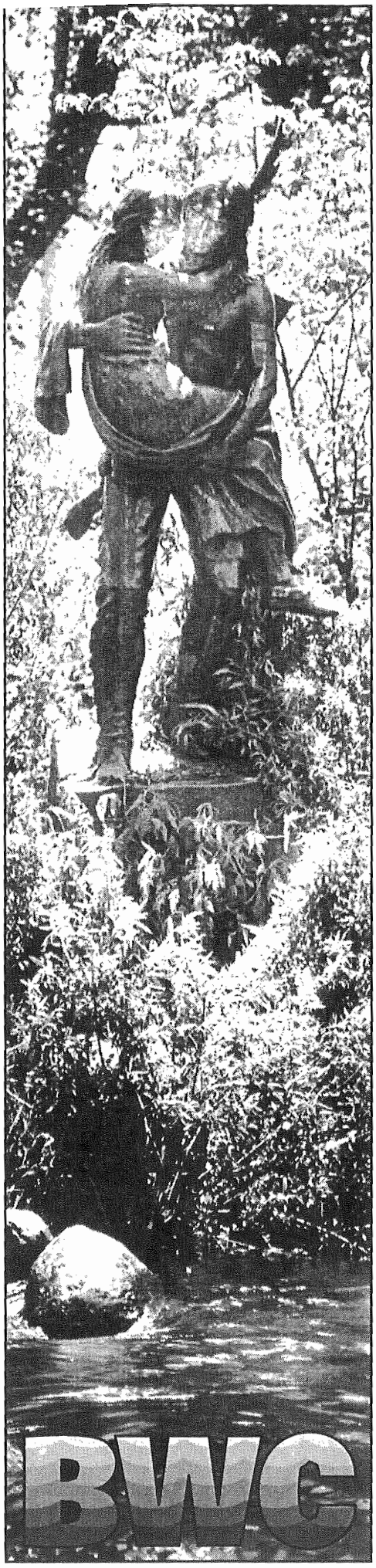

Blue Water Commission

REPORT AND RECOMMENDATIONS
FOR THE MANAGEMENT OF

LAKE NOKOMIS AND HIAWATHA

MAY 1998

Cover photo by Minneapolis Park and Recreation Board

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BLUE WATER COMMISSION

Lake Nokomis – Lake Hiawatha Water Quality Study

May 1998

Dear Interested Persons:

It has been my pleasure to serve as chair of the Blue Water Commission, a group of concerned and dedicated citizens who care deeply about the future of Lakes Nokomis and Hiawatha. These lakes are unique resources that deserve the serious attention recommended in this report. The Blue Water Commission's recommendations are the result of many hours of thoughtful consideration and hard work. They are ambitious but achievable. They should be fully implemented in a timely manner.

The recommendations in this report provide a solid starting point for addressing the problems facing Lakes Nokomis and Hiawatha. Timely implementation of the recommendations will result in significant progress toward preventing further degradation and developing the full potential of these jewels of the Minneapolis park system. This is a worthwhile endeavor that should be pursued without unnecessary delay.

I have greatly appreciated the opportunity to work with the Blue Water Commission as it has grappled with the difficult issues facing Lakes Nokomis and Hiawatha. It is my sincere hope that the recommendations in this report will receive the sustained support and active response they deserve from policymakers and the public. There is too much at stake to do otherwise.

Sincerely yours,

Hans Bjornson, Chair

BLUE WATER COMMISSION

Report and Recommendations

for the Management of

Lake Nokomis and Lake Hiawatha

May 1998

There among the ferns and mosses,
There among the prairie lilies.
On the Muskoday, the meadow,
In the moonlight and the starlight,
Fair Nokomis bore a daughter.
And she called her Wenonah,
As the first-born of her daughters.
And the daughter of Nokomis
Grew up like the prairie lilies,
Grew a tall and slender maiden,
With the beauty of the moonlight,
With the beauty of the starlight.

And Nokomis warned her daughter,
Saying oft, and oft repeating,
Oh beware of Mudjekeewis;
Listen not to what he tells you;
Lie not down upon the meadow,
Stoop not down among the lilies,
Lest the West-Wind come and harm you!"

But she heeded not the warning,
Heeded not those words of wisdom,
And the West-Wind came at evening,
Walking lightly o'er the prairie,
Whispering to the leaves and blossoms,
Bending low the flowers and grasses,
Found the beautiful Wenonah,
Lying there among the lilies,
Wooed her with his words of sweetness,
Wooed her with his soft caresses,
Till she bore a son in sorrow,
Bore a son of love and sorrow.

Thus was born my Hiawatha,
Thus was born the child of wonder;

From *The Song of Hiawatha*, Henry W. Longfellow, 1855

EXECUTIVE SUMMARY

As part of their Neighborhood Revitalization Program activities, the three neighborhood associations around Lakes Nokomis and Hiawatha - Hale Page Diamond Lake (HPDL), Nokomis East Neighborhood Association (NENA) & Standish Ericsson Neighborhood Association (SENA) - established the Blue Water Commission. The Blue Water Commission is a citizens committee that was convened to examine community concerns with the water quality of Lakes Nokomis and Hiawatha. The Blue Water Commission met over a period from November 1997 through May 1998 to further articulate their concerns, understand the causes of problems they identified, evaluate alternative management approaches, and recommend solutions. The outcome of their deliberations include specific recommended actions which are contained in the report titled, *BLUE WATER COMMISSION: Report and Recommendations for the management of Lake Nokomis and Lake Hiawatha* (May 1998).

BLUE WATER COMMISSION

Blue Water Commission members represented the neighborhoods, the Cities of Minneapolis and Richfield, the Minneapolis Park and Recreation Board, the Minnehaha Creek Watershed District, Hennepin County, the Metropolitan Airports Commission, and environmental groups.

FINDINGS

Lake Nokomis is eutrophic, meaning that it has elevated levels of nutrients which cause occasional algae blooms and turbid water. The main source of these nutrients is in runoff from the watershed immediately surrounding the lake. In addition, nutrients are recycled within the lake during the summer. Lake Nokomis also has been infested with Eurasian watermilfoil, which has not grown to nuisance levels. Carp occur in large numbers, and may be enhancing the nutrient problems in the lake. The shoreline around the lake is highly altered with little natural vegetation present.

The overall condition of Lake Nokomis, while not greatly better or worse compared to metro norms, poses concerns for the community. The Blue Water Commission believes that improvements in the condition of Lake Nokomis are a worthy goal.

Lake Hiawatha is also eutrophic, but the manifestations of elevated nutrients are not the same as in Lake Nokomis. Lake Hiawatha is influenced to a substantial degree by the flow of Minnehaha Creek through the lake. In fact, Lake Hiawatha acts more like a reservoir than a lake. This means that while nutrient levels are elevated, algae growth is much less compared to other lakes with similar nutrient levels. Yet, there are still algae blooms which interfere with recreation and enjoyment. About 90% of the nutrients entering Lake Hiawatha come from Minnehaha Creek. Because Minnehaha Creek drains such a vast watershed, mitigation opportunities are limited. Nonetheless, the Blue Water Commission believes improvements are possible over the long term.

GOALS

Early in their deliberations, the Blue Water Commission agreed on the following vision statement to guide their work:

> *Lakes Nokomis and Hiawatha are the focal points for our community and should be a showcase for Minneapolis. The lakes are valuable natural assets that must be protected and improved. Whatever the condition of Lakes Nokomis and Hiawatha, improvements in water quality will benefit our neighborhoods and the city as a whole by enhancing their value.*

The Blue Water Commission identified five discrete problem areas with respect to the water quality of Lakes Nokomis and Hiawatha. These are Swimmability, Fishability, Aesthetics, Diversity of plants and wildlife, and Shoreline environment

The Blue Water Commission considered these problems then articulated an overall goal followed by 19 specific goal statements:

> *"Our desire is to improve and protect the water quality of Lakes Nokomis and Hiawatha. Lakes Nokomis and Hiawatha should be swimmable, fishable, aesthetically pleasing, and support both diverse populations of plants and wildlife and recreational use. Management of Lakes Nokomis and Hiawatha should be as sustainable and ecologically sound as is possible within an urban environment. A sense of ownership, stewardship of the resource, combined with education, community awareness, financial support, and long-term commitment will be crucial in achieving these goals."*

1. Eliminate nuisance algae blooms.
2. Protect public health from fecal contamination, toxic chemicals, and other injurious agents.
3. Reduce the threat of swimmers' itch.
4. Assure that weeds not impede swimming and fishing in designated areas.
5. Ensure that fish communities are healthy, diverse, and balanced.
6. Protect the public from consumption of contaminated fish.
7. Prevent fish kills.
8. Eliminate displeasing odors.
9. Improve water clarity.
10. Reduce any negative impacts of exotic plants and animals.
11. Prevent introduction of additional exotic species.
12. Provide and preserve habitats for nesting, cover, and food for wildlife.
13. Facilitate movement of wildlife to and within the lake environment.
14. Achieve a healthy, balanced, diverse community of native plants and animals.
15. Ensure levels of toxic pollutants do not negatively affect plant and animal life or biodiversity.
16. Provide a natural transition from the land to the water while providing for adequate recreational use of and access to the lakes.
17. Design and manage the shoreline environment to reduce runoff, enhance pollution and sediment filtration, and minimize erosion.
18. Arrest the expansion of deltas.
19. Reduce the transport of pollution and sediment to the lakes from storm sewers.

RECOMMENDED ACTIONS

Short- and long-term management targets were identified for each of the Blue Water Commission goals. Short-term targets were specific and realistic statements with a desired outcome and a deadline. Long-term targets were more aggressive and represent a more optimistic outcome. To accomplish our goals, the Blue Water Commission recommends these ten actions.

1. REDUCE PHOSPHORUS IN LAKE NOKOMIS

Objective: To meet the short- and long-term targets in goal nos. 1, 8, 9, 12 & 14.

Action 1a: Remove carp.
Action 1b: Modify outlet structure.
Action 1c: Build wet detention ponds.
Action 1d: Build grit chambers.
Action 1e: Lake-wide alum application.
Action 1f: Street sweeping.
Action 1g: Phosphorus fertilizer restriction.

2. CONTROL NUISANCE ALGAE AT THE LAKE HIAWATHA BEACH

Objective: To meet the short-term targets in goal nos. 1, 2, 3 & 4 for the Lake Hiawatha beach.

Action 2a: Install and operate a beach curtain around the Lake Hiawatha beach.

3. REDUCE PHOSPHORUS IN LAKE HIAWATHA

Objective: To meet the short- and long-term targets in goal nos. 1, 8, 9, 12 & 14.

Action 3a: Remove carp.
Action 3b: Build wet detention ponds.
Action 3c: Street sweeping.
Action 3d. Artificial circulation – further evaluation.
Action 3e: Manage the intervening watershed.
Action 3f: Phosphorus fertilizer restriction.

4. PREPARE AQUATIC PLANT MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 4, 5, 10, 11 & 14.

The Blue Water Commission recommends that comprehensive management plans for aquatic plants in the two lakes be prepared. These plans should address the following concerns:

- ❑ Provide a diverse native plant community.
- ❑ Minimize recreational nuisances.
- ❑ Provide fish habitat.
- ❑ Control, or hopefully eliminate, exotic species.
- ❑ Prevent the introduction of additional exotic species.

5. PREPARE SHORELINE MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 10, 11, 12, 13, 14, 16 & 17.

The Blue Water Commission recommends that a comprehensive shoreline management plan be prepared that will coordinate the Blue Water Commission's various management goals and address the following concerns:

- ❑ Provide wildlife habitat.
- ❑ Protect the lakes from runoff and erosion.
- ❑ Reduce and someday eliminate exotic plants and animals.
- ❑ Reduce the population of geese.
- ❑ Increase the amount of native vegetation in designated areas.
- ❑ Increase the diversity of plants and animals in shoreline areas.
- ❑ Provide for recreational use and access.

6. PREPARE AND UPDATE FISHERIES MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 4, 5, 7, 10 & 14.

The Blue Water Commission recommends that comprehensive fisheries management plans be prepared - or the DNR's management plans amended if necessary - that will coordinate the Blue Water Commission's various management goals and address the following concerns:

- ❑ Provide and improve fish habitat.
- ❑ Balance the need for aquatic plant control with the need for fish habitat.
- ❑ Reduce and someday eliminate carp.
- ❑ Prevent winterkills in Lake Hiawatha.
- ❑ Sustain a recreational fishery that balances the needs of the community with the health of the lakes.

7. REDUCE THE LEVEL OF HARMFUL MATERIALS TO LEVELS SAFE FOR PUBLIC HEALTH AND ECOSYSTEM INTEGRITY

Objective: To meet the short- and long-term targets in goal nos. 2, 3, 6 & 15.

Action 7a: Continue monitoring the level of fecal coliform bacteria at public beaches.

Action 7b: Develop and implement a plan for the systematic monitoring and evaluation of the occurrence and impact of harmful agents.

Action 7c: Prohibit waterfowl feeding on public lands.

8. REDUCE THE TRANSPORT OF SEDIMENTS AND NON-NUTRIENT POLLUTION TO BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 18 & 19.

Action 8a: Identify and remove, to the greatest possible extent, sources of sediments to the lakes.

Action 8b: Implement Best Management Practices throughout the watersheds of both lakes.

9. IMPLEMENT A PUBLIC EDUCATION PROGRAM

Objective: To meet the short- and long-term targets in all goals.

The Blue Water Commission recommends that these programs continue. The public education program should address at least the following:

- ❑ Actions individuals can take to minimize pollution.
- ❑ Actions individuals can take to reduce stormwater runoff from their property.
- ❑ Inform people that stormwater flows untreated into our lakes.
- ❑ Advise the public about beach contamination.
- ❑ Keep the consumption of contaminated fish to within Minnesota Department of Health guidelines.
- ❑ Advise bathers about preventative measures for swimmers' itch.
- ❑ Advise the public about the balance between:
  - Aquatic plant health and nuisance control
  - Manicured versus natural shoreline vegetation
  - Artificially versus naturally sustained fisheries
  - Water clarity and the abundance and extent of aquatic plant growth
- ❑ Increase awareness of potential exotic species and the need to prevent their introduction.
- ❑ Inform citizens about how they can contribute to a positive, long-lasting management program for Lakes Nokomis and Hiawatha.

10. WHAT NEXT? IDENTIFY OR CREATE AN ENTITY TO CHAMPION THE GOALS AND RECOMMENDATIONS OF THE BLUE WATER COMMISSION

Objective: To make it work.

This report is the beginning of a meaningful management program for the long-term protection and improvement of the conditions of Lakes Nokomis and Hiawatha. To be sustainable, the management effort must be sustained.

The Blue Water Commission members representing the neighborhood associations agreed that the neighborhoods - HPDL, NENA & SENA - should take the lead in carrying out the implementation of the Blue Water Commission's recommendations. They will do this by:

- ❑ Becoming formally organized with a mission compatible with the Blue Water Commission's goals.
- ❑ Their mission will include coordinating, facilitating and advocating the Blue Water Commission's recommendations.
- ❑ Identifying and securing funding necessary to protect the lakes.
- ❑ Providing the resources needed to sustain their effort.
- ❑ Monitoring, evaluating and reporting progress toward accomplishing our goals.
- ❑ Amending this plan in response to evolving community values, developments in lake and watershed management technologies and changes in the environment in and around the two lakes.

ACKNOWLEDGEMENTS

This project was made possible through the City of Minneapolis' Neighborhood Revitalization Program. Funds from that program were used in the initial planning effort and then for support to coordinate the activities of the Blue Water Commission by Dick Osgood of Ecosystem Strategies.

SUPPORT AGENCIES

The Minnehaha Creek Watershed District funded the diagnostic study which included intensive field monitoring, data analysis and modeling, working with the Technical Advisory Committee, and preparing an analysis of alternate management options for consideration by the Blue Water Commission. As well, the District provided funds for copying, postage and refreshments associated with the Blue Water Commission's meetings.

The Minneapolis Park and Recreation Board provided staff assistance, field monitoring, meeting space, and many of the education materials for the Blue Water Commission members.

RESOURCE SPEAKERS

During the course of the Blue Water Commission's deliberations, we invited speakers familiar with the resource and management issues confronting us. These speakers provided invaluable input.

John Barten - Water Quality Manager, Suburban Hennepin Regional Park District
Professor Pat Brezonik - Director of the University of Minnesota Water Resources Center
Daryl Ellison - Area Fisheries Manager, Minnesota Department of Natural Resources
Steve Heiskary - Senior Biologist, Minnesota Pollution Control Agency
Jeff Lee - Environmental Services Manager, Minneapolis Park & Recreation Board
Gary Oberts - Senior Environmental Planner, Metropolitan Council
Dick Osgood - Consultant, Ecosystem Strategies
Deb Pilger - Environmental Coordinator, Minneapolis Park & Recreation Board
Mary Lynn Pulsher - Park Planner, Minneapolis Park & Recreation Board
Duane Shodeen - Regional Fisheries Manager, Minnesota Department of Natural Resources
Doug Thomas - Water Planning Coordinator, Minnesota Board of Water & Soil Resources
Chip Welling - Eurasian Watermilfoil Coordinator, Minnesota Department of Natural Resources
Bruce Wilson - Research Scientist, Minnesota Pollution Control Agency
David Wright - Monitoring & Control Unit Supervisor, MN Department of Natural Resources

STAFF & CONSULTANTS

A large part of the city and agency support for our work was realized through their staff and consultants.

Dale Claridge, John Erdmann & John Thene - Wenck Associates, engineer for the Minnehaha Creek Watershed District. Base maps used in this report were taken from Wenck (1998).
Jeff Lee - Environmental Operations Manager, Minneapolis Park & Recreation Board.
Diane Lynch - Administrator for the Minnehaha Creek Watershed District.

The Hale Page Diamond Lake Community Association (HPDL), Nokomis East Neighborhood Association (NENA), and the Standish Ericsson Neighborhood Association (SENA) thanks the following people (in alphabetical order) who volunteered their time and efforts between September 1996 and November 1997 to launch the Blue Water Commission:

- Bob Babin
- Philip Behrend
- Joe Berns
- John Betcher
- Pamela Blixt
- Vicki Bonk
- Monica Gross
- Kay Hughes
- Woody Love
- Tom Ritzer
- Dave Schmidt

The Blue Water Commission thanks the residents of HPDL, NENA and SENA for identifying improvement of water quality in Lakes Nokomis and Hiawatha as a high priority and choosing to devote a portion of NRP funding for the creation and support of the Blue Water Commission.

ROSTER

	Representing
Hans Bjornson, chair	Minneapolis Park & Recreation Board and the Minnehaha Creek Watershed District
Randy Anhorn	Minneapolis Park & Recreation Board
Bob Babin	Hale, Page and Diamond Lake Community Association
Brian Bates	Sierra Club
Phil Behrend	Standish Ericsson Neighborhood Association
Joe Berns	Nokomis East Neighborhood Association
John Betcher	Standish Ericsson Neighborhood Association
Vicki Bonk	Nokomis East Neighborhood Association
James Calkins	Hennepin County
Steve Cramer, vice chair	Metropolitan Airports Commission
Mike Eastling	City of Richfield
Scott Foss	Hale, Page and Diamond Lake Community Association
Kay Hughes	Hale, Page and Diamond Lake Community Association
Tracy Kienitz	City of Minneapolis
Chris Kirkwood	Minneapolis Park & Recreation Board
Susan Lane	City of Minneapolis
Woody Love / Monica Gross	Minnehaha Creek Watershed District
Julia McPeek	Minneapolis Park & Recreation Board
Dick Miller, vice chair	Minnehaha Creek Watershed District
Mike Meyer	Minneapolis Park & Recreation Board
Beth Oschwald	Audubon Chapter of Minneapolis
Mark Riedel	Standish Ericsson Neighborhood Association
Dave Schmidt	Nokomis East Neighborhood Association
Stephen Stolarek	Sierra Club
Russ Susag	City of Richfield
Roscoe Van Pelt	Hennepin County

Staff

Pete Cangialosi	Minnehaha Creek Watershed District
Jeff Lee	Minneapolis Park & Recreation Board
Diane Lynch	Minnehaha Creek Watershed District
Dick Osgood - BWC Staff	Ecosystem Strategies

CONTENTS

I BACKGROUND

Lake Nokomis and Lake Hiawatha are the centerpiece of South Minneapolis neighborhoods. The Lake Nokomis-Lake Hiawatha Regional Park is the second most visited park in Minneapolis. Protecting and improving the water quality of these two lakes will increase their value to the neighborhoods, park users, the City and the region.

This is the report and recommendations of the Blue Water Commission - a citizens committee who met during 1997 and 1998 to consider community concerns about the water quality of Lakes Nokomis and Hiawatha.

BLUE WATER COMMISSION

As a part of their Neighborhood Revitalization Program activities, the three neighborhood associations around Lakes Nokomis and Hiawatha independently identified the water quality of the lakes as being of high importance. The neighborhood associations - Hale Page Diamond Lake, Nokomis East Neighborhood Association and Standish Ericsson Neighborhood Association - or HPDL, NENA and SENA - joined forces to address their mutual concern. The neighborhoods proposed organizing a citizens committee to examine community concerns with the condition of the two lakes and make recommendations for their management. The committee they envisioned is called the Blue Water Commission.

Representatives of the neighborhood associations asked the Minnehaha Creek Watershed District to help the Blue Water Commission by conducting a water quality study and preparing a feasibility report to support the work of the Blue Water Commission. The Minnehaha Creek Watershed District agreed to this request in February 1997. As well, staff of the Minneapolis Parks and Recreation Board provided monitoring and technical assistance.

THE PROCESS

The Blue Water Commission process consisted of the water quality study, the formation of the citizen's committee and a technical committee, their deliberations and this report.

The Blue Water Commission

Representatives of the neighborhoods, the Minnehaha Creek Watershed District and the Minneapolis Park and Recreation Board and other agencies and groups appointed members and alternates to form the Blue Water Commission. The Commission had representatives from:

- ❑ The neighborhoods
- ❑ The Cities of Minneapolis and Richfield
- ❑ The Minneapolis Park and Recreation Board
- ❑ The Minnehaha Creek Watershed District
- ❑ Hennepin County
- ❑ The Metropolitan Airports Commission
- ❑ Environmental groups

The Commission Chair was appointed by the Minneapolis Park and Recreation Board as an at-large Minneapolis resident. The Blue Water Commission roster is found in the preface of this report.

The neighborhoods hired Dick Osgood of Ecosystem Strategies to staff the Blue Water Commission and their Technical Advisory Committee and to coordinate their activities. Dick's responsibilities included facilitating the meetings, providing resources, assisting the chair and drafting this report.

The Blue Water Commission convened twice each month from November of 1997 through May of 1998. A complete file of meeting proceedings and resource materials is kept at the Nokomis East Neighborhood Association office. A summary of their meetings is found in Appendix One.

Charge to the Blue Water Commission

At their first meeting, the Blue Water Commission adopted this charge:

- ❑ Develop a vision for the desired condition of Lakes Nokomis and Hiawatha
- ❑ Articulate that vision by developing management goals and objectives
- ❑ Develop recommendations to realize those goals, and
- ❑ Prepare a report summarizing their work and detailing their recommendations

Lake Nokomis / Lake Hiawatha Diagnostic-Feasibility Study

Wenck Associates, engineers for the Minnehaha Creek Watershed District, prepared the Lake Nokomis and Lake Hiawatha Diagnostic Feasibility study, which provided the technical support for the Commission's deliberations. The two-volume report (Wenck 1998) detailed:

- ❑ The results of field monitoring
- ❑ The evaluation of the results
- ❑ Modeling and other diagnostic tools
- ❑ Conclusions regarding the source and amounts of nutrients and other pollution
- ❑ An analysis of alternate management approaches

Technical Advisory Committee

A technical Advisory Committee was comprised of technical representatives from various agencies to provide technical oversight to the Blue Water Commission (see Technical Advisory Committee Roster, Appendix Two). The Technical Advisory Committee was charged with overseeing the Diagnostic-Feasibility report and advising the Blue Water Commission on technical matters that related to their interests in protecting the two lakes. The Technical Advisory Committee met several times and formally reported their recommendations to the Blue Water Commission on several occasions.

II HISTORY AND PRESENT USE

Lakes Nokomis and Hiawatha were originally shallow, swampy marshes. Lake Nokomis (originally Lake Amelia) and Lake Hiawatha (originally Rice Lake) were 'born' when Park Superintendent Theodore Wirth had them dredged to transform the peat bogs and swamp-land into attractive parks to stimulate residential development in South Minneapolis.

Lake Nokomis was dredged in 1914-18. The original water area was reduced from about 300 acres to its present size of about 200 acres. 2,500,000 cubic yards of material were removed and placed on the adjacent lands. The lake's depth increased from about five feet, and its water was reported to be "as clear as any of our spring-fed lakes" (Wirth 1945). Similarly, Lake Hiawatha was dredged in 1929-31. Wirth's vision of stimulating growth was largely realized by 1924, when the area was completely developed.

The lake names were taken from Longfellow's 'The Song of Hiawatha' - Hiawatha being the grandson of Nokomis.

Today, the Nokomis-Hiawatha Regional Park is the second-most used park in Minneapolis. According to the Metropolitan Council, the recreational use of the park in 1995 was:

Summer visits	701,300
Winter visits	35,100
Cross-country ski uses	4,700
Skating uses	16,600
Spring & Fall uses	70,130
Total Uses	**827,000 visits**

The figures for each season include walkers, bicycle riders, picnickers, and other general uses. There are three beaches, two at Lake Nokomis and one at Lake Hiawatha. Additional uses include boating & canoeing, Aquatennial milk carton boat races, wind surfing, auto cruising, and 'hanging out.'

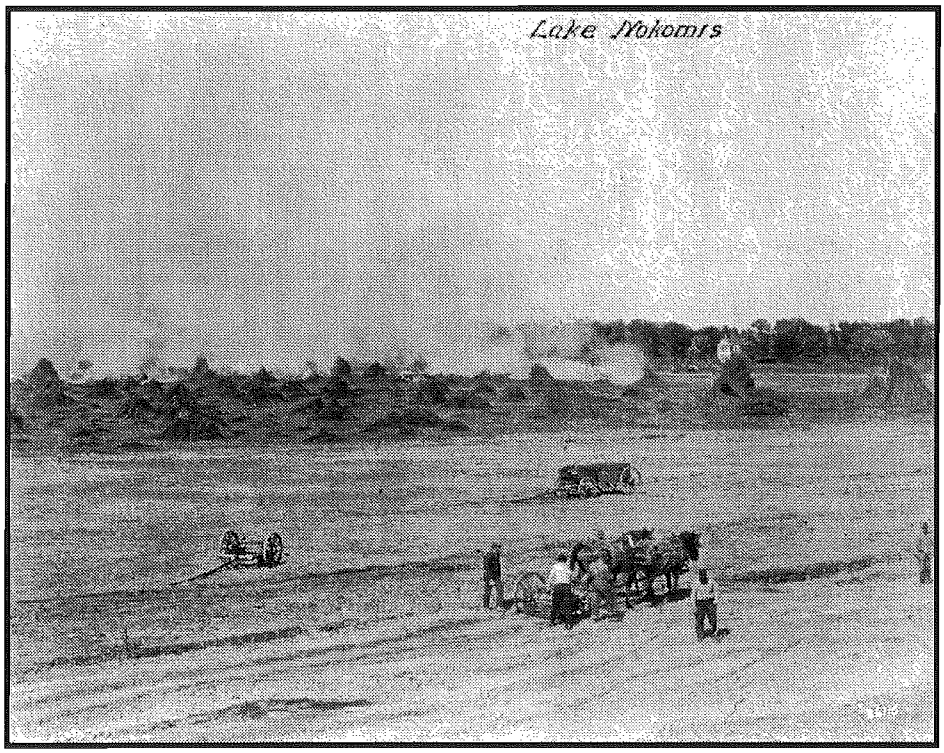
Lifeguard attendance reports in 1997 were:

Lake Hiawatha	14,452
Lake Nokomis (50th Street)	10,498
Lake Nokomis (Main Beach)	35,598

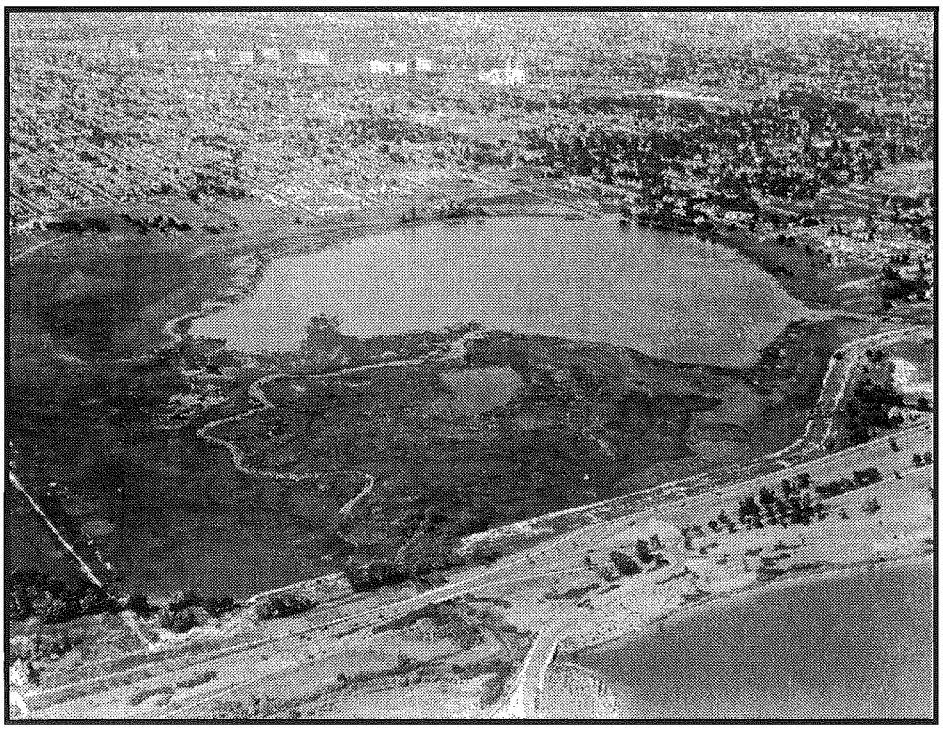
The main beach at Lake Nokomis is the highest attended beach in Minneapolis.

The Lake Nokomis refectory had gross revenues of $40,000 in 1997. The refectory also rented 30 sailboat buoys and 24 canoe racks. Boat launch facilities are available at Lake Nokomis and fishing docks are provided at Nokomis (two sites) and Lake Hiawatha (one site).

Ice fishing occurs on both lakes.



'Lake Nokomis' before dredging. Photo from the Minneapolis Park and Recreation Board.



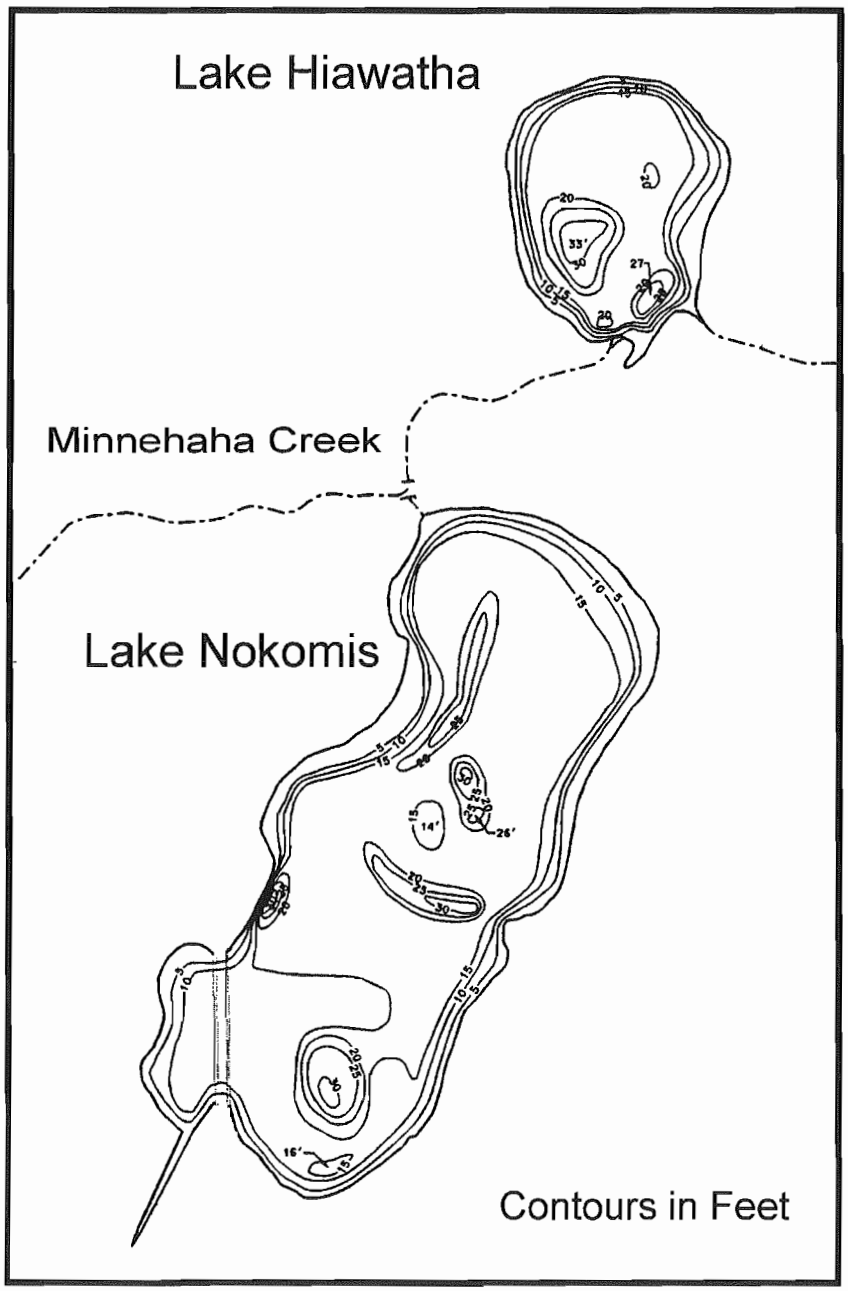
Lake Hiawatha and golf course, June 1929. Photo from the Minneapolis Park and Recreation Board.

There are 12 ballfields in Lake Nokomis Park which are used three seasons of the year for up to twelve hours per day. In 1997 there were 80,000 in attendance for 2,000 league games. As well, there are many unscheduled practices, tournament rentals and other uses.

The park also provided 80,000 seasonal uses at Nokomis Community Center and 22,000 uses at Lake Hiawatha Neighborhood Center, adding several hundred thousand visits to the parks in 1997. Finally, 52,126 rounds of golf were played at the Hiawatha golf course.

Total use of the 632-acre regional park exceeds 1.05 million visits per year - this is about one-third the number of visitors to Yellowstone National Park.

Figure 1. Lakes Nokomis & Hiawatha today. Base map, Minnehaha Creek Watershed District.



III FACTORS AFFECTING URBAN LAKES

Urban Lakes, indeed all lakes, are affected by many factors, which can include runoff, seepage, rainfall, air deposition, over-use, artificial alterations of their basin, manipulation of plants and animals, the introduction of exotic species, and on-and-on. To the extent that these factors lead to undesirable results, they may be called pollution. In an urban environment, lake management efforts normally aim to minimize rather than eliminate most pollution.

The following sections describe the most common factors affecting urban lakes - eutrophication, other chemical pollution, and biological impacts.

EUTROPHICATION

What is Eutrophication?

Eutrophication is a process by which lakes become enriched with nutrients that cause an increase in the productivity of the lakes. Eutrophication is often a concern because the manifestations of over-fertilization are perceived as nuisances. In the extreme, highly eutrophic lakes are plagued by persistent algae blooms, abundant aquatic plants, and unhealthy fish communities - all of which diminish the recreational use and environmental value of the lake.

Eutrophication is the process by which lakes become enriched with nutrients.

This can occur as a natural aging process – called ***natural eutrophication*** – or as a process accelerated by human activities – called ***cultural eutrophication***.

When this over-fertilization is a result of human activities rather than the natural aging process, it is called *cultural eutrophication* and can be managed and, to some extent, reversed. Indeed, this has already happened with Lakes Nokomis and Hiawatha, which were (probably) naturally eutrophic before they were 'restored' by dredging early in this century.

The nutrient most often associated with eutrophication is phosphorus. Phosphorus is referred to as the *limiting nutrient* because it is the element in lake water that is in shortest supply relative to the growth needs of algae. This means that when the amount of phosphorus in lakes increases, the amount of algae increases in turn. This is manifest in increased levels of algae, increased frequency of algae blooms, and turbid waters - all of which normally diminish recreational use and environmental value.

Sources of Phosphorus

There are three main sources of phosphorus to urban lakes:

- **Nonpoint Sources**, which enter lakes from broad areas. Nonpoint sources are generally runoff which can enter the lake from sheet flow off the land, via storm sewers or a creek that collects the runoff and routes it to the lake.

- **Point Sources**, which enter lakes directly from a discrete location, like a pipe. Point sources are usually discharges from sewage treatment plants or industries. There are no point sources entering Lakes Nokomis and Hiawatha.

- **Atmospheric Sources**, which include rainfall and wind-blown phosphorus.

Urban runoff contains significant amounts of phosphorus. Runoff over hard surfaces picks up phosphorus from many sources: deposited from wind and dust, applied as fertilizer, leaf and litter decomposition, and natural soil fertility. As the percentage of hard surface increases, the amount of phosphorus carried in runoff increases. Studies of runoff in urban areas have found phosphorus in runoff varies with land use (see Water Quality Management Citizens Advisory Committee 1993; and Osgood 1997):

Land Use	Phosphorus in Runoff	
Park & Open Space	0.1	Pounds per acre per year
Low Density Residential	0.7 – 2.1	Pounds per acre per year
High Density Residential & Commercial	1.9 – 3.4	Pounds per acre per year

Thus, the amount of phosphorus carried to a lake will depend on the watershed area and the mix of land use in the watershed. Phosphorus from atmospheric sources is normally a small part of the total annual input to urban lakes.

Internal Phosphorus Sources

Phosphorus from past years that has been deposited in lake sediments can be released back into the water. This process of recycling - referred to as internal phosphorus loading - can be a significant factor in a lake's overall phosphorus supply. Internal phosphorus seeps into the lake water in a form readily used by algae and other plants, and can occur at times when algae are actively growing, like the middle of the summer.

Impacts of Eutrophication

As the levels of lake fertility increase, so does the overall production of organic matter. In practical terms, this means that increased phosphorus causes increased algae. Lakes with low fertility are characterized as *oligotrophic*, meaning nutrient-poor. Lakes with high fertility are referred to as *eutrophic*, meaning nutrient-rich. As a practical matter, there is a continuum of lake fertility and productivity that defines the 'eutrophic state' or simply, trophic state of a lake.

A lake's trophic state is relevant to lake management because of the manifestations of increased nutrients. As phosphorus levels increase, so does:

- The abundance of algae and the frequency of algae blooms
- The predominance of blue-green (or scum-forming) algae
- A reduction in water clarity
- The depletion of oxygen below the thermocline

A number of scales are used to indicate lake trophic condition. The Carlson Trophic State Index (Carlson 1977), or TSI, ranks lakes on a 0 - 100 scale, where numbers less than about 40 are oligotrophic lakes, numbers greater than 50 are eutrophic lakes, and numbers greater than 70 are hyper-eutrophic lakes (very eutrophic). Osgood developed a grading scale which ranks lakes according to how they compare with other metro lakes. The lake grade is similar to a grading curve in school and indicates how a lake ranks by percentile. Finally, Heiskary and Wilson (1990) looked at perceived condition of the lakes compared to their trophic state.

All three ways of indicating lake condition can be calculated using one or a combination of measurements: total phosphorus, chlorophyll (a green pigment in algae), or lake transparency as measured using a Secchi disk. Because these measurements are related - more phosphorus means more algae (chlorophyll) means less transparency - they can normally be used in combination.

These indices are related to the open water condition of lakes. The indices may not characterize near-shore lake condition.

TP	CLA	SD	Percentile	Grade	TSI	Perceived Condition
<23	<10	>10	<10	A	<51	Crystal clear, beautiful
23-32	10-20	7-10	10-30	B	51-57	Little algae, minor problems
32-68	20-48	4-7	30-70	C	57-67	Definite algae, impaired use
68-152	48-77	2-4	70-90	D	67-75	High algae, un-enjoyable
>152	>77	<2	>90	F	>75	Severe algae, enjoyment impossible

TP = total phosphorus (parts per billion, ppb); CLA = chlorophyll (ppb); SD = Secchi disk transparency (feet).
Percentile is a ranking of metro lakes, like a grading curve.
Grade is a letter assignment (not meant to indicate 'passing' or 'failing').
TSI is Carlson's Trophic State Index.
Perceived Condition is based on user perceptions.

OTHER CHEMICAL POLLUTION

There are many kinds of chemical pollution that get into urban lakes. These chemicals include sediments, salts, metals, hydrocarbons, and synthetic chemicals.

Sediments

Sand, silt and clay are minerals that are carried in stormwater and deposited in lakes. While technically not chemicals because they are not reactive, these are of mineral origin. Sources of these sediments include eroded soils, materials exposed during construction activities, and sand applied to roads during the winter. Sediments are readily deposited as stormwater enters lakes and may build up. In addition to the negative effect on water clarity, sediments contribute to phosphorus loading and may also smother aquatic plants.

Salts

Salts are applied as de-icers to roads in the winter. As the snow melts, the salts dissolve and are readily carried in the runoff. The main constituents of salt are sodium and chloride. The environmental effects of salt are usually subtle, but their presence can indicate general pollution.

Metals

Metals such as copper, cadmium, chromium, zinc, nickel, iron, lead and mercury are found in urban stormwater. These chemicals, sometimes referred to as heavy metals, are of concern because they can be toxic to aquatic plants and animals. In urban areas, the main concern is not whether metals are present, but rather if they are present in quantities sufficient to have undesirable effects.

We know that mercury is present in Lake Nokomis to the extent there are contaminated fish resulting in consumption advisories (MDH 1998). The source of mercury in urban lakes is most likely atmospheric.

Hydrocarbons

The term hydrocarbon refers to a general class of organic chemicals derived from fossil fuels. These include gasoline and oils. These chemicals are released through the operation of automobiles and other vehicles. Hydrocarbons are readily carried in stormwater, especially from streets and parking lots. Because hydrocarbons are lighter than water, they often form a sheen on the water surface. Negative impacts of hydrocarbons on lakes are short-lived because in small amounts they are quickly broken down by sunlight.

Synthetic Chemicals

Synthetic chemicals are manufactured for specific purposes and are sometimes called 'man-made chemicals.' They can be problematic in urban lakes for two main reasons: first, because they are manufactured, they are not readily broken down and therefore persist in the environment; and second, many of these chemicals are toxic or cause chronic problems. One such class of chemicals are PCBs, which were used as coolants in electronic transformers. PCBs have been found in fish flesh, and has resulted in consumption advisories for many urban lakes.

BIOLOGICAL IMPACTS

Human activities relating to the use or abuse of aquatic resources often have unintended biological consequences, including negative impacts to fish and aquatic plants, and the introductions of pathogens and exotic species. Impacts on general lake condition and algae blooms were covered under 'eutrophication' above.

Fish

Fishing, over-fishing, selective fishing (preferentially taking certain species or sizes) and fish stocking all work to alter the nature of a native fishery. As well, alterations to a lake bottom or plant communities affect the ability of fish populations to sustain themselves. For the most part, the societal desire to catch fish is driven by recreational interests. However, there are some people in metro areas that rely on urban fisheries as a food source. In both cases, the demand for a quality fishery generally outweighs the ability of the urban lake resource to sustain that demand.

As a practical matter, the predominant fisheries management tool for urban lakes is stocking. To some extent, urban fisheries are managed through regulations which specify the numbers, size and kinds of fish that can be taken.

Aquatic Plants

Rooted aquatic plants - sometimes referred to as weeds - grow attached to the lake bottom either by roots or other simple structures. Native aquatic plants normally grow in areas where there is suitable bottom materials, sufficient sunlight, and the lack of any kind of scouring action. This usually means plants will grow in sandy or mucky lakebeds to depths of about 15 feet. Aquatic plants perform valuable ecosystem functions such as providing fish habitat, retarding beach erosion, providing a food source some aquatic animals, and sometimes even minimizing algae blooms. Aquatic plants can also become a nuisance. When aquatic plants become too abundant or grow over extensive areas, they can interfere with swimming, boating and fishing - and in the extreme, they can become a blight.

Balancing the benefits that aquatic plants provide with the nuisances they can create is a special challenge for urban lake management. Because rooted aquatic plants get their nutrients from the lake soils instead of the lake water, they cannot be simply 'starved' by reducing the input of nutrients as can be done with algae. Instead, control of nuisance aquatic plants is most often accomplished using mechanical methods (like harvesting) or chemical methods (like herbicides).

Pathogens

Fecal coliform bacteria are measured to indicate the presence of water contaminated by human or animal fecal waste. There are no set standards for this type of contamination, but the Great Lakes Upper Mississippi River Board or GLUMRB (1975) guidelines are often used. The GLUMRB (1975) guidelines state:

> *Fecal coliform density shall not exceed 200 CFU / 100 ml as a geometric mean or 1,000 CFU / 100 ml at any one time.* [CFU means colony forming unit].

In practice, fecal coliform bacteria are not measured daily, so the later guideline is more workable.

Exotic Species

Exotic or introduced species are plants and animals that are not native in a particular environment. Exotic species may get into lakes as a result of intentional introductions - like the stocking of gamefish or the cultivation of landscape plants - or as a result of accidental introductions associated with human activity - like Eurasian watermilfoil.

Exotic species are problematic because when they are introduced into a new environment, they are usually free from the checks and balances experienced in their native environments. As a result, exotic species often grow very quickly to nuisance levels, and may overtake native plants and animals. This problem is recognized to be of such a great concern that intentional introductions are prohibited and accidental introductions are actively avoided.

IV VISION, PROBLEMS & GOALS

VISION

Early in their deliberations, the Blue Water Commission agreed on the following vision statement to guide their work:

> ***Lakes Nokomis and Hiawatha are the focal points for our community and should be a showcase for Minneapolis. The lakes are valuable natural assets that must be protected and improved. Whatever the condition of Lakes Nokomis and Hiawatha, improvements in water quality will benefit our neighborhoods and the city as a whole by enhancing their value. Therefore, the Blue Water Commission will work to:***
>
> 1. ***Describe the present condition of the lakes and specify how that may detract from their value.***
> 2. ***Translate the difference between their present condition and their desired condition into meaningful and measurable goals.***
> 3. ***Explore ways to accomplish those goals, and***
> 4. ***Make recommendations to the appropriate agencies, groups and individuals.***

PROBLEMS

The Blue Water Commission has identified problems and concerns with respect to the water quality of Lakes Nokomis and Hiawatha in five areas:

- **Swimmability** - nuisance algae blooms, the threat of fecal contamination, occurrences of swimmers' itch, and aquatic plants impeding swimming.
- **Fishability** - healthy and diverse fish community, assure fish are safe to eat, prevent fish-kills, and assure that 'weeds' do not impede fishing access.
- **Aesthetics** - displeasing odors, water clarity, nuisance algae blooms, and shoreline environment.
- **Diversity of plants and wildlife** - reduce/prevent/eliminate exotic plants and animals, increase the numbers and kinds of native plants and animals, improve wildlife habitat, and assure that toxic agents do not affect biodiversity.
- **Shoreline environment** - manage shoreline environment to enhance pollution filtration, provide for a more natural transition from land to water, and arrest the expansion of deltas.

GOALS

The Blue Water Commission considered the problems they had identified with regard to the water quality of Lakes Nokomis and Hiawatha, and then developed specific goals for the improvement of Lakes Nokomis and Hiawatha using the following goal statement to guide them:

> ***"Our desire is to improve and protect the water quality of Lakes Nokomis and Hiawatha. Lakes Nokomis and Hiawatha should be swimmable, fishable, aesthetically pleasing, and support diverse populations of plants and wildlife and recreational use. Management of Lakes Nokomis and Hiawatha should be as sustainable and ecologically sound as is possible within an urban environment. A sense of ownership, stewardship of the resource, combined with education, community awareness, financial support, and long-term commitment will be crucial in achieving these goals."***

A more specific statement of the Commission's goals is organized under two main headings - those permitting recreational use and those fostering ecosystem/environmental preservation. The Commission intends for their goals to be broad and bold statements which challenge the status quo for Lakes Nokomis and Hiawatha. The Blue Water Commission's goals are to:

Recreational Use

1. Eliminate nuisance algae blooms.
2. Protect public health from fecal contamination, toxic chemicals, and other injurious agents.
3. Reduce the threat of swimmers' itch.
4. Assure that weeds not impede swimming and fishing in designated areas.
5. Ensure that fish communities are healthy, diverse, and balanced.
6. Protect the public from consumption of contaminated fish.
7. Prevent fish kills.
8. Eliminate displeasing odors.
9. Improve water clarity.

Ecosystem/Environmental Preservation

10. Reduce any negative impacts of exotic plants and animals.
11. Prevent introduction of additional exotic species.
12. Provide and preserve habitats for nesting, cover, and food for wildlife.
13. Facilitate movement of wildlife to and within the lake environment.
14. Achieve a healthy, balanced, diverse community of native plants and animals.
15. Ensure levels of toxic pollutants do not negatively affect plant and animal life or biodiversity.
16. Provide a natural transition from the land to the water while providing for adequate recreational use of and access to the lakes.
17. Design and manage the shoreline environment to reduce runoff, enhance pollution and sediment filtration, and minimize erosion.
18. Arrest the expansion of deltas.
19. Reduce the transport of pollution and sediment to the lakes from storm sewers.

V DIAGNOSTIC SUMMARY

The Lake Nokomis Lake Hiawatha Diagnostic-Feasibility Study (Wenck 1998) was prepared under the direction of the Minnehaha Creek Watershed District to support the work of the Blue Water Commission. The report evaluated field monitoring from 1997 as well as other complimentary data that were available. The results are summarized here.

PHYSICAL SETTING

The physical dimensions for the two lakes are:

	Lake Nokomis	**Lake Hiawatha**
Lake Area:	204 acres	54 acres
Maximum Depth:	30 feet	33 feet
Average Depth:	14 feet	15 feet
Littoral Depth :	15 feet	15 feet
Littoral Area:	89 acres	20 acres
Local Watershed Area:	672 acres	1,232 acres
Tributary Area of Minnehaha Creek:	130 square miles	130 square miles

The local watershed drainage includes all areas that contribute runoff directly to the lakes and the Minnehaha Creek drainage collects runoff beginning with the outlet of Lake Minnetonka and all along Minnehaha Creek, prior to entering the Lakes Nokomis and Hiawatha on its way to the Mississippi River. The Minnehaha Creek drainage is considered separately because its flow into Lake Nokomis is infrequent and short-lived. Creek flow into Lake Hiawatha is complicated by 'short circuiting' or bypassing - meaning a portion of the water flows directly from the inlet to the outlet without mixing with the lake water.

LAKE CONDITION

Water Quality

The water condition of a lake is usually measured in three ways - total phosphorus, chlorophyll-a content, and Secchi disk transparency - which are interrelated. Most metro area lakes with excessive phosphorus concentrations experience both intensive and frequent algae blooms resulting in low water clarity.

To account for the effects of variable weather conditions that in turn cause variable lake conditions, the data are presented from different perspectives - a five year average (1993-1997) and 1997 only. The annual numbers are averages of bi-weekly samples taken throughout the entire summer, May through September.

Parameter	Lake Nokomis		Lake Hiawatha	
	1997	5-Year	1997	5-Year
Total Phosphorus (ppb)	61	55	69	63
Chlorophyll (ppb)	27	25	14	16
Secchi disk (feet)	4.9	5.2	4.9	5.2
Lake Grade	C	C	NA*	NA*
Trophic State Index	60	59	NA*	NA*

* Lake grades and trophic state indices are not applicable for Lake Hiawatha because the lake behaves like a reservoir and these indices are designed for lakes.

These data indicate that Lake Nokomis is eutrophic and that its condition is not greatly better or worse than metro lake norms. This condition is typified by algae blooms and recreational impairment, both of which have been identified as problematic by the Blue Water Commission. Further, the diagnostic study has shown that the condition of Lake Nokomis has not changed significantly over the past 25 years.

Lake Hiawatha is more difficult to compare to other lakes because it works more like a reservoir than a lake. This means that Minnehaha Creek poses an overwhelming influence by continually 'flushing' or washing through the lake. Indeed, the amount of water that flows through Lake Hiawatha each year represents 83-times the volume of the lake. This compares to most other metro lakes which have annual water inputs representing about one lake volume. The result is that while Lake Hiawatha contains more phosphorus than Lake Nokomis, it has much less algae, and similar water clarity. Like Lake Nokomis, the condition of Lake Hiawatha has not changed significantly in the past 25 years.

Aquatic Plants

Rooted aquatic plants in Lakes Nokomis and Hiawatha occur in low- to moderate densities and grow in water depths of 2-5 feet. Eurasian watermilfoil - an exotic species - was discovered in both lakes in 1994 and now is the predominant plant. Coontail, a native plant, is the second-most abundant plant. Other native plants occur in very low numbers.

Fish

Fish population assessments are conducted by the Minnesota Department of Natural Resources about every five years. The results from these surveys indicate the following:

Lake Nokomis

- ❑ Perch and crappie numbers are high
- ❑ Northern pike numbers are low due to poor spawning habitat
- ❑ Walleye have been stocked since 1979
- ❑ Tiger muskie have been stocked since 1984
- ❑ Bluegill numbers have increased, possibly due to more rooted vegetation
- ❑ Carp numbers appear high enough to be problematic

Lake Hiawatha

- ❑ High numbers of small sized northern pike
- ❑ Walleye are present, although they have never been stocked
- ❑ Bluegill, pumpkinseed, and black crappie are present, but are small in size
- ❑ Relatively high numbers of black bullhead and suckers
- ❑ Carp are probably present in high numbers

The presence of carp is particularly significant in Lake Nokomis because they are known to be a source of phosphorus in lakes. They are a source of internal phosphorus by stirring up the lake bottom as well as excreting phosphorus directly into the water. It is estimated that this source of phosphorus in Lake Nokomis may be responsible for about 500 pounds of phosphorus per year.

Winterkills have occurred in Lake Hiawatha in three seasons over the past 30 years. Winterkills have not occurred in Lake Nokomis.

Certain fish in Lake Nokomis are known to be contaminated with PCBs and mercury. The level of contamination is of concern relative to human consumption, but there is no documented impact of mercury and PCBs on the health of the fish. No analysis has been done for fish in Lake Hiawatha, so there are currently no consumption advisories in effect (see table below).

Fish Consumption Advisory for Lake Nokomis (MDH 1998). Advisories are for all persons. For women of child-bearing age and young children, the advisories are more restrictive for mercury.

Species / Length	5 to 15 inches	15 to 20 inches	20 to 25 inches	25 to 30 inches	30+ inches
Black Crappie	Unlimited (Mercury)				
Carp	Unlimited (PCB)		1 meal/week (PCB)	1 meal/month (PCB)	
Walleye	Unlimited (Mercury)	Unlimited (Mercury)	1 meal/month (PCB)	1 meal/month (Mercury)	
White sucker		1 meal/month (PCB)			

Shoreline Habitat

The shoreline around both lakes is characterized by mowed turf, golf course (Lake Hiawatha), concrete and stone retaining walls in various states of disrepair, and a lack of 'natural' or native vegetation. Areas of erosion occur in places around both lakes. Approximately half the shoreline around Lake Nokomis contains old (circa 1930s) retaining walls. The only area that appears to support any significant wildlife or nesting habitat is located near Lake Nokomis west of Cedar Avenue and the delta from Minnehaha Creek as it enters Lake Hiawatha. This area has become inhabited with shrubs, grasses and other vegetation. There are two beaches on Lake Nokomis and one beach on Lake Hiawatha.

Swimming Health

Swimming health may be affected by fecal contamination from urban runoff and waterfowl. Fecal contamination is measured by testing for fecal coliform bacteria. Fecal coliform bacteria are measured weekly by the City of Minneapolis. While there are no specific standards for fecal coliform bacteria, the Technical Advisory Committee of the Blue Water Commission recommended that 1,000 CFU/100 ml (the standard measurement units) is an appropriate management goal.

The results of weekly monitoring show that fecal coliform counts regularly exceed 1,000 CFU/100 ml for both lakes, especially after rain. While no known illnesses have occurred at Lakes Nokomis or Hiawatha, the City recommends no swimming on days following rainfall.

POLLUTION SOURCES

Measuring the amounts of water and phosphorus that enter and leave each lake on an annual basis is important in evaluating their impacts on lake condition. During 1997, measurements were made at several locations tributary to the two lakes as well as along Minnehaha Creek. The results of this study were used to 'fill in the gaps' between the areas that were actually measured and those areas that could not be feasibly monitored. Because 1997 was a wet summer, these results were then used to estimate the inputs of water and phosphorus from various sources during an average year. These results are referred to as the 'benchmark' year. Details of this study are reported in Wenck (1998).

LAKE NOKOMIS

Sources		Water acre-feet (% of total)	Phosphorus pounds (% of total)
Benchmark Inputs			
Watershed:	Upper Watershed	171 (13%)	45 (2%)
	Local Watershed	420 (32%)	805 (43%)
	Local Park Watershed	65 (5%)	84 (4%)
	Minnehaha Creek	166 (13%)	172 (9%)
Atmosphere		481 (37%)	137 (7%)
Internal Sources		--	643 (34%)
TOTAL		**1,303 (100%)**	**1,886 (100%)**

Upper watershed	Runoff from the land area from the south under Highway 62.
Local watershed	Runoff from the land area immediately around the lake, excluding park land.
Local park	Runoff from the park land around the lake.
Minnehaha Creek	Runoff from the Creek that occasionally overflows into Lake Nokomis.
Atmosphere	Water and phosphorus that is deposited directly on the lake surface from precipitation or windblown sources.
Internal	Phosphorus that is recycled from within the lake.

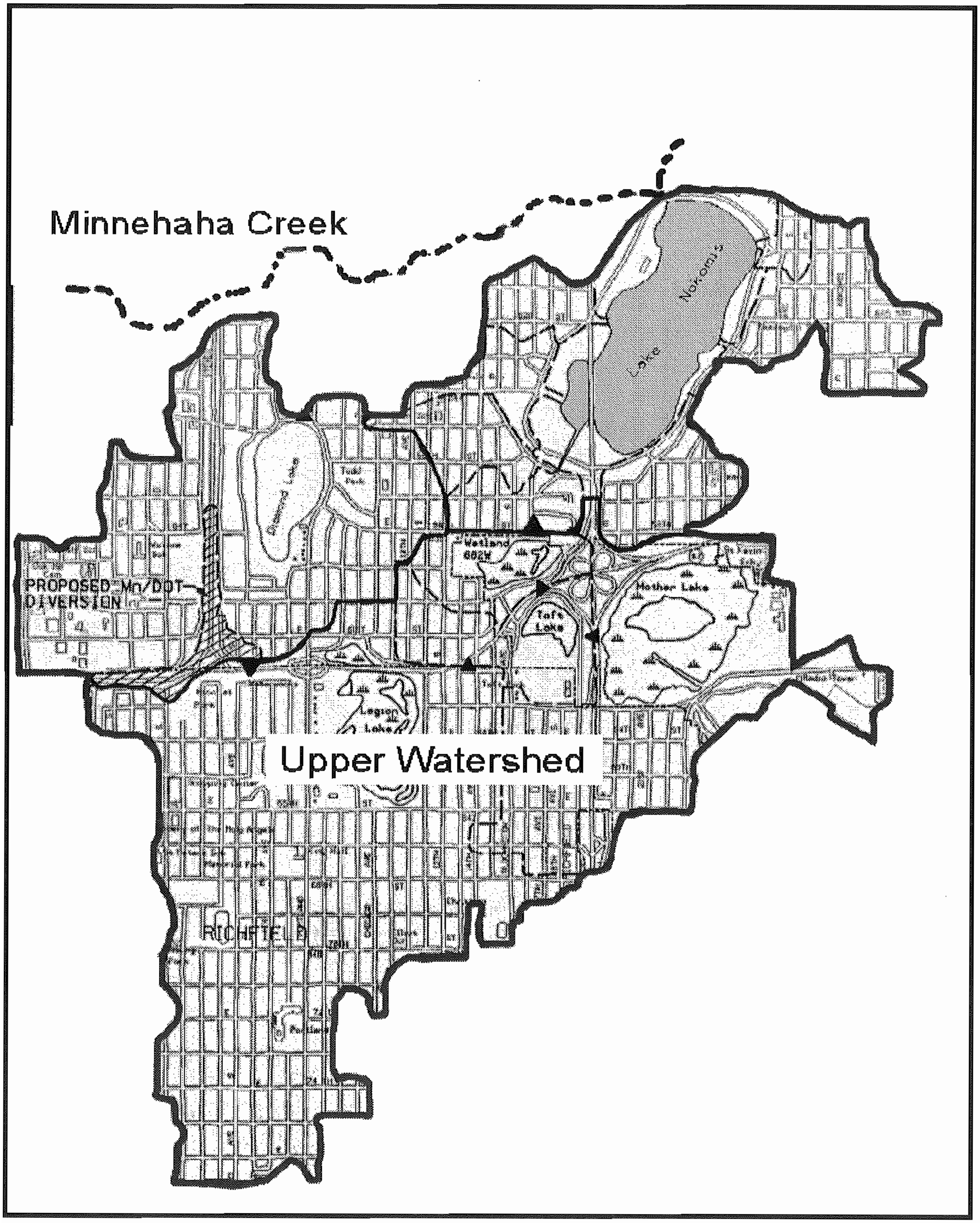


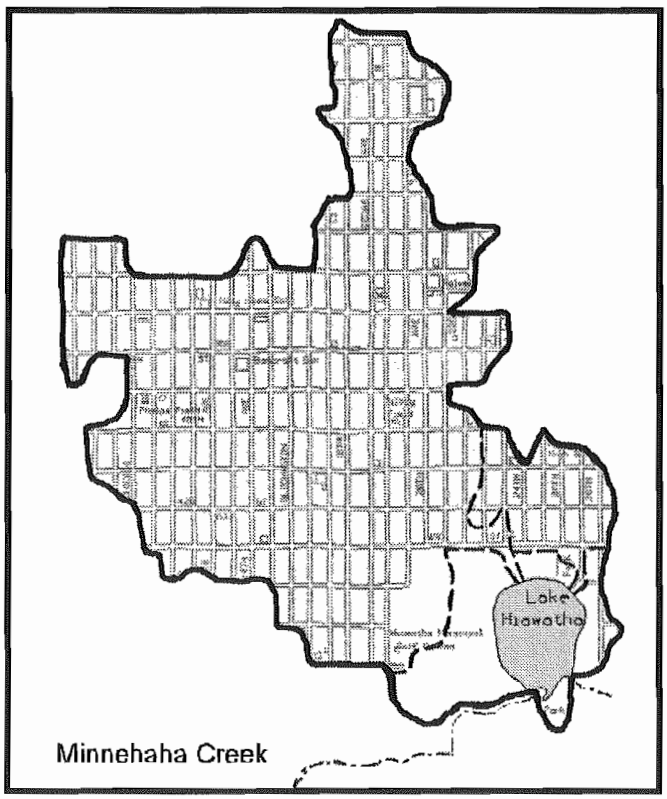
Figure 2. Lake Nokomis watershed. Base map, Minnehaha Creek Watershed District.

LAKE HIAWATHA

Sources		Water acre-feet (% of total)	Phosphorus pounds (% of total)
Benchmark Inputs			
Watershed:	Golf course	232 (1%)	63
	Local Watershed	863 (2%)	1,656 (10%)
	Local Park Watershed	15	20
	Minnehaha Creek	42,149 (97%)	14,610 (88%)
Atmosphere		127	36
Internal Sources		--	297 (2%)
TOTAL		**43,386 (100%)**	**16,682 (100%)**

Golf course	Runoff from the golf course.
Local watershed	Runoff from the land area immediately around the lake, excluding park land.
Local park	Runoff from the park land around the lake.
Minnehaha Creek	Runoff from the Creek that flows into Lake Hiawatha.
Atmosphere	Water and phosphorus that is deposited directly on the lake surface from precipitation or windblown sources.
Internal	Phosphorus that is recycled from within the lake.

Figure 3. Lake Hiawatha watershed. Base map, Minnehaha Creek Watershed District.



Lake Nokomis

The largest source of the annual phosphorus input to Lake Nokomis - 43% - comes from the local watershed area. The park watershed and the upper watershed were minor contributors, with a combined total of 6%. Minnehaha Creek flows into the lake during times of high water and contributes about 9% of the annual total. Internal sources represent the other significant phosphorus input - 34%.

As a practical matter, atmospheric inputs cannot be controlled. In addition, the contributions from the park watershed and the upper watershed are already so low that it is not reasonable to reduce them further.

Lake Hiawatha

Lake Hiawatha presents quite a different picture. Minnehaha Creek represents the overwhelming influence on the lake - 97% of the water flow and 88% of the phosphorus input. The diagnostic study has estimated that some of the Creek flow bypasses or short-circuits the lake altogether, but the influence of the Creek still dominates the lake. Phosphorus inputs from the local watershed represent about 10% of the annual total, suggesting that in years of low Creek flow, runoff from the local watershed may be proportionally greater.

The large water volumes flowing through Lake Hiawatha have another important influence - keeping algae levels low. Ordinarily a lake with a phosphorus concentration of 67 ppb would have an algae (chlorophyll) level of 37 ppb. The algae level in Lake Hiawatha is actually 19 ppb - the difference is due to the fact that the high Creek flows literally flushes the algae out of the lake. The water clarity in Lake Hiawatha is however, actually lower than expected based on the algae level. Secchi disk transparency in lakes with 19 ppb of algae would normally be about 7.7 feet. The transparency in Lake Hiawatha is actually 4.2 feet - the difference is due to the fact that the Creek brings in sediments that cloud the water.

The majority of the phosphorus input to Lake Hiawatha from Minnehaha Creek originates in the tributary area between the outlet of Lake Minnetonka at Gray's Bay dam and the inlet to Lake Hiawatha. This is referred to as the intervening watershed (see Figure 4). The water leaving Lake Minnetonka is very clean and phosphorus is added to the Creek on its way to Lake Hiawatha. This may be important for the long-term management of Lake Hiawatha.

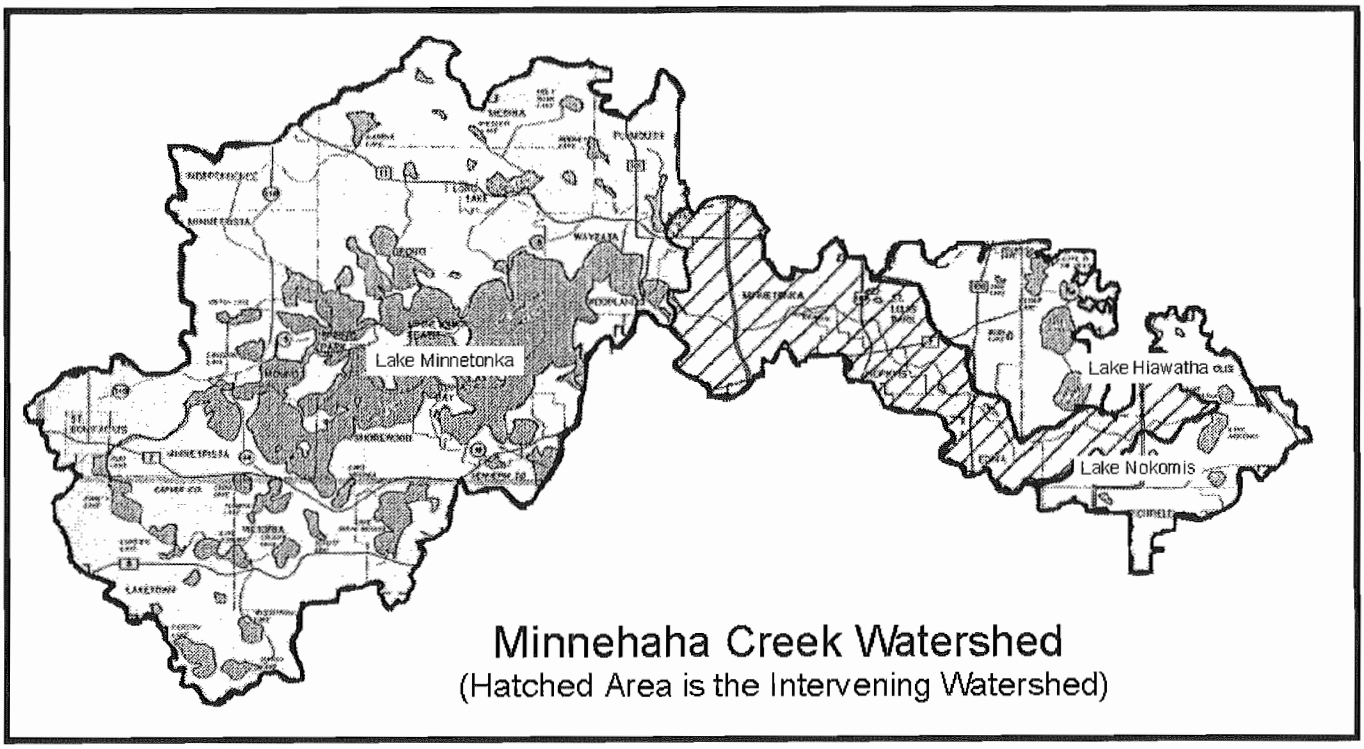


Figure 4. Minnehaha Creek watershed. Base map, Minnehaha Creek Watershed District.

VI MANAGEMENT TARGETS

The Blue Water Commission's goals (see Chapter IV, Vision, Problems & Goals) are big, broad statements of our long-term aspirations for Lakes Nokomis and Hiawatha. These goals provide a toehold as we work with stakeholders, governmental agencies and others to manage our lakes. The Blue Water Commission realizes that, to be useful, we need to articulate what can reasonably be done in the short- and long-term to work toward these goals.

To serve a useful purpose, goals must be clear, meaningful, attainable, and quantifiable. At the same time, goals must also be aggressive and dynamic. Our goals address some hard questions. Within reason, and with an eye to the future, our goals challenge the limits of standard watershed management theory and current technology. Assumptions and management strategies will likely change with time. Goals should, therefore, not simply focus on the present condition of Lakes Nokomis and Hiawatha, they should also look to the future with optimism.

This chapter is the result of the Commission's effort to reconcile our broad goals with the realities of the physical environment and the management institutions who will be called upon to help implement plans, programs and actions to protect Lakes Nokomis and Hiawatha. We do this by identifying specific short- and long-term targets for each goal, then listing appropriate management actions that address those targets. Unless otherwise noted, short-term targets refer to a five-year timeframe. The next chapter, RECOMMENDED ACTIONS, will identify those actions we think ought to be implemented.

GOAL #1
Eliminate nuisance algae blooms.

Algae are a normal part of lakes and a component of the food chain. High populations, however, are undesirable and can result in nuisance blooms, especially when they include blue-green algae, which can also produce toxins and bad odors. Nuisance algae blooms are an indicator of eutrophic conditions, which usually are the result of human activity. Phosphorus is typically the nutrient that is most limiting for algae growth in lake environments. Reductions in lake phosphorus levels and, subsequently, improved water quality, can be achieved by reducing phosphorus loading into the lakes from external sources and by limiting internal cycling of phosphorus from lake sediments.

With this in mind, the following targets are applicable for the two lakes. The targets are keyed to the benchmark year, which was used in the modeling and analyses in the Diagnostic Report. With respect to lake condition summarized on page 15, the benchmark year uses a different basis, so is not directly comparable. The benchmark analysis allows the determination of phosphorus load reductions for the Blue Water Commission's management targets and is consistent with their goals.

Lake Nokomis

By looking at the present condition - or benchmark - the Commission identified short- and long-term goals for Lake Nokomis with respect to algae bloom frequencies. Specifically, the Blue Water Commission found nuisance algae blooms to be problematic. Based on models from the Diagnostic Study, the Commission realizes that reducing phosphorus inputs to the lake will work toward accomplishing these targets. Therefore, the targets, along with other expected improvements and necessary phosphorus load reductions are as follows:

Lake Nokomis	TP (ppb)	CLA (ppb)	Secchi (feet)	Bloom Frequency Nuisance	Bloom Frequency Severe	TP Load (Lbs./year)	TP Reduction (%)
Benchmark	53	27	3.6	65%	32%	1,886	0
Short-Term Target	**45**	21	4.2	45%	16%	1,415	25
Long-Term Target	32	13	5.7	13%	2%	755	**60**

TP, CLA & Secchi are summertime averages (mid-June through mid-September); bloom frequencies refer to exceeding critical chlorophyll concentration (nuisance = 20 ppb and severe = 30 ppb) as a percentage of the summer. The bold numbers refer to the Commissions primary targets.

Lake Hiawatha

Nuisance algae blooms also occur in Lake Hiawatha. However, according to the Diagnostic Study, the level of algae is controlled more by the flushing action of Minnehaha Creek than the ambient nutrient levels in the lake. This means it is probably not feasible to sufficiently reduce nutrient levels in Lake Hiawatha, at least in the short-term.

Lake Hiawatha	TP (ppb)	CLA (ppb)	Secchi (feet)	Bloom Frequency Nuisance	Bloom Frequency Severe	TP Load (Lbs./year)	TP Reduction (%)
Benchmark	67	19	4.2	36%	12%	16,682	0
Short-Term Target	39	15	4.9	**20%**	**5%**	6,990	58
Long-Term Target	30	13	5.2	13%	2%	4,931	**70**

TP, CLA & Secchi are summertime averages (mid-June through mid-September); bloom frequencies refer to exceeding critical chlorophyll concentration (nuisance = 20 ppb and severe = 30 ppb) as a percentage of the summer. The bold numbers refer to the Commissions primary targets.

The Blue Water Commission has been advised by the Technical Advisory Committee that the short-term targets for Lake Hiawatha cannot be met. Rather than revise these targets, the Blue Water Commission will explore and recommend actions that work toward the short-term target and will continue to explore ways to meet the long-term targets.

GOAL #2
Protect public health from fecal contamination, toxic chemicals, and other injurious agents.

The presence of pathogenic bacteria, pesticides, heavy metals, polychlorinated biphenyls (PCB's), petrochemicals, and hazardous solid wastes in lake water and sediments can pose both direct and indirect threats to lake users. Pathogenic bacteria can pose a direct health threat to swimmers and other recreational users of the lakes. Levels of coliform bacteria, which are often high in surface runoff, are typically used as an indicator of the potential presence of harmful bacteria in surface waters. Some pesticides and other contaminants have been detected in Minneapolis stormwater at low concentrations. When these contaminants occur at higher concentrations than in stormwater, they have been correlated with negative health effects ranging from skin sensitivity to cancer. Management targets are based on a prudent level of caution, even though stormwater concentrations are in most cases below levels believed to affect human health.

Short-Term Targets (Both lakes):

- ❑ Fecal coliform levels should not exceed 1,000 CFU/100ml at the public beaches.
- ❑ Based on available information, there is no known problem with heavy metals, PCB's, pesticides, and petrochemicals. To set targets, the problems need to be further defined. Thus, wait for further problem definition to set targets.
- ❑ Keep the consumption of contaminated fish to within Department of Public Health guidelines.
- ❑ Eliminate glass and metal objects from public beaches.

Long-Term Targets (Both lakes):

- ❑ For fecal coliforms, same as short-term unless new information is available.
- ❑ For mercury and PCBs, reduce the level of contaminated fish to levels that are safe to eat.
- ❑ Eliminate glass and metal objects from lake bottom areas used for active recreation.

GOAL #3
Reduce the threat of swimmers' itch.

Swimmers' itch has been associated with the presence of waterfowl and snails. A swimmers' itch infection is extremely unpleasant, but poses no health threat. Swimmers' itch has occurred in both lakes, and therefore deserves some attention.

Short-Term Target (Both lakes):

- ❑ Control waterfowl in and around the lakes and have all swimmers knowledgeable about preventative measures.

Long-Term Target (Both lakes):

- ❑ Same as short-term unless new information becomes available.

GOAL #4
Assure that aquatic plants and algae not impede swimming and fishing and other recreational use in designated areas.

Aquatic plants - both rooted and free-floating - are an important part of a healthy lake. Aquatic plants provide habitat for fish and other aquatic life, contribute dissolved oxygen, and dampen the effects of waves. Over-abundant native aquatic plants and exotic plants can become a nuisance. A balanced healthy and diverse aquatic plant community is desired.

Short-Term Targets (Both lakes):

- ❑ Eliminate all aquatic plants from public beaches and control aquatic plants in designated shoreline fishing areas.
- ❑ Targets for algae, see Goal #1
- ❑ Targets for exotic plants, see Goal #10

Long-Term Targets (Both lakes):

- ❑ Same as short-term targets.

GOAL #5
Ensure that fish communities are healthy, diverse, and balanced.

The fish in both lakes suffer from poor habitat, an overabundance of carp and contamination (although likely, contamination in Lake Hiawatha has not been documented). Achieving a healthy balance in the fish community in both lakes is the Blue Water Commission's goal.

Lake Nokomis

Short-Term Target:

- ❑ Reduce the carp population to 10% of its present level. See also, water quality improvements under Goal #1 and habitat improvements under Goal # 14.

Long-Term Target:

- ❑ Eliminate carp and the need for stocking gamefish.

Lake Hiawatha

Short-Term Target: None

Long-Term Target:

- ❑ Provide for a healthy, diverse and balanced fish community in Lake Hiawatha and Minnehaha Creek.

GOAL #6
Protect the public from consumption of contaminated fish.

Mercury and PCB's bioaccumulate in fish and pose a health threat to those who eat contaminated fish. These contaminants most likely come from atmospheric fallout so, as a practical matter, local control is not possible. There are consumption advisories for fish from Lake Nokomis, but not for Lake Hiawatha because testing has not been performed.

Targets (Both lakes):

- ❑ See toxic contaminants under Goal #2.

GOAL #7
Prevent fish kills.

Maintenance of sufficient levels of dissolved oxygen is critical in the prevention of fish kills, especially during the winter. Infrequent fish kills have been reported for Lake Hiawatha, but not for Lake Nokomis.

Lake Nokomis

Targets:

- ❑ Not a problem. Targets under Goal #1 will assure problems do not develop.

Lake Hiawatha

Short-Term Target:

- ❑ Maintain winter dissolved oxygen concentrations above 2 ppm.

Long-Term Target:

- ❑ See Long-Term Target under Goal #1.

GOAL #8
Eliminate displeasing odors.

The consensus of the Blue Water Commission is that the main source of displeasing odors around Lakes Nokomis and Hiawatha are associated algae blooms

Targets (Both lakes):

- ❑ See Targets under Goals #1 and #7.

GOAL #9
Improve water clarity.

Turbidity in most lakes is caused by suspended algae. Lake Hiawatha is unusual in that turbidity is also caused by suspended sediments from Minnehaha Creek. Thus, measures to control algae, as guided by the targets in Goal #1, will improve water clarity only in Lake Nokomis in the short-term.

Targets (Lake Nokomis):

- ❑ See Goal #1

Targets (Lake Hiawatha):

- ❑ See Goals #1 and #18

GOAL #10
Reduce any negative impacts of exotic plants and animals and out of balance populations of native species.

Several species of exotic plants and animals have invaded the Lake Nokomis and Lake Hiawatha ecosystems. Several widely adapted exotic plants and animals, including Eurasian watermilfoil, purple loosestrife, common & glossy buckthorn, geese, and carp have become dominant, which have displaced less competitive native species of plants and animals.

Short-Term Targets (Both Lakes):

- ❑ Carp, see Goal #5
- ❑ Manage milfoil so it does not exceed its present level of infestation.
- ❑ Control purple loosestrife and the two kinds of buckthorn to eliminate it to the extent practical.
- ❑ Reduce goose populations in and around the lakes by 10% per year.

Long-Term Targets (Both lakes):

- ❑ Eliminate the impact of milfoil, purple loosestrife and buckthorn.
- ❑ Carp, see Goal #5.

GOAL #11
Prevent introduction of additional exotic species.

The potential exists for the introduction of already naturalized exotic species into areas not yet affected as well as the introduction of completely new exotic species. These introductions should be prevented.

Short-Term Target (Both lakes):

- ❑ Prevent the introduction of new exotic species.

Long-Term Target (Both lakes):

- ❑ Same as short-term target.

GOAL #12
Provide and preserve habitats for nesting, cover, and food for wildlife.

Habitat preservation is often the key to the survival of desirable plants and animals in any ecosystem. Over the years native habitats have been eliminated from much of the Lake Nokomis and Lake Hiawatha environments. While current management practices provide habitat for some species, many others that would normally be present are at the same time discouraged.

Short-Term Target (Both lakes):

- ❑ Cultivate native vegetation around 20% of the lakeshore.
- ❑ Create other habitat for native wildlife in the park.
- ❑ Provide habitat for native aquatic plants in at least 50% of the littoral area.

Long-Term Targets (Both lakes):

- ❑ Cultivate native vegetation around 75% of the lakeshore.
- ❑ Create other habitat for native wildlife in the park.
- ❑ Provide habitat for native aquatic plants in the littoral area, except areas designated for swimming and shore fishing.

GOAL #13
Facilitate movement of wildlife to and within the lake environment.

Wildlife corridors facilitate movement of animals from one area to another by providing necessary cover and expands access to the resources needed for survival including space, food, water, nesting territory, and refuge. The Technical Advisory Committee sees the Creek corridor as the main avenue for wildlife movement.

Targets (both lakes):

- ❑ See Goal nos. 4, 10, 12, 14, 16 & 17.

GOAL #14
Achieve a healthy, balanced, diverse community of native plants and animals.

In urban environments, ecosystems have been disturbed and thrown out of balance. The degree of disturbance may be inadvertently and unnecessarily excessive. The natural aura associated with urban parks, including the city's lakes, is an important part of what users are seeking and hold dear. Community stewardship will be important in the reestablishment and maintenance of some semblance of a natural system and the qualities the public desires.

Targets (both lakes):

- ❑ See Goal nos. 1, 2, 5, 7, 10, 11, 12, 14, 15, 16, 17 & 19.

GOAL #15
Ensure levels of toxic pollutants do not negatively affect plant and animal life or biodiversity.

Biodiversity within the Lake Nokomis, Lake Hiawatha, and Minnehaha Creek watersheds has been diminished as a result of human activity. The long-term effects of many urban pollutants, including de-icing salts, on biodiversity and life cycles are essentially unknown. Research is needed to better define the potential for negative impacts of these pollutants on plant and animal populations.

Both Lakes

Short-Term Target (Both lakes):

- ❑ Define any impacts of toxic pollution to plant and animal biodiversity.

Long-Term Target (Both lakes):

- ❑ Minimize those impacts to the extent possible.
- ❑ See also Goal #2.

GOAL #16
Provide a natural transition from the land to the water while providing for adequate recreational use of and access to the lakes.

A natural transition from the land to the water is desirable and must be balanced with the need for access - summer and winter - to the lakes.

Short-Term Target (Both lakes):

- ❑ Eliminate artificial and abandoned retaining structures in areas where native vegetation is to be cultivated.

Long-Term Target (Both lakes):

- ❑ Define, designate, and plan for lake access areas and limit these to no more than 20% of the lakeshore.

See also targets for goal nos. 4, 10, 12 & 14.

GOAL #17
Design and manage the shoreline environment to reduce runoff, enhance pollution and sediment filtration, and minimize erosion.

Buffer strips of vegetation and topography (berms and indentations) offer opportunities to decrease movement of runoff and associated pollutants directly into the lakes.

Short-Term Target (Both lakes):

- ❑ Identify areas around the lakes where erosion is significant and provide erosion control measures in these priority areas.

Long-Term Target (Both lakes):

- ❑ Same as short-term target.

GOAL #18
Arrest the expansion of deltas.

Wherever a body of water actively flows into another, deltas are a natural occurrence and as such should be expected. Deltas provide habitat essential to the existence of certain plants and animals and are not, therefore, inherently detrimental. Excessive expansion of deltas due to excess sediment loads and excessive surface runoff upstream are, however, undesirable and should be controlled. Deltas from surface streams are located at the southwest corner of Lake Nokomis and in Lake Hiawatha at the mouth of Minnehaha Creek.

Short-Term Target (Both lakes):

- ❑ Identify sources of sediment inputs and eliminate 50% of the sediments.

Long-Term Target (Both lakes):

- ❑ Eliminate all excessive sediment input to streams feeding the lakes.

GOAL #19
Reduce the transport of pollution and sediment to the lakes from storm sewers.

The storm sewer system is a significant source for pollutants and sediments entering Lakes Nokomis and Hiawatha. Any reduction in the pollution load entering the lakes via storm sewers will, therefore, have a direct effect on water quality.

Short-Term Target (Both lakes):

- ❑ Implement urban best management practices in the local watersheds around both lakes (see Appendix III).

Long-Term Target (Both lakes):

- ❑ Implement urban best management practices in the Minnehaha Creek watershed.
- ❑ At every opportunity, reduce urban pollution by at least 30% using BMPs (see MPCA 1989, figure 4.1-1).

Final Note

The goals and targets of the Blue Water Commission are based on contemporary data and technology and must be reviewed, revised, and updated as new information and management options become available. They are realistic, and we believe they are attainable. We are committed to their fulfillment and dedicated to them not being simply forgotten once this advisory report is completed and presented to our community.

VII RECOMMENDED ACTIONS

The Blue Water Commission considered a wide range of possible solutions to the water quality problems they identified. Using their goals and targets as guidance, the Commission recommends the following management actions - which take the form of projects, plans & programs - for implementation.

The Blue Water Commission recommends:

1. REDUCE PHOSPHORUS IN LAKE NOKOMIS

Objective: To meet the short- and long-term targets in goal nos. 1, 8, 9, 12 & 14.

A series of actions are recommended which are aimed at reducing, eliminating or controlling various phosphorus sources to and within Lake Nokomis. These actions will reduce phosphorus levels in the lake, which in turn will lessen the severity and frequency of algae blooms, increase water clarity, and generally improve the quality of the lake environment. The actions below are evaluated in detail in MCWD's Feasibility Report (1998).

Action 1a: Remove carp.

Carp are a source of internal phosphorus in Lake Nokomis. Their removal could reduce internal phosphorus input by up to 500 pounds per year. This amount is uncertain because there are no accurate estimates of carp numbers in the lake. It is recommended that commercial fishers be subsidized to harvest carp first before any other phosphorus reduction action. The benefits of this action will be positive in terms of phosphorus removal as well as for other Blue Water Commission targets. To be able to more precisely evaluate the positive impacts of this action, it should be implemented before the other actions recommended below.

It is anticipated that this process would occur every two to five years. The cost of the first treatment includes the installation of a fish barrier at the inlet from the upper watershed.

Expected Benefit: Reduction in internal phosphorus supply, decimation of the carp population, and healthier aquatic plant community.

Estimated Cost: $18,000 for the first removal and fish barrier; $5,000 per treatment thereafter.

Action 1b: Modify outlet structure.

The outlet from Lake Nokomis, which is also the inlet during high flows in Minnehaha Creek, can be modified to divert or reduce inflows from Minnehaha Creek that occur during high flow periods. This would result in blocking phosphorus from entering the lake. Some of the phosphorus diverted from Lake Nokomis would enter Lake Hiawatha. The Blue Water Commission was aware of this and agreed that the small, probably imperceptible, impact to Lake Hiawatha was outweighed by the benefits to Lake Nokomis.

The recommended project includes an incremental flood analysis which is required to assure downstream flood damage does not occur.

Expected Benefit: Reduction of phosphorus loading by up to 172 pounds per year and some control of rough fish migration into the lake.

Estimated Cost: $210,000 Investment.

Action 1c: Build wet detention ponds.

Wet detention ponds can be sited to treat about 56% of the local watershed tributary to Lake Nokomis. Three ponds are proposed to be located within Lake Nokomis Regional Park (see Figure 5) which would remove 294 pounds of phosphorus per year.

A fourth pond was considered by the Blue Water Commission, but is not recommended at this time. The fourth pond, located in the area of the more southerly proposed grit chamber (see Action 1d and Figure 5), should be considered prior to implementing Action 1d. While the Commission recognizes that a fourth pond would take up park land, they felt that the potential to remove up to 150 pounds of phosphorus per year (compared to the grit chamber, which removes 30 pounds) was worth further investigation.

Expected Benefit: Reduction of phosphorus loading (294 pounds per year). Reduction in the input of other kinds of pollution like sediments, oxygen demand, nitrogen, copper lead and zinc (see MPCA 1989). Wetland and wildlife habitat will also be created.

Estimated Cost: $1.5 million initial investment.

Action 1d: Build grit chambers.

Grit chambers can be constructed in the two sub-watersheds where stormwater detention basins are not recommended. Grit chambers are 'in-line' chambers which retain sediments, associated phosphorus, and some other kinds of pollution. See also Action 1c.

Expected Benefit: Reduction of phosphorus loading of 34 pounds per year.

Estimated Cost: $180,000 initial investment.

Action 1e: Lake-wide alum application.

Once the phosphorus reduction actions recommended above have been implemented, a lake-wide alum treatment is recommended to reduce internal phosphorus loading. It is possible that the other projects will meet the goals for Lake Nokomis such that further improved water clarity effected by the alum treatment could result in increased aquatic plant nuisances. This should be evaluated before implementing this action. An alum treatment normally has a ten year effectiveness.

Expected Benefit: Reduction of internal phosphorus input by 430 pounds per year over 10 years.

Estimated Cost: $97,000 per treatment.

Action 1f: Street sweeping.

Street sweeping is an established program in Minneapolis and it is recommended that this practice continue. Increasing the number of autumn sweeps to three or focusing the sweeps to beneficial times and places is recommended to increase the probability of capturing autumn leaves before the first snowfall.

Individuals can also help keep the streets clean (see Action 9).

Expected Benefit: Reduction of leaf litter, yard debris, and street sand entering the storm sewers.

Action 1g: Phosphorus fertilizer restriction.

The Blue Water Commission feels strongly that the use of phosphorus-containing fertilizers should be banned in all residential areas. The only exceptions to a ban would be where soil tests demonstrated a need for phosphorus. This recommendation applies to the local watershed of Lake Nokomis.

Actions considered, but not recommended by the Blue Water Commission.

A more complete evaluation of these actions can be found in the Feasibility Report (Wenck 1998). The following actions are not recommended because a) they provide no significant water quality benefit, b) were not economically justified, or c) were inappropriate or could not be permitted.

- ❑ Storm sewer inflow diversions.
- ❑ Dilution with Minnehaha Creek water.
- ❑ Artificial circulation.
- ❑ Hypolimnetic aeration.
- ❑ Sediment dredging.

Actions that may provide additional water quality benefits, but were not specifically evaluated in the Feasibility Report (Wenck 1998) include:

- ❑ Goose management.
- ❑ Yard waste management.
- ❑ Public education.
- ❑ City regulatory controls and management.

Taken together, these recommended actions will reduce phosphorus input to Lake Nokomis by 930 pounds per year. This represents a 49% reduction compared to the benchmark year and would achieve the Blue Water Commission's short-term target, as well as going a long way to accomplishing their long-term target.

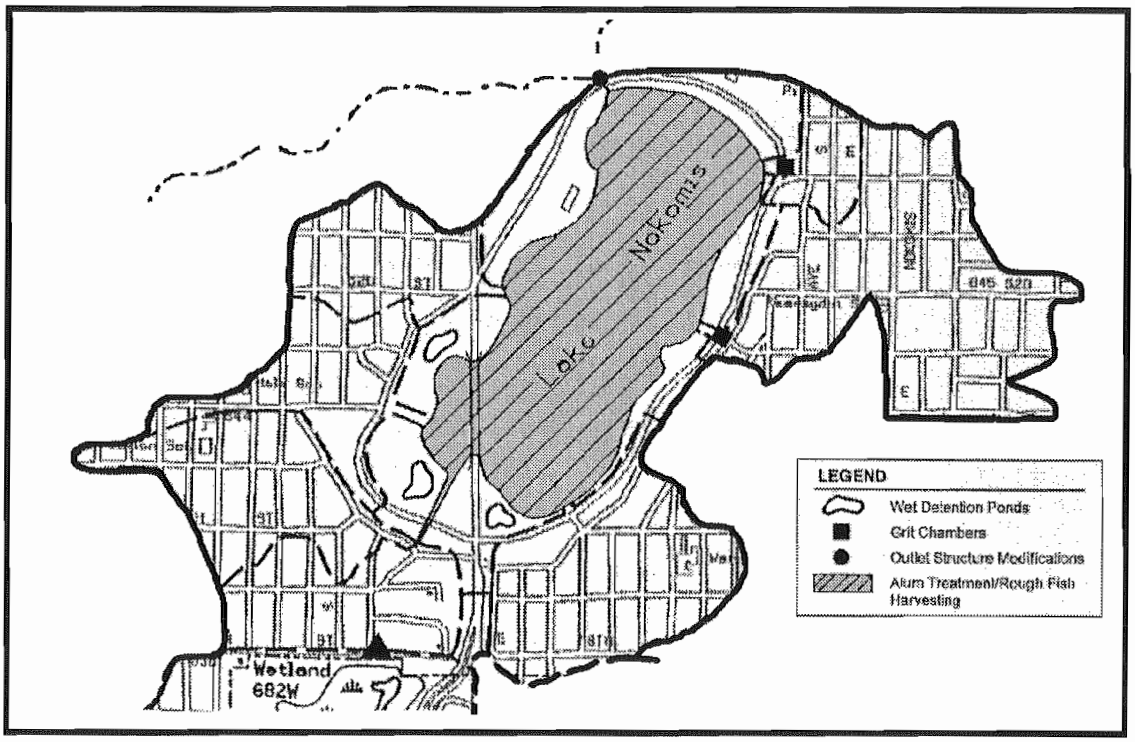


Figure 5. Recommended actions for Lake Nokomis. Base map, Minnehaha Creek Watershed District.

2. CONTROL NUISANCE ALGAE AT THE LAKE HIAWATHA BEACH

Objective: To meet the short-term targets in goal nos. 1, 2, 3 & 4 for the beach in Lake Hiawatha.

The Feasibility Report (Wenck 1998) has concluded that there is no feasible way to control nuisance algae in Lake Hiawatha due to the overwhelming influence of Minnehaha Creek. To provide relief from algae nuisances plus control of fecal contamination in the swimming beach, a beach curtain is recommended.

Action 2a: Install and operate a beach curtain around the Lake Hiawatha beach.

Beach curtains are vinyl-coated fabric with floatable collars and weighted bottoms that are anchored in place around the beach. The enclosure isolates the beach area allowing for focused control activities. In addition, the beach curtain protects the beach from high waves and floating debris.

The enclosed area must be large enough not to interfere with swimming, but small enough to make control efforts economical and effective. The curtain is installed each season, can be stored outdoors during the winter, and should last for about 10 years.

Effective control of algae nuisances and fecal contamination has been demonstrated within enclosed beaches, especially when lake-wide control options are not practical or feasible.

In most instances, simply enclosing the beach with no other treatment has resulted in improved conditions. When problems do occur, they tend to be less severe, more predictable, and more controllable than those problems that occur in the lake. The available control options depend on the specific nuisance or combination of nuisances encountered. In many cases, it is possible to flush the enclosure with lake water to eliminate the problem or dilute the problem to a tolerable level. When flushing is not effective, chemicals may be used.

There are various chemical control methods that are suited to the types of nuisance conditions that may develop within the enclosure. The chemicals and the nuisances they control are listed below:

Nuisance	Copper Sulfate	Alum	Herbicides
Swimmers' itch	X	--	--
Scum-forming algae	X	X	--
Fecal bacteria	--	X	--
Rooted aquatic plants	--	--	X
Leeches	X	--	--

The Blue Water Commission is aware that the Minneapolis Park & Recreation Board may have concerns with operating and maintaining a beach curtain. Their concerns deal with the finding operating and maintenance funds as well as a policy prohibiting the use of herbicides.
Expected Benefits: Improved water quality, fewer nuisance algae, and less severe fecal contamination in the enclosed beach area.

Estimated Cost: Purchase and installation of the curtain will be approximately $15,000. In addition, there will be annual operation and maintenance costs associated with seasonal deployment and control activities (approximately 10 – 12 staff days per season).

3. REDUCE PHOSPHORUS IN LAKE HIAWATHA

Objective: To meet the short- and long-term targets in goal nos. 1, 8, 9, 12 & 14.

The Feasibility Report (MCWD 1998) has concluded that there is no feasible way to control nuisance algae in Lake Hiawatha due to the overwhelming influence of Minnehaha Creek. However, certain actions were evaluated which may either a) have benefits during low-flow conditions or b) may result in phosphorus reductions in the long-term.

Action 3a: Remove carp.

As in Lake Nokomis, carp are a source of internal phosphorus. Since carp removal is technologically simple and relatively inexpensive, it is recommended. The reduced phosphorus load may result in improved water quality during periods of low Creek flow, may reduce oxygen consumption, and will increase the balance of native fish species.

Expected Benefit: Reduction in internal phosphorus supply by approximately 140 pounds per year, decimation of the carp population, and healthier aquatic plant community.

Estimated Cost: Can probably be included with the Nokomis harvesting with no substantial increase in cost.

Action 3b: Build wet detention ponds.

Ponds are proposed by the City of Minneapolis to be located within Hiawatha Golf Course (construction is scheduled for 2002). The main function of these ponds is to mitigate the impacts of flooding, but these ponds will provide some incidental water quality benefits. Water quality functions should be considered in the design of these ponds. The impact of phosphorus reductions may be realized as fewer nuisance algae blooms may occur in low-flow years.

Expected Benefit: Reduction of phosphorus loading.

Estimated Cost: This project is included in Minneapolis Public Works capital improvement program at an estimated cost of $1.5 million.

Action 3c: Street sweeping.

Same as Action 1f.

Action 3d. Artificial circulation - further evaluation.

Artificial circulation may be feasible to reduce the severity and intensity of nuisance algae blooms in Lake Hiawatha. The Feasibility Report (Wenck 1998) evaluated artificial circulation, but could not assure lake improvements, so it was not recommended at this time. However, the potential for improved conditions using artificial circulation exists.

Specifically, fewer blooms or a shift to less obnoxious algae could occur with artificial circulation. Therefore, the Blue Water Commission recommends that artificial circulation be further evaluated, and if found to be feasible, implemented in Lake Hiawatha.

Action 3e: Manage the intervening watershed.

It is reasonable to expect that management and regulatory controls in the intervening watershed (see figure 4) will lead to a reduction in Minnehaha Creek phosphorus concentrations. Since water leaving Lake Minnetonka is clean and water entering Lake Hiawatha is enriched with phosphorus and other pollution, focusing on the intervening watershed is relevant here. However, due to the overwhelming effect of flushing by the Creek, this will not result in significant water quality improvements for Lake Hiawatha.

Action 3f: Phosphorus fertilizer restriction.

The Blue Water Commission feels strongly that the use of phosphorus-containing fertilizers should be banned in all residential areas. The only exceptions to a ban would be where soil tests demonstrated a need for phosphorus. This recommendation applies to the local watershed of Lake Hiawatha and the intervening watershed (Figures 3 & 4).

Actions that may provide additional water quality benefits, but were not specifically evaluated in the Feasibility Report (MCWD 1998) include:

- ❑ Goose management.
- ❑ Yard waste management.
- ❑ Public education.
- ❑ City regulatory controls and management.

4. PREPARE AQUATIC PLANT MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 4, 5, 10, 11 & 14.

Aquatic plants in Lakes Nokomis and Hiawatha have been identified by the Blue Water Commission as an important factor in the overall lake health. Aquatic plants are also important for fish habitat.

There currently is no comprehensive management plan for aquatic plants in Lakes Nokomis and Hiawatha. Therefore, the Blue Water Commission recommends that comprehensive management plans for aquatic plants in the two lakes be prepared. These plans should address the following concerns:

- ❑ Provide a diverse native plant community.
- ❑ Minimize recreational nuisances.
- ❑ Provide fish habitat.
- ❑ Control, or hopefully eliminate, exotic species.
- ❑ Prevent the introduction of additional exotic species

5. PREPARE SHORELINE MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 10, 11, 12, 13, 14, 16 & 17.

The Blue Water Commission has found that the shoreline around both lakes can be improved to reduce erosion, improve wildlife habitat, reduce or eliminate exotic species, discourage water access by geese, and provide a more natural transition from land to water. The Blue Water Commission has identified numerous management goals and targets relating to this general concern. At this point, it makes sense to consider these concerns in a systematic and comprehensive way rather that attempting to implement management actions one at a time. Therefore, the Blue Water Commission recommends that a comprehensive shoreline management plan be prepared that will coordinate the Blue Water Commission's various management goals and address the following concerns:

- ❑ Provide wildlife habitat.
- ❑ Protect the lakes from runoff and erosion.
- ❑ Reduce and someday eliminate exotic plants and animals.
- ❑ Reduce the population of geese.
- ❑ Increase the amount of native vegetation in designated areas.
- ❑ Increase the diversity of plants and animals in shoreline areas.
- ❑ Provide for recreational use and access.

The wet detention basins recommended in Actions 1c and 3b will have their own 'shoreline' which specifically includes a fringe of emergent aquatic vegetation.

6. PREPARE AND UPDATE FISHERIES MANAGEMENT PLANS FOR BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 4, 5, 7, 10 & 14.

The Blue Water Commission understands that the fish populations of both lakes suffer as a result of degraded habitat. Further, the presence of carp and the need for stocking mean fish communities may be out of balance with respect to what might otherwise be naturally sustained. As well, the balance that is sought, needs to also consider the other management programs being recommended here. Therefore, the Blue Water Commission recommends that comprehensive fisheries management plans be prepared - or the DNR's management plans amended if necessary - that will coordinate the Blue Water Commission's management goals and address the following concerns:

- ❑ Provide and improve fish habitat.
- ❑ Balance the need for aquatic plant control with the need for fish habitat.
- ❑ Reduce and someday eliminate carp.
- ❑ Prevent winterkills in Lake Hiawatha.
- ❑ Sustain a recreational fishery that balances the needs of the community with the health of the lakes.

7. REDUCE THE LEVEL OF HARMFUL MATERIALS TO LEVELS SAFE FOR PUBLIC HEALTH AND ECOSYSTEM INTEGRITY

Objective: To meet the short- and long-term targets in goal nos. 2, 3, 6 & 15.

Some chemicals, like mercury and PCBs, are known to contaminate fish flesh in Lake Nokomis (MDH 1998). The Blue Water Commission is also aware that fecal contamination at the lakes' public beaches sometimes exceeds their target, although we are aware of no known public health problems that have resulted. Nonetheless, we are largely ignorant regarding the occurrence and impact of many other chemicals and injurious agents.

Action 7a: Continue monitoring the level of fecal coliform bacteria at public beaches.

The Minneapolis Park Board in cooperation with the Minneapolis Health Department should continue the practice of monitoring for fecal contamination at the public beaches. Contingencies should be developed for occasions when the level of fecal coliform bacteria exceeds the targets identified by the Blue Water Commission.

Expected benefit: Continued protection of public health.

Estimated cost: Not estimated.

Action 7b: Develop and implement a plan for the systematic monitoring and evaluation of the occurrence and impact of harmful agents.

Before meaningful management action can be considered, more information regarding the kinds of agents, their source and level of occurrence, and their impacts to public health and ecosystem integrity is required. When available, this information should be disseminated through the Public Education Program (see Recommended Action #9). We do know that PCBs and mercury contaminate fish flesh in Lake Nokomis to the extent that consumption advisories have been recommended (MDH 1998). At a minimum, testing to determine whether advisories are appropriate for fish in Lake Hiawatha needs to be done.

Expected benefit: A starting point for the consideration of meaningful management actions.

Estimated cost: To be determined.

Action 7c: Prohibit waterfowl feeding on public lands.

Because waterfowl is an important link in the swimmers' itch cycle, anything to discourage waterfowl from inhabiting areas near water bodies and watercourses will help to break the cycle. Therefore, the Blue Water Commission recommends that waterfowl feeding on public lands be prohibited.

8. REDUCE THE TRANSPORT OF SEDIMENTS AND NON-NUTRIENT POLLUTION TO BOTH LAKES

Objective: To meet the short- and long-term targets in goal nos. 18 & 19.

Sediments and other kinds of pollution enter Lakes Nokomis and Hiawatha via stormwater and from creek inflows. To some extent, sediments and other kinds of pollution will be removed through the implementation of recommended actions mentioned above (1c, 1d, 1f, 3b, 3c, 3e & 5). In addition, the Blue Water Commission recommends:

Action 8a: Identify and remove to the greatest possible extent sources of sediments to the lakes.

It makes sense to focus management efforts on known sources of sediments. Thus, to the extent excessive sediments are not being mitigated by the previously mentioned management actions, additional efforts should be implemented to reduce upstream bank erosion, to reduce stormwater sediment sources, and to reduce lake shoreline erosion.

Expected benefit: Minimization of delta formation and expansion, a reduction in sediment input to the lakes, and improved clarity in Lake Hiawatha.

Estimated cost: To be determined.

Action 8b: Implement Best Management Practices throughout the watersheds of both lakes.

Urban Best Management Practices (MPCA 1989) tend to 'fill in the gaps' and provide an overall level of coverage (see Appendix III).

Expected benefit: Overall pollution control and blanket coverage.

Estimated cost: To be determined.

9. IMPLEMENT A PUBLIC EDUCATION PROGRAM

Objective: To meet the short- and long-term targets in all goals.

An informed and aware public is essential to effective, sustainable and comprehensive watershed and lake management. There are a number of programs now available and being implemented in the watersheds of Lakes Nokomis and Hiawatha as well as throughout the Minnehaha Creek Watershed District. The Blue Water Commission recommends that these programs continue. A public education program should address at least the following:

- ❑ Actions individuals can take to minimize pollution.
- ❑ Actions individuals can take to reduce stormwater runoff from their property.
- ❑ Inform people that stormwater flows untreated into our lakes.
- ❑ Advise the public about beach contamination.
- ❑ Keep the consumption of contaminated fish to within MDH guidelines.
- ❑ Advise bathers about preventative measures for swimmers' itch.
- ❑ Advise the public about the balance between:
  - Aquatic plant health and nuisance control
  - Manicured versus natural shoreline vegetation
  - Artificially versus naturally sustained fisheries
  - Water clarity and the abundance and extent of aquatic plant growth
- ❑ Increase awareness of potential exotic species and the need to prevent their introduction.
- ❑ Inform citizens about how they can contribute to a positive, long-lasting management program for Lakes Nokomis and Hiawatha.

The City of Minneapolis has formed the Minneapolis Water Quality Education Committee. This committee will be helpful in implementing many of the program elements proposed under this action.

10. WHAT NEXT? IDENTIFY OR CREATE AN ENTITY TO CHAMPION THE GOALS AND RECOMMENDATIONS OF THE BLUE WATER COMMISSION

Objective: To make it work.

This report is the beginning of a meaningful management program for the long-term protection and improvement of the conditions of Lakes Nokomis and Hiawatha. To be sustainable, the management effort must be sustained. This means someone has to keep the process started by the Blue Water Commission going. Thus, the Blue Water Commission recommends that to make all of our recommended actions come alive in a meaningful and effective way, we first need to identify or create an entity to champion our goals.

The Blue Water Commission members representing the neighborhood associations agreed that the neighborhoods - HPDL, NENA & SENA - should take the lead in carrying out the implementation of the Blue Water Commission's recommendations. They will do this by:

- ❑ Becoming formally organized with a mission compatible with the Blue Water Commission's goals.
- ❑ Their mission will include coordinating, facilitating and advocating the Blue Water Commission's recommendations.
- ❑ Identifying and securing funding necessary to protect the lakes.
- ❑ Providing the resources needed to sustain their effort.
- ❑ Monitoring, evaluating and reporting progress toward accomplishing our goals.
- ❑ Amending this plan in response to evolving community values, developments in lake and watershed management technologies and changes in the environment in and around the two lakes.

VIII GLOSSARY

Algae: Microscopic plants that live suspended in lakes. Algae may be single-celled, filamentous, or colonial. Also called *phytoplankton* – which means floating plant. When algae become over-abundant, they form *blooms*.

Aquatic macrophyte: Larger forms of aquatic vegetation which include macro-algae, liverworts, mosses, horsetail and ferns, and flowering plants.

Best Management Practices or BMPs: Watershed management practices, activities and projects that have known water quality benefits. For more information, see MPCA 1989 in the references.

Blue-green algae: Blue-green algae tend to be obnoxious in lakes because they may form surface scums, they may become toxic, and they give off odors when the rot on the lakeshore. Technically blue-green algae are not algae, but bacteria.

Chlorophyll: A green pigment found in plants. It is measured from lake water to indicate the abundance of algae. Sometimes referred to as *chlorophyll-a*.

Epilimnion: The upper layer of water in a stratified lake. This layer literally floats on the cooler, denser *hypolimnion*. The two layers are separated by the *thermocline*.

Eutrophication: The process by which lakes become enriched with nutrients. This can occur as a natural aging process – called *natural eutrophication* - or as a process accelerated by human activities – called *cultural eutrophication*.

Exotic species: Plants and animals not native or indigenous to an area.

Hypolimnion: The lower layer of a stratified lake. This layer is cooler, more dense water.

Lake model: A mathematical planning tool used to predict the outcome of changing (usually reducing) the sources of phosphorus to lakes.

Limiting nutrient: See phosphorus.

Littoral zone: The underwater zone where rooted plants can grow. The areas suitable for plant growth are normally determined by bottom type, depth of light penetration, and water movements.

Limnology: The study of inland waters – lakes, rivers, streams and ponds - that includes the history, geology, biology, physics and chemistry of lakes, lake basins and watersheds.

Phosphorus: A chemical element used by algae and other plants. Phosphorus is generally referred to as the *limiting nutrient* in lakes because it is normally the element is shortest supply relative to the needs of algae. This means that lakes with higher phosphorus tend to have greater amounts of algae.

Phosphorus budget: An accounting of all sources of phosphorus entering and leaving a lake, usually on an annual basis.

Runoff: That portion of precipitation that does not soak into the ground or evaporate. In urban areas, runoff is usually collected by underground storm sewers.

Secchi disk: An 8-inch white or black-and-white disk used to measure water clarity by lowering it until it disappears.

Stratification: A layering of the water caused by warmer (lighter) water floating on top of cooler (heavier) water. The upper layer is called the *epilimnion* and the bottom layer is called the *hypolimnion*. The interface between the two layers is called the *thermocline*.

Thermocline: The sharp temperature boundary between the *epilimnion* and the *hypolimnion* in a stratified lake. The depth of the thermocline is variable depending on lake size and season.

Trophic state: Refers to the eutrophic condition of a lake. Trophic state can range from nutrient-poor (called oligotrophic) to nutrient-rich (called eutrophic).

Water budget: An accounting of all sources of water entering and leaving a lake, usually on an annual basis.

Watershed (of a lake): The land area tributary to a lake. Water that runs off is carried to the lake via storm sewers, streams, pond outlets, road gutters or over the land.

Winterkill: An episode of fish mortality caused by oxygen depletion during the winter.

Zooplankton: Small animals ($1/10^{th}$ of an inch or smaller) that float in lake water and eat algae and other microscopic organisms. Zooplankton are a link in the food chain between algae and fish.

IX REFERENCES

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APPENDIX I - BLUE WATER COMMISSION MEETING SCHEDULE

1997

Nov. 12	**Introductory meeting.** Welcome; committee charge; committee structure & process.
Nov. 15	**Workshop.** Introduction to lakes and watersheds; historical context; preliminary goal setting; vision.
Dec. 2	**Resource speakers.** Lake condition (David Wright); What is the deal with phosphorus? (Dick Osgood).
Dec. 16	**Resource speakers.** Aquatic plants (Chip Welling); Fish (Duane Shodeen & Daryl Ellison); Fish contamination (Jeff Lee).

1998

Jan. 6	**Resource speakers.** Urban watershed management (Gary Oberts); Watershed management authorities (Doug Thomas).
Jan. 20	**Resource speakers.** Setting realistic goals (Steve Heiskary); Education programs (Deb Pilger).
Feb. 3	**Goals.** Report from the Technical Advisory Committee; Preliminary discussion of goals.
Feb. 17	**Goals.** Continued discussion.
Mar. 10	**Diagnostic study.** Presentation of the diagnostic study results by the Technical Advisory Committee.
Mar. 24	**Management approaches.** Report from the Technical Advisory Committee.
Apr. 7	**Management approaches.** Setting targets and considering management alternatives.
Apr. 21	**Consideration of Management targets and actions.** Review draft chapters of report.
May 13	**Consider Draft Report.** Review Feasibility Report and recommended management actions.
May 27	**Final Meeting.** Wrap up.

APPENDIX II - TECHNICAL ADVISORY COMMITTEE ROSTER

Diane Lynch, chair	Minnehaha Creek Watershed District
Randy Anhorn	Metropolitan Council
Marie Asgian	Minneapolis Public Works
Greg Busacker	Minnesota Department of Transportation
Dale Claridge	Minnehaha Creek Watershed District/Wenck Associates
Carolyn Dindorf	Hennepin Conservation District
Mike Eastling	City of Richfield
Daryl Ellison	Minnesota Department of Natural Resources, West Metro Fisheries
Jeff Jontz	Minneapolis Park & Recreation Board
Dick Keinz	Metropolitan Airports Commission
Jeff Lee	Minneapolis Park & Recreation Board
Jodi Polzin	Minneapolis Public Works
Joel Settles	Hennepin County
Ceil Strauss	Minnesota Department of Natural Resources, Metro Waters
Bruce Wilson	Minnesota Pollution Control Agency
Joe Yanta	Army Corps of Engineers

Staff

Dick Osgood	Ecosystem Strategies

APPENDIX III – SUMMARY OF URBAN BEST MANAGEMENT PRACTICES

Best Management Practices, or BMPs, help to reduce the impacts of urban runoff which contains nutrients, metals, sediments, salts, pet wastes, and other kinds of pollution. BMPs can be used by individuals, municipalities and developers. A comprehensive stormwater management program will include various Best Management Practices.

A summary of categories of BMPs and their effectiveness in treating different kinds of pollution is presented below. Their effectiveness in treating different kinds of pollution are indicated as follows:

Nutrients (N); Sediments (S); Heavy Metals (M); Floatables (F)

Stormwater BMPs

- ❑ Detention Pond (N, S, M, F)
- ❑ Wetland Treatment (N, S, M, F)
- ❑ Oil/Grit Separator (M, F)
- ❑ Floatable Skimmer (F)
- ❑ Filter Strips (S)
- ❑ Vegetated Swales (S, F)

Housekeeping BMPs

- ❑ Fertilizer Management (N)
- ❑ Litter Control (N)
- ❑ Catch Basin Cleaning (M, S, low effectiveness)
- ❑ Street Sweeping (N, S, M, F)
- ❑ De-icing Chemical Use

Construction Site Erosion & Sediment Control

- ❑ Temporary sedimentation basin, silt fence, straw bale, storm drain inlet protection, floatation silt curtain, temporary rock construction entrance, diversion, stormwater conveyance channel, subsurface drain, temporary slope drain, grade stabilization structure, outlet protection, riprap, structural streambank protection, temporary and permanent seeding, sodding, and mulching.

* Sources: MPCA (1989) and the Minnehaha Creek Watershed District.