring and fall)
Common Merganser (used to be large numbers in spring, fewer now)
Red-Breasted Merganser (haven't seen in 5 years)
Hooded Merganser (stop by in spring for brief period, fewer now)
Ruddy Duck (small flocks arrive in spring and fall, numbers seem steady)
Bald Eagle (perched in a tree [since cut down] some 10 years ago)
Golden Eagle (harassing flock of C. geese, 3 years ago)
Cooper's Hawk (a pair has nested in Como Park frequently in last 10 years)
Sharp-Shinned Hawk
Red-Tailed Hawk (sometimes perching in tall trees near the water)
American Kestrel (they hunt near the shoreline, sometimes nest in the park)
American Coot (large rafts in spring and fall)
Killdeer (along shoreline in spring and fall, they nest on golf course)
Greater Yellowlegs (briefly, only occasionally, in spring)
Lesser Yellowlegs (briefly, only occasionally, in spring)
Solitary Sandpiper (passing through in spring and fall, few in number)
Spotted Sandpiper (same as above)
Bonaparte's Gull (occasional large flocks visit briefly in spring)

Ring-Billed Gull (many, in spring, summer and fall)
Herring Gull (very occasional in spring, none for 5 years or so)
Forster's Tern (A Few, In Spring)
Caspian Tern (usually three visible in spring and fall)
Rock Doves (numbers are steady)
Mourning Doves (same as above)
Great Horned Owl (seen infrequently, perched near the lake)
Common Nighthawk (fewer in past 10 years, similar to pattern everywhere)
Chimney Swift (large numbers in summer, holding steady)
Ruby-Throated Hummingbird (a few, in spring, not seen in last 3 years)
Belted Kingfisher (usually one resident pair each year)
Red-Bellied Woodpecker (seen occasionally near the lake)
Northern Flicker (seen near the lake, numbers holding steady)
Yellow-Bellied Sapsucker (seen occasionally near the lake)
Downy Woodpecker (resident throughout the year)
Hairy Woodpecker (resident thru year, seen near the lake)
Eastern Wood Peewee (several seen in spring each year)
Great Crested Flycatcher (heard more than seen, in most of last 10 years)
Eastern Kingbird (nesting around the lake in recent years)
Northern Shrike (seen once in 15 years, hunting in winter near lake)
Red-Eyed Vireo (may nest near lake, heard often in 15 years)
Blue-Headed Vireo (passes through in spring and fall)
Blue Jay (numbers holding steady)
American Crow (numbers increasing)
Tree Swallow (numbers steady)
Barn Swallow (numbers steady)
Northern Rough Winged Swallow (numbers steady)
Purple Martin (seen occasionally in spring near the lake)
Tufted Titmouse (seen only once, in 1986, near the lake)
Black-Capped Chickadee (year round resident, holding steady)
White-Breasted Nuthatch (same as above)
Red-Breasted Nuthatch (seen in invasion years)
Brown Creeper (spring and fall migrant, near the lake, stays for winter some years)
House Wren (seen spring, summer and fall in most years)
Ruby-Crowned Kinglet (seen during migration, numbers holding steady)
Golden-Crowned Kinglet (same as above)
Blue-Gray Gnatcatcher (same as above)
Eastern Bluebird (seen during migration three years out of five)
Gray-Cheeked Thrush (seen during migration three years out of five)
Swainson's Thrush (seen during migration most years)
American Robin (seen every year, in some years a few over winter)
Gray Catbird (used to see every year, they nested around lake, now seemingly too little brush for their liking)
Brown Thrasher (seen or heard most years during migration, some years

they nest near the lake)
European Starling (numbers steady, year round resident)
Cedar Waxwings (highly variable, often can find a small flock in park in winter)
Prothonotary Warbler (used to see 3 years out of five in shrubbery Around lake, haven't seen in five years)
Tennessee Warbler (large numbers pass through during migration, used to Nest in area, not certain if this is still true)
Orange Crowned Warbler (small flocks pass through in spring)
Nashville Warbler (spring migrant, seen less frequently)
Northern Parula (a few seen during migration, not often noted now)
Chestnut Sided Warbler (seen during spring and fall migration, holding steady)
Cape May Warbler (seen rarely during spring migration)
Yellow-Rumped Warbler (large flocks pass through in spring and fall)
Magnolia Warbler (seen frequently during migration)
Black And White Warbler (a few seen each year during migration)
Blackburnian Warbler (used to be able to count on seeing one each spring, haven't seen in three years)
Black-Throated Green Warbler (several pass through the park each year)
Bay-Breasted Warbler (seen twice in 15 years)
Palm Warbler (seen most years during migration, fewer in past 5 years)
Yellow Warbler (same as above)
Wilson's Warbler (seen occasionally during migration, less frequently now)
Canada Warbler (seen rarely during migration)
Ovenbird (seen frequently during migration)
Northern Waterthrush (seen infrequently during migration)
Common Yellowthroat (same as above)
American Redstart (seen frequently during migration, see fewer now)
Scarlet Tanager (seen infrequently during migration, fewer now)
American Tree Sparrow (seen frequently during migration)
Field Sparrow (seen infrequently during migration)
Chipping Sparrow (seen frequently, some nest in park)
Fox Sparrow (seen three years out of five during migration)
Lincoln's Sparrow (seen infrequently during migration)
Song Sparrow (seen frequently during migration, one overwintered in 2000-2001)
White-Throated Sparrow (seen frequently during migration)
White-Crowned Sparrow (seen infrequently during migration)
Dark-Eyed Junco (seen frequently during migration)
Rose-Breasted Grosbeak (seen frequently during migration)
Northern Cardinal (year-round resident, numbers steady)
Indigo Bunting (seen infrequently during migration)
Red-Winged Blackbird (nest around lake, numbers are down)
Common Grackle (numbers steady, mostly seen during migration)

Baltimore Oriole (numbers steady, some nest around lake and in park)
House Finch (resident in park and near lake)
Red Crossbill (seen only in invasion years [1986 was a biggie])
White-Winged Crossbill (same as above)
American Goldfinch (resident bird, some nest near lake)
Common Redpoll (seen only in invasion years)
House Sparrow (resident, numbers holding steady)

APPENDIX B – Subwatershed Loading Plan & Assumption Tables

Several of the water quality implementation activities had the similar goal of reducing external phosphorus loading into Como Lake. In order to reduce loadings, it is first necessary to know where the sources of phosphorus are coming from. One way to do this is to investigate each subwatershed with in the Como Lake watershed. The following section is a detailed description of how the Subwatershed Loading Plan was developed for the lake.

To address nutrient loads into Como Lake, and in particular phosphorus, which is the driving nutrient in lake systems, a Subwatershed Loading Plan was developed to reduce nutrient loads. Reduction of other nutrients and pollutants will generally correlate well with the phosphorus reductions estimated here. Some best management practices (BMPs) will vary in their response and effectiveness to pollutant removals, so further professional judgement in the final selection and design of BMPs should be used during final design and implementation.

The Subwatershed Loading Plan focuses on using a suite of different BMPs to reduce the phosphorus and other pollutant loads to Como Lake to accomplish the defined water quality goals. The nutrient budget driving the water quality of the lake includes external or watershed generated loads to the lake as well as internal loadings to the lake. The internal sources are being addressed through another avenue, while the subwatershed loadings from non-point source pollution are addressed here.

The Subwatershed Loading Plan is summarized in detail in Appendix B, but focuses on:

- Basic assumptions on BMPs – size, cost, and removal efficiencies
- Summary of Phosphorus subwatershed source loadings (per P8 modeling, Barr, 2000) and reduction targets/goals to meet overall goal
- Summary of BMPs (number and costs) by subwatershed proposed to meet reductions
- Summary of costs by subwatershed, construction and operation and maintenance (O&M) and summary over 1, 5, and 20 years.

To facilitate sizing and quantifying the required number of various BMPs by subwatershed, a standard treatment area was assumed for a given size BMP. In actual implementation, the size can vary to meet the specific site requirements based on site constraints and drainage area. One limitation of this approach is that it assumes a linear relationship between BMP sizing and removal efficiencies. The target reduction must be considered during the final design and implementation. The costs presented for the assumed practices are provided for planning purposes. In retrofitting situations such as those that exist here; the actual costs can vary significantly. The potential land costs is an example of a potentially highly variable cost depending on the location, timing, and installation coordination opportunities that are present or not present.

The loadings to the lake were quantified and tracked by subwatershed based on the P8 modeling results from a recent study (Barr, 2000) for the District. Priority for treatment and reductions for subwatersheds 3, 4, and 7 was used to adjust the target removals by subwatershed based on the intensive land uses of those subwatersheds and lack of existing pretreatment. A portion of the 60% reduction, namely 20%, over the 20-year period was eliminated across the board based on watershed-wide improvements. The watershed-wide improvements to water quality would originate from improved “Good Housekeeping Practices” (ex. street sweeping, reduced fertilizer use, and improved public awareness) and redevelopment (application of watershed performance standards in review and permitting of redevelopment projects over time). After applying the 60% reduction goal, prioritizing removals for three subwatersheds, and accounting for watershed-wide reductions, specific phosphorus reduction goals were established in terms of pounds of phosphorus/year.

The types of BMPs selected were intended to best fit the individual subwatershed based on land use, level of existing treatment, and density of development. BMPs were distributed by subwatershed to meet the reduction goal and included:

Treatment Basins (Infiltration, Wetland, or Wet Ponds)*
Rain Gardens & Infiltration Trenches*
Alum Treatment Plant*
Mechanical Separators/Filters
Catch Basin Sump Manholes
** Identified as Priority Activities*

The final selection of practices can vary and will be further defined during implementation based on specific site conditions, access to land, and collaboration opportunities. The sizing, configuration, regulatory aspects, and specific design of an alum treatment system will require careful study and analysis to fit the situation presented at the golf course ponding site, but also may provide the potential for significant removals. The BMPs shown in the table are intended to demonstrate that a variety of practices can and should be used to meet the treatment goals. The relative costs for treatment by practice vary somewhat, but not so dramatically that practices could be shifted and interchanged to some extent. Costs, both construction and Operation and Maintenance (O&M) are shown by subwatershed and by practice. The differing level of future O&M are reflected by bringing these O&M costs to a present day value for comparative purposes.

The costs of all BMPs are then summarized by subwatershed in two fashions. The first is the present day value of all the improvements to summarize costs in a common denominator (today’s dollars). Next, the costs are displayed in a more useful form for budgeting and planning purposes with construction costs and O&M costs separately, so the O&M costs can be incorporated over time as the improvements are staged in. Finally the costs are then shown for the entire target period to implement over 20 years, and then divided out to show the projected 5-year cost and annual cost. The costs are distributed back to annual costs by dividing the overall cots by a uniform fraction of 1/20th, which assumes a constant level of implementation of the practices. Incorporation of individual practices, especially the alum treatment system, and accelerated or decelerated implementation would impact the annual costs. Inflation of the base costs shown here has not explicitly been incorporated into the cost estimates. This is consistent with the District's overall Watershed Management Plan cost tables. It will be up to the District to account for inflationary factors as it sets its annual budget through time for Como Lake improvements along with the District's other projects.

Funding and acceleration of the water quality improvements and projects could also be facilitated with a bonding approach to fund more projects up front. This carries the trade off of paying interest on those funds and committing future budgets to fund these projects until the bonds are paid off. This may only be needed for constructing larger improvements, such as the alum treatment system, or if a unique opportunity arises to construct multiple projects in a short time span, such as having access to key land areas at a low cost.

Summary of Phosphorus Loadings and Reduction Goals

Subwatershed #	Subwatershed Area [Acres]	Loads / Subwatershed from P8 Modeling Results (Barr, 2000)	Loads/Subwatershed after Golf Course Ponds Removal from P8 Results (Barr, 2000) (removal from subw. 4, 5, 6, 7, 8-by % loads)	Priority for Treatment	Weighting Factor for Load Reduction Based on Priority	Target Subwatershed Load Reduction (60% Reduc.) including Priority Status	% Reduction from Good Housekeeping and Redevelopment*	**Target Load Reduction after GH and RD [lbs/yr]**
2	73.8	29	29		0.8	14	20%	**8**
3	516.5	228	228	*	1.1	150	20%	**105**
4	199.2	72	62	*	1	37	20%	**25**
5	96.8	39	34		0.8	16	20%	**9**
6	88.4	37	32		0.8	15	20%	**9**
7	298.2	129	111	*	1.2	80	20%	**58**
8	494.5	149	129		0.8	62	20%	**36**
Total	1767.5	683	625			375		**250**

*Based on estimated 10% reduction due to Good Housekeeping (GH) practices and 10% reduction for Redevelopment (RD) over 20 year period.

Target Reduction 60%	Golf Course pond Removal (lbs/yr)	Subwat. loads to G.C. pond- subwat. 4,5,6,7,8
	58	426

APPENDIX B, Subwatershed Loading Plan Assumption Tables

BMP	Size of Area Treated [acres]	Sizing Assumptions	Size of Land Acquisition per site [acres]	Cost of Land Acquisition per site	% TP Removal	Estimated Constructi on Cost	Site Selection, Planning, Design, and Permitting [%]	Site Selection, Planning, Design, and Permitting [$]	**Total Design, Construction , & Land Costs [$]**		Estimated Major O & M Cost [$]	Every **X** years	Estimated Annual O & M Cost [$]	O & M Description	**O&M Current Value**		**Total Cost/BMP**
Basins - Infiltration/Wetlands/Wet Ponds	10	1.2 ac-ft/pond, 0.4 acre pond area 3.0 ft avg. depth	1	$30,000	60	$67,950	25%	$16,988	**$114,937.50**		$15,000	15	$ 50	M-Excavate out sediment with back hoe, A-annual inspection	**$7,838**		**$122,776**
Rain Garden - Residential	0.5	100 sq.ft.	0	$0	50	$10,000	25%	$2,500	**$12,500.00**		$0	-	$ 100	on-going training for private maintanence, weed control, re-landscaping	**$ 1,246**		**$13,746**
-Community	2	400 sq.ft.	0	$0	50	$40,000	25%	$10,000	**$50,000.00**		$0				**$ 4,985**		**$54,985**
Infiltration Trenches	2	8' w X 20'l X 15' d filled washed gravel	0	$0	90	$30,000	40%	$12,000	**$42,000.00**		$3,000	5	$ 50	M-replace top filter fabric and covering material, A-annual visual inspection	**$ 7,389**		**$49,389**
Alum Treatment Plant	400	Building and Pond on 2 acreas	2	$60,000	75	$600,000	40%	$240,000	**$900,000.00**		$100,000	5	$ 40,000	M-Excavate & dispose of alum floc, repair and relace equipment; A-Chemcials, staff, dosing, adjustments, monitoring.	**$ 724,018**		**$2,324,018**
Catch Basin Sump Manholes	1	1 acre	0	$0	10	$3,000	25%	$750	**$3,750.00**		$0	-	$ 50	A-Approx. $100/cleaning (Ann Weber) and assumes cleaned every 2 yrs	**$ 623**		**$4,373**
Mechanical Separators / Filter Systems	1	1 acre, 15 cartridges	0	$0	60	$50,000	25%	$12,500	**$62,500.00**		$5,000	10	$ 3,000	M-vacuum & clean chamber, repair/replace equipment; A-replace filter cartridges	**$ 42,341**		**$104,841**

Land Acquisition Costs ($/acre) $ 30,000 /acre

Note: Spreadsheet does not contain columns for land cost for sheets: Rain Gardens, Infilt. Trenches, Mechanical Seperators, nor CB Sumps.

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Treatment Basins - Infiltration/Wetland/Wet Ponds

SubWatershed	Number of BMPs	Design & Construction-only Cost/BMP	Land Acquisition Cost	**Design, Construction, & Land Cost/BMP**	**Total Design & Construction Cost by Subwatershed**	**O&M Cost/BMP - In terms of Current $** Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor 15 years	Current $ Value of Major Maint. Cost over 20 yrs	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Current $ Value of Annual O&M Costs over 20 yrs	**Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP**	**Total O&M Cost by Subwatershed (current $ value)**	**Total BMP Cost/BMP (current $ value)** For Comparison Purposes	**Total BMP Cost by Subwatershed (current $ value)**	O R	**All O&M Costs/BMP - In terms of an Annual Cost**	**O&M Costs by Subwatershed - In terms of Annual Cost** Annual Cost to Cover all O&M into future
2	0.5	$ 114,938	$ 30,000	$ 144,938	$ 72,468.75	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ 3,919.06	$ 152,776	$ 76,387.81		$ 628.62	$ 314.31
3	15	$ 114,938	$ 30,000	$ 144,938	$ 2,174,062.50	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ 117,571.65	$ 152,776	$ 2,291,634.15		$ 628.62	$ 9,429.25
4	1	$ 114,938	$ 30,000	$ 144,938	$ 144,937.50	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ 7,838.11	$ 152,776	$ 152,775.61		$ 628.62	$ 628.62
5	0	$ 114,938	$ 30,000	$ 144,938	$ -	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ -	$ 152,776	$ -		$ 628.62	$ -
6	0	$ 114,938	$ 30,000	$ 144,938	$ -	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ -	$ 152,776	$ -		$ 628.62	$ -
7	4.5	$ 114,938	$ 30,000	$ 144,938	$ 652,218.75	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ 35,271.50	$ 152,776	$ 687,490.25		$ 628.62	$ 2,828.77
8	0	$ 114,938	$ 30,000	$ 144,938	$ -	$ 15,000.00	15	0.481	$ 7,215	$ 50	12.4622	0.0802	$ 623	$ 7,838	$ -	$ 152,776	$ -		$ 628.62	$ -
				Total	**$ 3,043,687.50**														**Total**	**$ 13,200.94**

interest rate, i
5%

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

"P/F Factor" is the multiplier to convert a Future sum to a Present value given an interest rate i and time period n

Example: What would be the present value of a $5000 future value in 5 years if average inflation is 6%
P=F/(P/F Factor) *P/F Factor for an interest rate of 5% over 5 years is .7875
P=$5000*.7875 *From *Civil Engineering Reference Manual, 1992*
P=$3937.50

"P/A Factor" is the multiplier to convert an Annual sum to the Present worth given an interest rate i and time period n

Example: If inflation is 5%, over 10 years what would be the present value of a dentention pond that has a maintance cost of 1000 per year
P=A/(P/A Factor) *P/A Factor for an interest rate of 5% over 10 years is 6.1446
P=$5000*6.1446 *From *Civil Engineering Reference Manual, 1992*
P=$30,723

"A/P Factor" is the multiplier to convert a Present worth to an Annual sum (series) given an interest rate i and time period n

Example: What would be the annual value of a $5000 future value in 15 years if average inflation is 6%
A=P/(A/P Factor) *A/P Factor for an interest rate of 5% over 15 years is .0963
A=$5000*.0963 *From *Civil Engineering Reference Manual, 1992*
A=$481.5

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Rain Gardens

SubWatershed	Number	Design & Constructio n Cost/BMP	Total Design & Construction Cost by Subwatershed	O&M Cost/BMP - In terms of Current $ — Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Value of Annual O&M Costs over 20 yrs	Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP	Total O&M Cost by Subwatershed (current $ value)	Total BMP Cost/BMP (current $ value) — For Comparison Purposes	Total BMP Cost by Subwatershed (current $ value)	OR	O&M Costs/BMP - In terms of Annual Cost	O&M Costs by Subwatershed - In terms of Annual Cost — Annual Cost to Cover all O&M into future
2	18	$ 12,500.00	$ 225,000.00	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ 22,431.96	$ 13,746.22	$ 247,431.96		$ 99.95	$ 1,799.04
3	70	$ 12,500.00	$ 875,000.00	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ 87,235.40	$ 13,746.22	$ 962,235.40		$ 99.95	$ 6,996.28
4	4	$ 12,500.00	$ 50,000.00	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ 4,984.88	$ 13,746.22	$ 54,984.88		$ 99.95	$ 399.79
5	0	$ 12,500.00	$ -	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ -	$ 13,746.22	$ -		$ 99.95	$ -
6	0	$ 12,500.00	$ -	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ -	$ 13,746.22	$ -		$ 99.95	$ -
7	38	$ 12,500.00	$ 475,000.00	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ 47,356.36	$ 13,746.22	$ 522,356.36		$ 99.95	$ 3,797.98
8	0	$ 12,500.00	$ -	0	-		100	12.4622	0.0802	$ 1,246.22	$ 1,246.22	$ -	$ 13,746.22	$ -		$ 99.95	$ -
		Total	**$ 1,625,000.00**													**Total**	**$ 12,993.09**

interest rate, i
5%

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

"P/F Factor" is the multiplier to convert a Future sum to a Present value given an interest rate and time period

"P/A Factor" is the multiplier to convert an Annual sum to the Present worth given an interest rate and time period

"A/P Factor" is the multiplier to convert a Present worth to an Annual sum (series) given an interest rate and time period

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Infiltration Trenches

SubWatershed	Number	Design & Construction Cost/BMP	Total Design & Construction Cost by Subwatershed	O&M Cost/BMP - In terms of Current $ Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor 5 years	P/F Factor 10 years	P/F Factor 15 Years	P/F Factor 20 Years	Current $ Value of Major Maint. Cost over 20 yrs	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Current $ Value of Annual O&M Costs over 20 yrs	Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP	Total O&M Cost by Subwatershed (current $ value)	Total BMP Cost/BMP (current $ value) For Comparison Purposes	Total BMP Cost by Subwatershed (current $ value)	OR	O&M Costs/BMP - In terms of Annual Cost	O&M Costs by Subwatershed - In terms of Annual Cost Annual Cost to Cover all O&M into future
2	4	$ 42,000.00	$ 168,000.00	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ 29,556.04	$ 49,389.01	$ 197,556.04		$ 592.60	$ 2,370.39
3	40	$ 42,000.00	$ 1,680,000.00	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ 295,560.40	$ 49,389.01	$ 1,975,560.40		$ 592.60	$ 23,703.94
4	2	$ 42,000.00	$ 84,000.00	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ 14,778.02	$ 49,389.01	$ 98,778.02		$ 592.60	$ 1,185.20
5	0	$ 42,000.00	$ -	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ -	$ 49,389.01	$ -		$ 592.60	$ -
6	0	$ 42,000.00	$ -	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ -	$ 49,389.01	$ -		$ 592.60	$ -
7	16	$ 42,000.00	$ 672,000.00	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ 118,224.16	$ 49,389.01	$ 790,224.16		$ 592.60	$ 9,481.58
8	0	$ 42,000.00	$ -	$ 3,000.00	5	0.7835	0.6139	0.481	0.3769	$ 6,765.90	50	12.4622	0.0802	$ 623.11	$ 7,389.01	$ -	$ 49,389.01	$ -		$ 592.60	$ -
		Total	**$ 2,604,000.00**																	**Total**	**$ 36,741.11**

interest rate, i
5%

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Alum Treatment

SubWatershed	Number	Design & Construction only Cost/BMP	Land Acquisition Cost	**Design, Construction, & Land Cost/BMP**	**Total Design & Construction Cost by Subwatershed**	**O&M Cost/BMP - In terms of Current $** Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor 5 years	P/F Factor 10 years	P/F Factor 15 Years	P/F Factor 20 Years	Current $ Value of Major Maint. Cost over 20 yrs	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Current $ Value of Annual O&M Costs over 20 yrs	**Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP**	**Total O&M Cost by Subwatershed (current $ value)**	**Total BMP Cost/BMP (current $ value)** For Comparison Purposes	**Total BMP Cost by Subwatershed (current $ value)**	OR	**O&M Costs/BMP - In terms of Annual Cost**	**O&M Costs by Subwatershed - In terms of Annual Cost** Annual Cost to Cover all O&M into future
2	0.0	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ -	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ -	$ 1,684,018.00	$ -		$ 58,066.24	$ -
3	0.0	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ -	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ -	$ 1,684,018.00	$ -		$ 58,066.24	$ -
4	0.2	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ 162,253.52	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ 122,369.24	$ 1,684,018.00	$ 284,622.76		$ 58,066.24	$ 9,814.01
5	0.1	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ 87,887.32	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ 66,283.34	$ 1,684,018.00	$ 154,170.66		$ 58,066.24	$ 5,315.92
6	0.1	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ 83,380.28	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ 62,884.19	$ 1,684,018.00	$ 146,264.47		$ 58,066.24	$ 5,043.31
7	0.3	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ 290,704.23	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ 219,244.89	$ 1,684,018.00	$ 509,949.11		$ 58,066.24	$ 17,583.44
8	0.3	$ 900,000.00	$ 60,000.00	$ 960,000.00	$ 335,774.65	$ 100,000.00	5	0.7835	0.6139	0.481	0.3769	$ 225,530	$ 40,000.00	12.4622	0.0802	$ 498,488.00	$ 724,018.00	$ 253,236.34	$ 1,684,018.00	$ 589,010.99		$ 58,066.24	$ 20,309.55
				Total	**$ 960,000.00**			interest rate, i 5%										Total $ 724,018.00				**Total**	**$ 58,066.24**

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

"P/F Factor" is the multiplier to convert a Future sum to a Present value given an interest rate and time period

"P/A Factor" is the multiplier to convert an Annual sum to the Present worth given an interest rate and time period

"A/P Factor" is the multiplier to convert a Present worth to an Annual sum (series) given an interest rate and time period

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Mechanical Separators/Filters

SubWatershed	Number	Design & Construction Cost/BMP	Total Design & Construction Cost by Subwatershed	O&M Cost/BMP - In terms of Current $: Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor 10 Years	P/F Factor 20 Years	Current $ Value of Major Maint. Cost over 20 yrs	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Current $ Value of Annual O&M Costs over 20 yrs	Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP	Total O&M Cost by Subwatershed (current $ value)	Total BMP Cost/BMP (current $ value) For Comparison Purposes	Total BMP Cost by Subwatershed (current $ value)	OR	O&M Costs/BMP - In terms of Annual Cost	O&M Costs by Subwatershed - In terms of Annual Cost: Annual Cost to Cover all O&M into future
2	1	$ 62,500.00	$ 62,500.00	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ 42,340.60	#########	$ 104,840.60		$ 3,395.72	$ 3,395.72
3	4	$ 62,500.00	$ 250,000.00	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ 169,362.40	#########	$ 419,362.40		$ 3,395.72	$ 13,582.86
4	0	$ 62,500.00	$ -	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ -	#########	$ -		$ 3,395.72	$ -
5	0	$ 62,500.00	$ -	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ -	#########	$ -		$ 3,395.72	$ -
6	0	$ 62,500.00	$ -	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ -	#########	$ -		$ 3,395.72	$ -
7	0	$ 62,500.00	$ -	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ -	#########	$ -		$ 3,395.72	$ -
8	0	$ 62,500.00	$ -	5000	10	0.6139	0.3769	4954	3000	12.4622	0.0802	$ 37,386.60	$ 42,340.60	$ -	#########	$ -		$ 3,395.72	$ -
		Total	**$ 312,500.00**															**Total**	**$ 16,978.58**

interest rate, i
5%

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

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"P/A Factor" is the multiplier to convert an Annual sum to the Present worth given an interest rate and time period

"A/P Factor" is the multiplier to convert a Present worth to an Annual sum (series) given an interest rate and time period

APPENDIX B, Subwatershed Loading Plan Assumption Tables

Detailed Cost Breakdown by BMP

Catch Basin Sump Manholes

SubWatershed	Number	**Design & Construction Cost/BMP**	**Total Design & Construction Cost by Subwatershed**	**O&M Cost/BMP - In terms of Current $** Major Maintenance Cost	Cycle of Major Maint. (yrs)	P/F Factor	Current $ Value of Major Maint. Cost over 20 yrs	Annual O&M Cost	P/A Factor 20 Years	A/P Factor 20 Years	Current $ Value of Annual O&M Costs over 20 yrs	**Current $ Value of Major & Annual O&M (for 20 yr cycle)/BMP**	**Total O&M Cost by Subwatershed (current $ value)**	**Total BMP Cost/BMP (current $ value)** For Comparison Purposes	**Total BMP Cost by Subwatershed (current $ value)**	OR	**O&M Costs/BMP - In terms of Annual Cost**	**O&M Costs by Subwatershed - In terms of Annual Cost** Annual Cost to Cover all O&M into future
2	50	$ 3,750.00	$ 187,850.50	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 31,213.74	$ 4,373.11	$ 219,064.24		$ 49.97	$ 2,503.34
3	351	$ 3,750.00	$ 1,315,068.09	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 218,515.22	$ 4,373.11	$ 1,533,583.31		$ 49.97	$ 17,524.92
4	135	$ 3,750.00	$ 507,205.52	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 84,278.62	$ 4,373.11	$ 591,484.14		$ 49.97	$ 6,759.15
5	66	$ 3,750.00	$ 246,551.56	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 40,967.66	$ 4,373.11	$ 287,519.22		$ 49.97	$ 3,285.61
6	60	$ 3,750.00	$ 225,047.87	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 37,394.55	$ 4,373.11	$ 262,442.42		$ 49.97	$ 2,999.04
7	202	$ 3,750.00	$ 759,246.30	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 126,158.39	$ 4,373.11	$ 885,404.69		$ 49.97	$ 10,117.90
8	336	$ 3,750.00	$ 1,259,030.17	$ -	-		0	$ 50.00	12.4622	0.0802	$ 623.11	$ 623.11	$ 209,203.81	$ 4,373.11	$ 1,468,233.98		$ 49.97	$ 16,778.15
		Total	**$ 4,500,000.00**														**Total**	**$ 59,968.11**

interest rate, i
5%

Note: Interest rate, i, is based on 8% earnings interest rate minus 3% inflationary rate for an effective interest rate of 8%-3% = 5%

"P/F Factor" is the multiplier to convert a Future sum to a Present value given an interest rate and time period

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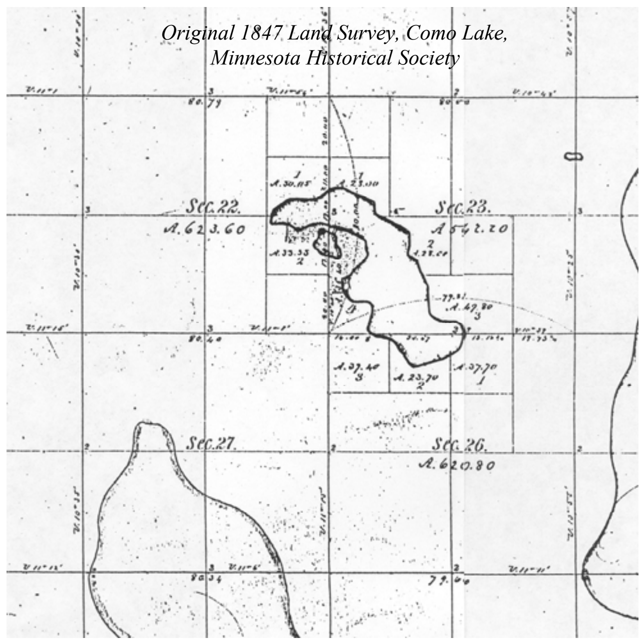
"A/P Factor" is the multiplier to convert a Present worth to an Annual sum (series) given an interest rate and time period

APPENDIX C A HISTORICAL SNAPSHOT OF COMO PARK AND COMO LAKE

The Development of Como Park

Saint Paul's beloved 348 acre Como Park, which now receives more than 2.5 million visitors annually, grew from humble beginnings. Prior to urbanization, the landscape was dotted by a handful of small farms, many with potato crops and interspersed with timber and open space. A few cabins stood on the shoreline of the Como Lake known at that time as "Sandy Lake." [1]

One potato farmer who farmed the area in the 1840s was Charles Perry. Perry is credited with renaming Sandy Lake to Lake "Como," after his birthplace in the Swiss-Italian Alps area of Como, Italy. [2]



Original 1847 Land Survey, Como Lake, Minnesota Historical Society

The beauty of the area was not lost on entrepreneurial instincts of Henry McKenty. He arrived in St. Paul in 1853, shortly before the real estate boom, purchased much of the land around the Lake and platted several areas on the east side. "Broad Acres" McKenty became quite wealthy due to his real estate activities and decided to build a road around the Lake at his own expense. He did not own the land to build the road on, but since everyone wanted roads at that time, no one objected. It crossed near today's Thomas and Western Avenues and ran about 100 feet north of Dale and Minnehaha and continued to the east side of the Lake. It was completed in 1857. What remains of the old Como Road can be found in the alley behind the houses between 730 Como Avenue and the stub of Como Place that crosses the railroad tracks. The south side of McMurray Field was known as McKenty Street until 1960 when the name was changed to West Jessamine. [3]

In addition to building the road, McKenty docked some boats at the Lake, two that were classified as "yachts" and stocked the Lake with fish. McKenty's prosperity plummeted

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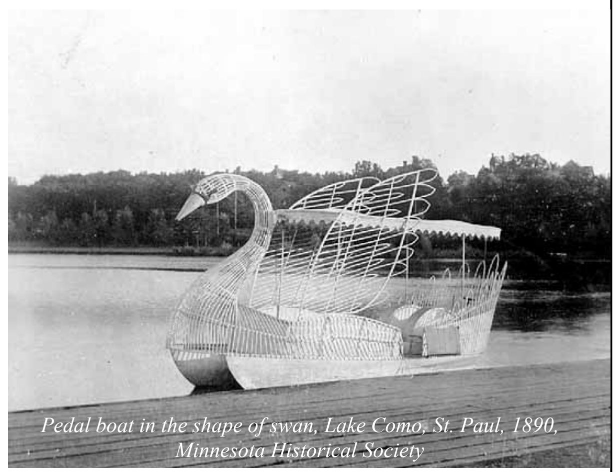
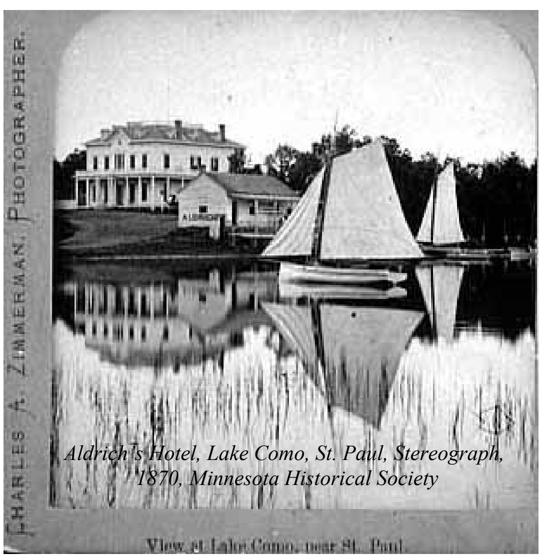
[1] Audrey Clasemann, St. Paul's Como Park: Its History, Its Charm, 1992, Como Park Lakeside Chapter
[2] Ibid.
[3] Patricia Murphy and Gary Phelps, *"Swamps, Farms, Boom or Bust--Como Neighborhood's Colorful History"* Ramsey County History, Vol. 19 No. 1, St. Paul
NOTE: Most footnotes in this report reference the entire proceeding paragraph.

during the Depression of 1857. The road deteriorated and became known as the "Swamp Route" by the City Council. On February 21, 1878, the Council approved the construction of a new road to replace it. It is now Como Avenue.[4]


Pedal boat in the shape of swan, Lake Como, St. Paul, 1890, Minnesota Historical Society

Despite the dire economic conditions during the mid-1800s, developers began building hotels on the shores of Como Lake. The Adler was built in September 1857 and was a "picturesque red brick manor house" located near the east entrance of Como Park. Its owner, Otto Adler, was a prominent businessman and operated the building as a hotel and a club. The family lived in the house until 1900, when Adler purchased a home at 927 Como Avenue. It is not known what happened to the hotel.[5]

The Aldrich Resort Hotel was built in the 1860s, after the Civil War. Located near the present Lakeside Pavilion, it stood on the farm of William B. Aldrich, on what is today's Como Boulevard, just north of Horton. The hotel had a lookout tower, bowling alley, merry-go-round and other attractions. The hotel was destroyed by fire in 1883.[6]



Aldrich's Hotel, Lake Como, St. Paul, Stereograph, 1870, Minnesota Historical Society

The Krauft Hotel is the third resort hotel that was built on the Lake. Unfortunately, no other information is available about this hotel.[7]

In 1872, the Minnesota State Legislature passed a bill authorizing the creation of a commission "whose duty it was to contract for and purchase not less than five but not more than 650 acres of land within a convenient distance of the city of St. Paul but beyond its present limits thereof for the uses and purposes of a public park." The City Council had the authority to sell up to $100,000 in bonds for the property and the Como Lake area was preferred. Using its bonding authority, the city purchased 348 acres from hotel and farm owner William Aldrich and from former Minnesota governor William R. Marshall, who was one of the prime movers behind the settlement of the

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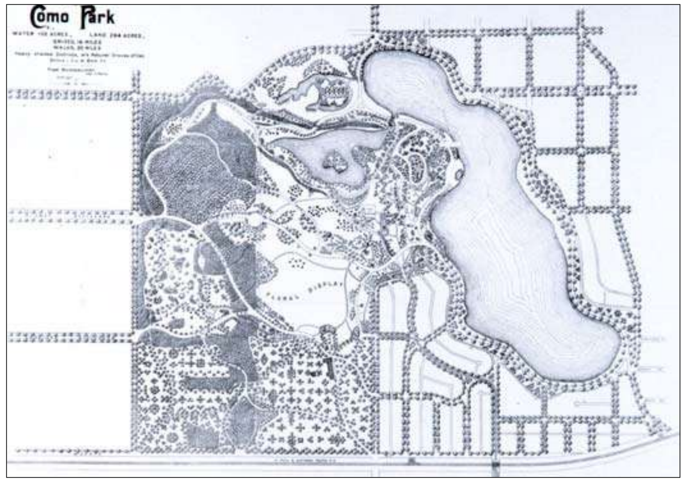
[4] Ibid.
[5] Audrey Clasemann, St. Paul's Como Park: Its History, Its Charm, 1992, Como Park Lakeside Chapter
[6] Ibid.
[7] Ibid.

nearby St. Anthony Park area. The purchase of the land and the plan to create a park was very controversial--in fact, 148 of the city's most prominent citizens petitioned for the sale of the Park based upon economic issues. Luckily, the opponents of the park did not prevail. [8]



Not far from Como Lake, a collection of business sprang up that supported the Northern Pacific Railway. These businesses, known as the "Como Shops" developed in an area that included timberland, swamps, a few farms and institutions such as the St. Paul Workhouse, the House of Good Shepard (for dependent and neglected girls), the Ramsey County Poor Farm and Hamline University. The Como Shops operated for a little over 100 years.

Once the Shops were completed in 1886, several residential developments were underway. Lots in the "Como Park Village Plat," located between the St. Paul, Minneapolis and Manitoba tracks and the Northern Pacific tracks east of Snelling were advertised in the following way: [9]

> *...you have the quiet and comfort of a country home and all the privileges of city life, without city taxation. That the value of the lots in Como Park Village will increase as rapidly as in any suburban plat about the city, and in all probability, will double within twelve months and quadruple as soon as Como Park is improved and opened as a pleasure grounds...*

In the late summer, 1886, the Northern Pacific built depots at Warrendale, Snelling and St. Anthony Park for its "Short Line" service. Warrendale was located on the southwest shore of Lake Como, partly on the site of a former hotel and had 218 homesites available. It was named for its promoter, Cary I. Warren. The area attracted workers from the Como Shops area as well as prominent professionals, such as Augustus F. Gauger who designed many of the Victorian homes in Warrendale. By 1892

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[8] Henry A. Castle, History of St. Paul and Vicinity, Vol. 1, Lewis Publishing Company, Chicago and New York, 1912

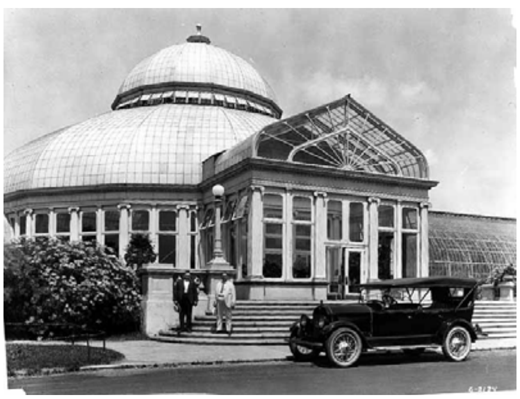
[9] Patricia Murphy and Gary Phelps. *"Swamps, Farms, Boom or Bust--Como Neighborhood's Colorful History"*[9] Ramsey County History, Vol. 19 No. 1, St. Paul

when the streetcar lines ran to Warrendale, only 30 lots were sold and built. The Depression of 1893 hit and left Warren bankrupt. The rest of the lots were sold at a sheriff's sale.[10]

The laying of more streetcar track resulted in the development of neighborhoods both south and east of the Shops in the 1880s and 1890s. It is estimated that 1/4 of Saint Paul's labor force was employed at the Shops in the 1880s. [11]

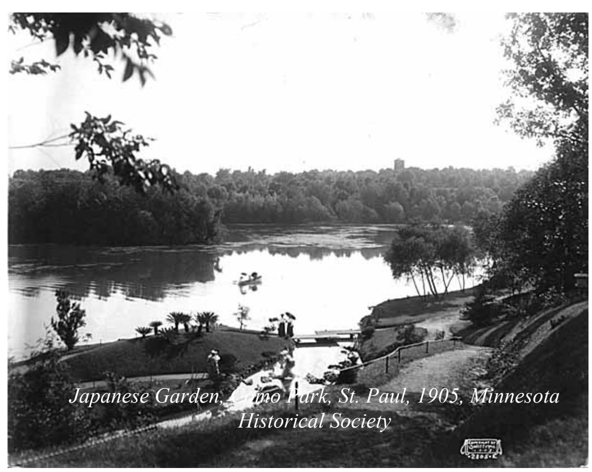
These neighborhoods grew in the shadow of industries that supported the Shops, such as iron foundries, lumber mills and manufacturing firms. Koppers Coke Plant was one of the largest industries built near the Shops. It produced coke, gas, ammonia, tar and benzyl and was shut down within the last twenty years due to its negative impact on the environment.[12]

Located on the northwest shore of the Lake, the concrete two-story Como Lake Pavilion was constructed between 1905 and 1907 to replace an earlier wood frame building and bandstand. The Spanish mission revival-styled pavilion and its columned promenade or bandstand was the scene of concerts, theatre productions, Winter Carnival happenings and other events. The Pavilion was restored in 1993 by the City of Saint Paul. [13]



The Japanese Tea Garden was built on three acres and opened in 1905. A wealthy drug entrepreneur, Rudolph Schiffman, who wanted to give the city a garden landscaped in an authentic Japanese style, invited a gardener from the Japanese Imperial Household, Yukio Ichikawa, to St. Paul. Ichikawa reproduced sections of the palace grounds of the Mikado Mutsuhito and imported plants from Japan as well as sculptures and trees from a Japanese exhibit at the World's Fair in St. Louis, Schiffman's hometown. The finished park was located on the shores of Cosey Lake and included bamboo entrance gates, a waterfall that fell into Cosey Lake, six-foot high carved rock lanterns and plots of Japanese plants.[14]

Park visitors enjoyed the Garden until at least 1909, when it disappears from Como Park's historical records. Some Park employees speculate that rising water in Cosey Lake threatened the shoreline, leading to the removal of the Japanese Tea Garden. Cosey Lake was



Japanese Garden, Como Park, St. Paul, 1905, Minnesota Historical Society

[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Landmarks Old and New: Minneapolis, St. Paul and Surrounding Areas, Nordin Press, Minneapolis
[14] Jack El-Hai, " Lost Minnesota," Architecture Minnesota, AIA Minnesota, March-April 2001

drained in 1928 to provide space for the Como Golf Course. When Como Lake was drained in 1923 (see natural history section), officials found old lanterns that were from the Japanese Tea Garden.[15]

In the 1940s and 1950s, the Como Shops area was fully utilized and residential areas north and northeast of the Shops were built because of demand from returning military personnel looking to reside there.

By 1967, however, the workforce declined precipitously and after the merger of the Northern Pacific, Great Northern and Burlington lines in 1970, it fell even further. By 1982, the Shops closed.

The timing was not without opportunity, however. The Master Plan for creating an Energy Park at the Shops location was approved by the St. Paul City Council in September of 1981. The 218-acre development attracted national attention as the first development in the country where industrial, business and residential facilities are located around a central energy system. The development preserved some of the original Shop buildings and renovated the space to become Bandana Square. Bandana Square opened on Thanksgiving Day, 1983.

The Natural History of Como Lake

Presently, Como Lake is 72 acres in size and has a maximum depth of sixteen feet and a median depth of 7.3 feet. The littoral area, where the depth of the Lake is shallow enough to allow sunlight to penetrate the bottom, occupies over 97% of the Lake area. It was formed in an ice-block depression and rests on glacial till with a mix of soils. Recent soil borings show extensive depths of organic material including visible plant material such as sedges. This suggests that the lake once had an emergent plant population and may have been a shallower system at one time..

Como Lake's 1,680-acre watershed is located within the boundaries of the Capitol Region Watershed District. The majority of water reaching Como Lake is delivered through an extensive system of stormwater pipes. There are twenty-two stormsewers that discharge directly into the lake. A large portion of the runoff from north of the lake, including the golf course, is routed through a series of two constructed wetland detention ponds. Gottfried's Pit is located upstream of Como Lake and collects the drainage from Roseville, Falcon Heights, Ramsey County right-of-ways and the city of Saint Paul. The water from the Pit is pumped to Como Lake. Discharge from the Lake enters into the Trout Brook stormsewer and is routed to the Mississippi River.

In 1847, survey records indicate the Lake was approximately 120 acres. For a variety of reasons, it continually diminished in size through the years. An 1898 map depicts three interconnected lakes, Lake Como, Lake Cosey, and Lagoon Lake. Lake Cosey and later, Lagoon Lake, were drained for the golf course. In 1923, in an effort to preserve Como Lake, officials drained it to try to seal the bottom and make whatever repairs it needed before filling it back up with water.

[15] Ibid.

Odor problems and major fish kills on the Lake have been recorded since 1945. Water quality monitoring began in 1982 at the start of the Clean Lakes Diagnostic Feasibility Study. The Study was funded through the Environmental Protection Agency (EPA) and Ramsey County and indicated that aeration; biomanipulation (management of the living plant and fish populations to improve water quality) and treatment of inflows were good management approaches to improve water quality, aesthetics and recreational fishing.

In the fall of 1986, Ramsey County and the city of Saint Paul diverted the runoff from the northern and western portions of the watershed to a holding pond located on the golf course, rather than allowing it to continue flowing directly into Como Lake and subsequently diverted a comparable area within the Como Lake watershed away from the lake. Previously, as part of its Combined Sewer Overflow (CSO) program, the city of Saint Paul had added 10 acres to the area draining into Como Lake and agreed to contribute funding assistance to help construct the holding ponds. Sediment and phosphorus settle out of the water and then the water is pumped into the Lake. Rough fish, mainly goldfish and carp were chemically eradicated with rotenone and the Lake was restocked with largemouth bass, walleye and bluegill sunfish by the Department of Natural Resources in 1986. In addition, the St. Paul Division of Parks and Recreation initiated a new program to allow vegetation to grow on the shoreline in some areas, rather than mowing the grass to the water's edge. These "buffer strips" filter pollutants and enhance water infiltration into the soil and discourage nuisance wildlife, such as Canada Geese, from feeding and creating pollution in and around the Lake.

Later, in the fall of 1994, the east parking lot on Como Parkway, also known as the Duck Point parking lot, was replaced. The drainage system was changed so that runoff was diverted from the Lake to a grass swale before entering a catch basin that leads to the Lake.

The Minnesota Department of Natural Resources has stocked fish in Como Lake since 1986, one year after the aerator was installed by Ramsey County Public Works on the Lake to minimize winter fish kills. When necessary, a back-up aerator is used.

Twenty-five acres of the macrophytes (large vascular plants which may or may not be rooted in sediment) in the Lake were harvested each summer from 1988-1991, 1993-1995 and 1999-2000. It is believed that harvesting the plants enhances summer recreational opportunities. In addition, there are other in-lake plant species that are beneficial to the Lake that are encouraged to grow. Harvesting of the plants is monitored by the Department of Natural Resources.

A Natural Resource Inventory was completed in July 1995 by Ed Olsen at the St. Paul Department of Parks and Recreation. The Inventory catalogued the entire park and did not distinguish the shoreline of Lake Como. The Inventory indicates that **Intermediate Upland Forest** in the Park (90.1 acres or 23.3% of the the Park) includes Mixed Forest (natural and landscaped areas) and Natural Forest areas (more natural areas). Vegetation includes such species as: Bur Oak, Northern Catalpa, Norway Maple, Crab Apple, White Fir, Green Ash, Eastern Cottonwood, American Elm, White Oak, Hackberry, Littleleaf

Linden, Black Cherry, Boxelder, Black Locust, American Linden (Basswood), Ohio Buckeye, Pin Oak, Gray Birch, Common Lilac and landscape grasses.

The Inventory indicates that the **Landscaped** portion of the Park (219.2 acres or 56.7% of the Park) includes a mixture of natural and planted trees and shrubs. In addition to the species indicated above, the Landscaped portion of the Park includes vegetation such as: Silver Maple, Sugar Maple, Honey Locust, White Mulberry, Willow species, Eastern White Pine, Pin Oak, River Birch, Northern Red Oak, Weeping Willow, Slippery Elm, Siberian Elm, Hop Hornbeam (Ironwood), Ginkgo, Red Maple, American Beech, Tamarack, White Poplar, Quaking Aspen, Lombardy Poplar, American Martin Ash, Douglas Fir, Austrian Pine, Russian Olive, Ponderosa Pine, White Spruce, Eastern Red Cedar, Northern White Cedar, Paper Birch, Amur Maple, Red Pine, Norway Spruce, Eastern Hemlock, Butternut, Black Walnut, Kentucky Coffee Tree, Tulip Tree, Red-osier Dogwood, Japanese Tree Lilac, European Buckthorn, Honeysuckle species, Creeping Juniper, Riverbank Grape and Virginia Creeper. The rest of the park is designated **Upland Shrub** (2.7 acres or .7% of the Park) that includes occasional immature trees such as green ash and basswood and a large percentage of shrubs such as: European buckthorn, lilac and honeysuckle with no one species dominating the area. Groundcover includes common burdock, riverbank grape, Virginia creeper and various grasses; **Exotic** (1.2 acres or .3% of the Park) which is a highly altered, manmade area; **Emergent Aquatic** (1.4 acres or .4% of the Park) which encompasses all aquatic plants with submerged roots but growth above the water level and includes forbs such as Chufa Nut Grass, Softstem Bulrush and Arrowhead sp.; and **Submergent Aquatic** (72 acres or 18.6% of the Park) which encompasses plants totally submerged and includes forbs such as Elodea, Coontail and Pondweed species

The Inventory indicates there are four groups of wildlife identified in Como Park. The groups are: birds, mammals, reptiles and fish. **Bird** species include: Black Capped Chickadee, American Robin, Brewer's Blackbird, House Sparrow, Downy Woodpecker, Hairy Woodpecker, Killdeer, Mourning Dove, Canada Geese, European Starling, Slate Colored Junco, Cedar Waxwing, Rusty Blackbird, Northern Cardinal, Mallard, American Woodcock, Rock Dove (domestic pigeon), American Coot, American Crow, Blue Jay and Double-crested Cormorant. For a list of bird species and comments related to trends, see **Appendix D Bird Species observed at Como Lake**. This information was provide to the CLSP by Val Cunningham, an avid birder living near Como Lake

Mammalian species include: Eastern Cottontail, Gray Squirrel, Northern Pocket Gopher, Muskrat and Fox Squirrel. **Reptiles** include the Painted Turtle and the Snapping Turtle. **Fish** species include: Walleye, Largemouth Bass, Bluegill Sunfish and Hybrid Sunfish.

The city of St. Paul developed a Shoreline Vegetation Management Plan in 1999 that incorporates a shoreline buffer zone of vegetation around the Lake while making provisions for maintaining sight views of the Lake for residents and visitors and providing areas for people to get close to the waters edge. Implementation of the Plan has begun on the east shore of the Lake and will continue over the next several years.