Phalen Chain of Lakes

Summary Report and Final Lake Management Recommendations

Prepared for
Ramsey-Washington Metro Watershed District

December 2005

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Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

This summary report presents a final, comprehensive list of the recommended lake management activities and water quality goals for each lake in the Phalen Chain based on the lake users' survey and the Phalen Chain of Lakes feasibility studies conducted in 2005. The overall conclusions of this summary report are as follows:

Gervais and Phalen Lakes continue to have good water quality. If non-degradation management measures are followed in these lakes, residents and visitors will enjoy good water quality in these lakes into the foreseeable future. Non-degradation measures would include development requirements, fisheries observation and public education, macrophyte management, and shoreline improvement projects. The District's water quality goals for these lakes can remain unchanged.

Although Keller Lake's initial water quality goal in the Plan was 40 µg/L, a higher goal of 60 µg/L seems reasonable at this time. This goal is consistent with the MPCA's proposed TP criteria for shallow lakes, and will likely be attainable in Keller Lake's future, especially if non-degradation management measures and cooperative improvement projects are pursued throughout the lake's watershed.

Kohlman Lake is a lake management challenge. Its water quality is poor, and lake residents think it's getting worse. The lake's water quality conditions are driven equally by the lake's internal load and its highly soluble external load. In the current array of permitted lake management options, only chemical treatment of the lake's sediments would affect cost-effective and noticeable change in the lake's transparency. In the future, other technologies may become available for controlling lakes' internal loads. If the District's goal, however, is to substantially reduce the amount of phosphorus in Kohlman Lake in the near future, managers are left with few other choices. If Kohlman Lake's TP concentration was significantly reduced (lowered to at least 90 µg/L), the positive result would be increased transparency in Kohlman Lake, and a significant decrease in the amount of phosphorus that would otherwise travel downstream to the other lakes in the chain (though the resulting overall reduction in downstream lakes' TP concentration would be, perhaps, only slight). A potential negative result of lowering Kohlman Lake's TP concentration would be increased growth of nuisance macrophytes in Kohlman Lake, exacerbating a problem already cited by lake users and residents under current water quality conditions. This problem is surmountable through a rigorous macrophyte management program that would target two invasive species- Curlyleaf pondweed and Eurasian water milfoil.

1.0 Introduction

During the development of the *Phalen Chain of Lakes Strategic Lake Management Plan Improvement Options and Recommendations* (SLMP) (Barr, October 2004) it was determined that the District's water quality goals for the Phalen Chain of Lakes (Kohlman, Gervais, Keller and Phalen Lakes) (Figure 1) warranted a second look. To that end, a survey of Kohlman , Gervais, and Keller lakeshore residents, as well as non-resident users of the Phalen Chain of Lakes (hereafter referred to as the lake users' survey) was conducted to gauge public opinion of the recreational value of the lakes and to determine whether significant improvements in the lakes' water quality was warranted. Concurrently, the SLMP called for a series of additional studies to better define the activities that would be the most effective in improving water quality in the Phalen Chain of Lakes. These additional studies, now completed, are titled:

- *Detailed Assessment of Phosphorus Sources to Ramsey-Washington Metro Watershed District, Barr, September 2005*
- *Phalen Chain of Lakes Carp Population Study, Barr, July 2005*
- *Phalen Chain of Lakes Study of Untreated Tributary Drainage and Other Improvement Areas, Barr, October 2005*
- *Internal Phosphorus Load Study: Kohlman and Keller Lakes, Barr, October 2005*
- *Phalen Chain of Lakes Wetland Vegetation Enhancement Study, Barr, September 2005*

The purpose of this report is to summarize the most significant findings of the lake users' survey and the additional studies mentioned above in terms of the overall management strategy for the Phalen Chain of Lakes. In this manner, a final, comprehensive list of the recommended management activities for the each of the lakes can be defined.

2.0 Summary of the Lake Users' Survey

In considering what the lakes' water quality goals should be it is useful to consider answers to the following questions, as described in the summaries of survey data from lake users and Kohlman, Gervais and Keller lakeshore residents (MMC Associates, 2005) (Appendix A). It is important to note that Kohlman and Keller Lakes (and, by association, Gervais Lake) were largely the focus of the lake users' and lakeshore residents' surveys.

How do people use the Phalen Chain of Lakes?

Lakeshore residents said that they use the lakes (Kohlman, Gervais, and Keller) for a range of activities, including fishing (especially for bass), enjoying the scenery, picnicking, swimming, and boating. Non-resident lake users cited fishing (especially for bass, muskie, and sunfish) and motor-boating as their primary activities, along with swimming, water skiing, tubing, canoeing, and enjoying the scenery.

What do the lake users think about the existing water quality in the Phalen Chain of Lakes?

Most respondents thought that the lakes' water quality had become "much worse" over time, calling existing water quality in Kohlman and Keller Lakes "murky", and that they would recreate on the lakes more often if the lakes were "cleaner" (most cited swimming as an example). There also appeared to be some confusion over what is impacting lake water quality.

How important is improved water quality to lake users?

Most respondents (both lakeshore residents and non-residents) also said that they would "strongly approve" of the Ramsey-Washington Metro Watershed District (District) taking additional measures to improve water quality, even though it could lead to an increase in beneficial plants.

How is "improved water quality" defined by lake users?

It appears that many lake users defined water quality not in terms of algae in the water, but in terms of the amount of "weeds" (macrophytes) in the lake. In fact, it appears that there is a great deal of concern about lake macrophytes and confusion about the difference between invasive macrophyte species and native macrophytes that are beneficial to the lakes' fisheries. The level of macrophyte growth in the lakes appears to be of great concern to the lakeshore owners and the non-resident users.

Are carp considered to be a problem in the lakes?

Most respondents said that they didn't think carp were a significant problem, although a number of people did express some concern about them. One respondent noted that "One of life's little

curiosities is that the DNR surveys always indicate a fairly low carp count, but the naked eye suggests otherwise."

Are lake users willing to pay for improved water quality?

Most people said that they would pay more to fund District activities. In fact, a significant number of respondents (~35 percent of non-resident users and ~50 percent of lakeshore owners) responded that they would be willing to pay an additional $20 or more per year to allow the District to do more to protect and improve water quality. However, several people said that they would want to know how the money would be used before paying.

Are lake users willing to do things on their own property to improve water quality?

Most respondents said that they would be willing to (or already do) personally do things to protect water quality in the lakes; including keeping leaves and grass clippings off of the sidewalk and street; directing downspouts onto a lawn instead of a driveway; and using native plants next to sidewalks, alleys and curbs.

In interpreting the lake users' survey results, two lake management questions arise:

- *How much improvement of the lakes is warranted, given the users' responses?*
- *What lake management practices and projects should be implemented to improve the lakes' recreational value?*

The remaining sections of this report will attempt to answer these questions, and in doing so, define the water quality goals for each lake in the Phalen Chain of Lakes.

3.0 Introduction to the Phalen Chain of Lakes Additional Studies

Because there is no directly quantifiable relationship between lake water quality and the happiness of the people who use the lakes (only the notion that better water transparency and fewer macrophytes are more desirable), it is instructive to look at the cost-effectiveness of many different lake management options. The District has already constructed several different capital improvement projects in the Phalen Chain Subwatershed, successfully improving water quality in the lakes to some degree. When considering additional water quality improvement projects, one must determine how much it costs to improve water quality to varying degrees. Clearly, some degree of water quality improvement is desired, especially in Kohlman and Keller Lakes. The actual extent to which the Phalen Chain of Lakes' water quality should be improved, however, is largely subjective, especially since swimming is not a popular activity in Kohlman or Keller Lakes. With this reality in mind, the degree to which water quality improvement in these lakes is warranted is the degree to which it is cost-effective. This section of the report summarizes the findings of the five additional studies conducted for the Phalen Chain of Lakes in order to highlight the most cost-effective management activities that would address the public's concerns.

3.1 Summary of the Detailed Assessment of Phosphorus Sources to the District

The purpose of the *Detailed Assessment of Phosphorus Sources to Ramsey-Washington Metro Watershed District* study (Barr, September 2005) was to identify specific sources of phosphorus within the District and estimate their relative loads to surface waters in the study areas. The most significant finding from this study was that residential streets, driveways/sidewalks and freeway/railroad right of ways, parking lots, and commercial and industrial streets combine to contribute approximately 70 percent of the total phosphorus loading within the District[1]. Therefore, it is recommended that infiltration practices, filtration/biofiltration, disconnection from drainageway, pollution prevention/good housekeeping, and public education are implemented in as many areas as possible to address the phosphorus loading that originate from all of these source areas. As a result, the District should work closely with the cities to implement BMPs on roadway and redevelopment projects to significantly reduce the phosphorus loadings. The results of the phosphorus source

[1] This assertion, however, is currently under review. Some reviewers feel that runoff from residential lawns in the District constitute a higher loading than the report shows.

assessment provide further support for the District's proposed infiltration requirements, as they would serve to control phosphorus loads at their sources.

3.2 Summary of the Phalen Chain of Lakes Carp Population Study

The approach of the *Phalen Chain of Lakes Carp Population* Study (Barr, July 2005) was to evaluate the population data of benthivorous fish in Minnesota Department of Natural Resources (Mn/DNR) fish surveys, to discuss the survey results with Mn/DNR staff, to estimate the impact of benthivorous fish on the water quality of the Phalen Chain of Lakes and to consider different benthivorous fish removal strategies.

The extent to which benthivorous fish affect the water quality of the Phalen Chain of Lakes remains largely unquantified. Mn/DNR fishery reports and Mn/DNR staff opinions do not reflect a significantly large benthivorous fish population in the lakes. However, large numbers of carp are often observed in the lakes, particularly during the spawning season. Anglers and District staff, in particular, report frequent sightings with large carp. Even if a benthivorous fish population magnitude could be agreed upon, the current body of literature doesn't offer much guidance in translating fish population densities into phosphorus loading rates. Only one relevant paper (published in 1975) was found in a literature review conducted as a part of this study.

Although an investment in removal of benthivorous fish from the lakes would appear to improve water quality and reduce impacts to lakeshore emergent plantings, it is difficult to quantify the extent of improvement with much certainty. Because of this, we recommend minimal cost efforts to control and monitor the situation. At this time, the recommended approach is to observe the lakes for evidence of any increase in either the density of benthivorous fish or resulting impacts in the water quality or lake vegetation, and to follow any technological advancements for controlling benthivorous fish populations, such as fish pheromones.

Specifically, the measures recommended for implementation, in the order of priority, include:

1. A meeting between the Mn/DNR Fisheries staff and the Ramsey-Washington Metro Watershed District staff to further discuss specific concerns and share strategies for fish and water quality management in the Phalen Chain of Lakes.
2. Post signs in fishing areas that advise anglers what to do if they catch a carp or bullhead.
3. Provide education about bottom-feeding fish at WaterFest '06.

4. Continue to observe the lake for evidence of any increase in density of benthivorous fish or resulting damage caused by them.
5. Follow any progress on improved technology for controlling benthivorous fish populations, such as fish pheromones
6. Define parameters for a study on the effect of benthivorous fish on water quality as well as impacts to the integrity of in-lake alum treatments for a graduate student and submit them to the University of Minnesota.
7. Consider the hiring commercial anglers to harvest carp at a future time if conditions appear to warrant.

The total cost of measures for immediate action (Items 1- 6) is expected to be less than $10,000.

3.3 Summary of Phalen Chain of Lakes Study of Untreated Tributary Drainage and Other Improvement Areas

The SLMP identified areas of water quality concern for further study, including a more detailed evaluation of the drainage patterns of stormwater in the untreated drainage areas surrounding each lake. The *Phalen Chain of Lakes Study of Untreated Tributary Drainage and Other Improvement* Areas (Barr, October 2005) evaluated the stormwater running off of these drainage areas flows directly to one of the lakes in the Phalen Chain, without first flowing through any ponds, wetlands, or treatment devices, and therefore is considered "untreated". Several other areas that are technically "treated" were also included in this study because they showed potential for requiring additional treatment.

Three different categories of recommended treatment measures were identified in order of cost effectiveness:

1. Eight capital improvement projects (mostly located in the Keller Lake and Lake Phalen Subwatersheds) that would treat a significant amount of the untreated runoff leaving their sub-drainage areas, annually removing a combined 182 lbs. of phosphorus from the Phalen Chain of Lakes.

2. Four "hot spot"[2] areas that would be targeted for further treatment in the future as cost-sharing opportunities arise (these areas currently contribute over 1,000 lbs. of phosphorus to the lakes annually)

3. Eleven "residential measure"[3] areas that would target runoff at its source across the sub-drainage area, reducing the annual phosphorus load to the lakes by 26 lbs. Some of the residential measures could be considered "hot spot areas" to be pursued when redevelopment occurs or when a cooperative arrangement for cost sharing can be formed

It should be noted that not all of the projects recommended in this study are included in the final recommendations for the Phalen Chain of Lakes, as described in this report. The untreated areas study only evaluated the most cost effective options for treating runoff from untreated (or under-treated) drainage areas tributary to the Phalen Chain of Lakes.

3.4 Summary of Internal Phosphorus Load Study: Kohlman and Keller Lakes

The purpose of the *Internal Phosphorus Load Study: Kohlman and Keller Lakes* (Barr, October 2005)was to evaluate the internal phosphorus loading in Kohlman and Keller Lakes, and to identify the most cost-effective ways to manage it. Sediment cores were collected and analyzed for mobile phosphorus content; results were used to predict internal phosphorus loading rates from the sediment of each lake.

Other internal phosphorus loading mechanisms were investigated as well. Both *Potamogeton crispus* (Curlyleaf pondweed) senescence and benthivorous rough fish activity can increase phosphorus loading within a lake during the summer months. Curlyleaf pondweed is present in both lakes, and is capable of contributing phosphorus loads as it senesces in the lakes each summer. Benthivorous rough fish (i.e., carp and bullheads) are also present in both lakes, however, the extent to which they contribute phosphorus to the water column is difficult to quantify at present.

Two management options were investigated to control internal phosphorus loading from the sediment: (1) alum treatment, and (2) sediment dredging. Due to the elevated sediment internal

[2] "Hot spots" are areas that contribute a significantly large phosphorus load to the lakes, but whose treatment is currently considered too high for the District to consider for implementation at this time and on its own.

[3] "Residential Measures" can be thought of as prescriptive practices (as defined in the SLMP) specific to residential areas.

loading rate estimated for Kohlman Lake (an average of 9.7 $mg \cdot m^{-2}\ d^{-1}$), reducing the internal load of phosphorus to the lake is recommended in order to reduce the overall TP concentration in the lake. It should be noted that this loading rate of phosphorus from Kohlman Lake's sediments is extremely high—few other Minnesota lakes analyzed in this manner have shown rates this high. The high phosphorus content of Kohlman Lake's sediments is very likely due to the fact that it received wastewater effluent up until the 1960s.

Internal phosphorus load from the sediment in Keller Lake (2.2 $mg \cdot m^{-2}\ d^{-1}$) is lower and comparable to the internal load contribution from Curlyleaf pondweed. Due to the relatively low sediment internal phosphorus loading rate and the low water residence time of the lake, treatment or dredging of Keller Lake's sediments is not recommended at this time.

The costs of dredging Kohlman and Keller Lake's sediments that contained excess phosphorus were extremely high (at least $800,000 and $500,000 respectively). This option is not considered a viable option for controlling the internal load of phosphorus for Kohlman or Keller Lakes.

Alum treatment, however, is considered a viable option in controlling Kohlman Lake's sediment phosphorus load, and is estimated to cost $141,000. The longevity of the treatment would depend on several factors, including the macrophyte population in the lake and the extent to which external (watershed) loads are controlled[4].

Before measures to limit internal phosphorus loading from the sediment are taken in Kohlman Lake, however, a macrophyte management plan should be implemented. The focus of the plan should be placed on the removal of Curlyleaf pondweed due to its contribution to internal phosphorus loading during the summer months. The plan should also consider the potential increase in growth of other species (especially Eurasian water milfoil [*Myriophyllum spicatum]*) due to increased water clarity in the lake following treatment. A similar plan is recommended for Keller Lake to control the growth of these nuisance species and the internal phosphorus load from Curlyleaf pondweed. The costs associated with removal of Curlyleaf pondweed are conservative and are estimated at $84,000 and $116,000 for Kohlman and Keller Lakes, respectively. It is expected that 4 years of treatment will be needed to significantly reduce the Curlyleaf pondweed population The costs cited here are the total cost for the 4 years combined.

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[4] Watershed loads are considered to be mostly controlled at present in the Kohlman Lake Subwatershed, except for the untreated drainage areas directly tributary to the lake.

3.5 Summary of the Phalen Chain of Lakes Wetland Vegetation Enhancement Study

The SLMP recommended that more study of several wetland areas surrounding the Phalen Chain of Lakes may be necessary to understand the best routes for improvements to wetland removal of phosphorus.

The *Phalen Chain of Lakes Wetland Vegetation Enhancement* Study (Barr, September 2005) concluded that no effort should be made to replace the current non-native vegetation with native vegetation in any of the wetlands investigated. Due to the prevalence of reed canary grass on all of the sites, efforts to introduce native vegetation would be lengthy, expensive and intrusive, and may ultimately fail. And, the current vegetative coverage may well provide as much phosphorus uptake and removal as a native wetland plant community.

The subwatershed phosphorus load from the outflow of Kohlman Basin generates over 80 percent of the total watershed phosphorus load to Kohlman Lake. Therefore, this location should have submersed vegetation monitoring on an annual basis, to ensure that this element of the phosphorus removal process is not compromised. If the submersed plant community would, for some reason, be found to be declining, measures to restore the submersed plant community would then need to be undertaken.

In the other tributary wetland areas, diffused flow, if reestablished in the basins that have channelized flow, would provide some additional treatment improvement. But, alteration of the flow channels through the use of berms or weirs would likely prove disruptive and costly for the small amount of increased phosphorus removal benefit those improvements would provide. Therefore, these improvements are not recommended, but may be further investigated in the future.

This study focused primarily on wetland vegetation enhancement to improve treatment effectiveness. In addition to the recommendations in vegetation enhancement, because of its prime location and the high overall percentage of the total watershed load of phosphorus entering the Chain of Lakes, further study of other treatment enhancement to Kohlman Basin should be investigated. Increases in retention time, lengthening hydraulic flow paths, filtration systems and chemical treatment are possible enhancements that might improve phosphorus removal rates.

4.0 History of the Phalen Chain of Lakes' Preliminary Water Quality Goals Listed in the Water Management Plan

The preliminary water quality goals cited in the District's *Watershed Management Plan* (Plan) (Barr, 1997) (Table 1) are based on the Minnesota Pollution Control Agency's (MPCA's) Trophic State Index (TSI) and its related recreational lake use classifications, as well as a District policy to prevent Foul odor potential during hot weather by keeping TP levels below 60 µg/L. In fact, 60 µg/L was the highest standard established for any lakes in the District in the Plan (except for Twin Lakes and Little Canada's Round Lake which were given a range of water quality goals—the highest TP value being 75 µg/L).

Table 1 Phalen Chain of Lakes' Recreational Uses and Preliminary Water Quality Goals (taken from Table 3.3-3 in the District's *Water Management Plan* (1997).

Lake	Recreation Uses Existing and Desired	Recreational Use Level	Preliminary Water Quality Goal	Management Class
Kohlman	Motorboating, canoeing, fishing, picnicking, viewing, limited wildlife habitat	3	60 µg/L TP 32 µg/L Chla 2.6 ft SD	Restore
Gervais	Swimming, skiing, speedboating, limited wildlife habitat, other	1	30 µg/L TP 10 µg/L Chla 5.25 ft SD	Restore
Keller	Speedboating, skiing, canoeing, fishing, picnicking, wildlife habitat, viewing	2	40 µg/L TP 15 µg/L Chla 3.9 ft SD	Restore
Phalen	Swimming, fishing, picnicking, viewing, scuba diving	1	30 µg/L TP 10 µg/L Chla 5.25 ft SD	Restore

A description of the different recreational use levels defined in the Plan follows:

- **Level 1—**requires excellent water clarity. As water begins to appear green, clarity and color appeal decline. Clarity for swimming and scuba diving should be at least 5.25 feet.
- **Level 2—**activities are less demanding of excellent clarity. To accommodate sailing and speed boating, clarity should be greater than 3.9 feet, and water depth of 7 to 8 feet is needed to keep rooted vegetation from tangling in propellers and keels. Public boat access is required.
- **Level 3—**activities require good lake habitat for fish and wildlife, along with public boat access for fishing. In the urban setting, it is wise to manage for less than or equal to 60 µg/L to minimize the potential for four odor when poor conditions occur, such as long periods of hot days.

The management class of each lake was determined by comparing historical water quality parameters (total phosphorus (TP), chlorophyll *a* (Chla) and Secchi Disc (SD)) with the preliminary water quality goal set for each lake based on its recreational use classification.

For the Plan, all four lakes' existing water quality was evaluated using data from 1984 to 1988 as cited in *An Evaluation of District Lake Water Quality Data Collected from 1975 through 1990* (Barr Engineering, 1990). For the Phalen Chain SLMP, the lakes' existing water quality was established using data from 1981 to 2002 that was collected by Ramsey County and the District.

5.0 Recommended Lake Management Activities and Lake Water Quality Goals

The findings of the lake users' survey and the additional studies shed significant light on the management activities that were best suited for the Phalen Chain of Lakes. This section of the report describes both the water quality goals that are deemed the most appropriate for the lakes, as well as the management activities that are recommended to achieve these goals.

5.1 Recommended Lake Management Activities

Based on the results of the lake users' survey and the additional studies, a final set of recommended water quality management activities is presented here. Because Gervais and Phalen Lakes already have relatively high water quality, a non-degradation management approach to these lakes seems appropriate.

A non-degradation goal for any of the lakes in the Phalen Chain would involve:

- Development of rules to ensure that new developments do not increase the sediment and phosphorus leaving their sites
- Continued observation of carp presence in the lake, following the research in benthivorous fish management and providing public education on benthivorous fish to lake users
- Creation and implementation of a macrophyte management plan that targets Curlyleaf pondweed and Eurasian water milfoil. A template for a macrophyte management plan, as provided by the Minnesota Department of Natural Resources, is included as Appendix B
- Creation and implementation of a shoreline study that seeks restoration opportunities around Kohlman, Gervais and Keller Lakes. This study could evaluate public shoreline areas as well as look for collaborative opportunities with private landowners.

5.1.1 Water Quality Management Options for Kohlman Lake

Kohlman Lake is the first lake in the Phalen Chain, with the worst water quality. Lake users' survey respondents indicate that improvement of the lake's water quality is warranted. The additional studies, however, indicate that improvement of Kohlman may be difficult and costly to come by, especially if alum treatment is not considered an option. If significant improvement of Kohlman Lake's water quality were achieved, it is possible that macrophyte growth would significantly increase as a result. Because nuisance macrophyte growths were consistently mentioned as a concern to lake users and lakeshore owners, this is no small issue. Any water quality improvement activity in Kohlman Lake would have to be accompanied by rigorous macrophyte management. Although improvements in Kohlman Lake's water quality would benefit downstream water bodies, expectations of significant (obvious to the eye) downstream change should be tempered, as Gervais

Lake already acts as a large treatment pond for downstream Keller and Phalen Lakes. However, it is true that any phosphorus removed from Kohlman Lake results in phosphorus removed from Gervais Lake. With all of these factors in mind, there are three different management options presented for Kohlman Lake (Table 2).

Table 2 Water Quality Management Options for Kohlman Lake

Water Quality Management Option	TP Goal	Water Quality Management Activities	Estimated Cost (2005 Dollars)	Pros	Cons
Non-Degradation	120 µg/L	• Development rules to promote non-degradation • Continued observation of carp presence in the lake, follow the research in benthivorous fish management, public education on carp • Implementation of a macrophyte management plan that targets Curlyleaf pondweed and Eurasian water milfoil • Conduct a shoreline management study, implement restoration projects as appropriate	Total First Cost: $10,000 (carp) + $77,100 (macrophytes) + shoreline mgmt = Total Annualized Cost[1]: (assuming a 20-year life span): $900 + $6700 + shoreline mgmt =	• Lake would still be frequently used.(based on the results of the lake users' survey)	• Lake users and residents already perceive that the lake's water quality has worsened, and this option would do nothing to improve conditions.
Improvement-Option 1	90 µg/L	• Same as "Non-Degradation" plus… • Residential Measures in Kohl-02g, Kohl-02i, Kohl-02j (Figure 2) • Chemical inactivation of Kohlman Lake's sediments	Total First Cost: $10,000 (carp) + $77,100 (macrophytes) + shoreline mgmt + $27,500 (Res Measures) + $141,000 (inactivation of sediments) = O & M: $300 (Res. Measures) Total Annualized Cost[1] (assuming a 10-year life span of alum treatment, 20-year life span of other projects): $900 + $6700[2] + shoreline mgmt + $2,700 + $19,200 =	• Residential measures in the drainage areas around Kohlman Lake would serve to educate the public and reduce phosphorus from drainage areas that otherwise contribute untreated TP loads to the lake • Chemical inactivation of Kohlman Lake's sediments would reduce a significant source of phosphorus to the lake, and would very likely improve the lake's transparency.	• Every ten to twenty years, the lake would require another chemical treatment to inactivate sediment release of phosphorus • Would likely result in increased macrophyte growth (both native and nuisance species) • A rigorous macrophyte management program would have to be implemented before and after chemical treatment to control macrophyte growth

Water Quality Management Option	TP Goal	Water Quality Management Activities	Estimated Cost (2005 Dollars)	Pros	Cons
Improvement- Option 2	70 µg/L	• Same as Improvement- Option 1 plus: • Explore innovative options in Kohlman Basin that would reduce TP outflow from Kohlman Basin by an additional 10%	Total First Cost: $10,000 (carp) + $77,100 (macrophytes) + shoreline mgmt + $27,500 (Res Measures) + $141,000 (inactivation of sediments) + $420,000 (Kohlman Basin) O & M: $300 (Res Measures) + $44,800 (Kohlman Basin) = Total Annualized Cost[1] (assuming a 10-year life span of alum treatment, 20-year life span of other projects): $900 + $6700[2] + shoreline mgmt + $2,700 + $19,200 + $81,400 =	• Same as Improvement- Option 1 plus: • Would likely result in a noticeable improvement in lake transparency (even more than with Improvement- Option 1)	• Every ten to twenty years, the lake would require another chemical treatment to inactivate sediment release of phosphorus • Would likely result in increased macrophyte growth (both native and nuisance species) (even more than with Improvement- Option 1) • Rigorous macrophyte management program would have to be implemented before and after chemical treatment to control macrophyte growth

[1]Total annualized costs were calculated assuming a certain life span of the project (noted in the table) and a 6% interest rate.

[2]It is likely that the macrophyte management costs would be higher than the ones presented here (higher than Improve-Option 1), as macrophyte growth would be more intense under the improved transparency conditions that an alum treatment could create

5.1.2 Capital Improvement Projects Recommended for the Keller Lake Subwatershed

For Keller Lake, a non-degradation goal appears to appropriate since the lake's water quality has, in general, been better over the last 10 years. However, there are two projects (Table 3) that already have potential funding partners (negotiation is in process). If these projects were pursued, the District would have a strong case for delisting Keller Lake from the MPCA's Impaired Waters List, as the lake's water quality over the last 10 years has, on average, been better than the proposed shallow lake listing criteria of 60 µg/L. This project would serve to strengthen the assertion that similarly good water quality can be expected of the lake in the future.

Table 3 Recommended Water Quality Management Projects for Keller Lake

Project (Named by Sub-Drainage Area)	Description of Project	Potential Funding Partner(s)	Estimated Cost to District (2005 Dollars, Not Including Funding Partner's Contribution- Only the District's Share)
Kell-03Bd (Cloverleaf of Hwy 36/61 Interchange)	Detention ponds/infiltration cell network in Hwy 36/61 interchange (Figure 3)	Federal Transportation Enhancement Fund (through the Met Council)	Total First Cost: $82,000 O & M $1,000 Total Annualized Cost: $8,150
Kell-03Bl (Oehrline Lake Project)	Series of treatment basins upstream of Keller Channel (Figure 4)	Ramsey County and City of Maplewood	Total First Cost*: $145,000 O & M: $1,500 Total Annualized Cost: $14,140

*This cost represents the entire project cost. It is possible that the District would actually pay less than this amount, if Ramsey County and/or the City of Maplewood contributed to the project cost as well.

5.1.3 Recommended Demonstration Projects

In addition, two demonstration projects are recommended- one in the Keller Lake Subwatershed and one in the Lake Phalen Subwatershed. These projects offer unique opportunities to reduce the phosphorus entering the Phalen Chain of Lakes while simultaneously educating the public about the District's involvement in their lake's water quality and the new infiltration rules currently being written.

Recommended demonstration projects in the Keller and Lake Phalen watersheds are:

- **Phal-06a: Our Redeemer Lutheran Church (Figure 6)**
- **Kell-03Be1W: Menard's parking lot (Figure 3)**

The estimated costs associated with these demonstration projects are shown in Table 4, below.

5.1.4 Recommended Site for a Cooperative Water Quality Project Arrangement

Cooperative funding agreements between the District and developers were suggested in the SLMP as a way to implement projects that would otherwise be too costly. Phal-16b (Gladstone Area Development Project) (Figure 5) is an area that could benefit from such an arrangement in the future. It is recommended that the District continue to pursue some sort of cooperative water quality treatment project in this development as plans for that area progress.

5.1.5 Additional Cost Effective Projects to "Keep in Mind"

The projects recommended in Sections 5.1.1 through 5.1.4 of this report address the existing water quality needs of the Phalen Chain of Lakes. In the future, additional projects (outlined in the *Study of Untreated Tributary Drainage and Other Improvement Areas* report) may be desired, as funding and opportunities arise. These additional projects, though not necessarily recommended for the District to pursue during the next few years, are shown in this report for the District to "keep in mind" for future improvements. The projects are listed below, named for the drainage areas in which they would be located.

- Kell-3Be2 (detention pond in the Keller Lake golf course)
- Kell-03 (detention pond west of the Hwy 36/61 interchange)
- Phal-08 (expansion of an existing detention pond east of Lake Phalen)
- Projects in hot-spot areas
- Areas recommended for Residential Measures

5.1.6 Summary of Estimated Costs for Recommended Management Activities in the Phalen Chain of Lakes

An overall summary of the recommended lake management activities for the Phalen Chain of Lakes is provided below. It should be noted that this table assumes that a goal of 70 µg/L is ultimately chosen for Kohlman Lake. If a goal of 90 µg/L were chosen, the "Reduce Kohlman Basin TP Outflow by 10%" would not be included in the total costs. Likewise, if 120 µg/L were chosen as Kohlman Lake's TP goal, many other items would be subtracted from the total costs.

Table 4 Summary of Estimated Costs for Recommended Management Activities in the Phalen Chain of Lakes

Kohlman Lake	**Total First Cost**	**O&M**	**Total Annualized Cost[3]**
Benthivorous Fish Management (Entire Chain)	$10,000	$0	$900
Macrophyte Management[1]	$77,100	$0	$6,700
Shoreline Study Projects	Projects not yet defined		
Residential Measures in Kohl-02g, Kohl-02i, Kohl-02j	$27,500	$300	$2,700
Chemical Inactivation of Kohlman Lake Sediments	$141,000	$0	$19,160
Reduce Kohlman Basin TP Outflow by 10%[2]	$420,000	$44,800	$81,400
Gervais Lake	**Total First Cost**	**O&M**	**Total Annualized Cost**
Benthivorous Fish Management	Costs accounted for in Kohlman Lake section		
Macrophyte Management[1]	$40,000	$0	$3,350
Shoreline Study	Projects not yet defined		
Keller Lake	**Total First Cost**	**O&M**	**Total Annualized Cost**
Benthivorous Fish Management	Costs accounted for in Kohlman Lake section		
Macrophyte Management[1]	$106,500	$0	$9,300
Shoreline Study Projects	Projects not yet defined		
Kell-03Bd (Hwy 36/61 cloverleaf)	$82,000	$1,000	$8,150
Kell-03Bl (treatment basins upstream of Keller Channel)	$145,000	$1,500	$14,140
Kell-03Be1W (Menard's parking lot)	$85,000	$1,000	$8,400

Kohlman Lake	Total First Cost	O&M	Total Annualized Cost[3]
Lake Phalen	**Total First Cost**	**O&M**	**Total Annualized Cost**
Benthivorous Fish Management	Costs accounted for in Kohlman Lake section		
Macrophyte Management[1]	$10,000	$0	
Phal-06a	$72,000	$1,000	$7,300
Phal-16b (Gladstone Area Development)	Projects not yet defined		
Total Cost of all Recommended Projects:	**$1,216,000**	**$49,600**	**$161,500**

[1]These costs differ from those presented in the SLMP because they include management of both Curlyleaf pondweed and Eurasian water milfoil (in the SLMP, only Eurasian water milfoil management costs were included, based on mechanical harvesting. The costs presented here are highly estimated; a macrophyte management plan would provide a much more accurate representation of the costs associated with macrophyte management in the Phalen Chain of Lakes.

2This project cost is roughly based on the cost of the Tanner's Lake treatment plant (scaled down to reflect the smaller percentage of phosphorus removal targeted here), although an inflow chemical treatment plant would not necessarily be implemented here.

3All project life spans are assumed to be 20 years, with the exception of chemical inactivation of sediment (10 year lifespan assumed).

Table 5 shows the increase in District funds that could be expected each year if District taxes on single family homes were increased by $20 per year.

Table 5 Potential Additional Budget for Phalen Chain Subwatershed Projects if District Taxes Were Raised by $20/year

Subwatershed	Number of Single Family Homes	Budget for Lake Improvement Projects if Taxes were Increased by $20/year
Kohlman Lake	5,657	$113,140
Gervais Lake	2,160	$43,200
Keller Lake	1,369	$27,380
Lake Phalen	4,353	$87,060
Entire Phalen Chain of Lakes	**13,539**	**$270,800**

As Table 5 shows, increasing the District's tax on single family households by $20 per year would generate an additional $270,000 for the District to do more lake management work in the Phalen Chain of Lakes each year. Of course, this calculation is a highly generalized one (the decision of

how much to tax homeowners and which homeowners to target for such a tax would be a much more detailed analysis than this exercise). However, as shown in the lake users' survey results, the District's constituents may be amenable to some degree of tax increase, if it means that their lake water quality will benefit as a result. Therefore, it is interesting to note how far a tax increase could go in supplementing the District's lake management activities in the Phalen Chain of Lakes.

5.2 Recommended Lake Water Quality Goals for the Phalen Chain of Lakes

In this section, a potential set of water quality goals is presented for review. These water quality goals, if accepted, would be included in the District's updated Watershed Management Plan.

Table 6 Recommended Water Quality Goals for the Phalen Chain of Lakes

Lake	Recreational Uses Existing and Desired	RWMWD Water Quality Goal	Management Class	Management Activities
Kohlman	Motorboating, canoeing, fishing, picnicking, viewing, limited wildlife habitat	**90 µg/L TP** ***30 µg/L Chla*** ***2.5 ft SD***	**Improvement**	**Macrophyte, fisheries and shoreline management, Residential Measures where appropriate, Chemical inactivation of Kohlman Lake's sediments.**
Gervais	Swimming, skiing, speedboating, limited wildlife habitat, other	30 µg/L TP 10 µg/L Chla 5.25 ft SD	**Non-Degradation**	**Macrophyte, fisheries and shoreline management**
Keller	Speedboating, skiing, canoeing, fishing, picnicking, wildlife habitat, viewing	**60 µg/L TP** ***25 µg/L Chla*** ***3.2 ft SD***	**Improvement/ Non-Degradation**	**Macrophyte, Fisheries and Shoreline Management, Projects in Kell-03b and Kell-03Bl, Demonstration project in Kell-03Be1W**
Phalen	Swimming, fishing, picnicking, viewing, scuba diving	30 µg/L TP 10 µg/L Chla 5.25 ft SD	**Non-Degradation**	**Cooperative Agreement Project in Phal-16b, Demonstration Project in Phal-06a**

In Table 4, **bold text** indicates information that differs from information presented in Table 3.3-3 of the Plan (also shown in Table 1 of this report). ***Bold text in italics*** indicates that a different, lake-specific relationship between TP, Chla and SD has been used to establish the goals for the lake, using paired data collected from 1981 to 2002. Previously, a relationship established by the MPCA was used to relate these three parameters.

A definition of the terms under Table 4's "Management Class" is provided below:

Improvement—Improvement of the water body is warranted if the public perceives a need for water quality improvement and there are feasible management options that will accomplish water quality improvement.

Improvement/Non-degradation—Cost-effective projects have been identified in this area as a part of the SLMP process and related feasibility studies. These projects should be pursued as budget and partnering opportunities allow, but no improvements are imminently necessary. Non-degradation of the waterbody is the highest goal.

Non-Degradation—Current water quality meets the goals set for the lake. Non-degradation of existing water quality is accomplished through development requirements, fisheries, shoreline, and macrophyte management. However, additional water quality improvement projects should be implemented as opportunities and budgets allow.

6.0 Conclusions

In 2004, the SLMP provided detailed information about the Phalen Chain of Lakes- its historical water quality, the water quality goals that have been set for the lakes over the years, and the projects that would be required to attain them. The lake users' survey conducted by MMC in summer, 2005 provided useful information that shed light on what lake residents and visitors value most about the Phalen Chain of Lakes, and what they consider to be the biggest challenges to its recreational value. Five other feasibility studies were conducted in 2005 to determine which of the lake management activities suggested in the SLMP were the most viable and cost effective options in terms of improving the lakes' water quality.

This summary report was created to combine the results of all of this work in a single document, teasing out the most significant findings from each study, and creating a final, comprehensive list of the recommended lake management activities and water quality goals for each lake in the Phalen Chain.

The overall conclusions of this summary report are as follows:

Gervais and Phalen Lakes continue to have good water quality. If non-degradation management measures are followed in these lakes, residents and visitors will enjoy good water quality in these lakes into the foreseeable future. Non-degradation measures would include development requirements, fisheries observation and public education, macrophyte management, and shoreline improvement projects.

Although Keller Lake's initial water quality goal in the Plan was 40 µg/L, a higher goal of 60 µg/L seems reasonable at this time. This goal is consistent with the MPCA's proposed TP criteria for shallow lakes, and will likely be attainable in Keller Lake's future, especially if non-degradation management measures and cooperative improvement projects are pursued throughout the lake's watershed.

Kohlman Lake is a lake management challenge. Its water quality is poor, and lake residents think it's getting worse. The lake's water quality conditions are driven equally by the lake's internal load and its highly soluble external load. In the current array of permitted lake management options, only chemical treatment of the lake's sediments would affect cost-effective and noticeable change in the lake's transparency. In the future, other technologies may become available for controlling lakes'

internal or soluble external loads. If the District's goal, however, is to substantially reduce the amount of phosphorus in Kohlman Lake in the near future, managers are left with few other choices.

If Kohlman Lake's TP concentration was significantly reduced (lowered to at least 90 µg/L), the positive result would be increased transparency in Kohlman Lake, and a significant decrease in the amount of phosphorus that would otherwise travel downstream to the other lakes in the chain (though the resulting overall reduction in downstream lakes' TP concentration would be, perhaps, only slight). A potential negative result of lowering Kohlman Lake's TP concentration would be increased growth of nuisance macrophytes in Kohlman Lake, exacerbating a problem already cited by lake users and residents under current water quality conditions. This problem is surmountable through a rigorous macrophyte management program that would target two invasive species- Curlyleaf pondweed and Eurasian water milfoil.

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MMC Associates. September 2005 *Summary of Survey Data from Gervais, Keller and Kohlman Lakeshore Residents.*

MMC Associates. September 2005 *Summary of Survey Data from Users of the Phalen Chain of Lakes.*

Figures

Appendices

Appendix A

Lake User's Survey Results

Summary of survey data from

Gervais, Keller and Kohlman Lakeshore Residents

Prepared by MMC Associates, September 2005

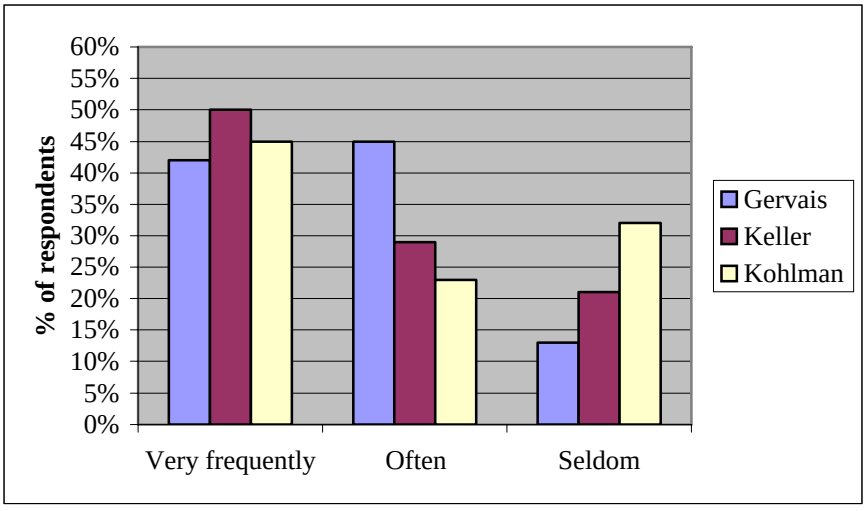
In July 2005 the Ramsey Washington Metro Watershed District (RWMWD) mailed surveys to lake shore residents on Gervais, Keller and Kohlman lakes. The goal of the survey was to gather information about use of the lakes by these residents, their perceptions about water quality and their willingness to take personal actions to reduce stormwater pollution. Sixty Gervais Lake households completed and returned surveys (61%); 14 Keller Lake households (45%) and 22 Kohlman Lake households (39%). Overall, respondents were 60 (55%) male and 49 (45%) female, with several households providing more than one response. Respondents tended to be older, with 28% being 65 or older, 26% being between 55-64 and another 26% being between 45-54 years old. Seventeen percent stated that they were between 35-44 and only 2% were between 25-34 years old. None were between 18-24.

Key findings include that across lakes, people think water quality has become worse over time and very few consider their lakes "clear." Questions related to what individuals can do to protect water quality found the majority of people willing to take the personal actions listed – sweeping leaves and grass off of the streets and sidewalks, directing downspouts away from hard surfaces and using native plants. Many said they already did these things. In the area of funding for increased watershed works, the majority of people from all three lakes said they would be willing to pay more to improve water quality, though some people questioned how the money would be managed. Across questions there were numerous responses that indicated a lack of understanding regarding native plants and the difference between beneficial plants (native species that provide fish habitat) and problem plants (algae and milfoil). In the sections below summary charts are included to show responses to the survey questions, with comments added when appropriate.

Lake use is frequent and varied

Most people said they recreate on their lake often or very frequently, with Kohlman Lake showing the most people who say they "seldom" use the lake.

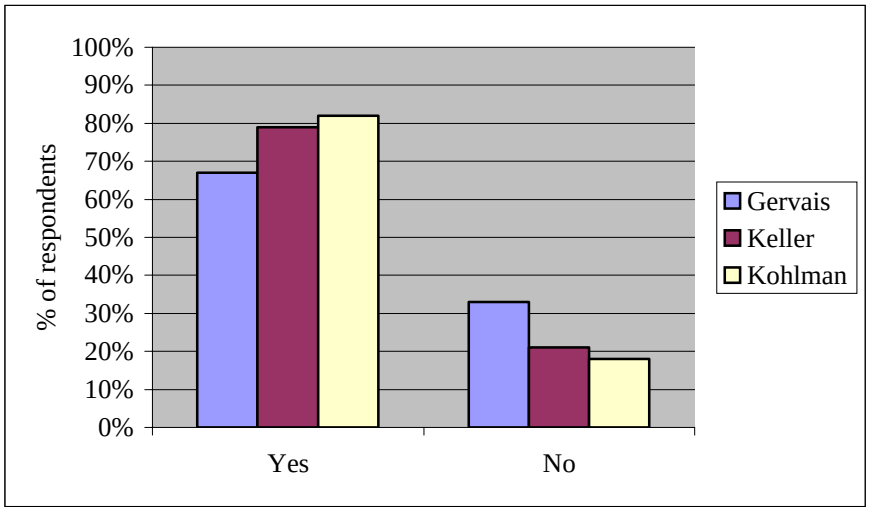
Chart 1: How often do you recreate on your lake?



People said they use the lakes they live on for a range of activities, including aesthetic viewing, picnicking, swimming and boating. Many people reported fishing for a number of species, with bass mentioned by the most people.

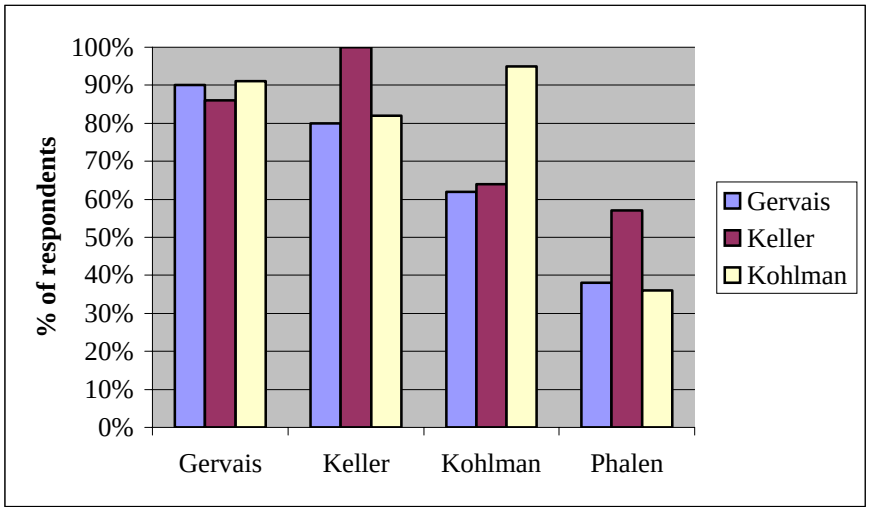
When asked if there were other things they would do on their lake if water quality was improved, most people said "yes" and mentioned numerous activities including more swimming and also scuba diving. Many people also said they would do more of what they are already doing on the lake.

Chart 2: Would you participate in other activities on the lake if it was cleaner?



When asked about all of the area lakes they visited during the year, nearly everyone said they used their own lake, and most visited Gervais. Phalen Lake was the least visited across respondents.

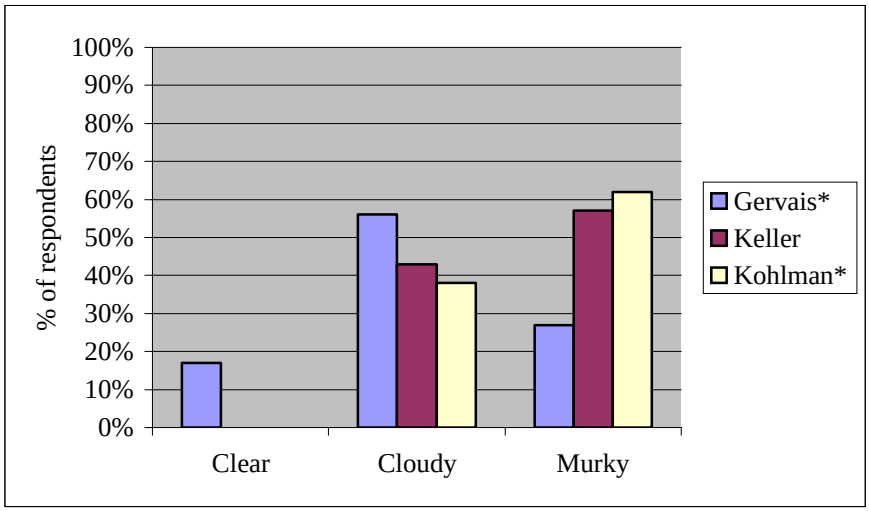
Chart 3: Which of these lakes have you visited in the last year?



Assessment of water quality: not so good and getting worse

All but a small number of Gervais Lake residents rated the clarity of their lake as "cloudy" or "murky". A number of people clarified their answer with comments, which included "murky on windy days" or "cloudy – two feet out." Several of the people who referred to Gervais as "clear" indicated that they meant that it was clear "this year" or "on calm days." One person said, "clear this year but it REALLY varies from year to year."

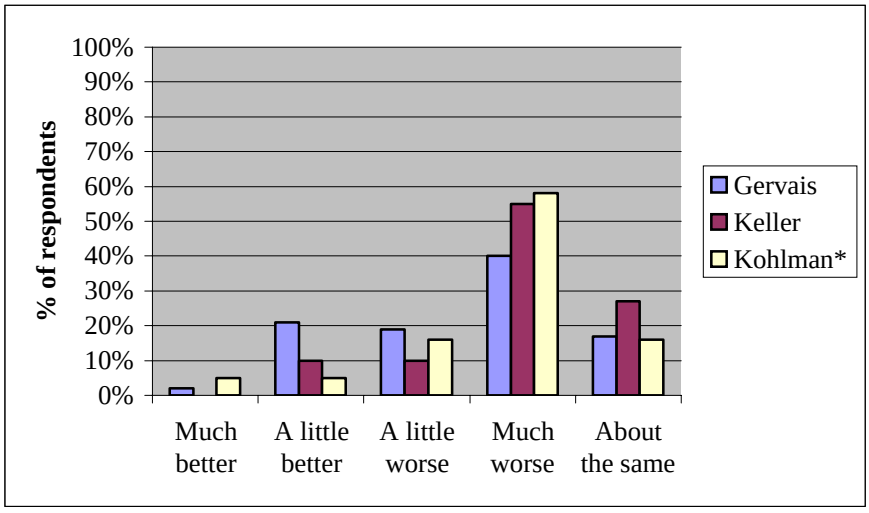
Chart 4: How would you describe overall lake clarity?



**some respondents provided more than one answer*

When asked to describe changes in the lake over time, "much worse" was the most frequent answer across lakes. Kohlman residents provided comments about the changing nature of their lake in response to this and other questions. "We built 35 years ago and had a beautiful lake," said one Kohlman lakeshore resident, "the lake is not in good shape now – it needs help." Another said "we haven't been to the lake for two years because we own a swamp."

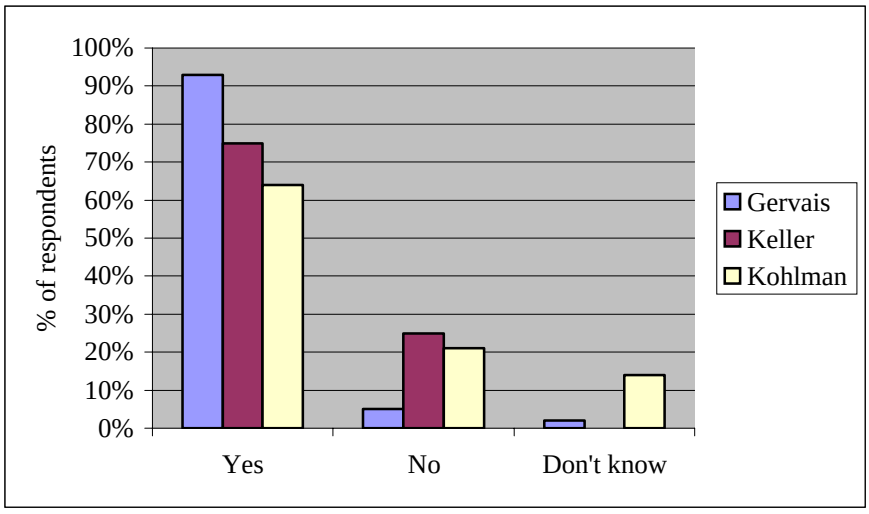
Chart 5: If you have been living or visiting the lake for 10 or more years, how would you describe the overall change in water quality?



**some respondents provided more than one answer*

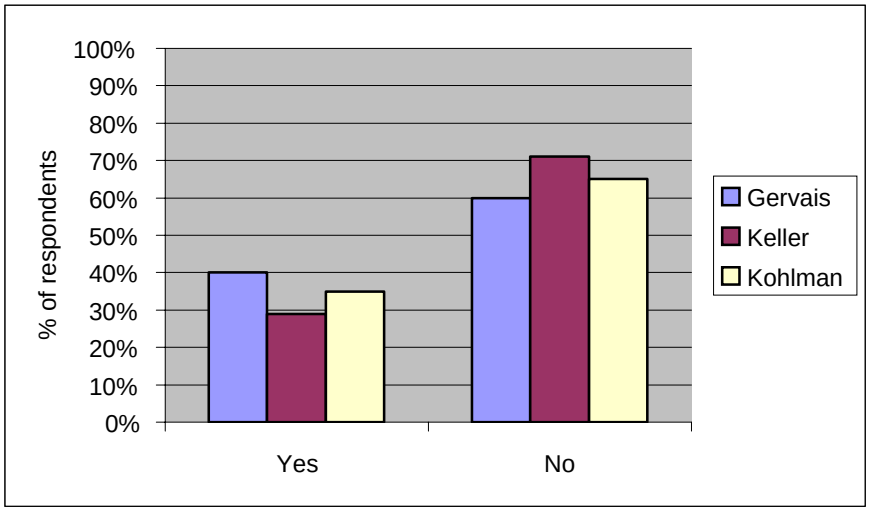
When asked if there were times of year when they saw a decrease in the lake's water quality, most people said "yes". However, people said the water quality was worst at a range of times from early spring to late September. In their comments, several people mentioned problems with algae blooms. One Gervais lakeshore resident said that they see a decrease in water quality, "early spring and now – this time of year weeds have been cut by motors so they float to shore so along with algae it becomes very smelly from decaying vegetation." A Keller Lake resident said, "from early July to September there are heavy algae blooms."

Chart 6: Are there times of the year when you notice a decrease in water quality?



When asked specifically about problems with carp, 60% or more people across lakes said "no," carp are not a problem. However, a number of people, particularly on Gervais, expressed concern about this species. "Yes, there are so many!" said one person. Another said, "one of life's little curiosities is that the DNR surveys always indicate fairly low carp count, but the naked eye suggests otherwise." This person went on to say that "I have not seen quite so many this year."

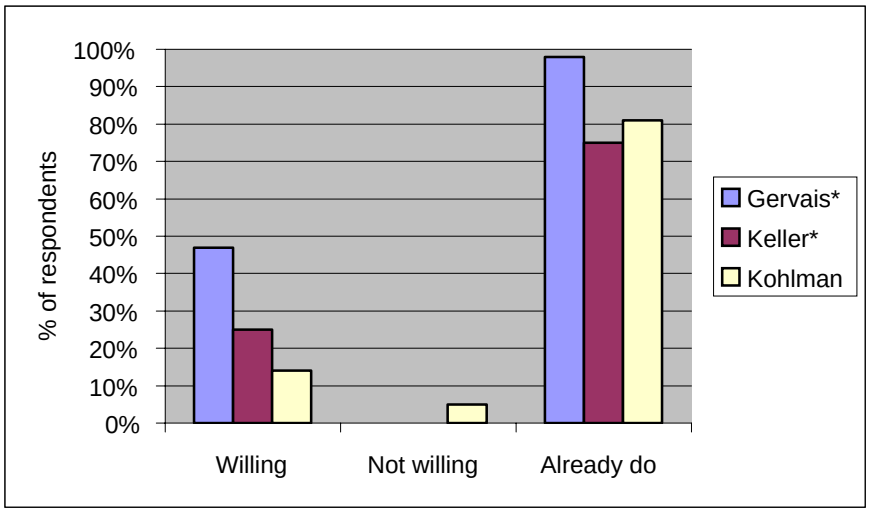
Chart 7: Are carp in the lake a problem for you?



People show willingness to do their part for water quality

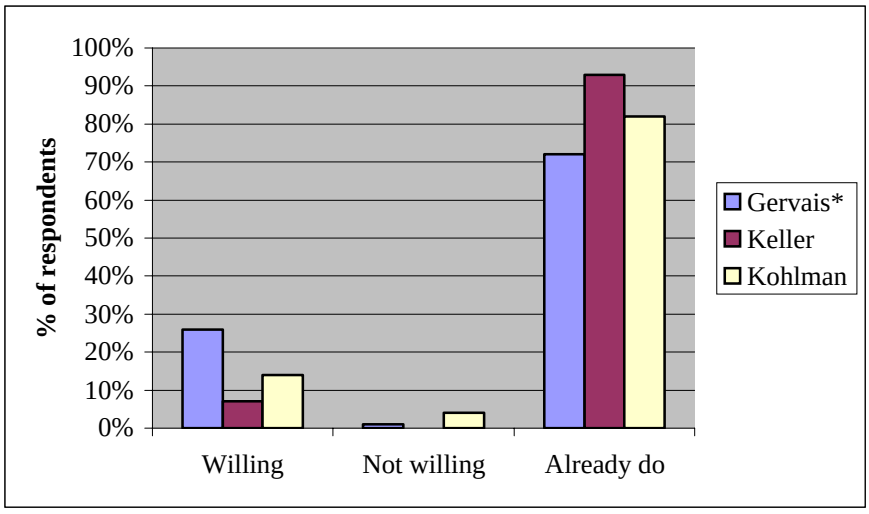
As the charts below show, almost all of the respondents said they were willing to – or already do – keep their leaves and grass clippings off of sidewalks and streets and direct downspouts onto lawns, instead of sidewalks or driveways.

Chart 8: Are you willing to keep leaves and grass clippings off of the sidewalk and street?



**some respondents provided more than one answer*

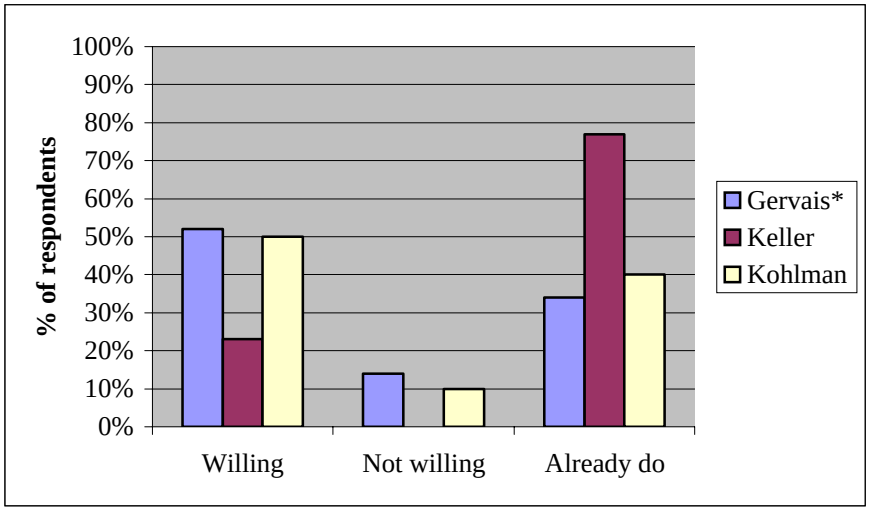
Chart 9: Are you willing to direct your downspouts onto your lawn instead of the sidewalk or driveway?



**some respondents provided more than one answer*

When asked if they would be willing to use native plant species, the majority of people still said they were willing. However the response was not quite as positive as the other two actions listed above and in comments throughout the survey there appeared to be some confusion regarding beneficial native plants and weeds, both in and out of the water. One Gervais lake resident said, "I already have enough weeds!"

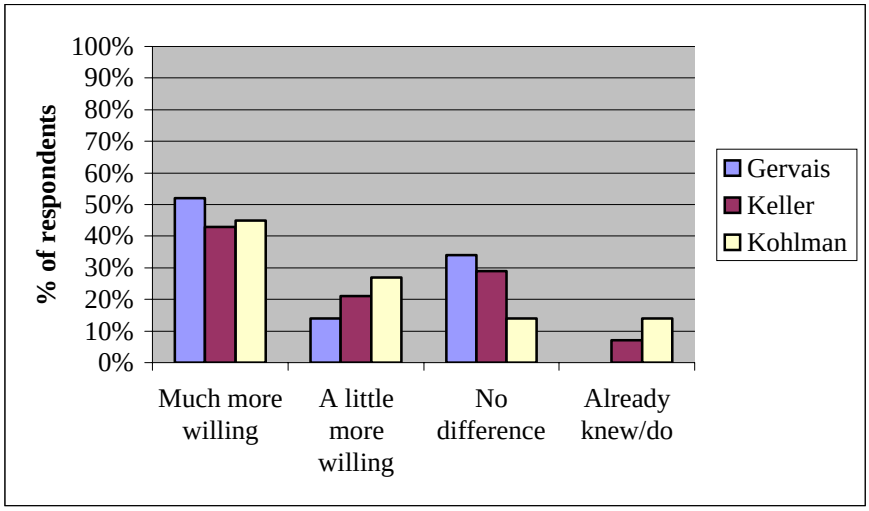
Chart 10: Would you be willing to use native plants, particularly next to sidewalks, alleys and curbs?



**some respondents provided more than one answer*

After learning that polluted runoff contributes significantly to the water pollution, respondents stated that they were generally more willing to take the above actions. Some clarified that it made no difference because they already were taking these actions. Others offered that they already knew or already did these things.

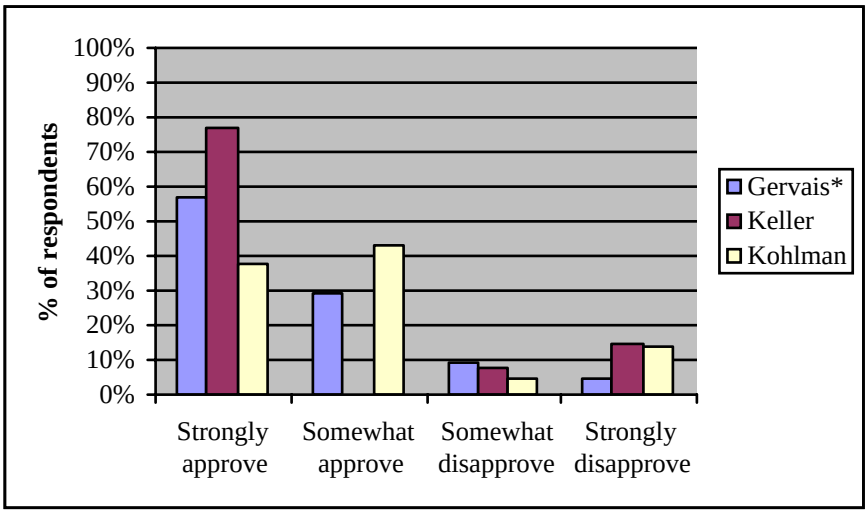
Chart 11: Knowing that polluted stormwater is the number one cause of pollution to our water, would you be more willing to take personal actions to prevent this problem?



The survey included an explanation of the fact that as water quality improves, more plants begin to grow on the lake bottom and along shore. People were asked whether they would approve of the district taking additional measures to improve water quality, knowing that improvements will lead to an increase in beneficial plants. Across lakes, the response was generally positive, though a number of people said, "depends on the plants." Multiple people said they did not want more cattails. Several people mentioned that the lakes were already too weedy. "How is swimming affected?" said

one Gervais resident, who went on to say that "weeds are icky." One Kohlman lake resident said "we have TOO MANY weeds on the lake – caused by Chem Lawn on some of our neighbors' lawns…(the weeds) need harvesting!" Another resident expressed concern that the weeds were preventing bass and encouraging carp. A Keller Lake resident said they "disagreed" that vegetation provided better fish habitat and said, "with more weeds we have less fish." From the nature of the comments related to this question there appears to be a need for more education on the weeds that are good for the lake as opposed to milfoil and algae blooms.

Chart 12: Do you approve of the Watershed District taking additional measures to improve water quality, knowing that it will lead to an increase in beneficial plants?

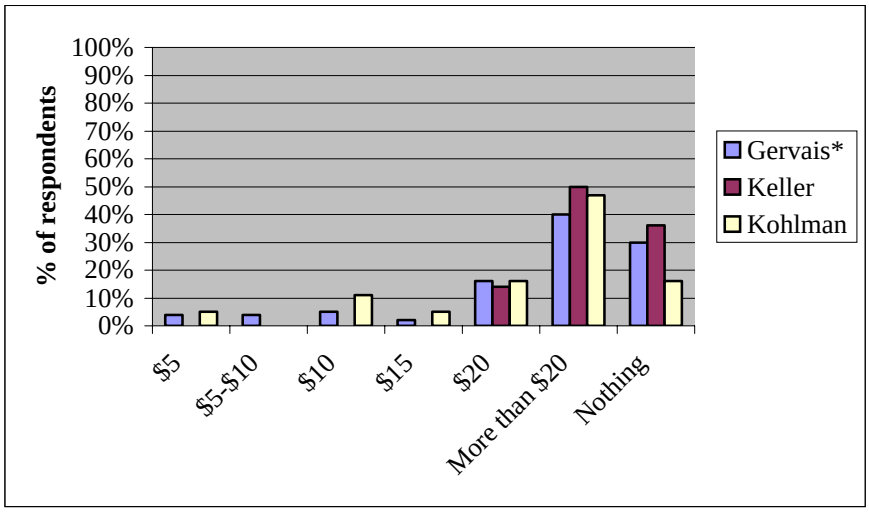


Support for funding Watershed District activities positive but mixed

When asked whether they would be willing to pay more for more aggressive district activities, more than 60% of people across the lakes said they would pay at least something more. The most people listing an amount said they were willing to pay more than $20. However, in the comments it became clear that many residents feel like they are already paying for lake improvements. One Gervais Lake resident said, "we have always paid to have weeds sprayed! 18 years!" A Keller Lake resident said, "we pay over $800 per year to a private lake management company to control milfoil……if RWMWD would resolve the milfoil issue we would be money ahead if you raised taxes more than $20!"

Several people said they would want to know how the money was used, specifically, before paying. Others suggested different strategies, such as credits for shoreline restoration and fees for boaters. A Keller Lake residents said that they did not want to pay more to make the lakes more appealing to outside users who make noise and litter. "No thank you," this person said, "I'll take weeds and peace and quite any time."

Chart 13: How much more would you be willing to pay to allow the district to do more to protect and improve water quality?



**some respondents provide more than one answer*

Summary of survey data from users of the Phalen Chain of Lakes

Prepared by MMC Associates, September 2005

MMC Associates conducted in-person surveys of people using the Phalen Chain of Lakes during the summer of 2005. The goal of the survey was to gather information on peoples' perceptions of lake water quality, to better understand how and why people use the different lakes and to gather data on willingness to take personal actions and/or support more funding for lake improvement activities.

The surveys were conducted on four days: Saturday, July 2, Thursday, July 7, Thursday, August 25 and Saturday, September 3. The surveys were timed to assess differences in perceptions between mid and late summer. However, there were no significant differences in answers based on the time of year.

Interviewers were stationed at the boat launch areas of Spoon Lake and asked everyone using the lake to take the survey. (When a group was using the lake together, one individual from the group was surveyed). In the four days of interviews approximately six people who were approached refused or did not speak English. A total of 80 people agreed to take the survey – 34 people using motorized boats and 46 people that were not using motorized boats. All motorized boat users planned to visit Gervais, while the nonmotorized users were mainly spending their time on Spoon. Those who said they planned to visit Spoon, Keller or Kohlman lakes were given a survey that included questions about their willingness to take action on their property to protect water quality. People planning to visit only Gervais or Phalen were only asked the first section of questions on lake use and perceptions of water quality.

Demographic information on lake users – age, race and gender – were approximated visually by the interviewers and recorded. Of all lake users, 68% were white, 13% Asian American, 8% Hispanic, 9% African American and 2% unknown. There were people of all ages using the lakes, though only 11% were 55 or over and more than half were between 25 and 44. The lake users were predominantly male – 75% men and 25% female.

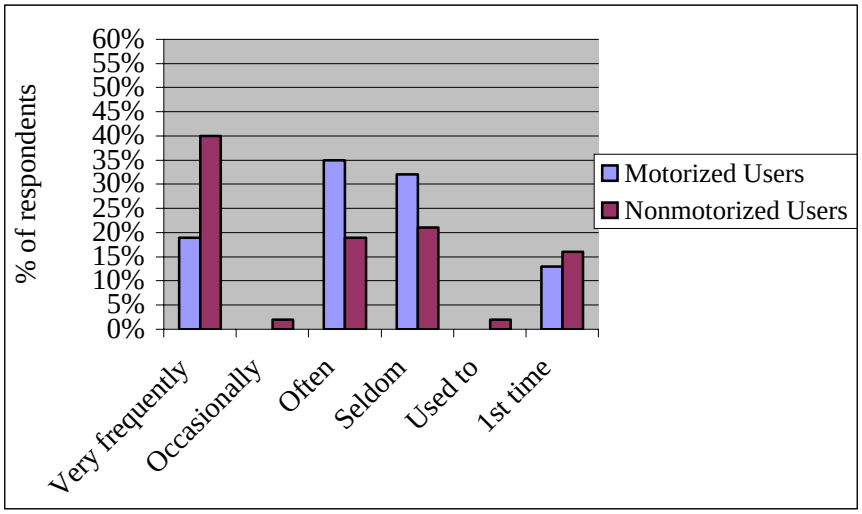
Zip code information collected from the lake users show the breadth of people who use the lakes. People who were not using motorized boats came from 20 different zip codes, with the most from 55117, 55109 and 55106. Motorized boat users reported 16 different zip codes, with 55106 being the most common. A large number of people reported zip codes outside of the watershed district boundaries, though all were from the Twin Cities metro area.

Key findings from the survey indicate that people consider the lake moderately clean, and there are mixed perceptions regarding whether it is getting better or worse, and whether water quality is better at different times of year. People expressed an interest in doing more activities on the lakes if they were cleaner. They also expressed willingness to take actions to protect the lakes, though there was some confusion about the role of native plants and lake water quality. Respondents also expressed a strong willingness to pay more for additional work by the Watershed District to improve water quality. Results are summarized in the sections below. Because there were consistent differences in responses between people using motorized boats and others, these two categories are separated in the charts and analysis.

Frequency of use is varied, but fishing is the most common activity

The lake users interviewed ranged from people who were visiting the lake for the first time, to those that come to the lake every day. A larger number of nonmotorized users said they came to the lakes very frequently.

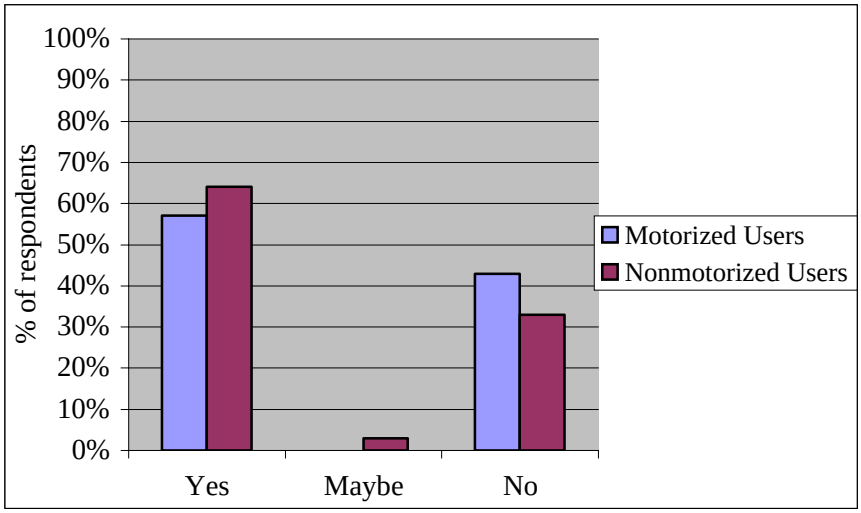
Chart 1: How often do you visit this lake?



When asked what they would be doing on the lake that day, fishing was the most common answer, with 63% of non-motorized users and 41% of motor boat users listing fishing as their primary activity. Other uses mentioned included "motor boating" (mentioned by 91% of motorized boat users), swimming, water skiing, tubing, canoeing or just relaxing and enjoying the scenery. When asked what they were fishing for, bass was mentioned most frequently, along with muskie and sunfish. Thirty eight percent of the people fishing from shore and 14% of those planning to fish from motorboats said they were fishing for "anything."

When asked if they would do more if the lake was cleaner, more than half of the respondents said "yes." Swimming was the most frequently mentioned activity people would do if the lake was cleaner.

Chart 2: Are there other activities you would participate in if the lake was cleaner?

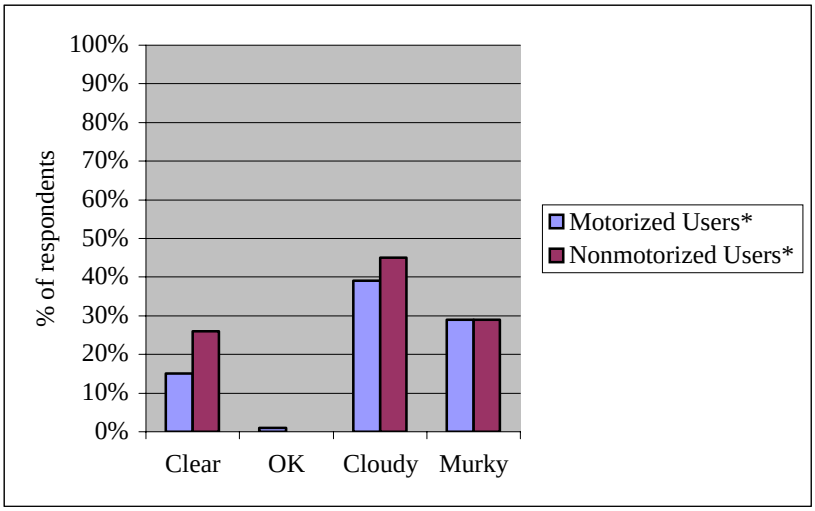


Evaluation of water quality generates a mixture of responses

Respondents voiced a range of opinions on the lake clarity, whether it is getting better or worse, and whether there are changes at different times of the year.

Slightly more nonmotorized users described the lake they were visiting as clear or "OK". Both the motorized and nonmotorized users described the lakes as cloudy or murky in near equal percentages. Comments about the lake clarity included "nasty," (about Spoon Lake), "good compared to other lakes," and "Keller seems clear, the channel is murky and the beach is cloudy."

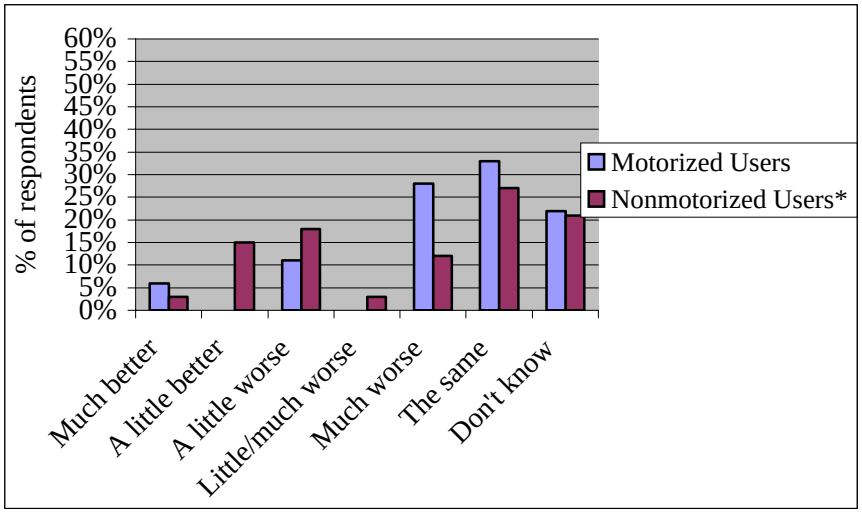
Chart 3: How would you describe the overall clarity of the lake you are visiting?



**some provided more than one answer*

When asked whether the lake quality was improving or decreasing over time, more nonmotorized users said the lake was getting at least somewhat better or staying the same. Among motorboat users there was a larger number (29%) who said the lake was "much worse." Among both groups a large number people said the lake was "the same" or that they "didn't know."

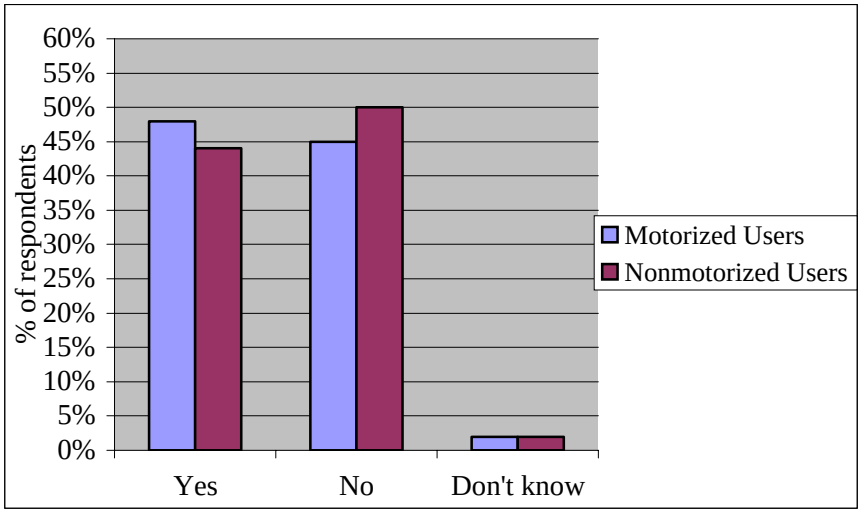
Chart 4: If you have been visiting this lake for 10 years or more, how would you describe the overall quality of the lake over this time?



**Some respondents provided more than one answer*

Respondents were split on whether they thought the water quality was worse at different times of year. Comments included, "I can't say when the lake is better or worse, it's up and down all season long." Another person said, "every time it's different, sometimes it's cleaner."

Chart 4: Are there times of year when you notice a decrease in the lake's water quality?



People are willing to take action to improve lakes

Visitors who said they would be visiting Spoon, Keller or Kohlman lakes were asked specifically about activities that residents can do to prevent polluted stormwater – a key concern for these water resources. As the charts below indicate, people said they were willing, or already did, many of the activities, particularly sweeping their leaves and grass and directing downspouts away from hard surfaces.

Chart 5: Are you willing to keep leaves and grass clippings off of the sidewalk and street?

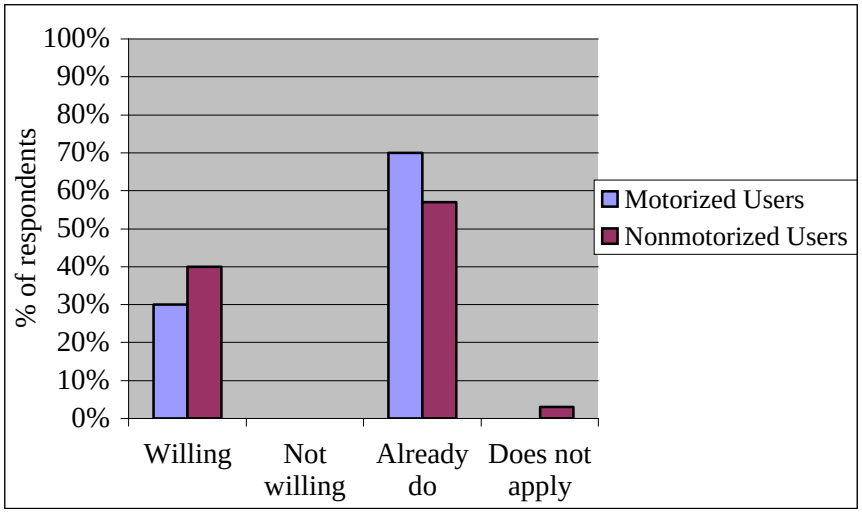
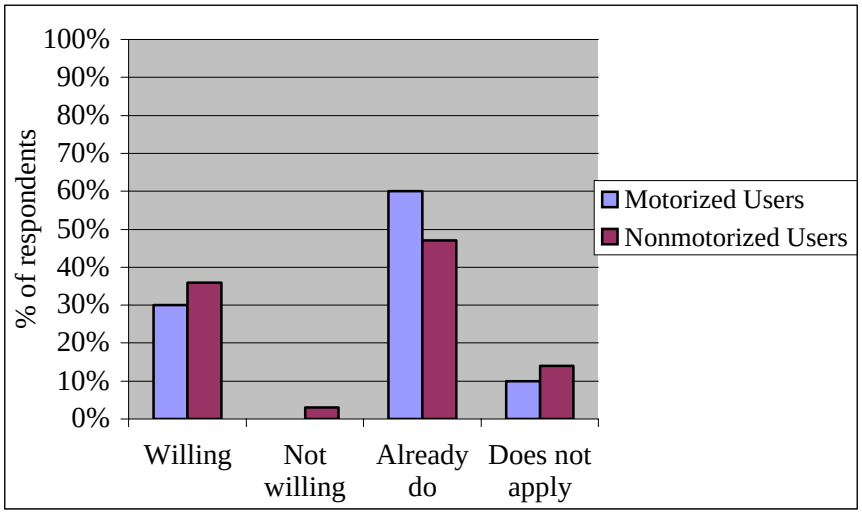
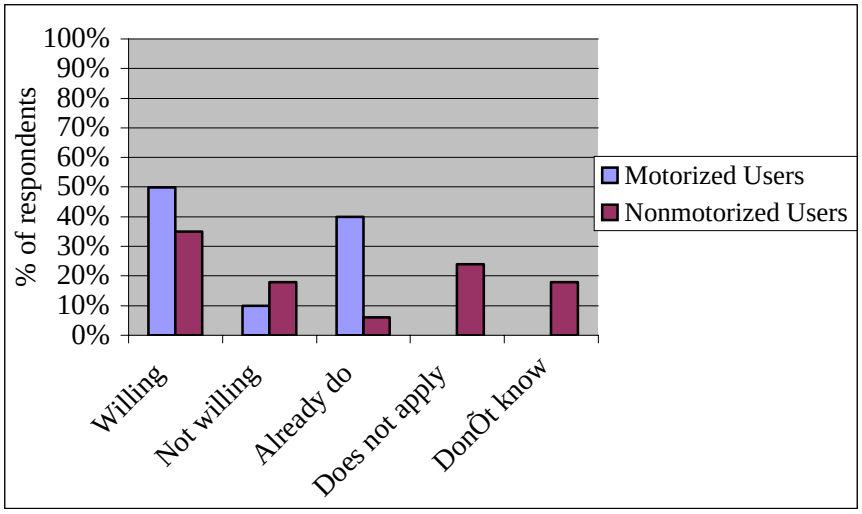


Chart 6: Are you willing to direct your downspouts onto your lawn instead of the sidewalk or driveway?



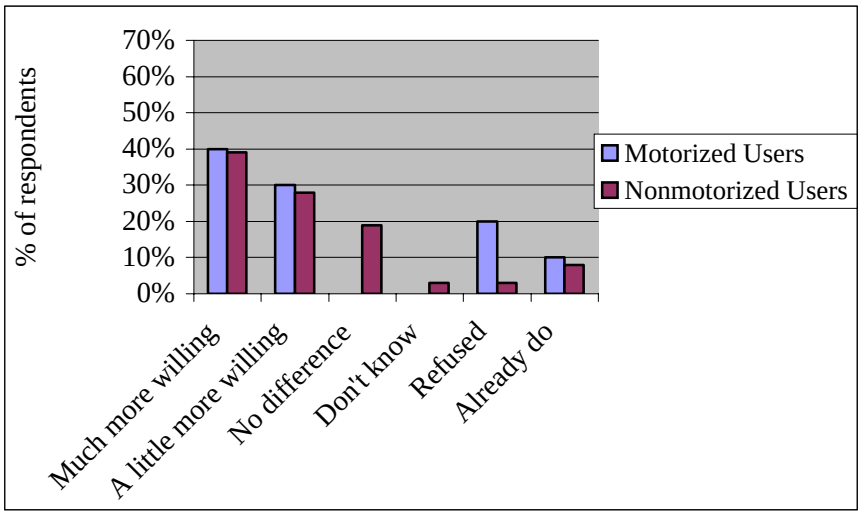
Support for using native plants was also strong, but slightly more people said they were "not willing" to use native plants. Several people said they would "consider" native plants and one commented that his wife was in charge of the plants.

Chart 7: Would you be willing to use native plants, particularly next to sidewalks, alleys and curbs?



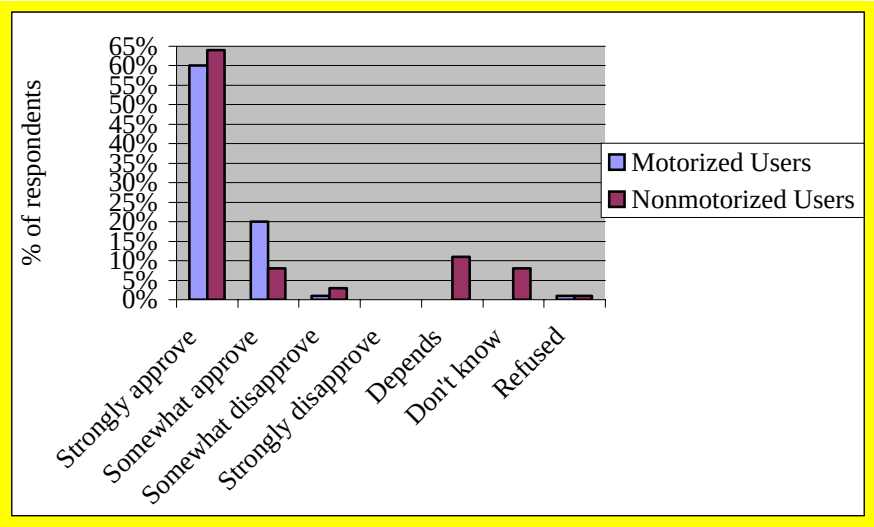
After learning that polluted runoff contributes significantly to the water pollution, respondents stated that they were "much" or "a little" more willing to take the above actions. Several clarified that it made no difference because they already were taking these actions. Others offered that they already knew or already did these things.

Chart 8: Knowing that polluted stormwater is the number one cause of pollution to our water, would you be more willing to take personal actions to prevent this problem?



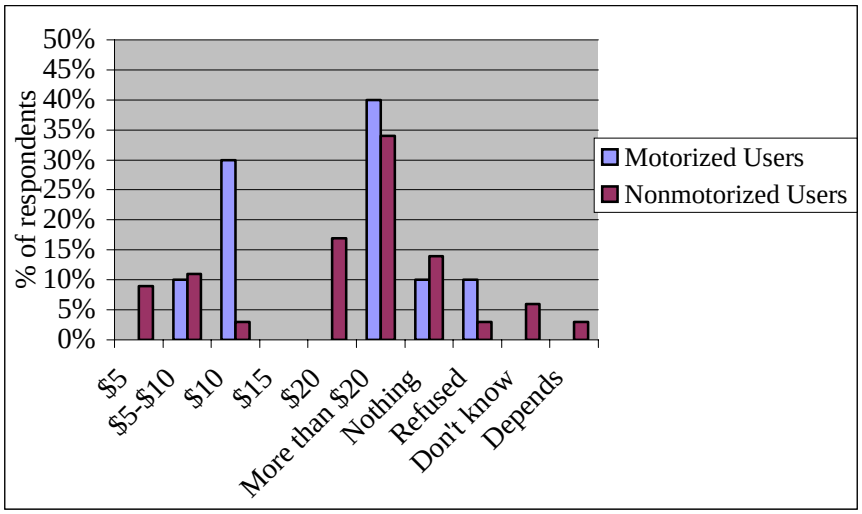
The survey included an explanation of the fact that as water quality improves, more plants begin to grow on the lake bottom and along shore. People were asked whether they would approve of the district taking additional measures to improve water quality, knowing that improvements will lead to an increase in beneficial plants. More than half of the respondents said they approve of the district taking on this work. However, comments included, "I want the water to be clean, but I don't want the under water stuff." Another person said they wanted "scattered vegetation so you can shore fish."

Chart 9: Do you approve of the Watershed District taking additional measures to improve water quality, knowing that it will lead to an increase in beneficial plants?



When asked whether they would be willing to pay more for more aggressive district activities, most people said they would pay at least something more. The most people listing an amount said they were willing to pay more than $20. Comments included a concern that it be clear how the funds are spent. "I would want proof of what is being done," said one person. Another said, "if it goes where it is supposed to go." One person said they would support more funding to restock fish and another said that they would pay extra to get rid of milfoil.

Chart 10: How much more would you be willing to pay to allow the district to do more to protect and improve water quality?



Appendix B

Template for a Lake Vegetation Management Plan